

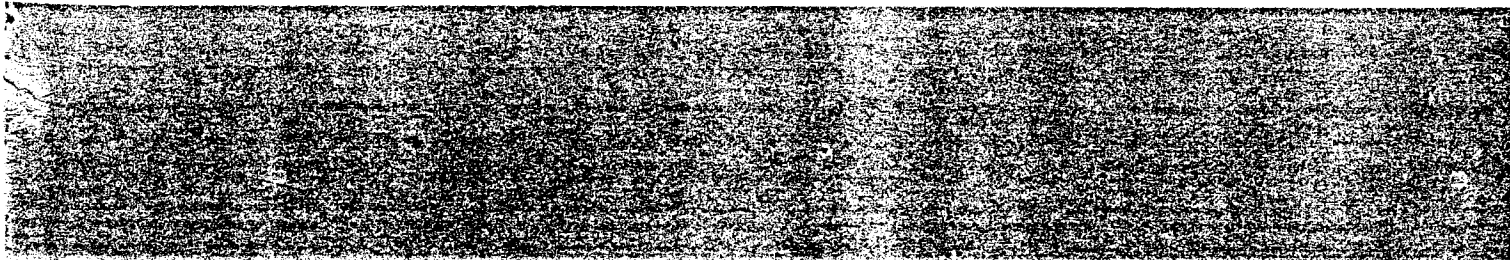
THE ENGINEERING EQUIPMENT AND MATERIALS USERS ASSOCIATION

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

SPECIFICATION: TUBES

Seamless and Welded

PUBLICATION No. 144 — 1987



EEMUA

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**SPECIFICATION: TUBES
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A list of other EEMUA Publications is given at the end of this Publication.

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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

The specified outside diameters of tubes, in sizes up to and including 20 in/508 mm, covered by this specification have been selected from BS 2871 : Part 2: 1972 "Copper and copper alloys — tubes (seamless) for general purposes: table 3, Preferred sizes of tubes for pipelines for shipbuilding and other engineering purposes". The specified outside diameters of the remaining sizes covered by this specification have been selected from BS MA 60 "Summary and application of copper and copper alloy tubes for ships' pipework systems." The wall thicknesses have been selected to cover the specific requirements of the oil and oil related industries.

This specification specifies the requirements for seamless and seam-welded tubes for offshore and associated piping installations based on BS MA 60, DIN 86007 and ANSI/ASME B31.3.

The table of tube outside diameters is also based on ISO 274 up to and including 16 in/419 mm.

The titles of other publications referred to in this publication are listed in Appendix A.

NOTE: The reference to "tube" rather than "pipe" in this specification is based on the usage of this word in existing copper and copper alloy standards.

SECTION ONE: SEAMLESS TUBES

1.1 Scope and design basis

Section one of this specification specifies the requirements for seamless 90/10 Cu/Ni Alloy — UNS 7060X* tubes for offshore and related industries. This section specifies the requirements for seamless tubes in diameters from ½ in/16 mm to 16 in/419 mm† for maximum design pressures of:

- (a) 16 bar at a temperature range of minus 29°C and a maximum of +75°C.
- (b) 20 bar at a temperature range of minus 29°C and a maximum of +38°C.

The two corresponding ranges of wall thicknesses comply with the pressure containment requirements of ANSI B.31.3 and DIN 86007 as well as the requirements of IACS (International Association of Classification Societies) with additional allowances for robustness to withstand mechanical damage, especially in the smaller sizes.

The ranges of diameters and related wall thicknesses of seamless tubes are given in tables 1.2.1 (16 bar) and 1.2.2 (20 bar), "Dimensions of seamless 90/10 Cu/Ni tubes for offshore and associated installations".

Note: Users of this specification should note that while observing the requirements of this specification they should at the same time ensure compliance with such statutory requirements, rules and regulations that may be applicable to an individual offshore or associated installation. It should also be noted that the wall thicknesses stated in tables 1.2.1 and 1.2.2 were calculated using an allowable design stress of 68.6N/mm², together with a corrosion allowance of 0.5 mm. However, to cater for the additional requirements for the use of saddle pieces, an overriding design stress of one fifth of the minimum tensile value of 270N/mm² has been used for final calculation purposes.

1.2 Information to be supplied by the purchaser

The purchaser shall state in his enquiry and order the following information:

- (a) The title and number of this section (EEMUA Publication No. 144: 1987 section 1) and material designation (see table 1.3).
- (b) Seamless or seam-welded as appropriate.
- (c) Pressure rating 16 or 20 bar.
- (d) Tube size and specified thickness in inches and millimetres†.
- (e) Whether supplementary mechanical tests are required (see clause 1.7.).
- (f) Since a hydraulic or eddy current test for each tube is mandatory, the purchaser shall state whether hydraulic testing is required in addition to, or in preference to, eddy-current testing (see clause 1.9.).
- (g) Whether manufacturer's certificates are required (see clause 1.11).
- (h) Whether it is his intention to inspect the material at the supplier's works (see Addendum).
- (j) Whether individual cast analyses are required to be supplied (see Addendum).
- (k) Whether any additional identification marking other than that specified herein is required.

* Alloy UNS 7060X is a modified form of the following national designated alloys — UNS 70600, BS CN102 and DIN 2.0872 — see table 1.3 of this specification for chemical composition and mechanical properties.

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

Seamless tubes

1.3 Freedom from defects

The tubes shall be visibly clean, smooth and free from harmful defects and from deleterious films in the bore. No defect shall penetrate the wall of the tube that will give a resulting thickness of less than the minimum stated in tables 1.2.1 and 1.2.2.

1.4 Materials and manufacture

The casts and the tubes shall comply with the properties of table 1.3.

The tubes shall be seamless and in no case shall they be redrawn from used tubes.

The tubes shall be supplied in straight lengths in the annealed condition.

1.5 Dimensions and tolerances

1.5.1 Outside diameter

The mean outside diameter of finished tubes in sizes up to and including 4 in/108 mm shall be within the outside diameter tolerances specified in tables 1.2.1 and 1.2.2. The mean outside diameter is half the sum of any two diameters measured at right angles on the same cross section of the tube.

Tube sizes 6 in/159 mm up to and including 16 in/419 mm are also based on BS 2871 : Part 2 : table 3 for specified diameters, but in this section the tolerances have been applied to the inside diameters to facilitate alignment of matching weld preparations.

1.5.2 Inside diameter

The mean inside diameter of finished tubes in sizes 6 in/159 mm and larger shall be within the inside diameter tolerances specified in tables 1.2.1 and 1.2.2 for a distance of 100 mm from each end. The mean inside diameter is half the sum of any two inside diameters measured at right angles on the same cross section of the tube.

1.5.3 Ovality

The ovality of finished tubes shall be such that the difference between the maximum and minimum diameters measured on the same cross section shall not exceed 2% of the size specified in column 2 in tables 1.2.1 and 1.2.2.

1.5.4 Thickness

The thickness of tubes at any point shall not vary from that specified by more than 10% for diameters up to and including 4 in/108 mm. For diameters 6 in/159 mm and larger the wall thickness at any point shall not be less than the minimum values which equate to minus 12½% as quoted in tables 1.2.1 and 1.2.2.

1.5.5 Length

- (a) When tubes are required in randoms, the minimum random lengths shall not be less than those specified below. Shorter random lengths may be supplied upon agreement between purchaser and manufacturer.

Table 1.1.1

Minimum random lengths for seamless tubes

DIAMETER		MINIMUM RANDOM LENGTHS	
Over	Up to and Including	16 bar	20 bar
mm	mm	m	m
—	57	6	6
57	159	5	5
159	323.9	5	4
323.9	368	4	3
368	419	3	—

- (b) When tubes are required in specific lengths they shall not vary from that specified by more than the tolerances on length given below, when measured at a temperature of $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

Table 1.1.2

Tolerances on lengths for seamless tubes.

DIAMETER		TOLERANCE FOR SPECIFIED LENGTH IN METRES					
Over	Up to and including	Over 1 m up to and including 3 m		Over 3 m up to and including 6 m		Over 6 m up to and including 9 m	
mm	mm	mm	mm	mm	mm	mm	mm
—	88.9	+3	−0	+6	−0	+8	−0
88.9	323.9	+5	−0	+8	−0	+10	−0
323.9	419.0	+7	−0	+10	−0	+12	−0

1.5.6 Squareness of ends

The departure from squareness of the plain ends of any tube shall not exceed 1.6% of the specified diameter. The departure from squareness for ends bevelled for welding shall not exceed 2.0 mm.

1.5.7 Straightness

The maximum deviation from straight for tube sizes 4 in/108 mm and larger is the depth of arc measured from a straight edge 1 metre in length which shall not exceed 3.0 mm.

1.6 Selection of test samples

A batch is defined as a definite quantity of material consisting of one or more casts, or the product or part of a continuous cast run, the composition of which complies with the analytical requirements of table 1.3 of this Section.

For the tests specified in clause 1.7 tubes of any one size and thickness shall be grouped in batches of 300 tubes or 1300 kg whichever is the greater weight, and one tube shall be taken at random from each and any remaining part of a batch for testing. When the size of the order does not permit batching in the above quantities, one tube of each size and thickness shall be selected for testing.

The sample selected from each batch, as defined above for test purposes, shall also be used for chemical analysis to confirm compliance with table 1.3.

1.7 Mechanical tests

1.7.1 Mandatory tests

(a) Tensile tests

Tensile, 0.2% proof stress and elongation shall be determined on test samples of tube selected in accordance with clause 1.6 and tested in full section or on longitudinal strips cut from any part of the tube. The tests shall be performed in accordance with BS 18 : Part 1 and the values obtained shall comply with the requirements of table 1.3 of this section.

Seamless tubes

1.7.2 Supplementary tests

The following tests are only required when so specified by the purchaser.

(a) Hardness test

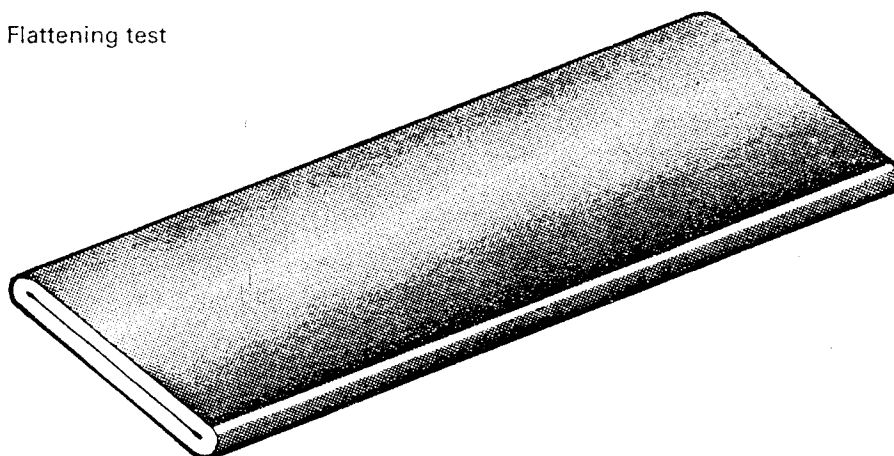
Hardness tests shall be made on test pieces in accordance with BS 427 : Part 1 and the values obtained shall not exceed 100 HV 5.

(b) Flattening test

This test applies to tubes not exceeding 4 in/108 mm outside diameter. The test pieces shall be flattened until the internal surface meets as shown in figure 1.1. When subjected to this test the tube shall show no crack or flaw.

Figure 1.1

Flattening test

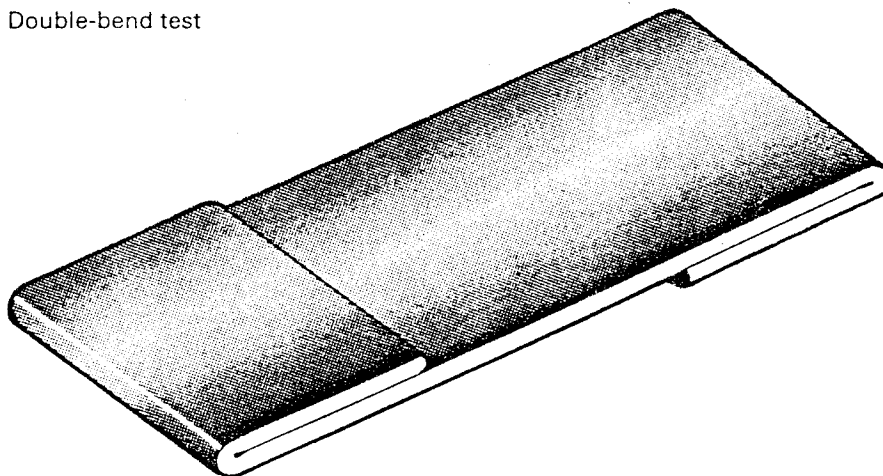


(c) Double-bend test

This test applies to tubes over 4 in/108 mm outside diameter. A test piece 50 mm wide shall be cut longitudinally from the tube. The longer edges shall be carefully rounded and smoothed so that a cross section has approximately semi-circular ends. The test piece shall be flattened and shall have its ends bent through 180° in opposite directions and doubled up close, as shown in figure 1.2. When subjected to this test the tube shall show no crack or flaw.

Figure 1.2

Double-bend test

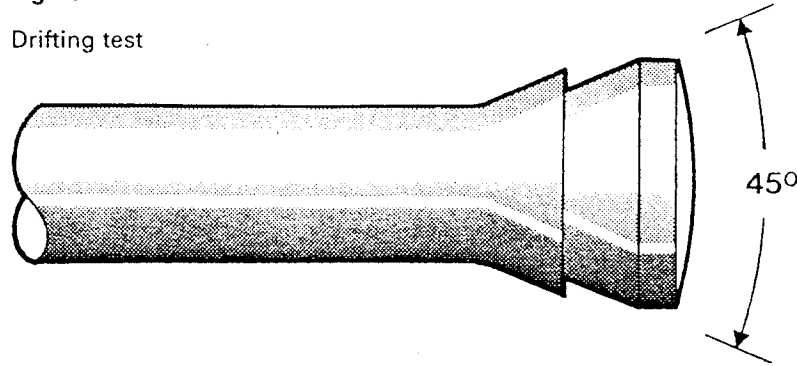


(d) Drifting test

This test applies to tubes not exceeding 4 in/108 mm outside diameter. The test piece shall be expanded as shown in Figure 1.3 by means of a taper drift having an included angle of 45°, until the outside diameter of the expanded portion exceeds the original outside diameter by 30%. When subjected to this test the tube shall show no crack or flaw.

Figure 1.3

Drifting test

**1.8****Retests**

Should any one of the test pieces first selected fail to pass any of the prescribed mechanical tests, two further samples from the same batch shall be selected for testing, one of which shall be from the tube from which the original test sample was taken, unless that tube has been withdrawn by the supplier. Should the test piece from both these additional samples pass, the batch represented by the test samples shall be deemed to comply with this specification.

Should the test pieces from either of these additional samples fail, the batch represented by the test samples shall be deemed not to comply with this specification.

1.9**Hydraulic or eddy current tests (mandatory tests)**

Manufacturers shall perform one of the following tests:

1.9.1**Hydraulic test**

Each tube shall be hydraulically tested to an internal pressure of not less than $1.5 \times$ the design pressure in line with the ratings given in tables 1.2.1 and 1.2.2. Thus the test pressure for 16 bar rated tubes shall be 24 bar and the test pressure for 20 bar rated tubes shall be 30 bar. In each case the pressure shall be stabilised and maintained for sufficient time to allow for inspection for leakage and/or signs of distress. In each case the test pressure shall be maintained for a minimum of 10 seconds for tubes up to and including 4 in/108 mm and a minimum of 20 seconds for tubes over 4 in/108 mm.

1.9.2**Eddy current test**

An eddy current test shall be performed on each tube with an outside diameter within the capacity of the equipment in accordance with BS 3889 : Part 2B or ASTM E243 and the acceptance levels specified in ASTM B466-85 paragraph 11.2.2 (paragraph 9.2.2 in ASTM B466M).

Seamless tubes

1.10 Marking

1.10.1 Tube sizes 1½ in/44.5 mm and above shall be individually marked.

All tubes shall be individually permanently marked and identified by clear legible printing by means of a vibratory etching tool, electrochemical etching or paint or ink stencilling in such colours as to be clearly visible, as follows:

- (a) Purchase order number (PO).
- (b) The number of this section (Publication No. 144: 1987: section 1).
- (c) Material designation UNS 7060X.
- (d) Size inches and millimetres.
- (e) Nominal pressure rating — 16 or 20 bar.
- (f) Manufacturer's name or trademark (MTM).
- (g) Test certificate number (TCN).
- (h) Batch traceability number (BTN).

Example of Marking:

PO 144/1 7060X 3/88.9 16 MTM TCN BTN

1.10.2 Tubes in sizes 1¼ in/38 mm and smaller, where it is not practicable to apply the full requirements of 1.10.1, shall be marked as follows:

- (a) Material designation UNS 7060X.
- (b) Size in inches and millimetres.
- (c) Nominal rating.
- (d) Manufacturer's trademark (MTM).
- (e) Batch traceability number (BTN).

In such cases the tubes shall be securely bundled and provided with secure indestructible type labels on which the remaining information given in 1.10.1 is 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 tube material.

1.11 Certification

Certificate(s) shall be supplied, either:

1.11.1 A certificate of compliance which shall state that the tubes have been made in accordance with all the requirements of this section (EEMUA Publication No. 144: 1987: section 1) or:

1.11.2 A manufacturer's certificate(s) which shall state that the tubes have been made in accordance with all the requirements of this section (EEMUA Publication No. 144: 1987: section 1) and:

- (a) State the actual compositional limits determined for each of the elements designated in table 1.3 of the casts used in the manufacture of each batch.

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

- (b) State product analysis of material selected from each batch in accordance with clause 1.6.
- (c) State the results of the mechanical tests detailed in clause 1.7.
- (d) State the results of any non-mandatory or special tests specified in the purchase order.
- (e) State the results of the hydraulic test in accordance with clause 1.9.

Seamless tubes

Table 1.2.1

Dimensions of seamless 90/10 Cu/Ni tubes:
16 bar rating

TUBE SIZE		THICKNESS		OUTSIDE DIAMETER		INSIDE DIAMETER	
1	2	3	4	5	6	7	8
Nom in	Specified OD mm	Specified mm	Minimum mm	Maximum mm	Minimum mm	Maximum mm	Minimum mm
				See notes 1, 3 and also clause 1.5		See notes 2, 3 and also clause 1.5	
1/2	16	2.0	1.80	16.045	15.965	—	—
3/4	25	2.0	1.80	25.055	24.975	—	—
1	30	2.5	2.25	30.055	29.975	—	—
1 1/4	38	2.5	2.25	38.07	37.99	—	—
1 1/2	44.5	2.5	2.25	44.57	44.49	—	—
2	57	2.5	2.25	57.20	57.12	—	—
2 1/2	76.1	2.5	2.25	76.30	76.15	—	—
3	88.9	2.5	2.25	89.15	89.00	—	—
4	108	3.0	2.70	108.25	108.00	—	—
6	159	3.0	2.63	—	—	153.87	153.63
8	219.1	4.0	3.50	—	—	211.40	210.80
10	267	4.5	3.94	—	—	258.37	257.57
12	323.9	5.5	4.81	—	—	313.38	312.28
14	368	6.5	5.69	—	—	354.92	353.52
16	419	7.0	6.13	—	—	404.97	403.37

Note 1 Tube sizes 1/2 in/16 mm up to and including 4 in/108 mm are based on BS 2871: Part 2: 1972 table 3 for outside diameters and their tolerances to allow for the use of capillary and compression fittings and brazed (and welded) slip-on flanges. The wall thicknesses of the 16 bar range have been increased to match the 20 bar range in table 1.2.2 for mechanical strength.

Note 2 Tube size 6 in/159 mm up to and including 16 in/419 mm are also based on BS 2871: Part 2: 1972 table 3 for specified diameters but the tolerances have been applied to the inside diameters to facilitate alignment of matching weld preparations.

Note 3 The ovality of finished tubes shall be such that the difference between the maximum and minimum diameters measured on the same cross section shall not exceed 2% of the size specified in column 2 in the above table (see also 1.5.3).

Table 1.2.2

Dimensions of seamless 90/10 Cu/Ni tubes:
20 bar rating

TUBE SIZE		THICKNESS		OUTSIDE DIAMETER		INSIDE DIAMETER	
1	2	3	4	5	6	7	8
Nom in	Specified OD mm	Specified mm	Minimum mm	Maximum mm	Minimum mm	Maximum mm	Minimum mm
				See notes 1, 3 and also clause 1.5		See notes 2, 3 and also clause 1.5	
1/2	16	2.0	1.80	16.045	15.965	—	—
3/4	25	2.0	1.80	25.055	24.975	—	—
1	30	2.5	2.25	30.055	29.975	—	—
1 1/4	38	2.5	2.25	38.07	37.99	—	—
1 1/2	44.5	2.5	2.25	44.57	44.49	—	—
2	57	2.5	2.25	57.20	57.12	—	—
2 1/2	76.1	2.5	2.25	76.30	76.15	—	—
3	88.9	2.5	2.25	89.15	89.00	—	—
4	108	3.0	2.70	108.25	108.00	—	—
6	159	3.5	3.06	—	—	152.50	152.26
8	219.1	4.5	3.94	—	—	210.40	209.80
10	267	5.5	4.81	—	—	256.33	255.53
12	323.9	7.0	6.13	—	—	310.29	309.19
14	368	8.0	7.00	—	—	351.70	350.30
16	419	9.0	7.88	—	—	400.64	399.04

Note 1 Tube sizes 1/2 in/16 mm up to and including 4 in/108 mm are based on BS 2871: Part 2: 1972 table 3 for outside diameters and their tolerances to allow for the use of capillary and compression fittings and brazed (and welded) slip-on flanges. The wall thicknesses of the 16 bar range in table 1.2.1 have been increased to match the 20 bar range in the above table for mechanical strength.

Note 2 Tube size 6 in/159 mm up to and including 16 in/419 mm are also based on BS 2871: Part 2: 1972 table 3 for specified diameters but the tolerances have been applied to the inside diameters to facilitate alignment of matching weld preparations.

Note 3 The ovality of finished tubes shall be such that the difference between the maximum and minimum diameters measured on the same cross section shall not exceed 2% of the size specified in column 2 in the above table (see also 1.5.3).

Seamless tubes

Table 1.3

Chemical composition and mechanical properties of seamless 90/10 copper/nickel tubes

Chemical composition – %			Mechanical properties.			
Element	min	max	Tensile strength – N/mm ²		0.2% Proof stress N/mm ² min	Elongation % min on L = 5.65 √So
			min	max		
Copper	Rem	—	300	380	105	30
Lead	—	0.010				
Iron†	1.50	2.00				
Nickel	10.0	11.00				
Zinc	—	0.20				
Manganese	0.50	1.00				
Sulphur	—	0.020				
Phosphorus	—	0.020				
Carbon	—	0.050				
Total impurities* including those in lighter type		0.30				

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

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

SECTION TWO: SEAM-WELDED TUBES

2.1 Scope and design basis

Section two of this specification specifies the requirements for seam-welded 90/10 Cu/Ni Alloy UNS 7060X* tubes for offshore and related industries. This specification specifies the requirements for seam-welded tubes in diameters from 6 in/159 mm up to 36 in/914 mm† for maximum design pressures of:

- (a) 16 bar at a temperature range of minus 29°C and a maximum of +75°C.
- (b) 20 bar at a temperature range of minus 29°C and a maximum of +38°C.

The two corresponding ranges of wall thicknesses comply with the pressure containment requirements of ANSI B31.3 and DIN 86007 as well as the requirements of IACS (International Association of Classification Societies) with a joint efficiency factor of 1.0.

The ranges of diameters and related wall thicknesses of seam-welded tubes are given in tables 2.2.1 (16 bar) and 2.2.2 (20 bar) respectively for seam-welded 90/10 Cu/Ni tubes for offshore and associated installations.

Note: Users of this specification should note that while observing the requirements of this specification they should at the same time ensure compliance with such statutory requirements, rules and regulations that may be applicable to an individual offshore or associated installation. It should also be noted that the wall thickness stated in tables 2.2.1 and 2.2.2 were calculated using an allowable design stress of 68.6N/mm², together with a corrosion allowance of 0.5 mm. However, to cater for the additional requirements for the use of saddle pieces, an overriding design stress of one fifth of the minimum tensile value of 270N/mm², has been used for final calculation purposes.

2.2 Information to be supplied by the purchaser

The purchaser shall state in his enquiry and order the following information:

- (a) The title and number of this section (EEMUA Publication No 144 : 1987 : section 2) and material designation (see table 2.3).
- (b) Seamless or seam welded as appropriate.
- (c) Pressure rating: 16 or 20 bar.
- (d) Tube size and specified thickness in inches and millimetres†.
- (e) Any additional mechanical tests: (see BS2870 or BS2875 or other tests as applicable).
- (f) Whether manufacturer's certificates are required (see clause 2.13).
- (g) Whether it is the intention of the purchaser to inspect the material at the supplier's works (see Addendum).
- (h) Whether individual cast analyses are required to be supplied (see Addendum).
- (j) Whether the external or internal weld reinforcement shall be removed (see clause 2.4).
- (k) Whether any additional identification marking other than that specified herein is required.

2.3 Freedom from defects

The tubes shall be visibly clean, smooth and free from harmful defects and free from deleterious films in the bore. No defect shall penetrate the wall of the tube that will give a resulting thickness of less than the minimum stated in tables 2.2.1 and 2.2.2

* Alloy UNS 7060X is a modified form of the following national designated alloys — UNS 70600, BS CN102 and DIN 2.0872 — see table 1.3 of this specification for chemical composition and mechanical properties.

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

2.4 Materials and manufacture

The tubes shall be manufactured from hot rolled or cold rolled and annealed sheets or plates manufactured in accordance with BS 2870, BS 2875, ASTM B171 or ASTM B402, but with mechanical properties and chemical composition as modified in table 2.3.

Mechanical testing shall be carried out in accordance with the relevant standards as stated above.

The tubes shall be supplied in the "as welded" condition with the external and internal weld reinforcement intact except for cosmetic improvement or unless specified by the purchaser that such reinforcements shall be removed.

2.5 Welding

2.5.1 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 wire 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.

2.5.2 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."

2.5.3 Welder Qualification

The welder qualification shall be in accordance with ASME code section IX.

2.6 Dimensions and tolerances

2.6.1 Outside diameter

The tube sizes quoted in tables 2.2.1 and 2.2.2 are based on BS 2871 : Part 2 for specified diameters up to and including 20 in/508 mm whereas larger sizes are based on BSMA 60.

2.6.2 Inside diameter

The mean inside diameter of finished tubes shall be within the inside diameter tolerances specified in tables 2.2.1 and 2.2.2 for a distance of 100 mm from each end. The mean inside diameter is half the sum of the maximum and minimum diameters measured on the same cross section of the tube.

2.6.3 Ovality

The ovality of finished tubes shall be such that the difference between the maximum and minimum diameters measured on the same cross section shall not exceed 2% of the size specified in column 2 in tables 2.2.1 and 2.2.2.

2.6.4 Circularity (permissible deviation from circularity)

In the region of the weld (but excluding the weld) tubes shall be circular within $\pm 0.5\%$ of the specified diameter for a distance of 100 mm from each end.

2.6.5 Thickness

The thickness of tubes at any point shall not be less than the minimum values which equate to minus $12\frac{1}{2}\%$ as quoted in tables 2.2.1 and 2.2.2.

2.6.6 Length

- (a) When tubes are required in randoms, the minimum random lengths shall not be less than those specified below. Shorter random lengths may be supplied by agreement between purchaser and manufacturer.

Table 2.1.1

Minimum random lengths for seam-welded tubes

DIAMETER		MINIMUM RANDOM LENGTHS	
Over	Up to and Including	16 bar	20 bar
mm	mm	m	m
—	323.9	5	4
323.9	368	4	3
368	610	3	3
610	914	2	2

- (b) When tubes are required in specific lengths they shall not vary from that specified by more than the tolerances on length specified below, when measured at a temperature of $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

Table 2.1.2

Tolerances on lengths for seam-welded tubes

DIAMETER		TOLERANCE FOR SPECIFIED LENGTH IN METRES					
Over	Up to and including	Over 1 m up to and including 3 m		Over 3 m up to and including 6 m		Over 6 m up to and including 9 m	
mm	mm	mm	mm	mm	mm	mm	mm
—	323.9	+5	—0	+8	—0	+10	—0
323.9	419	+7	—0	+10	—0	+12	—0
419	—	+9	—0	+12	—0	+13	—0

2.6.7 Squareness of ends

The departure from squareness of the plain ends of any tube shall not exceed 1.6% of the specified diameter. The departure from squareness for ends bevelled for welding shall not exceed 2.0 mm.

2.6.8 Straightness

The maximum deviation from straight for all sizes of tube is the depth of arc as measured from a straight edge 1 metre in length which shall not exceed 3 mm.

Seam-welded tubes

2.7 Selection of test samples

Samples representing each cast shall be selected from one sheet or plate. Refer to clause 11 of BS 2870 : 1980 or clause 1.8 of BS 2875 : 1969 but chemical composition and mechanical properties shall comply with table 2.3 of this section.

2.8 Non-destructive testing

2.8.1 Liquid dye penetrant test

The weld seams of all tube sizes 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.

2.8.2 Radiography

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

2.9 Repairs to weld seams

Visible defects such as cracks, pinholes and incomplete fusion and defects detected by the tests performed under clauses 2.8 and 2.11 shall be removed and repaired in accordance with clause 2.5.

2.10 Retest of repairs

A repaired weld seam shall meet the requirements of the original weld and be re-examined and retested in accordance with clauses 2.8 and 2.11.

2.11 Hydraulic test

Each tube shall be hydraulically tested to an internal pressure of not less than $1.5 \times$ the design pressure in line with the ratings given in tables 2.2.1 and 2.2.2. Thus the test pressure for 16 bar rated tube shall be 24 bar and the test pressure for 20 bar rated tubes shall be 30 bar.

In each case the pressure shall be stabilised and maintained for sufficient time to allow for inspection for leakage and/or signs of distress. In each case the test pressure shall be maintained for a minimum of 20 seconds for tube sizes up to and including 16 in/416 mm and a minimum of 30 seconds for sizes over 16 in/419 mm.

2.12 Marking

All tubes 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 (Publication No 144: 1987: section 2).
- (c) Material designation UNS 7060X.
- (d) Size: inches and millimetres.
- (e) Nominal pressure rating, 16 or 20 bar.
- (f) Manufacturer's name or trademark (MTM).

- (g) Test certificate number (TCN).
- (h) Cast identity number.
- (j) Welder identity (WI).

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 tube material.

Example of marking:

PO 144/2 7060X 14/368 16 MTM TCN Cast No WI.

2.13 Certification

Certificate(s) shall be supplied, either:

- 2.13.1 A certificate of compliance which shall state that the tubes have been made in accordance with all the requirements of this section (EEMUA Publication No. 144: 1987: section 2) or:
- 2.13.2 A manufacturer's certificate(s) which shall state that the tubes have been made in accordance with all the requirements of this section (EEMUA Publication No. 144: 1987: section 2) and:
 - (a) State the actual composition, determined for each of the elements specified in table 2.3 of each cast used in the manufacture of the tubes.
 - (b) State the results of mechanical tests performed on a plate or sheet from each cast formed into tubes as designated in table 2.3.
 - (c) State the results of the hydraulic test in accordance with clause 2.11.
 - (d) State the results of the dye penetrant and radiographic examinations of each weld seam in each tube in accordance with clause 2.8.
 - (e) State the results of any non-mandatory or special tests specified in the purchase order.

Seam-welded tubes

Table 2.2.1

Dimensions of seam-welded 90/10 CuNi tubes:
16 bar rating

TUBE SIZE		THICKNESS		INSIDE DIAMETER	
1	2	3	4	5	6
Nominal in	Specified OD mm	Specified mm	Minimum mm	Maximum mm	Minimum mm
				See Notes 1 & 2 and also clause 2.6	
6	159	3.0	2.63	153.87	153.63
8	219.1	4.0	3.50	211.40	210.80
10	267	4.5	3.94	258.37	257.57
12	323.9	5.5	4.81	313.38	312.28
14	368	6.5	5.69	354.92	353.52
16	419	7.0	6.13	404.97	403.37
18	457.2	8.0	7.00	443.0	440.0
20	508	8.5	7.44	492.0	489.0
24	610	10.5	9.19	591.0	588.0
28	711	12.0	10.50	689.0	686.0
32	813	13.5	11.81	788.0	785.0
36	914	15.5	13.56	885.0	882.0

Note 1: Tube sizes 6 in/159 mm up to and including 20 in/508 mm are based on BS2871: Part 2: 1972 table 3 for specified diameters, but the tolerances have been applied to the inside diameters to facilitate alignment of matching weld preparations. The inside diameters of tube sizes 6 in/159 mm up to and including 16 in/419 mm are also in alignment with the corresponding tube sizes and thicknesses in table 1.2.1.

Note 2: The ovality of finished tubes shall be such that the difference between the maximum and minimum diameters measured on the same cross section shall not exceed 2% of the size specified in column 2 in the above table (see also 2.6.3).

Table 2.2.2

Dimensions of seam-welded 90/10 CuNi tubes:
20 bar rating

TUBE SIZE		THICKNESS		INSIDE DIAMETER	
1	2	3	4	5	6
Nominal in	Specified OD mm	Specified mm	Minimum mm	Maximum mm	Minimum mm
				See Notes 1 & 2 and also clause 2.6	
6	159	3.5	3.06	152.50	152.26
8	219.1	4.5	3.94	210.40	209.80
10	267	5.5	4.81	256.33	255.53
12	323.9	7.0	6.13	310.29	309.19
14	368	8.0	7.00	351.70	350.30
16	419	9.0	7.83	400.64	399.04
18	457.2	9.5	8.31	440.0	437.0
20	508	11.0	9.63	488.0	485.0
24	610	13.0	11.38	586.0	583.0
28	711	15.0	13.13	683.0	680.0
32	813	17.0	14.88	781.0	778.0
36	914	19.0	16.63	878.0	875.0

Note 1: Tube sizes 6 in/159 mm up to and including 20 in/508 mm are based on BS2871: Part 2: 1972 table 3 for specified diameters, but the tolerances have been applied to the inside diameters to facilitate alignment of matching weld preparations. The inside diameters of tube sizes 6 in/159 mm up to and including 16 in/419 mm are also in alignment with the corresponding tube sizes and thicknesses in table 1.2.2.

Note 2: The ovality of finished tubes shall be such that the difference between the maximum and minimum diameters measured on the same cross section shall not exceed 2% of the size specified in column 2 in the above table (see also 2.6.3).

Seam-welded tubes

Table 2.3

Chemical composition and mechanical properties of seam-welded 90/10 Cu Ni tubes.

Chemical composition – %			Mechanical properties.				
Element	min	max	Tensile strength – N/mm ²		0.2% Proof stress N/mm ² min	Elongation % min on L = 5.65 √So	Hardness HV 5 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* including those in lighter type	—	0.30					

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

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

** Determined on finished tube outside of heat affected zone (HAZ)

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, welding procedures and welder qualifications, radiographs and radiographic reports and associated documents and to witness tests being performed.

If so requested (see 1.11.2) the purchaser shall be provided with copies of the individual cast analyses used in the manufacture of each batch of seamless tubes supplied against the order.

The purchaser shall be at liberty to take samples and have them tested to ensure compliance with the requirements of table 1.3 or 2.3 respectively.

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 the specification. Unless otherwise agreed, material for testing shall remain the property of the supplier. Failing facilities at his own works for performing the prescribed tests, the supplier shall make the necessary arrangements for performing the tests elsewhere.

APPENDIX A

List of standards and codes referred to in this publication.

British Standards

BS18: 1970	Methods for tensile testing of metals Part 1: Non-ferrous metals
BS427: 1961	Method for Vickers hardness test Part 1: Testing of metals
BS2870: 1980	Specification for rolled copper and copper alloys: sheet, strip and foil
BS2871: 1972	Copper and copper alloy tubes Part 2: Tubes for general purposes
BS2875: 1969	Copper and copper alloys. Plate
BS2901: 1983	Filler rods and wires for gas-shielded arc welding Part 3: Copper and copper alloys
BS3889: 1966	Non-destructive testing of pipes and tubes Part 2B: Eddy current testing of non-ferrous tubes
BS MA60: 1986	Copper and copper alloy tubes for ships' pipework systems

American National Standards

ANSI/ASME B31.3 Chemical plant and petroleum refinery piping

American Society of Mechanical Engineers

ASME Boiler and Pressure Vessel Code

Section V	Non-destructive examination
Section VIII	Pressure vessels Division 1
Section IX	Welding and brazing qualifications

American Society for Testing and Materials

ASTM B171 Copper-alloy condenser tube plates
 ASTM B402 Copper-nickel alloy plate and sheet for pressure vessels
 ASTM B466 Seamless copper-nickel pipe and tube
 ASTM B466M Seamless copper-nickel pipe and tube (metric edition)
 ASTM E243 Electromagnetic (eddy current) testing of seamless copper
 and copper-alloy tubes

American Welding Society

AWS-5-6 Flux coated electrodes
 AWS-5-7 Filler wire and rods

German Standards

DIN 86007 Tubes of wrought copper alloys:
 seamless drawn, for ships' pipelines

International Standards Organization

ISO 274 Copper tubes of circular section — dimensions

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Publication No.		ISBN No.
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113	General Principles of Static Control Applications in Electrical Engineering (1967) (formerly EEUA Handbook No. 24)	0 85931 057 4
132	Three-phase cage Induction Motors (Revised 1987) (formerly OCMA Spec. ELEC 1)	0 85931 137 6
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120	Installation of Instrumentation and Process Control Systems (1973) (1981 Reprint of EEUA Handbook No. 34)	0 85931 092 2
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<i>(formerly Handbook EEUA No. 26)</i> | 0 85931 062 0 |
| 115 | Dynamic Sealing of Rotating and Reciprocating Shafts (1971)
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<i>(formerly EEUA Handbook No. 30)</i> | 0 85931 077 9 |
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<i>(formerly OCMA Spec. HET 1)</i> | 0 85931 053 1 |
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121	Thermal and Chemical Welding of Plastics Materials (1976) <i>(formerly EEUA Handbook No. 35)</i>	0 85931 030 2
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105	Factory Stairways, Ladders and Handrails <i>(Reprint of EEUA Handbook No. 7. Revised 1982)</i>	0 85931 041 8
122	Guide to User Needs for Technical Documentation (Engineering) 1982 <i>(formerly EEUA Handbook No. 36)</i>	0 85931 036 1
148	Reliability Specification	0 85931 118 X