



Copper pipe and fittings—Installation and commissioning



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 - Australian Industry Group
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 - International Copper Association Australia
 - Master Plumbers Australia
 - Plumbing Products Industry Group
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Australian Standard®

Copper pipe and fittings—Installation and commissioning

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PREFACE

This Standard was prepared by the Standards Australia Committee WS-018, Copper and Copper Alloy Tubes for Plumbing and Gasfitting, to supersede AS 4809—2003.

The objective of this Standard is to provide the minimum requirements for the selection, installation and commissioning of copper plumbing, gas and waste water systems, including some aspects of design, to assist the industry in the installation of copper piping systems.

Attention is drawn to the following relevant requirements with respect to:

- (a) *Design and installation*—this Standard should be read in conjunction with the AS/NZS 3500 series, AS/NZS 5601 series and AS/NZS 4645.1.
- (b) The qualifications of persons permitted by law to do plumbing and gasfitting work.
- (c) The administrative procedures to be followed by persons performing plumbing and gasfitting work.
- (d) The authorization for certain materials, products, fittings, and other components to be connected to water supply systems in accordance with the WaterMark Certification Scheme (WMCS) in Australia and the Building Industry Authority (BIA) in New Zealand.

The terms ‘normative’ and ‘informative’ have been used in this Standard 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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STANDARDS AUSTRALIA

Australian Standard**Copper pipe and fittings—Installation and commissioning**

1 SCOPE

This Standard specifies requirements for the selection, installation and commissioning of copper plumbing, gas and waste water systems. Some aspects of design are also specified.

2 REFERENCED DOCUMENTS

A list of the documents referred to in this Standard, is given in Appendix A.

3 DEFINITIONS

For the purposes of this Standard, the definitions in AS/NZS 3500.0 and the one below apply.

3.1 Water hammer

A condition where a quick closing tap or valve closes against velocity of water at high pressure within a water supply system.

NOTE: A shock wave potentially in excess of 3 000 kPa can be created causing damage to not only the piping material but to appliances, tap ware and fittings.

4 PRODUCTS**4.1 Copper tube****4.1.1 General**

Copper tubes shall be in accordance with AS 1432 with the sizes shown in Tables 4.1 to 4.4. Copper tube may be supplied in annealed, bendable or hard drawn temper.

TABLE 4.1
AS 1432 TYPE A

Nominal size DN	Tube size metric (mm)	Tube size imperial (inch × swg)	Safe working pressure* (kPa)
6	6.35 × 0.91	1/4" × 20 g	11 320
8	7.94 × 0.91	5/16" × 20 g	8 810
10	9.52 × 1.02	3/8" × 19 g	8 350
15	12.70 × 1.02	1/2" × 19 g	6 100
18	15.88 × 1.22	5/8" × 18 g	5 750
20	19.05 × 1.42	3/4" × 17 g	5 560
25	25.40 × 1.63	1" × 16 g	4 750
32	31.75 × 1.63	1 1/4" × 16 g	3 750
40	38.10 × 1.63	1 1/2" × 16 g	3 100
50	50.80 × 1.63	2" × 16 g	2 310
65	63.50 × 1.63	2 1/2" × 16 g	1 840
80	76.20 × 2.03	3" × 14 g	1 900
90	88.90 × 2.03	3 1/2" × 14 g	1 630
100	101.60 × 2.03	4" × 14 g	1 500
125	127.00 × 2.03	5" × 14 g	1 200
150	152.40 × 2.64	6" × 12 g	1 300
200	203.20 × 2.64	8" × 12 g	910

* See Clause 4.1.4.

TABLE 4.2
AS 1432 TYPE B

Nominal sizes DN	Tube size metric (mm)	Tube size imperial (inch × swg)	Safe working pressure* (kPa)
6	6.35 × 0.71	1/4" × 22 g	8 560
8	7.94 × 0.71	5/16" × 22 g	6 700
10	9.52 × 0.91	3/8" × 20 g	7 220
15	12.70 × 0.91	1/2" × 20 g	5 290
18	15.88 × 1.02	5/8" × 19 g	4 810
20	19.05 × 1.02	3/4" × 19 g	3 970
25	25.40 × 1.22	1" × 18 g	3 500
32	31.75 × 1.22	1 1/4" × 18 g	2 780
40	38.10 × 1.22	1 1/2" × 18 g	2 300
50	50.80 × 1.22	2" × 18 g	1 710
65	63.50 × 1.22	2 1/2" × 18 g	1 370
80	76.20 × 1.63	3" × 16 g	1 520
90	88.90 × 1.63	3 1/2" × 16 g	1 300
100	101.60 × 1.63	4" × 16 g	1 200
125	127.00 × 1.63	5" × 16 g	960
150	152.40 × 2.03	6" × 14 g	1 000
200	203.20 × 2.03	8" × 14 g	720
250	254.00 × 2.64	10" × 12 g	730

* See Clause 4.1.4.

TABLE 4.3
AS 1432 TYPE C

Nominal size DN	Tube size metric (mm)	Tube size imperial (inch × swg)	Safe working pressure* (kPa)
10	9.52 × 0.71	3/8" × 22 g	5 520
15	12.70 × 0.71	1/2" × 22 g	4 070
18	15.88 × 0.91	5/8" × 20 g	4 180
20	19.05 × 0.91	3/4" × 20 g	3 450
25	25.40 × 0.91	1" × 20 g	2 560

* See Clause 4.1.4.

TABLE 4.4
AS 1432 TYPE D

Nominal size DN	Tube size metric (mm)	Tube size imperial (inch × swg)	Safe working pressure* (kPa)
32	31.75 × 0.91	1 1/4" × 20 g	2 040
40	38.10 × 0.91	1 1/2" × 20 g	1 690
50	50.80 × 0.91	2" × 20 g	1 260
65	63.50 × 0.91	2 1/2" × 20 g	1 010
80	76.20 × 1.22	3" × 18 g	1 130
90	88.90 × 1.22	3 1/2" × 18 g	970
100	101.60 × 1.22	4" × 18 g	890
125	127.00 × 1.42	5" × 17 g	830
150	152.40 × 1.63	6" × 16 g	800
250	254.00 × 2.03	10" × 14 g	580

* See Clause 4.1.4.

4.1.2 Identification

Copper tubes manufactured in accordance with AS 1432 shall be incized or have other permanent marking at not less than 0.5 m intervals along the tube with—

- (a) the manufacturer's trademark;
- (b) licence number;
- (c) the product certification mark (e.g. WaterMark);
- (d) the Australian Standard number;
- (e) nominal size;
- (f) thickness type; and
- (g) the letters 'BQ' where tubes are 'bendable' temper.

In addition, 'hard drawn' and 'bendable' temper copper tubes in accordance with AS 1432 are colour coded, with either a legend in the designated colour for the particular thickness type or the legend in black and a separate distinctive continuous mark in the designated colour.

The four colours that shall be used to represent the pipe types are the following:

- (i) Type A—Green.
- (ii) Type B—Blue.
- (iii) Type C—Red.
- (iv) Type D—Black.

The legend shall include—

- (A) the manufacturer's trademark;
- (B) country of origin;
- (C) nominal size;
- (D) thickness type;
- (E) the letters 'BQ' where tubes are 'bendable' temper;

- (F) the Australian Standard number;
- (G) licence number; and
- (H) the product certification mark (e.g. WaterMark).

NOTE: Other information may be provided at the discretion of the manufacturer.

4.1.3 Working pressures

The safe working pressures for copper tubes are shown in Tables 4.1 to 4.4 and are the pressures that the tubes can continually withstand. These values shall be applicable for temperatures up to 50°C and are based on annealed temper tube. Values for elevated temperatures shall be calculated by multiplying the safe working pressure figures for up to 50°C by the appropriate temperature factor listed in Table 4.5. Pressures for intermediate temperatures may be calculated by interpolation.

Where tubes are brazed or softened, the maximum safe working pressure for annealed temper shall apply.

TABLE 4.5
PRESSURE-TEMPERATURE
RE RATING FACTORS

Temperature range °C	Re-rating factor
Up to 50	1.00
Over 50–75	0.83
Over 75–125	0.80
Over 125–150	0.78
Over 150–175	0.68
Over 175–200	0.51

4.1.4 Test pressures

Test pressures for different piping systems and applications are given in Appendix C. Test pressure may exceed the safe working pressures shown in Tables 4.1 to 4.4 for the period required by the different testing requirements.

4.2 Copper pipe fittings

4.2.1 General

Copper and copper alloy fittings shall be in accordance with the relevant Australian Standard as listed in Table 4.6.

The type and size ranges of copper and copper alloy fittings are also listed in Table 4.6.

TABLE 4.6
COPPER AND COPPER ALLOY FITTINGS SIZE RANGES

Type	Standard	Fitting size range DN	
		Copper	Brass
Capillary fittings	AS 3688	15–250	—
Compression fittings	AS 3688	—	10–65
DWV fittings (see Note 1)	AS 3517	32–250	32–100
3D long radius bends	AS 3688	15–250	—
Expansion joints	AS 3517	32–150	32–100
Pan collars	AS 1589	100 and 100 × 80	100 and 100 × 80
Press fit end connectors	AS 3688	15–100	15–100
Push on end connectors	AS 3688	15–20	15–20
Reducers	AS 3688	10–250	32–100
Roll grooved	AS 3688	50–150	—
Traps, gullies & fittings	AS 1589	32–100	32–100
Water hammer arresters	AS 5200.007	15–50	15–50

NOTES:

- 1 DWV was previously known as SWV.
- 2 For gas applications, refer to approved materials nominated in AS/NZS 4645.1 and AS/NZS 5601 series.

4.3 Jointing materials

4.3.1 General

All jointing materials, including lubricants and sealing tapes used for drinking water applications, shall be in accordance with AS/NZS 4020.

All jointing materials used for gas applications shall be in accordance with AS/NZS 4645.1 and AS/NZS 5601 series.

4.3.2 Elastomeric rings

Elastomeric rings for water systems shall be in accordance with AS 1646 and be of dimensions, composition and hardness appropriate to the materials being joined and for the particular application.

Elastomeric seals for gas press fit shall be yellow hydrogenated nitrile butadiene rubber (HNBR) material and be in accordance with EN 549.

4.3.3 Gaskets

Elastomeric and fibre gasket materials shall be in accordance with WSA 109.

4.3.4 Silver brazing alloy

Silver brazing alloys for capillary jointing of copper and copper alloy pipes and fittings shall be in accordance with Table 1 or Table 2 of AS/NZS 1167.1 and contain a minimum of 1.8% silver and a maximum of 0.05% cadmium.

5 CORROSION, CONCEALMENT AND PROTECTION

5.1 Internal corrosion prevention

The service life of copper pipe installations may be compromised if used to convey water that falls outside the range nominated by the Australian Drinking Water Guidelines (ADWG) particularly in terms of pH, alkalinity, chloride, sulfate and residual disinfectant.

The composition of waters, other than from a reticulated water source that may also be used for drinking and re-use purposes, including treated, untreated, bore and rainwater supplies, should be examined to ensure compatibility with copper.

NOTE: Guidance on the types, causes and control measures of internal corrosion of copper pipes in drinking water is given in Appendix B.

5.2 External corrosion prevention

Copper has good corrosion resistance in most natural soils and atmospheric environments.

Copper pipework used to convey water below ground shall be laid in accordance with the AS/NZS 3500 series and suitably protected against external corrosion by means of using pre-insulated copper pipe, petrolatum-based wrapping or equivalent. All joins shall be wrapped with a durable inert waterproof tape. This will apply where copper pipes are in contact with such materials as—

- (a) ash;
- (b) sodium chloride (salt);
- (c) magnesite;
- (d) ammonia and its compounds or derivatives;
- (e) nitrates;
- (f) mercury salts;
- (g) foundry sands;
- (h) animal waste;
- (i) urine; or
- (j) any material identified as potentially aggressive to copper tube.

Copper pipework shall not be used in atmospheres containing excessive hydrogen sulfide, unless the copper pipes can be protected using pre-insulated copper pipe, petrolatum-based wrapping or equivalent. All joins shall be wrapped with a durable inert waterproof tape.

Corrosion protection of copper pipework used in gasfitting shall be in accordance with the above requirements or AS/NZS 4645.1 or AS/NZS 5601 series.

5.3 Pipes in concrete

When there is no suitable alternative to embedding pipes in concrete walls or floors, they shall be located in chase or ducts with removable covers in accordance with the AS/NZS 3500 series, AS/NZS 4645.1 and AS/NZS 5601 series. All piping shall be Type A or Type B and covered over its complete length with an approved foamed plastic material.

NOTE: Pipes should not extend through any expansion joint in the concrete.

Proper provision shall be made for expansion of the concealed pipes and the connecting pipes outside the concrete structure.

5.4 Pipes under concrete

Pipes laid under concrete shall be Type A or Type B. Joints shall be kept to a minimum and pipes shall be either pre-insulated or placed in a watertight conduit in accordance with the AS/NZS 3500 series, AS/NZS 4645.1 and AS/NZS 5601 series. The ends of the conduit and pre-insulated pipe shall be sealed to prevent ingress of water.

NOTE: See Clause 6.2.7.3 for water pipes under concrete slabs requirements.

5.5 Protection of copper pipes

Copper pipes shall be protected against damage caused by mechanical influences. Pipework installed externally shall be protected by providing mechanical guards where the service lines are exposed to—

- (a) vehicle impact; or
- (b) structural movement.

6 WATER SUPPLY PIPING

6.1 Pre-installation considerations

6.1.1 Planning

Planning considerations shall include calculating the correct pipe size for each part of the system to balance the inter-relationships of the following parameters:

- (a) Available mains pressure (consult the relevant Water Utility operation).
- (b) Pressure required at individual fixtures (refer to AS/NZS 3500.1 and AS/NZS 3500.4).
- (c) Static pressure losses due to height (refer to AS/NZS 3500.1 and AS/NZS 3500.4).
- (d) Water demand in the total system and each of its parts (refer to AS/NZS 3500.1 and AS/NZS 3500.4).
- (e) Pressure losses due to the friction of water flow in the system (refer to AS/NZS 3500.1 and AS/NZS 3500.4).

NOTE: See Appendix G for friction loss tables and calculations.

- (f) Velocity limitations based on noise application and erosion (refer to AS/NZS 3500.1 and AS/NZS 3500.4).
- (g) Water quality (see Clause 5.1 and Appendix B).
- (h) Environmental consideration (see Clause 5.2).
- (i) Accessibility of copper water services for maintenance purposes.

6.1.2 Layout

Dead leg piping shall be avoided or shall be as short as possible. A flushing facility (tap) shall be provided where there is low draw-off. To prevent problems with stagnation, fixtures that are seldom used shall be placed in a main flow line and/or close to a regularly used service.

6.1.3 Pipe sizing

Pipe sizes shall be limited to the following:

- (a) Water service branch offtakes to a single dwelling shall not be less than DN 20.
- (b) Branch offtake pipes extended from any water service shall be in accordance with Table 6.1.

TABLE 6.1
PIPE SIZE LIMITATIONS FOR BRANCH OFFTAKES*

Nominal size DN	Maximum length m	Supply limitations	Installation condition
18	6	One fixture or outlet	—
15	3	Only one fixture or outlet	—
10	1	Hot and cold water mixing tap	Reasonably straight line

* For further detailed descriptions refer to AS/NZS 3500.1.

6.1.4 Pressure requirements

The maximum and minimum pressures for the water main serving the property can be obtained from the network utility provider. Pipe sizing shall be based on the minimum head available.

The minimum working pressure at the furthestmost or the most disadvantaged fixture or outlet shall not be less than 50 kPa (5 m head), at the flow specified in accordance with AS/NZS 3500.1 and AS/NZS 3500.4.

Water pressure within the dwelling shall be limited, to reduce the impact of noise, water hammer and potential damage occurring to pipes, valves and appliances.

NOTE: Recommended maximum water pressure within a dwelling and to tap outlets is 500 kPa.

6.2 Installation

6.2.1 General

All installations, both underground and above ground shall be carried out in accordance with National Construction Code, Volume 3.

6.2.2 Jointing

6.2.2.1 General

Jointing of copper water services shall be in accordance with the following:

- (a) *Removal of burr* The burr formed in cutting any pipe shall be removed.
- (b) *Joints requiring use of heat* Care shall be taken so that pipes or fittings are not damaged by the application of excessive heat.
- (c) *Joining pipes of different diameter* Where straight sections of pipe of different diameter shall be joined, such increase or reduction in size shall be made by use of an appropriate fitting. Filling the annular space using a filler rod shall not be permitted.
- (d) *Crimping* Crimping, to reduce a larger diameter pipe when joining to a smaller diameter pipe, shall not be permitted.
- (e) *Fabricated fittings* Sockets and tees may be fabricated from copper or copper alloy pipes using tools specifically designed for such purposes. Fabricated joints shall be silver brazed.

Tees in copper water services shall not be fabricated from pipe of thickness less than Type C.
- (f) *Flux removal* All residues of flux shall be removed following the brazing or soldering of the joint.

6.2.2.2 *Mechanical joining, push-on and press-fit end connectors*

Mechanical couplings, both push-on and press-fit types, shall be in accordance with AS 3688. Mechanical couplings may be used to join copper pipes and fittings.

6.2.2.3 *Compression joints*

Compression type fittings may be used where tube ends have been flared or croxed with proprietary tools. Plastic nuts shall not be used to connect copper supply pipes to water heaters.

6.2.2.4 *Capillary fittings*

Capillary type fittings shall be in accordance with AS 3688.

6.2.2.5 *Flanged joints*

Copper alloy flanges that are in accordance with AS 4087 may be used.

Flange to copper adaptors, that are in accordance with AS 3688 and designed to the applicable mating flange standard, shall be attached by means of either silver brazing in accordance with Clause 6.2.2.8, or by use of a press-fit fitting that is suitable for the application.

6.2.2.6 *Shouldered or grooved joints*

Roll-grooved joints fittings shall be in accordance with AS 3688.

Where used below ground, the joints shall be—

- (a) protected against corrosion with each assembled copper or copper alloy joint protected with a petrolatum-based wrapping system; and
- (b) external to a building and not under concrete.

6.2.2.7 *Silver brazing*

A silver brazing alloy, as specified in Clause 4.3.4, may be used to join copper pipes and fittings. A compatible flux shall be used when making joints with copper alloy fittings.

6.2.2.8 *Pipe bending*

Bendable and annealed temper tube, in accordance with AS 1432, may be bent provided the following requirements are met:

- (a) Specialized equipment shall be used to form bends in copper pipe.
- (b) 'Hard drawn' temper pipe shall be annealed prior to bending.
- (c) The minimum centre-line radius for bending annealed temper copper pipe to a 90° bend shall be at least three times the outside diameter of the pipe.

NOTE: Bendable temper copper pipe has sufficient ductility to enable a 90° bend with minimum centre-line radii of 45 mm, 60 mm and 85 mm for nominal sizes DN 15, DN 18 and DN 20 respectively, without local annealing.
- (d) Pipes shall be free of physical damage that reduces the wall thickness by more than 10% of the minimum thickness.
- (e) Wrinkling shall not exceed 1 mm. This shall be measured between adjacent trough and crest at the midpoint of the bend.
- (f) Flattening of the pipe during bending shall not reduce the outside diameter in any one plane by more than 10% of the minimum mean diameter.