THE ENGINEERING EQUIPMENT AND MATERIALS USERS ASSOCIATION

90/10 COPPER NICKEL ALLOY PIPING FOR OFFSHORE APPLICATIONS

SPECIFICATION: FLANGES
Composite and Solid

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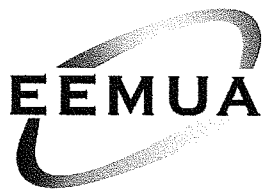
3rd Floor, 20 Long Lane
London
EC1A 9HL
Telephone: 020 7796 1293
Fax: 020 7796 1294
e-mail: sales@eemua.co.uk
website: www.eemua.co.uk



THE ENGINEERING EQUIPMENT AND MATERIALS USERS ASSOCIATION

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Contents

FOREWORD

The Publications in this series of specifications for 90/10 copper nickel tubes, flanges and fittings are as follows:

Publication No. 144 Tubes: seamless and welded

Publication No. 145 Flanges: composite and solid

Publication No. 146 Fittings

This specification is for a series of composite (lap type) and solid flanges in metric dimensions based on ANSI B16.5, MSS SP-44 and BS 1560.

The basic metric dimensions for drilling and flange outside diameters are those given in ANSI B16.5, BS 1560 and MSS SP-44 for Class 150 rating with inch size bolting.

The flanges covered in this specification are suitable for maximum design pressures of 16 bar at 75°C and 20 bar at 38°C.

For sizes of a particular type of flange not covered within this specification the purchaser should satisfy himself that the flange is suitable for the service intended.

The diameters of hubs have been chosen to permit the use of ring spanners.

A list of other standards and codes referred to in this publication is given in appendix A.

SECTION ONE — COMPOSITE WELD NECK FLANGES

1.1 Scope and design basis

Section 1 is divided into two sub-sections. Sub-section 1A gives details of the 90/10 copper nickel weld neck stub ends, whereas sub-section 1B gives details of the forged carbon steel plate-type backing flanges.

The range of sizes covered for these composite weld-neck flanges are ½ in/16 mm — 36 in/914 mm.*

Two types of weld neck stub ends are included in sub-section 1A. The short components (type S) are based on DIN 86037 but modified to suit the appropriate tube wall dimensions. The long components (type L) are based on MSS SP–43 to suit the appropriate tube wall dimensions. The long stub ends have been included to facilitate the attachment of this type of flange to butt welding elbows, tees, and the small end of reducers.

Only one type of backing flange is included in sub-section 1B. The same backing flange is required for all weld neck stub ends whether they be long or short, 16 bar or 20 bar. This type of backing flange is not suitable for use with composite slip-on stub ends (section 2B).

The thicknesses of the plate type backing flanges have been determined to meet the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 1983 edition, Appendix 2, except that design stresses have been established in accordance with ANSI B31.3 criteria.

The following design criteria have been used:

(a) Drilling and outside diameter dimensions of flange sizes ½ inch/16 mm – 24 in/610 mm are in accordance with ANSI B16.5 and BS 1560, whereas the larger sizes, 28 in/711 mm – 36 in/914 mm are in accordance with MSS SP-44.

(b) All calculations for backing flanges have been carried out using a design pressure of 20 bar at 38°C.

(c) Backing flanges: ASTM A105 forged carbon steel.

(d) Gaskets: 1.5 mm thick CAF (compressed asbestos fibre) inside bolt circle.

(e) Bolting: ASTM A193–B7.

Design stresses used in the calculations were as follows:

(i) Steel backing flanges: 160.7 N/mm^2.

(ii) B7 bolting: 172.4 N/mm^2.

Based on the results of the above calculations an attempt has been made to rationalise ½ in/16 mm up to and including 1½ in/44.5 mm backing flanges which utilise the same bolting. The opportunity was taken therefore to use the same flange thickness (dimension 'b') determined for the largest of this size range and apply it to the smaller sizes, resulting in identical bolt lengths for all flanges in that range. This was considered to be a practical and economical advantage within the industry.

The dimensions of backing flanges are governed by the strength required to resist the bolting forces which may occur on bolting up. Therefore all backing flanges are suitable for a maximum working pressure of 20 bar at 38°C.

This specification does not specify hydraulic test pressures for flanges or components, details of which should be obtained from the appropriate application standards.

* *For purposes of this specification inch dimensions are nominal and metric dimensions refer to specified outside diameters.*

1.2 Pressure/temperature ratings

Pressure/temperature ratings are the maximum allowable working pressures (MAWP) at the temperatures shown in appendix C.

If a stub end rated at 16 bar is required to be connected to a stub end rated at 20 bar then that flanged joint shall be rated at 16 bar (see tables 1.2 and 1.3).

The temperature shown for a corresponding pressure rating is considered to be the same as that of the contained fluid.

1.3 Materials

1.3.1 Flanges

Stub ends detailed in sub-section 1A shall be manufactured in 90/10 CuNi alloy UNS 7060X* the composition and mechanical properties of which are specified in table 1.6.1.

Backing flanges detailed in sub-section 1B shall be manufactured from the material specified in table 1.6.2. Alternative steels may be used for the backing flanges provided that they have mechanical properties equal to or better than those specified in ASTM A105 (normalised) and are acceptable to the purchaser.

1.3.2 Gaskets

The gaskets normally used with flanges to this specification are those made from compressed asbestos fibre (CAF) or equivalent. The gaskets shall not be graphited. Alternatively neoprene type gaskets with a minimum Shore hardness of not less than 75 may be used located within the bolt circle.

Note: Gaskets should not be used when mating with elastomer/rubber faced flanges.

1.3.3 Bolting (stud bolts)

Bolting for flanges to this specification shall be selected from ASTM A193-B7 and ASTM A194-2H and should be suitably protected from corrosion.

SUB-SECTION 1A — WELD NECK STUB ENDS

1A.1 Manufacture

Stub ends shall be manufactured by one or more of the following processes:

(a) Hot forging.

(b) Cold forging followed by annealing.

(c) Friction welded from wrought material in accordance with the requirements of BS 6223.

(d) Other methods of manufacture shall be as agreed between the purchaser and the manufacturer.

* *Alloy UNS 7060X is a modified form of the following national designated alloys — UNS 70600, BS CN 102 and DIN 2.0872.*

1A.2 Information to be supplied by the purchaser

The following shall be specified by the purchaser on the order (for stub ends).

(a) The title and number of this specification (EEMUA Publication No. 145: 1987: section 1A).

(b) Size: inches and millimetres.

(c) The pressure rating: 16 bar or 20 bar.

(d) Whether type "S" or type "L" stub ends are required, see tables 1.2 and 1.3.

(e) Whether certificates of compliance or manufacturer's certificates are required (see clause 1A.8).

(f) Whether it is his intention to inspect the material at the supplier's works.

(g) Whether the individual cast analyses are required to be supplied (see addendum).

See clause 1B.2 for information to be supplied by the purchaser for backing flanges.

(h) Whether any additional identification marking other than that specified herein is required.

1A.3 Freedom from defects

The stub ends shall be visibly clean, smooth and free from defects greater than 0.5 mm in depth, irregularities, scale or deposits.

1A.4 Joint facings and surface finish

All stub end jointing surfaces shall be machine finished and when compared by visual or tactile means with reference specimens, they shall comply with the values shown in table 1.1.

It is not intended that instrument measurements be taken on the faces themselves and the R_a and R_z values relate to the reference specimens.

Table 1.1

Surface finish (weld neck stub ends).

Method of machining	Ra* µm		Rz* µm	
	min	max	min	max
turning	3.2	12.5	12.5	50

Note: The term "turning" includes any method of machining producing concentric or spiral grooves.

1A.5 Selection of test samples

For stub ends produced by hot forging or cold forging followed by annealing, samples for determination of mechanical properties shall be selected in accordance with Clause 9.2 of BS 2872: 1969. The mechanical properties so determined shall comply with the requirements of table 1.6.1 of this section.

Samples shall be selected from each cast for chemical analysis and shall comply with the requirements of table 1.6.1 of this section.

* Ra and Rz are defined in BS 1134

For stub ends produced by friction welding using seamless tube and hot rolled or cold rolled and annealed sheet or plate, samples shall be selected as follows:

(a) Seamless tube in accordance with clause 1.6 of EEMUA Publication No. 144: 1987: section 1. The mechanical properties of the finished components shall comply with the requirements of table 1.6.1 of this section.

(b) Sheet/plate in accordance with clause 11 of BS 2870: 1980 or clause 1.8 of BS 2875: 1969. The analysis and mechanical properties of each sheet or plate used to produce the stub ends shall comply with the requirements of table 1.6.1 of this section.

1A.6 Marking

1A.6.1 All stub ends 2 in/57 mm and larger shall be clearly and permanently marked by means of a vibratory etching tool or electrochemical etching as follows:

(a) Purchase order number (PO).

(b) The number of this section (EEMUA Publication No. 145: 1987: section 1A).

(c) Size: inches and millimetres.

(d) The nominal pressure rating: 16 bar or 20 bar.

(e) Material designation UNS 7060X.

(f) Batch traceability number (BTN).

(g) Manufacturer's name or trademark (MTM).

Examples of marking:

PO 145/1 2/57 20 7060X BTN MTM

Notes: (i) Stamping with metallic stamps is not permitted.
(ii) Marking shall not be on the gasket contact surfaces.

1A.6.2 Stub ends in sizes 1½ in/44.5 mm and smaller where it is not practical to apply the full requirements of 1A.6.1 shall be marked as follows:

(a) Material designation UNS 7060X.

(b) Batch traceability number (BTN)

(c) Manufacturer's name or trademark (MTM).

(d) Size: inches and millimetres.

(e) Nominal pressure rating: 16 bar or 20 bar.

The remainder of the marking requirements shall be applied to indestructible-type labels securely attached to the component. The labels shall be clearly and permanently marked.

1A.7 Inspection and testing

This section does not make provision for routine pressure testing of stub ends. They shall, however, be dimensionally correct and be marked in accordance with this section. All stub ends shall be capable of withstanding without leakage or signs of distress a hydraulic pressure as follows:

16 bar rated flanges, test pressure = 24 bar.
20 bar rated flanges, test pressure = 30 bar.

1A.8 Certification

Certificate(s) shall be supplied, either:

1A.8.1 A certificate of compliance which shall state that the stub ends have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 1A) or:

1A.8.2 A manufacturer's certificate(s) which shall state that the stub ends have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 1A) and:

(a) State the actual compositional limits determined for each of the elements designated in table 1.6.1 of the casts used in the manufacture of each batch as defined in clause 9.2 of BS 2872: 1969.

In the case of stub ends produced by friction welding state the actual compositional limits determined for each of the elements separately designated in table 1.6.1 of the casts used for producing the seamless tube and for the sheet/plate used in each batch of stub ends.

Note: Individual cast analyses shall be retained by the manufacturer — see Addendum: discretionary contractual clauses.

(b) State the results of mechanical tests performed on each batch (see clause 1A.5 — selection of test samples).

SUB-SECTION 1B — WELD NECK BACKING FLANGES

1B.1 Manufacture

Backing flanges shall be of forged carbon steel to ASTM A105 (normalised) except that the carbon content and the carbon equivalent shall not exceed the values given in table 1.6.2.

1B.2 Information to be supplied by the purchaser

The following shall be specified by the purchaser on the order (for backing flanges):

(a) The title and number of this specification (EEMUA Publication No. 145: 1987 section 1B).

(b) Size: inches and millimetres.

(c) Pressure rating: Class 150.

(d) Whether it is his intention to inspect the material at the supplier's works (see Addendum).

(e) Whether manufacturer's certificates are required (see clause 1B.8).

(f) Whether any additional identification marking other than that specified herein is required.

(g) Whether any temporary or permanent corrosion protection is required other than that specified in clause 1B.9.

See clause 1A.2 for information to be supplied by the purchaser for stub ends.

1B.3 Drilling

All bolt holes shall be drilled and shall be equally spaced on the pitch circle diameter 'K' (see table 1.4).

1B.4 Facings and surface finish

The outside diameters and bores of backing flanges shall be machine finished and edges shall have a radius of 3 mm in accordance with table 1.4. The face of the backing flange to be in contact with the stub ends shall be machined flat.

1B.5 Selection of test samples

Samples representing each lot of backing flanges shall be selected, and subjected to testing, in accordance with the requirements of ASTM A105.

1B.6 Marking

Backing flanges shall be clearly marked with round-nose steel stamps around the rim.

Backing flanges shall be clearly marked as follows:

(a) Purchase Order Number (PO).

(b) The number of this section (EEMUA Publication No. 145: 1987: section 1B).

(c) Size: inches and millimetres.

(d) The nominal pressure rating: Class 150.

(e) Material designation: A105 (ASTM A105) see table 1.6.2.

(f) Batch traceability number (BTN).

(g) Manufacturer's name or trademark (MTM).

Examples of marking:

PO 145/1B 10/267 150 A105 BTN MTM.

1B.7 Inspection and testing

Backing flanges shall be dimensionally correct and be marked in accordance with this section.

Backing flanges shall be visually examined for defects and irregularities in the protective coat.

1B.8 Certification

Certificate(s) shall be supplied, either:

1B.8.1 a certificate of compliance which shall state that the backing flanges have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 1B) or:

1B.8.2 a manufacturer's certificate which shall state that the backing flanges have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 1B) and:

(a) State the analysis of each heat used in the manufacture of each order (see clause 1B.5: selection of test samples).

(b) State the results of mechanical tests performed on each heat used in the manufacture of each order (see clause 1B.5: selection of test samples).

1B.9 Temporary corrosion protection

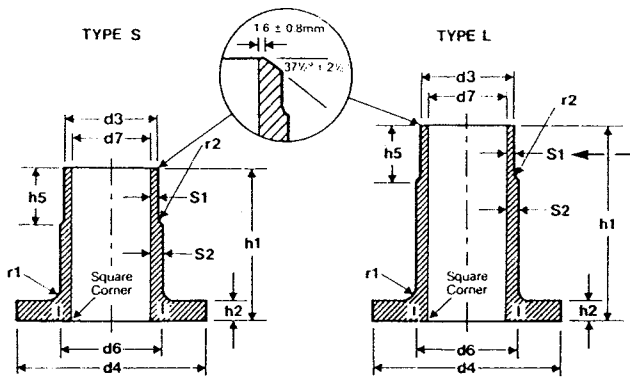
Unless otherwise specified by the purchaser flanges shall be protected against corrosion during transit and storage according to the following procedure:

(a) blast clean to standard Sa2½ as specified in Swedish Standard SIS 055 900.

(b) apply blast primer of zinc rich epoxy coating to a dry film thickness of 25–50μm immediately after blast cleaning. After blast priming the identification marking shall be repeated, as necessary, by painting in such colours as to be clearly visible.

Table 1.2

Weld neck 90/10 CuNi stub ends:16 bar rating *



Where S1 is less than 3 mm omit bevel on weld preparation.

for tolerances see table 1.5.1

Size in/mm	d3	d4	d6	d7	Type S h1 **	Type L h1	h2	r1	r2	h5	S1 min	S2
½/16	USE 20 bar SEE TABLE 1.3											
¾/25												
1/30												
1¼/38												
1½/44.5												
2/57												
2½/76.1												
3/88.9												
4/108												
6/159	159	212	161.5	153.75	50	89	9	5	5	15	3.0	4.0
8/219.1	219.1	270	222	211.10	50	102	9	5	5	15	4.0	5.5
10/267	267	320	270	257.97	50	127	9	5	5	15	4.5	6.0
12/323.9	323.9	370	327	312.83	50	152	11	7	5	16	5.5	7.0
14/368	368	430	371	364.22	50	152	11	7	5	16	6.5	8.0
16/419	419	482	422	404.17	50	152	12	7	7	16	7.0	8.5
18/457.2	457.2	530	460	441.5	50	152	12	7	7	16	8.0	9.5
20/508	508	585	511	490.5	50	152	12	7	7	20	8.5	10.0
24/610	610	685	613	589.5	60	152	14	9	7	20	10.5	12.0
28/711	711	800	719	687.5	60	190	19	9	7	24	12.0	14.5
32/813	813	905	821	786.5	60	190	20.5	9	7	24	13.5	16.0
36/914	914	1000	922	883.5	60	190	22	9	7	32	15.5	17.5

All dimensions in millimetres except where indicated

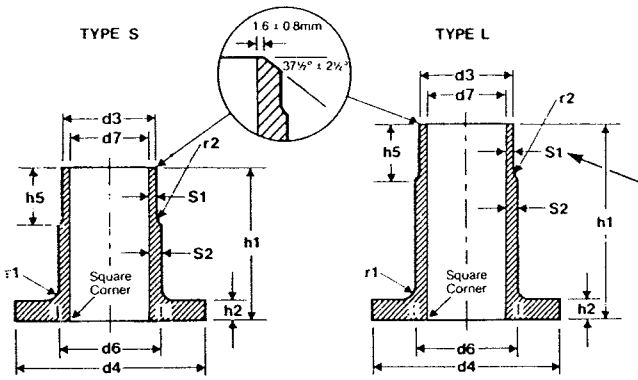
* For weld-neck stub-ends operating at a maximum design pressure of 20 bar at 38°C — see table 1.3

** Type 'S' stub ends are not suitable for welding with the backing flange in position on stub end

ERRATUM
Column d7
size 14/368
delete 364.22
insert 354.22

Table 1.3

Weld neck 90/10 CuNi stub ends 20 bar rating*



Where S1 is less than 3 mm omit bevel on weld preparation.

for tolerances see table 1.5.1

Size in/mm	d3	d4	d6	d7	Type S h1 **	Type L h1	h2	r1	r2	h5	S1 min	S2
½/16	16	40	18	12.00	35	51	4	2	3	15	2.0	3.0
¾/25	25	50	27	21.00	40	51	5	3	3	15	2.0	3.0
1/30	30	60	32	25.00	40	51	5	4	3	15	2.5	3.5
1¼/38	38	70	40	33.03	40	51	5	4	3	15	2.5	3.5
1½/44.5	44.5	80	46.5	39.53	45	51	6	4	3	15	2.5	3.5
2/57	57	99	59	52.16	45	64	6	5	3	15	2.5	3.5
2½/76.1	76.1	120	78	71.23	45	64	6	5	3	15	2.5	3.5
3/88.9	88.9	130	91	84.08	50	64	7	5	3	15	2.5	3.5
4/108	108	158	110	102.13	50	76	7	5	3	15	3.0	4.0
6/159	159	212	161.5	152.38	50	89	9	5	5	15	3.5	4.5
8/219.1	219.1	270	222	210.10	50	102	9	5	5	15	4.5	6.0
10/267	267	320	270	255.93	50	127	9	5	5	15	5.5	7.0
12/323.9	323.9	370	327	309.74	50	152	11	7	5	16	7.0	8.5
14/368	368	430	371	351.00	50	152	11	7	5	16	8.0	9.5
16/419	419	482	422	399.84	50	152	12	7	7	16	9.0	10.5
18/457.2	457.2	530	460	438.5	50	152	12	7	7	16	9.5	11.0
20/508	508	585	511	486.5	50	152	12	7	7	20	11.0	12.5
24/610	610	685	613	584.5	60	152	14	9	7	20	13.0	14.5
28/711	711	800	719	681.5	60	190	19	9	7	24	15.0	19.0
32/813	813	905	821	779.5	60	190	20.5	9	7	24	17.0	21.0
36/914	914	1000	922	876.5	60	190	22	9	7	32	19.0	23.0

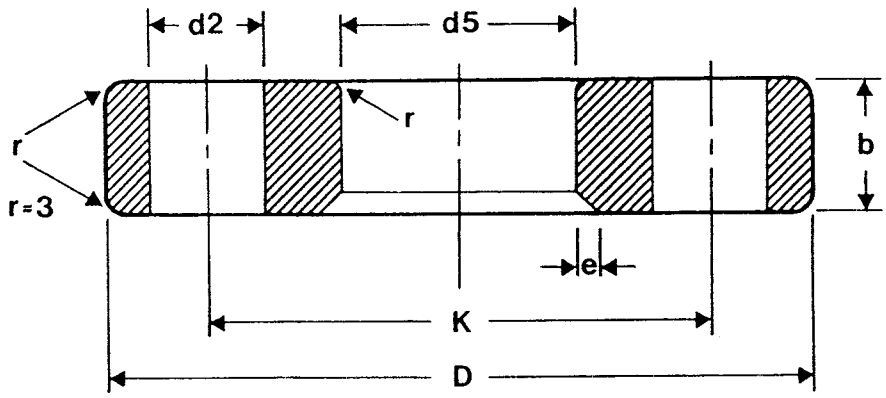
All dimensions in millimetres except where indicated

* For weld-neck stub-ends operating at a maximum design pressure of 16 bar at 75°C — see table 1.2

** Type 'S' stub ends are not suitable for welding with the backing flange in position on stub end

Table 1.4

Weld neck backing flanges: Class 150*



for tolerances see table 1.5.2

Size in/mm	D	b min	d2 in	d2 mm	d5	K	No of bolts	e
½/16	89	14	⅝	15.9	19	60.3	4	2
¾/25	98	14	⅝	15.9	28	69.8	4	3
1/30	108	14	⅝	15.9	33	79.4	4	3
1¼/38	117	14	⅝	15.9	41	88.9	4	3
1½/44.5	127	14	⅝	15.9	48	98.4	4	3
2/57	152	18	¾	19.0	62	120.6	4	3
2½/76.1	178	18	¾	19.0	81	139.7	4	3
3/88.9	190	19	¾	19.0	94	152.4	4	3
4/108	229	24	¾	19.0	113	190.5	8	3
6/159	279	27	⅞	22.2	164	241.3	8	4
8/219.1	343	31	⅞	22.2	225	298.4	8	5
10/267	406	38	1	25.4	273	362.0	12	5
12/323.9	483	41	1	25.4	330	431.8	12	7
14/368	533	45	1⅛	28.6	374	476.2	12	7
16/419	597	51	1⅛	28.6	426	539.8	16	7
18/457.2	635	52	1¼	31.8	465	577.8	16	7
20/508	698	58	1¼	31.8	517	635.0	20	7
24/610	813	71	1⅜	34.9	618	749.3	20	9
28/711	927	81	1⅜	34.9	727	864.0	28	9
32/813	1060	95	1⅝	41.1	829	978.0	28	9
36/914	1168	105	1⅝	41.1	931	1086.0	32	9

All dimensions in millimetres except where indicated

* These backing flanges are suitable for use in both 16 bar and 20 bar systems:

For 16 bar systems use with stub ends selected from table 1.2

For 20 bar systems use with stub ends selected from table 1.3

Table 1.5.1

Tolerances: weld neck stub ends

Symbol	h1		d6	d7	d4	h2
Flange size in/mm	Length through stub end		Neck dia	Inside dia	Flange dia	Flange thickness
	short type S	long type L				
up to ¾/25	±1.5	±2	±0.5	±0.44	±1	±0.5
over ¾/25 up to 2/57				±0.54		
2½/76.1				±0.58		
3/88.9	±2		±1.0		±2	
4/108				±0.73		
6/159			±1.5	±0.12		±1
8/219.1				±0.30		
10/267		±3		±0.40		
12/323.9			±3	±0.55		
14/368				±0.70		±1.5
16/419				±0.80		
over 16/419 up to 36/914				±1.5		

Table 1.5.2

Tolerances: backing flanges

Symbol	d5	D	b	K		d2
Flange size in/mm	Bore of flange	Outside dia of flange	Thickness of flange	Pitch circle dia	Centre to centre of bolt holes	Bolt hole dia
up to 3/88.9	+1 −0	±2	+3.5 −0	+0.9 −0	±0.45	+0.5 −0
4/108	+1.5 −0		+5 −0			+1 −0
6/159 up to & incl. 12/323.9						
14/368 16/419	+2 −0	±3	+7.5 −0	+1.4 −0	±0.7	
18/457.2 20/508		±5				
24/610 up to & incl. 36/914	+4 −0		+10 −0			

All dimensions in millimetres unless otherwise stated.

Table 1.6.1

Chemical composition and mechanical properties for wrought 90/10 copper-nickel weld-neck stub ends.

Chemical composition: %			Mechanical properties				
Element	min	max	Tensile strength – N/mm² min	Tensile strength – N/mm² max	0.2% Proof stress N/mm² min	Elongation % min on $L=5.65\sqrt{S_o}$	Hardness HV 5 max
Copper	**Rem**						
Lead	—	0.010					
Iron†	**1.5**	**2.00**					
Nickel	**10.0**	**11.0**					
Zinc	—	0.20					
Manganese	**0.50**	**1.00**	**280**	—	**105**	**30**	**120****
Sulphur	—	0.020					
Phosphorus	—	0.020					
Carbon	—	0.050					
Total impurities* including those in lighter type	—	0.30					

† The minimum iron content has been selected to improve erosion resistance

*** Impurities are elements other than copper (including silver) iron, nickel (including cobalt) and manganese**

**** Determined on finished stub ends**

Table 1.6.2

Chemical composition and mechanical properties for carbon steel backing flanges.

Material: forged carbon steel to ASTM A105 (normalised)

Chemical requirements: as per ASTM A105 except that the carbon content shall not exceed 0.22% (ladle) with a carbon equivalent of C + Mn/6 = 0.42% maximum.

Mechanical properties shall be as stated in ASTM A105.

SECTION TWO — COMPOSITE SLIP-ON FLANGES

2.1 Scope and design basis

Section 2 is divided into two sub-sections. Sub-section 2A gives details of the 90/10 copper nickel slip-on stub ends, whereas sub-section 2B gives details of the forged carbon steel plate-type backing flanges.

The range of sizes covered for these composite slip-on flanges are ½ in/16 mm – 4 in/108 mm.*

The thicknesses of the plate type backing flanges have been determined generally in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 — 1983 Edition, Appendix 2, except that design stresses have been established in accordance with ANSI B31.3 criteria.

The following design criteria were used:

(a) Drilling and outside diameter dimensions of flange sizes ½ in/16 mm – 4 in/108 mm are in accordance with ANSI B16.5 and BS 1560.

(b) All calculations for backing flanges have been carried out using a design pressure of 20 bar at 38°C.

(c) Backing flanges: ASTM A105 Forged carbon steel.

(d) Gaskets: 1.5 mm thick CAF (compressed asbestos fibre) inside bolt circle.

(e) Bolting: ASTM A193 B7.

Design stresses used in the calculations were as follows:

(i) Steel backing flanges: 160.7 N/mm^2.

(ii) Bolting: 172.4 N/mm^2.

Based on the results of the above calculations an attempt has been made to rationalise ½ in/16 mm up to and including 1½ in/44.5 mm backing flanges which utilise the same bolting. The opportunity was taken therefore to use the same flange thickness, (dimension "b"), determined for the largest of this size range and apply it to the smaller sizes, resulting in identical bolt lengths for all flanges in that range. This was considered to be a practical and economical advantage.

It is important to note however, that the backing flanges for these composite slip-on flanges have somewhat larger centre-hole diameters (dimension "d_5") than those used for the corresponding size of weld neck stub ends covered in section 1B of this specification. Backing flanges to sections 1B and 2B therefore are not interchangeable. Dimension "d_5" for the two flange types is given in appendix B.

The dimensions of backing flanges are governed by the strength required to resist the forces which may occur on bolting up. Therefore all flanges are suitable for a maximum working pressure of 20 bar at 38°C.

This specification does not specify hydraulic test pressures for flanges or components, details of which should be obtained from the appropriate application standards.

2.2 Pressure/temperature ratings

Pressure/temperature ratings are the maximum allowable working pressures (MAWP) at the temperatures shown in appendix C.

The temperature shown for a corresponding pressure rating is considered to be the same as that of the contained fluid.

* *For purposes of this specification inch dimensions are nominal and metric dimensions refer to specified outside diameters.*

2.3 Materials

2.3.1 Flanges

Stub ends detailed in sub-section 2A shall be manufactured in 90/10 Cu/Ni alloy UNS 7060X*, the composition and mechanical properties of which are specified in table 2.5.1.

Backing flanges detailed in sub-section 2B shall be manufactured from the material specified in table 2.5.2. Alternative steels may be used for the backing flanges provided that they have mechanical properties equal to or better than those specified in ASTM A105 (normalised) and are acceptable to the purchaser.

2.3.2 Gaskets

The gaskets normally used with flanges to this specification are those made from compressed asbestos fibre (CAF) or equivalent. The gaskets shall not be graphited. Alternatively neoprene type gaskets with a minimum Shore hardness of not less than 75 may be used located within the bolt circle.

Note: Gaskets shall not be used when mating with elastomer/rubber faced flanges.

2.3.3 Bolting (stud bolts)

Bolting for flanges to this specification shall be selected from ASTM A193-B7 and ASTM A194-2H and should be suitably protected from corrosion.

SUB-SECTION 2A — SLIP-ON STUB ENDS

2A.1 Manufacture

Stub ends shall be manufactured by one or more of the following processes:

(a) Hot forging.

(b) Cold forging followed by annealing.

(c) Friction welded from wrought materials in accordance with the requirements of BS 6223.

(d) Other methods of manufacture shall be as agreed between the purchaser and the manufacturer.

2A.2 Information to be supplied by the purchaser

The following shall be specified by the purchaser on the order (for stub ends):

(a) The title and number of this specification (EEMUA Publication 145: 1987: section 2A).

(b) Size: inches and millimetres.

(c) Whether certificates of compliance or manufacturer's certificates are required (see clause 2A.8).

(d) Whether it is his intention to inspect the material at the supplier's works (see addendum).

(e) Whether the individual cast analyses are required to be supplied (see addendum).

(f) Whether any additional identification marking other than that specified herein is required.

See clause 2B.2 for information to be supplied by the purchaser for backing flanges.

* *Alloy UNS 7060X is a modified form of the following national designated alloys — UNS 70600, BS CN 102 and DIN 2.0872.*

2A.3 Freedom from defects

The stub ends shall be visibly clean, smooth and free from defects greater than 0.5 mm in depth, irregularities, scale or deposits.

2A.4 Joint facings and surface finish

All stub end jointing surfaces shall be machine finished and when compared with visual or tactile means with reference specimens, they shall comply with the values shown in table 2.1.

It is not intended that instrument measurements be taken on the faces themselves and the R_a and R_z values relate to the reference specimens.

Table 2.1

Surface finish (Slip-on stub ends)

Method of Machining	Ra* µm		Rz* µm	
	min	max	min	max
Turning	3.2	12.5	12.5	50

Note: The term "turning" includes any method of machining producing concentric or spiral grooves.

2A.5 Selection of test samples

For stub ends produced by hot forging or cold forging followed by annealing, samples for determination of mechanical properties shall be selected in accordance with clause 9.2 of BS 2872: 1969, the mechanical properties so determined shall comply with the requirements of table 2.5.1 of this section.

Samples shall be selected from each cast for chemical analysis and shall comply with the requirements of table 2.5.1 of this section.

For stub ends produced by friction welding using seamless tube and hot rolled or cold rolled and annealed sheet or plate, samples shall be selected as follows:

(a) Seamless tube in accordance with clause 1.6 of EEMUA Publication No. 144: 1987: section 1. The mechanical properties of the finished components shall comply with the requirements of table 2.5.1 of this section.

(b) Sheet/plate in accordance with clause 11 of BS 2870: 1980 or clause 1.8 of BS 2875: 1969. The analysis and mechanical properties of each sheet or plate used to produce the stub ends shall comply with the requirements of table 2.5.1 of this section.

2A.6 Marking

2A.6.1 All stub ends 2 in/57 mm and larger shall be clearly and permanently marked by means of a vibratory etching tool or electrochemical etching as follows:

(a) Purchase order number (PO).

(b) The number of this section (EEMUA Publication No. 145: 1987: section 2A).

* Ra and Rz are defined in BS 1134

(c) Size: inches and millimetres.

(d) The nominal pressure rating 20 bar.

(e) Material designation UNS 706OX.

(f) Batch traceability number (BTN).

(g) Manufacturer's name or trademark (MTM).

Examples of marking:
PO 145/2 2/57 20 706OX BTN MTM.

Notes: (i) Stamping with metallic stamps is not permitted.
(ii) Marking shall not be on the gasket contact surfaces.

2A.6.2 Stub ends in sizes 1½ in/44.5 mm and smaller where it is not practical to apply the full requirements of 2A.6.1 shall be marked as follows:

(a) Size: inches and millimetres.

(b) Nominal pressure rating: 20 bar.

(c) Material designation UNS 7060X.

(d) Batch traceability number (BTN).

(e) Manufacturer's name or trademark (MTM).

The remainder of the marking requirements shall be applied to indestructible-type labels securely attached to the component. The labels shall be clearly and permanently marked.

2A.7 Inspection and testing

This section does not make provision for routine pressure testing of stub ends. They shall, however, be dimensionally correct and be marked in accordance with this section. All stub ends shall be capable of withstanding without leakage or signs of distress a hydraulic pressure as follows:

20 bar rated flanges, test pressure = 30 bar.

2A.8 Certification

Certificate(s) shall be supplied, either:

2A.8.1 A certificate of compliance which shall state that the stub ends have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 2A) or:

2A.8.2 A manufacturer's certificate which shall state that the stub ends have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 2A) and:

(a) State the actual composition limits determined for each of the elements designated in table 2.5.1 of each of the casts used in the manufacture of each batch as defined in clause 9.2 of BS 2872: 1969.

In the case of stub ends produced by friction welding state the actual composition limits determined for each of the elements separately designated in table 2.5.1 of the casts used for producing the seamless tube and for the sheet/plate used in each batch of stub ends in accordance with 2A.1.(c).

Note: Individual cast analyses shall be retained by the manufacturer (see addendum).

(b) State the results of mechanical tests performed on each batch (see clause 2A.5 — selection of test samples).

SUB-SECTION 2B — SLIP–ON BACKING FLANGES

2B.1 Manufacture

Backing flanges shall be of forged carbon steel to ASTM A105 (normalised) except that the carbon content and the carbon equivalent shall not exceed the values given in table 2.5.2.

2B.2 Information to be supplied by the purchaser

The following shall be specified by the purchaser on the order (for backing flanges):

(a) The title and number of this section (EEMUA Publication No. 145: 1987: Section 2B).

(b) Size: inches and millimetres.

(c) Pressure rating: Class 150.

(d) Whether it is his intention to inspect the material at the supplier's works (see addendum).

(e) Whether manufacturer's certificates are required (see clause 2B.8).

(f) Whether any additional identification marking other than that specified herein is required.

(g) Whether any temporary or permanent corrosion protection is required other than as specified in clause 2B.9.

See clause 2A.2 for information to be supplied by the purchaser for stub ends.

2B.3 Drilling

All bolt holes shall be drilled and shall be equally spaced on the pitch circle diameter K (see table 2.3).

2B.4 Facings and surface finish

The outside diameters and bores of backing flanges shall be machine finished and edges shall have a radius of 3 mm in accordance with table 2.3. The face of the backing flange to be in contact with the stub ends shall be machined flat.

2B.5 Selection of test samples

Samples representing each lot of backing flanges shall be selected and subjected to testing in accordance with the requirements of ASTM A105.

2B.6 Marking

Backing flanges shall be clearly marked with round-nose steel stamps around the rim.

Backing flanges shall be clearly marked as follows:

(a) Purchase Order Number (PO).

(b) The number of this section (EEMUA Publication No. 145: 1987: Section 2B).

(c) Size: inches and millimetres.

(d) The nominal pressure rating: Class 150.

(e) Material designation: A105 (ASTM A105) see table 2.5.2.

(f) Batch traceability number (BTN).

(g) Manufacturer's name or trademark (MTM).

Examples of marking:

PO 145/2B 2/57 150 A105 BTN MTM.

2B.7 Inspection and testing

Backing flanges shall be dimensionally correct and be marked in accordance with this section.

Backing flanges shall be visually examined for defects and irregularities in the protective coating.

2B.8 Certification

Certificate(s) shall be supplied, either:

2B.8.1 A certificate of compliance which shall state that the backing flanges have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 2B) or:

2B.8.2 A manufacturer's certificate which shall state that the backing flanges have been manufactured in accordance with all the requirements of this section (EEMUA Publication No: 145: 1987: section 2B) and:

(a) State the analysis of each cast used in the manufacture of each order (see clause 2B.5 — selection of test samples).

(b) State the results of mechanical tests performed on each cast used in the manufacture of each order (see clause 2B.5 — selection of test samples).

2B.9 Temporary corrosion protection

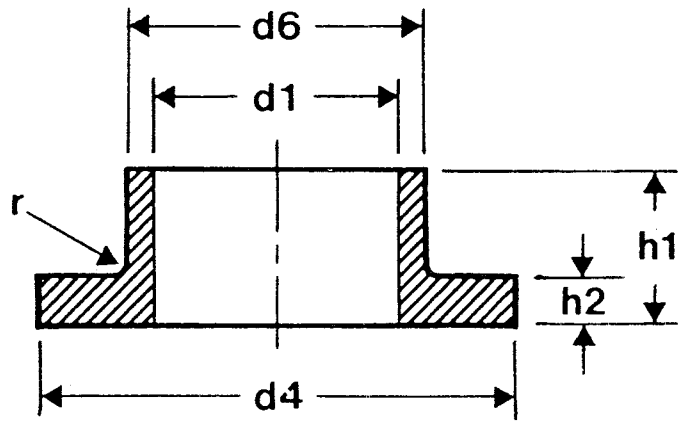
Unless otherwise specified by the purchaser flanges shall be protected against corrosion during transit and storage according to the following procedure:

(a) blast clean to standard Sa2½ as specified in Swedish Standard SIS 055 900.

(b) apply blast primer of zinc rich epoxy coating to a dry film thickness of 25-50μm immediately after blast cleaning. After blast priming the identification marking shall be repeated, as necessary, by painting in such colours as to be clearly visible.

Table 2.2

Slip-on 90/10 CuNi stub ends 20 bar rating*



for tolerances see Table 2.4.1
for pressure/temperature ratings — see appendix C

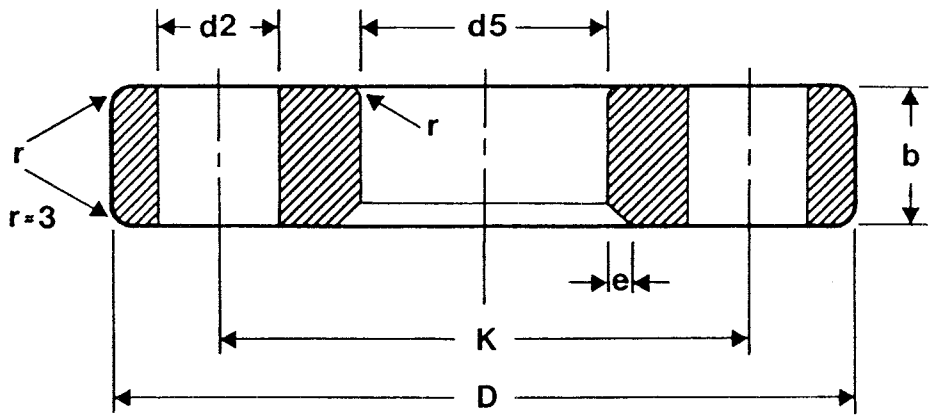
Size in/mm	d1	d6	d4	h1	h2	r
½/16	16.07	21	40	16	5	1
¾/25	25.08	31	53	16	5	1
1/30	30.08	36	60	18	5	1
1¼/38	38.10	45	70	18	5	1
1½/44.5	44.60	51	80	19	5	1
2/57	57.23	67	99	19	6	1
2½/76.1	76.33	87	120	19	6	1
3/88.9	89.18	100	130	21	7	1
4/108	108.38	120	158	23	7	1

All dimensions in millimetres except where indicated

** These stub ends are for use in both 16 bar and 20 bar systems*

Table 2.3

Steel backing flanges for use with 90/10 CuNi slip-on stub-ends: Class 150*.



for tolerances see table 2.4.2
for pressure/temperature ratings — see appendix C

Size in/mm	D	b min	d2 in/mm	d5	K	No of bolts	e
½/16	89	14	⅝/15.9	23	60.3	4	3
¾/25	98	14	⅝/15.9	33	69.8	4	3
1/30	108	14	⅝/15.9	38	79.4	4	3
1¼/38	117	14	⅝/15.9	47	88.9	4	3
1½/44.5	127	14	⅝/15.9	53	98.4	4	3
2/57	152	18	¾/19.0	69	120.6	4	3
2½/76.1	178	18	¾/19.0	89	139.7	4	3
3/88.9	190	19	¾/19.0	103	152.4	4	3
4/108	229	24	¾/19.0	123	190.5	4	3

All dimensions in millimetres except where indicated

** These backing flanges are for use in both 16 bar and 20 bar systems*

Table 2.4.1

Tolerances: slip-on stub ends

Symbol	h1	d6	d1	d4	h2
Flange size in/mm	Length through stub end	Neck diameter	Inside diameter	Flange diameter	Flange thickness
up to and including 2½/76.1	±1.5	±0.5	+0.05 −0	±1	±0.5
3/88.9 and 4/108	±2	±1	+0.05 −0	±2	±0.5

All dimensions in millimetres except where indicated

Table 2.4.2

Tolerances: steel backing flanges

Symbol	d5	D	b	K		d2
Flange size in/mm	Bore	Outside diameter	Thickness	Pitch circle diameter	Centre to centre of bolt holes	Bolt hole dia.
up to and including 3/88.9	+1 −0	±2	+3.5 −0	+0.9 −0	±0.45	+0.5 −0
4/108	+1.5 −0	±2	+3.5 −0	+0.9 −0	±0.45	+0.5 −0

All dimensions in millimetres except where indicated

Table 2.5.1

Chemical composition and mechanical properties for wrought 90/10 copper-nickel slip-on stub-ends

Chemical composition: %			Mechanical properties				
			Tensile strength — N/mm²		0.2% Proof stress	Elongation % min	Hardness HV_5
Element	min	max	min	max	N/mm² min	on L=5.65√So	max
Copper	**Rem**						
Lead	—	0.010					
Iron†	**1.5**	**2.00**					
Nickel	**10.00**	**11.00**					
Zinc	—	0.20					
Manganese	**0.50**	**1.00**	**280**	—	**105**	**30**	**120****
Sulphur	—	0.020					
Phosphorus	—	0.020					
Carbon	—	0.050					
Total impurities* including those in lighter type	—	0.30					

† The minimum iron content has been selected to improve erosion resistance

* Impurities are elements other than copper (including silver), iron, nickel (including cobalt) and manganese

** Determined on finished stub ends

Table 2.5.2

Chemical composition and mechanical properties for carbon steel backing flanges

Material: Forged carbon steel to ASTM A105 (normalised).

Chemical requirements: as per ASTM A105 except that the carbon content shall not exceed 0.22% (ladle) with a carbon equivalent of C + Mn/6 = 0.42% maximum.

Mechanical properties shall be as stated in ASTM A105.

SECTION THREE — SOLID 90/10 COPPER NICKEL WELD NECK FLANGES

3.1 Scope and design basis

Section 3 gives details of solid 90/10 copper nickel weld neck flanges.

The range of sizes covered for these flanges is ½ in/16 mm – 36 in/914 mm.*

The thicknesses of these weld neck flanges have been determined generally in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 1983 Edition, Appendix 2.

The following design criteria were used:

(a) Drilling and outside diameter dimensions of flange sizes ½ in/16 mm – 24 in/610 mm are in accordance with ANSI B16.5 and BS 1560, whereas the larger sizes, 28 in/711 mm – 36 in/914 mm are in accordance with MSS SP44.

(b) All calculations have been carried out using a design pressure of 20 bar at 38°C which additionally verifies the flanges for 16 bar at 75°C. The only difference between 16 bar and 20 bar flanges being the minimum bore and weld preparation

(c) Gaskets: 1.5 mm thick CAF (compressed asbestos fibre) inside bolt circle.

(d) Bolting: aluminium bronze, ASTM B150 (alloy UNS C63000).

Design stresses used were as follows:

(i) Flanges: 68.6 N/mm^2.

(ii) Bolting: 172.4 N/mm^2 up to 1 in size.
155.17 N/mm^2 over 1 in size.

The major differences from ANSI B16.5 and BS 1560 flanges are the length through hub, the thickness of flange and in some cases changes in the hub geometry to satisfy the design criteria, and permit the use of ring spanners.

This specification does not specify hydraulic test pressures for flanges or components, details of which should be obtained from the appropriate application standards.

3.2 Pressure/temperature ratings

Pressure/temperature ratings are the maximum allowable working pressures (MAWP) at the temperatures shown in appendix C.

If a flange rated at 16 bar is to be connected to a flange rated at 20 bar then that flanged joint shall be rated at 16 bar (see tables 3.2 and 3.3).

The temperature shown for a corresponding pressure rating is considered to be the same as that of the contained fluid.

3.3 Materials

3.3.1 Flanges.

Flanges detailed in this section shall be manufactured in 90/10 CuNi alloy UNS 7060X**, the composition and mechanical properties of which are specified in table 3.5.

* *For purposes of this specification inch dimensions are nominal and metric dimensions refer to specified outside diameters.*

** *Alloy UNS 7060X is a modified form of the following national designated alloys — UNS 70600, BS CN 102 and DIN 2.0872.*

3.3.2 Gaskets

The gaskets normally used with flanges to this section are those made from compressed asbestos fibre (CAF) or equivalent. The gaskets shall not be graphited.

Alternatively neoprene type gaskets with a minimum Shore hardness of not less than 75 may be used.

In order to ensure adequate seating, irrespective of materials, the gaskets shall be located within the bolt circle.

Note: Gaskets should not be used when mating with elastomer/rubber faced flanges.

3.3.3 Bolting

Suitable material for bolting (stud bolts) for flanges to this section is aluminium bronze alloy to ASTM B150 alloy UNS C63000.

Other suitable copper alloy bolting materials may be used providing they have comparable corrosion resisting properties and are compatible with the parent flange material. In addition, the mechanical properties of the alternative material shall be equal to or greater than those of ASTM B150 alloy UNS C63000.

3.4 Manufacture

Solid weld neck flanges shall be manufactured by hot forging or cold forging followed by annealing. Other methods of manufacture shall be as agreed between purchaser and manufacturer.

3.5 Information to be supplied by the purchaser

The following shall be specified by the purchaser on the order:

(a) The title and number of this section (EEMUA Publication No. 145: 1987: section 3).

(b) Size: inches and millimetres.

(c) The pressure rating: 16 bar or 20 bar, see tables 3.2 and 3.3 and Appendix C.

(d) Whether it is his intention to inspect the material at the suppliers works (see addendum).

(e) Whether manufacturer's certificates are required (see clause 3.11)

(f) Whether individual cast analyses are required to be supplied (see addendum)

(g) Whether any additional identification marking other than that specified herein is required.

3.6 Freedom from defects

Flanges shall be visibly clean and free from defects greater than 0.5 mm in depth, irregularities, scale or deposits.

3.7 Joint facings and surface finish

All flange jointing faces shall be machine finished and when compared by visual or tactile means with reference specimens they shall comply with the values shown in table 3.1.

It is not intended that instrument measurements be taken on the faces themselves and the R_a and R_z values relate to the reference specimens.

Table 3.1

Surface finish (solid weld neck flanges)

Method of machining	Ra* µm		Rz* µm	
	min	max	min	max
Turning	3.2	12.5	12.5	50

Note: The term "turning" includes any method of machining producing concentric or spiral grooves.

* Ra and Rz are defined in BS 1134

3.8 Selection of test samples

For solid weld neck flanges produced by hot forging or cold forging followed by annealing, samples for determination of mechanical properties shall be selected in accordance with Clause 9.2 of BS 2872: 1969. The mechanical properties so determined shall comply with the requirements of table 3.5 of this section.

Samples shall be selected from each cast for chemical analysis and shall comply with the requirements of table 3.5 of this section.

3.9 Marking

3.9.1 All flanges 2 in/57 mm and above shall be individually clearly and permanently marked by means of a vibratory etching tool or electrochemical etching as follows:

(a) Purchase order number (PO).

(b) The number of this section (EEMUA Publication No. 145: 1987: section 3).

(c) Size: inches and millimetres.

(d) The nominal pressure rating: 16 bar or 20 bar.

(e) Material designation — UNS 7060X.**

(f) Batch traceability number (BTN).

(g) Manufacturer's name or trademark (MTM).

Examples of marking:

PO145/3 2/57 20 7060X BTN MTM.

Notes: (i) Stamping with metallic stamps is not permitted.

(ii) Marking shall not be on the gasket contact surfaces.

3.9.2 Flanges in sizes 1½ in/44.5 mm and smaller where it is not practical to apply the full requirements of 3.9.1 shall be marked as follows:

(a) Size: inches and millimetres.

(b) Nominal pressure rating 16 or 20 bar.

** *Alloy UNS 7060X is a modified form of the following national designated alloys —UNS 70600, BS CN 102 and DIN 2.0872.*

(c) Material designation UNS 7060X.

(d) Batch traceability number (BTN).

(e) Manufacturer's name or trademark (MTM).

The remainder of the marking requirements shall be applied to indestructible type labels securely attached to the component. The labels shall be clearly and permanently marked.

3.10 Inspection and testing

This section does not make routine provision for pressure testing of flanges.

They shall, however, be dimensionally correct and be marked in accordance with this section. All flanges shall be capable of withstanding without leakage or signs of distress a hydraulic pressure as follows:

16 bar rated flanges, test pressure = 24 bar.

20 bar rated flanges, test pressure = 30 bar.

3.11 Certification

Certificate(s) shall be supplied, either:

3.11.1 A certificate of compliance which shall state that the flanges have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 3) or:

3.11.2 A manufacturer's certificate which shall state that the flanges have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 3) and:

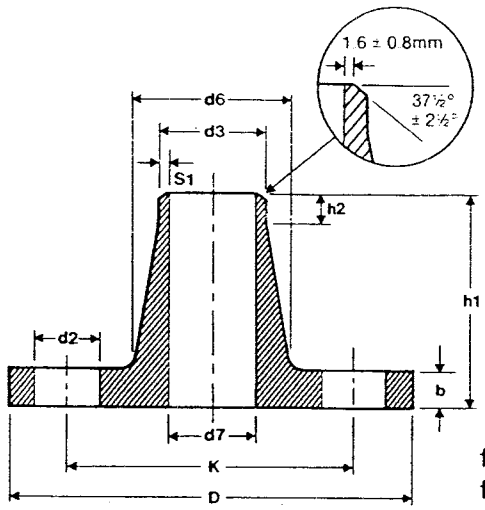
(a) State the actual compositional limits determined for each of the elements designated in table 3.5 of the casts used in the manufacture of each batch.

Note: Individual cast analyses shall be retained by the manufacturer (see addendum).

(b) State the results of mechanical tests performed on each batch (see clause 3.8: selection of test samples).

Table 3.2

Solid 90/10 CuNi weld neck flanges: 16 bar



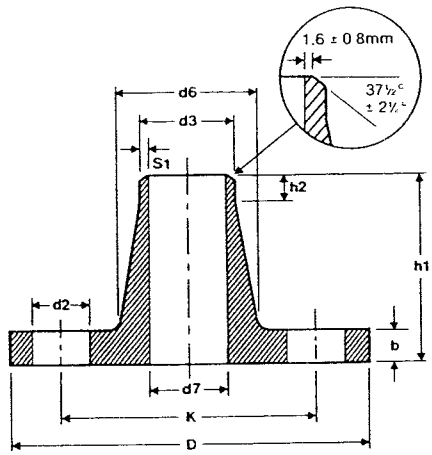
for tolerances — see Table 3.4
for pressure/temperature ratings see appendix C

Size		Outside diameter of flange	Thickness of flange	Diameter of hub	Hub dia at weld chamfer	Length through hub	Bore of flange	Thickness of hub at welding end	Parallel length on hub	Drilling		
in	mm									Diameter of bolt circle	No of bolts	Diameter of bolt holes
		D	b	d6	d3	h1	d7	S1 min	h2	K	–	d2
½	16	USE 20 bar SEE TABLE 3.3										
¾	25											
1	30											
1¼	38											
1½	44.5											
2	57											
2½	76.1											
3	88.9											
4	108											
6	159	279	27	192	159	89	153.75	3.0	8	241.3	8	22.2
8	219.1	343	31	246	219.1	98	211.10	4.0	8	298.4	8	22.2
10	267	406	31	305	267	98	257.97	4.5	8	362.0	12	25.4
12	323.9	483	35	365	323.9	98	312.83	5.5	8	431.8	12	25.4
14	368	533	41	400	368	99	354.22	6.5	8	476.2	12	28.6
16	419	597	43	457	419	106	404.17	7.0	8	539.8	16	28.6
18	457.2	635	45	505	457.2	113	441.5	8.0	8	577.8	16	31.8
20	508	698	45	559	508	118	490.5	8.5	8	635.0	20	31.8
24	610	813	49	664	610	137	589.5	10.5	8	749.3	20	34.9
28	711	927	72	748	711	145	687.5	12.0	8	864	28	34.9
32	813	1060	72	876	813	160	786.5	13.5	8	978	28	41.1
36	914	1168	72	984	914	175	883.5	15.5	8	1086	32	41.1

It should be noted that although these flanges are flat faced inside bolt circle gaskets shall be used and special care should be taken to avoid overtightening the bolts
All dimensions in millimetres except where indicated

Table 3.3

Solid 90/10 CuNi weld neck flanges: 20 bar



for tolerances — see table 3.4
for pressure/temperature ratings — see appendix C
Where S1 min is less than 3 mm omit bevel on weld preparation

Size		Outside diameter of flange	Thickness of flange	Diameter of hub	Hub dia at weld chamfer	Length through hub	Bore of flange	Thickness of hub at welding end	Parallel length on hub	Drilling		
in	mm									Diameter of bolt circle	No of bolts	Diameter of bolt holes
		D	b	d6	d3	h1	d7	S1 min	h2	K	-	d2
½	16	89	14	23	16	48	12.00	2.0	8	60.3	4	15.9
¾	25	98	16	32	25	52	21.00	2.0	7	69.8	4	15.9
1	30	108	16	42	30	56	25.00	2.5	8	79.4	4	15.9
1¼	38	117	17	51	38	57	33.03	2.5	8	88.9	4	15.9
1½	44.5	127	20	61	44.5	62	39.53	2.5	7	98.4	4	15.9
2	57	152	25	73	57	64	52.16	2.5	9	120.6	4	19.0
2½	76.1	178	27	91	76.1	70	71.23	2.5	8	139.7	4	19.0
3	88.9	190	27	105	88.9	70	84.08	2.5	8	152.4	4	19.0
4	108	229	27	135	108	76	102.13	3.0	8	190.5	8	19.0
6	159	279	27	192	159	89	152.38	3.5	8	241.3	8	22.2
8	219.1	343	31	246	219.1	98	210.10	4.5	8	298.4	8	22.2
10	267	406	31	305	267	98	255.93	5.5	8	362.0	12	25.4
12	323.9	483	35	365	323.9	98	309.74	7.0	8	431.8	12	25.4
14	368	533	41	400	368	99	351.00	8.0	8	476.2	12	28.6
16	419	597	43	457	419	106	399.84	9.0	8	539.8	16	28.6
18	457.2	635	45	505	457.2	113	438.5	9.5	8	577.8	16	31.8
20	508	698	45	559	508	118	486.5	11.0	8	635.0	20	31.8
24	610	813	49	664	610	137	584.5	13.0	8	749.3	20	34.9
28	711	927	72	748	711	145	681.5	15.0	8	864	28	34.9
32	813	1060	72	876	813	160	779.5	17.0	8	978	28	41.1
36	914	1168	72	984	914	175	876.5	19.0	8	1086	32	41.1

It should be noted that although these flanges are flat faced inside bolt circle gaskets shall be used and special care should be taken to avoid overtightening the bolts
All dimensions in millimetres except where indicated

Table 3.4

Tolerances: solid 90/10 CuNi weld neck flanges

Symbol	d7	D	d6	h1	b	K		d2
Flange size in/mm		Outside dia of flange	OD of hub	Length through flange	Thickness of flange	Pitch circle dia	Centre to centre of bolt holes	Bolt hole dia
up to ¾/25	±0.44	±2	±0.5	±1.5	+3.5 −0	+0.9 −0	±0.45	+0.5 −0
1/30 up to & incl 2/57	±0.54							
2½/76.1	±0.58		±1		+5 −0			
3/88.9								
4/108	±0.73							
6/159	±0.12		±1.5					+1 −0
8/219.1	±0.30							
10/267	±0.40							
12/323.9	±0.55	±3	±3	±3.2		+1.4 −0	±0.7	
14/368	±0.70							
16/419	±0.80	±5						
18/457.2 up to & incl 24/610	±1.5							
28/711 up to & incl 36/914	±1.5				+7.5 −0			

All dimensions in millimetres unless otherwise stated

Table 3.5

Chemical composition and mechanical properties for solid wrought 90/10 CuNi weld neck flanges

Chemical composition: %			Mechanical properties				
			Tensile strength — N/mm²		0.2% Proof stress	Elongation % min	Hardness HV_5
Element	min	max	min	max	N/mm² min	on L=5.65√So	max
Copper	**Rem**						
Lead	—	0.010					
Iron†	**1.5**	**2.00**					
Nickel	**10.00**	**11.00**					
Zinc	—	0.20					
Manganese	**0.50**	**1.00**	**280**	—	**105**	**30**	**120****
Sulphur	—	0.020					
Phosphorus	—	0.020					
Carbon	—	0.050					
Total impurities* including those in lighter type	—	0.30					

† The minimum iron content has been selected to improve erosion resistance.

* Impurities are elements other than copper (including silver) iron nickel (including cobalt) and manganese.

** Determined on finished flanges.

SECTION FOUR — SOLID 90/10 COPPER NICKEL SLIP-ON FLANGES

4.1 Scope and design basis

This section 4 gives details of solid 90/10 copper nickel slip-on flanges.

The range of sizes covered for these flanges is ½ in/16 mm – 4 in/108 mm.*

The thicknesses of these slip-on flanges have been determined generally in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 1983 Edition, appendix 2.

The following design criteria were used:

(a) Drilling and outside diameter dimensions of flange sizes ½ in/16 mm – 4 in/108 mm are in accordance with ANSI B16.5 and BS 1560.

(b) All calculations have been carried out using a design pressure of 20 bar at 38°C.

(c) Gaskets: 1.5 mm thick CAF (compressed asbestos fibre) inside bolt circle.

(d) Bolting: aluminium bronze ASTM B150 (alloy UNS C63000).

Design stresses used in the calculations were as follows:

(i) flanges: 68.6 N/mm^2.

(ii) bolting: 172.4 N/mm^2.

For solid slip-on flanges, in sizes greater than 4 in/108 mm, preliminary calculations have indicated that the solid weld neck flange design covered in section 3 of this specification is more economical and lighter in weight. For the included sizes of solid slip-on flanges (½ in/16 mm – 4 in/108 mm) in order to maintain consistency between the weld-neck and slip-on types, the flange thicknesses and hub diameters are the same for both types.

This specification does not specify hydraulic test pressures for flanges or components, details of which should be obtained from the appropriate application standards.

4.2 Pressure/temperature ratings

The pressure/temperature ratings are the maximum allowable working pressures (MAWP) at the temperatures shown in appendix C.

The temperature shown for a corresponding pressure rating is considered to be the same as that of the contained fluid.

4.3 Materials

4.3.1 Flanges

Flanges detailed in this specification shall be manufactured in 90/10 CuNi alloy UNS 7060X,** the composition and mechanical properties of which are specified in table 4.4.

4.3.2 Gaskets

The gaskets normally used with flanges to this section are those made from compressed asbestos fibre (CAF) or equivalent. The gaskets shall not be graphited.

Alternatively neoprene type gaskets with a minimum Shore hardness of not less than 75 may be used.

* *For purposes of this specification inch dimensions are nominal and metric dimensions refer to specified outside diameters.*

** *Alloy UNS 7060X is a modified form of the following national designated alloys — UNS 70600, BS CN 102 and DIN 2.0872.*

In order to ensure adequate seating irrespective of the material, the gaskets shall be located within the bolt circle.

Note: Gaskets should not be used when mating with elastomer/rubber faced flanges.

4.3.3 **Bolting**

Suitable material for bolting (stud bolts) for flanges to this section is aluminium bronze to ASTM B150 alloy UNS C63000.

Other suitable copper alloy bolting materials may be used providing they have comparable corrosion resisting properties and are compatible with the parent flange material. In addition the mechanical properties of the alternative material shall be equal to or greater than those of ASTM B150 alloy UNS C63000.

4.4 Manufacture

Solid slip-on flanges shall be manufactured by hot forging or cold forging followed by annealing. Other methods of manufacture shall be as agreed between purchaser and manufacturer.

4.5 Information to be supplied by the purchaser

The following shall be specified by the purchaser on the order:

(a) The title and number of this section (EEMUA Publication No. 145: 1987: section 4).

(b) Size: inches and millimetres.

(c) Whether it is his intention to inspect the material at the supplier's works (see addendum).

(d) Whether manufacturer's certificates are required (see clause 4.11).

(e) Whether individual cast analyses are required to be supplied (see addendum).

(f) Whether any additional identifying marking other than that specified herein is required.

4.6 Freedom from defects

Flanges shall be visibly clean and free from defects greater than 0.5 mm in depth, irregularities, scale or deposits.

4.7 Joint facings and surface finish

All flange jointing faces shall be machine finished and when compared by visual or tactile means with reference specimens they shall comply with the values shown in table 4.1.

It is not intended that instrument measurements be taken on the faces themselves and the R_a and R_z values relate to the reference specimens.

Table 4.1

Surface finish (solid slip-on flanges)

Method of machining	Ra* µm		Rz* µm	
	min	max	min	max
Turning	3.2	12.5	12.5	50

Note: The term "turning" includes any method of machining producing concentric or spiral grooves.

* Ra and Rz are defined in BS 1134

4.8 Selection of test samples

For solid slip-on flanges produced by hot forging or cold forging followed by annealing samples for determination of mechanical properties shall be selected in accordance with clause 9.2 of BS 2872: 1969. The mechanical properties so determined shall comply with the requirements of table 4.4 of this section.

Samples shall be selected from each cast for chemical analysis and shall comply with the requirements of table 4.4 of this section.

4.9 Marking

4.9.1 All flanges 2 in/55 mm and above shall be individually clearly and permanently marked by means of a vibratory etching tool or electro-chemical etching as follows:

(a) Purchase order number (PO).

(b) The number of this section (EEMUA Publication No. 145: 1987: section 4).

(c) Size: inches and millimetres.

(d) The nominal pressure rating 20 bar.

(e) Material designation: UNS 7060X.

(f) Batch traceability number (BTN).

(g) Manufacturer's name or trade mark (MTM).

Examples of marking:
PO 145/4 2/57 20 7060X BTN MTM.

Notes: (i) Stamping with metallic stamps is not permitted.

(ii) Marking shall not be on the gasket contact surface.

4.9.2 Flanges in sizes 1½ in/44.5 mm and smaller where it is not practical to apply the full requirements of 4.9.1 shall be marked as follows:

(a) Size: inches and millimetres.

(b) Nominal pressure rating 20 bar.

(c) Material designation UNS 7060X.

(d) Batch traceability number (BTN).

(e) Manufacturer's name or trademark.

The remainder of the marking requirements shall be applied to indestructible type labels securely attached to the component. The labels shall be permanently marked.

4.10 Inspection and testing

This section does not make routine provision for pressure testing of flanges. They shall, however, be dimensionally correct and be marked in accordance with this section. All flanges shall be capable of withstanding without leakage or signs of distress a hydraulic pressure as follows:

20 bar rated flanges, test pressure = 30 bar.

4.11 Certification

Certificate(s) shall be supplied, either:

4.11.1 A certificate of compliance which shall state that the flanges have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 4) or:

4.11.2 A manufacturer's certificate which shall state that the flanges have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 145: 1987: section 4) and:

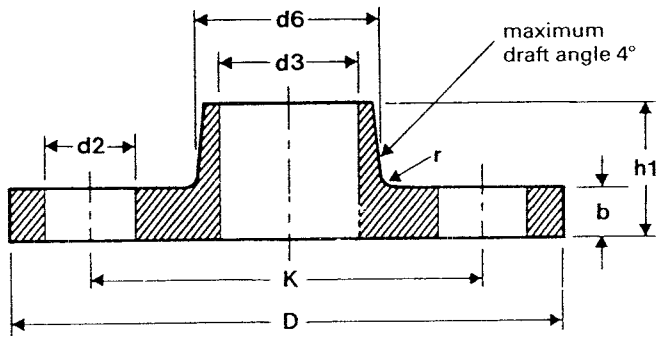
(a) State the actual compositional limits determined for each of the elements designated in table 4.4 of the casts used in the manufacture of each batch.

Note: Individual cast analyses shall be retained by the manufacturer (see addendum).

(b) State the results of mechanical tests performed on each batch (see clause 4.8: selection of test samples).

Table 4.2

Solid 90/10 CuNi slip-on flanges



for tolerances — see Table 4.3
for pressure/temperature ratings: see appendix C

Size		Outside diameter of flange	Thickness of flange	Bore of flange	Diameter of hub	Length through hub	Radius	Drilling			
								Diameter of bolt circle	No of bolts	Diameter of bolt holes	Diameter of bolts in
in	mm										
		D	b	d3	d6	h1	r	K	–	d2	–
½	16	89	14	16.07	23	20	4	60.3	4	15.9	½
¾	25	98	16	25.08	32	24	4	69.8	4	15.9	½
1	30	108	16	30.08	47	24	4	79.4	4	15.9	½
1¼	38	117	17	38.10	51	26	6	88.9	4	15.9	½
1½	44.5	127	20	44.60	61	26	6	98.4	4	15.9	½
2	57	152	25	57.23	73	28	6	120.6	4	19.0	⅝
2½	76.1	178	27	76.33	91	32	6	139.7	4	19.0	⅝
3	88.9	190	27	89.18	105	34	6	152.4	4	19.0	⅝
4	108	229	27	108.38	135	40	8	190.5	8	19.0	⅝

The calculations for the above flanges are in accordance with the design criteria given in clause 4.1 which indicate that in flange sizes above 4 in/108 mm the solid weld-neck design is more economical and lighter than its solid slip-on counterpart and for this reason have been omitted from this section

It should be noted that although these flanges are flat faced inside bolt circle gaskets shall be used and special care should be taken to avoid overtightening the bolting.

All dimensions in millimetres except where indicated

Table 4.3

Tolerances: solid 90/10 CuNi slip-on flanges

Symbol	D	h1	d6	b	K		d2	d3
Flange size in/mm	Outside diameter of flange	Length through flange	Diameter of hub	Thickness of flange	Pitch circle diameter	Centre to centre of bolt holes	Bolt hole diameter	Bore of flange
up to and incl 2 in	±2	±1.5	±0.5	+3.5 −0	+0.9 −0	±0.45	+0.5 −0	+0.05 −0
2½/76.1				+5 −0				
3/88.9			+1.0					+0.1 −0
4/108								

All dimensions in millimetres except where indicated

Table 4.4

Chemical composition and mechanical properties for solid wrought 90/10 CuNi slip-on flanges

Chemical composition: %			Mechanical properties				
			Tensile strength — N/mm²		0.2% Proof stress	Elongation % min	Hardness HV5
Element	min	max	min	max	N/mm² min	on L=5.65√So	max
Copper	**Rem**						
Lead	—	0.010					
Iront	**1.5**	**2.00**					
Nickel	**10.00**	**11.00**					
Zinc	—	0.20					
Manganese	**0.50**	**1.00**	**280**	—	**105**	**30**	**120****
Sulphur	—	0.020					
Phosphorus	—	0.020					
Carbon	—	0.050					
Total impurities* including those in lighter type	—	0.30					

† The minimum iron content has been selected to improve erosion resistance

* Impurities are elements other than copper (including silver), iron, nickel (including cobalt) and manganese

** Determined on finished flanges

ADDENDUM

DISCRETIONARY CONTRACTUAL CLAUSES

INSPECTION

The purchaser shall notify the supplier when placing the order if it is his intention to inspect the material at the supplier's works. The supplier shall afford the purchaser all reasonable facilities to satisfy himself that the material is in accordance with this specification. For this purpose the purchaser or his representative may, by prior agreement, attend to inspect the material, welding procedures and welder qualifications, radiographs and radiographic reports and associated documents and to witness tests being performed.

The purchaser shall be at liberty to take additional samples and have them tested.

The results of such tests shall be communicated to the supplier if they are not in accordance. In addition, the purchaser shall also, if he so specifies, be at liberty to receive copies of the individual cast analysis used in the manufacture of each batch or order.

FACILITIES FOR TESTING

For making tests on samples selected as specified in the governing material specification, the supplier shall provide and prepare the necessary test pieces, and supply labour and appliances for such testing as may be carried out on his premises in accordance with this specification. Unless otherwise agreed, material for testing shall remain the property of the supplier. Failing facilities at his own works for performing the prescribed tests, the supplier shall make the necessary arrangements for performing the tests elsewhere.

APPENDIX A

List of standards and codes referred to in this publication

British Standards (BS)

BS 1134: 1972 Method for the assessment of surface texture.
BS 1560 (Part 2): 1970 Steel pipe flanges and flanged fittings.
BS 2870: 1980 Rolled copper and copper alloys: sheet, strip and foil.
BS 2872: 1969 Copper and copper alloys: Forging stock and forgings.
BS 2875: 1969 Copper and copper alloys: Plate.
BS 4882: 1973 Bolting for flanges and pressure containing purposes.
BS 6223: 1982 Specification for friction welding of butt joints in metals for high duty applications.

German Standards (DIN)

DIN 86036 Lapped flanges and brazing collars for tubes of copper alloys, nominal pressure 16.
DIN 86037 Lapped joint short stub-ends for tubes of copper alloys, nominal pressures 10, 16 and 25.

American Standards and Codes (ANSI/ASME/ASTM/MSS)

ANSI B16.5 Steel pipe flanges and flanged fittings.
ANSI/ASME B31.3 Chemical plant and petroleum refinery piping.
ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Appendix 2.
ASTM A105 Forgings, carbon steel, for piping components.
ASTM A193 Alloy steel and stainless steel bolting materials for high temperature service.
ASTM A194 Carbon and alloy steel nuts for bolts for high pressure and high temperature service.
ASTM B150 Specification for aluminium bronze rod, bar and shapes.
MSS SP43 Wrought stainless steel butt welding fittings.
MSS SP44 Steel pipe line flanges.

Swedish Standards (SIS)

SIS 055 900.

APPENDIX B

Comparison of backing flanges for use with weld neck and slip-on stub ends.

(See clause 2.1 – Scope and design basis).

Comparison of the bore dimensions (dimension "d5") of steel backing flanges for weld neck type stub ends (EEMUA Publication 145: 1987: section 1B and slip-on type stub ends (EEMUA Publication 145: 1987: section 2B).

size in/mm	composite weld neck type (see table 1.4) d5 (mm)	composite slip-on type* (see table 2.3) d5 (mm)
½/16	19	23
¾/25	28	33
1/30	33	38
1¼/38	41	47
1½/44.5	48	53
2/57	62	69
2½/76.1	81	89
3/88.9	94	103
4/108	113	123

* Backing flanges manufactured and intended for use with slip-on type stub ends to section 2 shall not be used with weld neck stub ends to section 1.

APPENDIX C

Pressure/temperature ratings : flanges

Type of Flange	Size Range	Maximum Allowable Working Press-bar							
		16 bar system				20 bar system			
		38°C	50°C	75°C	100°C	38°C	50°C	75°C	100°C
Composite weld neck (section 1)	½ in/16 mm to 4 in/108 mm	see 20 bar system				20	19.7	18.6	17.3
	6 in/159 mm to 36 in/914 mm	16.0	16.0	16.0	15.7	20	19.7	18.6	17.3
Composite slip-on (section 2)	½ in/16 mm to 4 in/108 mm	see 20 bar system				20	19.7	18.6	17.3
Solid weld neck (section 3)	½ in/16 mm to 4 in/108 mm	see 20 bar system				20	19.7	18.6	17.3
	6 in/159 mm to 36 in/914 mm	16.0	16.0	16.0	15.7	20	19.7	18.6	17.3
Solid slip-on (section 4)	½ in/16 mm to 4 in/108 mm	see 20 bar system				20	19.7	18.6	17.3

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140 Noise Procedure Specification

141 Guide to the Use of Noise Procedure Specification

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168	A Guide to the Pressure Testing of In-Service Pressurised Equipment
169	Specification for High Frequency Electric Welded (HFEW) Pipe
170	Specification for Production Testing of Valves—Part 1 Ball Valves *(Incorporating Amendments No 1)*
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