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THE ENGINEERING EQUIPMENT AND MATERIALS USERS ASSOCIATION

**90/10 COPPER NICKEL ALLOY PIPING  
FOR OFFSHORE APPLICATIONS**

**SPECIFICATION: FITTINGS**

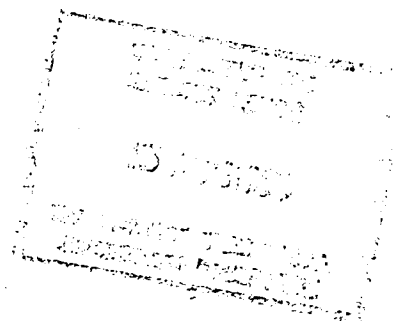
PUBLICATION No. 146 — 1987

**EEMUA**



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## 90/10 COPPER NICKEL ALLOY PIPING FOR OFFSHORE APPLICATIONS

# SPECIFICATION: FITTINGS

PUBLICATION No. 146 — 1987

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**EEMUA**

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## 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

Material selected from the series of specifications contained in EEMUA Publications Nos. 144, 145 and 146 provide for the total requirements of 90/10 copper nickel piping systems intended to operate at pressures up to 16 bar at 75°C or 20 bar at 38°C.

This publication comprises a series of sections for pipe fittings suitable for use with 90/10 Cu Ni tube. The sections are as follows:—

- Section one 90/10 Cu Ni butt welding fittings.
- Section two 90/10 Cu Ni socket welding fittings (including unions)
- Section three copper alloy capillary brazing fittings (including unions)
- Section four copper alloy flareless, non manipulative type compression fittings
- Section five copper alloy threaded fittings
- Section six 90/10 Cu Ni reinforced branch connectors
- Section seven 90/10 Cu Ni saddle pieces

Fittings other than butt weld tube may be suitable for design pressures and temperatures higher than those required by this specification. Where this is required the manufacturer of such fittings should be consulted.

In order that a more satisfactory match than hitherto is obtained between the bores of fittings (and other butt welding components) and the bores of tubes to which they would be butt welded, a greater emphasis has been placed on the bore dimensions and tolerances of the fittings. The mean bore dimensions of butt weld fittings (See section one of this publication) correspond to the mean bore dimensions of the corresponding 16 or 20 bar rated tubes covered by EEMUA Publication 144: 1987: Tubes — seamless and welded.

The "building in" dimensions of butt-welding fittings, apart from end caps, have been based on ANSI B16.9. End caps have been based on DIN 28011 (with suitable amendments) since the majority of manufacturers tend to follow this particular specification.

Additional compensatory thicknesses have been applied to the intrados of long radius (butt welded) elbows and to the end caps, (see section one of this publication).

Socket weld type fittings are included as an alternative to capillary brazed fittings or flareless, non manipulative fittings.

Threaded fittings including caps, plugs and bushings have also been included in this publication.

Materials of manufacture for each type of fitting are covered in the relevant sections within this publication. Where other copper base or non ferrous materials are covered in the various sections, the purchaser may select accordingly. All materials covered are compatible with the 90/10 Cu Ni alloy. However, reference should also be made to BS MA18 for design limitations.

The basic dimensions, based on ANSI B16.11, together with the acceptance criteria are included with additional test requirements for union type fittings. With reference to capillary brazed fittings, appropriate tests to establish that sufficient brazing alloy has been included as an integral part of the fitting design are outlined, together with the extra test requirements for the acceptance of union type fittings.

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

The correlation between nominal inch sizes and the specified sizes in millimetres are given below:

| Nominal size in | Specified O/D mm |
|-----------------|------------------|
| 1/2             | 16               |
| 3/4             | 25               |
| 1               | 30               |
| 1 1/4           | 38               |
| 1 1/2           | 44.5             |
| 2               | 57               |
| 2 1/2           | 76.1             |
| 3               | 88.9             |
| 4               | 108              |
| 6               | 159              |
| 8               | 219.1            |
| 10              | 267              |
| 12              | 323.9            |
| 14              | 368              |
| 16              | 419              |
| 18              | 457.2            |
| 20              | 508              |
| 24              | 610              |
| 28              | 711              |
| 32              | 813              |
| 36              | 914              |

Note: For threaded fittings see table 5.2.



## SECTION ONE — 90/10 CU NI BUTT WELDING FITTINGS

### 1.1 Scope and design basis

Section one 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\* as modified in Appendix C 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 D). 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 No. 144 sections 1 and 2 respectively.

This section 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 clause 9 of ANSI B16.9 – 1978.

### 1.2 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 No. 146: 1987: section 1).
- (b) The type of fitting and size in inches and millimetres — and material designation (see appendix C).
- (c) The pressure rating — 16 or 20 bar.
- (d) Whether manufacturer's certificates are required; (see clause 1.12).
- (e) Whether it is his intention to inspect the material at supplier's works (see Addendum).
- (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 Addendum).

### 1.3 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.

### 1.4 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 No 144:1987 section 1, "Specification for 90/10 Cu Ni seamless tubes."

\* Alloy UNS 7060X is a modified form of the following national designated alloys — UNS 70600, BS CN102 and DIN 2.0872. See Appendix C of this specification for chemical composition and mechanical properties.

## **Butt welding fittings**

Tubes (seam-welded) shall have chemical composition and mechanical properties in accordance with EEMUA Publication No 144: Section 2, "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 2870, BS 2875, ASTM B171 or ASTM B402 but with chemical composition as modified in this specification (see appendix C).

The dimensions and tolerances of seamless and seam-welded fittings shall comply with the requirements of tables 1.1 to 1.9.

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

## **1.5 Welding**

### **1.5.1 Consumables**

The composition of the filler wire or rods used for the production of seam welds shall be selected from BS 2901 : Part 3, Table 1 – Alloy C18.

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.

### **1.5.2 Welding procedure qualification**

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

### **1.5.3 Welder qualification**

The welder qualification shall be in accordance with ASME Code Section IX.

## **1.6 Selection of test samples**

- (a) Fittings made from seamless or seam-welded tube to EEMUA Publication No. 144: 1987 sections 1 or 2 do not require any additional testing other than hardness testing in order to ensure compliance with Appendix C of this specification.
- (b) Fittings formed from sheet or plate shall be subject to the relevant requirements of EEMUA Publication 144: 1987: Section 2.

## **1.7 Non-destructive testing**

### **1.7.1 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 Code Section V, Article 6 and shall meet the acceptance requirements of ASME Code Section VIII, Division 1, Appendix 8.

### **1.7.2 Radiography**

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

## **1.8 Repairs to welded seams**

Visible defects such as cracks, pinholes and incomplete fusion and defects detected by the tests performed under clause 1.7 shall be removed and repaired in accordance with clause 1.5.

## 1.9 Retests of repairs

A repaired weld seam shall meet the requirements of the original weld and be re-examined and retested in accordance with clause 1.7.

## 1.10 Marking

**1.10.1** 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 No. 146: 1987: section 1).
- (c) Material designation UNS 7060X (See appendix C).
- (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.
- (j) Where applicable — welder identity (WI).

Example of marking:

PO 146/1 7060X 14/368 16 MTM TCN Cast No WI

**1.10.2** On fittings 44.5 mm and smaller and where it is not practical to apply the full requirements of 1.10.1 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.

## 1.11 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

## Butt welding fittings

### 1.12 Certification

Certificate(s) shall be supplied, either:

- 1.12.1 A certificate of compliance which shall state that the fittings have been made in accordance with all the requirements of this section (EEMUA Publication No. 146: section 1: 1987) or:
- 1.12.2 A manufacturer's certificate which shall state that the fittings have been made in accordance with all the requirements of this section (EEMUA Publication No. 146: section 1: 1987) and:

- (a) State the actual compositional limits determined for each of the elements designated in appendix C of the casts used in the manufacture of each order for seamless tubes used to manufacture fittings and/or:

State the actual compositional limits determined for each of the elements designated in appendix C of each cast used in the manufacture of each sheet or plate used in the manufacture of fittings.

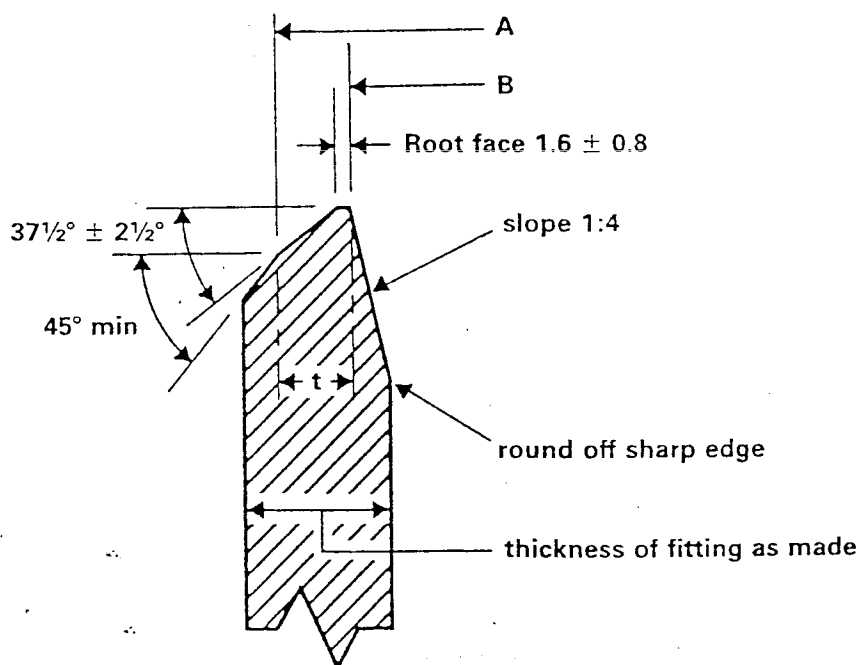
**Note:** Individual cast analyses shall be retained by the manufacturer — see Addendum.

- (b) State the results of mechanical tests performed on the seamless tubes used to manufacture fittings in accordance with appendix C and/or state the results of mechanical tests performed on sheets or plates formed into fittings in accordance with appendix C.
- (c) State the results of the dye penetrant and radiographic examination of each weld on each fitting carried out in accordance with and complying with clauses 1.7, 1.8 and 1.9.

**Figure 1.1**

Dimensions of welding ends on butt welding components

See Tables 1.1 and 1.2 for dimensions A, B and t, for 16 and 20 bar ratings respectively.



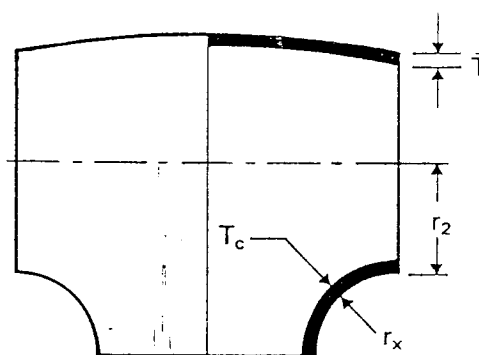
**Note:** In the case of specified wall thicknesses (t) of less than 3mm, the weld bevel of  $37\frac{1}{2}^\circ \pm 2\frac{1}{2}^\circ$  may be omitted.

**Figure 1.2**

Guidance for the design of tees

(See also appendix D of ANSI/ASME B31.3 1984 edition)

Welding tee per  
ANSI B16.9 with  
 $r_x \geq 1/8 D_b$   
 $T_c \geq 1.5 \bar{T}$



where:  $\bar{T}$  = nominal thickness of the  
matching pipe.

$T_c$  = crotch thickness of tees.

$r_2$  = mean radius of matching  
pipe.

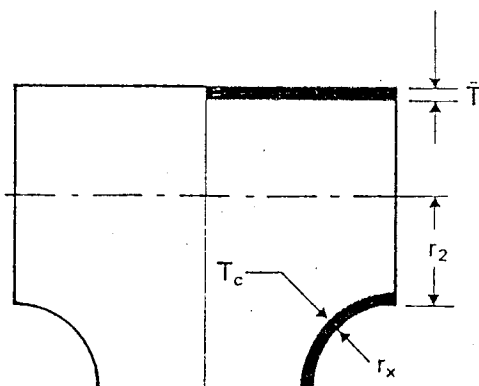
$r_x$  = see definition in 304.3.4(c)  
of ANSI/ASME B31.3 – 1984  
edition.

$D_b$  = outside diameter of  
branch pipe.

Extruded welding tee

$r_x \geq 0.05 D_b$

$T_c < 1.5 \bar{T}$



## Butt welding fittings

**Table 1.1**

Dimensions of welding ends for all butt welding components

16 bar rating (see also fig. 1.1).

For tolerances see table 1.3

| Size*        | pipe wall thickness            |         | inside diameter at welding ends B |         |
|--------------|--------------------------------|---------|-----------------------------------|---------|
| A            | t                              |         |                                   |         |
| specified OD | specified                      | minimum | maximum                           | minimum |
| 30           | Use<br>20 bar<br>SEE TABLE 1.2 |         |                                   |         |
| 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 foreword. All dimensions in millimetres

**Table 1.2**

Dimensions of welding ends for all butt welding components

20 bar rating (see also fig 1.1).

For tolerances see table 1.3

| Size*        | Pipe wall thickness |         | Inside diameter at welding ends B |         |
|--------------|---------------------|---------|-----------------------------------|---------|
| A            | t                   |         |                                   |         |
| 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                             | 70.65   |
| 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.

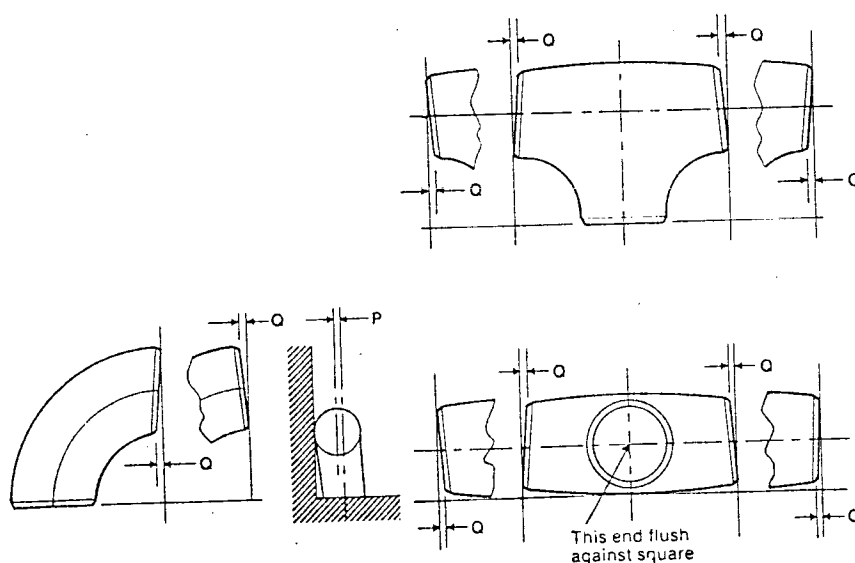
\* For inch/millimetre correlation – see foreword.  
All dimensions in millimetres.

## Butt welding fittings

**Table 1.3**  
Tolerances – fittings

| Size *                        | 90 deg & 45 deg elbows & tees<br>(see tables 1.4, 1.6 & 1.7) | reducers<br>(see table 1.9) | end caps<br>(see table 1.8) |
|-------------------------------|--------------------------------------------------------------|-----------------------------|-----------------------------|
| Specified OD                  | centre-to-end dimension<br>D, E, C & M                       | overall length<br>H         | overall length<br>h1 + h2   |
| up to and including 267       | $\pm 2$                                                      | $\pm 2$                     | $+0.015 D_o$<br>$-0$        |
| 323.9 up to and including 711 | $\pm 3$                                                      | $\pm 3$                     |                             |
| 813 up to and including 914   | $\pm 5$                                                      | $\pm 5$                     |                             |

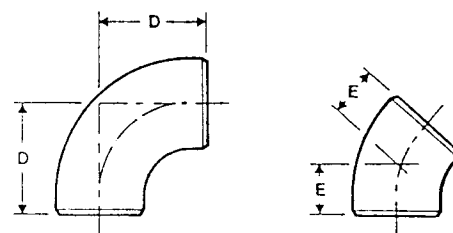
| Size *                             | angularity     |                |
|------------------------------------|----------------|----------------|
| Specified OD                       | off angle<br>Q | off plane<br>P |
| up to and including 108            | $\pm 1$        | $\pm 2$        |
| over 108 up to and including 219.1 | $\pm 2$        | $\pm 4$        |
| 267 up to and including 323.9      | $\pm 3$        | $\pm 5$        |
| 368 up to and including 419        | $\pm 3$        | $\pm 7$        |
| 457.2 up to and including 610      | $\pm 4$        | $\pm 10$       |
| 711                                | $\pm 5$        | $\pm 10$       |
| 813 up to and including 914        | $\pm 5$        | $\pm 13$       |



All dimensions in millimetres  
\* For inch/millimetre correlation – see foreword

**Table 1.4**  
Dimensions of long radius elbows

| Size*<br>Specified<br>OD | Centre-to-end      |      |      |                    |     |     |
|--------------------------|--------------------|------|------|--------------------|-----|-----|
|                          | 90 deg elbows<br>D |      |      | 45 deg elbows<br>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 1.1 & 1.2 and figure 1.1.

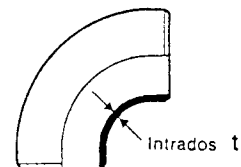
See table 1.5 for elbow wall thicknesses.

\* For inch/millimetre correlation – see foreword.

## Butt welding fittings

**Table 1.5**  
Intrados thickness of long radius elbows

| Size *<br><br>Specified<br>OD | Thickness                |                      | Thickness                |                      |
|-------------------------------|--------------------------|----------------------|--------------------------|----------------------|
|                               | minimum<br>t<br>intrados | minimum<br>tube wall | minimum<br>t<br>intrados | minimum<br>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                           | 12.24                    | 11.81                | —                        | —                    |
| 914                           | 13.70                    | 13.56                | —                        | —                    |



All dimensions in millimetres \* For inch/millimetre correlation — see foreword

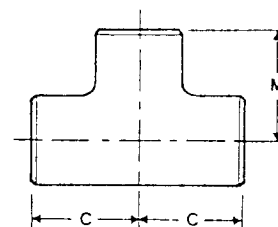
**Note 1:** See appendix B for basis for the calculation of "t" — intrados thickness. The minimum thickness at the centre of the intrados of an elbow shall not be less than the thickness shown in the above table.

**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 1.1 and 1.2 and figure 1.1

**Table 1.6**  
Dimensions of straight (equal) tees

| Size *<br>Specified<br>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 1.1 & 1.2 and figure 1.1.

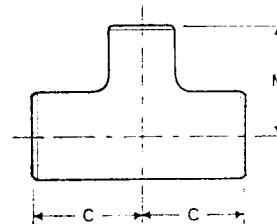
\* For inch/millimetre correlation — see foreword

## Butt welding fittings

**Table 1.7.1**

Dimensions of reducing outlet tees – sizes up to 159 × 159 × 108.

| Size *<br>Specified OD |      |        | Centre-to-end |     |     |             |     |     |
|------------------------|------|--------|---------------|-----|-----|-------------|-----|-----|
|                        |      |        | run<br>C      |     |     | outlet<br>M |     |     |
| run                    | run  | outlet | max           | nom | min | max         | nom | min |
| 30                     | 30   | 25     | 40            | 38  | 36  | 40          | 38  | 36  |
| 38                     | 38   | 30     | 50            | 48  | 46  | 50          | 48  | 46  |
| 38                     | 38   | 25     |               |     |     |             |     |     |
| 44.5                   | 44.5 | 38     | 59            | 57  | 55  | 59          | 57  | 55  |
| 44.5                   | 44.5 | 30     |               |     |     |             |     |     |
| 44.5                   | 44.5 | 25     |               |     |     |             |     |     |
| 57                     | 57   | 44.5   | 66            | 64  | 62  | 62          | 60  | 58  |
| 57                     | 57   | 38     |               |     |     | 59          | 57  | 55  |
| 57                     | 57   | 30     |               |     |     | 53          | 51  | 49  |
| 76.1                   | 76.1 | 57     | 78            | 76  | 74  | 72          | 70  | 68  |
| 76.1                   | 76.1 | 44.5   |               |     |     | 69          | 67  | 65  |
| 76.1                   | 76.1 | 38     |               |     |     | 66          | 64  | 62  |
| 88.9                   | 88.9 | 76.1   | 88            | 86  | 84  | 85          | 83  | 81  |
| 88.9                   | 88.9 | 57     |               |     |     | 78          | 76  | 74  |
| 88.9                   | 88.9 | 44.5   |               |     |     | 75          | 73  | 71  |
| 108                    | 108  | 88.9   | 107           | 105 | 103 | 100         | 98  | 96  |
| 108                    | 108  | 76.1   |               |     |     | 97          | 95  | 93  |
| 108                    | 108  | 57     |               |     |     | 91          | 89  | 87  |
| 159                    | 159  | 108    | 145           | 143 | 141 | 132         | 130 | 128 |
| 159                    | 159  | 88.9   |               |     |     | 126         | 124 | 122 |
| 159                    | 159  | 76.1   |               |     |     | 123         | 121 | 119 |



All dimensions in millimetres

Note: For inside diameters at the plain or bevelled ends – see tables 1.1 & 1.2 and fig. 1.1.

\* For inch/millimetre correlation – see foreword

**Table 1.7.2**

Dimensions of reducing outlet tees – sizes 219.1 × 219.1 × 88.9 up to and including 508 × 508 × 457.2.

| Size *<br>Specified OD |       |        | Centre-to-end |     |     |             |     |     |
|------------------------|-------|--------|---------------|-----|-----|-------------|-----|-----|
|                        |       |        | run<br>C      |     |     | outlet<br>M |     |     |
| run                    | run   | outlet | max           | nom | min | max         | nom | min |
| 219.1                  | 219.1 | 159    | 180           | 178 | 176 | 170         | 168 | 166 |
| 219.1                  | 219.1 | 108    |               |     |     | 158         | 156 | 154 |
| 219.1                  | 219.1 | 88.9   |               |     |     | 154         | 152 | 150 |
| 267                    | 267   | 219.1  | 218           | 216 | 214 | 205         | 203 | 201 |
| 267                    | 267   | 159    |               |     |     | 196         | 194 | 192 |
| 267                    | 267   | 108    |               |     |     | 186         | 184 | 182 |
| 323.9                  | 323.9 | 267    | 257           | 254 | 251 | 244         | 241 | 238 |
| 323.9                  | 323.9 | 219.1  |               |     |     | 232         | 229 | 226 |
| 323.9                  | 323.9 | 159    |               |     |     | 222         | 219 | 216 |
| 368                    | 368   | 323.9  | 282           | 279 | 276 | 273         | 270 | 267 |
| 368                    | 368   | 267    |               |     |     | 260         | 257 | 254 |
| 368                    | 368   | 219.1  |               |     |     | 251         | 248 | 245 |
| 419                    | 419   | 368    | 308           | 305 | 302 | 308         | 305 | 302 |
| 419                    | 419   | 323.9  |               |     |     | 298         | 295 | 292 |
| 419                    | 419   | 267    |               |     |     | 286         | 283 | 280 |
| 457.2                  | 457.2 | 419    | 346           | 343 | 340 | 333         | 330 | 327 |
| 457.2                  | 457.2 | 368    |               |     |     | 333         | 330 | 327 |
| 457.2                  | 457.2 | 323.9  |               |     |     | 324         | 321 | 318 |
| 508                    | 508   | 457.2  | 384           | 381 | 378 | 371         | 368 | 365 |
| 508                    | 508   | 419    |               |     |     | 359         | 356 | 353 |
| 508                    | 508   | 368    |               |     |     | 359         | 356 | 353 |

All dimensions in millimetres

**Note:** For inside diameters at the plain or bevelled ends – see tables 1.1 & 1.2 and fig. 1.1.

\* For inch/millimetre correlation – see foreword

## Butt welding fittings

**Table 1.7.3**

Dimensions of reducing outlet tees – sizes 610 × 610 × 419 up to and including 914 × 914 × 813.

| Size *<br>Specified OD |     |        | Centre-to-end |     |     |             |     |     |
|------------------------|-----|--------|---------------|-----|-----|-------------|-----|-----|
|                        |     |        | run<br>C      |     |     | outlet<br>M |     |     |
| run                    | run | outlet | max           | nom | min | max         | nom | min |
| 610                    | 610 | 508    | 435           | 432 | 429 | 435         | 432 | 429 |
| 610                    | 610 | 457.2  |               |     |     | 422         | 419 | 416 |
| 610                    | 610 | 419    |               |     |     | 409         | 406 | 403 |
| 711                    | 711 | 610    | 524           | 521 | 518 | 511         | 508 | 505 |
| 711                    | 711 | 508    |               |     |     | 486         | 483 | 480 |
| 711                    | 711 | 457.2  |               |     |     | 473         | 470 | 467 |
| 813                    | 813 | 711    | 602           | 597 | 592 | 577         | 572 | 567 |
| 813                    | 813 | 610    |               |     |     | 564         | 559 | 554 |
| 813                    | 813 | 508    |               |     |     | 538         | 533 | 528 |
| 914                    | 914 | 813    | 678           | 673 | 668 | 653         | 648 | 643 |
| 914                    | 914 | 711    |               |     |     | 627         | 622 | 617 |
| 914                    | 914 | 610    |               |     |     | 615         | 610 | 605 |

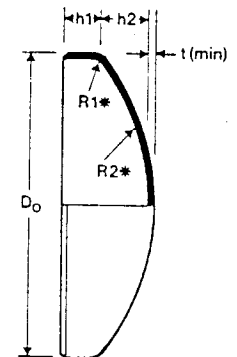
All dimensions in millimetres

**Note:** For inside diameters at the plain or bevelled ends – see tables 1.1 & 1.2 and fig. 1.1.

\* For inch/millimetre correlation – see foreword

**Table 1.8**  
Dimensions of end caps

| Size<br>$D_o * \dagger$ | $R_1$<br>min. | $R_2$<br>max. | 16 bar        |             | 20 bar  |             |
|-------------------------|---------------|---------------|---------------|-------------|---------|-------------|
|                         |               |               | t (min)       | $h_1 + h_2$ | t (min) | $h_1 + h_2$ |
| 44.5                    | 4.5           | 44.5          | USE<br>20 bar |             | 2.25    | 19.6        |
| 57                      | 5.7           | 57            |               |             | 2.25    | 22.0        |
| 76.1                    | 7.6           | 76.1          |               |             | 2.25    | 25.7        |
| 88.9                    | 8.9           | 88.9          |               |             | 2.25    | 28.2        |
| 108                     | 11            | 108           |               |             | 2.70    | 31.7        |
| 159                     | 16            | 159           | 2.63          | 41          | 3.12    | 44          |
| 219.1                   | 22            | 219.1         | 3.54          | 55          | 4.29    | 60          |
| 267                     | 27            | 267           | 4.29          | 69          | 5.23    | 69          |
| 323.9                   | 32            | 323.9         | 5.24          | 80          | 6.34    | 85          |
| 368                     | 37            | 368           | 5.90          | 93          | 7.21    | 103         |
| 419                     | 42            | 419           | 6.73          | 102         | 8.21    | 112         |
| 457.2                   | 46            | 457.2         | 7.33          | 119         | 8.97    | 119         |
| 508                     | 51            | 508           | 8.15          | 129         | 9.96    | 139         |
| 610                     | 61            | 610           | 9.81          | 148         | 11.96   | 163         |
| 711                     | 71            | 711           | 11.50         | 176         | 13.97   | 191         |
| 813                     | 81            | 813           | 13.17         | 200         | 15.97   | 210         |
| 914                     | 91            | 914           | 14.81         | 221         | 17.96   | 231         |



All dimensions in millimetres

**Note 1:** For inside diameters at the plain or bevelled ends – see tables 1.1 and 1.2 and fig 1.1.

**Note 2:** The additional compensatory thickness over and above the minimum pipe wall thicknesses in tables 1.1 and 1.2 were established and calculated on the basis of BS 5500, fig 3.5.2.3 where the allowable stress “f” was taken to be 68.6 N/mm<sup>2</sup> (up to 75°C) and “P” = maximum design pressure of 1.6 N/mm<sup>2</sup> (16 bar) and 2.0 N/mm<sup>2</sup> (20 bar) and P/f values of 0.0233 and 0.0292 respectively.

\* Dimension “A” from fig. 1.1

† For inch/millimetre correlation –see foreword

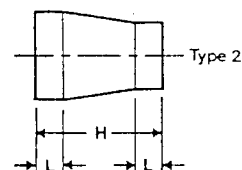
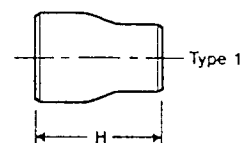
## Butt welding fittings

**Table 1.9.1**

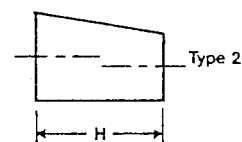
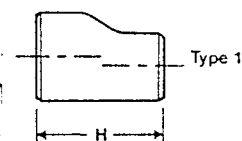
Dimensions of butt welding reducers – sizes 30 × 25 up to and including 159 × 88.9

| Size*<br>Specified<br>OD |      | End-to-end length of reducers<br>H |     |     | Parallel<br>end |
|--------------------------|------|------------------------------------|-----|-----|-----------------|
|                          |      | max                                | nom | min | L**             |
| 30                       | 25   | 53                                 | 51  | 49  | 10              |
| 38                       | 30   | 53                                 | 51  | 49  | 10              |
| 38                       | 25   |                                    |     |     |                 |
| 44.5                     | 38   | 66                                 | 64  | 62  | 10              |
| 44.5                     | 30   |                                    |     |     |                 |
| 44.5                     | 25   |                                    |     |     |                 |
| 57                       | 44.5 | 78                                 | 76  | 74  | 10              |
| 57                       | 38   |                                    |     |     |                 |
| 57                       | 30   |                                    |     |     |                 |
| 76.1                     | 57   | 91                                 | 89  | 87  | 10              |
| 76.1                     | 44.5 |                                    |     |     |                 |
| 76.1                     | 38   |                                    |     |     |                 |
| 88.9                     | 76.1 | 91                                 | 89  | 87  | 10              |
| 88.9                     | 57   |                                    |     |     |                 |
| 88.9                     | 44.5 |                                    |     |     |                 |
| 108                      | 88.9 | 104                                | 102 | 100 | 12              |
| 108                      | 76.1 |                                    |     |     |                 |
| 108                      | 57   |                                    |     |     |                 |
| 159                      | 108  | 142                                | 140 | 138 | 15              |
| 159                      | 88.9 |                                    |     |     |                 |
| 159                      | 76.1 |                                    |     |     |                 |
| 159                      | 57   |                                    |     |     |                 |

Concentric



Eccentric



All dimensions in millimetres

**Note:** For inside diameters at the plain or bevelled ends – see tables 1.1 & 1.2 and fig. 1.1.

\*For inch/millimetre correlation – see foreword

\*\*Seamless concentric only

**Table 1.9.2**

Dimensions of butt welding reducers — sizes 219.1 × 159 up to and including 457.2 × 323.9

| Size*<br>Specified OD |       | End-to-end length of reducers<br>H |     |     | Parallel<br>end |
|-----------------------|-------|------------------------------------|-----|-----|-----------------|
|                       |       | max                                | nom | min | L**             |
| 219.1                 | 159   | 154                                | 152 | 150 | 15              |
| 219.1                 | 108   |                                    |     |     |                 |
| 219.1                 | 88.9  |                                    |     |     |                 |
| 219.1                 | 76.1  |                                    |     |     |                 |
| 267                   | 219.1 | 180                                | 178 | 176 | 16              |
| 267                   | 159   |                                    |     |     |                 |
| 267                   | 108   |                                    |     |     |                 |
| 323.9                 | 267   | 206                                | 203 | 200 | 16              |
| 323.9                 | 219.1 |                                    |     |     |                 |
| 323.9                 | 159   |                                    |     |     |                 |
| 368                   | 323.9 | 333                                | 330 | 327 | —               |
| 368                   | 267   |                                    |     |     |                 |
| 368                   | 219.1 |                                    |     |     |                 |
| 419                   | 368   | 359                                | 356 | 353 | —               |
| 419                   | 323.9 |                                    |     |     |                 |
| 419                   | 267   |                                    |     |     |                 |
| 457.2                 | 419   | 384                                | 381 | 378 | —               |
| 457.2                 | 368   |                                    |     |     |                 |
| 457.2                 | 323.9 |                                    |     |     |                 |

All dimensions in millimetres

**Note:** For inside diameters at the plain or bevelled ends — see tables 1.1 & 1.2 and fig. 1.1.

\*For inch/millimetre correlation — see foreword

\*\*Seamless concentric only

## Butt welding fittings

**Table 1.9.3**

Dimensions of butt welding reducers – sizes 508 × 368 up to and including 914 × 813.

| Size*<br>Specified OD |       | End-to-end length of reducers<br>H |     |     |
|-----------------------|-------|------------------------------------|-----|-----|
|                       |       | max                                | nom | min |
| 508                   | 457.2 | 511                                | 508 | 505 |
| 508                   | 419   |                                    |     |     |
| 508                   | 368   |                                    |     |     |
| 610                   | 508   | 511                                | 508 | 505 |
| 610                   | 457.2 |                                    |     |     |
| 610                   | 419   |                                    |     |     |
| 711                   | 610   | 613                                | 610 | 607 |
| 711                   | 508   |                                    |     |     |
| 711                   | 457.2 |                                    |     |     |
| 813                   | 711   | 615                                | 610 | 605 |
| 813                   | 610   |                                    |     |     |
| 914                   | 813   | 615                                | 610 | 605 |
| 914                   | 711   |                                    |     |     |
| 914                   | 610   |                                    |     |     |

All dimensions in millimetres

**Note:** For inside diameters at the plain or bevelled ends – see tables 1.1 & 1.2 and fig. 1.1.

\* For inch/millimetre correlation – see foreword

## 2. SECTION TWO – 90/10 CU NI SOCKET WELDING FITTINGS

### 2.1 Scope and design basis

This section covers wrought socket welding fittings in sizes 16 mm up to and including 57 mm in 90/10 copper nickel alloy UNS 7060X\* as modified in appendix C of this publication, for maximum allowable working pressure (MAWP) of 20 bar, at a temperature of 38°C.

These fittings are intended for use with seamless 90/10 copper nickel tubes to EEMUA Publication No. 144: 1987: section 1.

Details of test and acceptance requirements for union fittings are given as well as materials for union nuts.

The adequacy of union type fittings whose design cannot be established by mathematical analyses given in a nationally recognised pressure vessel or piping code, shall be established by proof testing in accordance with clause 2.5 of this section.

**Notes:** The use of an anti-galling compound on the threads compatible with the material of the fitting shall be considered.

### 2.2 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 No. 146: 1987: section 2)
- (b) The type of fitting and size in inches and millimetres and material designation – see appendix C.
- (c) Whether manufacturer's certificates are required – (see clause 2.8)
- (d) Whether it is his intention to inspect the material at the supplier's works. (see Addendum)
- (e) Whether any additional identification marking other than that specified herein is required.
- (f) Whether any test samples or individual test analyses are required to be supplied (see Addendum)

### 2.3 Freedom from defects

The fittings shall be visually clean, smooth and free from harmful defects greater than 0.5 mm in depth, irregularities, scale or deposits and shall be free from deleterious films in the bore.

### 2.4 Materials and manufacture

The fittings in 90/10 Cu Ni shall be manufactured by hot forging, or cold forging followed by annealing or machined from forging stock† and with chemical composition in accordance with appendix C.

Alternatively, union nuts shall be manufactured from one of the following materials:

- (1) Aluminium bronze (BS CA104/UNS 63200)  
(BS CA107/UNS 64200)
- (2) Gunmetal (bronze) BS LG2/UNS 83600
- (3) Aluminium brass (BS CZ110/UNS 68700)

\*Alloy UNS 7060X is a modified form of the following national designated alloys – UNS 70600, BS CN102 and DIN 2.0872. See appendix C of this specification for chemical composition and mechanical properties.

†Forging stock – forged, rolled or extruded bar (solid or hollow) intended for the production of forgings. Only straight fittings, eg couplings may be machined directly from forging stock.

## Socket welding fittings

The mechanical properties of socket welding fittings manufactured from 90/10 copper nickel shall comply with the requirements of appendix C.

The dimensions of socket welding fittings shall comply with the requirements of table 2.2 of this section. All socket welding ends shall be at right angles to the axis of the fitting and be provided with an adequate surface for the required fillet welds – see figure 2.1.

The forging radius shall not reduce the flat welding surface to less than 75% of “C<sub>x</sub>” (minimum) – see figure 2.1.

The sockets shall be of uniform depth and circularity, and all terminal threaded ends shall be in accordance with ANSI B1.20.1

### 2.5 Proof tests for adequacy of socket welding union type fittings (prototype test)

The maximum working pressures required for fittings to this section are those given in the table below for temperatures up to and including 75°C when assembled with the appropriate size and thickness of tube.

**Table 2.1**

Basis for hydraulic proof pressure test of assembled union joints

| Size of union fitting* | Maximum allowable working pressure |
|------------------------|------------------------------------|
| mm                     | bar                                |
| 16                     | 106                                |
| 25                     | 70                                 |
| 30                     | 30                                 |
| 38                     | 30                                 |
| 44.5                   | 30                                 |
| 57                     | 30                                 |

To determine the relative strength and leak tightness of union fittings, straight tube of a suitable size and wall thickness shall be welded to each end of the socket welding union fitting, at least 150 mm in length. Proper end closures shall be applied beyond the minimum length of straight tube.

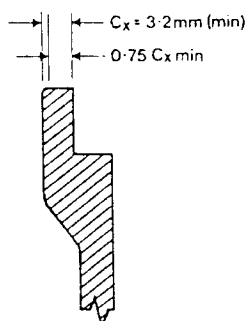
The fittings and their component parts when assembled at normal atmospheric temperature and in accordance with the manufacturer's instructions shall be capable of withstanding an internal hydraulic pressure of 1.5 times the stated maximum working pressure without showing signs of leakage or distress in the fittings or joint. The pressure shall be maintained for 15 minutes.

\*For inch/millimetre correlation – see foreword

The union joints shall be broken down and reassembled three times (with the cone and seat rotated through 90° relative to one another on each occasion) and retested to 1.5 times the stated working pressure and maintained for 15 minutes and shall provide a sound joint on each occasion.

**Figure 2.1**

Welding dimensions required for socket welding fittings



## 2.6 Marking

### 2.6.1

All fittings shall be individually permanently marked and identified by clear legible printing by means of a vibratory etching tool or by electro-chemical etching, as follows:

- Purchase order number (PO).
- The number of this section (EEMUA Publication No. 146: 1987: section 2).
- Material designation UNS 7060X (See appendix C).
- Size: inches and millimetres.
- Manufacturer's name and/or trademark (MTM).
- Test certificate number (TCN).
- Cast number.

Example of Marking: P.O. 146/2 7060X 2/57 MTM TCN Cast No.

### 2.6.2

Where it is not practical to apply the full requirements of 2.6.1 to the fitting, the marking shall detail:

- Material designation.
- Size: inches and millimetres.
- Manufacturer's name or trademark (MTM).
- Cast number.

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

**Note:** Stamping fittings with metallic stamps is not permitted.

## 2.7

### Inspection and testing

This section does not make provision for routine pressure testing of fittings. They shall 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 30 bar.

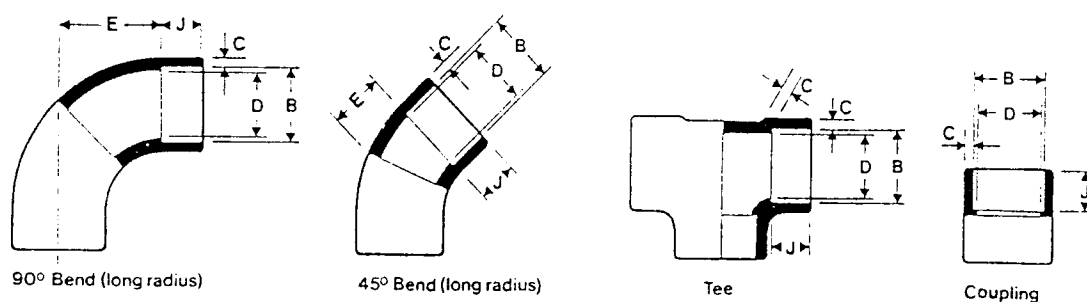
## Socket welding fittings

### 2.8 Certification

Certificate(s) shall be supplied, either:

- 2.8.1 A certificate of compliance which shall state that the fittings have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 146: 1987: section 2) or:
- 2.8.2 A manufacturer's certificate which shall state that the fittings have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 146: 1987: section 2) and:
  - (a) State the actual compositional limits determined for each of the elements of the casts used in the manufacture of each batch or order.
  - (b) State the results of mechanical tests performed on each cast used in the manufacture of each batch or order.

**Table 2.2**  
Dimensions of socket welding fittings



| Size*<br>Specified<br>OD | D**<br>fitting<br>bore | B<br>socket<br>size | C<br>socket<br>wall | J<br>socket<br>depth | E<br>centre-to-socket<br>(± 1m) |      |
|--------------------------|------------------------|---------------------|---------------------|----------------------|---------------------------------|------|
|                          |                        |                     |                     |                      | 45°                             | 90°  |
| 16                       | 12                     | 16.121/<br>16.070   | 3.2                 | 10                   | 12                              | 30   |
| 25                       | 21                     | 25.131/<br>25.080   | 3.2                 | 13                   | 15.5                            | 37.5 |
| 30                       | 25                     | 30.131/<br>30.080   | 3.2                 | 13                   | 18.6                            | 45   |
| 38                       | 33                     | 38.146/<br>38.095   | 3.2                 | 13                   | 23.6                            | 57   |
| 44.5                     | 39.5                   | 44.646/<br>44.595   | 3.2                 | 13                   | 27.6                            | 66.8 |
| 57                       | 52                     | 57.276/<br>57.225   | 3.2                 | 16                   | 35.3                            | 85.5 |

All dimensions in millimetres.

Notes: For other socket weld fitting types and dimensions – See manufacturer's catalogues.

For welding dimensions for socket welding fittings – see figure 2.1

\* For inch/millimetre correlation – see foreword

\*\* To suit seamless 90/10 Cu Ni tubes to EEMUA Publication No. 144: 1987: section 1.

## SECTION THREE — COPPER ALLOY CAPILLARY BRAZING FITTINGS

### 3.1 Scope and design basis

Section three covers proprietary capillary silver brazing fittings including unions, in sizes 16 mm up to and including 57 mm for a maximum allowable working pressure (MAWP) of 20 bar at a temperature of 38°C. In addition to 90/10 Cu Ni alloy UNS7060X\* as modified in appendix C of this publication, alternative materials are as follows:

- 1) Aluminium brass (BS CZ110/UNS 68700)
- 2) Gunmetal/bronze (BS 1400-LG2/UNS 83600)

Union nuts may, in addition, be manufactured from aluminium bronze alloys as designated in section 2 of this specification.

These fittings are intended for use with seamless 90/10 Cu Ni tubes to EEMUA Publication No. 144: 1987: section 1.

Integral silver brazing alloy wire rings shall be incorporated in the sockets as part of the fitting design. The brazing alloy used shall comply with the requirements of BS 1845, type AG14 or American Welding Society Specification AWS-A5.8 — BAG 28.

As there are no testing requirements to ensure the adequacy of the volume of integral silver brazing alloy in the fittings, the manufacturer shall demonstrate the acceptability of his product by means of procedure tests in accordance with ASME Code, Section IX, Part QB. The procedure tests shall be performed on samples representative of each size of outlet. Such joints shall be made up in accordance with ANSI B31.3, section 317.2 — "Brazed and braze welded joints".

The adequacy of union type fittings shall be established by proof testing in accordance with clause 3.5 of this section.

**Notes:** The use of an anti-galling compound on the threads of union fittings, compatible with the material of the fitting, shall be considered.

### 3.2 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 No. 146: 1987: section 3).
- (b) The type of fitting and size in inches and millimetres and material designation.
- (c) Whether certificates of compliance are required — (see clause 3.8).
- (d) Whether it is his intention to inspect the material at supplier's works (see Addendum).
- (e) Whether any additional identification marking other than that specified herein is required.
- (f) Whether any test samples or individual test analyses are required to be supplied (see Addendum).

### 3.3 Freedom from defects

The fittings shall be visually clean, smooth and free from harmful defects greater than 0.5 mm in depth, irregularities, scale or deposits and shall be free from deleterious films in the bore.

Cast fittings shall be sound, free from laps, blow holes, pitting and free from sand. They shall be neatly dressed and none shall be burned, plugged or patched.

\*UNS 7060X is a modified form of the following material designated alloys — UNS 70600, BS CN102 and DIN 2.0872. See appendix C of this publication for chemical composition and mechanical properties.

## Capillary brazing fittings

### 3.4 Materials and manufacture

Fittings in 90/10 Cu Ni and aluminium brass shall be manufactured by hot forging, or cold forging followed by annealing or machined from forging stock\*, with chemical composition in accordance with appendix C of this specification for 90/10 Cu Ni and in accordance with BS alloy CZ110 (UNS 68700) in table 2 of BS 2871: part 2 for aluminium brass.

Cast fittings in BS alloy LG2 (UNS 83600) shall be produced by shell moulding or by sand casting processes with chemical composition in accordance with BS 1400: Table 5.

The dimensions of capillary brazed fittings shall comply with the requirements of table 3.2 of this section. All ends of the brazing sockets shall be at right angles to the axis of the fitting.

The sockets shall be of uniform depth and circularity.

All female ends and male stud ends shall be threaded NPT (US standard taper pipe thread) to ANSI B1.20.1 (other thread forms may be used for the union part of union type fittings).

### 3.5 Proof tests for adequacy of capillary brazing union type fittings (prototype test)

The maximum working pressures required for fittings to this section are those given in the table below for temperatures up to and including 75°C when assembled with the appropriate size and thickness of tube.

Table 3.1

Basis for hydraulic proof pressure test of assembled union joints

| Size of union fitting | Maximum allowable working pressure |
|-----------------------|------------------------------------|
| mm**                  | bar                                |
| 16                    | 106                                |
| 25                    | 70                                 |
| 30                    | 30                                 |
| 38                    | 30                                 |
| 44.5                  | 30                                 |
| 57                    | 30                                 |

To determine the relative strength and leak tightness of union fittings, straight tube of the designated size and wall thickness shall be brazed in each end of the capillary brazed type union, at least 150 mm in length. Proper end closures shall be applied beyond the minimum length of straight tube.

\*Forging stock: forged, rolled or extruded bar (solid or hollow) intended for the production of forgings. Only straight fittings, e.g. couplings may be machined directly from forging stock.

\*\*For inch/millimetre correlation – see foreword

The fittings and their component parts when assembled at normal atmospheric temperature and in accordance with the manufacturer's instructions shall be capable of withstanding an internal hydraulic pressure of 1.5 times the stated maximum working pressure without showing signs of leakage or distress in the fittings or joint. The pressure shall be maintained for 15 minutes.

The union joints shall be broken down and reassembled three times (with the cone and seat rotated through 90° relative to one another on each occasion) and retested to 1.5 times the stated maximum working pressure and maintained for 15 minutes and shall provide a sound joint on each occasion.

### 3.6 Marking

3.6.1 All fittings shall be individually and permanently marked and identified by clear legible printing by means of a vibratory etching tool or by electro-chemical etching as follows:

- (a) Purchase order number (PO).
- (b) The number of this section (EEMUA Publication No. 146: 1987: section 3).
- (c) Material designation.
- (d) Size: inches and millimetres.
- (e) Manufacturer's name or trademark (MTM).

Example of marking: PO 146/3 CZ110 2/57 MTM

3.6.2 On fittings where it is not practical to apply the full requirements of 3.6.1. the marking shall detail:

- (a) Material designation.
- (b) Size: inches and millimetres.
- (c) Manufacturer's name or trademark (MTM).

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

Alternatively, the additional marking requirements shall be applied to the carton in which the fittings are packed.

**Note:** Stamping fittings with metallic stamps is not permitted.

### 3.7 Inspection and testing

This section does not make provision for the 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 30 bar.

However, for cast fittings after all machining and threading operations have been completed, each body shall be tested for porosity as follows:

The application of an internal air pressure test of not less than 5 bar and not more than 7 bar:

- (a) Whilst the fitting is completely immersed in water for a minimum of three seconds.  
or
- (b) By a leak detection system no less effective or suitable than (a), for example by an electronic test.

When so tested the fittings shall show no signs of leakage or distress.

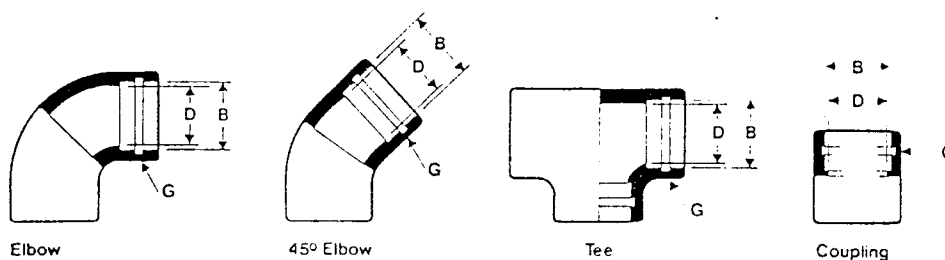
## Capillary brazing fittings

### 3.8 Certification

If so specified in the enquiry and order a certificate of compliance shall be supplied.

The certificate for compliance shall state that the fittings have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 146: 1987: section 3).

**Table 3.2**  
Dimensions of capillary brazing fittings



| Size*<br>Specified<br>OD | D**<br>Fitting<br>bore<br>min | B<br>Socket<br>size<br>max/min |
|--------------------------|-------------------------------|--------------------------------|
| 16                       | 12                            | 16.121/<br>16.070              |
| 25                       | 21                            | 25.131/<br>25.080              |
| 30                       | 25                            | 30.131/<br>30.080              |
| 38                       | 33                            | 38.146/<br>38.095              |
| 44.5                     | 39.5                          | 44.646/<br>44.595              |
| 57                       | 52                            | 57.276/<br>57.225              |

G=Inset Brazing Alloy Ring

All dimensions in millimetres.

**Note:** For other capillary fittings types and dimensions – see manufacturers' catalogues.

\*For inch/millimetre correlation – see foreword

\*\*To suit nominal bores of seamless 90/10 Cu Ni tubes of EEMUA Publication No. 144: 1987: section 1.

## SECTION 4 — COPPER ALLOY FLARELESS NON-MANIPULATIVE TYPE COMPRESSION FITTINGS

### 4.1 Scope and design basis

Section four covers flareless proprietary non-manipulative type compression fittings in sizes 16 mm up to and including 57 mm for a maximum allowable working pressure (MAWP) of 20 bar at 38°C.

In addition to 90/10 Cu Ni Alloy UNS 7060X\*, as modified in appendix C of this publication, alternative materials are as follows:

Aluminium bronze (BS Alloy CA104/UNS 63200)  
(BS Alloy CA107/UNS 64200)

70/30 Cu Ni (BS Alloy CN107/UNS 71500)

Gunmetal (bronze) (BS Alloy LG2/UNS 83600)

Where other non-ferrous alloys are used, reference should be made to BSMA 18 for design limitations and compatibility. These fittings are intended for use with seamless 90/10 Cu Ni tubes to EEMUA Publication No. 144: 1987: section 1.

The adequacy of non-manipulative type fittings shall be established by proof testing in accordance with clause 4.5 of this section.

All female ends and male stud ends shall be threaded NPT (US Standard taper pipe thread) to ANSI B1.20.1.

**Note:** The use of an anti-galling compound on the threads compatible with the material of the fitting shall be considered.

### 4.2 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 (Publication No. 146: 1987: section 4).
- (b) Fitting type and size in inches and millimetres and material designation.
- (c) Whether certificates of compliance are required (see clause 4.8).
- (d) Whether it is his intention to inspect the material at the supplier's works (see Addendum).
- (e) Any additional identification marking other than that specified herein is required.
- (f) Whether any test samples or individual test analyses are required to be supplied (see Addendum).

### 4.3 Freedom from defects

The fittings shall be visibly clean, smooth and free from harmful defects greater than 0.5 mm in depth, irregularities, scale or deposits and shall be free from deleterious films in the bore.

Cast fittings shall be sound, free from laps, blow holes, pitting and free from sand. They shall be neatly dressed and none shall be burned, plugged, stopped or patched.

### 4.4 Materials and manufacture

Wrought fittings shall be manufactured by hot forging, or cold forging followed by annealing, or machined from forging stock\*\* with chemical composition as modified in

\*Alloy UNS 7060X is a modified form of the following material designated alloys UNS 70600, BS CN102 and DIN 2.0872. See appendix C of this publication for chemical composition and mechanical properties.

\*\*Forging stock: forged, rolled or extruded bar (solid or hollow) intended for the production of forgings. Only straight fittings e.g. couplings may be machined directly from forging stock.

## Compression fittings

accordance with appendix C of this publication for 90/10 Cu Ni. Other materials shall have chemical compositions in accordance with the following specifications:

BS Alloy CA104 (UNS 63200) — BS 2872

BS Alloy CA107 (UNS 64200) — ASTM B124

BS Alloy CN107 (UNS 71500) — BS 2871: Part 2

Cast fittings shall be manufactured by shell moulding or sand casting processes with chemical composition in accordance with BS Alloy LG2 (UNS 83600) — BS 1400.

The dimensions of compression fittings shall be such that they comply with the requirements of table 4.1 and are suitable for use with annealed 90/10 Cu Ni tubes with outside diameters and specified wall thicknesses given in EEMUA publication No. 144: 1987: section 1.

### 4.5 Proof test for adequacy of compression fittings (prototype test)

The maximum allowable working pressures (MAWP) are those given in the Table below for temperatures up to and including 75°C when assembled with the appropriate size and thickness of tube.

**Table 4.1**

Basis for hydraulic proof pressure test of assembled non-manipulative compression joints

| Fitting size | Maximum allowable working pressure |
|--------------|------------------------------------|
| mm*          | bar                                |
| 16           | 106                                |
| 25           | 70                                 |
| 30           | 30                                 |
| 38           | 30                                 |
| 44.5         | 30                                 |
| 57           | 30                                 |

To determine the relative strength and leak tightness of compression type joints, straight pipe of the designated size and wall thickness shall be attached to each end of the compression fitting and shall be at least 150 mm in length. Proper end enclosures shall be applied beyond the minimum length of straight tube.

The fittings and their component parts when assembled at normal atmospheric temperature and in accordance with the manufacturer's instructions shall be capable of withstanding an internal hydraulic pressure of 1.5 times the maximum working pressure specified in table 4.1 above without showing signs of leakage or distress in the fitting or the joint. The pressure shall be maintained for 15 minutes.

The joints shall be broken down and reassembled three times (with the compression ring (and tube) and seat rotated through 90° relative to one another on each occasion) and retested to 1.5 times the maximum working pressure specified in table 4.1 above and maintained for 15 minutes and shall provide a sound joint on each occasion.

\*For inch/millimetre correlation — see foreword

## 4.6 Marking

4.6.1 All fittings shall be individually and permanently marked and identified by clear legible printing by means of a vibratory etching tool or by electro-chemical etching, as follows:

- (a) Purchase order number (PO).
- (b) The number of this section (EEMUA Publication No. 146: 1987: section 4).
- (c) Material designation.
- (d) Size: inches and millimetres.
- (e) Manufacturer's name or trademark (MTM).

Example of Marking: PO 146/4 LG2 1½/44.5 MTM

4.6.2 On fittings where it is not practical to apply the full requirements of 4.6.1 to the fitting the marking shall detail:

- (a) Material designation.
- (b) Size: inches and millimetres.
- (c) Manufacturer's name or trademark (MTM).

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

Alternatively the additional marking requirements shall be applied to the carton in which the fittings are packed.

**Note:** Stamping fittings with metallic stamps is not permitted.

## 4.7 Inspection and testing

This section does not make provision for the 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 30 bar.

However, for cast fittings after all machining and threading operations have been completed, each body shall be tested for porosity as follows:

- (a) The application of an internal hydraulic pressure of not less than 30 bar for a minimum of 10 seconds, or
- (b) The application of an internal pneumatic pressure of not less than 5 bar and not more than 7 bar, whilst the fitting is completely immersed in water for a minimum of 3 seconds.

When so tested the fittings shall show no signs of leakage or distress.

## 4.8 Certification

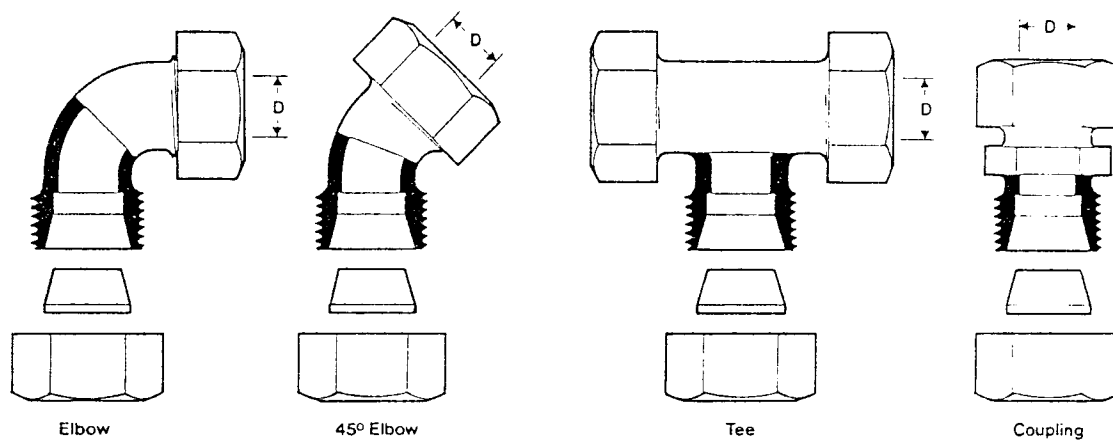
If so specified on the enquiry and order a certificate of compliance shall be supplied.

The certificate of compliance shall state that the fittings have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 146: 1987: section 4)

## Compression fittings

**Table 4.2**

Dimensions of flareless non-manipulative compression fittings



| Size*<br>Specified<br>OD | D**<br>fitting<br>bore<br>mm |
|--------------------------|------------------------------|
| 16                       | 12                           |
| 25                       | 21                           |
| 30                       | 25                           |
| 38                       | 33                           |
| 44.5                     | 39.5                         |
| 57                       | 52                           |

All dimensions in millimetres.

**Note:** For other compression fitting types and dimensions – see manufacturer's catalogues.

\*For inch/millimetre correlation – see foreword.

\*\*To suit seamless 90/10 Cu Ni tubes of EEMUA Publication No. 144: 1987: section 1.

## SECTION FIVE — COPPER ALLOY THREADED FITTINGS

### 5.1 Scope and design basis

Section five covers threaded type fittings such as couplings, caps, plugs and bushes as shown in Tables 5.1.1 & 5.1.2 with dimensions generally in accordance with ANSI B16.11 and NPT threads in accordance with ANSI B1.20.1, (American National Standard for Pipe Threads) in the following nominal pipe sizes —  $\frac{1}{2}$ ",  $\frac{3}{4}$ ", 1",  $1\frac{1}{4}$ ",  $1\frac{1}{2}$ " and 2" for a maximum allowable working pressure of 20 bar at a temperature of 38°C. Other sizes may be supplied as agreed between the purchaser and manufacturer.

The diameter and thickness (Schedule No) of tubes for threading, or for the manufacture of barrel type nipples, shall be as given in Table 5.2

In addition to 90/10 Cu Ni alloy (UNS 7060X\* as modified in Appendix C of this specification), alternative materials (for caps, plugs and bushings only) are as follows:

BS Alloy CZ110/UNS 68700 (Aluminium Brass)

BS Alloy LG2/UNS 83600 (Gunmetal Bronze)

BS Alloy CA104/UNS 63200 (Aluminium Bronze)

BS Alloy CA107/UNS 64200 (Aluminium Bronze)

Where other non-ferrous alloys are used reference should be made to BS MA18 for compatibility.

**Note:** The use of an anti-galling compound on the threads compatible with the material of the fitting shall be considered.

### 5.2 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 No. 146: 1987 section 5).
- (b) The type of fitting or bushing and size in inches and millimetres and material designation.

**Note:** Although not covered by this specification when barrel nipples are required, the overall length, thickness and whether one or both ends are required to be threaded (NPT) shall be stated on the enquiry and order.

- (c) Whether certificates of compliance are required (See clause 5.7)
- (d) Whether it is his intention to inspect material at the suppliers' works (see Addendum)
- (e) Whether any additional identification marking other than that specified herein is required.
- (f) Whether any test samples or individual test analyses are required to be supplied (See Addendum)

### 5.3 Freedom from defects

The fittings shall be visibly clean, smooth and free from harmful defects greater than 0.5 mm in depth and free from deleterious films in the bores.

Cast fittings shall, in addition, be sound, free from laps, blow holes, pitting and free from sand. The cast fittings shall be neatly dressed and none shall be burned, plugged, stopped or patched.

\*UNS 7060X is a modified form of the following national designated alloys — UNS 70600, BS CN102 and DIN 2.0872. See appendix C of this specification for chemical composition and mechanical properties.

## Threaded fittings

### 5.4 Materials and manufacture

Wrought fittings shall be manufactured by hot forging or cold forging followed by annealing, or machined from forging stock\* or seamless tube with chemical composition as modified in accordance with appendix C of this publication for 90/10 Cu Ni alloy (UNS 7060X). Other materials shall have chemical compositions in accordance with the following specifications:

BS Alloy CZ110 (UNS 68700) — BS 2871: part 2

BS Alloy CA104 (UNS 63200) — BS 2872 :

BS Alloy CA107 (UNS 64200) — ASTM B124 :

Cast fittings shall be manufactured by shell moulding or sand casting processes with chemical composition in accordance with BS 1400: alloy LG2 or ASTM B62 alloy UNS 83600.

Dimensions of threaded fittings shall be in accordance with Tables 5.1.1 and 5.1.2. The dimensions of barrel nipples, including length(s) and threading requirements, shall be as specified by the purchaser.

### 5.5 Marking

5.5.1 All fittings shall be individually and permanently marked and identified by clear legible printing by means of a vibratory etching tool or by electro-chemical etching as follows:

- (a) Purchase Order Number (PO)
- (b) The title and number of this section — (EEMUA Publication No. 146: 1987: section 5)
- (c) Material designation
- (d) Size: inches and millimetres (see Table 5.2)
- (e) Manufacturer's name or trademark (MTM)

Example of marking: PO 146/5 CZ110 1¼/42.2 MTM

5.5.2 On fittings where it is not practical to apply the full requirements of 5.5.1 the marking shall detail:

- (a) Material designation
- (b) Size: inches and millimetres (See table 5.2)
- (c) Manufacturer's name or trademark (MTM).

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

Alternatively the additional marking requirements shall be applied to the carton in which the fittings are packed.

**Note:** Stamping fittings with metallic stamps is not permitted.

### 5.6 Inspection and testing

This section does not make provision for the routine pressure testing of fittings. They shall, however, be dimensionally correct and be marked in accordance with this section. All fittings apart from plugs shall be capable of withstanding without leakage or signs of distress a hydraulic pressure of 30 bar.

*\*Forging stock — forged, rolled or extruded bar (solid or hollow) intended for the production of forgings. Only straight fittings e.g. couplings may be machined directly from forging stock.*

However, for cast caps or bushings, after all machinery and threading operations have been completed, each body shall be tested for porosity as follows:

- (a) The application of an internal hydraulic pressure of not less than 30 bar for a minimum of 10 seconds, or
- (b) The application of an internal pneumatic pressure of not less than 5 bar and not more than 7 bar whilst the fitting is completely immersed in water for a minimum of 3 seconds.

When so tested the fittings shall show no signs of leakage or distress.

### 5.7

#### Certification

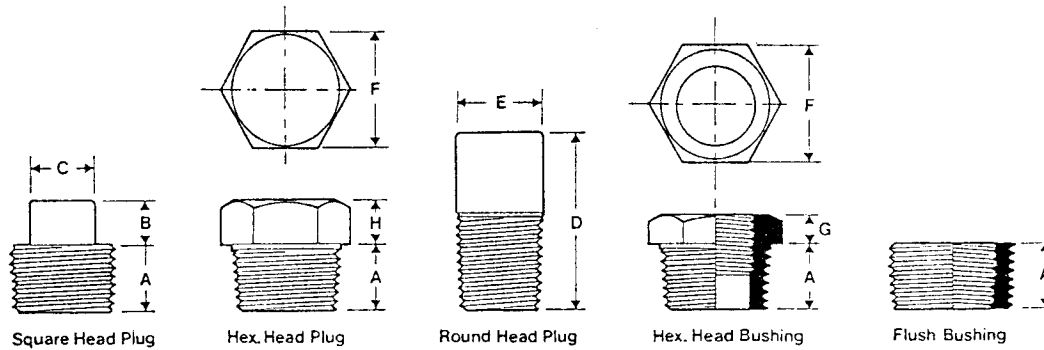
If so specified in the enquiry and order a certificate of compliance shall be supplied.

The certificate of compliance shall state that the fittings have been manufactured in accordance with all the requirements of this section (EEMUA Publication No. 146: 1987: section 5).

## Threaded fittings

**Table 5.1.1**

Dimensions of copper alloy threaded plugs and bushings

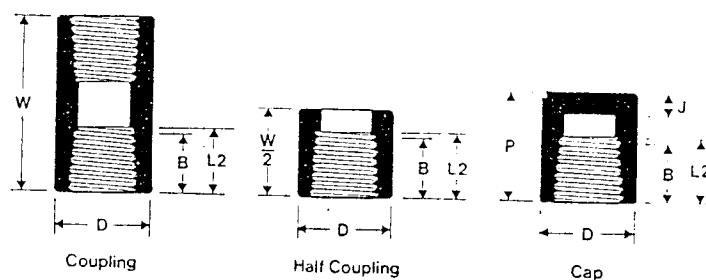


| Copper alloy plugs and bushings |        |                     |                   |                     |             |                           |              |           |
|---------------------------------|--------|---------------------|-------------------|---------------------|-------------|---------------------------|--------------|-----------|
| Nominal<br>pipe<br>size         | length | Plugs-square head   |                   | Plugs-round head    |             | Plugs-hex head & bushings |              |           |
|                                 |        | Height of<br>square | Width of<br>flats | Dia<br>of head<br>E | Length<br>D | Width of<br>flats<br>F    | Hex height   |           |
|                                 | A      | B                   | C                 |                     |             |                           | Bushing<br>G | Plug<br>H |
| in                              | min    | min                 | min               | nom                 | min         | nom                       | min          | min       |
| 1/2                             | 14.5   | 10                  | 14.5              | 21                  | 44          | 22                        | 5            | 8         |
| 3/4                             | 16.0   | 11                  | 16.0              | 27                  | 44          | 27                        | 6            | 10        |
| 1                               | 19.0   | 13                  | 20.5              | 33                  | 51          | 35                        | 6            | 10        |
| 1 1/4                           | 20.5   | 14                  | 24.0              | 43                  | 51          | 44.5                      | 7            | 14        |
| 1 1/2                           | 20.5   | 16                  | 28.5              | 48                  | 51          | 51                        | 8            | 16        |
| 2                               | 22.0   | 17                  | 33.5              | 60                  | 64          | 63.5                      | 9            | 17        |

All dimensions in millimetres unless otherwise indicated.

**Table 5.1.2**

Dimension of copper alloy threaded couplings, half couplings and caps



| Copper alloy threaded fittings |                                  |                             |                                 |                                   |                       |           |
|--------------------------------|----------------------------------|-----------------------------|---------------------------------|-----------------------------------|-----------------------|-----------|
| Nominal<br>pipe<br>size<br>in  | Length-<br>couplings<br>W<br>min | Length-<br>caps<br>P<br>min | Outside<br>diameter<br>D<br>min | End wall<br>thickness<br>J<br>min | Length of**<br>thread |           |
|                                |                                  |                             |                                 |                                   | B<br>min              | L2<br>min |
| 1/2                            | 48                               | 32                          | 29                              | 6.5                               | 11                    | 13.5      |
| 3/4                            | 51                               | 37                          | 35                              | 6.5                               | 12.5                  | 14        |
| 1                              | 60                               | 38                          | 44                              | 6.5*                              | 14.5                  | 17.5      |
| 1 1/4                          | 67                               | 41                          | 57                              | 6.5*                              | 17                    | 18        |
| 1 1/2                          | 79                               | 41                          | 64                              | 6.5*                              | 18                    | 18.5      |
| 2                              | 86                               | 42                          | 76                              | 6.5*                              | 19                    | 19        |

All dimensions in millimetres unless otherwise stated.

\*These thicknesses are less than the corresponding values specified in ANSI B16.11 for class 3000 caps.

\*\*Dim "B" is the minimum length of full thread. The length of useful thread ("B" plus threads with fully formed roots and flat crests) shall not be less than "L2" – effective length of external thread required in ANSI B1.20.1.

## Threaded fittings

**Table 5.2**

Dimensions of 90/10 Cu Ni alloy tubes suitable for screwing NPT to ANSI B1.20.1\*.

| Outside diameter |              | Thickness       |      |
|------------------|--------------|-----------------|------|
| Nominal<br>in    | Actual<br>mm | Schedule<br>No. | mm   |
| 1/2              | 21.3         | 160             | 4.78 |
| 3/4              | 26.7         |                 | 5.56 |
| 1                | 33.4         |                 | 6.35 |
| 1 1/4            | 42.2         |                 | 6.35 |
| 1 1/2            | 48.3         |                 | 7.14 |
| 2                | 60.3         |                 | 8.74 |

\*The dimensions to the above table have been chosen to be suitable for threading NPT to ANSI ASME B1.20.1 and shall be used for the manufacture of barrel nipples where the requirements for length, and whether one or both ends are required to be threaded, shall be specified by the purchaser.

†Subject to the tolerances permitted by the applicable specification.

## SECTION SIX — 90/10 CU NI SELF REINFORCED BRANCH CONNECTION FITTINGS

### 6.1 Scope and design basis

Section six covers wrought proprietary self reinforced branch connectors in 90/10 Cu Ni alloy UNS 7060X\* as modified in appendix C of this specification for maximum allowable working pressures (MAWP) of 16 or 20 bar at 75°C and 38°C respectively.

The dimensions and tolerances are such that they are suitable for welding to seamless or seam-welded 90/10 Cu Ni tubes to EEMUA Publication No.: 144: 1987: sections 1 and 2 respectively.

Self reinforced branch connectors covered are suitable for application to headers sizes ½ in/16 mm up to 24 in/610 mm. Butt welding type connectors cover branch sizes up to and including the same as the header, whilst the branches of socket welding type and threaded type connectors are limited to 2 in/57 mm and 2 in NPT respectively.

A design feature of self-reinforced branch connectors shall include the additional compensatory reinforcement necessary to comply with the requirements of Section 304.3 (Branch connections in metallic piping) in ANSI/ASME B31.3 "Chemical plant and petroleum refinery piping."

In addition the design shall include such features as will promote as smooth an entry into the connection as practicable in order to reduce the effects of turbulence and risk of subsequent corrosion.

The design features, including reinforcement, may be established by mathematical analyses contained in a nationally recognised pressure vessel or piping code, as agreed between the manufacturer and purchaser. The design of connectors which cannot be qualified by such analyses shall be established in accordance with the proof testing procedure in clause 9 of ANSI B16.9 — 1978.

The basic overall dimensions of proprietary branch connectors are given in tables 6.1, 6.2 and 6.3.

Threaded type branch connectors shall have NPT threads to ANSI B1.20.1 (American National Standard Taper Pipe Threads).

**Note:** The use of an anti-galling compound on the threads compatible with the fitting material shall be considered.

### 6.2 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 146: 1987: section 6) and material designation.
- (b) Fitting type (ie butt, socket welding or threaded) and size in inches and millimetres.
- (c) The pressure rating — 16 or 20 bar (butt welding type only)
- (d) Whether manufacturer's certificates are required (see clause 6.8).
- (e) Whether it is his intention to inspect the material at the supplier's works (see Addendum).
- (f) Whether any additional identification marking other than that specified herein is required.
- (g) Whether any test samples or individual analyses are required to be supplied (see Addendum).

\*Alloy UNS 7060X is a modified form of the following national designated alloys — UNS 70600, BS CN102 and DIN 2.0872. See appendix C of this specification for chemical composition and mechanical properties.

## Reinforced branch connection fittings

### 6.3 Pressure/temperature ratings

Pressure/temperature ratings are the maximum allowable working pressure (MAWP) shown in Appendix D.

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

### 6.4 Freedom from defects

The connectors shall be visually clean, smooth and free from harmful defects greater than 0.5 mm in depth, irregularities, scale or deposit and shall be free from deleterious films in the bore.

### 6.5 Materials and manufacture

The connectors shall be manufactured by hot forging, or cold forging followed by annealing or machined from forging stock\* with chemical composition in accordance with Appendix C.

The mechanical properties of the connectors shall comply with the requirements of Appendix C. The overall dimensions and tolerances of connectors shall comply with the requirements of tables 6.1, 6.2 and 6.3.

### 6.6 Marking

6.6.1 All connectors shall be individually permanently marked and identified by clear legible printing 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 146: 1987: section 6)
- (c) Material designation UNS 7060X
- (d) Size: inches and millimetres
- (e) Pressure rating — 16 or 20 bar
- (f) Manufacturer's name or trademark (MTM).
- (g) Test certificate number (TCN)
- (h) Cast number

Example of marking: PO 146/6 7060X 14/368 x 2/57 16 MTM TCN Cast No.

6.6.2 Where it is not practical to apply the full requirements of 6.7.1 to the connector, the marking shall detail:

- (a) Material designation
- (b) Cast Number
- (c) Size: inches and millimetres
- (d) Manufacturer's name or trademark (MTM).
- (e) Pressure rating — 16 or 20 bar

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

**Note:** Stamping with metallic stamps is not permitted.

\*Forging stock — forged, rolled or extruded bar (solid or hollow) intended for the production of forgings.

## 6.7 Inspection and testing

This section does not make provision for routine pressure testing of branch connectors. They shall, however, be dimensionally correct and be marked in accordance with this section.

All connectors shall be capable of withstanding without leakage or signs of distress a hydraulic pressure of 1.5 times the maximum design pressure at ambient temperature as follows:

16 bar rated fittings, test pressure = 24 bar

20 bar rated fittings, test pressure = 30 bar

## 6.8 Certification

Certificates shall be supplied, either:

6.8.1 A certificate of compliance which shall state that the connectors have been manufactured in accordance with all the requirements of this specification (EEMUA Publication No. 146: 1987: section 6) or:

6.8.2 A manufacturer's certificate(s) which shall state that the connectors have been manufactured in accordance with all the requirements of this specification (EEMUA Publication No 146: 1987: section 6) and:

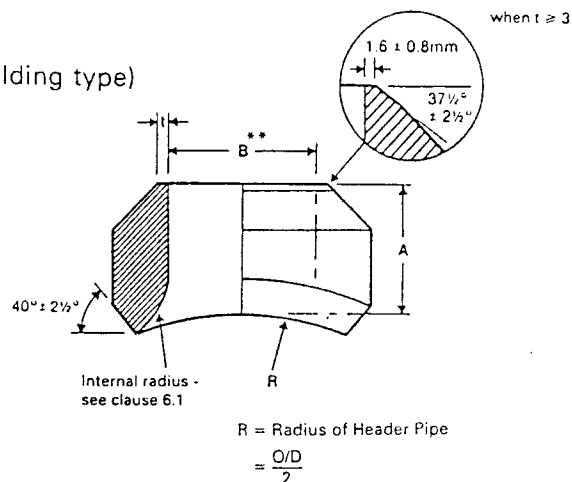
- (a) State the actual compositional limits determined for each of the elements of the cast used in the manufacture of each batch or order in accordance with Appendix C.
- (b) State the results of mechanical tests performed on each cast used in the manufacture of each batch or order in accordance with Appendix C.

**Note:** Individual cast analyses shall be retained by the manufacturer — see Addendum.

## Reinforced branch connection fittings

**Table 6.1**

Self reinforced branch connection fittings (butt welding type)



| Branch Specified OD* | Header size range | A<br>nom | B**<br>(bore) |        | t         |      |
|----------------------|-------------------|----------|---------------|--------|-----------|------|
|                      |                   |          | max           | min    | specified | min  |
| 16                   | 16 — 44.5         | 19.05    | 12.445        | 11.565 | 2.0       | 1.8  |
|                      | 57 — 610          | 17.5     | 12.445        | 11.565 | 2.0       | 1.8  |
| 25                   | 25 — 44.5         | 22.2     | 21.445        | 20.575 | 2.0       | 1.8  |
|                      | 57 — 610          | 20.6     | 21.445        | 20.575 | 2.0       | 1.8  |
| 30                   | 30 — 44.5         | 27.0     | 25.555        | 24.475 | 2.5       | 2.25 |
|                      | 57 — 610          | 22.2     | 25.555        | 24.475 | 2.5       | 2.25 |
| 38                   | 38 — 44.5         | 30.2     | 33.57         | 32.49  | 2.5       | 2.25 |
|                      | 57 — 610          | 25.4     | 33.57         | 32.49  | 2.5       | 2.25 |
| 44.5                 | 44.5 —            | 33.3     | 40.07         | 38.99  | 2.5       | 2.25 |
|                      | 57 — 610          | 28.6     | 40.07         | 38.99  | 2.5       | 2.25 |
| 57                   | 57 — 76.1         | 38.1     | 52.70         | 51.62  | 2.5       | 2.25 |
|                      | 88.9 — 610        | 33.3     | 52.70         | 51.62  | 2.5       | 2.25 |
| 76.1                 | 76.1 — 108        | 47.6     | 71.80         | 70.65  | 2.5       | 2.25 |
|                      | 159 — 610         | 44.5     | 71.80         | 70.65  | 2.5       | 2.25 |
| 88.9                 | 88.9 — 108        | 47.6     | 84.65         | 83.50  | 2.5       | 2.25 |
|                      | 159 — 610         | 44.5     | 84.65         | 83.50  | 2.5       | 2.25 |
| 180                  | 108 —             | 46.8     | 102.85        | 101.40 | 3.0       | 2.70 |
|                      | 159 —             | 52.4     | 102.85        | 101.40 | 3.0       | 2.70 |
|                      | 219.1 — 610       | 49.2     | 102.85        | 101.40 | 3.0       | 2.70 |
| 159                  | 159 — 610         | 60.3     |               |        |           |      |
| 219.1                | 219.1 — 610       | 69.9     |               |        |           |      |
| 267                  | 267 — 610         | 77.8     |               |        |           |      |
| 323.9                | 323.9 — 610       | 85.7     |               |        |           |      |
| 368                  | 368 — 610         | 88.9     |               |        |           |      |
| 419                  | 419 — 610         | 93.7     |               |        |           |      |
| 457.2                | 457.2 — 610       | 96.8     |               |        |           |      |
| 508                  | 508 — 610         | 115.9    |               |        |           |      |
| 610                  | 610 —             | 115.9    |               |        |           |      |

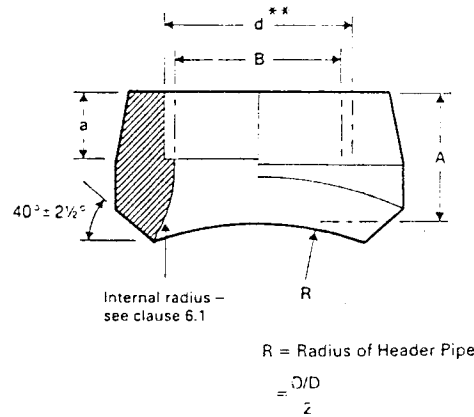
All dimensions in millimetres.

\*For inch/millimetre correlation — see foreword

\*\*For inside diameters at the welding ends, see tables 1.1 and 1.2 for 16 and 20 bar respectively.

**Table 6.2**

Self reinforced branch connection fittings (socket welding type)



| Branch Specified OD* | Header size range | a min | d**    |        | A nom | B (bore) |        |
|----------------------|-------------------|-------|--------|--------|-------|----------|--------|
|                      |                   |       | max    | min    |       | max      | min    |
| 16                   | 25 — 44.5         | 10    | 16.121 | 16.070 | 25.4  | 12.445   | 11.565 |
|                      | 57 — 914          | 10    | 16.121 | 16.070 | 23.8  | 12.445   | 11.565 |
| 25                   | 30 — 44.5         | 13    | 25.131 | 25.080 | 26.9  | 21.445   | 20.575 |
|                      | 57 — 914          | 13    | 25.131 | 25.080 | 25.4  | 21.445   | 20.575 |
| 30                   | 38 — 44.5         | 13    | 30.131 | 30.080 | 33.3  | 25.555   | 24.475 |
|                      | 57 — 914          | 13    | 30.131 | 30.080 | 28.6  | 25.555   | 24.475 |
| 38                   | 57 — 914          | 13    | 38.146 | 38.095 | 33.3  | 33.57    | 32.49  |
| 44.5                 | 57 — 914          | 13    | 44.646 | 44.595 | 30.2  | 40.07    | 38.99  |
| 57                   | 76.1 — 914        | 16    | 57.276 | 57.225 | 38.1  | 52.70    | 51.62  |

All dimensions in millimetres.

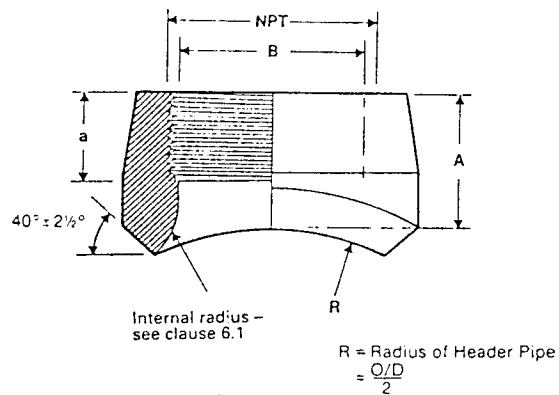
\*For inch/millimetre correlation – see foreword

\*\*To suit tube sizes listed in EEMUA Publication No 144: 1987: section 1

## Reinforced branch connection fittings

**Table 6.3**

Self reinforced branch connection fittings (threaded type)



| Nominal Branch size<br>in (NPT)* | Header size range<br>min      max | A<br>nom     | B<br>(bore)<br>nom | Pipe Schedule<br>number and<br>thickness | Length<br>of<br>thread a **<br>min |
|----------------------------------|-----------------------------------|--------------|--------------------|------------------------------------------|------------------------------------|
| 1/2                              | 25 — 44.5<br>57 — 914             | 25.4<br>23.8 | 11.74<br>11.74     | 160 — 4.78                               | 13.5<br>13.5                       |
| 3/4                              | 30 — 44.5<br>57 — 914             | 26.9<br>25.4 | 15.58<br>15.58     | 160 — 5.56                               | 14<br>14                           |
| 1                                | 38 — 44.5<br>57 — 914             | 33.3<br>28.6 | 20.70<br>20.70     | 160 — 6.35                               | 17.5<br>17.5                       |
| 1 1/4                            | 57 — 914                          | 33.3         | 29.50              | 160 — 6.35                               | 18                                 |
| 1 1/2                            | 57 — 914                          | 30.2         | 34.02              | 160 — 7.14                               | 18.5                               |
| 2                                | 76.1 — 914                        | 38.1         | 42.82              | 160 — 8.74                               | 19                                 |

All dimensions in millimetres unless otherwise indicated

\*See table 5.2 of section 5 of this specification

\*\*The length of threading shall not be less than 2 threads in addition to dimension "a"

## SECTION SEVEN — 90/10 CU NI SADDLE PIECES

### 7.1 Scope and design basis

Section seven covers requirements for seamless saddle pieces for use in header sizes 6 in/159 mm up to 36 in/914 mm for a MAWP of 16 bar whereas sizes 1¼ in/38 mm up to 24 in/610 mm covers a MAWP of 20 bar. Seam-welded saddle pieces are applicable to header sizes 12 in/323.9 mm up to 36 in/914 mm for 16 bar rating and 12 in/323.9 mm up to 24 in/610 mm for 20 bar rating.

The design features, including reinforcement, may be established by mathematical analyses contained in a nationally recognised pressure vessel or piping code as agreed between the manufacturer and purchaser. The design of saddle pieces which cannot be qualified by such analyses shall be proof tested in accordance with ASME Unfired Pressure Vessel Code Section VIII Division 1 paragraph UG 101 (m).

### 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 specification (EEMUA Publication 145: 1987: section 7) and designation of the material, see appendix C
- (b) The type of saddle and size in inches and millimetres.
- (c) The pressure rating — 16 bar or 20 bar.
- (d) Whether manufacturer's certificates are required (see clause 7.13)
- (e) Whether it is his intention to inspect the material at the supplier's works (see Addendum)
- (f) Whether any additional identification marking other than that specified herein is required.
- (g) Whether any test samples or individual analyses are required to be supplied — see Addendum

### 7.3 Pressure/temperature ratings

Pressure/temperature ratings are the maximum allowable working pressure (MAWP) shown in appendix D.

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

### 7.4 Freedom from defects

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

### 7.5 Materials and manufacture

The saddles shall be seamless or seam-welded and manufactured from tube (pipe) sheet or plate as follows:

Tubes (seamless) shall have chemical composition and mechanical properties in accordance with table 1.3 of EEMUA Publication No 144: 1987: section 1, specification for 90/10 Cu Ni seamless tubes.

Tubes (seam-welded) shall have chemical composition and mechanical properties in accordance with table 2.3 of EEMUA Publication No 144: 1987: section 2, specification for 90/10 Cu Ni seam-welded tubes.

Sheets or plates shall be hot rolled or cold rolled and annealed in accordance with BS 2870 or BS 2875 but with chemical composition as modified in this specification. See appendix C.

## **Saddle pieces**

The overall dimensions and tolerances of seamless saddle pieces shall comply with the requirements of tables 7.1.1 and 7.2.1, tables 7.1.2 and 7.2.2, as well as Figures 7.1 and 7.2. Seam-welded saddle pieces shall comply with the requirements of tables 7.1.1 and 7.3.1, tables 7.1.2 and 7.3.2, as well as Figures 7.1 and 7.3.

## **7.6 WELDING**

### **7.6.1 Consumables**

The composition of the filler wire or rods used for the production of seam welds shall be selected from BS 2901: Part 3, table 1 – alloy C18.

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.

### **7.6.2 Welding procedure qualification**

The welding procedure qualifications shall be as quoted in ASME Code Section IX – “Qualification Standard for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators.”

### **7.6.3 Welder qualification**

The welder qualification shall be in accordance with ASME Code Section IX.

## **7.7 Selection of test samples**

For saddles produced from seamless tube or from hot rolled or cold rolled and annealed sheet or plate, samples shall be selected as follows:

- (a) Seamless tube in accordance with clause 1.8, selection of Test Samples of EEMUA Publication No. 144: 1987: section 1 for seamless 90/10 Cu Ni Tubes. The analysis and mechanical properties of the tube used to produce the saddles shall comply with the requirements of appendix C of this specification.
- (b) Sheet/plate in accordance with BS 2870, clause 11 or BS 2875 clause 1.6. The analysis and mechanical properties of each sheet or plate used to produce the saddles shall comply with the requirements of appendix C of this specification.

## **7.8 Non-destructive testing**

### **7.8.1 Liquid dye penetrant test**

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

### **7.8.2 Radiography**

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

## **7.9 Repairs to weld seams**

Visible defects such as cracks, pinholes and incomplete fusion and defects detected by the tests performed under clause 7.8 shall be removed and repaired in accordance with Clause 7.6.

### **7.10 Retest of repairs**

A repaired weld seam shall meet the requirements of the original weld and be re-examined and retested in accordance with 7.8.1 and 7.8.2.

## 7.11 Marking

**7.11.1** All saddles 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 No 146: 1987: section 7).
- (c) Material designation UNS 7060X.
- (d) Size: inches and millimetres.
- (e) Pressure rating — 16 or 20 bar.
- (f) Manufacturer's name or trademark (MTM).
- (g) Test certificate number (TCN).
- (h) Cast number.
- (j) Where applicable — welder identity (WI).

Example of marking:

PO 146/7 7060X 14/368 20 MTM TCN Cast No WI

**7.11.2** Where the maximum size is 1½"/44.5 mm and smaller and where it is not practical to apply the full requirements of 7.11.1 the marking shall detail:

- (a) Material designation
- (b) Cast Number
- (c) Manufacturer's name or trademark (MTM)
- (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 component. The labels shall be clearly and permanently marked.

**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.

## 7.12 Inspection and testing

This Section does not make provision for routine pressure testing of saddles. They shall, however, be dimensionally correct and be marked in accordance with this section. All saddles when welded into appropriate header pipes selected from EEMUA Publication 144: 1987: section 1 or 2 shall be capable of withstanding without leakage or signs of distress a hydraulic pressure of 1.5 times the maximum design pressure at ambient temperature as follows:

16 bar rated saddles — 24 bar  
20 bar rated saddles — 30 bar

## 7.13 Certification

Certificate(s) shall be supplied, either:

**7.13.1** A certificate of compliance which shall state that the saddles have been made in accordance with all the requirements of this section (EEMUA Publication No. 146: section 7: 1987) or:

## Saddle pieces

### 7.13.2

A manufacturers' certificate which shall state that the saddles have be made in accordance with all the requirements of this section (EEMUA Publication No 146: section 7: 1987) and:

- (a) State the actual compositional limits determined for each of the elements designated in appendix C of the casts used in the manufacture of each order for seamless tubes used to manufacture fittings and/or:

State the actual compositional limits determined for each of the elements designated in appendix C of each cast used in the manufacture of each sheet or plate used in the manufacture of fittings.

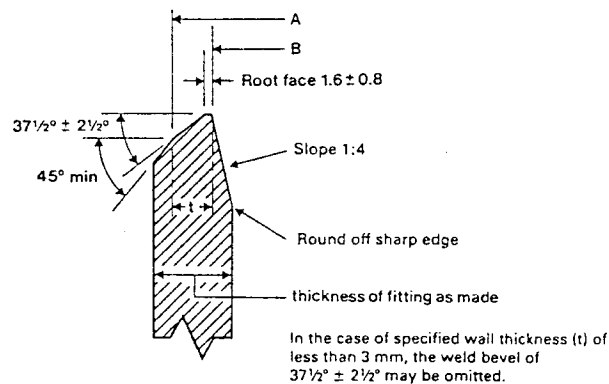
**Note:** Individual cast analyses shall be retained by the manufacturer (see Addendum).

- (b) State the results of mechanical tests performed on the seamless tubes, used to manufacture fittings in accordance with appendix C and/or state the results of mechanical tests performed on sheets or plates formed into fittings in accordance with appendix C.
- (c) State, if applicable, that dye penetrant and radiographic examination of each weld on each saddle has been carried out and complies with clause 7.8.

**Figure 7.1**

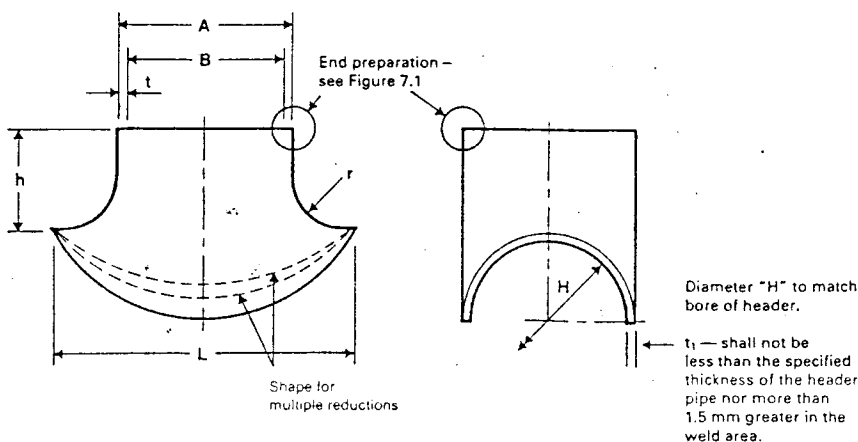
Dimensions of welding ends on butt welding saddle pieces

See tables 7.1.1 and 7.1.2 for dimensions A, B and t for 16 and 20 bar ratings respectively



**Figure 7.2**

Saddle pieces — seamless



**Table 7.1.1**

Dimensions of butt welding ends

16 bar rating (see also fig. 7.1)

For tolerances see table 7.2.1

| Size*        | pipe wall thickness              |         | inside diameter at welding ends B |         |
|--------------|----------------------------------|---------|-----------------------------------|---------|
| A            | t                                |         |                                   |         |
| specified OD | specified                        | minimum | maximum                           | minimum |
| 30           | Use<br>20 bar<br>SEE TABLE 7.1.2 |         |                                   |         |
| 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 foreword.

All dimensions in millimetres

## Saddle pieces

**Table 7.1.2**

Dimensions of butt welding ends

20 bar rating (see also fig. 7.1)

| Size*        | Pipe wall thickness |         | Inside diameter at welding ends |         |
|--------------|---------------------|---------|---------------------------------|---------|
| A            | t                   |         | 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                           | 70.65   |
| 88.9         | 2.5                 | 2.25    | 84.65                           | 83.5    |
| 108          | 3.0                 | 2.70    | 102.85                          | 101.4   |
| 159          | 3.5                 | 3.06    | 153.0                           | 151.5   |
| 219.1        | 4.5                 | 3.94    | 210.9                           | 209.4   |
| 267          | 5.5                 | 4.81    | 256.7                           | 255.2   |
| 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 foreword.  
All dimensions in millimetres.

**Table 7.2.1**

Tolerances — Seamless saddle pieces — 16 bar rating

| Size*                                                                                            |                             | Dimension                  | Tolerance<br>on<br>L | Dimension | Tolerance<br>on<br>h | r   |
|--------------------------------------------------------------------------------------------------|-----------------------------|----------------------------|----------------------|-----------|----------------------|-----|
| Header                                                                                           | Branch                      | L                          |                      | h         |                      |     |
| 38 × 2.5<br>to<br>108 × 3.0                                                                      | 38 × 2.5<br>to<br>108 × 3.0 | USE 20 bar SEE TABLE 7.2.2 |                      |           |                      |     |
| All header<br>sizes equal<br>to or larger<br>than branch<br>up to and<br>including<br>914 × 15.5 | 323.9 × 5.5                 | 560                        | ±6                   | 185       | ±2.5                 | 100 |
|                                                                                                  | 267 × 4.5                   | 447                        | ±5                   | 155       |                      | 90  |
|                                                                                                  | 219.1 × 4.0                 | 379                        |                      | 125       |                      | 80  |
|                                                                                                  | 159 × 3.0                   | 279                        | ±4                   | 95        | ±1.6                 | 60  |
|                                                                                                  | 108 × 3.0                   | 188                        |                      | 75        |                      | 40  |
|                                                                                                  | 88.9 × 2.5                  | 149                        | ±3                   | 55        |                      | 30  |
|                                                                                                  | 76.1 × 2.5                  | 126                        |                      | 50        |                      | 25  |
|                                                                                                  | 57 × 2.5                    | 97                         |                      | 40        |                      | 20  |
|                                                                                                  | 44.5 × 2.5                  | 74                         |                      | 35        |                      | 15  |
|                                                                                                  | 38 × 2.5                    | 64                         |                      | 35        | 13                   |     |

All dimensions in millimetres

Note: See also figures 7.1, 7.2 and table 7.1.1

\* For inch/millimetre correlation — see foreword

**Table 7.2.2**

Tolerances — Seamless saddle pieces — 20 bar rating

| Size*                                                                                          |             | Dimension | Tolerance | Dimension | Tolerance | r   |
|------------------------------------------------------------------------------------------------|-------------|-----------|-----------|-----------|-----------|-----|
| Header                                                                                         | Branch      | L         | on L      | h         | on h      |     |
| All header<br>sizes equal<br>to or larger<br>than branch<br>up to and<br>including<br>610 × 13 | 323.9 × 7.0 | 560       | ±6        | 185       | ±2.5      | 100 |
|                                                                                                | 267 × 5.5   | 447       | ±5        | 155       | ±1.6      | 90  |
|                                                                                                | 219.1 × 4.5 | 379       | ±4        | 125       |           | 80  |
|                                                                                                | 159 × 3.5   | 279       |           | 95        |           | 60  |
|                                                                                                | 108 × 3.0   | 188       | ±3        | 75        |           | 40  |
|                                                                                                | 88.9 × 2.5  | 149       |           | 55        |           | 30  |
|                                                                                                | 76.1 × 2.5  | 126       |           | 50        |           | 25  |
|                                                                                                | 57 × 2.5    | 97        |           | 40        |           | 20  |
|                                                                                                | 44.5 × 2.5  | 74        |           | 35        |           | 15  |
|                                                                                                | 38 × 2.5    | 64        |           | 35        |           | 13  |

All dimensions in millimetres

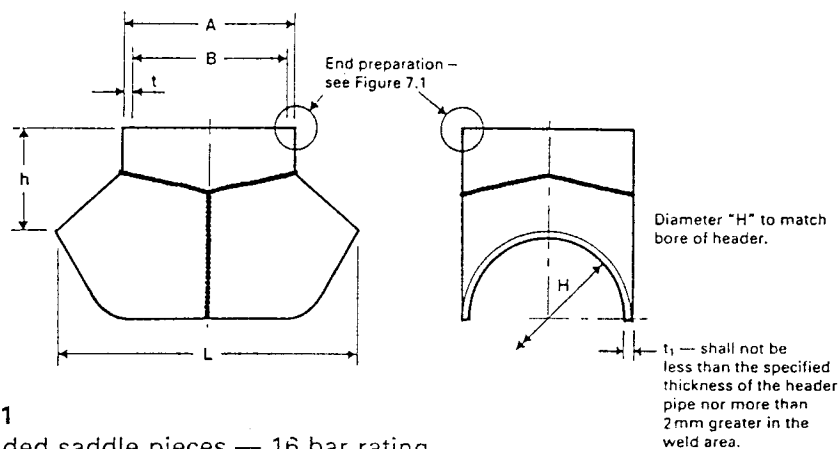
Note: See also figures 7.1, 7.2 and table 7.1.2

\* For inch/millimetre correlation — see foreword

## Saddle pieces

**Figure 7.3**

Saddle pieces — seam welded



**Table 7.3.1**

Seam-welded saddle pieces — 16 bar rating

| Size*                                                                                                   |             | Dimension | Tolerance | Dimension | Tolerance |
|---------------------------------------------------------------------------------------------------------|-------------|-----------|-----------|-----------|-----------|
| Header                                                                                                  | Branch      | L         | on L      | h         | on h      |
| All header sizes equal to or larger than branch in the range 323.9 × 5.5 up to and including 914 × 15.5 | 914 × 15.5  | 1550      | ±7        | 460       | ±3.5      |
|                                                                                                         | 813 × 13.5  | 1400      |           | 410       |           |
|                                                                                                         | 711 × 12    | 1225      |           | 360       |           |
|                                                                                                         | 610 × 10.5  | 1020      |           | 300       |           |
|                                                                                                         | 508 × 8.5   | 880       | ±6        | 275       | ±3        |
|                                                                                                         | 457.2 × 8.0 | 800       |           | 250       |           |
|                                                                                                         | 419 × 7.0   | 680       |           | 225       |           |
|                                                                                                         | 368 × 6.5   | 613       |           | 200       |           |
|                                                                                                         | 323.9 × 5.5 | 560       | ±5        | 185       | ±2.5      |
|                                                                                                         | 267 × 4.5   | 447       |           | 155       | ±1.6      |
|                                                                                                         | 219.1 × 4.0 | 379       |           | 125       |           |

All dimensions in millimetres

Note: See also figures 7.1, 7.3 and table 7.1.1

\* For inch/millimetre correlation — see foreword

**Table 7.3.2**

Seam-welded saddle pieces — 20 bar rating

| Size*                                                                                                 |             | Dimension | Tolerance | Dimension | Tolerance |
|-------------------------------------------------------------------------------------------------------|-------------|-----------|-----------|-----------|-----------|
| Header                                                                                                | Branch      | L         | on L      | h         | on h      |
| All header sizes equal to or larger than branch in the range 323.9 × 7.0 up to and including 610 × 13 | 610 × 13    | 1020      | ±7        | 300       | ±3        |
|                                                                                                       | 508 × 11    | 880       |           | 275       |           |
|                                                                                                       | 457.2 × 9.5 | 800       |           | 250       |           |
|                                                                                                       | 419 × 9.0   | 680       | ±6        | 225       |           |
|                                                                                                       | 368 × 8.0   | 613       |           | 200       |           |
|                                                                                                       | 323.9 × 7.0 | 560       |           | 185       |           |
|                                                                                                       | 267 × 5.5   | 447       | ±5        | 155       | ±2.5      |
|                                                                                                       | 219.1 × 4.5 | 379       |           | 125       | ±1.6      |
|                                                                                                       |             |           |           |           |           |

All dimensions in millimetres

Note: See also figures 7.1, 7.3 and table 7.1.2

\* For inch/millimetre correlation — see foreword

## **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 suppliers' 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 and to witness any tests being performed. The purchaser shall be at liberty to take samples and have them tested to ensure compliance with the requirements of Appendix C. In addition, for fittings incorporating seamless tube the purchaser shall also be at liberty to receive copies of the individual cast analyses used in the manufacture of each batch or order.

#### **FACILITIES FOR TESTING**

For making tests on samples selected by the purchaser, or his representative 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 tests elsewhere.

**APPENDIX A****LIST OF STANDARDS AND CODES  
REFERRED TO IN THIS PUBLICATION****BRITISH STANDARDS**

|                       |                                                                             |
|-----------------------|-----------------------------------------------------------------------------|
| BS 1400: 1985         | Copper alloy ingots and copper alloy and high conductivity copper castings. |
| BS 2870: 1980         | Rolled copper and copper alloys : sheet, strip and foil.                    |
| BS 2871: Part 2: 1972 | Copper and copper alloys. Tubes for general purposes.                       |
| BS 2872: 1969         | Copper and copper alloys. Forging stock and forgings.                       |
| BS 2875: 1969         | Copper and copper alloys. Plate.                                            |
| BS 2901: Part 3       | Filler rods and wires for gas-shielded arc welding.                         |
| BS MA 18: 1973        | Specification for salt water piping systems in ships.                       |

**GERMAN STANDARD**

|           |                                                 |
|-----------|-------------------------------------------------|
| DIN 28011 | Torispherical Heads with Short Straight Flange. |
|-----------|-------------------------------------------------|

**AMERICAN STANDARDS AND CODES**

|                                         |                                                                                                                |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------|
| ASTM B124                               | Copper and Copper Alloy Forging Rod, Bar and Shapes.                                                           |
| ASME Boiler and<br>Pressure Vessel Code |                                                                                                                |
| Section V                               | Non-Destructive Examination                                                                                    |
| Section VIII                            | Pressure Vessels – Division 1.                                                                                 |
| Section IX                              | Qualification Standard for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators. |
| AWS A5.6                                | Specification for Copper and Copper Alloy Covered Electrodes.                                                  |
| AWS A5.7                                | Specification for Copper and Copper Alloy Bare Welding Rods and Electrodes                                     |
| ANSI B16.9 – 1978                       | Factory made Wrought Steel Butt Welding Fittings.                                                              |
| ANSI B16.11                             | Forged Steel Fittings – Socket Welding and Threaded.                                                           |
| ANSI B1.20.1                            | Pipe Threads (Except Dryseal).                                                                                 |
| ANSI/ASME B31.3                         | Chemical Plant and Petroleum Refinery Piping.                                                                  |

## APPENDIX B

Intrados thickness of long radius elbows  
(See also table 1.5)

The additional compensatory thickness in the centre of the intrados of the long radius elbows shown in Table 1.5 were established and calculated by the following procedure:

$$t_{(int)} = \left\{ \frac{P D_o}{2 (SE + PY)} \times \frac{2R - r}{2R - 2r} \right\} + C_a$$

Where:

- $t_{(int)}$  = Minimum intrados thickness (mm).
- $P$  = Maximum design pressure 1.6 and 2.0 N/mm<sup>2</sup>\*
- $D_o$  = Outside diameter of pipe (mm).
- $S$  = Maximum allowable stress 68.6 N/mm<sup>2</sup>
- $E$  = Quality factor –  $E = 1.0$ .
- $R$  = Elbow centre-line radius (mm)  
(See ANSI B16.9)
- $r$  = Pipe radius –  $D_o/2$
- $Y$  = 0.4 (See ANSI/ASME B31.3 – Table 304.1.1).
- $C_a$  = Corrosion allowance – 0.5 mm.

\*1 N/mm<sup>2</sup> = 10 bar.

## APPENDIX C

Chemical composition and mechanical properties of 90/10 Cu Ni fittings.

| Chemical composition – %                                |      |       | Mechanical properties                |     |                                               |                                                    |                         |
|---------------------------------------------------------|------|-------|--------------------------------------|-----|-----------------------------------------------|----------------------------------------------------|-------------------------|
| Element                                                 | min  | max   | Tensile strength – N/mm <sup>2</sup> |     | 0.2% Proof stress<br>N/mm <sup>2</sup><br>min | Elongation<br>% min<br>on L = 5.65 √S <sub>0</sub> | Hardness<br>HV 5<br>max |
|                                                         |      |       | min                                  | max |                                               |                                                    |                         |
| Copper                                                  | Rem  |       | 280                                  | —   | 105                                           | 30                                                 | 120**                   |
| Lead                                                    | —    | 0.010 |                                      |     |                                               |                                                    |                         |
| Iron†                                                   | 1.50 | 2.00  |                                      |     |                                               |                                                    |                         |
| Nickel                                                  | 10.0 | 11.0  |                                      |     |                                               |                                                    |                         |
| Zinc                                                    | —    | 0.20  |                                      |     |                                               |                                                    |                         |
| Manganese                                               | 0.50 | 1.00  |                                      |     |                                               |                                                    |                         |
| Sulphur                                                 | —    | 0.020 |                                      |     |                                               |                                                    |                         |
| Phosphorus                                              | —    | 0.020 |                                      |     |                                               |                                                    |                         |
| Carbon                                                  | —    | 0.050 |                                      |     |                                               |                                                    |                         |
| Total impurities*<br>including those<br>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 fittings.

## APPENDIX D

## Pressure/temperature ratings – fittings

| Type of fitting           | Size range              | MAXIMUM ALLOWABLE WORKING PRESSURE – bar |      |      |       |               |      |      |       |
|---------------------------|-------------------------|------------------------------------------|------|------|-------|---------------|------|------|-------|
|                           |                         | 16 bar rating                            |      |      |       | 20 bar rating |      |      |       |
|                           |                         | 38°C                                     | 50°C | 75°C | 100°C | 38°C          | 50°C | 75°C | 100°C |
| Butt welding fittings     | 1in/30mm to 4in/108mm   | Use 20 bar                               |      |      |       | 20.0          | 19.7 | 18.6 | 17.3  |
|                           | 6in/159mm to 36in/914mm | 16.0                                     | 16.0 | 16.0 | 15.7  | 20.0          | 19.7 | 18.6 | 17.3  |
| Socket weld fittings      | ½in/16mm to 2in/57mm    | Use 20 bar                               |      |      |       | 20.0          | 19.7 | 18.6 | 17.3  |
| Capillary brazed fittings | ½in/16mm to 2in/57mm    |                                          |      |      |       | 20.0          | 19.7 | 18.6 | 17.3  |
| Compression fittings      | ½in/16mm to 2in/57mm    |                                          |      |      |       | *             | *    | *    | *     |

\*In accordance with manufacturer's recommendations.



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| 111                         | Chemical Resistant Materials, Part I (1965) and Part II (1968)<br>(formerly EEUA Handbook No. 21)                               | 0 85931 047 7 |
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| 121                         | Thermal and Chemical Welding of Plastics Materials (1976)<br>(formerly EEUA Handbook No. 35)                                    | 0 85931 030 2 |
| <b>GENERAL</b>              |                                                                                                                                 |               |
| 101                         | Lifting Points — A Design Guide (1984)                                                                                          | 0 85931 037 X |
| 105                         | Factory Stairways, Ladders and Handrails<br>(Reprint of EEUA Handbook No. 7. Revised 1982)                                      | 0 85931 041 8 |
| 122                         | Guide to User Needs for Technical Documentation (Engineering) 1982<br>(formerly EEUA Handbook No. 36)                           | 0 85931 036 1 |
| 148                         | Reliability Specification                                                                                                       | 0 85931 118 X |