



Copper — Seamless tubes for air-conditioning and refrigeration



AS 1571:2020

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- Australian Institute of Refrigeration Air Conditioning and Heating
- Consumer Electronics Suppliers Association
- International Copper Association Australia
- Weld Australia

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Copper — Seamless tubes for air-conditioning and refrigeration

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Preface

This document was prepared by the Standards Australia Committee MT-002, Copper and Copper Alloys, to supersede AS/NZS 1571:1995, *Copper — Seamless tubes for airconditioning and refrigeration*.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this document as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this document is to specify requirements for round seamless copper tubes for use in air-conditioning and refrigeration.

The major changes in this edition include —

- (a) increase in the range of sizes for 1/2H tubes;
- (b) provision that combination of selection of diameter and wall thickness must conform to AS 4041;
- (c) limitations on the minimum wall thickness of tubes being flared;
- (d) refinement of the method of testing for cleanness; and
- (e) addition of the calculation for determining safe working pressure.

The terms "normative" and "informative" are used in Standards to define the application of the appendices to which they apply. A "normative" appendix is an integral part of a Standard, whereas an "informative" appendix is only for information and guidance.

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NOTES

Australian Standard[®]

Copper — Seamless tubes for air-conditioning and refrigeration

1 Scope

This document specifies the requirements for round, seamless copper tubes, manufactured from phosphorus-deoxidized copper containing high residual phosphorus and intended for use in air-conditioning and refrigeration.

NOTE Guidance on information to be supplied by the purchaser to the manufacturer or supplier at the time of enquiry and order are contained in [Appendix A](#).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

AS 1733, *Methods for the determination of grain size in metals*

AS 1817.1, *Metallic materials—Vickers hardness test, Method 1: Test method (ISO 6507-1:1997, MOD)*

AS 2084, *Non-destructive testing—Eddy current testing of metal tubes*

AS 2706, *Numerical values—Rounding and interpretation of limiting values*

AS 4041, *Pressure piping*

ASTM B280, *Standard specification for seamless copper tube for air conditioning and refrigeration field service*

ASTM E243, *Standard practice for electromagnetic (Eddy current) examination of copper and copper-alloy tubes*

EN 723, *Copper and Copper Alloys — Combustion Method for Determination of the Carbon Content on the inner surface of copper tubes or fittings*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

coil

annealed copper tube supplied in a coiled form

EXAMPLE Pancake coil, wound pack, or pair coil.

3.2

may

indicates the existence of an option

3.3

mean outside diameter

half the sum of two outside diameter measurements taken at right angles to each other on one cross-section of the tube

3.4

shall

indicates that a statement is mandatory

3.5

should

indicates a recommendation

4 Designation

4.1 General

The copper designation shall comprise the number of this Australian Standard, i.e. AS 1571, followed by additional characters in accordance with [Clauses 4.2](#) and [4.3](#).

4.2 Temper

A designation comprising O (annealed), 1/2 H or H (hard drawn) shall be used to signify the temper of the alloy.

4.3 Dimension

Two numbers separated by a multiplication sign shall be used to indicate outside diameter and wall thickness.

EXAMPLE AS 1571—1/2H 12.70 × 0.91

5 Form, temper and end sealing of tubes

5.1 Form

Tubes shall be supplied in straight lengths or coils.

5.2 Temper

Tubes in coil form shall be supplied as O temper. Tubes in straight lengths shall be supplied as O, 1/2H or H temper.

The following letters and numbers are used to indicate the condition of the temper:

- (a) *O temper* — fully softened condition (annealed).
- (b) *1/2H temper* — intermediate temper (half hard). This temper is only applicable to tubes having nominal outside diameters up to 54 mm.
- (c) *H temper* — as drawn (hard).

NOTE Other tempers and forms may be supplied.

5.3 End sealing

Tubes shall be either capped, plugged, crimped or otherwise packaged in order to maintain internal cleanness under normal conditions of handling and storage.

6 Chemical composition

Tubes shall conform to the chemical composition requirements given in [Table 1](#).

The chemical composition shall be determined by recognized chemical analysis methods of sufficient accuracy and reproducibility to meet the requirements of [Table 1](#).

Table 1 — Chemical composition requirements

Element	Composition	
	Min.	Max.
Copper (including silver)	99.90 %	—
Phosphorus	0.015 %	0.040 %

7 Freedom from defects

The finished tube shall be clean, smooth and free from defects detrimental to its subsequent processing and end use. The internal surface shall have a clean and bright appearance.

If, after acceptance of the tube, subsequent processing reveals that it contains manufacturing defects found to be detrimental, the tube shall be deemed not to conform to this document.

NOTE Defects referred to in this Clause cannot be completely quantified. Where the presence, size or frequency of any defect is considered to be of concern, an agreement should be made between the purchaser and the manufacturer. This agreement may be achieved by acceptable type samples or methods of test.

8 Dimensions and tolerances

8.1 General

Tubes shall conform to the manufacturing tolerances specified in [Clause 8.2](#).

The selection of the appropriate diameter and wall thickness combination for the working pressure of pipes shall conform to the design criteria specified in AS 4041.

NOTE 1 AS 4041 sets out minimum requirements for the materials, design, fabrication, testing, inspection, reports and pre-commissioning of piping subject to internal pressure and applies to pipes carrying refrigerants.

NOTE 2 [Appendix B](#) shows the safe working pressure calculation and the design tensile stress at various operating temperatures for copper.

NOTE 3 A list of commonly available products is shown in [Appendix C](#).

8.2 Manufacturing tolerances

8.2.1 Mean outside diameter

For tubes in all tempers either coiled or in straight lengths, the mean outside diameter shall not vary from the specified diameter by more than the tolerances specified in [Table 2](#).

Table 2 — Dimensional tolerances for outside diameter

Specified outside diameter mm	Tolerance ^a	
	Straight lengths	Coils
> 3.18 ≤ 12.70	+0, -0.08	+0, -0.13
> 12.70 ≤ 19.05	+0, -0.08	+0, -0.20
> 19.05 ≤ 25.40	+0, -0.08	+0, -0.31
> 25.40 ≤ 31.75	+0, -0.08	+0, -0.38
> 31.75 ≤ 50.80	+0, -0.08	+0, -0.46
> 50.80 ≤ 101.60	+0, -0.15	—
> 101.60 ≤ 155.58	+0, -0.30	—

^a Allowable deviation of mean outside diameter.

8.2.2 Out-of-roundness

For tubes in 1/2H and H temper supplied in straight lengths, the outside diameter at any point shall not vary from the mean diameter by more than 1 %.

8.2.3 Thickness

The thickness of tubes at any point shall not vary from the specified thickness by more than $\pm 10\%$.

The minimum nominal wall thickness of any refrigeration tube shall be not less than 0.8 mm when being joined by flared fittings.

NOTE The minimum wall thickness allows for thinning of the wall during flaring and minor damage that may occur during installation and handling.

8.2.4 Length

Tubes ordered to a specified length shall not vary from that length by more than the amount of tolerance specified in [Table 3](#).

Table 3 — Length tolerances

Form of material	Specified length m	Length tolerance mm
Straight lengths	≤ 2	-0, +12
	> 2 ≤ 10	-0, +24
Coils	≤ 15	-0, +300
	> 15	-0, +2 %

9 Hardness tests

When tested in accordance with AS 1817.1, the hardness of tubes shall conform to [Table 4](#).

Table 4 — Hardness requirements

Temper	Vickers hardness (HV)	
	Min.	Max.
H	100	—
1/2H	75	100
O	—	75

10 Eddy current test

An eddy current test shall be carried out on each tube in accordance with AS 2084 or ASTM E243 to detect significant discontinuities.

11 Grain size (applicable to O temper tube)

The grain size shall be determined in accordance with the procedure in AS 1733. Microscopic examination shall show complete recrystallization. Average grain size shall not exceed 0.065 mm.

12 Cleanness

The measured residue of the internal surface of a tube (supplied with ends sealed) shall not exceed 0.038 g/m² of the internal surface when tested by either of the following methods:

- (a) When washed with trichloroethylene, or other suitable solvent, the residue after evaporation of the solvent shall not exceed the limit stated above. Testing for cleanness shall be conducted in accordance with the method described in ASTM B280.
- (b) When tested in accordance with the method described in EN 723, the lubricant residue as total carbon content shall not exceed the limit stated above.

Tubes manufactured or tested with trichloroethylene, or any chlorinated hydrocarbon solvent, shall not be supplied to the market with any residual solvent present.

NOTE UV radiation from arc welding processes and/or intense heat from gas brazing processes in the vicinity of certain solvents may cause the formation of highly toxic by-products.

13 Rounding of test result values

The observed or calculated values shall be rounded to the same number of figures as in the specified values and then compared with the specified values. For example, for specified maximum or minimum values of 2.5, 2.50 and 2.500, the observed or calculated value would be rounded respectively to the nearest 0.1, 0.01 and 0.001, see also AS 2706.

14 Marking

Each batch of tube supplied by the manufacturer shall be legibly and durably marked or tagged with the appropriate designations in accordance with [Clause 4](#) and with the manufacturer's name or trademark.

NOTE 1 Information may be incised or ink marked along tubes at the option of the manufacturer.

NOTE 2 Manufacturers claiming conformance to this document on a product, or packaging and promotional material related to that product, are advised to ensure that such conformance can be verified.

Appendix A (informative)

Purchasing guidelines

A.1 General

Australian Standards provide the technical requirements for products but do not address provisions of a contract. This Appendix lists the information to be supplied by the purchaser at the time of inquiry or order.

A.2 Information to be supplied by the purchaser

The purchaser should supply the following information at the time of enquiry and order:

- (a) The form of material, i.e. coils, straight lengths or packs.
- (b) Quantity (length or mass) and delivery instructions (dates, schedules, delivery point).
- (c) Designation of tube (see [Clause 4](#)).

NOTE Equivalent designations for high residual phosphorus alloy given in Australian and overseas Standards are as follows:

- (i) Australia: C12200
 - (ii) Britain: C106.
 - (ii) ISO: Cu-DHP.
- (d) Whether a test certificate or certificate of conformance is required.

NOTE A test certificate shows the results of tests carried out to establish conformance to this document. A certificate of conformance states that the material conforms with the requirements of this document.

- (e) Reference to this document, i.e. AS 1571.

Appendix B (informative)

Safe working pressure and testing pressure for copper tubes

The safe working pressure is the recommended maximum continuous pressure to which the tubes shall be subjected for the design life of the installation. The design tensile stress stated in [Table B.1](#) are based on tubing in the annealed temper, to allow for braze jointing which will result in softening of the tube.

$$P_{sw} = \frac{2000 \times S_D \times t_m}{D - t_m} \quad \text{B.1}$$

where

- P_{sw} = safe working pressure, in kPa
- S_D = maximum allowable design tensile stress for annealed copper, MPa
- t_m = minimum thickness at any point, in mm
- D = maximum mean outside diameter, in mm

Values of S_D for temperature ranges specified in AS 4041 are given in [Table B.1](#). Design strengths at intermediate temperatures may be obtained by linear interpolation.

Table B.1 — Allowable design tensile stress for annealed copper

Temperature range °C	Maximum allowable design tensile stress MPa
≤ 50	41
> 50 ≤ 75	34
> 75 ≤ 125	33
> 125 ≤ 150	32
> 150 ≤ 175	28
> 175 ≤ 200	21

Appendix C (informative)

Nominal diameter and wall thickness combinations

Table C.1 — Nominal diameter and wall thickness combinations for refrigerants up to 40 bar (4.0 MPa) applications

		Wall thickness (mm)												
Metric	Imperial	0.71	0.81	0.91	1.02	1.14	1.22	1.40	1.63	1.83	2.03	2.29	2.41	2.79
4.76	3/16"	*												
6.35	1/4"	*	† #	† #										
7.94	5/16"		†	†										
9.52	3/8"	*	† #	† #										
12.70	1/2"	*	† #	† #										
15.88	5/8"		*	* ‡	† #									
19.05	3/4"			* ‡	‡	† #								
22.22	7/8"			* ‡			‡	#	#					
25.40	1"			‡			‡		#					
28.58	1 1/8"			‡			‡		‡	#				
31.75	1 1/4"			‡			‡				#			
34.92	1 3/8"			‡			‡				#			
38.10	1 1/2"						‡					#		
41.28	1 5/8"			‡			‡						#	
50.80	2"						‡							
53.98	2 1/8"			‡			‡		‡					
66.68	2 5/8"						‡		‡		‡			
76.20	3"								‡					
101.60	4"								‡					
104.78	4 1/8"													‡

Key
 * Annealed coils
 # Straight length 4.2 MPa (42 Bar)
 † Annealed coils 4.2 MPa (42 Bar)
 ‡ Straight lengths

Table C.2 — Nominal diameter and wall thickness combinations for 60 Bar (6.0 MPa) applications

Metric	Imperial	Wall thickness (mm)				
		0.81	0.97	1.20	1.45	1.69
9.52	3/8"	‡				
12.70	1/2"		‡			
15.88	5/8"			‡		
19.05	3/4"				‡	
22.22	7/8"					‡
Key						
‡ Straight lengths						
NOTE Pressures noted are in gauge pressure.						

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For information regarding the development of Standards contact:

Standards Australia Limited

GPO Box 476

Sydney NSW 2001

Phone: 02 9237 6000

Email: mail@standards.org.au

www.standards.org.au



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