7. 90/10 Cu Ni butt welding fittings

7.1 Scope and design basis

Chapter 7 covers wrought butt welding fittings in sizes 1 in/30 mm up to and including 36 in/914 mm in 90/10 Cu Ni alloy UNS 7060X[*30] as modified in Appendix D of this Publication, for maximum allowable working pressures (MAWP) of 16 bar and 20 bar for temperatures up to and including 75°C and 38°C respectively (see appendix E). The dimensions and tolerances are such that they are suitable for butt welding to seamless or seam-welded 90/10 Cu Ni tubes to EEMUA Publication 234 Chapters 7 and 8 respectively.

This Chapter also covers the acceptance criteria and proof testing requirements for butt welding fittings.

The design features and wall thicknesses of butt welding tees and reducers shall be established by mathematical analysis given in a nationally recognised pressure vessel or piping code acceptable to the Purchaser. The design of fittings which cannot be qualified by such analyses shall be established in accordance with the proof testing procedure in ASME B16.9:2012.

7.2 Information to be supplied by the Purchaser

The Purchaser shall state in the enquiry and order the following information:

(a) The title and number of this section (EEMUA Publication 234: Chapter 7).
(b) The type of fitting and size in inches and millimetres and material designation (see appendix D).
(c) The pressure rating – 16 or 20 bar.
(d) Whether manufacturer's certificates are required; (see Section 7.12).
(e) Whether it is his intention to inspect the material at supplier's works (see Chapter 14).
(f) Whether any additional identification marking other than that specified herein is required.
(g) Whether any test samples or individual test analyses are required to be supplied (see Chapter 14).

7.3 Freedom from defects

The fittings shall be visually clean, smooth and free from defects greater than 0.5 mm in depth, irregularities, scale or deposits, and shall be free from deleterious films in the bore. Repairs by welding shall be limited to seam welds only.

7.4 Materials and manufacture

The fittings shall be seamless or seam-welded and manufactured from tube sheet or plate as follows:

Tubes (seamless) shall have chemical composition and mechanical properties in accordance with EEMUA Publication 234 Chapter 7, "Specification for 90/10 Cu Ni seamless tubes."

Tubes (seam-welded) shall have chemical composition and mechanical properties in accordance with EEMUA Publication 234: Chapter 7, "Specification for 90/10 copper nickel seam-welded tubes."

Sheets or plates shall be hot rolled or cold rolled and annealed in accordance with BS EN 1652:1998, BS EN 1653:1998 or ASTM B171-12 but with chemical composition as modified in this Specification (see appendix D).

[*30] UNS 7060X is a modified form of the following material designated alloys - UNS 70600, BS CN102 and DIN 2.0872. See appendix D of this publication for chemical composition and mechanical properties.

The dimensions and tolerances of seamless and seam-welded fittings shall comply with the requirements of Tables 35 to 43.

The chemical composition and mechanical properties of butt-welding fittings to this Specification are given in appendix D.

7.5 Welding

7.5.1 Consumables

The composition of the filler wire or rods used for the production of seam welds shall be selected from BS EN ISO 24373:2009, Table 1 - Alloy Cu7158.

Alternatively filler wires and rods shall be selected from the American Welding Society Specification AWS-A5.7 - Class ER Cu Ni. Flux coated electrodes shall be selected from the American Welding Society Specification AWS A5.6 - Class E Cu Ni.

7.5.2 Welding procedure qualification

The welding procedure qualifications shall be as quoted in ASME Boiler and Pressure Vessel Code Section IX "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators."

7.5.3 Welder qualification

The welder qualification shall be in accordance with ASME Boiler and Pressure Vessel Code Section IX.

7.6 Selection of test samples

(a) Fittings made from seamless or seam-welded tube to EEMUA Publication 234 Chapters 1 or 2 do not require any additional testing other than hardness testing in order to ensure compliance with Appendix D of this Specification.
(b) Fittings formed from sheet or plate shall be subject to the relevant requirements of EEMUA Publication 234: Chapter 2.

7.7 Non-destructive testing

7.7.1 liquid dye penetrant test

The weld seams of all welded fittings shall be examined externally by the liquid dye penetrant method in accordance with ASME Boiler and Pressure Vessel Code Section V, Article 6 and shall meet the acceptance requirements of ASME Boiler and Pressure Vessel Code Section VIII, Division 1 Appendix 8.

7.7.2 Radiography

Radiographic examination shall be performed for the complete length of each weld to meet the requirements of ASME Boiler and Pressure Vessel Code Section VIII, UW51.

7.8 Repairs to welded seams

Visible defects such as cracks, pinholes and incomplete fusion and defects detected by the tests performed under Section 7.7 shall be removed and repaired in accordance with Section 7.5.

7.9 Retests of repairs

A repaired weld seam shall meet the requirements of the original weld and be re-examined and retested in accordance with Section 7.7.

7.10 Marking

i. All fittings shall be individually permanently marked and identified by clear, legible printing by means of a vibratory etching tool, electro chemical etching, paint or ink stencilling and where applicable, in such colours as to be clearly visible as follows:

(a) Purchase order number (PO).
(b) The number of this section (EEMUA Publication 234: Chapter 7.
(c) Material designation UNS 7060X (See appendix D).
(d) Size: inches and millimetres.
(e) Pressure rating -16 or 20 bar.
(f) Manufacturer's name and/or trademark (MTM).
(g) Test certificate number (TCN).
(h) Cast number.
(i) Where applicable welder identity (WI).

Example of marking: PO 234/7 7060X 14/368 16 MTM TCN Cast No WI

ii. On fittings 44.5 mm and smaller and where it is not practical to apply the full requirements of 7.10 i to the fitting the marking shall detail:

(a) Material designation.
(b) Cast Number.
(c) Manufacturer's name or trademark.
(d) Size: inches and millimetres.
(e) Pressure rating 20 bar.

The remainder of the marking requirements shall be applied to indestructible type labels securely attached to the components. The labels shall be clearly and permanently marked. Alternatively the additional marking requirements shall be applied to the carton in which the fittings are packed.

Note 1: Stamping with metallic stamps is not permitted.

Note 2: Manufacturers shall ensure that any marking materials used shall not be detrimental to the material of the fittings.

7.11 Inspection and testing

This section does not make provision for routine pressure testing of fittings. They shall, however, be dimensionally correct and be marked in accordance with this section. All fittings shall be capable of withstanding without leakage or signs of distress a hydraulic pressure of 1.5 times the maximum design pressure at ambient temperatures as follows:

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

7.12 Certification

Certificate(s) shall be supplied either:

7.12.2: A manufacturer's certificate which shall state that the fittings have been made in accordance with all the requirements of this section (EEMUA Publication 234: Chapter 7) and:

(a) State the actual compositional limits determined for each of the elements designated in appendix D of the casts used in the manufacture of each order for seamless tubes used to manufacture fittings and/or:
(b) State the actual compositional limits determined for each of the elements.
(c) designated in appendix D of each cast used in the manufacture of each sheet or:
(d) plate used in the manufacture of fittings.
(e) Note: Individual cast analyses shall be retained by the manufacturer - see Chapter 14.
(f) State the results of mechanical tests performed on the seamless tubes used to manufacture fittings in accordance with appendix D and/or state the results of mechanical tests performed on sheets or plates formed into fittings in accordance with appendix D.
(g) State the results of the dye penetrant and radiographic examination of each weld on each fitting carried out in accordance with and complying with Sections 7.7, 7.8 and 7.9.

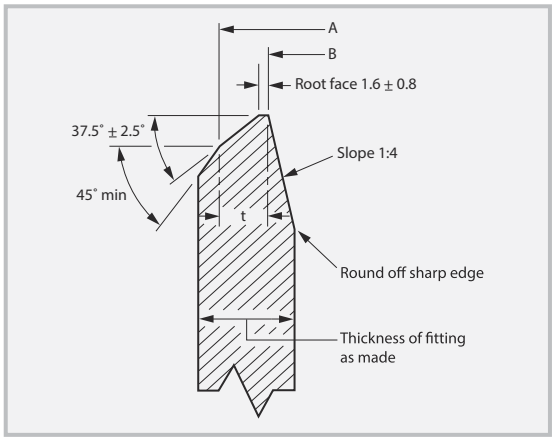


Figure 4 Dimensions of welding ends on butt welding components

See Tables 35 and 36 for dimensions A, B and t, for 16 and 20 bar ratings respectively.

Note: In the case of specified wall thicknesses (t) of less than 3mm, the weld bevel of 37½° ± 2½° may be omitted.

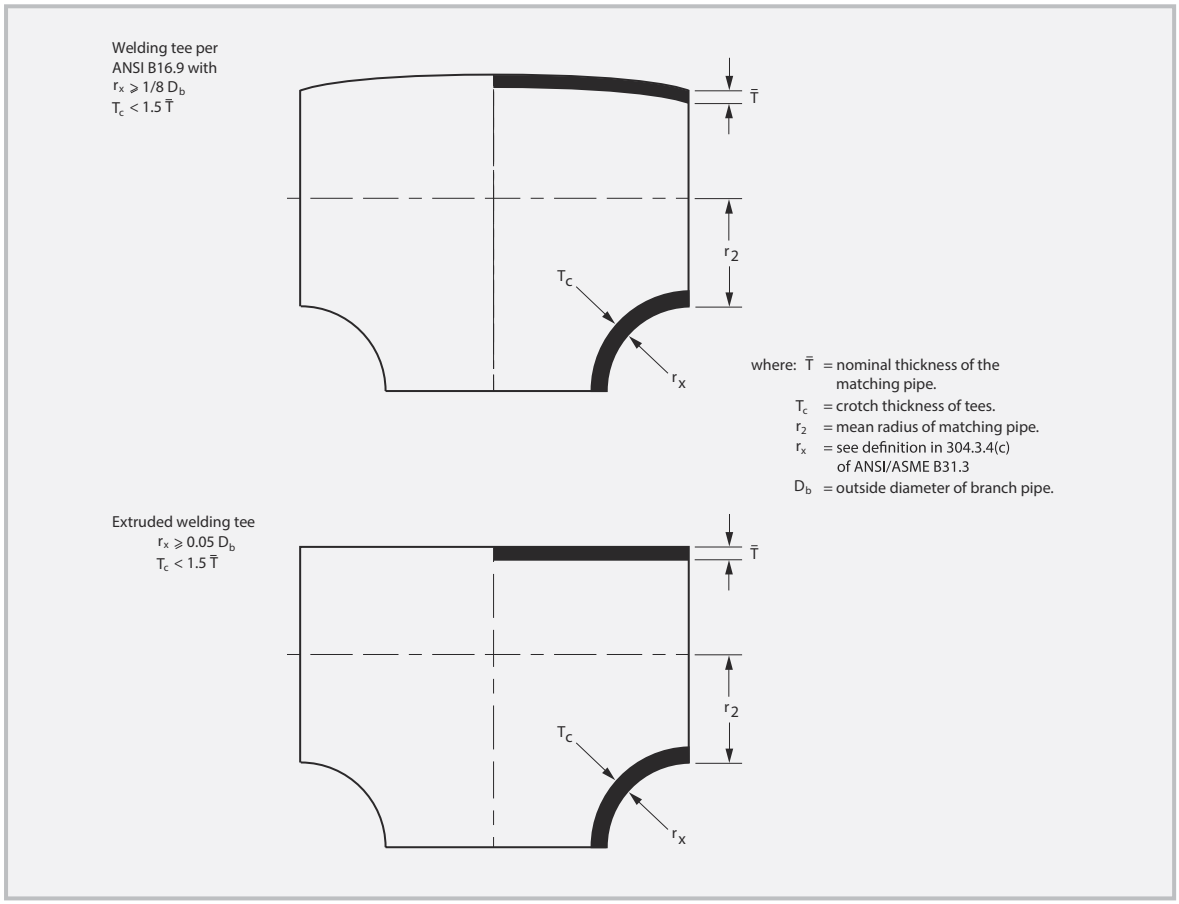


Figure 5 Guidance for the design of tees

(See also appendix D of ASME B31.3-2014)

Table 35 Dimensions of welding ends for all butt welding components

16 bar rating. For tolerances see Table 37

Size* A	Pipe wall thickness t		Inside diameter at welding ends B	
specified OD	specified	minimum	maximum	minimum
30	Use 20 bar see Table 36			
38				
44.5				
57				
76.1				
88.9				
108				
159	3.0	2.63	154.5	153.0
219.1	4.0	3.50	211.9	210.4
267	4.5	3.94	258.7	257.2
323.9	5.5	4.81	313.6	312.0
368	6.5	5.69	355.2	353.2
419	7.0	6.13	405.0	403.0
457.2	8.0	7.00	443.0	440.0
508	8.5	7.44	492.0	489.0
610	10.5	9.19	591.0	588.0
711	12.0	10.50	689.0	686.0
813	13.5	11.81	788.0	785.0
914	15.5	13.56	885.0	882.0

Note: Ovality -The ovality of finished butt welding fittings shall be such that the difference between the maximum and minimum diameters measured on the same cross section shall not exceed 2% of the specified size in column 1 of this Table.

** For inch/millimetre correlation - see Preface. All dimensions in millimetres.*

Table 36 Dimensions of welding ends for all butt welding components

20 bar rating. For tolerances see Table 37

Size* A	Pipe wall thickness t		Inside diameter at welding ends B	
specified OD	specified	minimum	maximum	minimum
30	2.5	2.25	25.555	24.475
38	2.5	2.25	33.57	32.49
44.5	2.5	2.25	40.07	38.99
57	2.5	2.25	52.70	51.62
76.1	2.5	2.25	71.80	70.62
88.9	2.5	2.25	84.65	83.50
108	3.0	2.70	102.85	101.40
159	3.5	3.06	153.0	151.50
219.1	4.5	3.94	210.9	209.40
267	5.5	4.81	256.7	255.20
323.9	7.0	6.13	310.5	309.0
368	8.0	7.00	352.0	350.0
419	9.0	7.88	401.0	399.0
457.2	9.5	8.31	440.0	437.0
508	11.0	9.63	488.0	485.0
610	13.0	11.38	586.0	583.0
711	15.0	13.13	683.0	680.0
813	17.0	14.88	781.0	778.0
914	19.0	16.63	878.0	875.0

Note: Ovality -The ovality of finished butt welding fittings shall be such that the difference between the maximum and minimum diameters measured on the same cross section shall not exceed 2% of the specified size in column 1 of this Table.

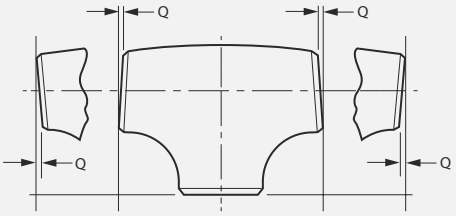
** For inch/millimetre correlation - see Preface. All dimensions in millimetres.*

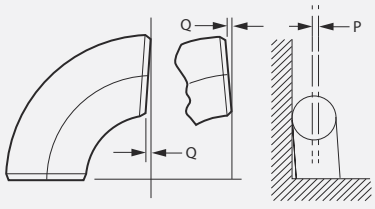
Table 37 Tolerances – fittings

Size*	90 deg & 45 deg elbows & tees (see Table 38, 40, 41, 42 & 43)	Reducers (see Table 45, 46 & 47)	End caps (see Table 44)
Specified OD	centre-to-end dimension D, E, C & M	overall length H	overall length h1 + h2
Up to and including 267	±2	±2	+0.015 D_o -0
323.9 up to and including 711	±3	±3	
813 up to and including 914	±5	±5	

Size*	Angularity	
Specified OD	Off angle Q	Off plane P
Up to and including 108	±1	±2
Over 108 up to and including 219.1	±2	±4
267 up to and including 323.9	±3	±5
368 up to and including 419	±3	±7
457.2 up to and including 610	±4	±10
711	±5	±10
813 up to and including 914	±5	±13

All dimensions in millimetres.
** For inch/millimetre correlation - see Preface*





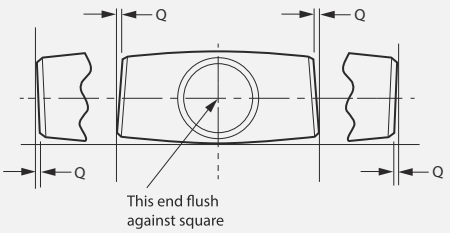
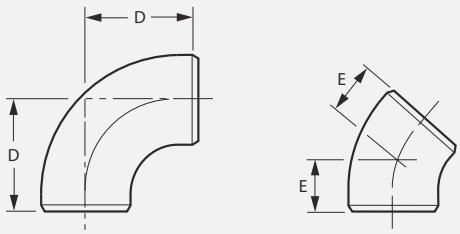


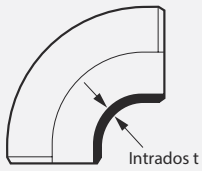
Table 38 Dimensions of long radius elbows



Size* specified OD	Centre-to-end					
	90 deg elbows D			45 deg elbows E		
	max	nom	min	max	nom	min
30	40	38	36	24	22	20
38	50	48	46	27	25	23
44.5	59	57	55	31	29	27
57	78	76	74	37	35	33
76.1	97	95	93	46	44	42
88.9	116	114	112	53	51	49
108	154	152	150	66	64	62
159	231	229	227	97	95	93
219.1	307	305	303	129	127	125
267	383	381	379	161	159	157
323.9	460	457	454	193	190	187
368	536	533	530	225	222	219
419	613	610	607	257	254	251
457.2	689	686	683	289	286	283
508	765	762	759	321	318	315
610	917	914	911	384	381	378
711	1070	1067	1064	441	438	435
813	1224	1219	1214	507	502	497
914	1377	1372	1367	570	565	560

All dimensions in millimetres
Notes: For inside diameters at the plain or bevelled ends - see Tables 35, 36.
See Table 39 for elbow wall thicknesses.
** For inch/millimetre correlation - see Preface.*

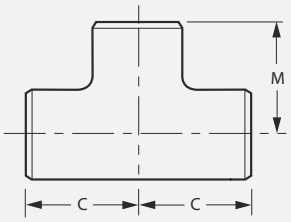
Table 39 Intrados thickness of long radius elbows



Size* specified OD	Thickness		Thickness	
	minimum t intrados	minimum tube wall	minimum t intrados	minimum tube wall
	see note 1	see note 2	see note 1	see note 2
	16 bar		20 bar	
30	USE 20 bar		2.25	2.25
38			2.25	2.25
44.5			2.25	2.25
57			2.25	2.25
76.1			2.25	2.25
88.9			2.25	2.25
108			2.70	2.70
159	2.83	2.63	3.40	3.06
219.1	3.74	3.50	4.54	3.94
267	4.42	3.95	5.38	4.81
323.9	5.27	4.81	6.45	6.13
368	5.88	5.69	7.20	7.00
419	6.61	6.13	8.12	7.88
457.2	7.10	7.00	8.73	8.31
508	7.84	7.44	9.65	9.63
610	9.31	9.19	11.49	11.38
711	10.76	10.50	-	-
813	12.27	11.81	-	-
914	13.70	13.56	-	-

*All dimensions in millimetres *For inch/millimetre correlation see Preface.*
Note 1: See appendix C for basis for the calculation of "t" -intrados thickness. The minimum thickness at the centre of the intrados of an elbow shall not be less than the thickness shown in the above Table.
Note 2: The minimum allowable thickness of an elbow at any point shall not be less than the minimum allowable thickness of the corresponding tube.
Note 3: For inside diameters at the plain or bevelled ends - see Tables 35 and 36.

Table 40 Dimensions of straight (equal) tees



Size* specified OD	Centre-to-end					
	run C			outlet M		
	max	nom	min	max	nom	min
30	40	38	36	40	38	36
38	50	48	46	50	48	46
44.5	59	57	55	59	57	55
57	66	64	62	66	64	62
76.1	78	76	74	78	76	74
88.9	88	86	84	88	86	84
108	107	105	103	107	105	103
159	145	143	141	145	143	141
219.1	180	178	176	180	178	176
267	218	216	214	218	216	214
323.9	257	254	251	257	254	251
368	282	279	276	282	279	276
419	308	305	302	308	305	302
457.2	346	343	340	346	343	340
508	384	381	378	384	381	378
610	435	432	429	435	432	429
711	524	521	518	524	521	518
813	602	597	592	602	597	592
914	678	673	668	678	673	668

All dimensions in millimetres.
Note: For inside diameters at the plain or bevelled ends -see Tables 35, 36.
** For inch/millimetre correlation - see Preface.*