

AS/NZS 3500.4:2021



Australian/New Zealand Standard™

Plumbing and drainage

Part 4: Heated water services



AS/NZS 3500.4:2021

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- Australian Industry Group
- Australian Stainless Steel Development Association
- Backflow Prevention Association of Australia
- Engineers Australia
- Hydraulic Consultants Association Australasia
- Institute of Plumbing Australia
- International Copper Association Australia
- Master Plumbers Australia and New Zealand
- Master Plumbers, Gasfitters and Drainlayers New Zealand
- Ministry of Business, Innovation and Employment (NZ)
- Plastics Industry Pipe Association of Australia
- Plastics New Zealand
- Plumbers, Gasfitters and Drainlayers Board (NZ)
- Plumbing Distributors Association of New Zealand
- Plumbing Products Industry Group
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Plumbing and drainage

Part 4: Heated water services

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Preface

This document was prepared by the joint Standards Australia/Standards New Zealand Committee WS-014, Plumbing and Drainage, to supersede AS/NZS 3500.4:2018.

The objective of this document is to provide Deemed-to-Satisfy solutions for compliance with —

- (a) the National Construction Code (NCC) Volume Three, Plumbing Code of Australia (PCA), and
- (b) the New Zealand Building Code (NZBC), Clause G12 Water Supplies.

A list of all parts in the AS/NZS 3500 series for plumbing and drainage can be found in the Standards Australia and Standards New Zealand online catalogues.

The major changes in this revision are as follows:

- (i) Conformance to individual product standards has been removed. All products used in plumbing and drainage systems in Australia need to comply with the PCA and, in New Zealand, the NZBC, see [Appendix B](#) for further information. Removal of specific product standard conformance requirements avoids inconsistencies and contradictions between this document and the PCA and NZBC
- (ii) Definitions have been relocated to AS/NZS 3500.0 for consistency across the series.
- (iii) Jointing requirements for plastics pipes have been clarified and expanded to allow different methods.
- (iv) Changes to the requirements for the marking of pipes in commercial buildings to assist in the better identification of pipework and avoid cross connections.
- (v) Changes to the requirements for the installation of water services located in metal-framed walls to bring the provisions in line with those of the National Association of Steel-Framed Housing (NASH).
- (vi) The separation between above-ground heated water services pipe work and electrical services has been reduced to bring it in line with AS/NZS 3000 and AS/NZS 3500.1.
- (vii) To improve the amenity of users and reduce wastage of water and energy, changes have been made to requirements for circulated heated water systems including water meters and entry points for heated water, thermal insulation for non-circulatory heated water piping, and maximum capacities of any dead leg from the branch offtake to its termination. [Appendix Q](#) has been added to provide a guide to determining capacity of dead legs and estimating wait times.
- (viii) Heated water temperature control provisions, which are considered matters of public policy, were elevated from AS/NZS 3500.4 to the PCA Part B2 Heated Water Systems. To avoid conflict between the PCA and this document, clauses relating to sanitary fixtures delivery temperature and solutions for control of delivery temperatures have been deleted. In New Zealand, these provisions are contained within NZBC Acceptable Solution G12/AS1.

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.

Notes or footnotes to tables or figures that are expressed in mandatory terms are deemed to be requirements of this document.

Notes to clauses in this document are informative only and do not include requirements.

This document includes commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by “C” preceding the clause number, and is printed in italics in a box. The commentary is for information and guidance and does not form part of the document.

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Section 1 Scope and general

1.1 Scope

This document sets out the requirements for the design, installation and commissioning of heated water services using drinking water or rainwater or a combination thereof. It includes aspects of the installation from, and including, the valve(s) on the cold water inlet to any cold water storage tank or water heater and the downstream fixtures and fittings. It applies to new installations as well as alterations, additions and repairs to existing installations.

This document applies to the installation of the following types of water heaters:

- (a) Storage water heaters with a rated delivery or capacity of up to 700 L per heater.
- (b) Heat exchange water heaters.

NOTE 1 Electric heat exchange water heaters are defined in AS 1361. Other fuel sources are covered in the applicable Standards, e.g. AS/NZS 2712, AS/NZS 5263.1.2.

- (c) Instantaneous, continuous flow water heaters.

NOTE 2 [Appendix M](#) provides guidelines for the operation and maintenance of heated water services.

Illustrations used in this Standard are diagrammatic only and have been chosen without prejudice.

1.2 Application

1.2.1 Australia

This document shall be read in conjunction with the relevant mandatory requirements for heated water services under the National Construction Code (NCC), primarily Volume Three, Plumbing Code of Australia (PCA).

Where alternative Australian or New Zealand Standards are referenced (e.g. AS 1345), the Australian Standard shall be used for Australia only.

1.2.2 New Zealand

This document shall be read in conjunction with the New Zealand Building Code. This document may be used to demonstrate compliance with the New Zealand Building Code, Clause G12 Water Supplies.

Where alternative New Zealand Standards are referenced (e.g. NZS 5807), the New Zealand Standard shall be used for New Zealand only.

1.3 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.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1432, *Copper tubes for plumbing, gasfitting and drainage applications*

AS 3498, *Authorization requirements for plumbing products—Water heaters and hot-water storage tanks*

AS 4809, *Copper pipe and fittings — Installation and commissioning*

AS/NZS 2032, *Installation of PVC pipe systems*

AS/NZS 2642.2, *Polybutylene (PB) plumbing pipe systems, Part 2: Polybutylene (PB) pipe for hot and cold water applications*

AS/NZS 3500.0, *Plumbing and drainage, Part 0: Glossary*

AS/NZS 3500.1, *Plumbing and drainage, Part 1: Water services*

AS/NZS 4234, *Heated water systems — Calculation of energy consumption*

NZS 3501, *Specification of copper tubes for water, gas and sanitation*

NZS 4603, *Installation of low pressure thermal storage electric water heaters with copper cylinders (open-vented systems)*

NZS 4607, *Installation of thermal storage electric water heaters: valve-vented systems*

NZS 4219 *Seismic performance of engineering systems in buildings*

EN 10312, *Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption — Technical delivery conditions*

ASME B36.19M, *Stainless Steel Pipe*

New Zealand Building Code, *Acceptable Solution H1/AS1: Energy Efficiency*

1.4 Terms and definitions

For the purpose of this document, the terms and definitions given in AS/NZS 3500.0 apply.

1.5 Plastics abbreviations

The following plastics abbreviations are used in this document:

ABS	Acrylonitrile butadiene styrene
GRP	Glass-filament-reinforced thermosetting plastic
PB	Polybutylene
PE	Polyethylene
PE-X	Cross-linked polyethylene
PP	Polypropylene
PP-R	Polypropylene random copolymer
PVC-C	Chlorinated polyvinyl chloride
PVC-M	Modified polyvinyl chloride
PVC-O	Oriented polyvinyl chloride
PVC-U	Unplasticized polyvinyl chloride

1.6 Water chemistry

Water chemistry can have a significant effect on the performance and life of water heaters and other items forming part of, or connected to, the heated water system.

C1.6 Information on chemistry of the reticulated water should be available from the network utility operator. Where there is doubt about the suitability of a product for connection to the available water supply, advice about suitability should be sought from the manufacturer. The manufacturer may request a water sample or analysis, which should be in accordance with [Appendix A](#).

Where rainwater is used in heated water systems, it is particularly important that consumers are made aware of the advice from enHealth (Environmental Health Committee, “Guidance on use of rainwater tanks”) and manufacturers of items forming part of, or connected to, the heated water system.

1.7 Pipe sizes

Sizing based on internal diameter shall be as specified in [Appendix C](#).

Where the nominal size of a pipe or fitting is specified in this document, an equivalent pipe size appropriate to the material being used shall be selected from [Tables 1.7\(A\)](#) and [1.7\(B\)](#).

Table 1.7(A) — Pipe size conversion for non-circulatory system

Specified nominal size DN	Acceptable equivalent size						
	Copper		Stainless steel	PE-X	PB	PP-R	PE-X/AL/PE-X PE-X/AL/PE
	AS 1432	NZS 3501					
10	10	10	10	12	16 (15) ^a	12	10
15	15	15	15	16	16 (18)	16	15
18	18	—	18	20	20 (22)	20	20
20	20	20	20	25	25 (22)	25	20
25	25	25	25	32	32 (28)	32	25
32	32	32	32	40	40	40	32
40	40	40	40	50	50	50	50
50	50	50	50	63	63	63	63

^a Sizes in brackets are for pipe in accordance with AS/NZS 2642.2.

Table 1.7(B) — Pipe size conversion for circulatory flow systems inclusive of allowable hot water velocity differentials

Specified nominal size DN	Acceptable equivalent size						
	Copper		Stainless steel	PE-X	PB	PP-R	PE-X/AL/PE-X PE-X/AL/PE
	AS 1432	NZS 3501					
15	15	15	15	16	16 (15) ^a	16	15
18	18	—	15	16	16 (18)	16	15
20	20	20	18	20	20 (22)	20	20
25	25	25	20	25	25 (22)	25	25
32	32	32	25	32	32 (28)	32	32
40	40	40	32	40	40	40	40
50	50	50	40	50	50	50	50
65	65	65	50	63	63	63	
80	80	80	65	75	75	75	



Documents

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Table 1.7(B) *(continued)*

Specified nominal size DN	Acceptable equivalent size						
	Copper		Stainless steel	PE-X	PB	PP-R	PE-X/AL/PE-X PE-X/AL/PE
	AS 1432	NZS 3501					
90	90	90	80	90	90	90	
100	100	100	90	110	110	110	
125	125	125	100	125	125	140	
150	150	150	125	160	140	160	

^a Sizes in brackets are for pipe in accordance with AS/NZS 2642.2.

NOTE 1 The acceptable equivalent sizes are determined from internal pipe diameters and the maximum water velocity requirements of [Clause 1.8](#) as applicable to each pipe material such that delivery rates are not less than the copper equivalent. This table is based on pipe diameters only.

NOTE 2 This table is based on pipe conforming to [Clause 2.4.1](#) and on Type B copper pipes, Series 2 or Schedule 5S and 10S stainless steel, SDR 9 – PEX, SDR 11 – PB pipe and SDR 7.4 PP – R pipes.

1.8 Velocity requirements

The maximum water velocity in piping up to 65 °C shall be in accordance with [Table 1.8](#).

Table 1.8 — Maximum allowable velocities

Piping	Maximum velocities, m/s	
	Copper pipes	Other materials
Circulatory (flow)	1.2	2.0
Circulatory return line	1.0	1.0
Non-circulatory (flow)	3.0	3.0

NOTE 1 Circulatory piping means piping where there is forced circulation of heated water.

NOTE 2 Circulatory piping does not include — (a) systems where the circulatory flow only occurs in response to activation by a user; and (b) primary circulation in a solar water heater.

NOTE 3 In circulatory piping, the maximum flow velocity is derived from the sum of forced circulation and probable simultaneous demand flow in the relevant section of piping.

NOTE 4 Pipework should be designed for velocities lower than the maximum to allow for variations in flow.

1.9 Pressure requirements

1.9.1 Available pressure

Pipe sizing shall be based on the minimum available pressure at the outlet from the water heater.

1.9.2 Pressure at outlets

The minimum working pressure at the furthestmost or most disadvantaged fixture or outlet shall be not less than 50 kPa (5 m head), at the flow rate specified in [Table 10.3.2](#).

NOTE 1 Storage tanks or booster pumps in accordance with AS/NZS 3500.1 may be required to achieve the minimum pressure.

NOTE 2 Some fixtures may require more than 50 kPa supply pressure in order to function.

1.9.3 Pressure losses

Allowance shall be made for pressure losses through pipes, valves, fittings, meters and any other equipment present in the installation.

1.9.4 Pressure booster pumps

1.9.4.1 General

Pressure booster pumps installed in the cold water service supplying a water heater shall be installed in accordance with AS/NZS 3500.1.

1.9.4.2 Pump control

Pressure booster pumps shall be sized, installed and controlled so as to prevent repetitive pressure cycling or spiking.

Cyclic pressures within the heated water system shall not exceed a 25 kPa differential three times per minute when averaged over a 24 h period.

***C1.9.4.2** Cyclic pressures in heated water systems are damaging to both pipework and heated water tanks and equipment. Cyclic pressures can be caused by incorrectly sized backflow valves, pressure reduction valves and booster pumps, particularly when operating at low flow rates. Pressure variations within heated water systems are intensified when systems have trapped entrained air which can lead to cavitation damage.*

1.10 Flow rates

Flow rates and loading units shall be as specified in [Clause 10.3](#).

1.11 Water temperature

1.11.1 General

In Australia, the requirements for heated water temperature control are specified in the Plumbing Code of Australia.

In New Zealand, the requirements for maximum heated water delivery temperatures and acceptable temperature control devices are specified in the NZBC Acceptable Solution G12/AS1.

1.11.2 Storage temperature

To avoid the likelihood of legionella bacteria growth, an installation shall —

- (a) store water at a temperature not less than 60 °C; or
- (b) use a water heater that satisfies the requirements of AS 3498:2020 Clause 7.2 (Australia only).

Section 2 Materials and products

2.1 Scope of section

This section specifies requirements for materials and products to be used in heated water services.

2.2 General

Materials and products used in a heated water service shall be selected to ensure fitness for their intended purpose.

NOTE 1 See [Appendix B](#) for more information.

In New Zealand, materials and products in contact with water that is intended for human consumption, food preparation, utensil washing, personal hygiene or oral hygiene shall conform to AS/NZS 4020. Linings and coatings shall conform to AS/NZS 4020 at a surface area to volume ratio not greater than that applicable to the installation.

NOTE 2 In New Zealand, the requirements for materials and products are contained in NZBC Clauses B2 Durability and G13 Foul Water.

NOTE 3 In Australia, the requirements for products in contact with drinking water are contained in the Plumbing Code of Australia.

2.3 Pipes and fittings — General limitations

The following limitations shall apply to the use of pipes and fittings for heated water services:

- (a) Pipes and fittings —
 - (i) up to and including DN 100, shall have a maximum allowable operating pressure of at least 1.0 MPa at 60 °C; and
 - (ii) larger than DN 100, shall be selected to accommodate the nominated operating pressure and temperature for the system.
- (b) Bends in pipes shall be free from wrinkling and flattening.
- (c) Semi-flexible connectors and braided flexible hoses shall only be used above surface level and in accessible locations.
- (d) Pipes and fittings shall be protected from excessive ambient heat.

NOTE 1 Limitations on the use of pipes and fittings should take into consideration the manufacturer's installation specifications, provided they do not contradict the requirements of this document.
- (e) Soft solder jointing shall not be used for new joints.

NOTE 2 For the repair of existing joints, soft solder should not contain more than 0.1 % lead by weight.

2.4 Metallic pipes and fittings

2.4.1 Heated water services

Where metallic pipes and fittings are used in a heated water service, they shall be of the following material types:

- (a) Copper pipes and fittings.
- (b) Copper alloy fittings.

- (c) Stainless steel pipes and fittings.

NOTE See [Appendix B](#) for information on demonstrating products and materials are fit for purpose.

2.4.2 Limitations

Metallic pipes and fittings shall conform to the following:

- (a) Fittings used to join stainless steel (SS) pipes shall be dezincification resistant (DR) copper alloy or stainless steel.

NOTE 1 Refer to AS 3688 for information on metallic fittings and end connectors.

- (b) For corrosion resistance, the composition of stainless-steel pipes, tubes and fittings shall have a minimum pitting resistance equivalent number (PREN) of 22.

NOTE 2 The PREN may be calculated as follows:

$$\text{PREN} = \% \text{Cr} + (3.3 \times \% \text{Mo}) + (16 \times \% \text{N})$$

NOTE 3 A PREN of 18 is approximately equivalent to Grade 304, and a PREN of 23 is approximately equivalent to Grade 316.

- (c) Copper pipe shall only be of Type A, B or C.

NOTE 4 Copper pipes manufactured in accordance with NZS 3501 are also suitable for use in New Zealand.

NOTE 5 Refer to AS 1432 for information on copper types (A, B or C).

NOTE 6 Refer to AS 3688 for information on metallic fittings and end connectors.

2.5 Plastics pipes and fittings

2.5.1 Heated water services

Where plastic pipes and fittings are used in a heated water service, they shall be of the following material types:

- (a) Polybutylene (PB) pipes and fittings.
- (b) Cross-linked polyethylene (PE-X) pipes and fittings.
- (c) Polypropylene random copolymer (PP-R) pipes and fittings.
- (d) Multilayer pipes (MLP) and fittings.
- (e) Chlorinated polyvinyl chloride (PVC-C) pipes and fittings.

NOTE 1 See [Appendix B](#) for information on demonstrating products and materials are fit for purpose.

NOTE 2 The following Standards contain additional information:

- (a) AS/NZS 2642.2 or AS 5082.1 — hot and cold. water polybutylene (PB) pipes
- (b) AS/NZS 2642.3 or AS 5082.2 — mechanical jointing fittings for use in PB piping systems.
- (c) AS/NZS 2492 — cross-linked polyethylene (PE-X) pipes
- (d) AS/NZS 2537 (parts 1, 2 and 5) — mechanical jointing fittings for use with crosslinked polyethylene (PE-X) pipes.
- (e) ISO 15874-2 — polypropylene random copolymer (PP-R) pipes and ISO 15874-3. — fittings for PP-R pipes

- (f) AS 4176 (parts 1, 2, 3, 5 and 7) — multilayer pipes (MLP) and fittings for pressure applications.
- (g) ASTM D2846 — chlorinated polyvinyl chloride (PVC-C) fittings

2.5.2 Limitations

Plastics pipes and fittings shall conform to the following:

- (a) When installed, plastics pipes and fittings shall be protected from direct sunlight.
NOTE 1 Examples of protection include sleeving with metal or plastics pipe or conduit, lagging.
- (b) Plastics pipes and fittings shall not be used between the isolation valve and the inlet to a water heater.
- (c) Plastics pipes and fittings shall not be used within 1 m of the outlet of a water heater.
NOTE 2 Plastics pipes and fittings may be used immediately downstream of a temperature control device or a 50 °C temperature-limited water heater.
- (d) Plastics pipes shall not be used to support isolation valves, non-return valves and equipment used to connect water heaters.
- (e) Plastics pipes and fittings shall not be used between solar collectors and heated water containers, unless supplied as an integral component of the solar water heater system.
- (f) Plastics pipes and fittings shall not be used between an uncontrolled heat source and a heated water tank.
- (g) Plastics pipes and fittings shall not be used for the drain lines from temperature/pressure-relief valves.

NOTE 3 It is recommended that the minimum pressure rating for plastic pipes used in a heated water service is PN 16. For further information refer to AS/NZS 2492.

2.6 Safe tray and safe waste materials

2.6.1 Safe tray

Safe trays shall be fabricated from —

- (a) 0.6 mm thick galvanized steel sheet with a minimum nominal zinc coating mass of 275 g/m²; or
- (b) other materials not inferior to Item (a), under the conditions of use.

NOTE Refer to AS 1397 for information on continuous hot-dip metallic coated steel sheet and strip coatings of zinc and alloyed with aluminium and magnesium.

2.6.2 Safe wastes

Safe waste pipes from safe trays shall be fabricated from the following materials:

- (a) PVC-U.
- (b) Galvanized steel pipe.
- (c) Seamless copper pipe (minimum thickness of 0.9 mm).
- (d) Sheet steel (minimum thickness of 0.6 mm) with a minimum nominal zinc coating mass of 275 g/m².

2.7 Joints

2.7.1 Flanged joints

Where flanged joints are used, they shall be of the following material types:

- (a) Ductile iron, cast iron and grey cast iron.
- (b) Copper alloy and composite.
- (c) Steel.

NOTE The following Standards contain additional information:

- (a) AS 2129 — flanges for metal pipes, valves and fittings.
- (b) AS/NZS 4331.1 — steel flanges.
- (c) AS/NZS 4331.2 — cast iron flanges.
- (d) AS/NZS 4331.3 — copper and copper alloy composite flanges.
- (e) AS/NZS 4087 — metallic flanges for waterworks purposes.
- (f) AS/NZS 1477 — PVC pipes and fittings for pressure applications.
- (g) AS/NZS 2280 — ductile iron pipes and fittings.
- (h) AS/NZS 2544 — grey iron pressure fittings.

2.7.2 Elastomeric seals

Where an elastomeric seal gasket is provided in the line or in a fitting, it shall not be replaced with mastic or sealant compounds.

NOTE Refer to AS 1646 for information on elastomeric seals for waterworks purposes.

2.7.3 Silver brazing alloy

2.7.3.1 Copper and copper alloys

Silver brazing alloys for capillary jointing of copper and copper alloy pipes and fittings shall conform to the requirements for silver or copper phosphorus brazing alloys and contain a minimum of 1.8 % silver and a maximum of 0.05 % cadmium.

NOTE Refer to AS/NZS 1167.1 for information on filler metal for brazing and braze welding.

2.7.3.2 Stainless steel

Silver brazing alloys for capillary jointing of stainless steel pipes and fittings shall contain a minimum of 38 % silver and a maximum of 0.05 % cadmium.

NOTE Refer to AS/NZS 1167.1 for information on filler metal for brazing and braze welding.

2.7.4 Filler rods for stainless steel joints

Welded joints in stainless steel pipework larger than DN 25 shall be made using filler rods of low carbon stainless steel not greater than 2 mm in diameter.

NOTE Refer to AS/NZS 1167.2 for information on welding for brazing, filler metal for welding.

2.8 Miscellaneous materials

2.8.1 Concrete mix

Ready-mixed concrete shall have a minimum characteristic compressive strength of 20 MPa.

Site-mixed concrete shall consist of cement, fine aggregate and coarse aggregate, all measured by volume, properly mixed with water sufficient to render the mix workable. It shall have a minimum characteristic compressive strength of 20 MPa.

NOTE 1 Refer to AS 1379 for information on the specification and supply of concrete.

NOTE 2 The compressive strength of concrete is defined in —

- (a) AS 3600 for Australia; and
- (b) NZS 3109 and NZS 3124 for New Zealand.

NOTE 3 Refer to AS/NZS 4671 for information for steel reinforcing materials.

2.8.2 Cement mortar

Cement mortar shall consist of one part cement and two parts of fine aggregate measured by volume, properly mixed with the minimum amount of water necessary to render the mix workable.

NOTE 1 For bedding pipes, a mixture consisting of one part cement to four parts fine aggregate may be used.

Cement mortar that has been mixed and left standing for more than 1 h shall not be used.

NOTE 2 Refer to AS 1478.1 for information on chemical admixtures for concrete, mortar and grout.

2.8.3 Water for concrete and mortar

Water used for mixing concrete and cement mortar shall be free from impurities that are harmful to the mixture, the reinforcement, or any other items embedded within the concrete or mortar.

2.8.4 Timber

2.8.4.1 Timber in Australia

In Australia, timber exposed to the weather shall be of durability Class 2 or treated with an appropriate preservative. Timber in contact with the ground shall be of durability Class 1.

NOTE 1 Refer to AS/NZS 2878 for information on timber classification into strength groups.

NOTE 2 Refer to the AS/NZS 1604 series for information on preservative treatment of sawn and round timber.

2.8.4.2 Timber in New Zealand

In New Zealand, timber exposed to the weather shall be treated to H3 (CCA). Timber in contact with the ground shall be treated to H4 (CCA).

NOTE 1 Refer to NZS 3631 for information on timber grading rules.

NOTE 2 Refer to NZS 3640 for information on chemical preservation of round and sawn timber.

2.8.5 External protective coatings

External coatings used for protection against corrosion of pipelines buried in corrosive areas shall —

- (a) be impervious to the passage of moisture;

- (b) be resistant to the external corrosive environment;
- (c) be resistant to abrasion by the surrounding fill; and
- (d) not contain any material that could cause corrosion to the underlying pipes or fittings.

NOTE Polyethylene sleeving used to protect underground pipelines may require additional protection if installed in rock or stony ground.

Section 3 Cross-connection and backflow prevention and thermostatic mixing valves

3.1 Scope of section

This section sets out the requirements for the installation of backflow prevention devices and thermostatic mixing valves.

3.2 Cross-connection control and backflow prevention

Cross-connection controls and backflow prevention devices shall be installed in accordance with AS/NZS 3500.1.

3.3 Thermostatic mixing valves

The following apply to the installation of thermostatic mixing valves:

- (a) Each thermostatic mixing valve shall have an isolating stop tap/valve, line strainer and cross-flow prevention device (non-return) valve fitted to the heated and cold water supply lines.

NOTE 1 These devices may be fitted separately from the thermostatic mixing valve or as an integral part of the valve.

NOTE 2 See [Figure 3.3](#) for a typical installation of a thermostatic mixing valve.

NOTE 3 Refer to AS 4032.1 for information on metallic-bodied thermostatic mixing valves.

- (b) There shall be no branch line off-take between a non-integral isolating valve and the inlet to the thermostatic mixing valve except in multiple installations, see Item (d).
- (c) Thermostatic mixing valves shall be supported independent of all piping.
- (d) Where multiple installations of thermostatic mixing valves are located in the same area, a stop tap/valve, line strainer and non-return valve may control each of the hot and cold water supplies to more than one thermostatic mixing valve, provided each of the individual thermostatic mixing valves is controlled by an isolating stop tap/valve and installed with a cross-flow non-return valve.
- (e) Each thermostatic mixing valve and each associated valve, pressure control or temperature control shall be readily accessible.
- (f) The nominal size of the connecting piping and associated valves shall be not less than the nominal size of the thermostatic mixing valve.

NOTE 4 Refer to AS/NZS 3500.1 for sizing of pipes.

- (g) The flushing specified in [Clause 9.2](#) shall be undertaken —
- (i) prior to the installation of the thermostatic mixing valve(s); or
 - (ii) after the installation of the thermostatic mixing valve(s), provided each line-strainer integral and non-integral isolating valve and each thermostatic element/sensor is removed and cleaned and replaced after the flushing operation is completed.

NOTE 5 See [Clauses 9.3](#) and [9.4](#) for testing and commissioning requirements.

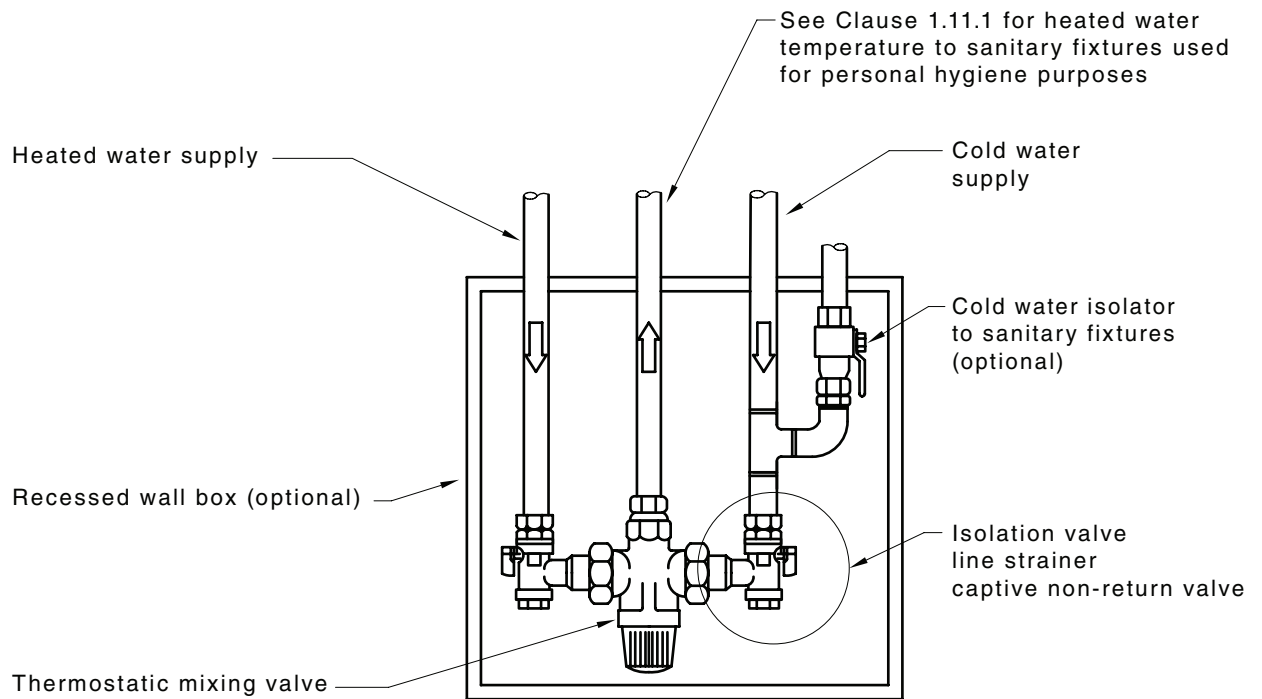


Figure 3.3 — Typical installation of thermostatic mixing valve

Section 4 Installation of cold and heated water piping and controls

4.1 Scope of section

This section sets out requirements for the installation of pipes, fittings, cold water storage tanks and apparatus used to supply water to and from a water heater.

***CA.1** Safety precautions need to be observed when cutting into pipework or disconnecting water meters, fittings and devices on pipework. There have been fatalities and injuries that have been attributed to water services carrying an electrical current.*

Where existing metallic service pipework is to be replaced in part or in its entirety by plastics pipe or other non-metallic fittings or couplings, the work should not commence until the earthing requirements have been checked by an electrical contractor and modified, if necessary.

4.2 Installation of pipes and fittings

Copper pipes and fittings shall be installed in accordance with AS 4809.

4.3 Proximity to other services

4.3.1 General

Where electrical conduits, wires, cables or consumer gas pipes, drains and other services are in existence, pipes shall be installed in accordance with [Clause 4.3.2](#).

4.3.2 Electrical cables, gas pipes and other services

4.3.2.1 General

Both above- and below-ground pipework associated with heated water services shall be installed so that —

- (a) no potential safety hazard is created when in close proximity to other services; and
- (b) access for maintenance and potential branch insertions is not impaired by other services.

4.3.2.2 Above-ground services

Separation of at least 25 mm shall be maintained between any above-ground water service and any of the following services:

- (a) Electrical or telecommunications conduits.
- (b) Electrical or telecommunications wires or cables.
- (c) Consumer gas pipes.
- (d) Sanitary plumbing and drainage.
- (e) Storm water drainage.
- (f) Other above-ground water services.
- (g) Any other services.

Where a pipe is insulated, the measurement shall be from the outer edge of any insulation or wrapped material applied to the pipework.

4.3.2.3 Below ground — Electrical cables and gas pipes

Below ground, the separation between pipework associated with heated water services and electrical cables and gas pipes shall be —

- (a) not less than 300 mm; or
- (b) not less than 100 mm, provided the electrical cables or gas pipes are marked and mechanically protected along their length within the exclusion zone.

NOTE Mechanical protection may be provided by concrete slabs, continuous concrete pour, polymeric cover strips, or bricks designed for protecting electrical supply cables and may include a suitable conduit.

4.3.2.4 Below ground — Communications

Below ground, the separation between pipework associated with heated water services and communication services shall be maintained at 100 mm.

4.3.3 Crossover of underground services

Below ground, any crossover of pipework associated with heated water service shall —

- (a) cross at an angle of not less than 45°;
- (b) have a vertical separation of not less than 100 mm; and
- (c) be marked and mechanically protected.

4.4 Methods of jointing

4.4.1 General

Jointing of pipework associated with heated 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* — Pipes or fittings shall not be damaged by the application of excessive heat.
- (c) *Use of fittings* — Where straight sections of pipe of different diameter are to be joined, such increase or reduction in size shall be made by a fitting.
- (d) *Crimping* — Crimping shall not be used to reduce pipe diameter when jointing.
- (e) *Jointing of copper or stainless steel pipes* — Copper or stainless steel water service pipes of different diameter shall not be joined by filling the annular space using a filler rod.

NOTE 1 AS 3688 specifies the types of metallic joints and end connectors.

- (f) *Fabricated fittings* — Where sockets and tees are fabricated from copper, copper alloy or stainless steel pipes:
 - (i) They shall be made using tools designed for such purposes.
 - (ii) They shall be jointed by silver brazing.
 - (iii) Copper tees shall not be fabricated from pipe of thickness less than Type C.

NOTE 2 In Australia, AS 1432 provides information on copper types.

NOTE 3 In New Zealand, copper tube conforming to NZS 3501 may also be used.

4.4.2 Compression joints

Plastics nuts shall not be used to connect any pipe to a cold water storage tank that supplies water to a water heater.

NOTE For further information on compression fittings, refer to AS 3688 and AS/NZS 4129.

4.4.3 Silver brazing

4.4.3.1 Joints

A compatible flux shall be used when making joints using silver brazing.

4.4.3.2 Taps and valves

Silver brazing shall not be used as a means of jointing taps or valves to pipes larger than DN 20. To prevent damage, the tap assembly and jumper valve shall be removed from the body of taps and valves prior to silver brazing.

4.4.4 Flanged joints

Flanged joints shall be appropriate for the test pressure requirements of [Section 9](#). Flanged joints shall be attached to the pipe by the following means:

- (a) Silver brazing in accordance with [Clause 2.7.3](#) for copper alloy to copper or copper alloy pipes or fittings.
- (b) Set screws for cast iron pipes and fittings.

Flange joints below ground shall be protected against corrosion in accordance with [Clause 4.9](#).

NOTE Refer to AS 2129 for information on flanges for pipes, valves and fittings.

4.4.5 Roll-grooved joints

Where used below ground, roll-grooved joints shall be —

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

NOTE Refer to AS 3688 for information on metallic fittings and end connectors.

4.4.6 Jointing of copper and copper alloy pipes

Fittings used to join copper and copper alloy pipes shall be installed in accordance with the installation requirements of AS 4809.

NOTE Fittings used for copper and copper alloys include capillary, press-fit, push-fit, roll-grooved, compression and threaded end connectors.

4.4.7 Jointing of stainless-steel pipe and fittings

4.4.7.1 Jointing of piping up to and including DN 25

Joints not larger than DN 25 shall be made by using either mechanically jointed compression fittings, press-fit end connectors or silver-brazed stainless steel capillary joints.

NOTE Refer to AS 3688 for information on metallic fittings and end connectors.

4.4.7.2 Jointing of piping larger than DN 25

Joints in stainless steel piping larger than DN 25 shall be one of the following:

- (a) Butt-welded using a tungsten inert gas (TIG) argon arc method and —
 - (i) have a gap not greater than 0.5 mm between the abutting pipe ends to be joined;
 - (ii) have inserted a back-up ring 6 mm long, made from the parent pipe, to straddle the joint of pipes with a wall thickness less than 1.2 mm;
 - (iii) use a low carbon stainless steel type filler rod not greater than 2 mm in diameter; and
 - (iv) be tack-welded in not less than four spots around the circumference, prior to welding the entire joint.
- (b) Flanged joints, using a stub flange, fabricated by rolling or welding to the pipe. The stub flange shall have —
 - (i) the same wall thickness as the pipe;
 - (ii) a diameter equal to the outside diameter (OD) of the mating part or have a mild steel backup flange fitted; and
 - (iii) a gasket not less than 3 mm thick inserted.
- (c) Stainless steel press-fit end connectors.

NOTE 1 Refer to AS 2129 for information on flanges for pipes, valves and fittings.

NOTE 2 Refer to AS/NZS 4331.1 for information on steel flanges.

NOTE 3 Refer to AS/NSS 4331.2 for information on cast iron flanges.

NOTE 4 Refer to AS/NZS 4331.3 for information on copper alloy and composite flanges.

NOTE 5 Refer to ASTM A182/A182M for information on forged or rolled alloy and stainless-steel pipe flanges.

4.4.8 Jointing of plastics pipes

4.4.8.1 PVC-C

Jointing of pipes and fittings of PVC-C material shall be carried out in accordance with AS/NZS 2032.

4.4.8.2 Other plastics pipes

Jointing of PB pipes shall be carried out using fittings that are compatible with PB pipes.

NOTE 1 The following Standards contain additional information:

- (a) AS/NZS 2642.3 — mechanical jointing fittings for use with hot and cold water polybutylene piping systems.
- (b) AS 5082.2 — mechanical and fusion jointing of polybutylene piping systems.

Jointing of PE-X pipes shall be carried out using fittings that are compatible with PE-X pipes.

NOTE 2 Refer to the AS/NZS 2537 series for information on mechanical jointing fittings for use with crosslinked polyethylene for pressure applications.

Jointing of MLP pipes shall be carried out using fittings that are compatible with MLP pipes.

NOTE 3 Refer to the AS 4176 series for information on multilayer pipes for pressure applications.

Jointing of PP-R pipes shall be carried out using fittings that are compatible with PP-R pipes.

NOTE 4 Refer to ISO 15874-3 for information on plastic piping systems for hot and cold water installations including appropriate PP-R fittings.

4.5 Support and fixing above ground

4.5.1 General

Water services installed above ground shall be retained in position by brackets, clips or hangers.

4.5.2 Brackets, clips and hangers

Brackets, clips and hangers shall be —

- (a) formed from a material compatible with the pipe;
- (b) securely attached to the building structure;
- (c) designed to withstand the applied loads;
- (d) protected against corrosion where exposed to a corrosive environment;
- (e) of like material or lined with a non-abrasive, inert material for that section where contact with the piping may occur;
- (f) clamped securely to prevent movement, unless designed to allow for thermal movement;
- (g) restrained to prevent lateral movement; and
- (h) installed so that no movement can occur while a valve is being operated and that the weight of the valve is not transferred to the pipe.

4.5.3 Limitations on pipe supports

The following methods of support shall not be used:

- (a) Pipes supported by brazing or welding short sections of any material to the pipe surface or by clamping, brazing or welding to adjacent pipes.
- (b) Brackets, clips and hangers incorporating PVC used in contact with stainless steel pipes.

4.5.4 Spacing

Water services shall be supported and fixed at the intervals specified in [Table 4.5.4](#).

Table 4.5.4 — Spacing of brackets and clips

Nominal pipe size DN	Maximum spacing of brackets and clips, m		
	Copper, copper alloy and stainless steel pipes	PE-X, PB, PVC-C and PP-R PE/AL/PE PE-X/AL/PE-X pipes	
		Horizontal or graded pipes	Vertical pipes
10	1.5	0.5	1
15	1.5	0.6	1.2
16	—	0.6	1.2
18	1.5	0.6	1.2
20	1.5	0.7	1.4
22	—	0.7	1.4

Table 4.5.4 (continued)

Nominal pipe size DN	Maximum spacing of brackets and clips, m		
	Copper, copper alloy and stainless steel pipes	PE-X, PB, PVC-C and PP-R PE/AL/PE PE-X/AL/PE-X pipes	
		Horizontal or graded pipes	Vertical pipes
25	2	0.75	1.5
32	2.5	0.85	1.7
40	2.5	0.9	1.8
50	3	1.05	2.1
63	—	1.1	2.2
65	3	1.2	2.4
75	—	1.3	2.6
80	3	1.35	2.7
90	3	1.4	2.8
100	3	1.5	3
110	—	1.5	3
125	3	1.7	3.4
140	—	1.7	3.4
150	3	2	4
160	—	2	4
200	3	2	4

NOTE Due to water pressure effects, additional brackets, clips or hangers (conforming to [Clause 4.5.2](#)) may be required to prevent movement.

4.5.5 Securing of pipes and fittings

Any pipe or fitting that may be subjected to strain or torsion shall be positively fastened against twisting or any other movement.

For heated water piping, the fixing shall be in such a manner as to allow movement due to thermal expansion and not to cause damage or corrosion to the pipe.

NOTE See [Clause 4.5.3\(b\)](#).

4.6 Location of piping

4.6.1 Concealed piping

4.6.1.1 Walls

Water services located in timber- or metal-framed walls shall be installed in accordance with the following:

- (a) *Timber wall framework* — Holes or notches made in timber studs and plates in walls shall be in accordance with the following:
 - (i) The maximum size and spacing of holes or notches in studs shall be in accordance with [Figure 4.6.1.1\(A\)](#) and [Table 4.6.1.1](#).
 - (ii) Where unlagged pipes are used, a collar of lagging material or a neutral cure silicone sealant shall be used to fill the annular space.
- (b) *Timber beams, bearers and joists* — Holes or notches made in timber beams, bearers and joists in floors shall be in accordance with [Figure 4.6.1.1\(B\)](#).

- (c) *Metal wall framework* — Water services shall be installed in existing preformed holes where possible. Additional holes, where required, shall be no larger than the preformed holes installed by the manufacturer or 32 mm when there are no pre-existing holes. The additional holes shall be placed —
- (i) with hole centres no further from the centreline of the member than $\pm 10\%$ of the member depth;
 - (ii) at a minimum spacing or end distance of 4 times the hole diameter (for single holes); and
 - (iii) at a minimum spacing or end distance of 8 times the hole diameter (for pair-to-pair or single-to-pair holes), see [Figure 4.6.1.1\(C\)](#).

If holes are less than 4 times the hole diameter apart, they are considered a pair.

NOTE 1 An engineered system may have more numerous or closely spaced holes depending on the design.

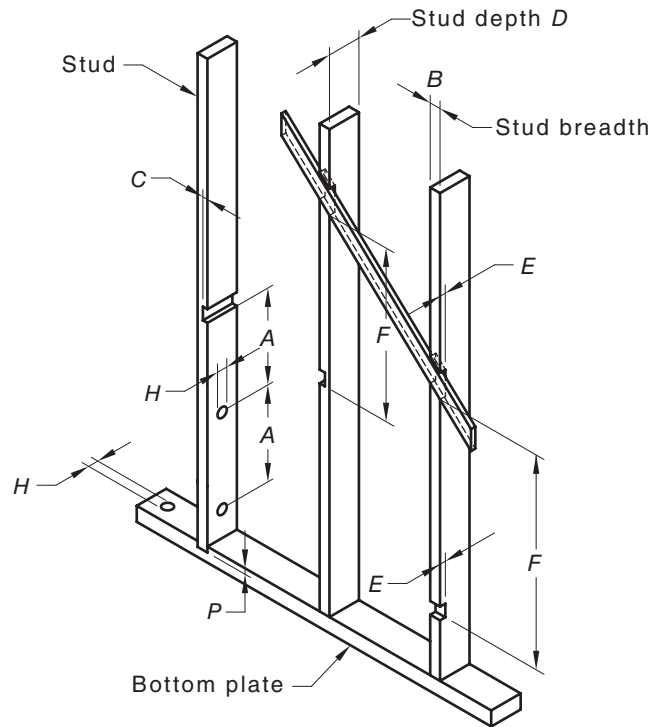
Holes may be plain (unflared) or flared. For plain holes, metal and polymer pipes shall be protected from contact with the hole edge. For flared holes, metal pipes shall be isolated from contact with the hole flare. Protection or isolation shall be provided using suitable grommets, insulation, or a short sleeve of oversize pipe firmly secured in the framework to be inserted around the pipe. There shall be no direct contact between the pipe and framework. There shall be free longitudinal movement of the pipe through the grommet, lagging or sleeve.

All pipes shall be secured in accordance with [Clause 4.5](#).

- (d) *Metal beams, bearers and joists* — Holes made in metal beams, bearers and joists shall be in accordance with [Figure 4.6.1.1\(D\)](#).

NOTE 2 Care should be taken to ensure that the air cavity moisture barrier within an external wall of any building is not bridged with pipe or pipe duct penetrations and porous pipe insulation materials. A clear air gap is required between the external wall and the pipe insulation material.

- (e) Pipes located in cavities shall be installed to prevent the transfer of moisture from the outer wall to the inner wall.



NOTE For definitions of symbols, see [Table 4.6.1.1](#).

Figure 4.6.1.1(A) — Notching of wall studs

Table 4.6.1.1 — Holes and notches in studs and plates

Symbol	Definition	Limits	
		Notched	Not notched
<i>A</i>	Distance between holes and/or notches in stud breadth	Minimum $3D$	Minimum $3D$
<i>H</i>	Hole diameter (studs and plates)	Maximum 25 mm (wide face only)	Maximum 25 mm (wide face only)
<i>C</i>	Notch into stud breadth	Maximum 10 mm	Maximum 10 mm
<i>E</i>	Notch into stud depth	Maximum 20 mm (for diagonal cut in bracing only) ^a	Not permitted ^a
<i>F</i>	Distance between notches in stud depth	Minimum $12B$	N/A
<i>P</i>	Trenches in plates	3 mm maximum	
^a horizontal line of notches up to 25 mm may be provided for the installation of baths.			

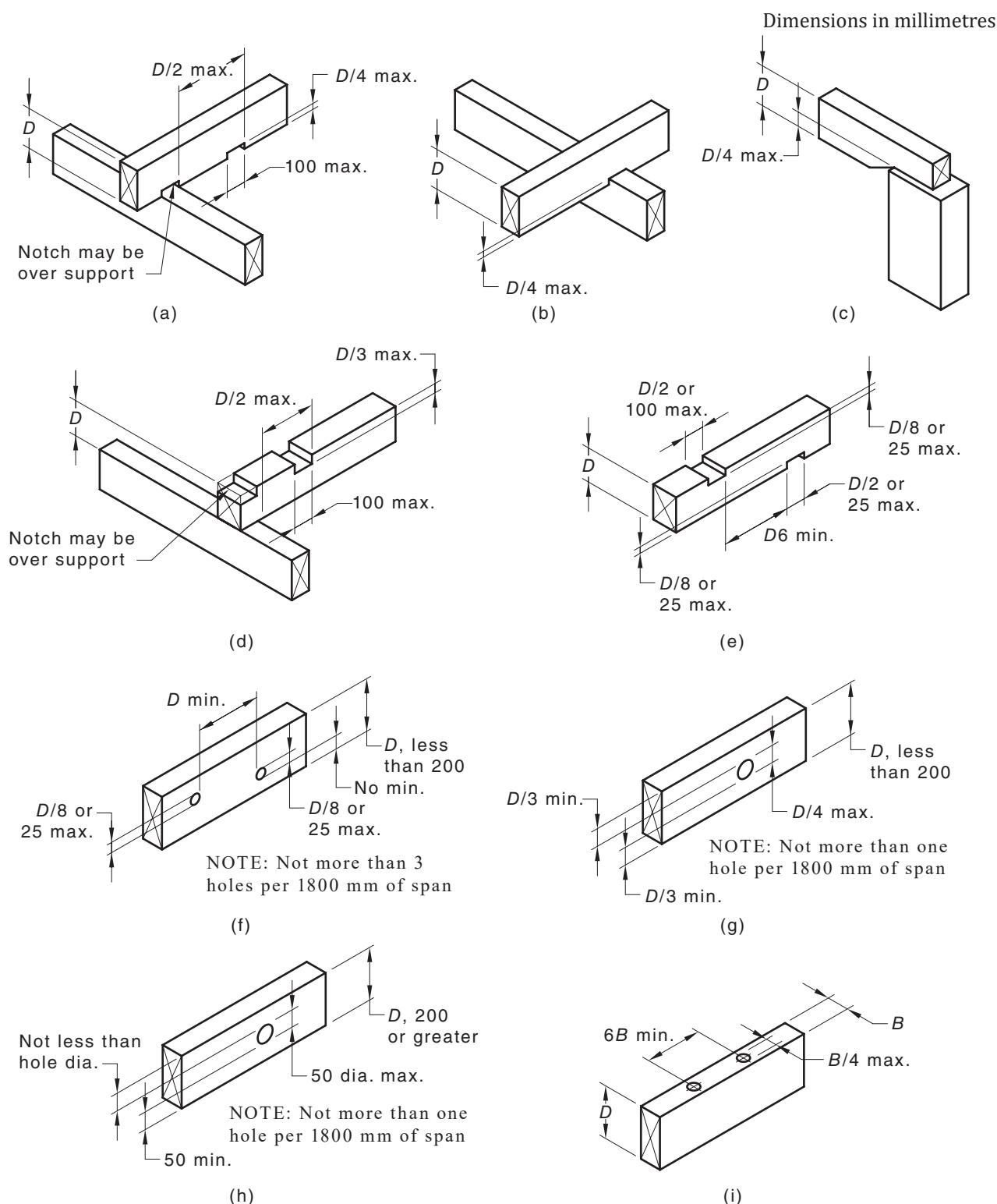


Figure 4.6.1.1(B) — Notches, cuts and holes in beams, bearers, joists, rafters

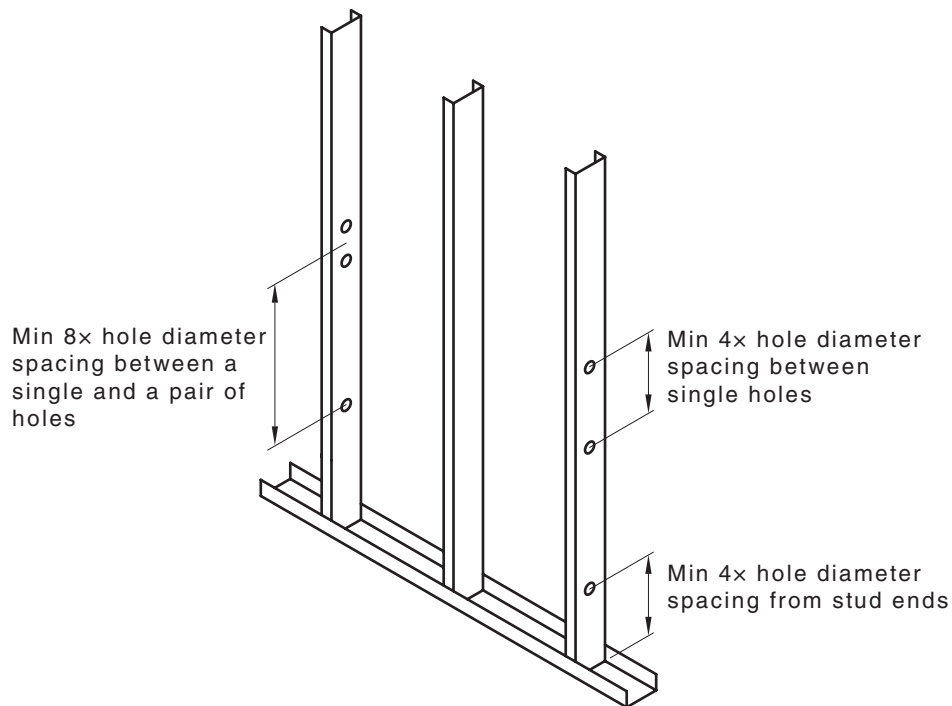


Figure 4.6.1.1(C) — Hole spacing in metal wall framework

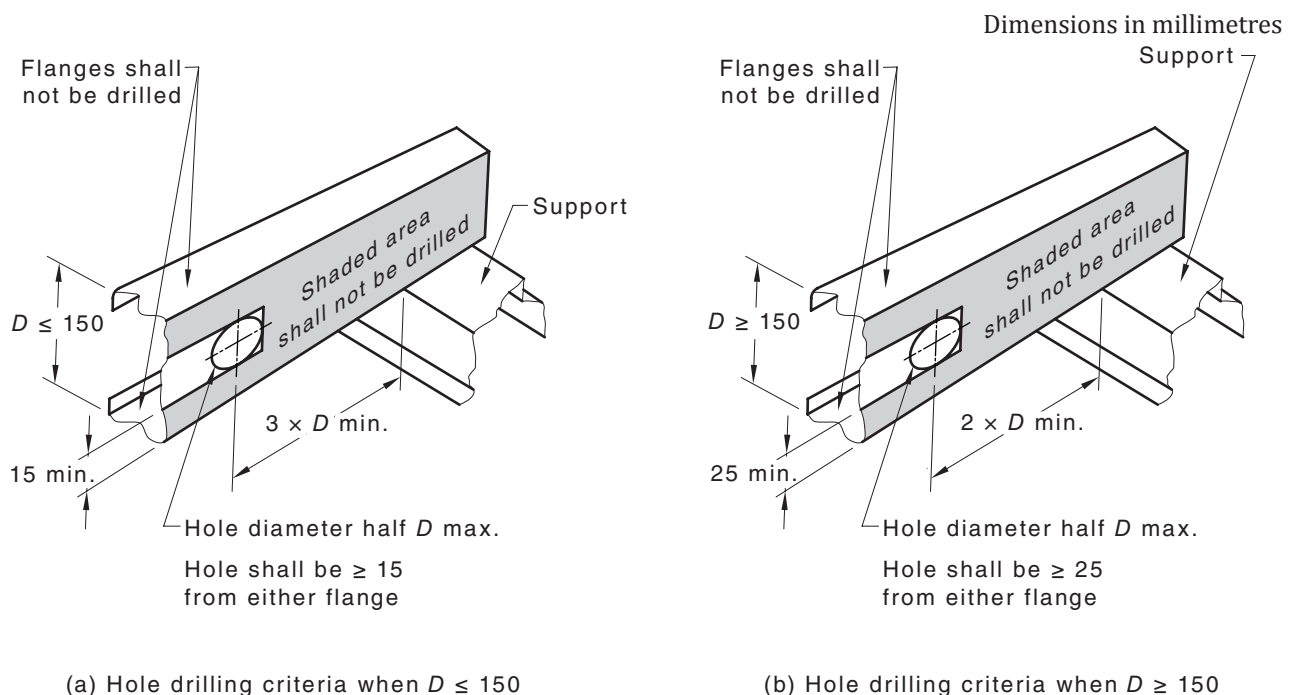


Figure 4.6.1.1(D) — Penetrations to steel floor joist

4.6.1.2 Chases, ducts or conduits

Pipes located in chases, ducts, conduits or embedded in masonry or concrete shall be installed in accordance with the following:

- (a) Pipes and fittings in chases shall be continuously wrapped with an impermeable flexible material.

- (b) Ducts shall be fitted with removable covers.
- (c) Adequate allowance shall be made for expansion and contraction in accordance with [Clause 4.13.3](#).
- (d) Pipes shall not be embedded or cast into concrete structures.

4.6.1.3 Under concrete slabs

Water service pipes located beneath concrete slabs on ground level shall conform to the following:

- (a) Pipes shall be insulated in accordance with [Clause 8.2](#), laid in a narrow trench on a bed of sand or fine-grained soil, placed and compacted in a manner that will not damage the piping or insulation. There shall be a minimum distance of 75 mm between the pipe and the underside of the slab.
- (b) Pipe ends shall be crimped or capped prior to pouring of the concrete. The exposed pipe shall be protected from damage.
- (c) Any piping that penetrates the slab shall be at right angles to the surface of the slab and be lagged with an impermeable, flexible plastic material not less than 6 mm thick for the full depth of the slab penetration.
- (d) Soft-soldered joints shall not be used.
- (e) The number of joints shall be kept to a minimum.

4.6.2 Protection during building construction

Concealed pipework shall be maintained under normal water pressure during subsequent building operations. The service shall be flushed with clean water at regular intervals until the building is occupied.

NOTE Care should be taken to ensure that the pipes are not damaged during building activities.

4.6.3 Floor or roof penetrations

Any suspended floor or roof penetration shall be rendered waterproof to allow for expansion.

4.6.4 Provision for movement of encased piping

All heated water piping, including relief drain pipes, encased in plaster, mortar or similar material shall be wrapped to allow movement due to expansion and contraction.

4.7 Bedding and backfill

The water services shall be surrounded with not less than 75 mm of compacted sand, or fine-grained soil, with no hard-edged object in contact with or resting against any pipe or fitting.

NOTE See [Figure 4.7](#) for a typical installation in a trench.

Backfill shall be free from builder's waste, bricks, concrete pieces, rocks or hard matter larger than 25 mm and broken up so that it contains no soil lumps larger than 75 mm.

Copper and stainless steel pipelines may be installed in soil excavated from the trench in which it is to be installed, provided the soil is compatible with copper and stainless steel and free from rock and rubble.

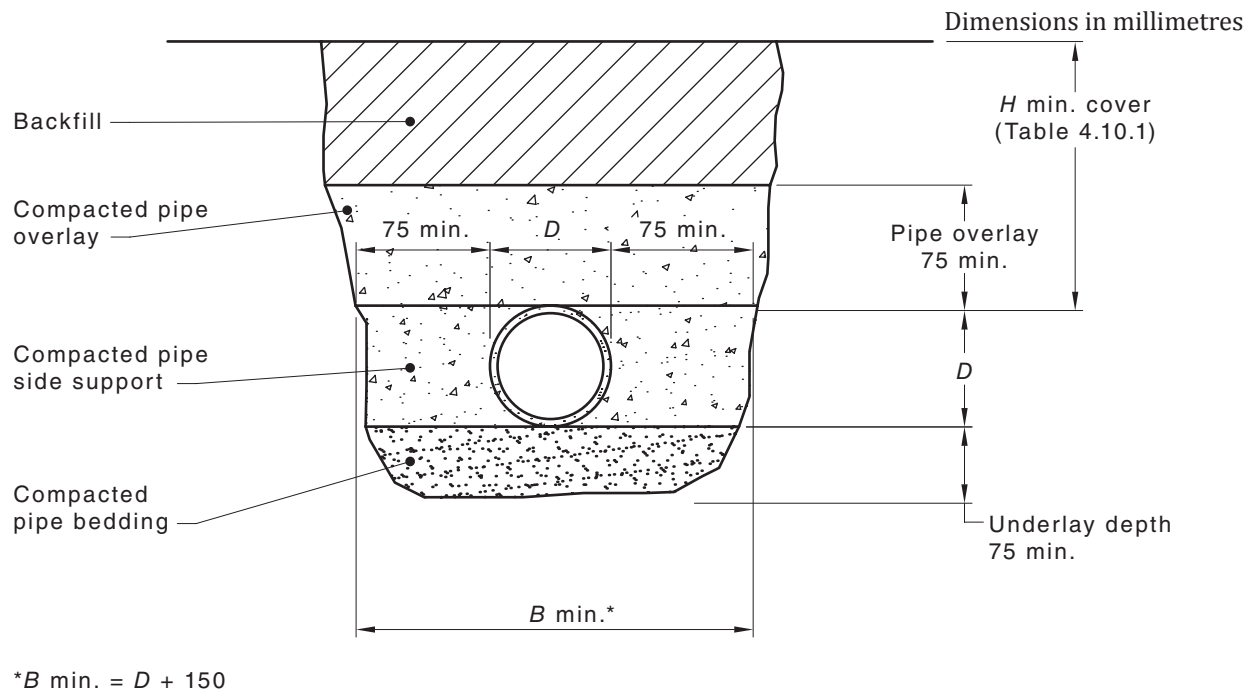


Figure 4.7 — Typical installation in a trench

4.8 Contaminated areas — Installation

Water services shall not be installed in or through a contaminated area unless the water service is —

- (a) laid through a watertight, corrosion-resistant conduit of length and strength adequate to protect the water service; or
- (b) fixed not less than 600 mm above the surface of the ground likely to be contaminated.

NOTE Contaminated areas are areas that may be contaminated by bacterial or chemical pollution and may include ashpits, tanks, ponds, manure bins, waste disposal sites and wastewater treatment works.

4.9 Corrosive areas

Where metallic pipes, metallic fittings or Type M multilayer pipes are installed in a water service in a corrosive area, they shall be externally protected by —

- (a) having an impermeable flexible plastic coating;
- (b) a sealed polyethylene sleeve; or
- (c) fully wrapped in a petrolatum taping material.

NOTE Corrosive areas are those that contain substances such as any compound consisting of magnesium oxychloride (magnesite) or its equivalent, coal wash, acid sulfate soils, sodium chloride (salt), ammonia or materials that could produce ammonia.

4.10 Depth of cover

4.10.1 Depth of cover in public areas

Where heated water services are installed below ground in public areas, the minimum cover shall conform to [Table 4.10.1](#).

Table 4.10.1 — Minimum cover in public areas for buried piping

Location	Minimum cover measured below finished surface level, mm
Unpaved	450
Paved or road surface	450
Solid rock	300

4.10.2 Depth of cover in private areas

Where heated water services are installed below ground in private property, the minimum cover shall conform to [Table 4.10.2](#).

Table 4.10.2 — Minimum cover in private property for buried piping

Location	Minimum cover measured below finished surface level, mm
Subject to vehicular traffic	300
Under houses or concrete slabs	75
All other locations	225
NOTE Heated water services with flexible joints laid below ground in sandy conditions may require a minimum cover of 600 mm.	

4.11 Protection against freezing

4.11.1 Requirement for protection

In areas where the ambient temperature frequently falls to or below 0 °C, water services shall be protected to prevent damage from freezing.

NOTE 1 See also [Section 8](#).

NOTE 2 Information regarding locations which have annual minimum temperatures below 0 °C can be obtained from —

- (a) the Bureau of Meteorology (BOM) in Australia; or
- (b) the National Institute of Water and Atmosphere (NIWA) in New Zealand.

4.11.2 Piping located outside buildings

All pipes and fittings shall be buried to a minimum depth of 300 mm. Where this is not practicable, the piping shall be covered with waterproof insulation.

4.11.3 Pipes located on metal roofs

Pipes shall not be installed in direct contact with metal roofs. Where it is necessary to run piping across a metal roof, it shall be fixed above the roof and surrounded with a waterproof insulation of minimum thickness as given in [Table 4.11.5\(B\)](#) or [Table 8.2.2](#), as appropriate.

NOTE Consideration should be given to the effects of thermal expansion and contraction of the roof material.

4.11.4 Pipes located inside buildings

4.11.4.1 General

Pipes shall be installed so as to avoid those areas of the building that are difficult to keep warm and where temperatures are likely to fall below freezing. These areas include —

- (a) unheated roof spaces;
- (b) unheated cellars;
- (c) locations near windows, ventilators or external doors where cold drafts are likely to occur; and
- (d) locations in contact with cold surfaces, such as metal roofs, metal framework, or external metal cladding materials.

4.11.4.2 Pipes in unheated roof spaces

Pipes in unheated roof spaces shall be located not less than 100 mm from the roof covering and external walls.

NOTE Where practicable, pipes should be located under any insulating material laid for restricting heat losses through the ceilings.

4.11.4.3 Pipes adjacent to external walls

Pipes in external walls shall be positioned not less than 20 mm away from the external surface.

NOTE Where practicable, pipes should be located on the heated side of any wall insulation present.

4.11.5 Insulation of piping and fittings

Where it is necessary to install piping in areas where temperatures are likely to fall below freezing (see [Clause 4.11.4.1](#)), the pipes and fittings shall be surrounded by an appropriate thickness of insulation. The minimum thickness of thermal insulation to prevent freezing of water in pipes shall be in accordance with [Table 4.11.5\(B\)](#).

NOTE 1 Typical examples of materials are given in [Table 4.11.5\(A\)](#).

NOTE 2 If conditions are particularly severe over an extended time, additional thicknesses of insulation may be necessary to prevent water freezing.

NOTE 3 In situations where the building, or part of the building, is not in use over the winter months and no heating of the inside areas is maintained, it may be necessary to drain the pipes to prevent damage by freezing of the water. For effective drainage to occur, it is essential for air to enter freely the pipes, and for all draw-off taps and float valves to be left open when draining is being carried out.

Table 4.11.5(A) — Typical examples of insulating materials

Example of material	Thermal conductivity, W/m.K
Rockwool or fibreglass section pipe insulation (prefabricated sections)	0.032
Rockwool or fibreglass loose fill or blanket material	0.032–0.045
Flexible polyethylene foam pipe	0.034–0.040
Closed-cell polymer	0.040
Loose vermiculite (exfoliated)	0.06–0.07

Table 4.11.5(A) *(continued)*

Example of material	Thermal conductivity, W/m.K
Pre-insulated copper pipe	0.070–0.075

Table 4.11.5(B) — Minimum thicknesses for thermal insulation to prevent freezing of water in pipes

Pipe size DN	Minimum thickness required, mm				
	Thermal conductivity of insulating material, W/m.K				
	0.03	0.04	0.05	0.06	0.07
15	9	14	20	29	40
18	6	9	12	15	20
20	4	6	8	10	12
25	3	4	5	6	8
32	2	3	4	5	6

NOTE The insulation thicknesses were calculated using the equations given in BS 5422 to just prevent freezing of water initially at 15 °C if exposed to an ambient temperature of –5 °C for a period of 8 h.

4.12 Cold water piping and storage tanks

4.12.1 General

The following requirements shall apply to cold water piping to water heaters and storage tanks, and to cold water storage tank piping:

- (a) *Tank connections* — Unions or similar couplings shall be used for the connections to the inlet and outlet of a separately mounted cold water storage tank.
- (b) *Cold water storage tank piping* — Cold water feed piping between a cold water storage tank that is not an integral part of a water heater and the water heater shall —
 - (i) have a nominal size not less than DN 25 for a displacement water heater, and larger than the nominal size of the heater outlet;
 - (ii) be fitted with a gate valve or other full-way valve of the same nominal size as the piping, if the cold water storage tank has a capacity exceeding 50 L; and
 - (iii) be connected to the water heater inlet by unions or similar couplings to facilitate disconnection.

4.12.2 Cold water storage tank

4.12.2.1 General

Cold water storage tanks installed to supply water to a water heater shall meet the following requirements:

- (a) They shall be constructed of a material conforming to [Clause 2.3](#) and having equivalent strength and durability to copper sheet of 0.55 mm thickness.
- (b) For metal tanks, they shall —
 - (i) be reinforced along the upper edges to prevent distortion of the tank;
 - (ii) be welded, brazed or soft-soldered at all joints;

- (iii) be independent of the solder for mechanical strength of soldered joints; and
 - (iv) have joints of a type suitable for the water conditions for which the cold water storage tank is intended.
- (c) They shall have a threaded outlet of brass or other suitable material.
- NOTE 1 In Australia, refer to AS ISO 7.1 for information on pipe threads where pressure-tight joints are made on threads.
- NOTE 2 In New Zealand, refer to NZS/BS 21 for information on pipe threads for tubes and fittings where pressure-tight joints are made on the threads.
- The outlet shall be —
- (i) placed as far as practicable from the float valve outlet;
 - (ii) fixed so as to provide a distance of not less than 25 mm between the floor of the tank and the invert of outlet; and
 - (iii) secured into the tank by a method appropriate to the materials to ensure a permanent watertight and mechanically strong connection, which shall not rely on soft solder alone for this purpose.
- (d) They shall be fitted with a float valve.
- (e) They shall incorporate an air gap in accordance with AS/NZS 3500.1.
- (f) They shall be clearly and indelibly marked with the static level at which the water is to be set.
- (g) They shall be fitted with a close-fitting cover, which, in the case of external tanks, shall be secured and of material having corrosion-resisting properties not inferior to 0.5 mm thick galvanized steel sheet.
- (h) In New Zealand, they shall be seismically restrained against movement in accordance with NZS 4219 or NZBC Acceptable Solution G12/AS1.

NOTE 3 Typical installations of water tanks are shown in [Figures 5.4.5](#) and [5.5.1](#).

NOTE 4 Refer to AS 1910 for information on float control valves for use in heated and cold water.

NOTE 5 Refer to AS 1397 for information on continuous hot-dip metallic coated steel sheet and strip.

4.12.2.2 Water storage tank capacity

Where a displacement water heater or container is supplied from a remote tank, the tank shall have an effective capacity between the outlet and the marked water level not less than the following:

- (a) 36 L for water heaters or containers up to and including 400 L capacity.
- (b) 68 L for water heaters or containers greater than 400 L up to and including 700 L capacity.

NOTE Allowance for extra capacity should be made where the cold water storage tank is required to supply water additional to the supply to the water heater.

4.12.2.3 Flow capacity

The capacity of the float valve and all pressure piping to the float valve and connecting pipes from the cold water storage tank to the water heater or container shall be capable of maintaining a water flow rate of not less than —

- (a) 0.21 L/s (12.5 L/min) for water heaters or containers with volumetric storage capacity up to 400 L; or

- (b) 0.27 L/s (16 L/min) for water heaters or containers with volumetric storage capacity greater than 400 L up to and including 700 L.

This flow rate shall be maintained during the drawing-off of the capacity of the water heater or container without the water level of the cold water feed tank falling to a point that allows air to enter either the water heater or container, or the heated water supply piping.

4.12.2.4 Cold water storage tank overflow

Each cold water storage tank shall be fitted with an overflow conforming to the following requirements:

- (a) The overflow from the cold water storage tank shall be so placed that, with the water in the tank at the marked level, either —
- (i) a further quantity of water, not less than 3 % of the hot water capacity of the heater, can be added before overflow occurs; or
 - (ii) there shall be no discharge from the overflow during the initial heating of the water through a 70 °C temperature rise.
- (b) The overflow from an internally mounted cold water storage tank shall discharge into —
- (i) the safe tray of the cold water storage tanks, terminating not less than 20 mm above the top edge of the safe tray; or
 - (ii) into the waste from the safe tray at a point not less than 75 mm below the floor of the safe tray.
- (c) The overflow shall be constructed so that with the float valve discharging at its maximum flow, with water pressure of 700 kPa and with all service outlets closed, no spillage occurs from the cold water storage tanks. The vertical distance between the static overflow level and the lowest outlet of the float valve shall be in accordance with AS/NZS 3500.1.
- (d) The overflow from an externally mounted cold water storage tank shall —
- (i) discharge so as to be readily discernible and not cause a nuisance over windows, open doors or incur damage to buildings or injury to persons; and
 - (ii) be installed in a manner to prevent blockage due to freezing.

4.12.2.5 Position of cold water storage tanks

Cold water storage tanks shall be placed in accordance with the following:

- (a) *Mounted on water heater* — Where the water heater is supplied complete with an attached cold water storage tank that is connected to the container, the tank shall not be removed from that position.
- (b) *Separately mounted* — Each separately mounted cold water storage tank shall be placed so that the vertical distance from the marked water level of the tank to the base of the water heater or container does not exceed a height equivalent to the maximum pressure rating marked on the water heater.

NOTE See also [Clause 4.13.5\(c\)](#).

4.12.3 Safe tray for cold water storage tanks

Cold water storage tanks fixed in a roof space or other concealed space shall be placed on a safe tray conforming to [Clause 5.4.3](#). Where the tank is mounted on the water heater, a water heater safe tray conforming to [Clause 5.4](#) shall be deemed acceptable as the safe tray for the cold water storage tanks.

NOTE In New Zealand, safe trays are only required where leakage could result in damage to another occupancy in the same building.

4.12.4 Support for separately mounted cold water storage tanks

4.12.4.1 Platform

Each separately mounted cold water storage tank shall be supported on a platform conforming to [Clause 5.5](#).

4.12.4.2 Spacing between cold water storage tank and safe tray

The cold water storage tank shall be placed on the safe tray on supports in accordance with [Clause 5.4.5](#).

4.13 Installation of heated water services

4.13.1 Design and installation

Water flow velocities in heated water piping shall be in accordance with [Clause 1.8](#).

NOTE 1 See [Table 10.3.2](#) for minimum rates of flow.

NOTE 2 See [Appendix D](#) for preferred sizes of pipes ([Table D.1](#)).

NOTE 3 Where the distance between hot water outlets causes an excessive amount of dead water, the use of two or more heaters, trace heating of pipes or a heated water circulatory system should be considered.

NOTE 4 See [Clause 4.13.4](#) for gradient requirements.

NOTE 5 For New Zealand, refer to NZS 4305 for pipe lengths from cylinders to kitchen outlets.

NOTE 6 [Appendix M](#) provides guidelines for the operation and maintenance of heated water services.

4.13.1 *In the interests of amenity and water efficiency, the design of a heated water system should also —*

- (a) *reduce to a minimum the amount of dead (cold) water drawn off before hot water commences to flow at any tap;*
- (b) *be sufficient to give the required flow at all outlets (including branches from non-circulatory services);*
- (c) *be by the shortest practicable route for the main flow heated water pipes and branches to the heated water outlets; and*
- (d) *be the minimum necessary diameter of the heated water pipes required to supply the outlet draw-off.*

4.13.2 Identification of piping

Accessible pipework shall be permanently marked so as to be readily identifiable as part of the heated water service within:

- (a) In Australia, all Class 2 to Class 9 buildings (multi-unit, commercial and industrial buildings).
- (b) In New Zealand —
 - (i) multi-unit dwellings, including apartment buildings but excluding low rise multi-unit dwellings such as an attached dwelling or flat;
 - (ii) communal residential buildings, excluding holiday cabins and backcountry huts;
 - (iii) communal non-residential buildings;
 - (iv) commercial buildings; and
 - (v) industrial buildings.

NOTE 1 In Australia, refer to the NCC for information on building classes.

NOTE 2 In New Zealand, refer to NZBC Clause A1 Classified Uses for information on building use categories.

Identification markings shall be placed —

- (i) at spacings not exceeding 6 m;
- (ii) adjacent to branches, junctions, valves, service appliances, bulkheads, and wall and floor penetrations; and
- (iii) at every floor level within vertical ducts and riser cupboards.

NOTE 3 Refer to AS 1345 for information on identification tags and labels in Australia.

NOTE 4 Refer to NZS 5807 for information on identification marking in New Zealand.

4.13.3 Provision for expansion

Heated water supply pipes shall be installed with allowance for expansion and contraction and have —

- (a) a free length of piping around the bend or along the branch sufficient to prevent overstressing the pipe and allow for thermal expansion;
- (b) a clear space to allow movement for expansion as calculated and have unrestrained offsets at changes in direction;
- (c) expansion loops at or near midpoint in straight lengths that exceed 18 m; or
- (d) expansion joints fitted.

Expansion loops shall be placed horizontally to avoid forming air locks at the top of the loops and to ensure circulation of the water.

The rates of thermal expansion for common pipe materials shall be calculated in accordance with [Appendix N](#).

4.13.4 Gradient

The grading of a heated water reticulation service shall conform to the following:

- (a) *Mains pressure or pressure-limiting valve-controlled reticulation* — rise or fall as required subject to the requirements of [Clause 4.13.5](#).

- (b) *Reducing valve-controlled reticulation* — rise and fall as required subject to the provisions of [Table 4.13.4](#).
- (c) *Cold water storage tank-fed reticulation* — rise or fall continuously in the direction of flow with a minimum grade of 1 in 200.

Table 4.13.4 — Maximum rise

Reducing valve setting kPa	Highest point of reticulation above reducing valve outlet m
25	1.5
30	1.75
35	2.0
40	2.5
45	2.75
50	3.0
70	4.5
100	6.5

4.13.5 Maximum rise of heated water supply pipes

The maximum rise of heated water supply pipes shall be as follows:

- (a) *For mains pressure reticulation* — 60 % of the available mains pressure, expressed in metres head, above the level of the cold water inlet.
- (b) *For pressure-limiting valve or pressure-reducing valve-controlled reticulation* — 60 % of the valve setting, expressed in metres head, above the level of the cold water inlet.
- (c) *For cold water storage tank-fed reticulation* — 1 m below the marked water level of the cold water storage tank.

NOTE For the purpose of this clause, 10 kPa = 1 m head should be used.

4.13.6 Shower assemblies

Where the heated water is at a lower pressure than the cold water, the heated and cold water mixing assembly shall be constructed so that the cold water flow does not restrict the heated water flow.

4.13.7 Venting of secondary circuit

Each low-pressure-fed secondary circuit shall be vented at the highest point of the rise on the secondary flow pipe by either —

- (a) a vertical vent pipe conforming to [Clause 5.12](#); or
- (b) an automatic air elimination device suitable for that purpose.

4.13.8 Recirculation of cold water

A heated water return line may be returned to the water heater inlet by either —

- (a) connecting between the non-return valve and the water heater; or

NOTE For typical arrangements of the above, see [Figures 5.10.2\(A\)](#) and [5.10.2\(B\)](#).

- (b) connecting to the cold water pipes using a device that will prevent heated water from entering the cold water pipes.

Section 5 Installation of water heaters — General requirements

5.1 Scope of section

This section sets out general requirements for the installation of water heaters, their location, support, cold water service valves, the vent or drain lines and the first 2 m of heated water supply piping.

NOTE For energy efficiency requirements, see —

- (a) [Section 8](#); and
- (b) in Australia, the National Construction Code; or
- (c) in New Zealand, New Zealand Building Code Clause H1 Energy Efficiency.

5.2 Water heaters

5.2.1 Selection of anode

Any anode fitted to a water heater shall be compatible with the water supplied to the water heater.

NOTE 1 See [Clause 1.6](#) for water chemistry requirements and [Appendix A](#) for water analysis recommendations.

NOTE 2 Refer to the water heater manufacturer for information on the suitability of the anode.

5.2.2 Working pressure

Water heaters shall be installed so that the maximum rated working pressure is not exceeded during normal operation.

NOTE Maximum rated working pressure should be listed on the heater label affixed by the manufacturer.

5.3 Location

5.3.1 Placement

The water heater shall be placed as close as practicable to the most frequently used outlet point or points. Consideration shall be given to the route taken by vent pipes, drain lines or safe wastes.

5.3.2 Accessibility and clearances

Water heaters shall be located and oriented in accordance with the following:

- (a) The rating plate and instruction notice shall be in a visible position.
- (b) Unobstructed access shall be available to the burner, heating units, controls, cold water storage tanks and other apparatus requiring maintenance.
- (c) All valves and the easing gear on a relief valve shall be readily accessible.
- (d) There shall be 150 mm minimum clearance from the end of the easing gear of temperature/pressure-relief valves to allow for valve removal.
- (e) The heater shall be subsequently removable without major structural alteration to the building or major alteration to the piping.

NOTE 1 Wherever practicable, clearance should be allowed for removal and replacement of anodes, where fitted.

NOTE 2 See [Clause 4.13.4](#) for cold water storage tank-fed water heaters.

5.3.3 Ventilation and fluing

Fuel-burning water heaters shall be located to provide the correct ventilation and fluing.

5.4 Protection against damage from leaking water

5.4.1 Concealed water storage tanks

All water containers, cold water storage tanks, cold water storage tank-fed water heaters or storage water heaters that are installed in roof spaces, in cupboards or otherwise concealed shall be placed on safe trays conforming to [Clause 5.4.3](#). The safe trays shall be drained by safe wastes conforming to [Clause 5.4.4](#).

Notwithstanding the above requirements, mains pressure water heaters may be installed on a safe tray without a safe waste, provided a leak protection device is fitted adjacent to the cold water inlet and upstream of any expansion control valve.

NOTE See [Clause 5.9.4\(f\)](#) and [Figures 5.9.4\(A\) to 5.9.4\(D\)](#) for typical valve installations.

5.4.2 Unconcealed water storage tanks

Unconcealed water storage tanks, installed inside buildings on or above a floor surface that is impervious to water and suitably drained to a trapped or untrapped floor drain or an external doorway, do not require safe trays.

A mains pressure water heater with a leak protection device fitted adjacent to the cold water inlet and upstream of any expansion control valve does not require a safe waste.

All other unconcealed water storage tanks that are installed inside buildings shall be installed with safe trays conforming to [Clause 5.4.3](#) and safe wastes conforming to [Clause 5.4.4](#).

NOTE Free outlet-type storage water heaters not exceeding 13.5 L capacity and instantaneous water heaters do not require safe trays.

5.4.3 Safe tray construction

Safe trays shall be fabricated from materials that conform to the requirements of [Clause 2.6.1](#). The sides of the safe tray shall be turned up not less than 50 mm. All joints shall be made watertight.

5.4.4 Safe wastes

5.4.4.1 Sizes of safe wastes

The minimum sizes of safe wastes shall be —

- (a) DN 25 for safe trays in under-sink situations; or
- (b) DN 50 (DN 40 New Zealand only) for all other situations.

5.4.4.2 Safe waste construction

Safe wastes shall be fabricated with all joints in sheet metal pipe lapped in the direction of the flow and all circumferential joints made watertight.

5.4.4.3 Safe waste installation

Each safe waste shall conform to the following:

- (a) It shall have a continuous fall to its discharge point.

- (b) All seams in sheet metal pipe shall be uppermost.
- (c) It shall include support in the vicinity of the tray and at intervals not greater than 1 m horizontally and 2.4 m vertically.
- (d) The discharge position shall conform to the following:
 - (i) Where discharging outside the building, it shall discharge to a point within the property boundaries that is readily visible from within the property, clear of doors, windows and other openings and is unlikely to cause injury to people or damage to property.
 - (ii) Where discharging inside the building, it shall discharge to a readily visible position that is unlikely to cause injury to people or damage to property.
 - (iii) Where cold water storage tanks or cold water storage tank-fed water heaters are outside the building, it shall discharge to a readily visible position.

5.4.5 Placement of water heater or cold water storage tank on a safe tray

The water heater or cold water storage tank shall be placed on a safe tray and conform to the following:

- (a) It shall have no portion of any attached feed tank closer than 75 mm to a vertical line from the edge of the safe tray and no portion of the heater or cold water storage tank or any attached auxiliary part closer than 25 mm to the vertical line.
- (b) It shall have placed, between the tank and the safe tray, supports not less than 12 mm thick and of an area not less than $0.5A$, nor more than $0.6A$, where A is the area of the base of the tank. The support shall project beyond the sides and walls of the tank but not closer than 20 mm to the sides of the safe tray.

NOTE See [Figure 5.4.5](#) for a typical installation of a safe tray, including position of water heater or cold water storage tank.