COMMITTEE WS-014-04

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Plumbing and drainage
Part 4: Heated water services
(Revision of AS/NZS 3500.4:2015)

STANDARDS Australia

STANDARDS® NEW ZEALAND PAEREWA AOTEAROA

Draft for Public Comment
Australian/New Zealand Standard

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Draft for Public Comment

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Committee WS-014-04—Plumbing and Drainage

Subcommittee Plumbing and Drainage—Heated Water

DRAFT

Australian/New Zealand Standard

Plumbing and drainage

Part 4: Heated water services

Revision of AS/NZS 3500.4:2015

To be AS/NZS 3500.4:201X

Comment on the draft is invited from people and organizations concerned with this subject. It would be appreciated if those submitting comment would follow the guidelines given on the inside front cover.

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This document is a draft Australian/New Zealand Standard only and is liable to alteration in the light of comment received. It is not to be regarded as an Australian/New Zealand Standard until finally issued as such by Standards Australia/Standards New Zealand.

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee WS-014, Plumbing and Drainage, to supersede AS/NZS 3500.4:2015.

The objective of this Standard is to provide solutions to comply with—

(a) the National Construction Code (NCC), Volume Three—Plumbing Code of Australia (PCA), and

(b) the New Zealand Building Code (Clause G12 Water Supplies).

This Standard is part of a series of Standards for plumbing and drainage, as follows:

AS/NZS		
3500	Plumbing and drainage	
3500.0	Part 0:	Glossary of terms
3500.1	Part 1:	Water services
3500.2	Part 2:	Sanitary plumbing and drainage
3500.3	Part 3:	Stormwater drainage
3500.4	Part 4:	Heated water services (this Standard)

The objective of this revision of to update requirements relating to plastic pipes in direct sunlight, circulatory heated water, thermostatically controlled taps and clarification for jointing methods. Some materials and products used in a heated water service are provided with instructions for installation and use. While not a requirement of this Standard, or acceptable as an alternative to the requirements of this Standard, conformance with these instructions generally ensures that—

(A) the material or product is fit for the application;

(B) the performance of the system is not degraded;

(C) the durability of the material or product is not impaired; and

(D) the manufacturer's warranty remains valid.

PROVISION FOR REVISION

This Standard necessarily deals with existing conditions, but is not intended to discourage innovation or to exclude materials, equipment and methods that may be developed in future. Revisions will be made from time to time in view of such developments and amendments to this edition will be made only when absolutely necessary.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to figures and tables are deemed to be requirements of this Standard.

Notes used in this Standard are of an advisory nature only and are used to give explanation or guidance to the user on recommended considerations or technical procedures, or to provide an informative cross-reference to other documents or publications. Notes to clauses in this Standard do not form a mandatory part for conformance with this Standard.

This Standard 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 Standard.

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out 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 Standard 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: 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.

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

NOTE: Appendix M provides guidelines for the operation and maintenance of heated water services.

1.2 APPLICATION

1.2.1 Australia

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

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 Standard shall be read in conjunction with the New Zealand Building Code in New Zealand. This Standard may be used for compliance with the New Zealand Building Code, Paragraph 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 are the normative documents referenced in this Standard.

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

AS

1074 Steel tubes and tubulars for ordinary service

1345 Identification of the contents of pipes, conduits and ducts

1379 Specification and supply of concrete

1397 Continuous hot-dip metallic coated steel sheet and strip—Coatings of zinc and zinc alloyed with aluminium and magnesium

1432 Copper tubes for plumbing, gasfitting and drainage applications

1478 Chemical admixtures for concrete, mortar and grout
1478.1 Part 1: Admixtures for concrete

1604 Specifications for preservative treatment (series)

1646 Elastomeric seals for waterworks purposes

1910 Water supply—Float control valves for use in hot and cold water

2129 Flanges for pipes, valves and fittings

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

3600 Concrete structures

3688 Water supply—Metallic fittings and end connectors

3795 Copper alloy tubes for plumbing and drainage applications

4032 Water supply—Valves for the control of heated water supply temperatures
4032.1 Part 1: Thermostatic mixing valves—Materials design and performance requirements
4032.2 Part 2: Tempering valves and end-of-line temperature-actuated devices

4087 Metallic flanges for waterworks purposes

4176 Multilayer pipes for pressure applications
4176.1 Part 1: Multilayer piping systems for hot and cold water plumbing applications—General (ISO 21003-1:2008, MOD)
4176.2 Part 2: Multilayer piping systems for hot and cold water plumbing applications—General Multilayer piping systems for hot and cold water plumbing applications—Pipes (ISO 21003-2:2008, MOD)
4176.3 Part 3: Multilayer piping systems for hot and cold water plumbing applications—Fittings (ISO 21003-3:2008, MOD)
4176.5 Part 5: Multilayer piping systems for hot and cold water plumbing applications—Fitness for purpose of the systems (ISO 21003-5:2008, MOD)
4176.7 Part 7: Multilayer piping systems for hot and cold water plumbing applications—Assessment of conformity (ISO/TS 21003-7:2008, MOD)

4809 Copper pipe and fittings—Installation and commissioning

5082 Polybutylene (PB) plumbing pipe systems—Metric series
5082.1 Part 1: Metric polybutylene (PB) pipes for hot and cold water applications
5082.2 Part 2: Mechanical and fusion jointing systems

5200 Plumbing and drainage products
5200.053 Part 053: Stainless steel pipes and tubes for pressure applications

AS/NZS
1167 Welding and brazing—Filler metals
1167.1 Part 1: Filler metal for brazing and braze welding

AS/NZS

1167.2 Part 2: Filler metal for welding

1260 PVC-U pipes and fittings for drain, waste and vent applications

2280 Ductile iron pipes and fittings

2492 Cross-linked polyethylene (PE-X) pipes for pressure applications

2537 Mechanical jointing fittings for use with crosslinked polyethylene (PE-X) for pressure applications (series)

2544 Grey iron pressure fittings

2642 Polybutylene (PB) plumbing pipe systems
2642.2 Part 2: Polybutylene (PB) pipe for hot and cold water applications
2642.3 Part 3: Mechanical jointing fittings for use with polybutylene (PB) pipes for hot and cold water applications

2712 Solar and heat pump water heaters—Design and construction

2878 Timbers—Classification into strength groups

3500 Plumbing and drainage
3500.0 Part 0: Glossary of terms
3500.1 Part 1: Water services

4020 Testing of products for use in contact with drinking water

4129 Fittings for polyethylene (PE) pipes for pressure applications

4234 Heated water systems—Calculation of energy consumption

4331 Metallic flanges (series)

4671 Steel reinforcing materials

AS ISO
7 Pipe threads where pressure-tight joints are made on the threads—
7.1 Part 1: Dimensions, tolerances and designation

ISO
15874 Plastics piping systems for hot and cold water installations—Polypropylene (PP)
15874.2 Part 2: Pipes
15874.3 Part 3: Fittings

NZS
3109 Concrete construction

3124 Specification for concrete construction for minor works

3501 Specification of copper tubes for water, gas and sanitation

3631 New Zealand timber grading rules

3640 Chemical preservation of round and sawn timber

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

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

4613 Domestic solar water heaters

4614 Installation of domestic solar water heating systems

5807 Code of practice for industrial identification by colour, wording or other coding

NZS/BS

21 Pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)

3601 Specification for carbon steel pipes and tubes with specified room temperature properties for pressure purposes

ASTM

D2846 Standard Specification for Chlorinated Poly(Vinyl Chloride) Plastic Hot-and Cold-Water Distribution Systems

ABCB

NCC National Construction Code

MIBE

NZBC New Zealand Building Code (G1, Personal hygiene; G12, Water supplies)

1.4 DEFINITIONS

For the purpose of this Standard the definitions given in AS/NZS 3500.0 and those below apply.

1.4.1 Container

The vessel, including fittings, in which the heated water is stored.

NOTE: A container is sometimes referred to as a storage container, cylinder or tank.

1.4.2 Integral solar water heater

A solar water heating system in which the container and collector are constructed as a single unit.

1.5 PLASTICS ABBREVIATIONS

The following plastics abbreviations are used in this Standard:

ABS Acrylonitrile butadiene styrene

GRP Glass-filament-reinforced thermosetting plastic

HDPE High density polyethylene

PP Polypropylene

PP-R Polypropylene random copolymer

PB Polybutylene

PE Polyethylene

PE-X Cross-linked polyethylene

PVC-C Chlorinated polyvinyl chloride

PVC-U Unplasticized polyvinyl chloride

PVC-M Modified polyvinyl chloride

PVC-O Oriented 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 consumers are made aware of the advice from enHealth (see Environmental Health Committee, 'Guidance on use of rainwater tanks', 3rd ed, 2010 and the manufacturers of items forming part of, or connected to, the heated water system.

1.7 PIPE SIZES

For sizing based on internal diameter see Appendix C.

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

TABLE 1.7(A)
PIPE SIZE CONVERSION FOR CIRCULATORY SYSTEM

Specified nominal size	Acceptable equivalent size						
	Copper		Stainless steel	PE-X	PB	PP-R	PE-X/AL/PE-X PE-X/AL/PE
DN	AS 1432	NZS 3501					
10	10	10	10	12	16 (15)*	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

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

TABLE 1.7(B)
PIPE SIZE CONVERSION FOR CIRCULATORY SYSTEMS

Specified nominal size	Acceptable equivalent size						
	Copper		Stainless steel	PE-X	PB	PP-R	PE-X/AL/PE-X PE-X/AL/PE
DN	AS 1432	NZS 3501					
15	15	15	15	16	16 (15)	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	
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	

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

NOTE: The acceptable equivalent sizes are determined from internal pipe diameters and the maximum water velocity requirements of Clause 1.8.

1.8 VELOCITY REQUIREMENTS

The maximum water velocity in piping 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
Non-circulatory (flow)	3.0	3.0
Circulatory return line	1.0	1.0

NOTES:

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

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.

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.

1.9 WATER TEMPERATURE

1.9.1 Storage temperature

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

(a) store water at a temperature of not less than 60°C; or

(b) utilize water heater(s) conforming with AS 3498 (Australia only).

1.9.2 Sanitary fixtures delivery temperature

All new heated water installations shall deliver heated water not exceeding—

(a) 45°C at the outlet of sanitary fixtures used primarily for personal hygiene purposes for the aged, the sick, children or people with disabilities in healthcare and aged care buildings, early childhood centres, primary and secondary schools and nursing homes or similar facilities for the aged, the sick, children or people with disabilities; and

(b) 50°C at the outlet of sanitary fixtures used primarily for personal hygiene purposes for all other situations.

NOTES:

1 Sanitary fixtures used for personal hygiene purposes include showers, baths, handbasins and bidets.

2 Temperature limits are required to minimize the risk of scalding. At greatest risk from scalding are children, the aged, the sick and people with disabilities, particularly those in institutional care.

3 For Australia, 'healthcare building' means a building whose occupants or patients undergoing medical treatment generally need physical assistance to evacuate the building during an emergency, and includes—

(a) a public or private hospital;

(b) a nursing home or similar facility for sick or disabled persons needing full-time care; or

(c) a clinic, day surgery or procedure unit where the effects of the predominant treatment administered involve patients becoming non-ambulatory and requiring supervised medical care on the premises for some time after the treatment.

4 For Australia, 'aged care building' means a building for residential accommodation of aged persons who, due to varying degrees of incapacity associated with the ageing process, are provided with personal care services and 24 h staff assistance to evacuate the building during an emergency.

1.9.3 Solutions for control of delivery temperatures

For control of delivery temperatures the following shall apply:

(a) Where a maximum delivery temperature of 45°C is required, all sanitary fixtures used primarily for personal hygiene purposes shall be supplied from—

(i) a thermostatic mixing valve conforming with AS 4032.1 and adjusted to an outlet temperature not exceeding 45°C at each outlet supplied from the thermostatic mixing valve; or

(ii) a thermostatically controlled tap conforming with AS 4032.4 and adjusted to an outlet temperature not exceeding 45°C at each outlet supplied from the thermostatically controlled tap.

(b) Where a maximum delivery temperature of 50°C is required, all sanitary fixtures used primarily for personal hygiene purposes shall be supplied from—

(i) a thermostatic mixing valve conforming with AS 4032.1 and adjusted to an outlet temperature not exceeding 50°C at each outlet supplied from the thermostatic mixing valve;

(ii) a tempering valve conforming with AS 4032.2 and adjusted to an outlet temperature not exceeding 50°C at each outlet supplied from the tempering valve; or

(iii) a water heater conforming with AS 3498 and marked with the following:

THIS APPLIANCE DELIVERS WATER NOT EXCEEDING 50°C IN ACCORDANCE WITH AS 3498.

NOTE: Temperature control devices require routine maintenance and performance testing. For information on maintenance, refer to AS 4032.3.

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 AUTHORIZATION

Materials and products used in Australia for plumbing and drainage installations shall have been authorized in accordance with the National Construction Code. In New Zealand, product authorization is not required.

NOTE: A database of authorized products is available from the ABCB at www.abcb.gov.au.

2.3 SELECTION AND USE OF MATERIALS AND PRODUCTS

Materials and products for use in contact with heated water shall conform with the hot water exposure requirements of AS/NZS 4020. Linings and coatings shall conform with AS/NZS 4020 at a surface area to volume ratio less than that nominated in the conformance report.

The products and materials used shall be selected to ensure that they are fit for their intended purpose.

The pipes and fittings shall be selected from those listed in Appendix B.

Factors that shall be taken into account include, but are not limited to—

(a) the type of usage likely to occur;

(b) the nature and temperature of the water to be conveyed and the risk of corrosion, degradation and leaching;

(c) the nature of the environment, the ground and the possibility of chemical attack therefrom;

(d) the physical and chemical characteristics of the materials and products;

(e) compatibility of materials and products;

(f) the pressure rating of pipes and fittings at elevated temperatures; and

(g) accessibility for inspection, service, repair and replacement.

NOTES:

1 Information on some of the items listed above may be obtainable from the manufacturer or supplier of the product or material.

2 Plastics pipe and fittings are classified according to nominal working pressure (PN) at 20°C.

2.4 LIMITATIONS ON USE OF PIPES AND FITTINGS

2.4.1 General

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: 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 Standard.

(e) Copper pipe in accordance with AS 1432 shall only be of Types A, B or Type C.

(f) Soft solder jointing shall not be used.

2.4.2 Metallic pipes and fittings

Metallic pipes and fittings shall conform with the following:

(a) Stainless steel (SS) pipes shall be used in conjunction with dezincification resistant (DR) copper alloy fittings or stainless steel fittings conforming with AS 3688.

(b) Fittings used to join copper and copper alloy pipes shall conform with AS 3688 and be installed in accordance with the installation requirements of AS 4809. Copper pipe shall conform with AS 1432.

2.4.3 Plastics pipes and fittings

Plastics pipes and fittings shall conform with the following:

(a) Plastics pipes shall be in accordance with Appendix B.

(b) When installed, plastics pipes and fittings shall be protected from direct sunlight.

NOTE: Examples of protection include sleeving with metal or plastics pipe or conduit, lagging or painting with UV resistant paint.

(c) Plastics pipes and fittings shall not be used between the isolation valve and the inlet to a water heater.

(d) Plastics pipes and fittings shall not be used within 1 m of the outlet of a water heater.

NOTE: Where a water heater is fitted with a temperature control valve, plastics pipes and fittings may be used immediately downstream of the temperature control valve.

(e) Plastics pipes shall not be used to support isolation valves, non-return valves and equipment used to connect water heaters.

(f) 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.

(g) Plastics pipes and fittings shall not be used between an uncontrolled heat source and a heated water tank.

(h) Plastics pipes and fittings shall not be used for the drain lines from temperature/pressure-relief valves.

2.5 SAFE TRAY AND SAFE WASTE MATERIALS

2.5.1 Safe tray

Safe trays shall be fabricated from—

(a) 0.60 mm thick galvanized steel sheet conforming with AS 1397 and having a minimal nominal zinc coating mass of 275 g/m^2; or

(b) other materials not inferior to Item (a), under the conditions of use.

2.5.2 Safe wastes

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

(a) PVC-U conforming with AS/NZS 1260.

(b) Galvanized steel pipe conforming with AS 1074 or NZS/BS 3601.

(c) Seamless copper pipe (min. 0.9 mm thickness) conforming with AS 1432 or NZS 3501.

(d) Sheet steel (min. 0.6 mm thickness) conforming with AS 1397.

2.6 JOINTS

2.6.1 Flanged joints

Flanged joints shall conform with—

(a) AS/NZS 2280 and AS/NZS 2544 for ductile iron and grey cast iron; or

(b) AS 2129 or AS/NZS 4331 or AS 4087 and be appropriate for the test pressure requirements of Section 9.

2.6.2 Elastomeric seals

Materials used for elastomeric seals shall conform with AS 1646.

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

2.6.3 Silver brazing alloy

2.6.3.1 *Copper and copper alloys*

Silver brazing alloys for capillary jointing of copper and copper alloy pipes and fittings shall conform with the requirements for silver or copper phosphorus brazing alloys of AS/NZS 1167.1 and contain a minimum of 1.8% silver and a maximum of 0.05% cadmium.

2.6.3.2 *Stainless steels*

Silver brazing alloys for capillary jointing of stainless steel pipes and fittings shall conform with the requirements of AS/NZS 1167.1 and contain a minimum of 38% silver and a maximum of 0.05% cadmium.

2.6.4 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 and conforming with AS/NZS 1167.2.

2.7 CONCRETE AND MORTAR

2.7.1 Concrete mix

Ready-mixed concrete shall conform with AS 1379 and shall have a minimum characteristic compressive strength of 20 MPa as defined in AS 3600 or NZS 3109 and NZS 3124.

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.

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

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

2.7.3 Chemical admixtures

Chemical admixtures used in concrete shall conform with AS 1478.1.

2.7.4 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.

2.7.5 Steel reinforcement

Steel reinforcing materials used in concrete structures shall conform with AS/NZS 4671.

2.8 MISCELLANEOUS MATERIALS

2.8.1 Timber

Timber exposed to the weather shall be of durability Class 2 conforming with AS/NZS 2878 or NZS 3631, or treated in accordance with AS 1604 or NZS 3640.

2.8.2 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.

NOTES:

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

2 For a typical installation of a thermostatic mixing valve, see Figure 3.3.

(b) Integral stop tap/valves and cross-flow valves shall conform with AS 4032.1.

(c) There shall be no branch line offtake between a non-integral isolating valve and the inlet to the thermostatic mixing valve except in multiple installations, see Item (e).

(d) Thermostatic mixing valves shall be supported, independent of all piping.

(e) 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.

(f) Each thermostatic mixing valve and each associated valve, pressure control or temperature control shall be readily accessible.

(g) The nominal size of the connecting piping and associated valves shall be not less than the nominal size of the thermostatic mixing valve.

NOTE: For sizing of pipes, refer to AS/NZS 3500.1.

(h) 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.

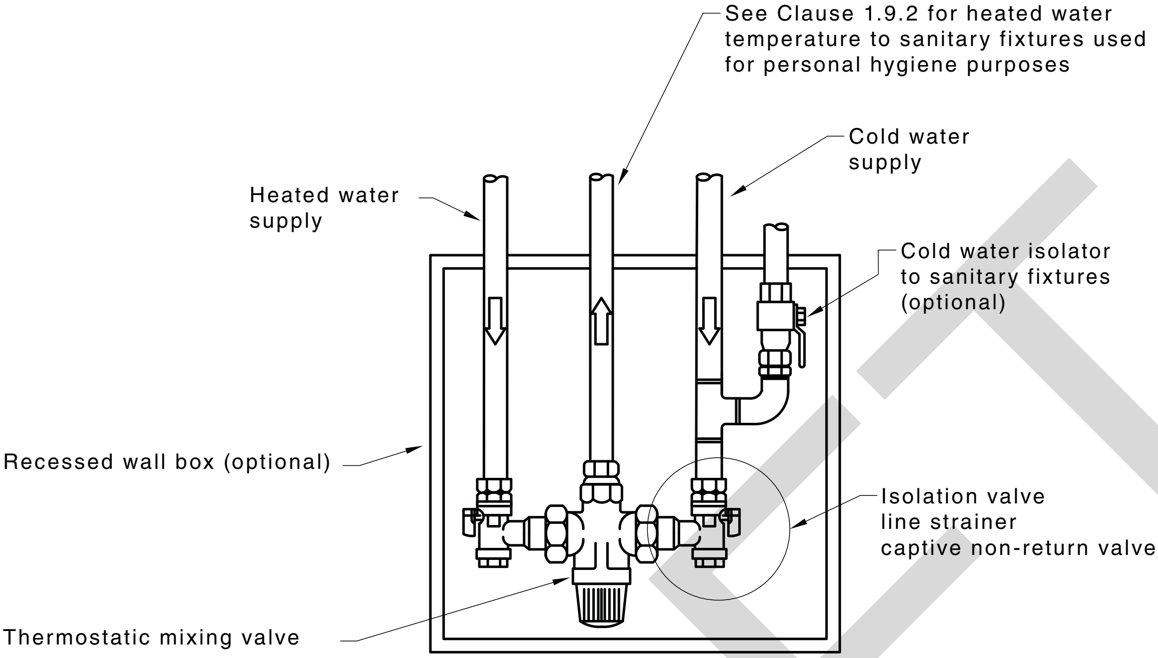


FIGURE 3.3 TYPICAL INSTALLATION OF THERMOSTATIC MIXING VALVE

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.

> ***C4.1*** *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 PROXIMITY TO ELECTRICAL CABLES AND GAS PIPES

4.2.1 General

Where electrical conduits, wires, cables or consumer gas pipes, drains and other services are in existence, pipes shall be installed in accordance with the requirements of Clause 4.2.2.

4.2.2 Electrical cables, gas pipes and other services

4.2.2.1 *Above- and below-ground pipework*

Above-ground 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.

4.2.2.2 *Above-ground pipework*

Above-ground pipework associated with heated water services shall not be installed within 100 mm of electrical cables, gas pipes or other services.

4.2.2.3 *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.

4.2.2.4 *Below ground—Communications services*

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

4.2.2.5 *Below ground—Crossover*

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.

4.3 METHODS OF JOINTING

4.3.1 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* Care shall be taken so that pipes or fittings are not 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.

(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; and

  (iii) copper tees shall not be fabricated from pipe of thickness less than Type C of AS 1432.

4.3.2 Compression-type fittings

Compression fittings shall conform with AS 3688 or AS/NZS 4129. Plastics nuts shall not be used to connect any pipe to a cold water storage tank that supplies water to a water heater.

4.3.3 Joining of copper and copper alloy pipes

Fittings used to join copper and copper alloy pipes shall conform with AS 3688 and be installed in accordance with the installation requirements of AS 4809. Copper pipes shall conform with AS 1432.

4.3.4 Silver brazing

4.3.4.1 *Joints*

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

4.3.4.2 *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.

4.3.5 Flanged joints

Flanged joints shall be appropriate for the test pressure requirements of Section 9 and shall be attached to the pipe by the following means:

(a) Silver brazing in accordance with Clause 2.6.3 for copper alloy to copper or copper alloy pipes or fittings.

(b) Set screws for cast iron pipes and fittings.

(c) For stainless steel pipes larger than DN 25, flanged joints fabricated by rolling or welding to the pipe a stub flange of the same gauge and wall thickness as the pipe, having a diameter conforming to dimensions ‘F’ in AS 2129. A mild steel backup flange conforming with AS 2129 shall be fitted, and a gasket, not less than 3 mm thick, shall be inserted.

Flange joints below ground shall be protected against corrosion in accordance with Clause 4.9.

4.3.6 Roll-grooved joints

Roll-grooved joints shall conform with AS 3688.

NOTE: Roll-grooved joints may be used above ground or below ground.

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.

4.3.7 Jointing of stainless steel pipe and fittings

4.3.7.1 *Jointing of piping, up to and including DN 25*

Joints not larger than DN 25 shall be made by using mechanically jointed compression fittings or press-fit end connectors conforming with AS 3688 or using silver-brazed stainless steel capillary joints. Silver brazing alloys shall conform with Clause 2.6.3.2.

4.3.7.2 *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, fabricated by rolling or welding to the pipe, a stub flange of the same wall thickness as the pipe, having a diameter conforming to dimension 'F' in AS 2129 or AS/NZS 4331, with mild steel backup flange conforming with AS 2129 or AS/NZS 4331 fitted, and a gasket not less than 3 mm thick inserted.

(c) Stainless steel press-fit end connectors.

NOTE: Jointing should be carried out by suitably trained personnel.

4.4 SUPPORT AND FIXING ABOVE GROUND

4.4.1 General

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

4.4.2 Brackets, clips and hangers

Brackets, clips and hangers shall be—

(a) formed from a suitable 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.

4.4.3 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.

4.4.4 Spacing

Water services shall be supported and fixed at the intervals specified in Table 4.4.4.

TABLE 4.4.4

SPACING OF BRACKETS AND CLIPS

Nominal pipe size	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	
DN		Horizontal or graded pipes	Vertical pipes
10	1.50	0.50	1.00
15	1.50	0.60	1.20
16	—	0.60	1.20
18	1.50	0.60	1.20
20	1.50	0.70	1.40
22	—	0.70	1.40
25	2.00	0.75	1.50
32	2.50	0.85	1.70
40	2.50	0.90	1.80
50	3.00	1.05	2.10
63	—	1.10	2.20
65	3.00	1.20	2.40
75	—	1.30	2.60
80	3.00	1.35	2.70
90	3.00	1.40	2.80
100	3.00	1.50	3.00
110	—	1.50	3.00
125	3.00	1.70	3.40
140	—	1.70	3.40
150	3.00	2.00	4.00
160	—	2.00	4.00

NOTE: Due to water pressure effects, additional brackets, clips or hangers (conforming with Clause 4.4.2) may be required to prevent movement.

4.4.5 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 4.4.3(b).

4.5 LOCATION OF PIPING

4.5.1 Concealed piping

4.5.1.1 *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 4.5.1.1(A) and Table 4.5.1.1.

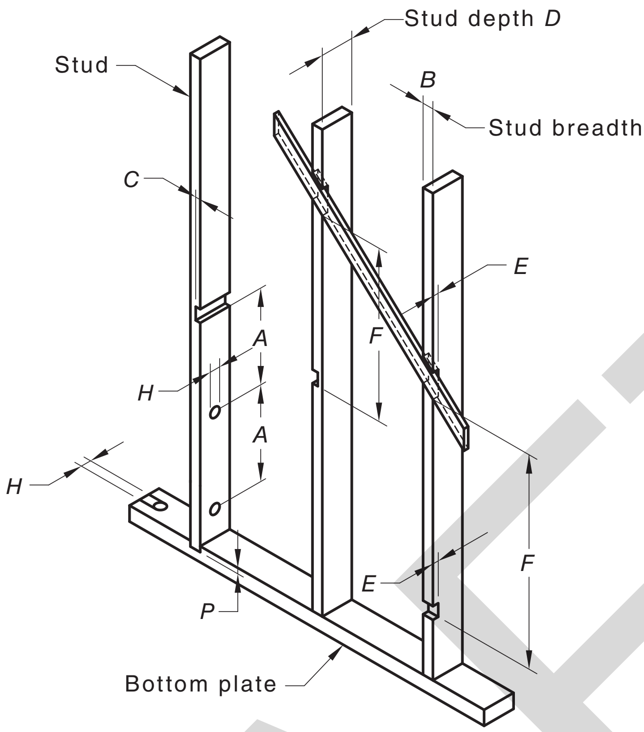
(ii) Where unlagged pipes are used, a collar of lagging material or a neutral cure silicone sealant shall be used to fill the annular space.

(b) *Timber beams, bearers and joists* Holes or notches made in timber beams, bearers and joists in floors shall be in accordance with Figure 4.5.1.1(B).

(c) *Metal framework* Holes drilled in metal studs or plates shall be accurately sized to enable suitable grommets, lagging or a short sleeve of oversize pipe firmly secured in the framework to be inserted around the pipe to ensure no direct contact between the pipe and framework but allowing free longitudinal movement of the pipe through the grommet, lagging or sleeve.

NOTE: 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.

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



NOTE: For definitions of symbols, see Table 4.5.1.1.

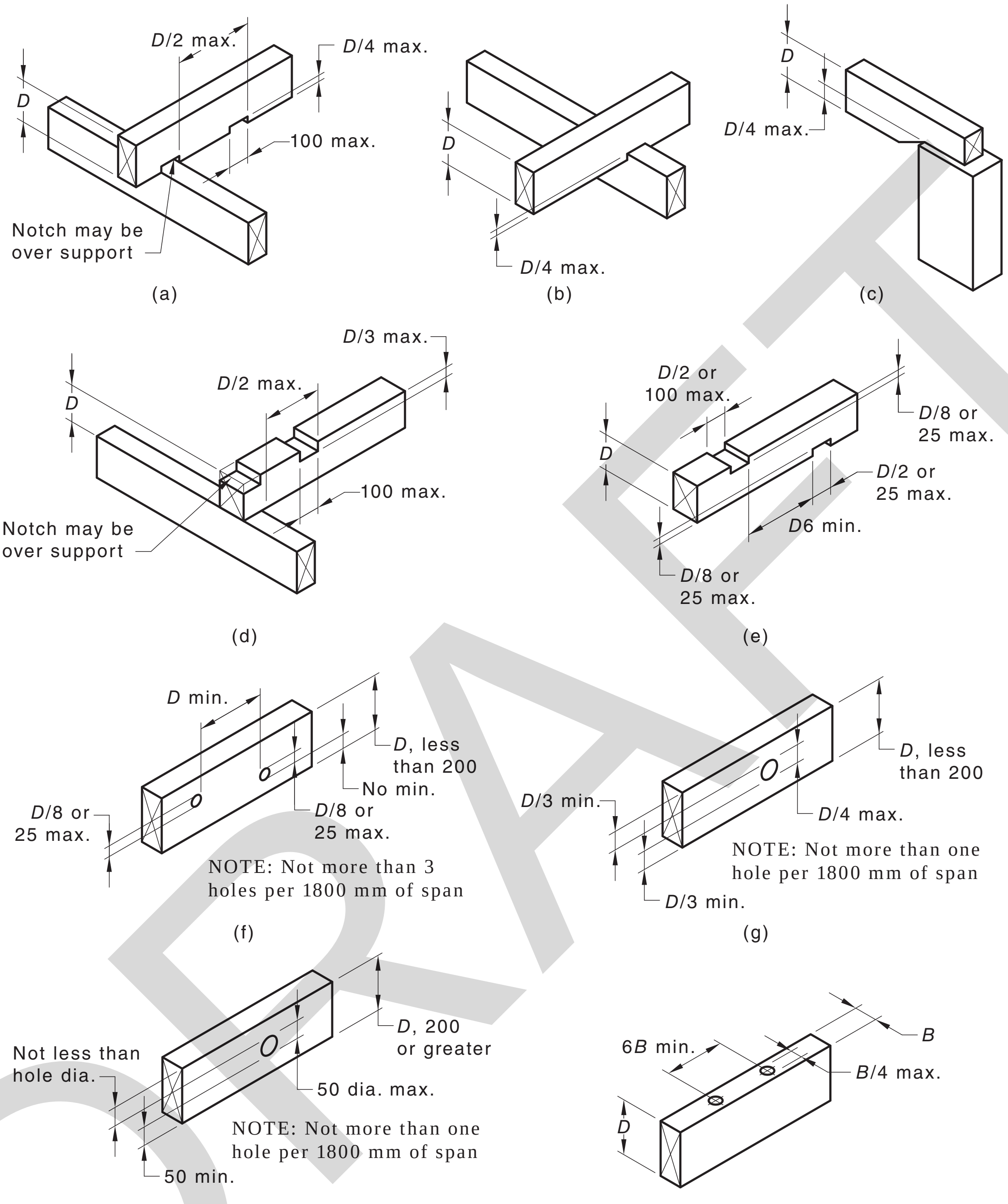
FIGURE 4.5.1.1(A) NOTCHING OF WALL STUDS

TABLE 4.5.1.1

HOLES AND NOTCHES IN STUDS AND PLATES

Symbol	Definition	Limits	
		Notched	Not notched
A	Distance between holes and/or notches in stud breadth	Min. 3*D*	Min. 3*D*
H	Hole diameter (studs and plates)	Max. 25 mm (wide face only)	Max. 25 mm (wide face only)
C	Notch into stud breadth	Max. 10 mm	Max. 10 mm
E	Notch into stud depth	Max. 20 mm (for diagonal cut in bracing only) (see Note)	Not permitted (see Note)
F	Distance between notches in stud depth	Min. 12*B*	N/A
P	Trenches in plates	3 mm max.	

NOTE: A horizontal line of notches up to 25 mm may be provided for the installation of baths.



DIMENSIONS IN MILLIMETRES

FIGURE 4.5.1.1(B) NOTCHES, CUTS AND HOLES IN BEAMS, BEARERS, JOISTS, RAFTERS

4.5.1.2 *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) Conduits shall conform with the requirements of the NCC or New Zealand Building Code, as applicable.

(d) Adequate allowance shall be made for expansion and contraction in accordance with Clause 4.12.3.

(e) Pipes shall not be embedded or cast into concrete structures.

4.5.1.3 *Under concrete slabs*

Water service pipes located beneath concrete slabs on ground level shall conform with 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 and measures shall be taken to protect the exposed pipe from damage.

(c) Any piping that penetrates the slab shall be at right angles to the surface of the slab and shall 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.

4.5.2 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.

4.5.3 Floor or roof penetrations

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

4.5.4 Provision for movement of encased piping

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

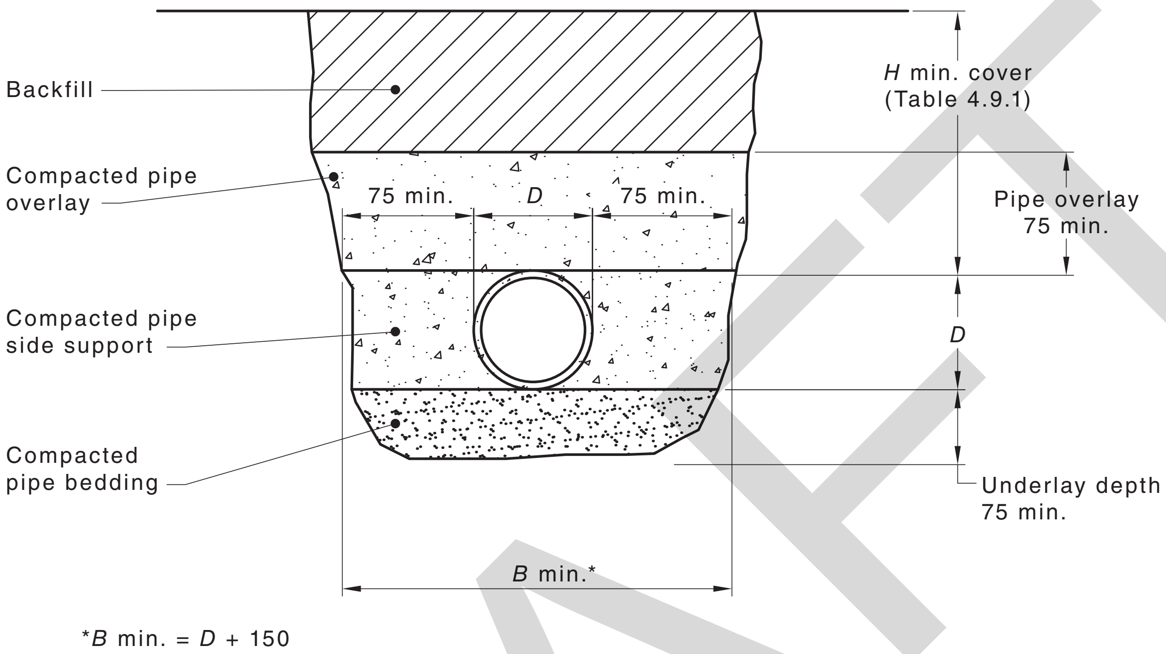
4.6 BEDDING AND BACKFILL

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: For a typical installation in a trench, see Figure 4.6.

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, providing the soil is compatible with copper and stainless steel and free from rock and rubble.



DIMENSIONS IN MILLIMETRES

FIGURE 4.6 TYPICAL INSTALLATION IN A TRENCH

4.7 CONTAMINATED AREAS—INSTALLATION

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

(a) is laid through a watertight, corrosion-resistant conduit of length and strength adequate to protect the water service; or

(b) is 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.

4.8 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) continuously wrapping 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.

4.9 DEPTH OF COVER

4.9.1 Depth of cover in public areas

Where heated water services are installed below ground in public areas, the minimum cover shall conform with Table 4.9.1.

TABLE 4.9.1

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

4.9.2 Depth of cover in private areas

Where heated water services are installed below ground in private property, the minimum cover shall conform with Table 4.9.2.

TABLE 4.9.2

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.

4.10 PROTECTION AGAINST FREEZING

4.10.1 Requirement for protection

In areas where the ambient temperature frequently falls below 0°C, care shall be taken to avoid the likelihood of the water service being damaged by water freezing within the pipes.

NOTE: See also Section 8.

4.10.2 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.

4.10.3 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 4.10.5(B) or Table 8.2.2, as appropriate.

NOTE: Consideration should be made for thermal expansion and contraction of the roof material.

4.10.4 Pipes located inside buildings

4.10.4.1 *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.

4.10.4.2 *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.

4.10.4.3 *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.

4.10.5 Insulation of piping and fittings

Where it is necessary to install piping in areas where temperatures are likely to fall below freezing (see Clause 4.10.4.1), the pipes and fittings shall be surrounded by an appropriate thickness of insulation.

NOTES:

1 Typical examples of materials and minimum thicknesses for insulation of various thermal conductivity ranges are given in Tables 4.10.5(A) and 4.10.5(B) respectively.

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

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 4.10.5(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
Foamed PVC nitrile rubber	0.040
Loose vermiculite (exfoliated)	0.06–0.07
Pre-insulated copper pipe	0.070–0.075

TABLE 4.10.5(B)

TYPICAL EXAMPLES OF MINIMUM THICKNESSES FOR THERMAL INSULATION TO PREVENT FREEZING OF WATER IN PIPES

Pipe size	Minimum thickness required mm				
	Thermal conductivity of insulating material W/m.K				
DN	**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.

4.11 COLD WATER PIPING AND STORAGE TANKS

4.11.1 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.

4.11.2 Cold water storage tank

4.11.2.1 *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 with Clause 2.3 and having equivalent strength and durability to copper sheet of 0.55 mm thickness.

(b) For metal tanks, they shall be—

(i) reinforced along the upper edges to prevent distortion of the tank;

(ii) welded, brazed or soft-soldered at all joints;

(iii) 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 an outlet of brass or other suitable material threaded in accordance with AS ISO 7.1 or NZS/BS 21. 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 conforming with AS 1910.

(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 conforming with AS 1397.

NOTE: Typical installations of water tanks are shown in Figures 5.4.5 and 5.5.1.

4.11.2.2 *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.

NOTES:

1 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.

2 In New Zealand, allowance has to be made for seismic restraint (see NZBC, Clause G12 Water supplies).

4.11.2.3 *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.

4.11.2.4 *Cold water storage tank overflow*

Each cold water storage tank shall be fitted with an overflow conforming with 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 so constructed that with the float valve discharging at its maximum flow, with water pressure of 700 kPa and with all service outlets closed, no spillage shall occur 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.

4.11.2.5 *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 4.12.5(c).

4.11.3 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 with Clause 5.4.3. Where the tank is mounted on the water heater, a water heater safe tray conforming with 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.

4.11.4 Support for separately mounted cold water storage tanks

4.11.4.1 *Platform*

Each separately mounted cold water storage tank shall be supported on a platform conforming with Clause 5.5.

4.11.4.2 *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.

4.12 INSTALLATION OF HEATED WATER SERVICES

4.12.1 Design and installation

Water flow velocities in heated water piping shall be in accordance with Clause 1.8.

C4.12.1 *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.

NOTES:

1 Minimum rates of flow are given in Table 10.2.2.

2 Preferred sizes of pipes are given in Appendix D.

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 pumped circulation should be considered.

4 For gradients requirements, see Clause 4.12.4.

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

4.12.2 Identification

In other than domestic or residential buildings, where water services are installed in ducts, accessible ceilings and exposed in basements or plant rooms, they shall be identified in accordance with AS 1345 or NZS 5807.

4.12.3 Provision for expansion

4.12.3.1 *General*

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

(a) have free length of piping around the bend or along the branch sufficient to prevent overstressing the pipe and allow for thermal expansion;

(b) have a clear space to allow movement for expansion as calculated; or

(c) have expansion loops, or offsets located at or near midpoint in straight lengths that exceed 18 m, or have expansion joints fitted; and

(d) have expansion loops and offsets placed horizontally to avoid forming air locks at the top of the loops and to ensure circulation of the water.

Rates of thermal expansion for common pipe materials, calculations for and examples of offsets and expansion loops are given in Appendix N.

4.12.4 Gradient

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

(a) *Mains pressure or pressure-limiting valve-controlled reticulation*—rise or fall as required subject to the requirements of Clause 4.12.5.

(b) *Reducing valve-controlled reticulation*—rise and fall as required subject to the provisions of Table 4.12.4.

(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 4.12.4

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

4.12.5 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.

4.12.6 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.

4.12.7 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 with Clause 5.12; or

(b) an automatic air elimination device suitable for that purpose.

4.12.8 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 Section 8.

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.

NOTES:

1 For water chemistry requirements, see Clause 1.6 and for recommendations for water analysis, see Appendix A.

2 For information on the suitability of the anode, reference should be made to the water heater manufacturer.

5.2.2 Working pressure

Water heaters shall be installed so that the maximum rated working pressure is not exceeded during normal operation. Reference shall be made to the heater label for the relevant information.

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.

NOTES:

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

2 For cold water storage tank-fed water heaters, see Clause 4.12.5.

5.3.3 Ventilation and fluing

Fuel-burning water heaters shall be located so that the correct ventilation and fluing can be provided.

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 with Clause 5.4.3. The safe trays shall be drained by safe wastes conforming with 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 5.9.3(f) and Figures 5.9.3(A) to 5.9.3(D).

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 with Clause 5.4.3 and safe wastes conforming with 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 with the requirements of Clause 2.5.1. 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 with 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 with the following:

(i) Where discharging outside the building, it shall discharge to a point within the property boundaries, which 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.

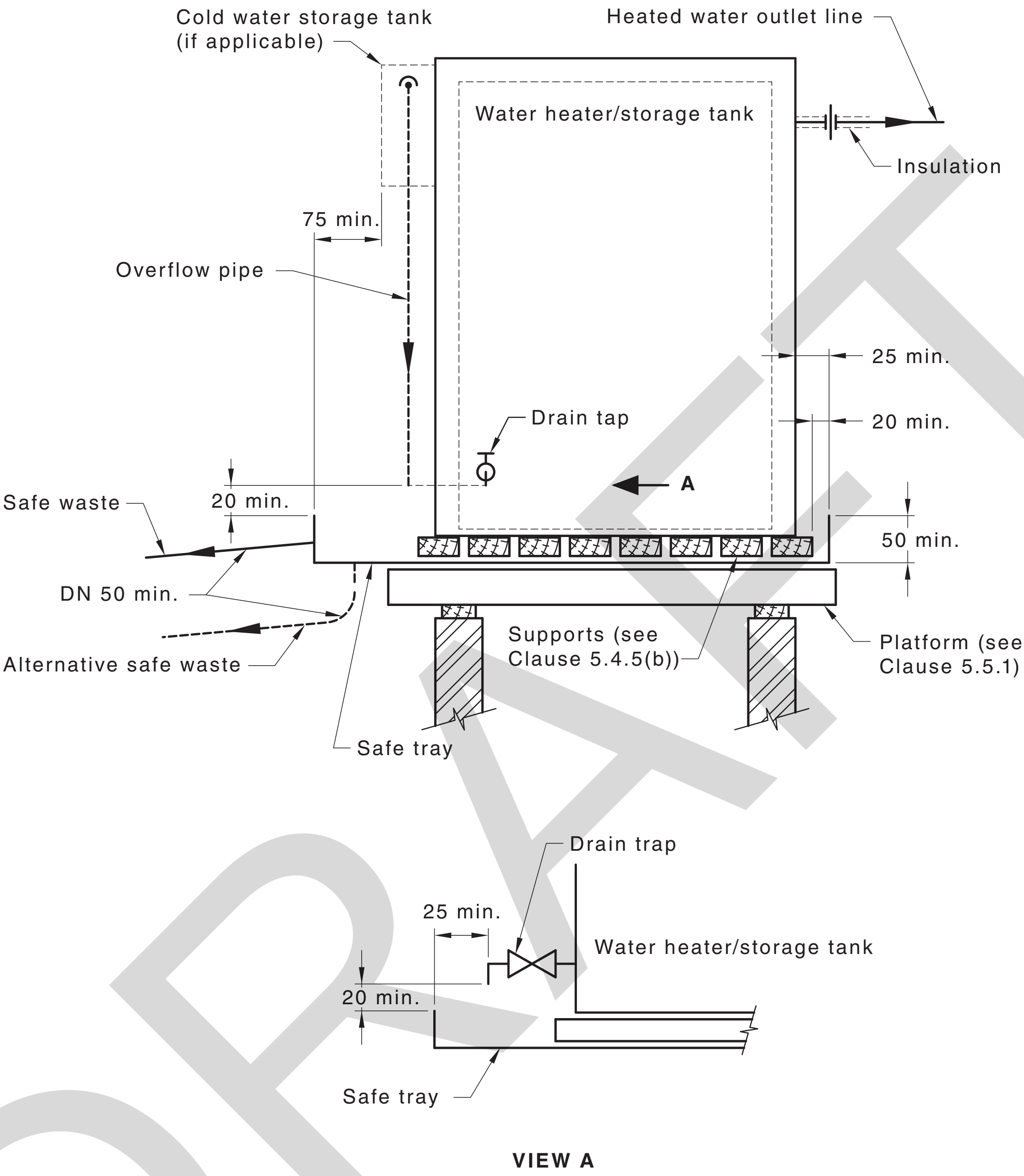
5.4.5 Placement of water heater or cold water storage tank on a safe tray

The water heater or cold water storage tank shall be placed on a safe tray and shall conform with 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: A typical installation of a safe tray, including position of water heater or cold water storage tank, is shown in Figure 5.4.5.



DIMENSIONS IN MILLIMETRES

FIGURE 5.4.5 TYPICAL INSTALLATION OF A SAFE TRAY AND POSITION OF WATER HEATER OR COLD WATER STORAGE TANK

5.5 SUPPORT

5.5.1 Support of water storage tanks installed in a roof

Storage water heaters and cold water storage tanks installed in a roof space shall be placed on a safe tray that is supported by a platform of hardwood or other suitable and not less durable material, and conforming with the following requirements:

(a) The safe tray shall drain to its safe waste.

(b) The safe tray shall be placed so that the load of the water heater or cold water storage tank is supported by one or more loadbearing walls that are vertically continuous to a solid foundation, a concrete slab or similar support of comparable strength, and shall be in accordance with the following:

  (i) Where the platform is placed over one wall only, it shall be placed centrally over the wall, and any ceiling joist that is subjected to additional stress shall cross the wall at right angles. The capacity of the water heater or cold water storage tank, or both, supported by the platform shall not exceed 450 L.

  (ii) Where the load is carried by beams or bearers spanning two walls, no ceiling joists shall carry any of the load, except where immediately over a wall.

  (iii) Where the load is carried on loadbearing walls supported on piers, the water heater or cold water storage tank shall be placed centrally above a solid pier that supports the wall immediately under the water heater or cold water storage tank, or the load shall be transmitted to a designed floor beam or bearer supported by two piers not more than 2 m apart.

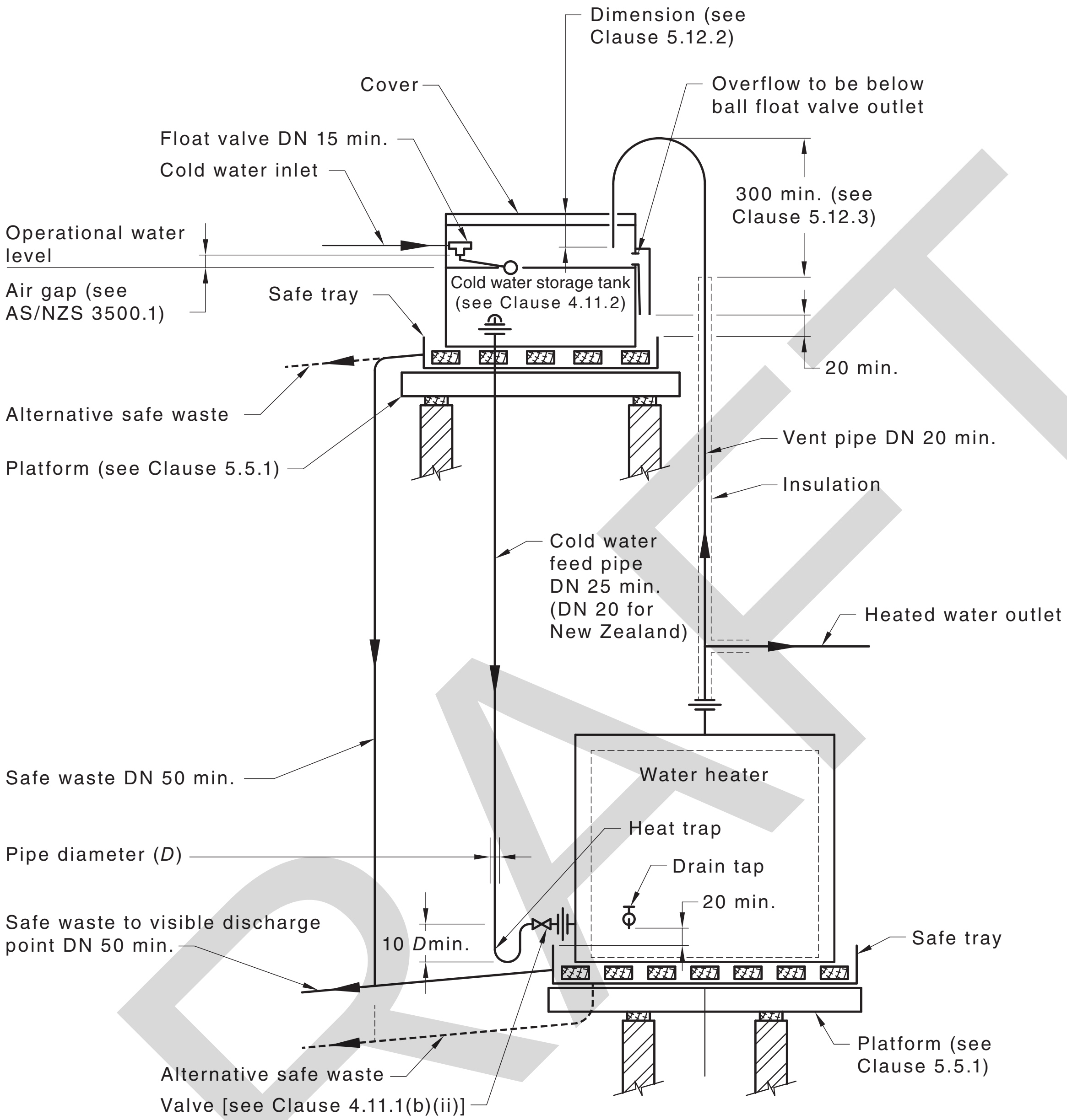
(c) Where the roof is constructed from trusses, the platform supporting a water storage tank shall not be supported from any part of the trusses unless the trusses are specifically designed to carry the load of the water storage tank.

NOTES:

1 These requirements do not preclude the load or part of the load from being carried on a beam or bearer that spans an opening in a wall. As such, the wall immediately above the opening is not subjected to additional stress and the load is distributed over at least 0.6 m of vertical continuous wall on either side of the opening.

2 For typical installation of water tank in roof space, see Figure 5.5.1.

3 For typical platform construction, see Figure 5.5.3.



DIMENSIONS IN MILLIMETRES

FIGURE 5.5.1 TYPICAL INSTALLATION IN ROOF SPACE OF COLD WATER STORAGE TANK-FED WATER HEATER WITH SEPARATELY MOUNTED COLD WATER STORAGE TANK

5.5.2 Support of water heaters or water storage tanks installed above a roof

Storage water heaters (other than solar water heaters) and cold water storage tanks installed above a roof shall be supported on a platform that is not less durable than timber conforming with Clause 2.8.1 and the following:

(a) The clearance between the lowest part of the platform and the roof shall be not less than 75 mm.

(b) The load shall be distributed over two walls continuous to a solid foundation without any stress being placed on the roof structure.

(c) The support shall have structural members that penetrate the roof, flashed or rendered watertight in a manner that will allow for expansion.

NOTE: In cyclone-prone areas, further regulatory requirements may also apply.

5.5.3 Support of water heaters or water storage tanks installed other than in a roof space or above a roof

Storage water heaters and cold water storage tanks installed other than in a roof space or above a roof shall be floor-mounted, or supported, as follows:

(a) By brackets or hangers, designed to withstand the applied load.

(b) On a level, stable and impervious base designed and located to avoid ponding and made of—

  (i) bonded brick or concrete cast in situ, having a thickness of not less than 75 mm; or

  (ii) pre-cast concrete having a thickness of not less than 50 mm.

(c) On a platform of timber, or other suitable and not less durable material. Where such a platform is located at or near ground level, it shall be supported so that a clearance of not less than 100 mm is maintained from the surrounding ground.

  NOTE: A typical platform construction is shown in Figure 5.5.3.

(d) In a recess in a wall structure able to withstand the applied load.

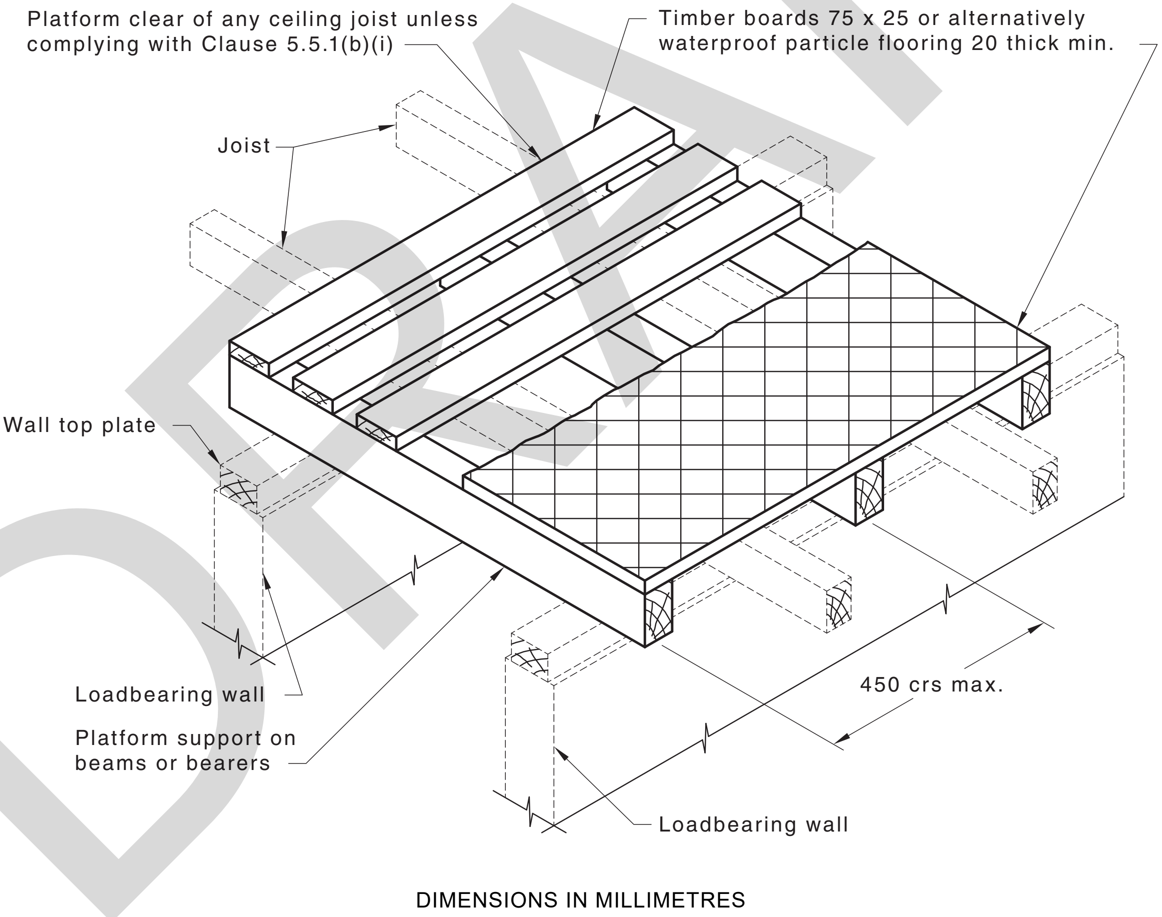
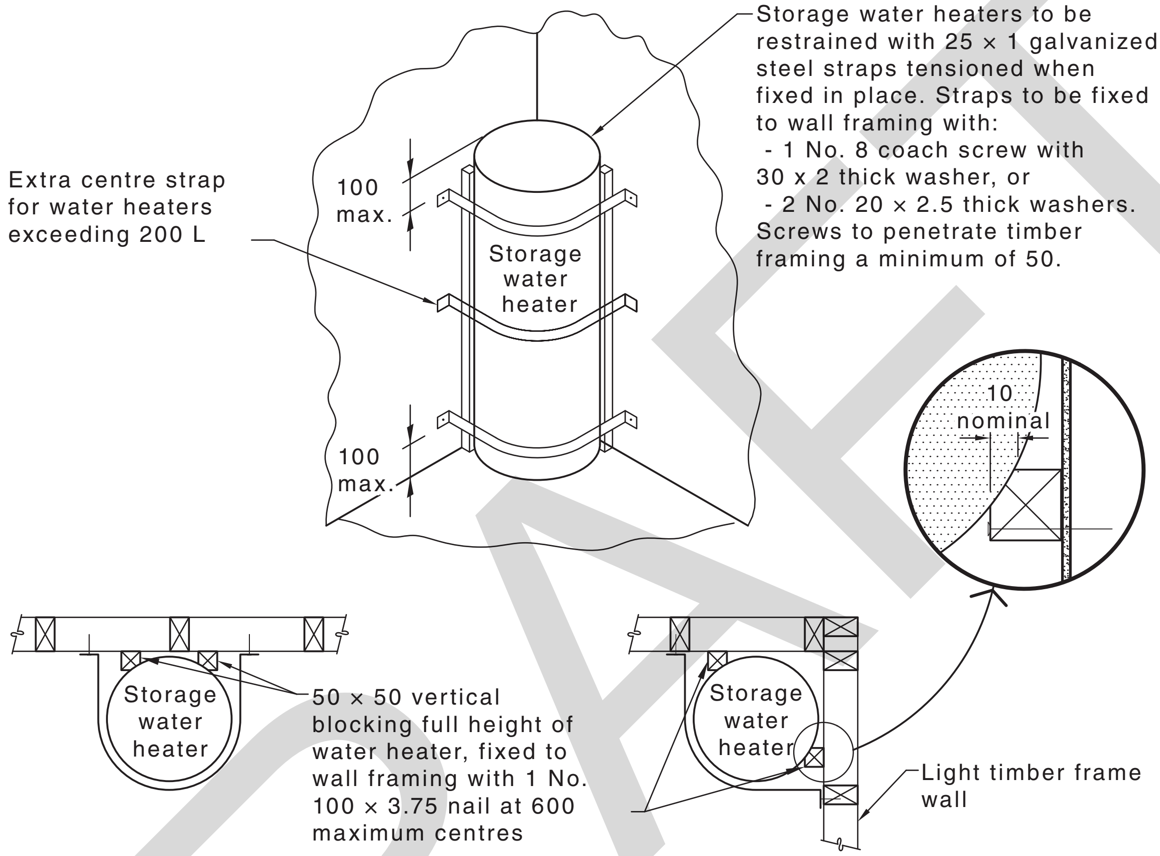


FIGURE 5.5.3 TYPICAL CONSTRUCTION OF A PLATFORM

5.5.4 Seismic restraints

In New Zealand, cold water storage tanks and hot water container assemblies shall be restrained against movement in accordance with NZS 4603 or NZS 4607.

NOTE: For a typical arrangement for seismic restraint of storage water heaters, see Figure 5.5.4.



DIMENSIONS IN MILLIMETRES

FIGURE 5.5.4 TYPICAL ARRANGEMENT FOR SEISMIC RESTRAINT OF STORAGE WATER HEATERS LESS THAN 350 L (NEW ZEALAND ONLY)

5.6 CORROSION PREVENTION AND WEATHER PROTECTION

5.6.1 Water heater base—Corrosion avoidance

Water heaters located on surfaces that may become wet shall be installed to allow free air circulation between the surface and the base of the water heater except where the base of the water heater is constructed from a material that protects against corrosion.

5.6.2 Weather protection of externally installed water heaters

Water heaters installed externally shall be—

(a) of a type designed for external installation; or

(b) protected by a weatherproof enclosure.

NOTE: A water heater or enclosure conforming with the above requirements may not necessarily be suitable for extreme conditions, such as sustained freezing temperature or for salt-laden or corrosive atmospheres. For installations under such conditions, reference should be made to the water heater manufacturer.

5.7 CONNECTIONS TO WATER HEATERS

Unions or similar couplings shall be provided for the connections of any service pipe to the inlet or outlet of the water heater.

5.8 PRESSURE RELIEF AND VENTING OF WATER HEATERS AND CONTAINERS

For the pressure relief and venting of water heaters and containers the following requirements apply:

(a) The storage container of a vented storage water heater shall be fitted with a free and unobstructed vent open to the atmosphere at all times.

(b) A vented heat exchange water heater shall be fitted with a vent and protective devices as required in AS 3498.

(c) An unvented storage water heater shall be fitted with a temperature/pressure-relief valve.

(d) An unvented pressure water container, not designed to withstand a full vacuum, shall be fitted with a vacuum-relief valve.

NOTES:

1 Where the water supply is scaling in nature, an expansion control valve or expansion vessel should be incorporated in the installation of an unvented water heater, otherwise the temperature/pressure-relief valve may become blocked due to the deposition of calcium carbonate from the heated water that is relieved during thermal expansion. See Figures 5.9.3(C) and 5.9.3(D)(a).

2 For instantaneous water heaters see also Clause 5.9.1 for valve requirements.

3 In New Zealand only, when the valve set pressure is not greater than 120 kPa, a pressure-relief valve may be used in lieu of a temperature/pressure-relief valve.

4 In New Zealand, expansion control valves or an expansion vessel are required to be fitted to all unvented (i.e. valve vented) cylinders.

5 A vacuum-relief valve is usually incorporated in the pressure-relief valve on a container that is not designed to withstand a full vacuum.

6 In New Zealand, ‘valve vented’, describes water heaters that are vented by valves rather than by an open vent pipe.

7 See Clause 5.10.3(b)(ii) for location and capacity of expansion vessels.

5.9 VALVES AND EXPANSION VESSEL

5.9.1 General

The valves and expansions vessels used in the installation of water heaters shall conform with Tables 5.9.1(A) and 5.9.1(B).

TABLE 5.9.1(A)

VALVE AND FITTING REQUIREMENTS FOR WATER HEATERS

Valves and fittings	Valves and fittings required							
	Instantaneous water heaters	Unvented water heater		Vented water heater				Heat exchange water heater [see Figure 5.9.3(B)]
		Mains pressure [see Figures 5.9.3(B) and 5.9.3(C)]	Unvented reduced pressure [see Figure 5.9.3(D)(a)]	Vented reduced pressure [see Figure 5.9.3(D)(b)]	Reduced pressure uncont. heat source	Free outlet water heater	Side-fed water heater	
Isolating valve	Yes†	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Non-return valve	N/A	Yes	Yes	Yes	Yes	Yes	N/A	Yes
Pressure-limiting valve	As required by Table 5.9.1(B)	As required by Table 5.9.1(B)	N/A			N/A	N/A	As required Table 5.9.1(B)
Pressure-reducing valve	N/A	N/A	Yes	Yes	Yes	N/A	N/A	N/A
Expansion control valve or expansion vessel (Australia only)	N/A	See Note 1 of Clause 5.8	See Note 1 of Clause 5.8	N/A	N/A	N/A	N/A	Yes
Expansion control valve or expansion vessel (New Zealand only)	N/A	Yes	Yes	N/A	N/A	N/A	N/A	Yes
Temperature/ pressure-relief valve*	N/A	Yes	Yes	N/A	N/A	N/A	N/A	N/A

* In New Zealand, where the valve set pressure is not greater than 120 kPa, a pressure-relief valve may be used in lieu of a temperature/pressure-relief valve.

† Isolating valves shall provide full flow.

LEGEND:

N/A = Not applicable

NOTES:

1 This Table is not applicable to a water heater fed from a remote cold water storage tank.

2 For Australian valve requirements, see AS 1357 and for New Zealand valve requirements, see NZS 4608.

TABLE 5.9.1(B)

SET PRESSURES FOR VALVES

Temperature/ pressure-relief valve or pressure-relief valve setting	Without expansion control valve		With expansion control valve			Inlet pressure control valve type required
	Maximum mains pressure	Inlet valve maximum setting	Exp. control valve setting	Maximum mains pressure	Inlet valve maximum setting	
kPa	kPa	kPa	kPa	kPa	kPa	
Open vent	N/A	35	N/A	N/A	N/A	Pressure reducing
56	N/A	45	46	N/A	35	Pressure reducing
74	N/A	65	65	N/A	55	Pressure reducing
Open vent	N/A	76	N/A	N/A	N/A	Pressure reducing
80	N/A	65	65	N/A	50	Pressure reducing
85	N/A	70	70	N/A	55	Pressure reducing
100	N/A	85	85	N/A	70	Pressure reducing
115	N/A	100	100	N/A	85	Pressure reducing
120	N/A	110	110	N/A	100	Pressure reducing
130	N/A	115	115	N/A	100	Pressure reducing
150	N/A	130	130	N/A	115	Pressure reducing
180	N/A	160	160	N/A	140	Pressure reducing
215	N/A	195	195	N/A	175	Pressure reducing
500	400	350	400	350	300	Pressure limiting
700	550	450	550	450	350	Pressure limiting
850	680	500	700	550	450	Pressure limiting
1000	800	600	850	680	500	Pressure limiting
1200	960	600	1000	800	600	Pressure limiting
1400	1120	600	1200	960	600	Pressure limiting
N/A	N/A	N/A	1400	1100	600	Pressure limiting

NOTE: Where the maximum mains pressure is likely to be exceeded, inlet pressure-control valve shall be used.

5.9.2 Required set pressure of valves (for unvented water heaters)

The required set pressure of expansion control valves, expansion vessels and inlet-pressure-control valves shall be determined from the set pressure of the temperature and pressure-relief valve supplied with the water heater with reference to Table 5.9.1(B).

5.9.3 Installation of valves and expansion vessels

Valve and expansion vessel installations shall—

(a) have the isolating valve in a position readily accessible from floor or finished surface level;

(b) have the cold water supply valves (where fitted) in the sequence isolating valve, line strainer, pressure control valve, non-return valve, expansion control valve or expansion vessel or as a combined unit;

(c) have unobstructed access for maintenance or replacement and meet the requirements of Items (c) and (d) of Clause 5.3.2;

(d) have no heat applied to any valve that has screwed pipe connections;

(e) have no other valve, tap or shut-off device between the temperature/pressure-relief valve or pressure-relief valve and the water heater;

(f) except for the heater isolating valves required in Clause 5.10.2(h) for multiple installations, have no other valve, tap or shut-off device between any expansion control valve or expansion vessel and the inlet to the water heater;

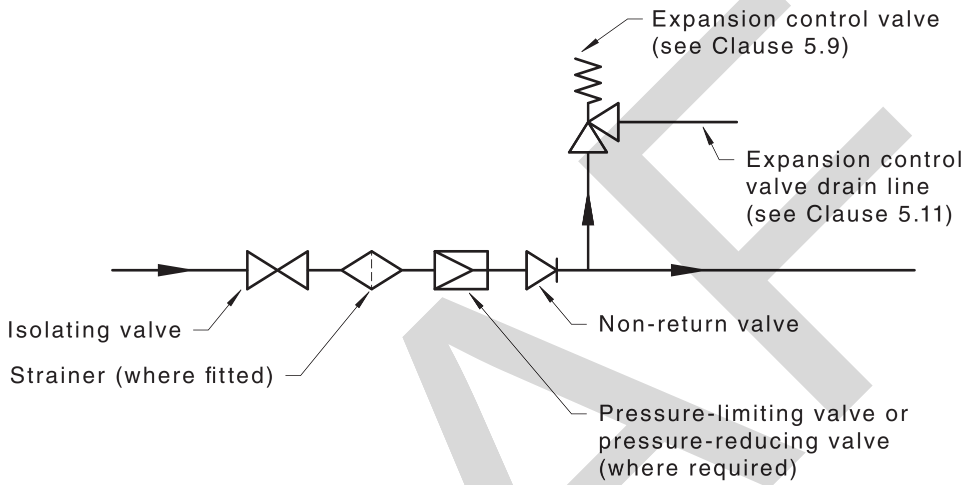
(g) have the temperature/pressure-relief valves fitted in the position identified on the water heater; and

(h) be protected from freezing in accordance with Clause 4.10.

NOTES:

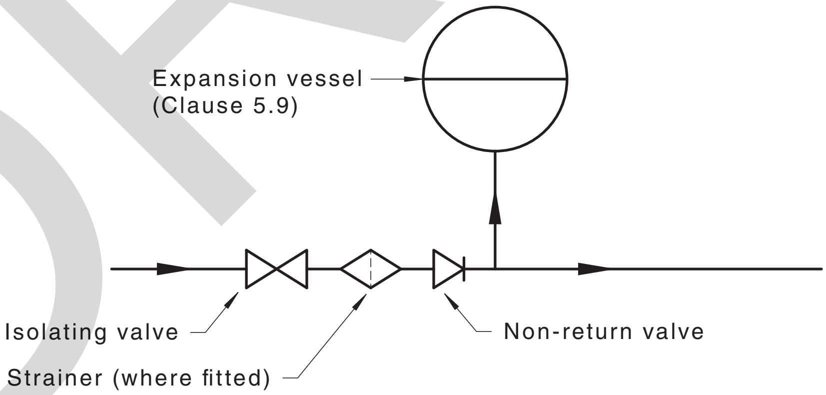
1 For typical sequence of valve installation, see Figure 5.9.3(A).

2 For typical valve installations, see Figures 5.9.3(B) to 5.9.3(E).



(a) Typical assembly incorporating a pressure-limiting or pressure-reducing valve usig expansion control valve

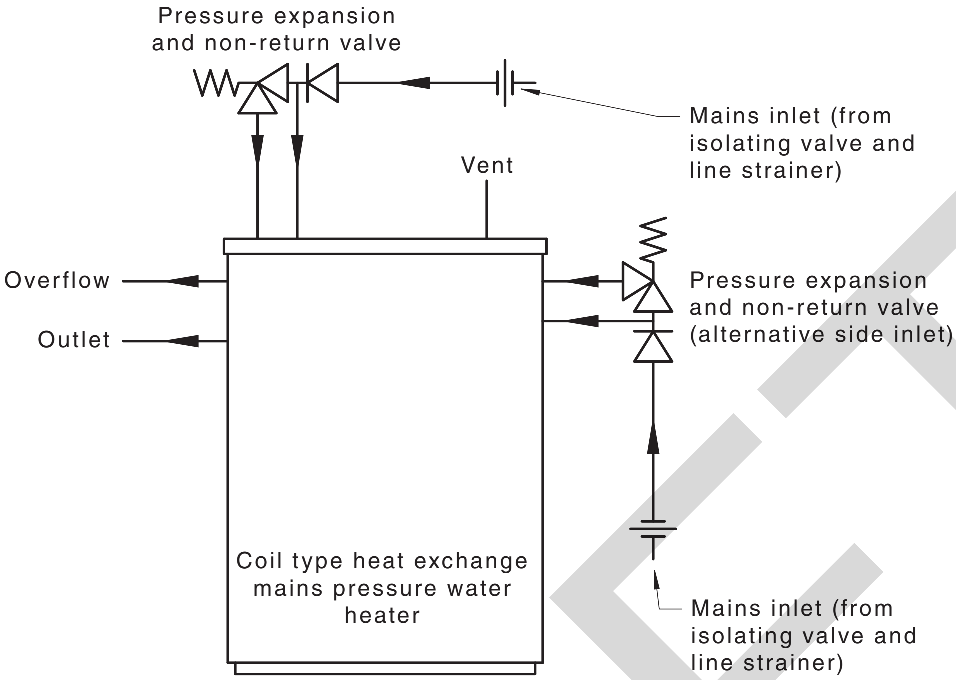
Note: Expansion control valve may be combined with the pressure-limiting valve



(b) Typical assembly with no pressure-limiting or pressure-reducing valve using an expansion vessel

NOTE: Expansion control valve may be combined with the pressure-limiting valve.

FIGURE 5.9.3(A) TYPICAL INSTALLATION OF VALVES



NOTE: Expansion control valve may be combined with the pressure-limiting valve.

FIGURE 5.9.3(B) TYPICAL INSTALLATION OF A HEAT EXCHANGE MAINS PRESSURE WATER HEATER FITTED WITH A COMBINATION EXPANSION CONTROL VALVE AND NON-RETURN VALVE

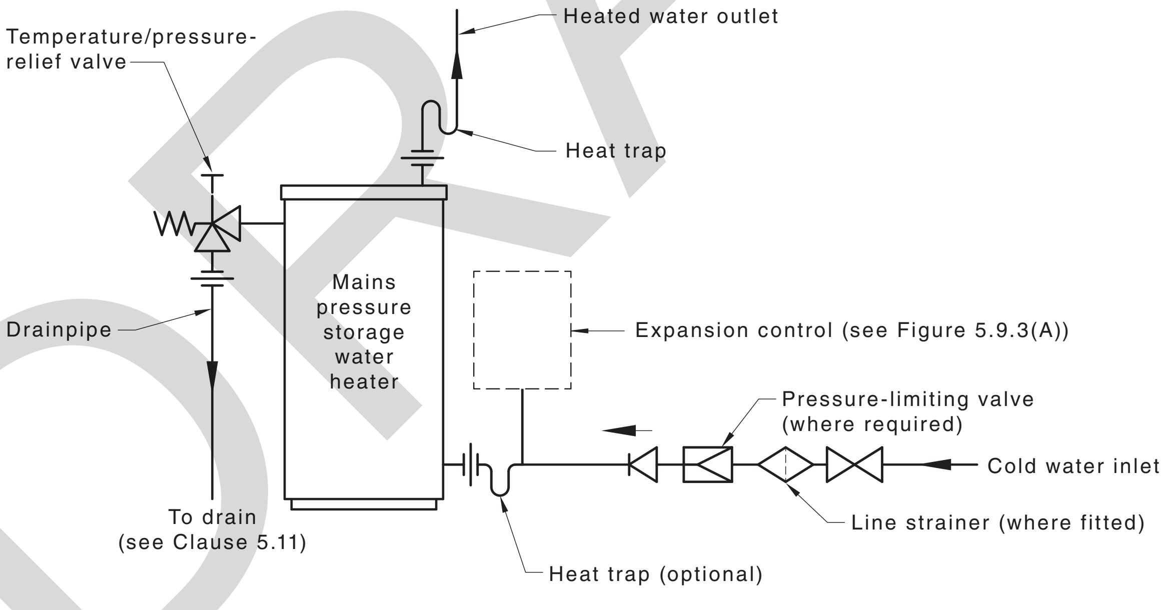
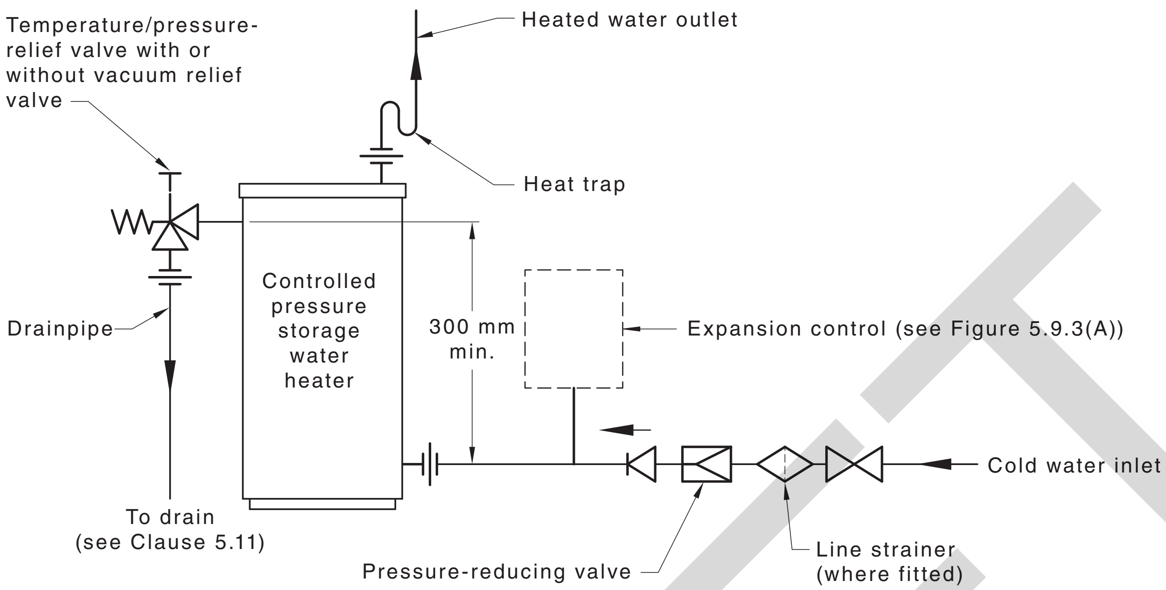
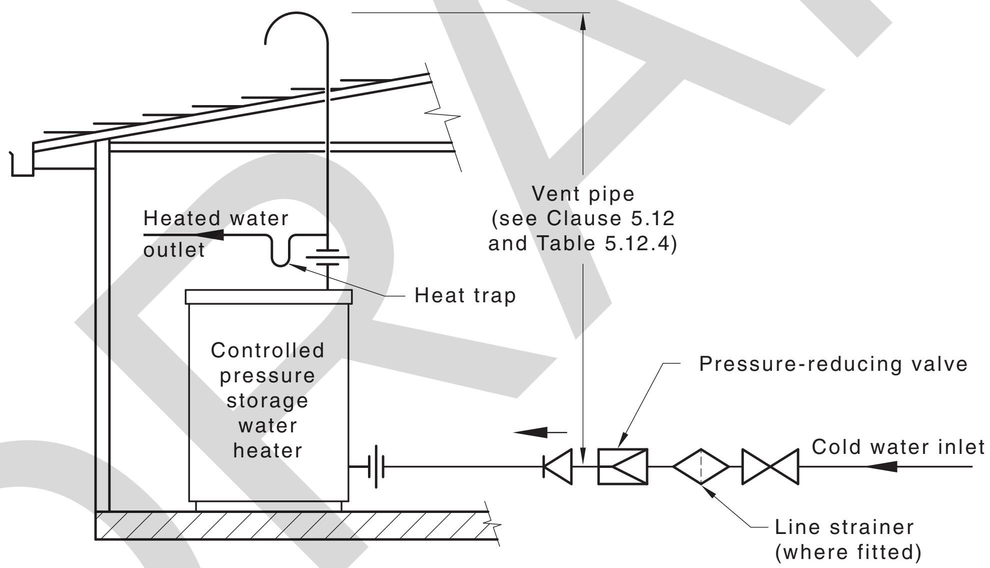


FIGURE 5.9.3(C) TYPICAL INSTALLATION OF A MAINS PRESSURE STORAGE WATER HEATER

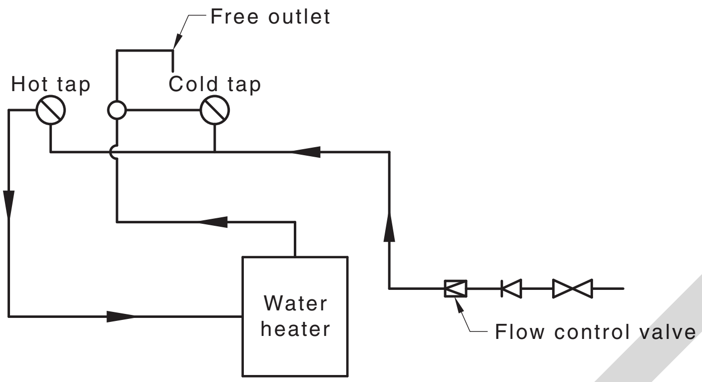


(e) With temperature/pressure-relief and vacuum-relief valves



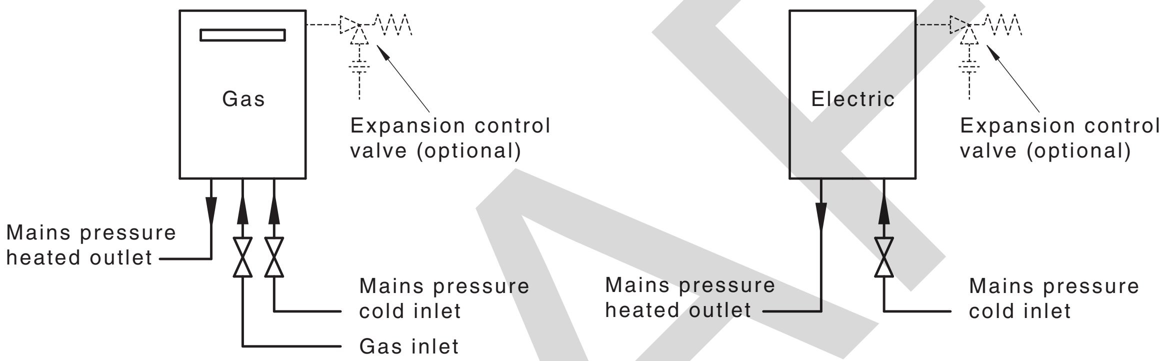
(f) With vent pipe

FIGURE 5.9.3(D) TYPICAL INSTALLATION OF A PRESSURE WATER HEATER CONTROLLED WITH A PRESSURE-REDUCING VALVE

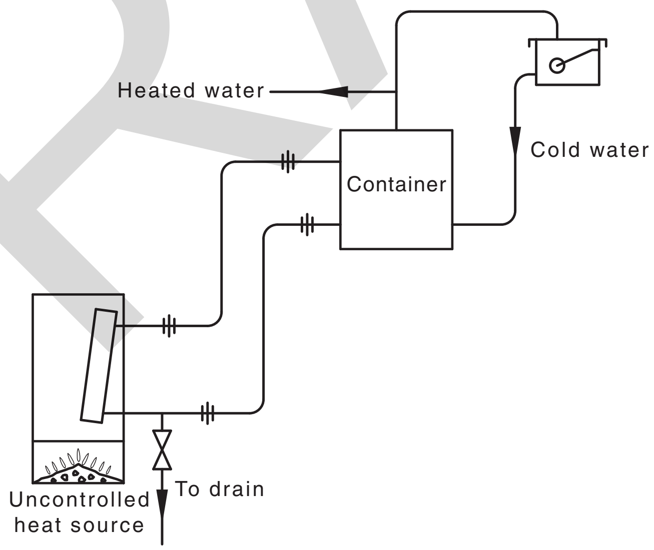


(g) Free outlet under-sink water heater

NOTE: For expansion control, where installed in conjunction with a heated water vessel, see Figure 5.9.3(A)



(h) Instantaneous water heater



(i) Uncontrolled water heater

NOTE: For expansion control, where installed in conjunction with a heated water vessel see Figure 5.9.3(A).

FIGURE 5.9.3(E) TYPICAL WATER HEATER ARRANGEMENTS

5.10 MULTIPLE INSTALLATIONS OF PRESSURE-TYPE STORAGE WATER HEATERS

5.10.1 General

Where large volumes of hot water are required over a short period, several pressure-type storage water heaters may be combined into one service.

Each water heater shall be fitted with temperature/pressure-relief valve(s) in accordance with Table 5.9.1(A).

In all such installations, access shall be provided in front of each water heater for the servicing and removal of any one water heater without the need to disconnect any others.

5.10.2 Balanced flow conditions

Banks of storage water heaters shall be installed in accordance with the following to ensure similar resistance to flow through all the heaters in the bank and that each delivers similar volumes of hot water at a similar temperature:

(a) The water heaters shall be of the same storage capacity and energy input capacity, with the same nominal temperature setting and be connected in parallel.

(b) The cold water service to the inlet header shall enter the bank from the opposite end to that from which the heated water service leaves the outlet header.

NOTE: For typical arrangements, see Figures 5.10.2(A) and 5.10.2(B).

(c) The heated water return in a recirculation system shall connect to the cold water header, and enter the bank from the opposite end to that from which the heated water service leaves the outlet header.

(d) Inlet and outlet headers shall be of the same nominal size and length and the same shape with identical connections. The size of the headers shall be either the nominal size or the minimum size, as given in Table 5.10.2, whichever is the larger.

(e) All inlet branch pipes shall be of the same nominal size and be of the same length and shape.

(f) All outlet branch pipes shall be of the same nominal size and be of the same length and shape.

(g) Where a hot water return header is installed, all return branch pipes shall be of the same nominal size and be of the same length and shape, i.e. balanced.

(h) Heater-isolation valves shall be fitted to inlet, outlet and return branch pipes. These valves shall be full-way gate valves or ball valves and be of the same nominal size as the pipe to which they are fitted.

(i) Offtakes shall not be connected to any branch pipe or any intermediate part of the headers.

TABLE 5.10.2

HEADER SIZES FOR MULTIPLE INSTALLATIONS

Number of heaters in bank	Nominal size of headers	Minimum size of headers DN
2	Same pipe size as branch pipes	20
3–5	One pipe size larger than branch pipes	25
6–10	Two pipe sizes larger than branch pipes	32
11–15	Three pipe sizes larger than branch pipes	40

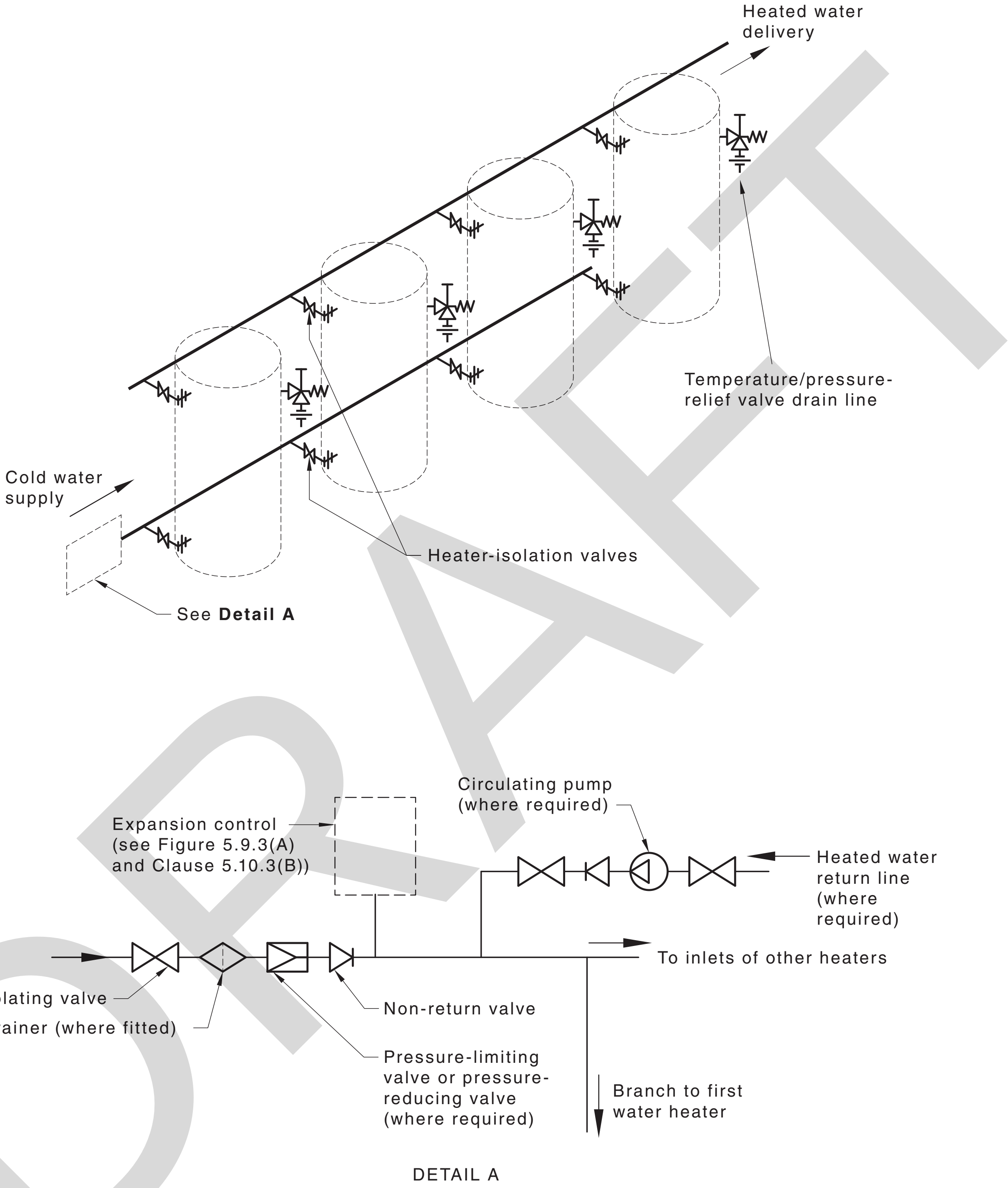


FIGURE 5.10.2(A) TYPICAL IN-LINE ARRANGEMENT OF MULTIPLE STORAGE WATER HEATERS

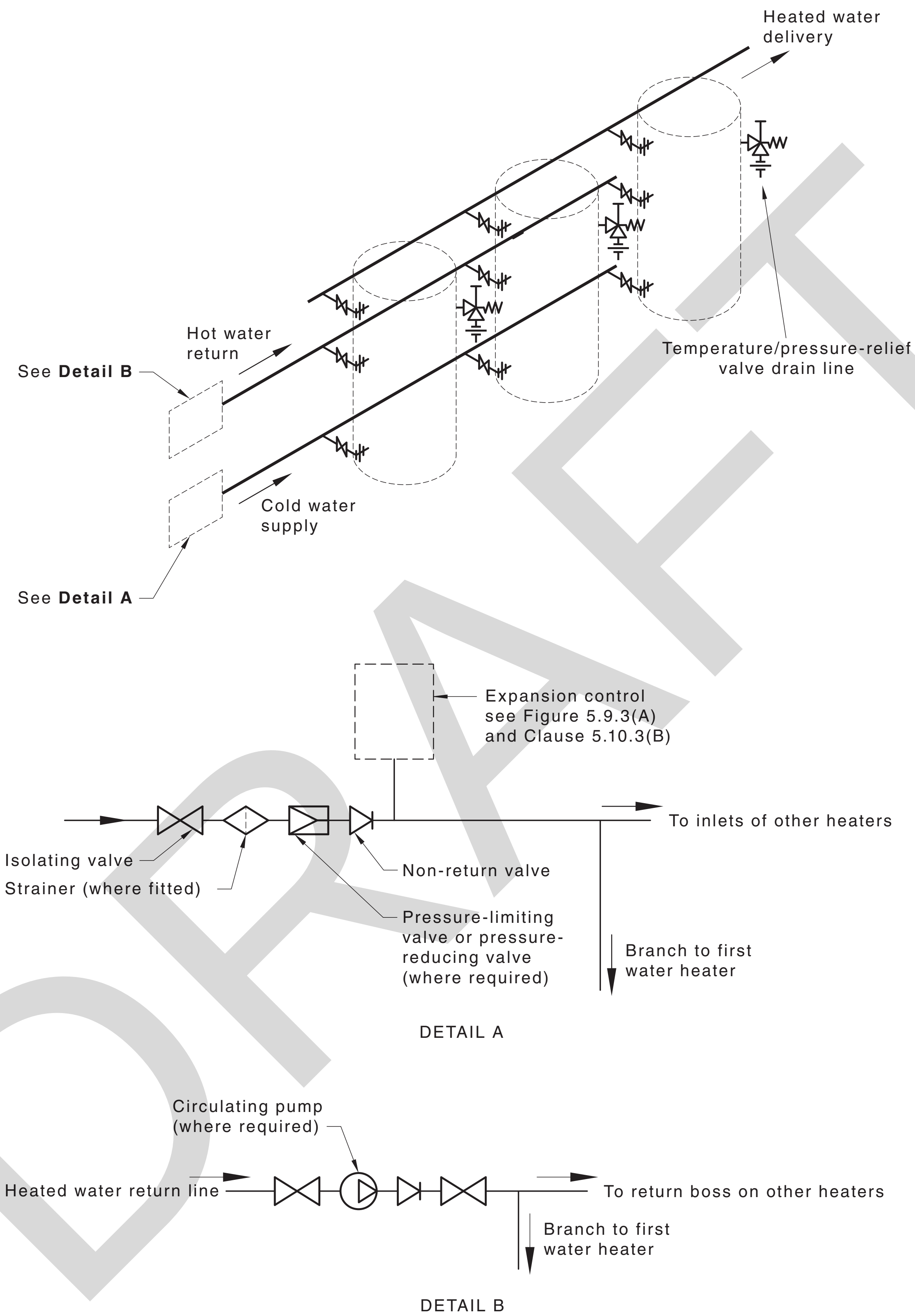


FIGURE 5.10.2(B) TYPICAL ALTERNATIVE ARRANGEMENT OF HEATED WATER RETURN LINE FOR CIRCULATING HEATED WATER SERVICE

5.10.3 Positioning and sizing of control valves on the cold water supply

Where fitted, control valves installed for water heaters in a multiple configuration shall meet the following requirements:

(a) *Inlet-pressure-control valves* Inlet-pressure-control valves shall be installed between the cold water supply isolating valve and the branch to the first water heater. Where two or more inlet-pressure-control valves are fitted in parallel, they shall be of the same pressure setting.

(b) *Cold water expansion control valves and expansion vessels* One or more expansion control valves shall be installed immediately after the cold water isolation valve and the non-return valve assembly to each bank of heaters as follows:

 (i) The total kilowatt rating of the expansion control valves shall be not less than the total kilowatt rating of all the heaters in the bank.

 (ii) The expansion vessel shall have a capacity at least twice the thermal expansion of the total volume of water in the system for the greatest temperature rise, being the difference between the coldest temperature in the pipe work (i.e during installation of the system, or when the system is not in operation) and the highest temperature during operation.

 (iii) The expansion vessel shall be set to maintain a pressure within the system that is between the inlet pressure after any pressure reducing/limiting valves and 85% of the pressure relief valve setting.

 (iv) The expansion vessel shall be designed for the maximum operating temperature of the system.

 NOTE: The expansion vessel should be located in the cold water supply immediately downstream from the system main isolating valve, non-return valve and pressure reducing or limiting valve, if installed.

For rates of thermal expansion, methods for sizing expansion vessels and examples, see Appendix P.

5.11 TEMPERATURE/PRESSURE-RELIEF VALVE AND EXPANSION CONTROL VALVE DRAIN LINES

5.11.1 Size and material

For other than the expansion control valve fitted to heat exchange water heaters, every temperature/pressure-relief valve and expansion control valve shall be fitted with a drain line that shall—

(a) be of a diameter not smaller than the nominal size of the valve outlet;

(b) have a length in accordance with Table 5.11.1; and

(c) be of copper piping.

NOTE: It may be necessary to have the valve drain line discharge into a tundish when the distance to the point of final discharge is greater than the maximum given in the table.

TABLE 5.11.1

LENGTHS AND CHANGES OF DIRECTION

Maximum relief drain length m	Maximum numbers of changes of direction (greater than 45°)
9	3
8	4
7	5
6	6

5.11.2 Interconnection of drain lines

5.11.2.1 *Individual water heaters*

The drain lines from the outlet of the temperature/pressure-relief valve and the expansion control valve on an individual water heater may be joined together subject to the following:

(a) Interconnection is limited to the drain lines from the outlets of one temperature/pressure-relief valve and one expansion control valve, see Clauses 5.8(c) and 5.10.3(b).

(b) Installation of the drain lines conforms with Clause 5.11.3.

NOTE: Some regulatory authorities may not permit interconnection of drain lines.

5.11.2.2 *Multiple relief valves*

Except for drain lines conforming with Clause 5.11.2.1, the drain lines from multiple relief valves shall not be interconnected. Where multiple relief valves discharge over a tundish on a common drain line, the common drain line shall be sized in accordance with Clause 5.11.5.

5.11.3 Installation

Drain lines from temperature/pressure-relief valves, expansion control valves and tundishes shall be installed as follows:

(a) There shall be no tap, valve or other restrictions in any line.

(b) Each line shall fall continuously from the valve to the point of discharge.

(c) Drain lines from expansion control or temperature/pressure-relief valves shall not discharge into a safe tray.

(d) The point of discharge from each drain line shall be located so that the release of steam or hot water does not cause a nuisance, is readily discernible and incurs no risk of damage to the building or injury to persons.

(e) Where a drain line terminates outside a building, the end of the line shall be—

   (i) not lower than 75 mm or higher than 300 mm above an overflow relief gully or disconnector gully;

   (ii) not lower than 75 mm or higher than 300 mm above a gravel pit not less than 100 mm in diameter;

   (iii) over a tundish in accordance with Item (h) below; or

   (iv) not lower than 200 mm or higher than 300 mm above an unpaved surface.

   NOTE: Where discharges from valves may adversely affect slabs and footings of buildings, the drain lines should discharge away from the building. Further guidance is provided in the National Construction Code (NCC).

(f) Where the drain line from the expansion control valve on a heat exchange water heater is directed into the water storage container, there shall be a minimum air gap of 20 mm, except where the valve and associated drain lines are supplied as an integral part of the water heater.

(g) Where a water heater is externally located, the drain line from the relief valve shall be terminated so as to discharge water away from the operator during operation of the valve.

(h) Where discharging over a tundish or gully, drain lines shall have an air gap of a size at least twice the diameter of the drain line.

(i) Where installed, plastics drain lines shall be—

   (i) continuously supported;

   (ii) fixed and secured in accordance with Clause 4.4;

   (iii) protected from UV if exposed to direct sunlight; and

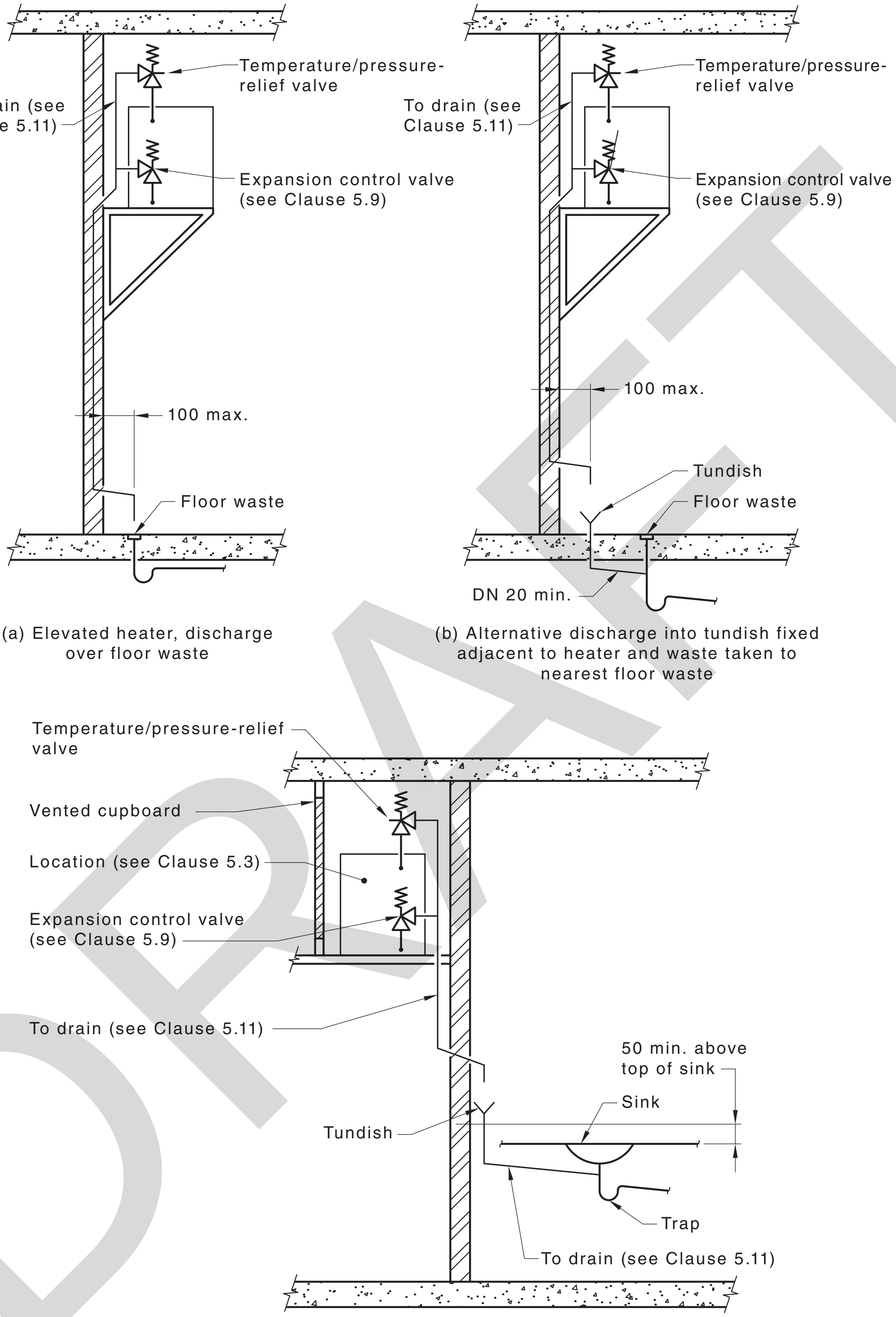
   (iv) installed with a suitable allowance for thermal movement.

NOTES:

1 Typical installations of drain lines are illustrated in Figure 5.11.3(A) and 5.11.3(B).

2 Ponding should be avoided.

3 As the function of the temperature/pressure-relief valve on this water heater is to discharge high temperature water under certain conditions, the pipework downstream of the relief valve should be capable of carrying water exceeding 93°C. Failure to observe this precaution may result in damage to pipework and property.



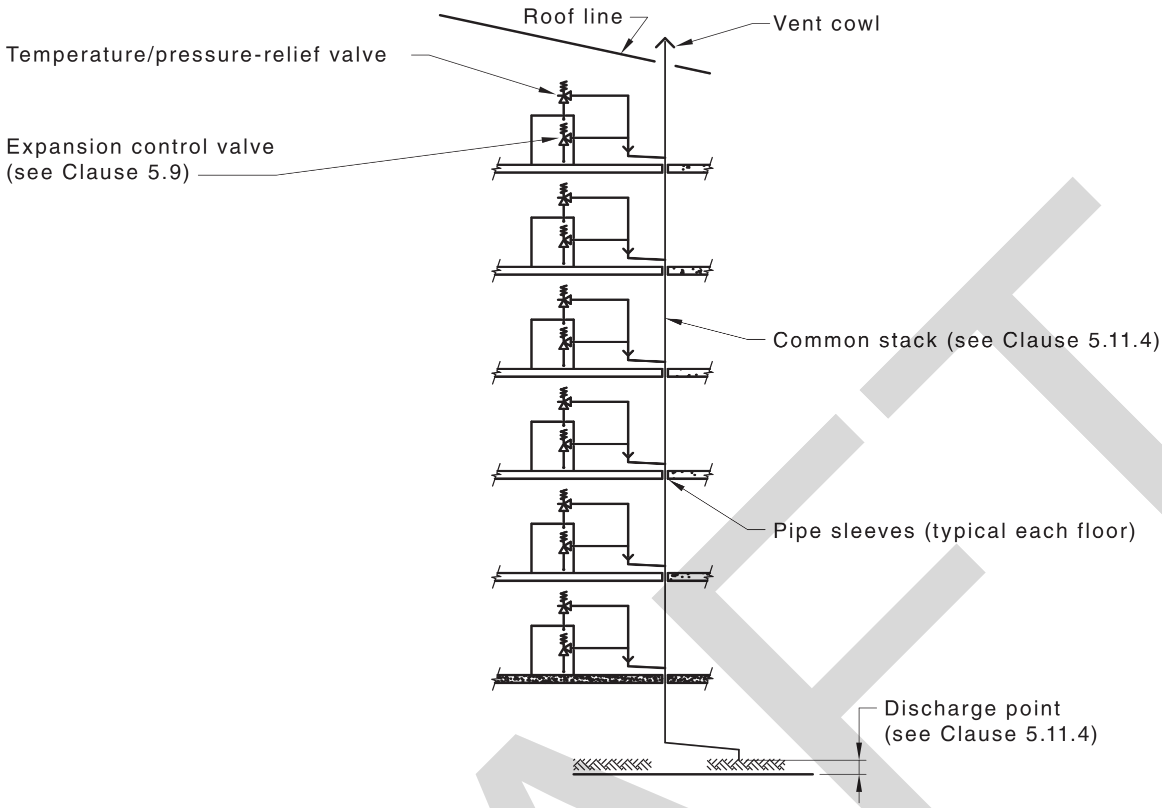
(a) Elevated heater, discharge over floor waste

(b) Alternative discharge into tundish fixed adjacent to heater and waste taken to nearest floor waste

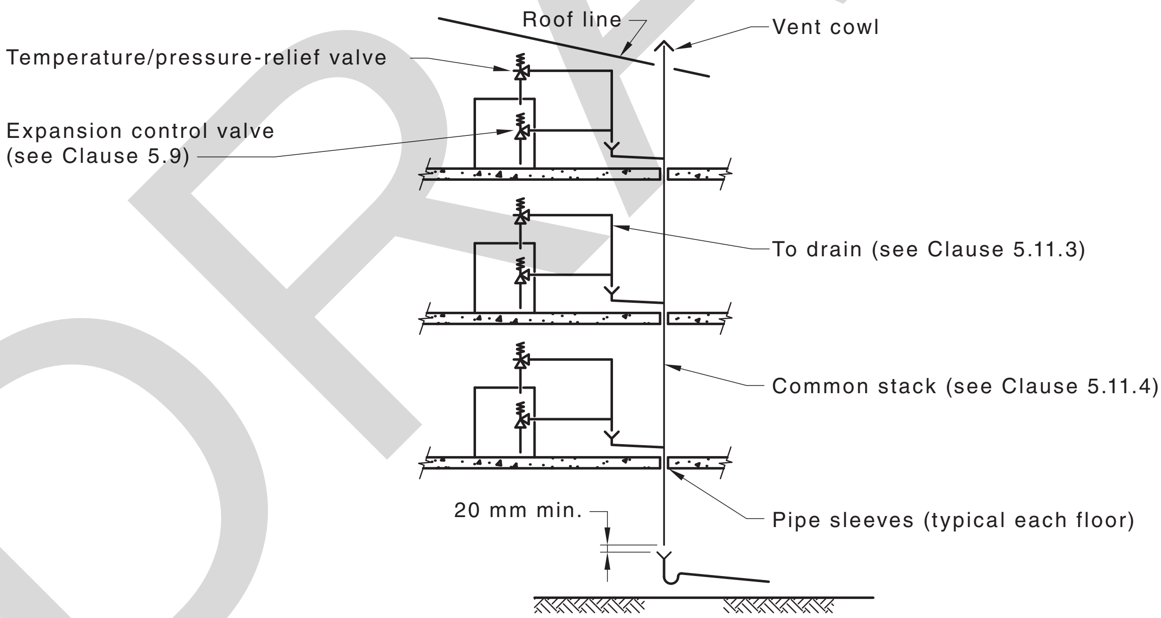
(c) Heater located in vented cupboard, discharge to kitchen sink waste

DIMENSIONS IN MILLIMETRES

FIGURE 5.11.3(A) TYPICAL RELIEF DRAINAGE



(a) Common stack discharge over ground, stormwater drain or gully



(b) Common stack discharge to a soil or waste stack

FIGURE 5.11.3(B) TYPICAL TEMPERATURE/PRESSURE-RELIEF VALVE DRAIN LINES—COMMON STACK DISCHARGE METHODS

5.11.4 Common stack discharge

Where individual water heaters are installed in a multistorey building, the relief drain lines may discharge into a common stack, provided the following criteria are met:

(a) The discharge from the common stack is to a tundish, having a discharge line that is not less than the size of the common stack, directly connected to a fixture trap, and installed in connection with any adjacent soil or waste stack.

(b) The discharge point of the common stack is such that any discharge is readily visible and does not cause any nuisance.

(c) The common stack is vented by extending the pipe upwards, above the roof level.

5.11.5 Tundish drain lines

The drain line from any tundish shall be not less than one size larger than that of the largest drain line discharging into the tundish. Tundish drain lines shall conform with Clause 5.11.3.

5.11.6 Areas subject to freezing

In areas where water pipes are prone to freezing, the drain line from any valve shall be insulated and not exceed 300 mm in length. It shall discharge into a tundish through an air gap of not less than 75 mm and not more than 150 mm measured from the outlet of the drain line to the rim of the tundish.

5.12 VENT PIPES

5.12.1 Installation

5.12.1.1 *Storage water heaters*

Each vented storage water heater shall be fitted with a vent pipe of copper not smaller than DN 20 and shall—

(a) have no tap, valve, sharp change of direction or other restrictions in the pipe;

(b) rise continuously from the point of connection; and

(c) have any roof or wall penetration rendered waterproof with due allowance made for expansion.

5.12.1.2 *Heat exchange water heaters and boiling water units*

Where required, vent pipes shall be installed for heat exchange type water heaters and boiling water units.

NOTE: The venting requirements for heat exchange type water heaters and boiling water units may be product specific.

5.12.2 Termination of vent pipe

Vent pipes installed on a water heater shall—

(a) when over a cold water storage tank, be turned downward and discharge into the cold water storage tank by passing through the lid, finishing not lower than the outlet of the float valve and not discharging over the float valve assembly;

(b) when taken through a roof, have the open end of the pipe point upwards or be turned downwards and if projecting more than 1 m above the roof, be supported; and

NOTE: For a typical treatment, see Figure 5.9.3(D)(b).

(c) in locations subject to freezing conditions, vent pipes shall be insulated to at least 300 mm above the working water level.

5.12.3 Cold water storage tank-fed water heaters (other than side-fed types)

When fitted in conjunction with a cold water storage tank, vent pipes shall rise to a height not less than 80 mm above the static water level in the tank for every 1 m between the overflow water level in the feed tank and the base of the heater, or 300 mm, whichever is the greater.

5.12.4 Vented storage water heaters, inlet pressure-controlled

When installed in conjunction with a water heater fitted with a pressure-reducing valve, a vent pipe shall rise to a height above the outlet of the pressure-reducing valve in accordance with Table 5.12.4, and be in accordance with Equation 5.12.4:

$$H = \frac{SP}{10} + 1 \qquad \text{. . . 5.12.4}$$

where

H = the height of vent pipe, in metres, to the nearest 0.5 m

SP = set outlet pressure of the reducing valve, in kilopascals

TABLE 5.12.4

HEIGHT FOR VENT PIPES ABOVE A PRESSURE-REDUCING VALVE

Pressure-reducing valve setting kPa	Height of vent pipe m
25	3.5
30	4.0
35	4.5
45	5.5
50	6.0
70	8.0

SECTION 6 INSTALLATION OF SOLAR WATER HEATERS

6.1 SCOPE OF SECTION

This Section covers the installation of solar water heating systems with fixed orientation and inclination used either in single-unit or in multiple-unit installations. It is applicable to the following types of solar heated water systems which include collectors with either flat plate or evacuated tube absorbers:

(a) Systems with the solar collector remote from the heated water container, with both components supplied as a complementary and packaged system and with primary circuit piping arranged to suit site conditions.

(b) Custom-built systems where the solar collector is connected to an existing remote heated water container or new container not sold packaged with the collector, and with primary circuit piping arranged to suit site conditions.

(c) Close-coupled or integral solar water heaters.

6.2 APPLICATION OF SECTION (NEW ZEALAND ONLY)

For the installation of solar water heaters in New Zealand, NZS 4613 and NZS 4614 shall apply.

6.3 GENERAL INSTALLATION REQUIREMENTS

6.3.1 Sizing and solar performance

The performance of particular system configurations and installations, particularly packaged systems, shall be determined using the methods given in AS/NZS 4234.

NOTES:

1 For recommendations for the installation of unrated solar heated water supply systems, see Appendix E.

2 The ratio of container volume to collector area should be in the range 40–90 L per square metre of collector area.

3 Collector area and container size will affect system performance.

6.3.2 Location

The components of the system shall be located so as to maximize solar gain and minimize energy losses, and shall be positioned to facilitate maintenance and the choice of a suitable route for piping between the container and the collector.

NOTES:

1 For placement of water heater, see Clause 5.3.1.

2 Recommendation on the installation of close-coupled and integral solar heated water systems on roofs are given in Appendix F.

3 For suggested component sizes, see Appendix G.

4 For information on effect of inclination and orientation on system performance, see Appendix I.

C6.3.2 *Environmental factors of solar radiation for the area, local consideration of dust, hail, frost, shade and wind, and the aspects of both the quality of water used and the consumer habits, with regard to heated water usage, will affect both the performance and the service life of the unit. Performance will also be affected by storage container size and time of day when supplementary heating is applied.*

Where geographical locations are less than ideal, improved performance of a system may be achieved by the installation of either an additional collector(s) or higher performing collectors.

6.3.3 Structural integrity

The collective weight of collector(s), any associated filled container and their mounting frames shall not exceed the loading prescribed for the roof.

Where systems are supported on roof battens crossing rafters or trusses the battens shall be continuous across not less than three rafters or trusses.

Supporting battens and their fixing to each rafter or truss shall be in accordance with the requirements of the NCC.

NOTES:

1 Mounting frames, support rails or brackets that are used to support and/or orientate a roof-mounted system or system components should be supported on rafters or trusses spaced at a maximum of 1200 mm centres.

2 Where mounting frames are used for orientation and connection to the roof structure, the mounting frame and its attachments should be suitable for local wind conditions, specially in cyclonic regions, where local advice should be sought.

3 A map of regional basic design wind speeds is shown in Appendix J.

4 Verification of frames or components as to their structural suitability may be required by the regulatory authority.

5 The weight of the container and collector full of water should be considered in the design of the roof structure and supports.

6 Installation of a container on an existing roof will require that the roof structure is adequate for the load of the container and collector. Where the roof is considered to have inadequate strength to support the container and collector, the roof structure will need to be strengthened prior to installation.

6.3.4 Water hardness and dissolved solids

Where the Saturation Index (SI) of the water exceeds +0.4, collectors shall not be charged with water, unless they are covered by an opaque material, until required for use.

NOTE: Water supplies with high total dissolved solids content may have a detrimental effect on some collectors. Advice should be sought from the manufacturer as to the suitability of a particular product intended to be used with water of high total dissolved solids (generally in excess of 500 mg/L).

6.3.5 Collector circuit

The collector circuit shall utilize a direct system or indirect system, as defined under ‘solar water heater’ in AS/NZS 3500.0.

6.3.6 Flow and return pipes and fittings

Piping used between the collector and the container shall be a minimum of DN 15 copper or stainless steel.

Plastics pipes and fittings shall not be used between the collector and the container except as specified in Clause 2.4.3(f).

Thermal insulation shall be in accordance with Section 8.

6.3.7 Corrosion resistance

All materials shall conform with the following:

(a) Materials that are jointed directly to, or in contact with, other materials shall have chemical and galvanic compatibility with those materials to prevent corrosion or other deterioration that would impair their function during their intended service life.

(b) All brackets, fixing straps, support rails, mounting frames and fixings used for the external installation of solar water heaters and their components shall be manufactured from hot dip galvanized mild steel, grades 304, 316 or 430 stainless steel or a material of equivalent strength and corrosion resistance.

(c) Where components are fabricated from welded mild steel they shall be hot dip galvanized after fabrication.

(d) Containers installed externally shall conform with Clause 5.6.

6.3.8 Entrapped air

All piping shall be installed to eliminate air from the heat transfer fluid circuit.

NOTES:

1 For thermosiphon systems, this may be achieved if the pipes connecting the collector and the storage container rise continuously from the collector to the storage container.

2 In a thermosiphon system, the circulation pipe from the top of the collectors to the entry point in the container should have an average upward slope of not less than 1 in 7. The minimum upward slope at any point should be not less than 1 in 20, unless the pipe is vented at that point.

6.3.9 Over-temperature protection

Over-temperature protection shall be provided in accordance with AS/NZS 2712.

6.3.10 Pressure and temperature relief

Relief valves shall have a relief capacity—

(a) not less than the total output power of the collectors at 99°C and 1100 W/m^2 and 50°C effective ambient, plus that of any supplementary heater; or

(b) in accordance with AS/NZS 2712.

NOTE: The design of the system should be such that the temperature of the water in the container does not activate any supplementary energy safety cut-outs under normal conditions of operation.

6.3.11 Drain lines

Drain lines for temperature and pressure-relief and expansion control valves shall be installed in accordance with Clause 5.11.

Copper pipe used for drain lines crossing a metal roof shall be fully insulated with UV resistant weatherproof lagging to prevent corrosion of the metal surface.

6.3.12 Unintentional circulation

The plumbing installation shall be designed—

(a) to minimize unintentional circulation of heated water through the collector;

(b) prevent reverse thermosiphoning from containers with electrical or gas heating; and

(c) prevent thermosiphon circulation from wetbacks to the collectors.

NOTE: This may be achieved through the use of—

1 a heat trap in accordance with Items (b) and (c) of Clause 8.4; or

2 a non-return valve.

6.3.13 Mounting

Rails or angles used for the support of collectors, containers or mounting frames shall be installed across the slope of the roof and fixed through the upper profile of the roof sheeting into the supporting battens.

Support rails used on tiled roofs shall be securely fixed to fixing straps. Fixing straps that are used to restrain collectors and/or containers on tiled roofs shall pass beneath the tiles and be securely fixed directly to the rafters or trusses with a minimum of three screws 40 mm long per fixing strap.

NOTE: A reference to tiles and tiled roofs in this Section is a reference to cement, terracotta or other composite tiles.

6.3.14 Supplementary heating

Supplementary heating equipment shall be provided and it shall have thermal capacity to supply heated water requirements in accordance with AS/NZS 2712.

6.3.15 Penetrations through roof cladding

Penetrations through the roof cladding of structural supports, fixings, pipes and wiring shall be—

(a) through the upper profile of roof tiling or through the upper rib of metal sheeting;

(b) flashed or sealed around the penetrating member using purpose made sealing washers or boots, with allowance made for thermal expansion; and

(c) installed in a manner that will not prevent rainwater flow across the roof, trap debris or cause ponding.

All metal swarf shall be removed from the roof and guttering on completion of the installation.

6.4 INSTALLATION OF SOLAR WATER HEATER STORAGE CONTAINERS

6.4.1 General

Storage containers for solar water heaters shall be located in accordance with Clause 5.3 and shall be installed in accordance with relevant requirements of Clauses 5.4 to 5.12.

6.4.2 Thermosiphon systems

For thermosiphon systems where the collector is remote from the container, the top of the collectors shall be not less than 150 mm (measured vertically) below the bottom of the container.

6.4.3 Support

Containers of close-coupled or integral systems mounted directly onto or above a roof structure shall be supported in accordance with Clause 6.3.

NOTE: A typical installation of a close-coupled solar water heater is shown in Figure 6.4.3.

Containers located remotely from the collectors and those located in roof spaces shall be supported in accordance with Clause 5.5.

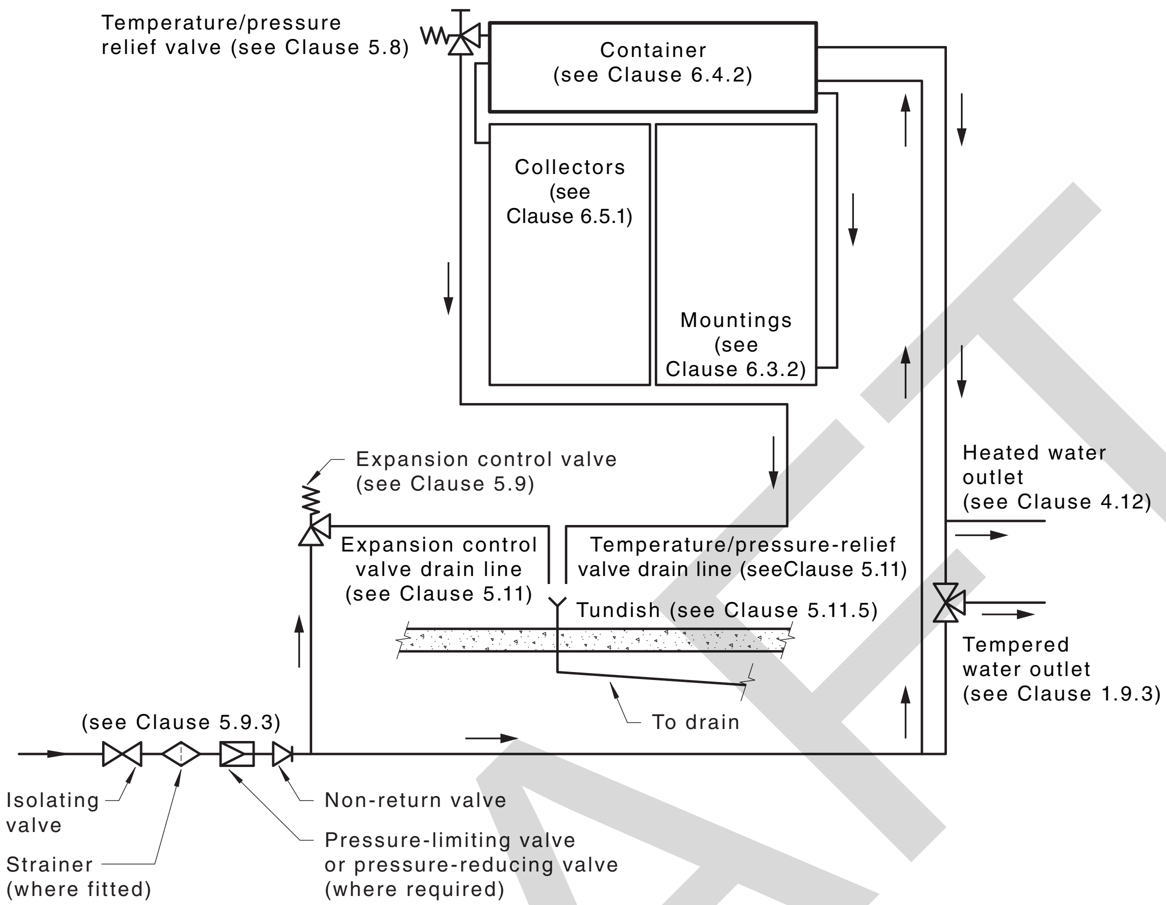


FIGURE 6.4.3 TYPICAL INSTALLATION OF CLOSE-COUPLED SOLAR WATER HEATER

6.4.4 Safe trays

Where containers are installed in roof spaces, cupboards, or are otherwise concealed, they shall be placed on a safe tray in accordance with Clause 5.4.

6.4.5 Auxiliary water heating

A solar water heater provided with auxiliary water heating shall conform with the following:

(a) Only connection points in the container or in fittings or components intended for this purpose shall be used.

(b) The temperature/pressure-relief valve or expansion control valve shall conform with Clause 5.9.

(c) The installation of auxiliary heating by uncontrolled heat sources shall conform with Clause 7.2.

(d) For systems with remote containers, an auxiliary heating connection shall not be made to the primary circuit flow and return lines.

6.5 INSTALLATION OF COLLECTORS

6.5.1 Positioning

6.5.1.1 *Shade*

Collectors shall be located so that they are clear of shade for not less than 3 hours either side of solar noon at any time during the year. Partial shading by small objects, such as chimneys, flues and TV antennas, is permissible during this period.

NOTES:

1 Nominal times to be clear of shade would be between 9 am and 3 pm standard time.

2 Information on estimation of shading of collectors is given in Appendix H.

6.5.1.2 *Orientation*

Collectors shall be installed so that they face no more than 45° east or west of true north.

NOTES:

1 In general, better performance will be achieved the closer the collectors are placed to true north.

2 True north should not be confused with a compass reading of magnetic north. The difference between true north and magnetic north is known as magnetic declination. Where a magnetic compass is used, it is important to adjust for magnetic declination from true north.

3 Examples of magnetic declination adjustments are given in Table 6.5.1.2.

TABLE 6.5.1.2

EXAMPLES OF MAGNETIC DECLINATION

Location	Angle of declination (degrees east or west of magnetic north)
Adelaide	8.1 East
Alice Springs	4.5 East
Auckland	19.3 East
Brisbane	10.6 East
Cairns	6.5 East
Canberra	12.2 East
Christchurch	23.3 East
Darwin	3.10 East
Hobart	14.5 East
Invercargill	25.1 East
Melbourne	11.3 East
Perth	1.4 West
Sydney	12.3 East
Wellington	22.1 East

6.5.1.3 *Inclination*

Collectors shall be inclined at an angle within 20° of the local latitude angle.

For thermosiphon systems, the minimum inclination angle shall be 10°.

NOTES:

1 The optimum inclination angle is the latitude of the site (for example, an inclination angle of 27° for the city of Brisbane would be optimum). However, inclination within 20° of the latitude angle will only reduce efficiency minimally. Inclination between 10° and 45° from the horizontal is generally suitable, depending on site location.

2 Improved winter performance may be obtained by an angle of inclination greater than the latitude angle while improved summer performance is obtained from an angle of inclination less than the latitude angle.

3 Examples of local latitudes of major cities are given in Table 6.5.1.3.

4 Data on the effect on system performance of changes in orientation and inclination is provided in Appendix I.

TABLE 6.5.1.3

EXAMPLES OF LOCATION LATITUDES

Location	Latitude degrees
Darwin	12
Brisbane	27
Perth	32
Sydney	34
Adelaide	35
Canberra	35
Auckland	37
Melbourne	38
Devonport	41
Wellington	41
Hobart	43
Christchurch	43.5
Invercargill	46

6.5.1.4 *Provision for removal of collector*

Collectors shall be installed with fittings that will enable their removal without disturbing adjacent piping or collectors.

6.5.2 Precautions

6.5.2.1 *Avoidance of damage*

The collector shall be securely covered with an opaque material during installation and commissioning to prevent solar gain and to avoid collector damage or burn hazards.

6.5.2.2 *Frost-prone areas*

Collectors used in frost-prone areas shall be—

(a) marked ‘passed test to frost level 1’ or ‘passed test to frost level 2’ in accordance with AS/NZS 2712; or

(b) protected by a frost protection system or device in accordance with AS/NZS 2712.

6.5.2.3 *Hail-prone areas*

In areas where hailstones in excess of 15 mm diameter are experienced, collectors shall—

(a) conform with the impact resistance requirements of AS/NZS 2712; or

(b) be fitted with suitable impact guards.

6.6 SOLAR WATER HEATERS WITH REMOTE CONTAINERS

6.6.1 Pumps and controllers

Circulating pumps and controllers supplied with, or as an integral part of, a packaged system shall conform with the requirements of AS/NZS 2712.

Where circulating pumps and controllers are not supplied as an integral part of a packaged system, they shall be installed in accordance with Clause 6.6.2.

NOTE: A typical installation is shown in Figure 6.6.1.

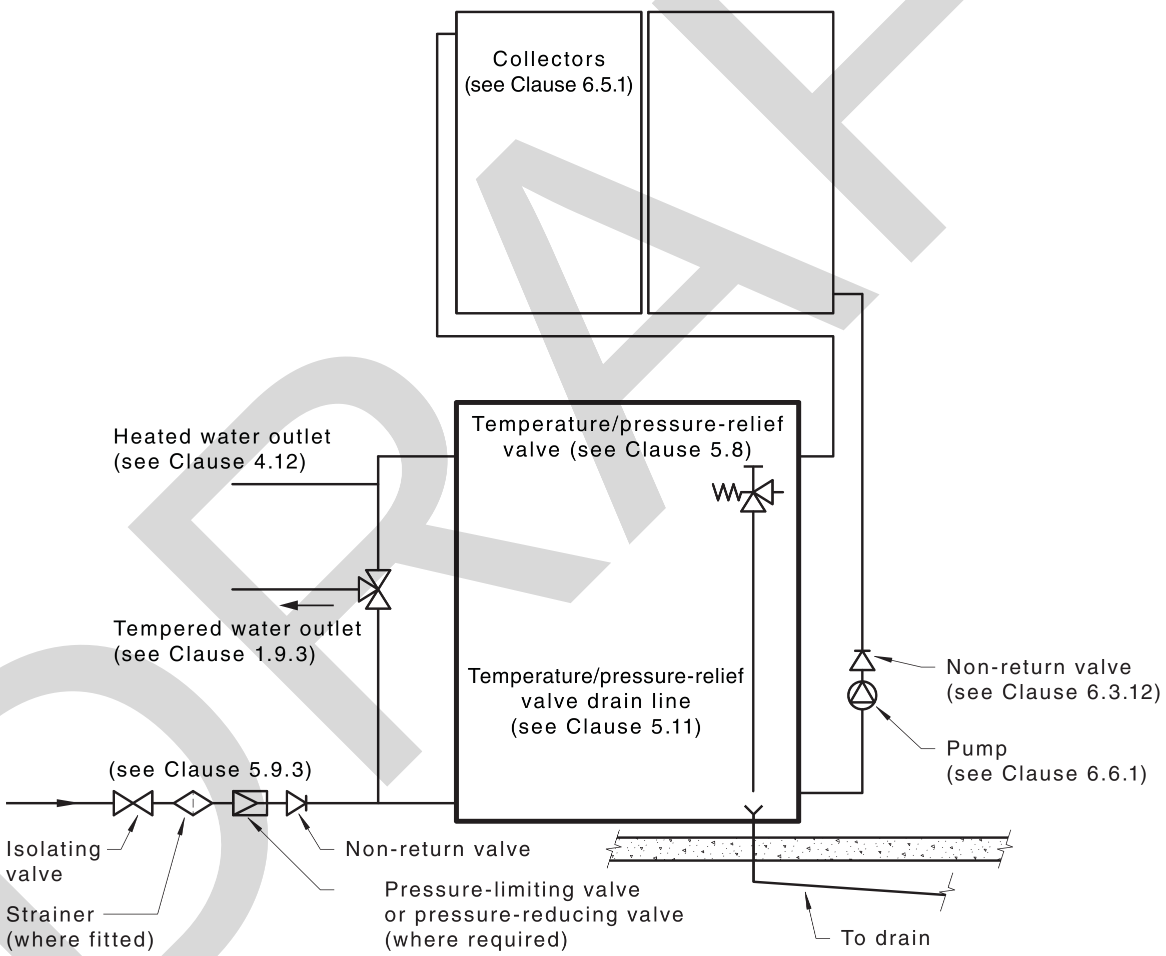


FIGURE 6.6.1 TYPICAL INSTALLATION OF A SOLAR WATER HEATER WITH REMOTE CONTAINER AND FORCED CIRCULATION

6.6.2 Pump and controller installation

The pump and controller installation shall conform with the following requirements:

(a) The primary circulating pump shall be installed to draw the colder water from the lower section of the container and to circulate this water through the collectors and return the heated water to the container at a point higher than the draw-off point.

(b) For packaged systems, only connection points in the container, or in fittings or components supplied with the system, shall be used for the cold water supply from the container and hot water return to the container.

(c) The pump shall be fixed to the building structure or the container, or otherwise rigidly supported and the piping system arranged so that no perceptible vibration is transmitted to either the collector or the building.

(d) Pumps and pump controls shall be fitted and connected in an accessible location to facilitate removal for servicing and maintenance.

(e) If mounted outdoors, the pump and pump controls shall be resistant to or protected against the ingress of water and dust.

(f) Where an exposed-gland pump is used inside a building, it shall be installed above a safe tray that drains to the outside of the building or suitable outfall in accordance with Clause 5.4.4.3(d).

(g) Pump controllers shall be mounted in a position that enables any 'pump running' indicator to be prominent.

NOTES:

1 Where pumped circulation is part of a freeze protection mechanism, the pump should be connected to an uninterruptible electricity supply wherever possible.

2 Valves that will allow routine maintenance to be performed without draining the container should be provided.

SECTION 7 UNCONTROLLED HEAT SOURCES

7.1 SCOPE OF SECTION

This Section sets out requirements for heated water systems that use uncontrolled heat sources.

7.2 WATER HEATERS WITH UNCONTROLLED ENERGY SOURCE

7.2.1 Installation

The installation of water heaters with an uncontrolled heat input shall conform with the following:

(a) Thermosiphon water heaters connected to slow combustion stoves or room heaters with water-heating coils, wetback boilers, or the like, shall—

(i) have no valves fitted or connected to the primary flow and return pipes between the water heater and the heat source;

(ii) have the primary flow and return pipes of a minimum nominal diameter relative to the length, as given in Figure 7.2.1;

(iii) have the primary flow and return pipes rise or fall in a continuous gradient;

(iv) have the primary flow and return pipes insulated so as not to present a hazard and, where exposed to the weather, have the insulation waterproofed;

(v) have the primary flow and return pipes installed in accordance with Figure 7.2.1;

(vi) have no dissimilar metals in the primary flow and return lines;

(vii) have no elbows fitted in or to the primary flow and return lines; and

(viii) have the flow and return line connections made only with unions or similar type couplings.

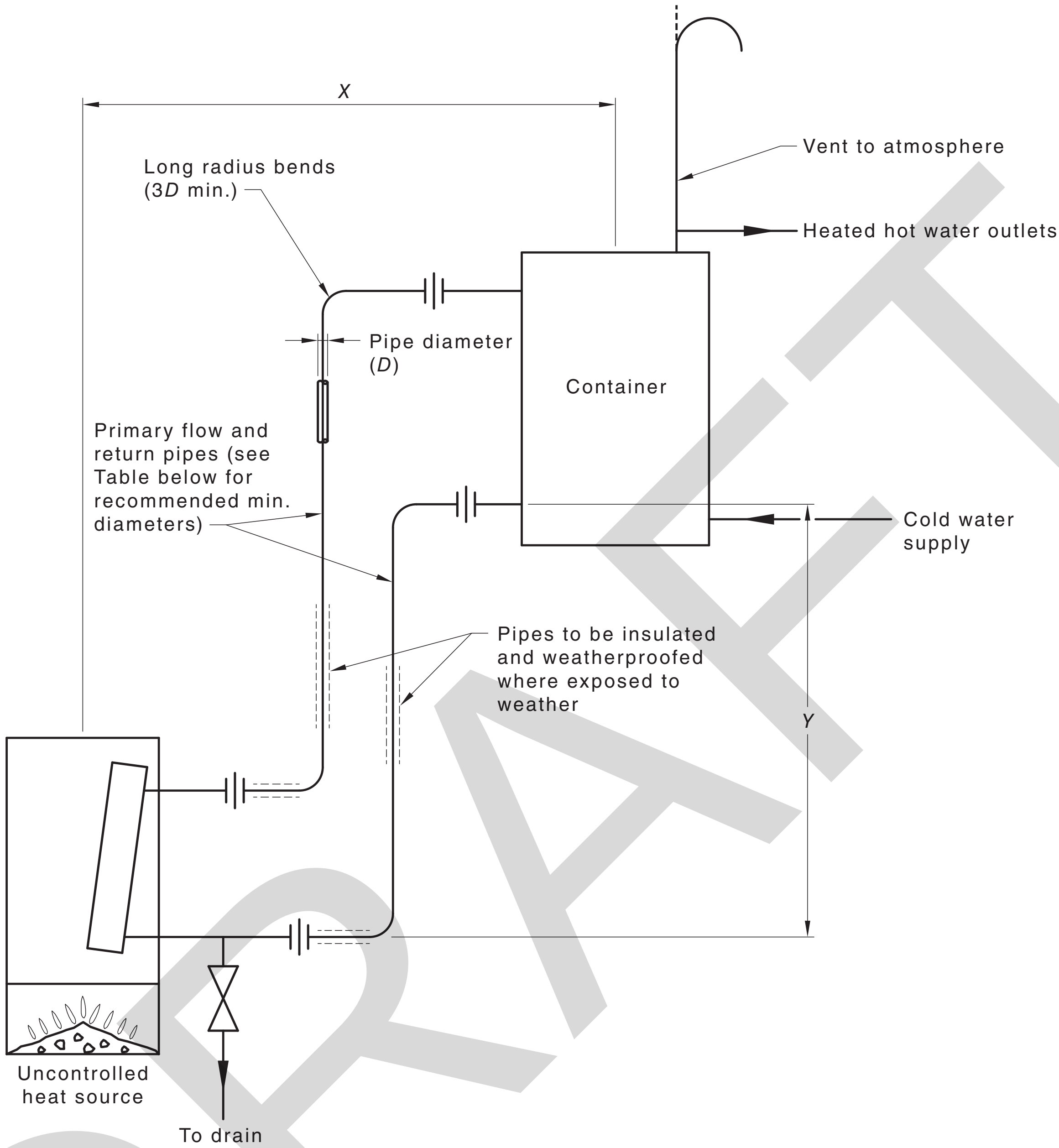
(b) Thermosiphon water heaters specified in Item (a), and direct-fired water heaters, shall—

(i) be vented to atmosphere with a vent pipe in accordance with Clause 5.12, as appropriate;

(ii) be installed so that the maximum working pressure measured at the base of the water container does not exceed 50 kPa; and

(iii) be fitted with a tempering valve.

NOTE: For the purpose of this Clause, solar hot water systems fitted with a thermosiphon arrester, a heat dump valve, or a differential pump controller with a high limit cut-out are considered as having a controlled heat source.



Y	Minimum nominal diameter DN				
	X m				
m	**2**	**4**	**6**	**8**	**10**
1	20	20	25	32	32
2	20	20	25	32	32
3	20	20	20	25	32
4	18	20	20	25	25
5	18	20	20	20	25
6	18	18	20	20	25

NOTE: Dimensions *X* and *Y* are true horizontal and vertical distances, respectively.

FIGURE 7.2.1 PIPE COORDINATES—THERMOSIPHON SYSTEMS

7.2.2 Supplementary external heating

Supplementary heating connection shall not be made into the primary circuit flow or return piping.

7.2.3 Provision for drainage

A drain point to which a hose may be attached shall be provided at the system's lowest point.

SECTION 8 ENERGY EFFICIENCY

8.1 SCOPE OF SECTION

This Section specifies energy efficiency requirements for heated water installations.

In New Zealand, it applies to all systems supplying hot water to sanitary fixtures except where individual storage vessels exceed 700 L in capacity.

NOTES:

1 This Section does not apply to central heating systems.

2 The provisions in this Section are to assist in the reduction of greenhouse gas emissions by arranging heated water services to use energy efficiently.

8.2 THERMAL INSULATION

8.2.1 Piping associated with storage water heaters

Piping shall be thermally insulated to achieve a minimum R-value as given in Table 8.2.1 for the climate regions identified in Appendix K for Australia and Appendix L for New Zealand, as follows:

(a) The inlet and outlet pipes, including valves, for a storage water heater, for at least the first 500 mm or, where an external heat trap is fitted, to a point 150 mm down the heat trap vertical leg closest to the water heater.

(b) All relief valves fitted directly to a storage water heater.

(c) The primary flow and return pipes, including valves, between an auxiliary heater and a storage water heater.

(d) All vent pipes to 300 mm above the maximum operating water level of the heated water system.

(e) On multiple installations, the whole heated water manifold, including valves, to a point at least 500 mm past the heated water outlet branch from the last water heater.

(f) On a solar water heater installation, the pipework between a solar pre-heater and an in-line supplementary water heater.

The insulation installed in accordance with the above shall be installed so as not to impede the operation of the valves.

NOTES:

1 Care should be taken to ensure the continuity of insulation at wall and roof penetrations. Insulation should be carried through roof penetrations into the ceiling area.

2 In New Zealand, refer to Document H1/AS1 and NZS 4305.

3 All exposed heated and cold water piping to and from externally mounted water heaters in frost-prone areas may require additional insulation to prevent freezing.

TABLE 8.2.1

MINIMUM THERMAL INSULATION—PIPING ASSOCIATED WITH STORAGE WATER HEATERS

	Internal locations	External locations			
	All climate regions	Climate region A	Climate region B	Climate region C (*except alpine areas and as in Note 3)	Climate region C alpine areas (see Note 4)
Pipe	0.3	0.3	0.6	0.6*	1.0
Valve	0.2	0.2	0.2	0.2	0.2

NOTES:

1 An external location of a building is an unenclosed area and includes—

(a) an open sub-floor area of a building; and

(b) the area of a building located under an open veranda or carport.

2 The total R-values specified in this Table may be achieved for most heated water piping materials by using the following insulation:

(a) 9 mm of closed cell polymer, R = 0.2.

(b) 13 mm of closed cell polymer, R = 0.3.

(c) 25 mm of closed cell polymer, R = 0.6.

(d) 38 mm of closed cell polymer, R = 1.0.

3 Where the length of the piping to or from the water heater is exposed in an external location for more than 1 m, the minimum thermal insulation in Region ‘C’ shall be R 1.0.

4 Alpine areas are areas in New South Wales, Australian Capital Territory and Victoria higher than 1200 m above Australian Height Datum, and in Tasmania higher than 900 m above Australian Height Datum.

8.2.2 Other piping for heated water systems

Heated water system piping shall be thermally insulated in accordance with Table 8.2.2 for the climate regions identified in Appendix K for Australia and Appendix L for New Zealand.

Where piping is required to be thermally insulated, valves in the line of pipe shall be insulated to a minimum total R-value of 0.2.

NOTE: See Note 2(a) of Table 8.2.1.

TABLE 8.2.2

MINIMUM THERMAL INSULATION—HEATED WATER PIPING

System	Location of piping to be insulated	Minimum total R-values		
		Climate region A	Climate region B	Climate region C
Non-circulating heated water piping	All heated water piping that is buried or is within a conduit encased within a concrete floor slab	0.3	0.3	0.3
	All external piping from the water heater to the primary kitchen sink	0.3	0.6	1.0
	All external piping with trace heating including 500 mm along any branch off the trace-heated line	0.3	0.6	1.0
	All internal piping with trace heating, including 500 mm along any branch off the trace-heated line	0.3	0.3	0.3
Circulating heated water piping	All heated water piping that is buried or is within a conduit encased within a concrete floor slab (except for piping that is part of a floor heating system)	0.6	0.6	0.6
	All external flow and return piping, including 500 mm along any branch from the flow and return piping	0.6	0.6	1.0
	All internal flow and return piping, including 500 mm along any branch from the flow and return piping	0.6	0.6	0.6

NOTES:

1 An external location of a building is an unenclosed area and includes—

(a) an open sub-floor area of a building; and

(b) the area of a building located under an open veranda or carport, or the like.

2 The total R-values specified in this Table may be achieved for most heated water piping materials by using the following insulation:

(a) 13 mm of closed cell polymer, R = 0.3.

(b) 25 mm of closed cell polymer, R = 0.6.

(c) 38 mm of closed cell polymer, R = 1.0.

3 Total R-values for insulation materials are calculated using the following:

(a) R-value: the thermal resistance ($m^2.K/W$) of a component calculated by dividing its thickness by its thermal conductivity.

(b) Total R-value: the sum of the R-values of the individual component layers in a composite element including the air space and associated surface resistances.

4 Circulating heated water piping includes piping on solar water heating systems.

8.3 PROTECTION OF INSULATION

8.3.1 Insulation exposed to the weather

Where insulation is exposed to the weather, it shall be of a weather-resistant type or surrounded by a weather-resistant enclosure.

8.3.2 Protection of thermal insulation on buried piping

Thermal insulation on buried piping shall be protected as follows:

(a) All absorptive insulation material shall be effectively protected against moisture penetration by an outer cover made of a durable waterproof material.

(b) Where insulation is cut for joining purposes, the joint shall be wrapped with a durable inert waterproof tape.

8.4 HEAT TRAPS

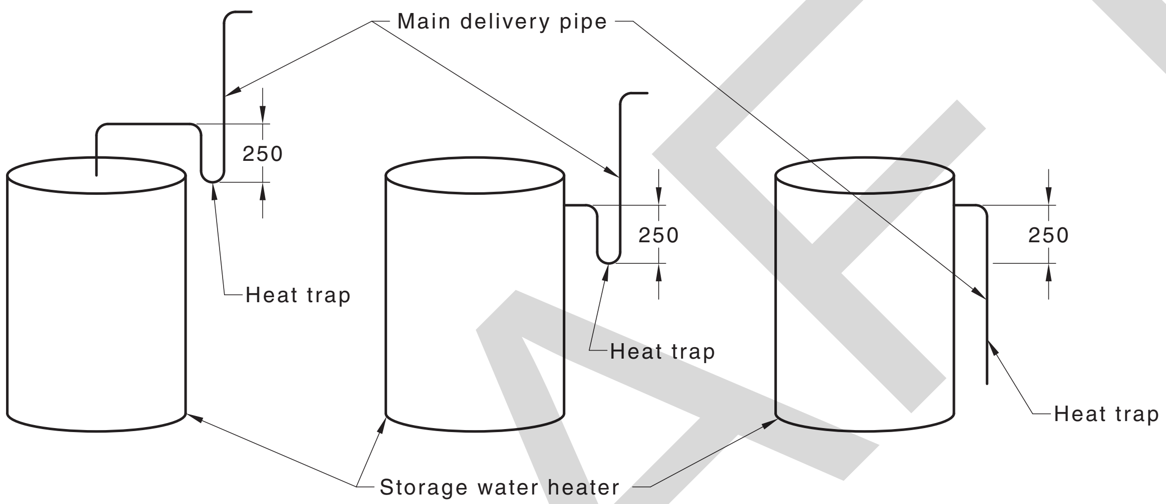
Heat traps shall be included in new and replacement non-circulatory installations as follows:

(a) All storage water heaters shall have a heat trap within 1 m from the outlet of the water heater and before the first branch.

NOTE: For typical configurations, see Figure 8.4.

(b) The heat trap shall have a vertical drop of 250 mm from the outlet level of the storage water heater if the heat trap is not an integral part of the water heater.

NOTE: Where a heat trap is integral with the storage water heater and this is indicated by the permanent marking on the water heater, an external heat trap is not required.



NOTE: Heat traps to be within 1 m from the outlet of unvented storage water heaters.

DIMENSIONS IN MILLIMETRES

FIGURE 8.4 TYPICAL CONFIGURATIONS OF EXTERNAL HEAT TRAPS

8.5 CONTAINER FOR STORAGE OF HEATED WATER

Any container used to store heated water shall be thermally insulated to a minimum total R-value of 1.0 unless it is—

(a) a water heater; or

(b) marked as conforming with AS 3498 or AS/NZS 2712.

NOTE: This Clause applies to a container that is not included in the authorization of water heaters and other heated water storage tanks covered by the Minimum Energy Performance Scheme (MEPS).

8.6 R-VALUE CALCULATIONS

The total R-value of a pipe fitted with a single layer of insulation may be calculated approximately as follows:

$$R = \frac{x_i}{k_i} + \frac{x_p}{k_p}$$

where

R = total thermal resistance, in square metre kelvin per watt (m^2 K/W)

x_i = thickness of insulation, in metres (m)

k_i = thermal conductivity of insulation material, watt per metre kelvin (W/m K)

x_p = thickness of pipe wall, in metres (m)

k_p = thermal conductivity of pipe material, watt per metre kelvin (W/m K)

SECTION 9 TESTING AND COMMISSIONING

9.1 SCOPE OF SECTION

This Section specifies requirements for testing and commissioning a heated water service.

NOTE: All fixtures, appliances, water tanks, storage water heaters and other equipment, which may be damaged during pressure testing, should be isolated before testing.

9.2 FLUSHING

Prior to hydrostatic testing, the piping system shall be cleaned and flushed to remove foreign matter. The flushing shall continue until the flushed water runs completely clear. After flushing, each line strainer shall be inspected and cleaned as necessary.

NOTE: For special conditions for thermostatic mixing valves, see Clause 3.3.

9.3 TESTING

When all draw-off points are closed, those pipes that are subjected to pressure shall be hydrostatically tested in accordance with the following:

(a) The completed heated water reticulation, excluding the storage container or water heater, shall not leak when tested with water at ambient temperature at a pressure of 1500 kPa for a period of not less than 30 min. Prior to testing, the heating medium shall be isolated.

NOTE: It may be necessary to disconnect fixtures, appliances and valves in order to prevent damage during testing.

(b) Testing shall be carried out on all piping prior to being insulated or concealed in ducts, chases or trenches.

(c) The complete system, including valves, pumps and other equipment, shall be tested under normal working conditions for a period of not less than 48 h. The system shall be checked visually for leaks.

(d) All safe trays and safe wastes shall be tested with water to ensure that they do not leak under full flow conditions.

(e) All drain pipes from expansion control and temperature/pressure-relief valves, air eliminator valves and all vent pipes shall be tested with water to ensure that they are unobstructed and are open to the atmosphere.

9.4 COMMISSIONING

The heated water service shall be commissioned in accordance with the following:

(a) Where an expansion vessel is fitted adjust the pre-charge pressure to equal the water supply pressure and each vessel shall be labelled with a water and fade resistant label affixed to the vessel, stating the pre-charge pressure.

(b) The system shall be charged with water prior to the heating medium being applied to the heater.

(c) All air shall be fully purged from the system.

(d) The following items shall be checked for correct operation, as applicable:

(i) Leakage from each temperature/pressure-relief valve, pressure-relief valve and expansion control valve.

(ii) Stored water temperature in accordance with Clause 1.9.1 or the water heater is certified to AS 3498.

(iii) Hot water delivery temperature limitation.

(iv) Water level in a gravity-type system.

(v) Inlet isolating valve, fully open.

(vi) Flow rate at outlet points.

(vii) Temperature at outlet points.

(viii) Pumps.

(ix) Air eliminator valves.

(x) Inlet pressures where a reduced pressure valve is installed.

(xi) Vibration, noise or water hammer.

(xii) Each multiple heater unit shall be checked for operation, individually.

(e) For a circulating heated water system on completion of Item (c) the following items shall be checked and adjusted for correct operation, as applicable:

(i) Flow and return temperatures at the water heater or heated water storage vessel.

(ii) Temperature, flow rate and velocity at each balancing valve.

(iii) Velocity of heated water relating to the return pipework.

(iv) Thermal insulation has been installed correctly.

(v) Circulating pump(s) operation.

(vi) Velocity measurement at the inlet or outlet of the circulating pump(s).

(vii) Joints are not leaking when at full operating pressures and temperatures.

(viii) Repeat checks 24 hours after commissioning to confirm system operation.

(f) On completion of Item (e) each balancing valve shall be labelled with a water and fade resistant label affixed to the valve, with the following information:

(i) Identification number.

(ii) Valve size.

(iii) Design flow rate.

(iv) Actual flow rate at completion of commissioning.

9.5 HEATED WATER CIRCULATING SYSTEM DIAGRAM

Where a circulating heated water system is installed, there shall be water, fade and weather resistant diagram(s) that conform with the following:

(a) A diagram shall be permanently affixed in a prominent location adjacent to the circulation pumps.

(b) The diagram shall be not less than A3 in size and not more than A1 in size.

NOTE: Where a single diagram cannot appropriately represent the size and or complexity of the building or buildings consideration should be given to the provision of multiple block plans.

(c) The diagram shall display a diagrammatic layout of the circulatory heated water piping and the water heating plant.

NOTE:A typical diagram is shown in Figure 9.5.

(d) The diagram shall include a schematic diagram showing the following:

(i) The source and size of the cold water supply to the water heating plant.

(ii) Water heating plant capacity, recovery rate and fuel source.

(iii) The pressure and flow of the cold water supply to the water heating plant.

(iv) Expansion valves, expansion vessels and relief valves.

(v) Temperature setting for pipe system over temperature alarm.

(vi) Circulation pump configuration including valves.

(vii) Circulation pump activation.

(viii) Pressure and flow duties of circulation pumps.

(ix) For circulation pumps with adjustable speed setting the speed setting used for commissioning.

(x) The maximum flow and velocity for each section and pipe size as used for commissioning.

(xi) Pressure zones, maximum and minimum pressures.

(xii) Balancing valves size, type, identification number and location.

(xiii) Pipe material.

(xiv) Pipe sizes.

(xv) Location of isolation valves.

(xvi) Location of expansion loops, offsets and fittings.

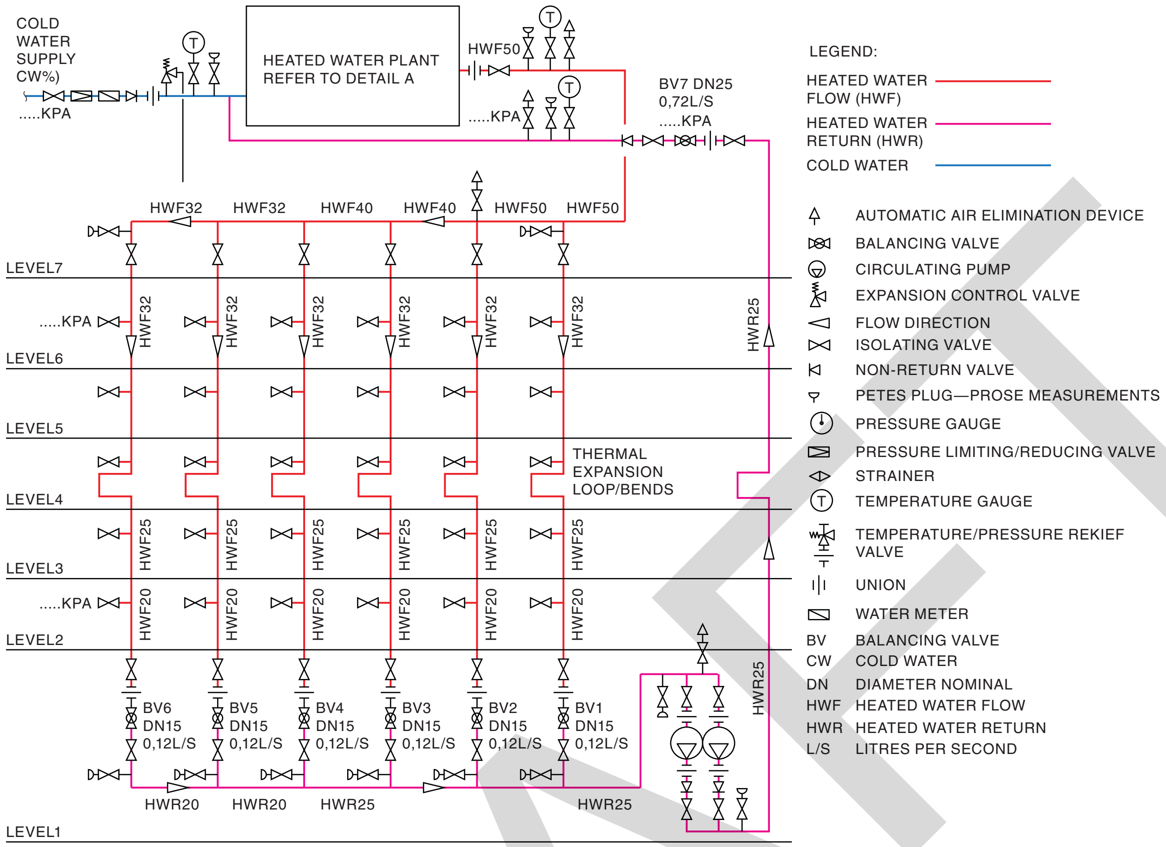
(e) The diagram shall include—

(i) the year of installation of the circulatory piping system;

(ii) any alterations or extensions to the system beyond the original installation date;

(iii) the name of the contractor who installed or modified the system; and

(iv) the name of the commissioning agent who commissioned the system.



DETAIL A—HOT WATER PLANT

SYSTEM INFORMATION

AUSTRALIAN STANDARD: AS/NZS 3500.4 2015
YEAR OF INSTALLATION/MODIFICATION:....................................
DATE OF COMMISSIONING:...
MATERIAL: COPPER TYPE B/PPR/STAINLESS STEEL 316
CIRCULATING PUMP OPERATION: DUAL-DUTY/STANDBY
AUTOMATIC CHANGE OVER 24 HR
CIRCULATING PUMP SPEED SETTING: SPEED 3

CIRCULATING PUMPS DUTY 0,72L/S @ * M/H (Each pump)
HOT WATER HEATER PLANT CAPACITY/RECOVERY:
2,400 LIRES 1ST HOUR & 900 LITRES RECOVERY
BALANCING VALVE TYPE:..
TOTAL NUMBER OF BALANCING VALVES: 7
HEATING PLANT EBERGY SOURCE; NATURAL GAS

COMMISSIONING AGENT INFORMATION

INSTALLER NAME:.................................... PLUMBING PTY LTC
ADDRESS:...
ABN:...
CONTRACTORS LICENCE NUMBER:...

INSTALLER INFORMATION

INSTALLER NAME:.................................... PLUMBING PTY LTC
ADDRESS:...
ABN:...
CONTRACTORS LICENCE NUMBER:...

FIGURE 9.5 TYPICAL CIRCULATORY HEATED WATER DIAGRAM

9.6 OPERATING INSTRUCTIONS

Operating instructions including an electronic copy of the diagram shall be made available to the owner or occupier of the premises.

SECTION 10 SIZING AND INSTALLATION OF CIRCULATORY HEATED WATER RETICULATION

10.1 SCOPE OF SECTION

This Section sets out minimum requirements for the sizing and installation of forced circulation heated water reticulation installations, where the delivery temperature flowing from a water heater, bank of water heaters or a heated water storage vessel shall be no less than 60°C and shall not exceed 65°C. The return water temperature to the water heater, bank of heaters or heated water storage vessel shall be no less than 55°C.

10.2 FLOW REQUIREMENTS

10.2.1 General

The circulatory heated water reticulation system shall be sized to meet the Probable Simultaneous Demand (PSD) requirements of the fixtures connected to the heated water installation.

NOTE: See Appendix O as a guide to determine the PSD from estimated Loading Units (LU's) for residential buildings.

10.2.2 Flow rates

The flow rates to fixtures, appliances, taps and valves shall be not less than the flow rates specified in Table 10.2.2.

The maximum flow rate from a shower, basin and kitchen sink or laundry outlet shall not exceed 9 L/min.

TABLE 10.2.2

FLOW RATES AND LOADING UNITS FOR HEATED WATER

Fixture/appliance	Flow rate L/s	Flow rate L/min	Loading units
Bath	0.15	9	4
Basin (standard outlet)	0.10	6	1
Spray tap	0.03	1.8	0.5
Shower (heated water in a mixed flow)	0.10	6	2
Sink (standard tap)	0.12	7	3
Sink (aerated tap)	0.10	6	2
Laundry trough	0.12	7	3
Washing machine/dishwasher	0.10	6	2

NOTES:

1 Flow rates and loading units are applicable to domestic applications. For commercial applications refer to the technical specifications of the fixture outlet.

2 In the case of valves and appliances where test information indicates that they will function satisfactorily with a flow rate less than that shown in this Table, the tested flow rate may be substituted and the loading units adjusted accordingly.

3 This Table does not make allowance for commercial fixtures.

10.2.3 Loading units

Loading units are factors that take into account the flow rate, length of time in use and frequency of use of the fixture or appliance. Loading units for fixtures/appliances shall be in accordance with Table 10.2.2.

10.2.4 Continuous demand outlets

The flow rate from outlets connected to the heated water reticulation system which have a continuous demand shall not be included in the summary of loading units.

The flow rate from continuous demand fixtures shall be added to the estimated flow rate determined from the loading units summary.

NOTE: Examples of continuous demand include commercial washing machines and commercial kitchens.

10.2.5 Probable simultaneous demand (PSD)

The PSD shall be determined by adding up the total connected loading units in the system and applying a suitable diversity factor to the total connected loading units and then adding the flow rates from any continuous flow fixtures to the flow rates determined from the diversity factor applied to the loading units.

NOTES:

1 See Appendix O for examples of flow rates determined from the total of loading units.

2 The PSD for commercial premises should be derived in consultation with the building owner.

10.2.6 Probable simultaneous flow rate (PSFR)

Conversion of loading units to probable simultaneous flow rates (PSFRs) for branch piping within dwellings is given in Table 10.2.6.

NOTES:

1 A method for sizing piping within dwellings is shown in Appendix D of AS/NZS 3500.1.

2 Flow rates may be used to estimate the minimum size of piping within dwellings.

TABLE 10.2.6

PROBABLE SIMULTANEOUS FLOW RATES (PSFRs)

Loading units	PSFR L/s	Loading units	PSFR L/s	Loading units	PSFR L/s
1	0.09	21	0.39	41	0.55
2	0.12	22	0.40	42	0.56
3	0.14	23	0.41	43	0.57
4	0.16	24	0.42	44	0.58
5	0.18	25	0.43	45	0.58
6	0.20	26	0.43	46	0.59
7	0.22	27	0.44	47	0.60
8	0.24	28	0.45	48	0.60
9	0.25	29	0.46	49	0.61
10	0.26	30	0.47	50	0.62
11	0.28	31	0.48	51	0.62
12	0.29	32	0.49	52	0.63
13	0.30	33	0.49	53	0.64

(*continued*)

TABLE 10.2.6 (*continued*)

Loading units	PSFR L/s	Loading units	PSFR L/s	Loading units	PSFR L/s
14	0.31	34	0.50	54	0.64
15	0.33	35	0.51	55	0.65
16	0.34	36	0.52	56	0.65
17	0.35	37	0.52	57	0.66
18	0.36	38	0.53	58	0.67
19	0.37	39	0.54	59	0.67
20	0.38	40	0.55	60	0.68

10.3 PRESSURE REQUIREMENTS

10.3.1 Available pressure

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

10.3.2 Pressure at outlets

The minimum working pressure at the furthermost or most disadvantaged fixture or outlet shall be not less than 50 kPa (5 m head), at the flow rate specified in Table 10.2.2.

NOTES:

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

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

10.3.3 Pressure losses

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

10.3.4 Maximum pressure within buildings

Provision shall be made to ensure that the maximum static pressure at any heated water outlet within a building does not exceed 500 kPa.

NOTE: Pressure above 500 kPa can cause damage from water hammer, reduced life of appliances, taps, pipes and fittings and cause excessive noise in the system.

10.3.5 Pressure differential

10.3.5.1 *General*

Any dynamic pressure differential between the heated water and cold water shall not cause temperature fluctuations at a tap outlet.

10.3.5.2 *Maximum differential*

Where heated water is mixed with cold water at a mixing valve or combined tap the dynamic pressure differential between the heated and cold water supplies shall not exceed 10%.

10.3.6 Pressure booster pumps

10.3.6.1 *General*

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

10.3.6.2 *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.

> ***C10.3.6.2*** *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.*

10.4 VELOCITY REQUIREMENTS

10.4.1 General

Other than for Clause 10.4.2, the maximum water flow velocity at any point in the circulatory piping shall be as specified in Table 1.8.

10.4.2 Circulating pumps

10.4.2.1 *General*

Circulating pumps installed in a heated water service shall conform with testing for use in contact with drinking water to AS/NZS 4020, see Clause 2.3.

10.4.2.2 *Return pipe*

The internal diameter of the return pipe shall not be less than 10 mm.

The maximum velocity in the return pipe shall be 1.0 m/s.

10.4.2.3 *Sizing circulating pumps*

Friction and head losses shall be calculated along the hydraulically most disadvantaged pipe run. Include losses at all check valves, water heaters and other associated equipment. The pump shall be sized to achieve the required flow rate to maintain a circuit temperature drop of no greater than 5°C.

NOTE: The circulating pump is only required to overcome the head losses when all outlets are closed and the system is operating at the flow rate to achieve the temperature drop.

> ***C10.4.2.3*** *Increasing thermal insulation and locating circulating heated water pipes into warmer ambient air temperature will reduce heat loss and increase efficiency of the system.*

10.4.3 Velocity, pressure and temperature

10.4.3.1 *General*

Velocities, pressures and temperatures associated with water flowing through forced secondary circuits shall not exceed the limits specified for the materials and components in the system.

10.5 EXPANSION OF HEATED WATER

10.5.1 General

Any allowance at the water heater for relieving pressure increase caused by the heating of water shall include the capacity of the secondary flow and return piping.

NOTE: See Clause 5.8.

10.6 AIR ELIMINATION

10.6.1 General

All circulatory heated water piping shall be designed and installed to eliminate air that can become entrained.

10.6.2 Air elimination valves

Automatic air elimination devices shall be installed—

(a) at the highest point or points of the circulatory piping;

(b) on the secondary flow adjacent to the water heater or bank of water heaters;

(c) in an accessible location; and

(d) with a connected drain delivering over a tundish.

Automatic air elimination devices shall not be installed on the suction side immediately prior to the pump.

> ***C10.6.2*** *Trapped air in circulatory heated water pipe systems can lead to increased corrosion of pipes as well as cause column separation which causes water hammer, pressure surges and cavitation.*
>
> *Water hammer is caused by sudden changes in velocity. Trapped air leading to column separation and fast acting valves or tapware can be causes of water hammer within heated water pipework. Piping should be designed so that entrapped air is automatically removed and pipes are sized to minimize the effect of pressure shock.*
>
> *Cavitation is the formation of vapour bubbles within a liquid that can occur due to rapid drop in pressure. When a vapour bubble collapses it generates an immediate pressure shock wave of several thousand kPa and extreme temperatures. Vapour bubbles that collapse near a pipe wall or surface will over time cause significant damage to the piping material. Cavitation damage is more likely to occur in heated water piping systems at higher water temperatures due to a reduced vapour pressure of the liquid. As the temperature of water increases and the pressure decreases the ability of a liquid to contain dissolved gases reduces and vapour bubbles form. The damage to pipes typically occur when vapour bubbles are present and the pressure of the system increases, forcing the vapour bubbles to implode. Heated water plant located on the roof tops of high-rise buildings with the piping system circulating down throughout the building are particularly susceptible to these actions. Where the heated water plant is located within the basement of high-rise buildings it is the return pipe that becomes susceptible to damage. Central heated water systems should be designed and installed to eliminate the damaging effects of cavitation.*

10.7 LOCATION OF CIRCULATORY PIPING

10.7.1 General

Flow and return heated water piping that services more than one apartment, dwelling or secure area shall be located in the common property, subject to the limitations of Clause 4.5.

10.7.2 Branch offtakes

Circulatory piping shall be located so that dead leg branch offtakes are as close as practicable to the most frequently used outlet point or points serviced by a branch.

NOTE: See also Clause 4.12.1.

10.7.3 Proximity to cold water piping

Flow and return heated water pipe systems shall be designed so as to prevent unintentional transfer of heat to any cold water service.

NOTE: This may be achieved through one or more of—

(a) installing circulating heated water pipes in separate duct to cold water services;

(b) additional thermal insulation to the heated water pipes;

(c) applying thermal insulation to the cold water pipes; or

(d) ventilating the duct to expel warmed air.

10.8 ISOLATING VALVES

10.8.1 General

The flow within circulating piping including branches shall be controlled by means of isolating valves.

10.8.2 Location

Isolating valves shall be installed in the following locations:

(a) At the outlet and return connections to a water heater or heated water storage vessel subject to the limitations of Clause 5.10.

(b) At branch offtakes.

(c) At branch offtakes and returns from and to the main flow and return piping for both vertical and horizontal sub flow and return circuits.

(d) At branch offtakes serving any individual apartment, dwelling or secure area and be accessible by the individual apartment, dwelling or secure area occupier.

(e) At the inlet to any heated water meter.

(f) At the inlet to each air elimination valve.

(g) At each testable backflow prevention device.

(h) At each pressure-limiting or pressure reduction valve.

(i) At the delivery side and suction side to each pumping apparatus.

10.8.3 Multiple apartments, dwellings and secure areas

An isolation valve installed on a branch serving an individual apartment, dwelling or secure area shall be accessible by the individual occupier from common property.

The isolation of flow and return piping to any individual apartment, dwelling or secure area shall not limit the supply to any other area.

10.8.4 Maintenance

Isolating valves shall be installed so they are accessible.

10.9 BALANCING VALVES

10.9.1 General

Balancing valves shall be installed to control the temperature within a circulating heated water system by dynamically adjusting the flow rate in a branch or circuit.

10.9.2 Commissioning

Balancing valves shall be commissioned, see Clause 9.4.

APPENDIX A

WATER ANALYSIS

(Informative)

A1 WATER ANALYSIS

Water analysis should be performed by an accredited analytical laboratory.

NOTE: When heated, some waters may produce excessive scaling due to the deposition of calcium carbonate. This type of scaling can eventually lead to the blockage of valves, pipes and specially tubes in solar collectors.

A2 CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS (TDS)

The selection of anode should be made, based on the conductivity of the water.

NOTES:

1 The concentration of the total dissolved solids affects the conductivity.

2 Anode selection should be made in accordance with the manufacturer's recommendation or, in the absence of such a recommendation, see Table A2.

TABLE A2

ANODE SELECTION

Anode material*		
TDS mg/L		
0–50	**50–400**	**>400**
M1	M2	A5

* Refer to AS 2239.

APPENDIX B

ACCEPTABLE PIPES AND FITTINGS

(Normative)

This Appendix sets out the acceptable solutions for pipes and fittings, subject to the limitations of Clause 2.4, as follows:

(a) Copper pipes and fittings in accordance with AS 1432 (Types A, B and C only) or NZS 3501 (water pipes).

(b) Copper alloy pipes in accordance with AS 3795.

(c) Copper and copper alloy fittings in accordance with AS 3688.

(d) Polybutylene (PB) pipes in accordance with AS/NZS 2642.2 or AS 5082.1 and fittings in accordance with AS/NZS 2642.3 or AS 5082.2.

(e) Cross-linked polyethylene (PE-X) pipes in accordance with AS/NZS 2492 and fittings in accordance with AS/NZS 2537 series.

(f) Polypropylene random copolymer (PP-R) pipes in accordance with ISO 15874-2 and fittings in accordance with ISO 15874-3.

(g) Multilayer pipes and fittings in accordance with AS 4176.1, AS 4176.2, AS 4176.3, AS 4176.5 and AS 4176.7.

(h) Chlorinated polyvinyl chloride (PVC-C) fittings in accordance with ASTM D2846.

(i) Stainless steel (SS) pipes in accordance with AS 5200.053 and fittings in accordance with AS 3688.

APPENDIX C

INTERNAL PIPE SIZES

(Normative)

This Appendix sets out the internal diameter for different nominal diameters (DN), pipe materials and types, standard dimension ratios (SDRs) or pressure classes, as marked on the pipe.

For multilayer pipes, the internal diameters shall be specified by the pipe supplier, see Tables C1 to C3.

TABLE C1
INTERNAL DIAMETERS FOR COPPER PIPES AND TUBES

DN	Copper (Australia only)			Copper (New Zealand only) mm
	Type A mm	Type B mm	Type C mm	
10	7.5	7.7	8.1	9.5
15	10.7	10.9	11.3	12.7
18	13.4	13.8	14.1	—
20	16.2	17.0	17.2	19.0
25	22.1	23.0	23.6	25.4
32	28.5	29.3	—	31.8
40	34.8	35.7	—	38.1
50	47.5	48.4	—	50.8
65	60.2	61.1	—	63.5
80	72.1	72.9	—	76.2
90	85.8	85.6	—	88.9
100	97.5	98.3	—	101.6
125	122.9	123.7	—	127.0
150	147.1	148.3	—	152.4
200	197.9	199.1	—	188.5

TABLE C2
INTERNAL DIAMETERS FOR STAINLESS STEEL PIPES AND TUBES

DN	Stainless steel pipes in accordance with ASME B36.19M		Stainless steel tubes in accordance with EN 10312
	Schedule 5S mm	Schedule 10S mm	Series 2 mm
15	18.0	17.1	13.0
18	—	—	16.0
20	23.4	22.5	19.6
25	30.1	27.9	25.6
32	38.9	36.6	32.0
40	45.0	42.7	39.0
50	57.0	54.8	51.0
65	68.8	66.9	72.1
80	84.7	82.8	84.9
100	110.1	108.2	104.0
125	135.8	134.5	—
150	162.8	161.5	—
200	213.6	211.6	—

TABLE C3

INTERNAL DIAMETERS FOR POLYOLEFIN PIPES

PE-X, PP-R, PB (metric)			
DN/OD	SDR 11 mm	SDR 9 mm	SDR 7.4 mm
16	13.1	12.3	11.9
20	16.5	15.7	14.7
25	20.7	19.7	18.3
32	26.5	25.1	23.5
40	33.0	31.4	29.4
50	41.2	39.3	36.7
63	52.0	49.4	46.4
75	62.1	58.6	55.1
90	74.5	70.7	66.3
110	91.0	86.4	80.8
125	103.4	98.2	92.0
140	115.9	109.9	102.9
160	132.3	125.7	117.1
180	148.9	141.5	132.5
200	165.4	157.0	147.2

NOTES:

1 Standard dimension ratio (SDR)—Plastic pipes may be categorized by their SDR value. It is the ratio of the nominal outside diameter of the pipe to its nominal wall thickness, SDR = DN/T. SDR values are printed onto pipes and can be obtained from the pipe manufacturer.

2 Values were calculated from the values for maximum outside diameter and minimum wall thickness as specified in the respective pipe product Standards as follows:

(a) AS 1432 .... Copper (Australia only).

(b) NZS 3501 .... Copper (New Zealand only).

(c) AS/NZS 2492 .... PE-X.

(d) AS 5082.1.. PB (metric series).

(e) AS/NZS 2642.2 .... PB (imperial series).

(f) ISO 15874.2 .... PP-R.

(g) AS 5200.053 .... Stainless Steel.

APPENDIX D

PREFERRED SIZES OF PIPE FOR NON-CIRCULATORY TYPICAL SINGLE-STOREY HOUSEHOLD INSTALLATIONS

(Informative)

Feed	Minimum internal diameters of pipe mm			
	Heater operating head kPa			
	Less than 85	85 to 170	In excess of 170	
			Storage	Instantaneous
From heater to first branch	15.0	12.5	12.5	15.0
A branch to kitchen sink or washbasin	10.0	10.0	10.0	10.0
A branch to kitchen sink and laundry	10.0	10.0	10.0	10.0
A branch to bathroom and one other room	15.0	12.5	10.0	10.0
A branch to bathroom only, all pipe in bathroom	12.5	10.0	10.0	10.0

NOTE: The above are recommended sizes only. Individual installations may require larger piping to give the flow rates detailed in Table 10.2.2.

APPENDIX E

RECOMMENDATIONS FOR THE INSTALLATION OF UNRATED SOLAR HEATED WATER SUPPLY SYSTEMS

(Informative)

E1 GENERAL

A custom-built system, which may comprise components that are manufactured by different manufacturers and are not specifically designed for use with each other, may not perform in a predictable manner nor be rated. Such systems commonly result from the addition of a new component to an existing component, e.g. solar collectors added to an existing hot water system. However, it is possible to avoid fundamental design mistakes in such systems, and the recommendations provided in this Appendix embody what is considered good practice in order to obtain a reasonable solar contribution.

E2 VOLUMETRIC STORAGE CAPACITY

The volumetric storage capacity of the container should be not less than the anticipated average daily consumption of the household.

For increased solar performance, a volumetric storage capacity of 1.5 to 2.0 times the anticipated average daily consumption of the household is recommended (see also Appendix G).

For systems using off-peak supplementary electric heating, the volumetric storage capacity of the container should be not less than 1.5 times the anticipated average daily consumption of the household.

E3 RECOMMENDED OPERATING TEMPERATURE

The solar hot water system needs to incorporate supplementary heating. For the purpose of obtaining an acceptable solar contribution, such supplementary heating (whether integral or remote) should be suitable for operation at 60°C nominal temperature.

E4 TEMPERATURE/PRESSURE-RELIEF VALVE

The temperature/pressure-relief-valve should be sized to allow for the energy input of the collectors at 99°C.

E5 COLLECTOR/CONTAINER SIZE RATIO

E5.1 Normal conditions

The collector aperture should be related to the volume of the container and to the location of the installation as indicated in Table G1, Appendix G.

NOTE: Slightly less collector aperture will be required for collectors with selective surfaces. Care has to be taken to prevent excessive hot water temperatures with selective surface collectors.

Reference should also be made to Clauses 6.5.2.2 and 6.5.2.3.

E5.2 Non-optimum conditions

Where the operation of the collector is adversely affected by shade, inclination, orientation, excessive dust, smog, cloud, or the like, the size of the collector should be increased to compensate.

E6 COMPONENTS

Where a system is made up of components that have not been tested as a packaged system in accordance with AS/NZS 2712, the individual components should conform with AS/NZS 2712.

E7 CLAIMED PERFORMANCE

Claimed performance of a custom-built system may be related to a tested packaged system where the components have been individually tested and the ratio of collector aperture area to volume of the container are similar for the custom built system and tested packaged system.

APPENDIX F

RECOMMENDATIONS FOR THE INSTALLATION OF CLOSE-COUPLED AND INTEGRAL SOLAR HEATED WATER SUPPLY SYSTEMS ON ROOFS

(Informative)

F1 GENERAL

The installation of a close-coupled or integral solar heated water supply system, which includes a container as well as collectors, on the roof of a building will impose additional loading on the roof structure. Care should be taken to ensure that the roof and building structure are capable of accepting this additional load. The recommendations provided in this Appendix are intended as a basic guide to a practice that has been found satisfactory in non-cyclonic areas.

F2 SUPPORT

F2.1 'With pitch' installations

Solar heated water supply systems mounted directly onto a roof structure, i.e. 'with pitch' installations (see Figure F2.1), should be arranged so that their weight is distributed evenly over as many roof rafters as possible. Roof struts supporting underpurlins that are affected by the additional load should be directly supported from loadbearing walls or appropriately designed strutting beams.

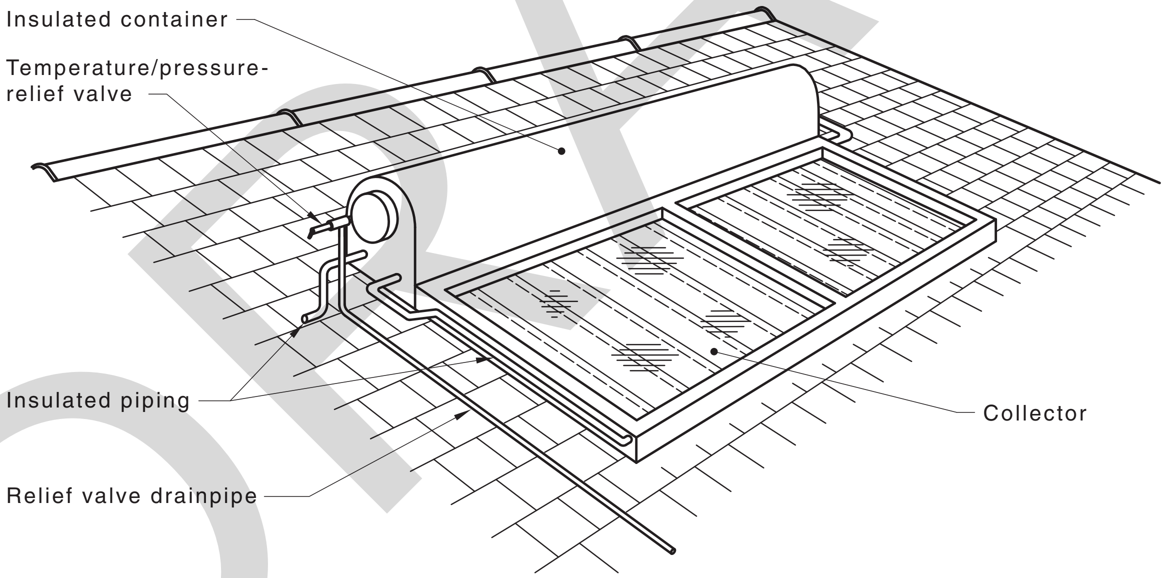


FIGURE F2.1 'WITH PITCH' INSTALLATION

F2.2 ‘Against pitch’ installations

Solar heated water supply systems mounted on frames above roof structures at angles opposed to the roof pitch, i.e. ‘against pitch’ installations (see Figure F2), and which cause point loads, should have the container point loads taken through the roof membrane and be directly supported from loadbearing walls or appropriately designed strutting beams.

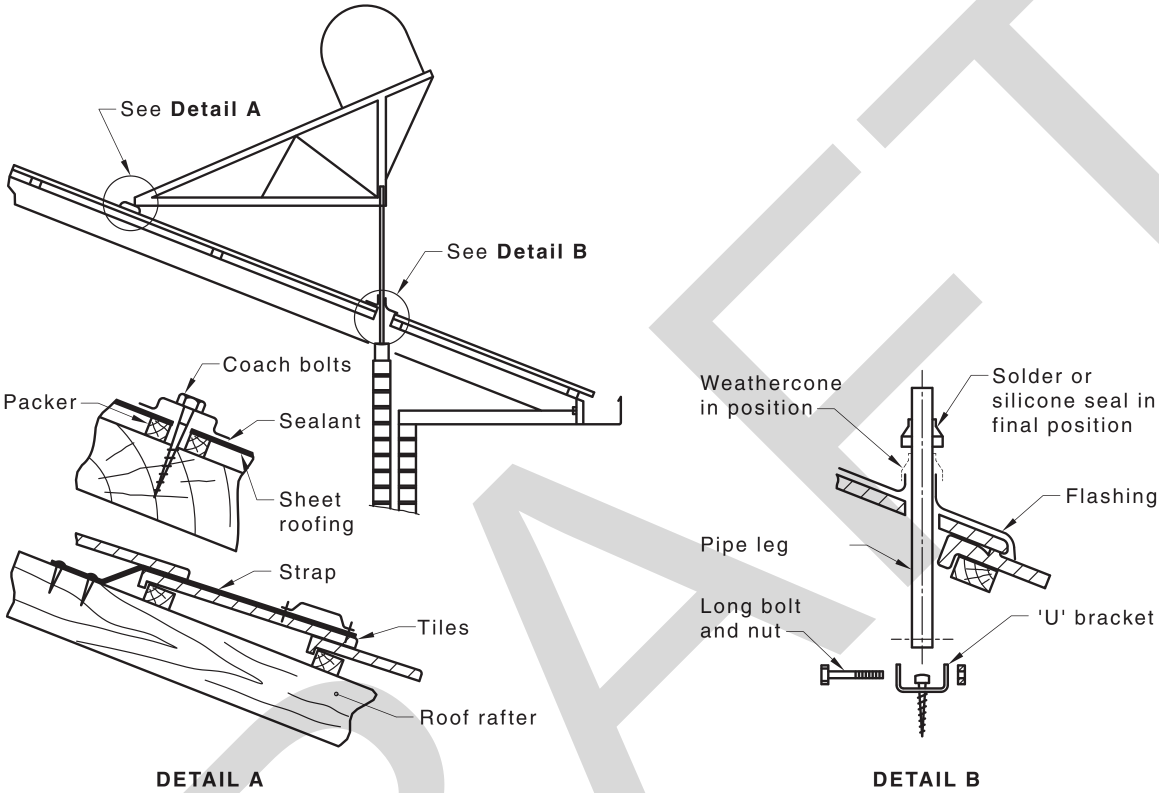


FIGURE F2.2 ‘AGAINST PITCH’ INSTALLATION

F2.3 ‘Cross-pitch’ installations

Solar heated water supply systems mounted on frames above roofs across the pitch of the roof, i.e. ‘cross-pitch’ installations (see Figure F2.3), and which cause point loads, should be arranged so that one side of the system is directly supported from a loadbearing wall; the other side of the system should be directly supported from a strutting beam taking the load to not less than two timber studs at each end of the beam.

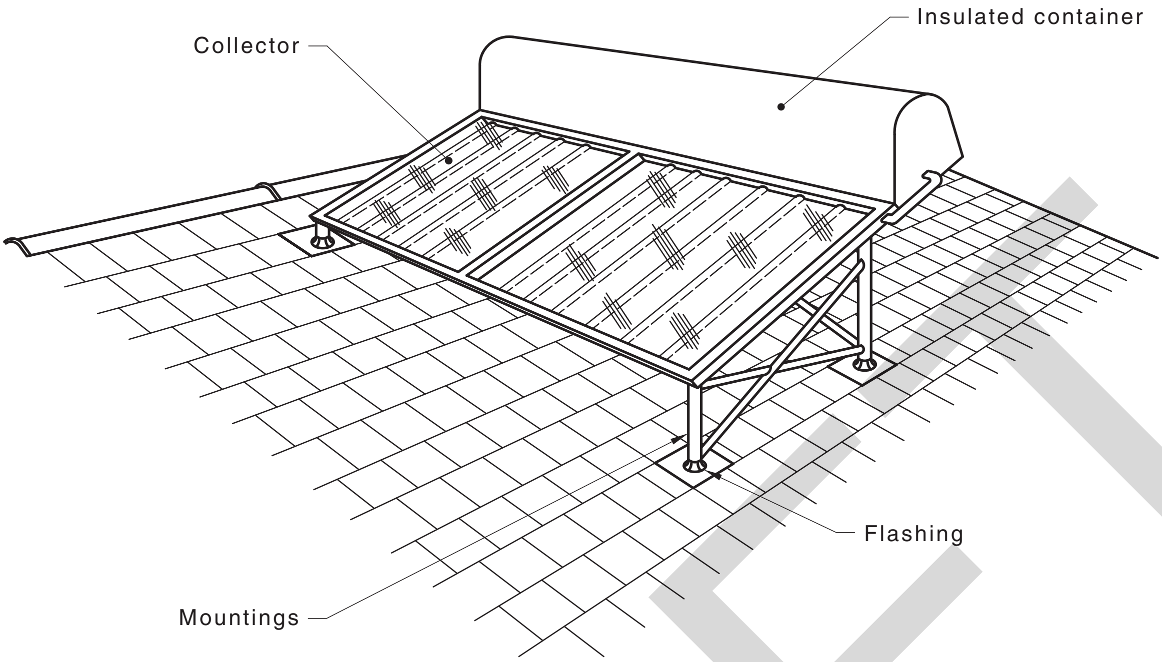


FIGURE F2.3 CROSS-PITCH INSTALLATION

F3 POINTS TO NOTE

When installing close-coupled and integral solar water heaters, it is necessary to observe the following precautions:

(a) The internal structure of the existing roof and the soundness of the roof timbers should be checked. Based on these observations or the recommendations of an engineer's report, additional strengthening may be required.

(b) Containers should not be placed in the middle of the roof over a large room.

(c) Where possible, the container should be located towards the apex of the roof and over bathroom or laundry areas, where the internal roof structures are usually supported from internal walls.

(d) Particular attention should be paid to installations on sheet-clad roofs. The generally wider timber spacings may require each rafter affected by the additional load to be strengthened or provided with additional support.

(e) On roofs where it is not possible to make an internal inspection, or where inspection reveals marginal agreement with the recommendations of this Standard, a further check should be made with the building authority prior to proceeding with the installation.

(f) Where a secondary metallic tile roofing has been installed over the initial roof cladding, any fixings that can be made to the roof members, should be made to the original roof structure and not to any secondary roofing members.

APPENDIX G

SOLAR HEATED WATER SUPPLY SYSTEMS—SUGGESTED COMPONENT SIZES (CUSTOM-BUILT SYSTEMS)

(Informative)

G1 GENERAL

The data provided in this Appendix should be read in conjunction with the text of the Standard.

G2 ANTICIPATED SOLAR FRACTION

The anticipated solar fraction (*f*) listed in Table G2 is for typical solar heated water supply systems installed in houses and incorporating a well-designed flat plate collector with a well-insulated container having a draw-off capacity not less than 80% container storage volume. However, the values for storage container capacity and collector area do not necessarily relate to any particular commercially available close-coupled systems. All data presented in this Appendix correspond to the average requirements of a four-person household.

TABLE G2

SUGGESTED COMPONENT SIZES (CUSTOM-BUILT SYSTEMS)

1	2	3	4	5
	Collector			
Location	Angle of inclination	Area	Container storage	Anticipated solar fraction (*f*)
	degrees	m^2	L	percent
Adelaide	35 (35)	4	315	74
Alice Springs	32 (24)	4	315	94
Auckland	35 (37)	4	360	65
Brisbane	29 (27)	4	315	81
Christchurch	35 (43.5)	4	360	60
Canberra	33 (35)	4	315	67
Darwin	15 (12)	3	270	97
Hobart	42 (43)	5	360	65
Invercargill	20 (40)	4	360	56
Melbourne	38 (38)	5	360	67
Perth	33 (32)	4	315	77
Sydney	34 (34)	4	315	76
Wellington	35 (41)	4	360	60

NOTES:

1 Column 2—Nominal angle of inclination of flat plate collector to horizontal (see Clause 6.5.1.3). Latitude angle is shown in parentheses.

2 Column 3—Collector aperture area, expressed in square metres. This area is for optimum conditions of collector inclination and orientation. For non-optimum conditions, the solar fraction will be reduced (see Appendix J) and a greater area may be required.

3 Column 5—Anticipated average annual solar energy fraction (*f*) expressed as a percentage of total hot water energy delivered, i.e.—

$$f = \frac{E_{\mathrm{wh}} - E_{\mathrm{p}}}{E_{\mathrm{wh}}} \times 100$$

where

E_{wh} = hot water energy delivered at water heater outlet (mass × specific heat capacity × temperature differential)

E_{p} = total supplementary energy purchased for water heating

4 The actual solar fraction will vary with household hot water use patterns and with weather variations from year to year. The figures given should be accurate to within 5% for normal situations.

G3 SOLAR RADIATION DATA

Basic solar radiation data is given in Figures G3(A) and G3(B) for Australia and Figure G3(C) for New Zealand.

NOTE: For more comprehensive details of solar radiation, reference should be made in Australia to ‘Australian Solar Radiation Data Handbook’, 4th ed, and, in New Zealand to the National Institute of Water and Atmospheric Research (NIWA), Wellington.

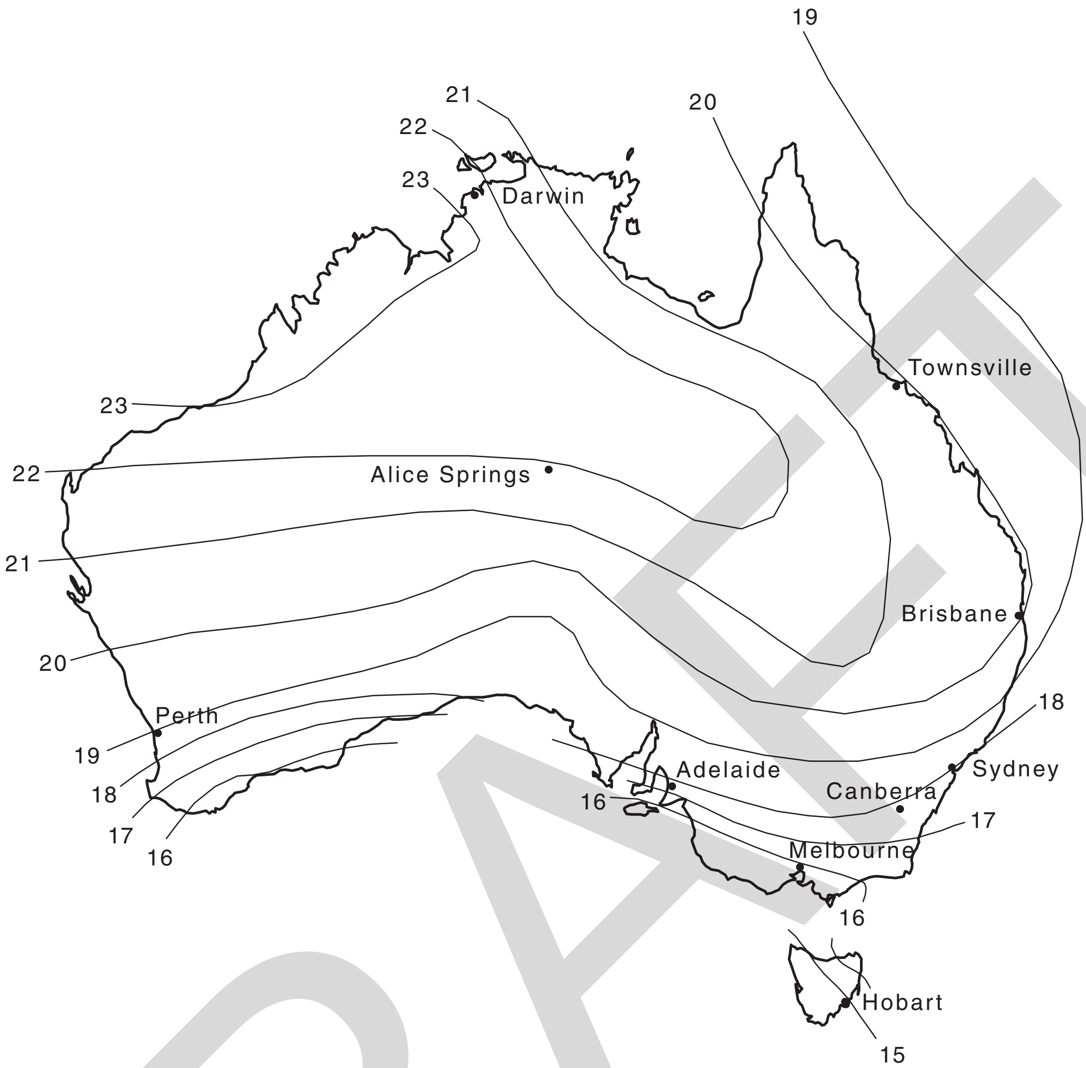


FIGURE G3(A) CONTOURS OF ANNUAL MEAN DAILY SOLAR RADIATION ON A HORIZONTAL SURFACE (MJ/m^2.d)

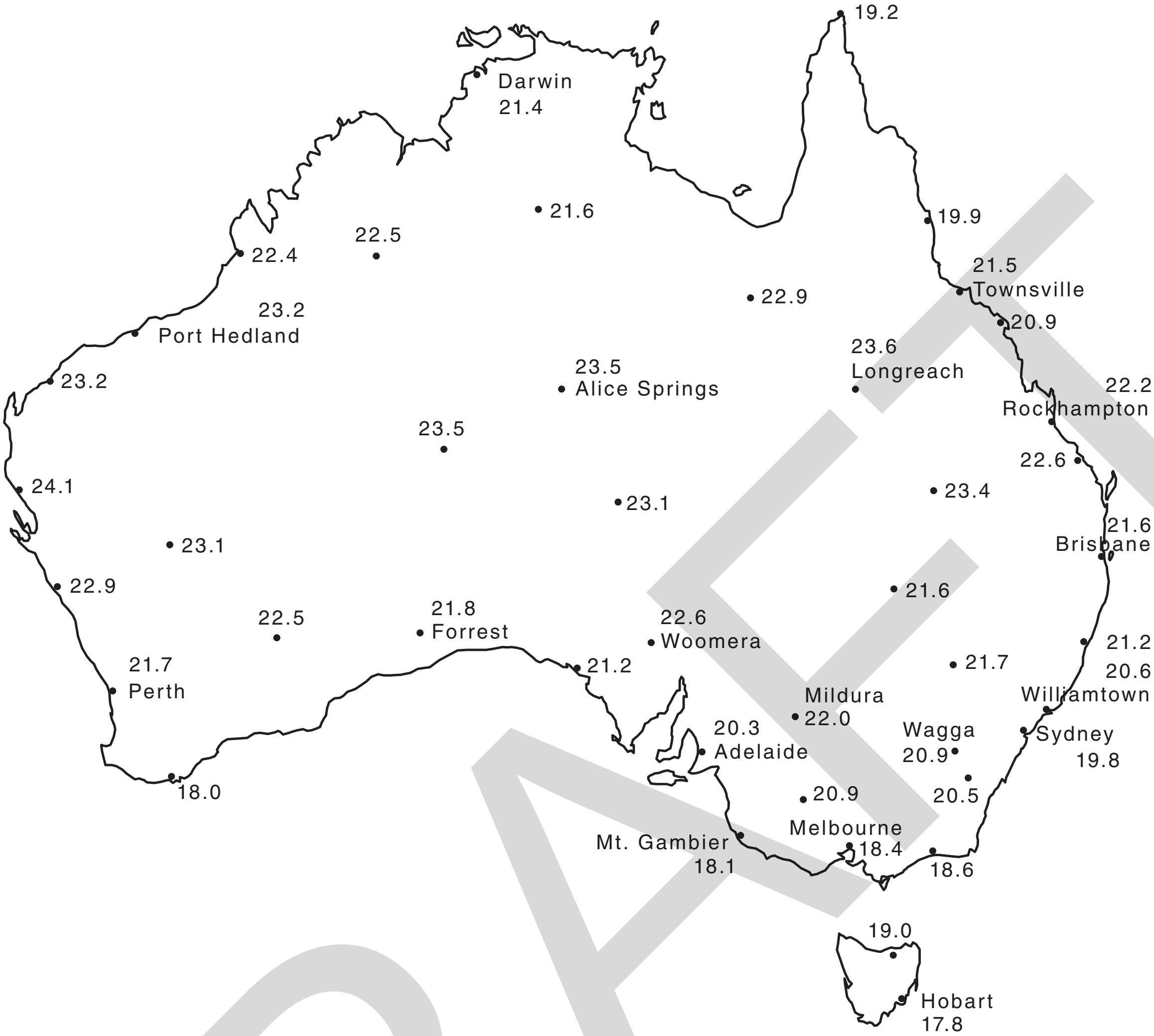


FIGURE G3(B) ANNUAL MEAN DAILY SOLAR RADIATION ON A NORTH FACING SURFACE INCLINED AT THE LATITUDE ANGLE (MJ/m^2.d)

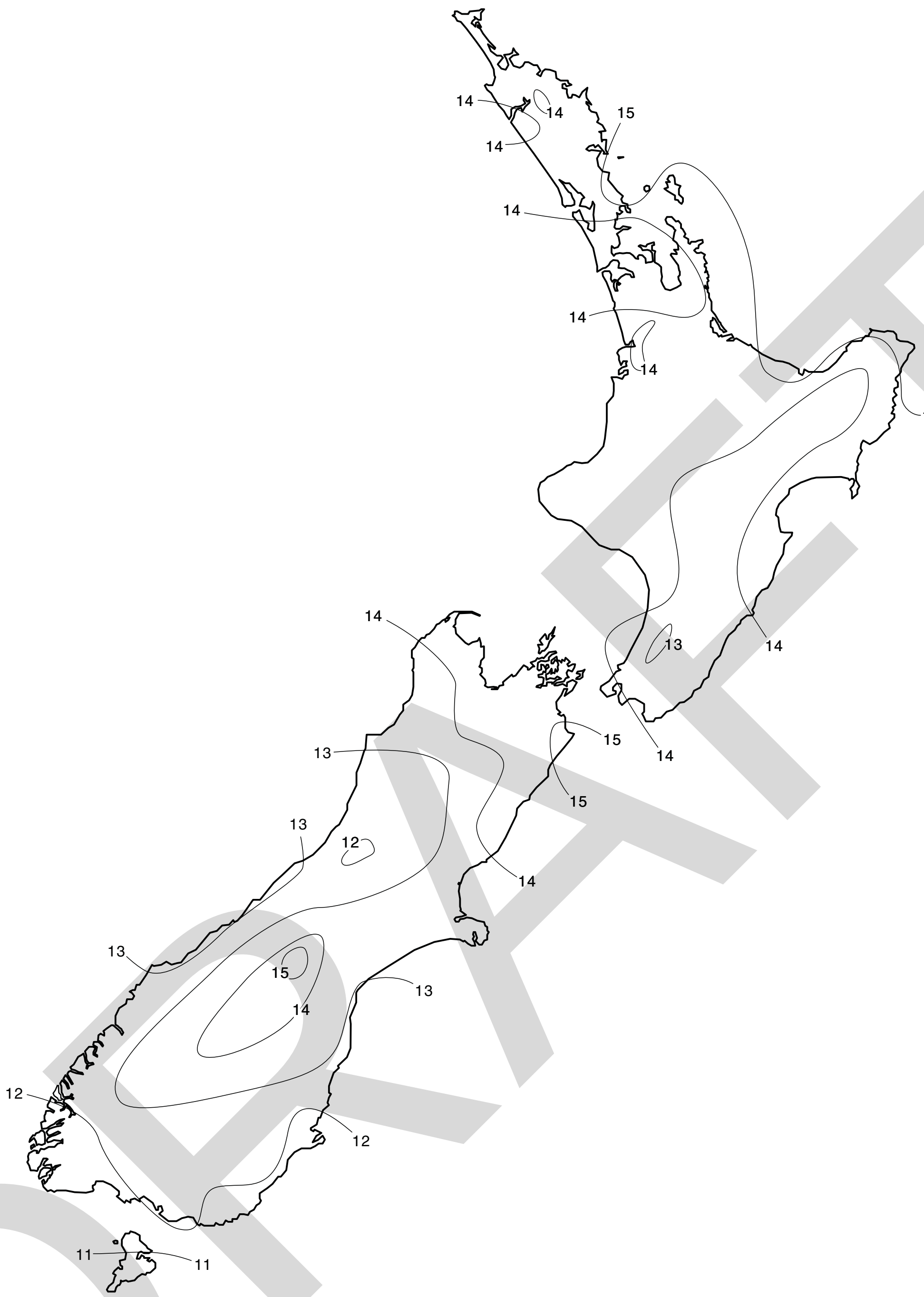


FIGURE G3(C) CONTOURS OF ANNUAL MEAN DAILY SOLAR RADIATION ON A HORIZONTAL SURFACE (MJ/m^2.d)

APPENDIX H

ESTIMATION OF SHADING OF COLLECTORS

(Informative)

H1 GENERAL

In order to be able to assess whether or not collectors will be subject to shading during the year, it is necessary to know the solar altitude for the installation location when the sun is at its lowest, i.e. in mid-winter. As most of the useful solar radiation is received within 3 h either side of solar noon for any system installed at or near the recommended orientation and inclination, any significant shading of collectors in these hours, i.e. 9 am to 3 pm standard time, will affect the performance of such a system, and should be avoided in locating the unit. Table H1 lists the solar altitude at mid-winter for various locations in Australia and New Zealand. By checking the solar altitude, as observed at the lower edge of the collectors, the installer can determine whether or not nearby buildings, trees or other obstructions will cast a shadow on the collector. For example, if a building, observed from the base of the collectors, is above the mid-winter solar altitude, then that building will cast a shadow on the collectors.

TABLE H1

SOLAR ALTITUDE AT MID-WINTER

City	Latitude degrees	Solar altitude degrees		
		9 am	Noon	3 pm
Darwin	12	33.5	54.5	33.5
Brisbane	27	23.4	39.5	23.4
Perth	32	19.8	34.5	19.8
Sydney	34	18.3	32.5	18.3
Adelaide	35	17.6	31.5	17.6
Canberra	35	17.6	31.5	17.6
Auckland	37	16.1	29.5	16.1
Melbourne	38	15.4	28.5	15.4
Devonport	41	13.2	25.6	13.7
Wellington	41	13.2	25.5	13.2
Hobart	43	11.7	23.6	11.7
Christchurch	43.5	11.2	23.0	11.2
Invercargill	46	9.0	20.0	9.0

H2 SUN LOCATOR

The mid-winter solar altitude may be checked using a commercial ‘sun locator’; however, a simple solar altitude sight may be constructed from the diagram in Figure H2(A) for Australia and Figure H2(B) for New Zealand. The diagram may be glued to cardboard, or preferably reproduced to a larger scale on cardboard, and then cut out and assembled. An assembled sight is shown in Figure H2(C).

The solar altitude sight is used by aligning the arrow due north, using a compass or map, and with the base of the sight horizontal, sighting the 9 am, noon and 3 pm positions of the winter sun, from a viewpoint near the base of the solar collectors. Any objects that can be seen above the sight will cast a shadow on the collector in winter. The use of the solar altitude sight is shown in Figure H2(C).

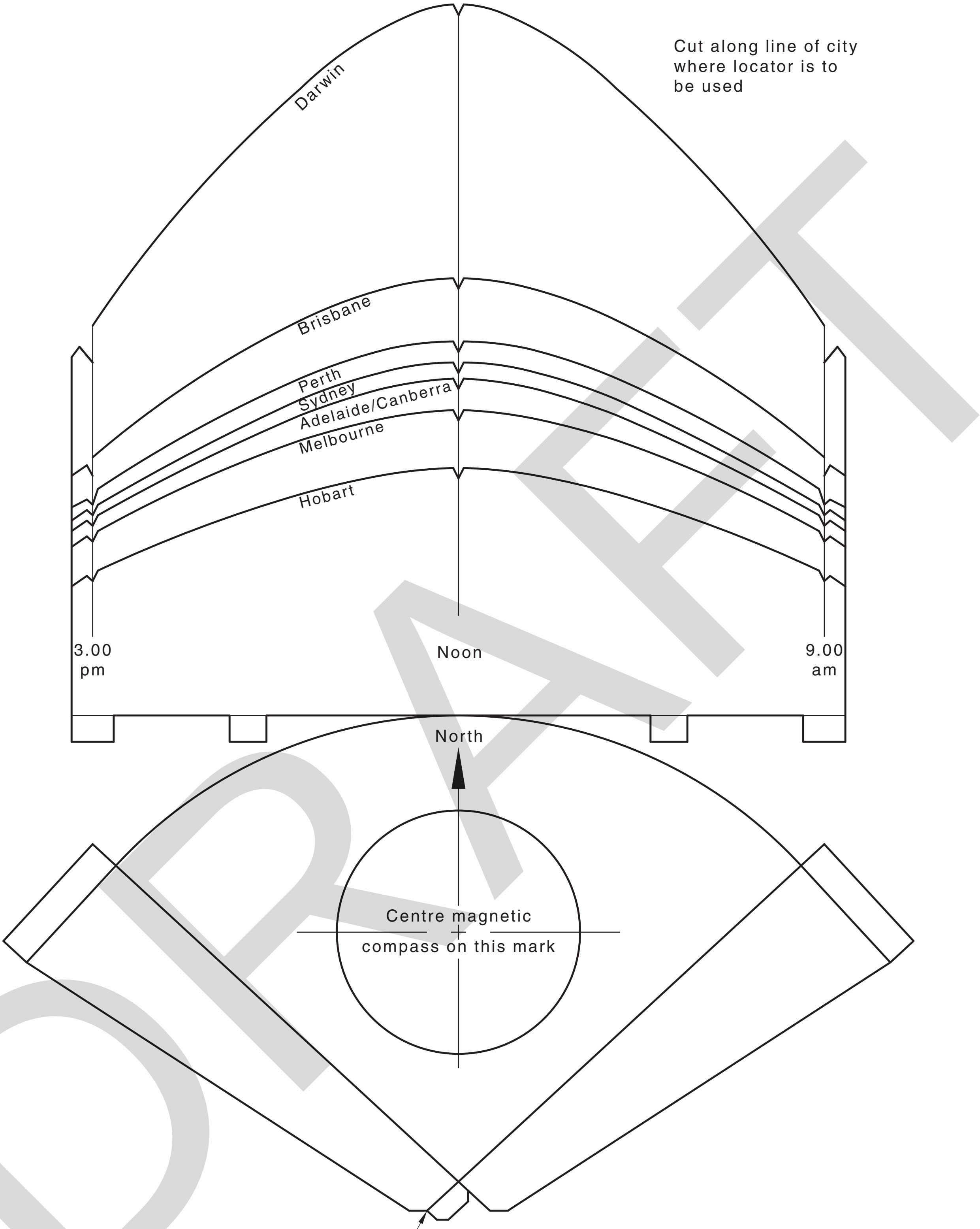


FIGURE H2(A) MID-WINTER SOLAR ALTITUDE SIGHT (AUSTRALIA)

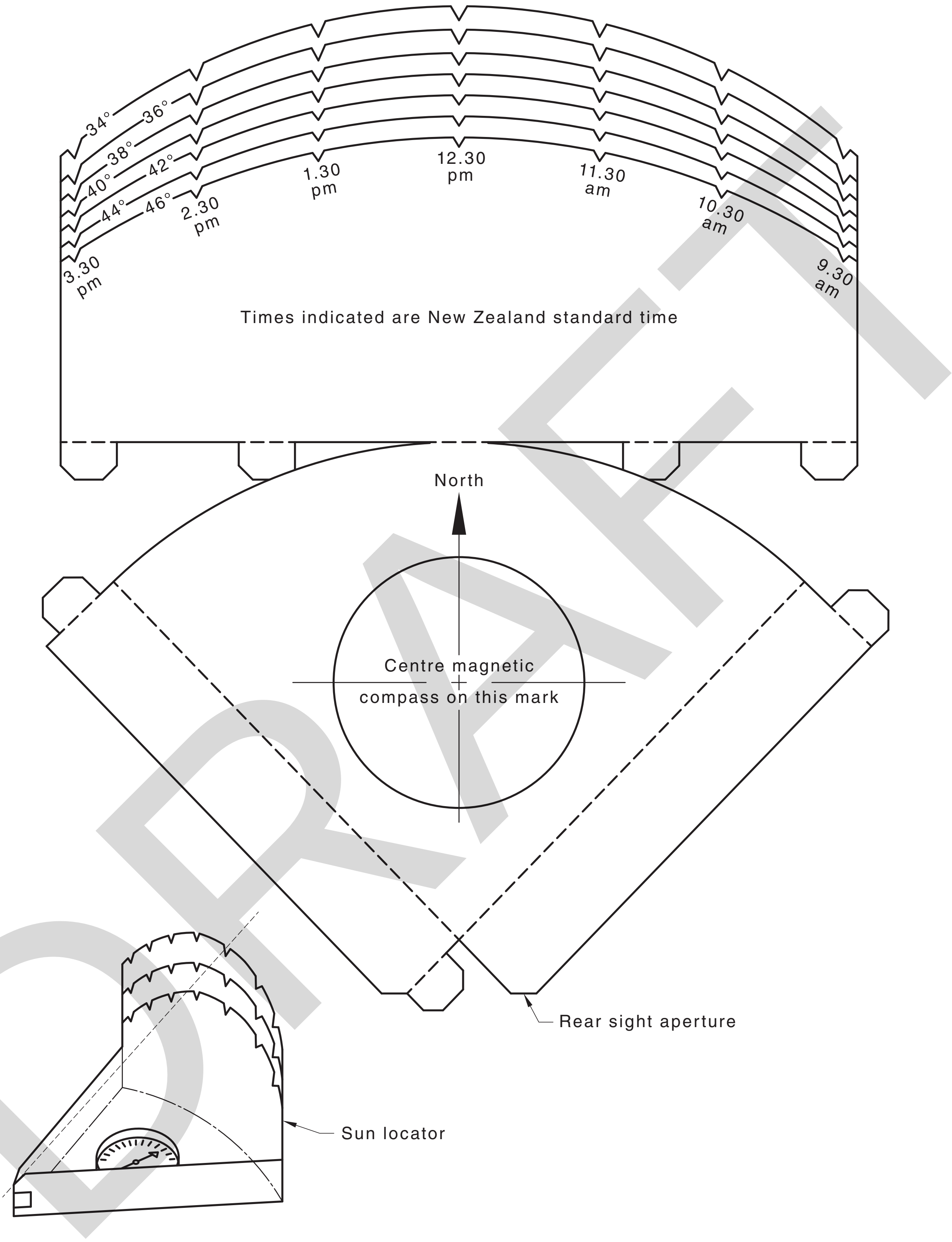


FIGURE H2(B) MID-WINTER SOLAR ALTITUDE SIGHT (NEW ZEALAND)

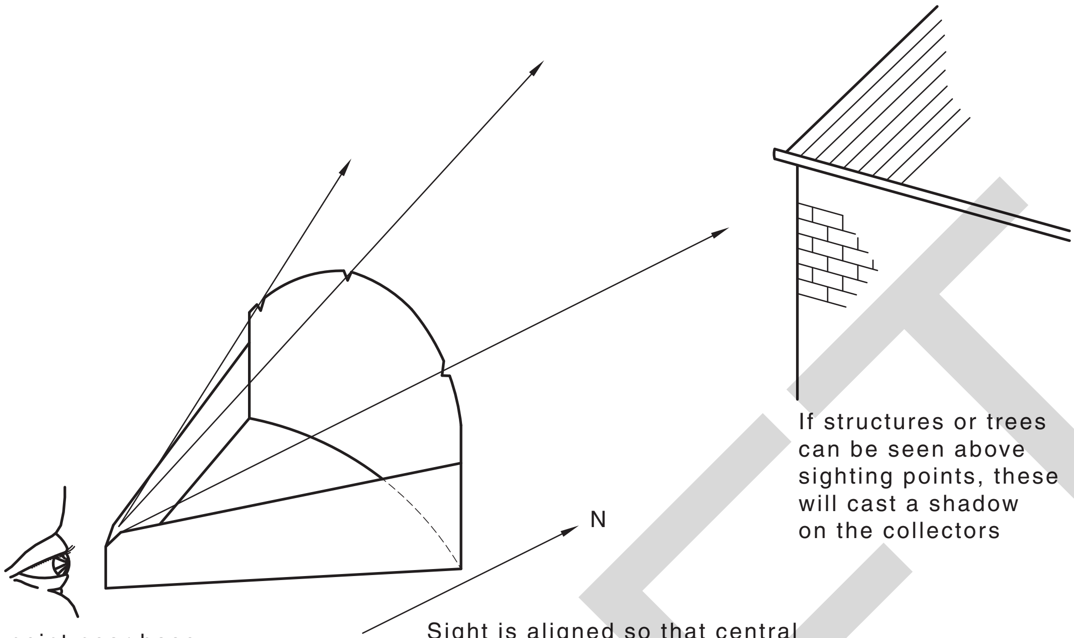


FIGURE H2(C) USE OF SOLAR ALTITUDE SIGHT

H3 APPROXIMATE METHOD OF DETERMINING SOLAR ALTITUDE

In the absence of a solar altitude sight, the mid-winter solar altitude can be estimated by eye, using the fact that a closed fist extended at arm's length from the head subtends approximately 10° at the eye (see Figure H3), as follows:

(a) Select a viewpoint close to the lower edge of the collectors, and face due north.

(b) Extend one arm with the index finger in line between your eye and the true horizon.

(c) Make a closed fist with your other hand, place it upright on top of the extended index finger; this gives a solar altitude of 10°.

(d) Place the second fist on top of the first, which gives 20°, and so on. Then, using Table H1, estimate the altitude of the noon sun in mid-winter and note any likely shading.

(e) Repeat this procedure facing N-E and N-W to estimate the mid-winter solar altitude at 9 am and 3 pm, respectively, using the data from Table H1.

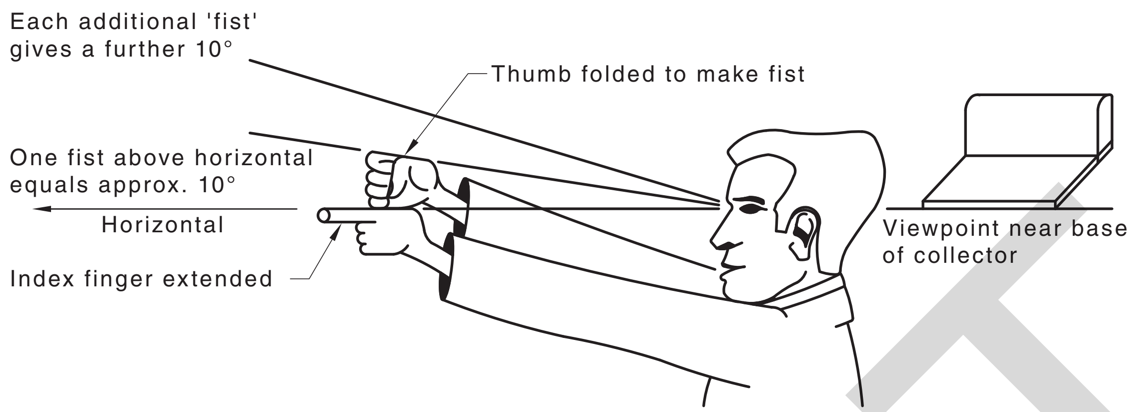


FIGURE H3 ‘FIST’ METHOD OF ESTIMATING SOLAR ALTITUDE

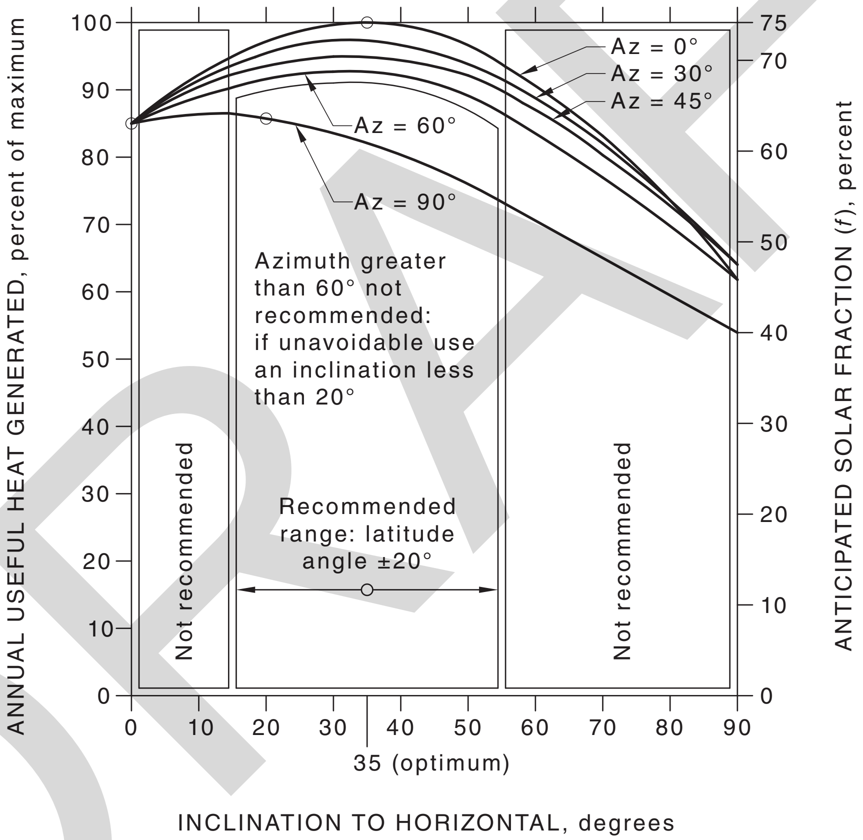
APPENDIX I

EFFECT OF INCLINATION AND ORIENTATION ON SYSTEM PERFORMANCE

(Informative)

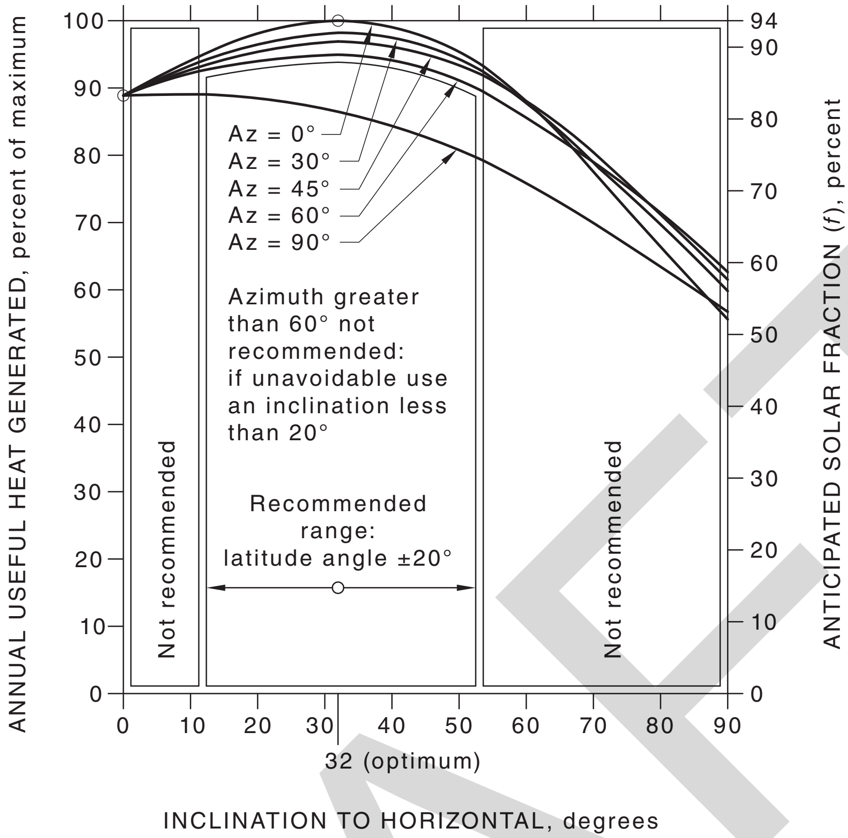
This Appendix provides a series of figures (Figures I1 to I9 for Australia, and I10 to I13 for New Zealand) showing the effect on system performance of variations in collector inclinations for different orientations of the collector. The graphs were plotted using data generated by the 'Sunbear' solar simulation program with radiation data appropriate for each area.

Figures are provided for a variety of locations, and relate to the suggested component sizes for those locations given in Table G1, Appendix G.



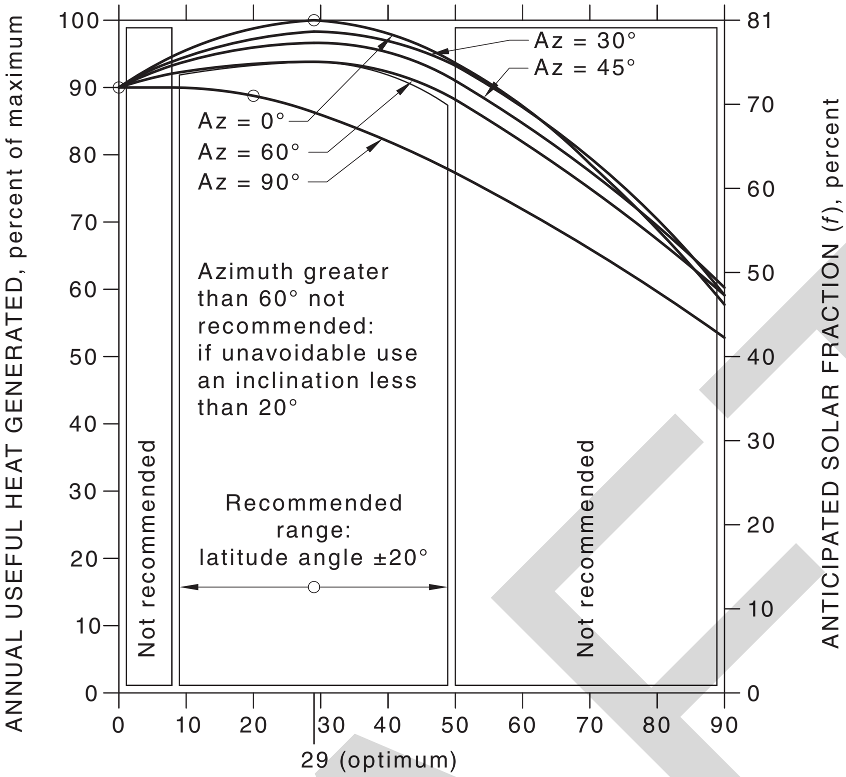
The curves are indicative for the coastal areas of eastern South Australia

FIGURE I1 ADELAIDE—LATITUDE 35°S



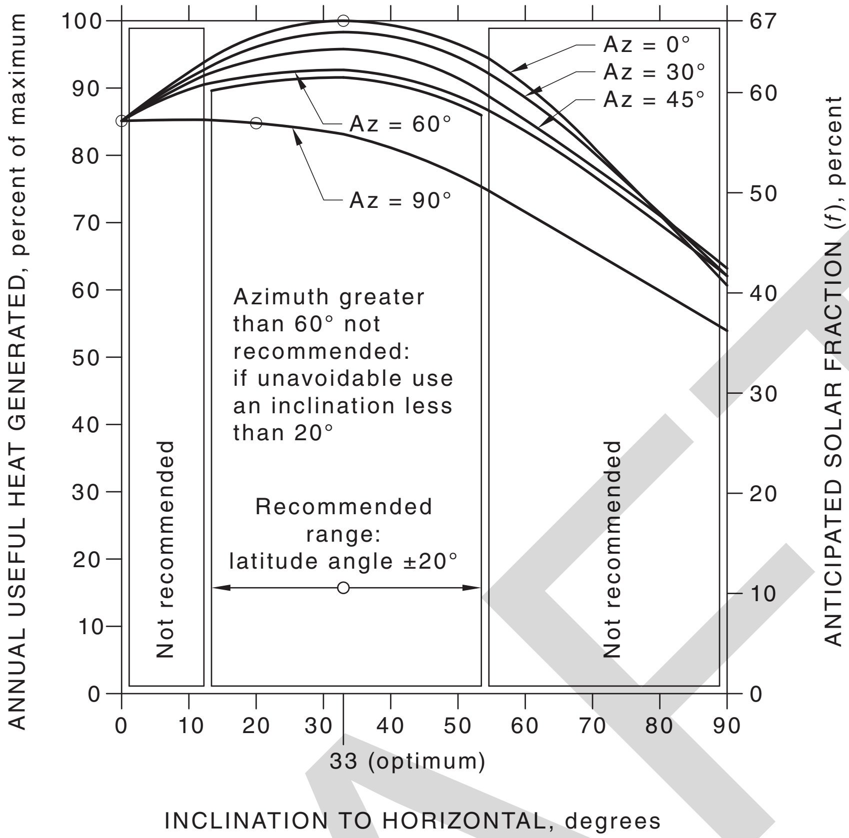
The curves are indicative for the inland areas of central Australia

FIGURE I2 ALICE SPRINGS—LATITUDE 24°S



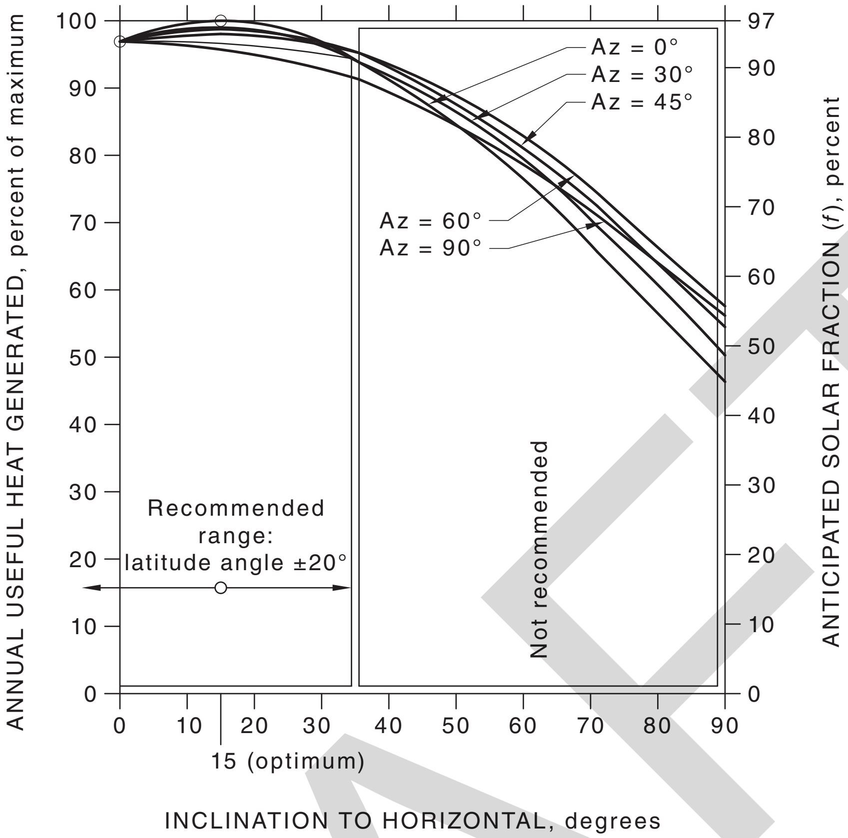
The curves are indicative for the coastal areas of southern Queensland and northern New South Wales

FIGURE I3 BRISBANE—LATITUDE 27°S



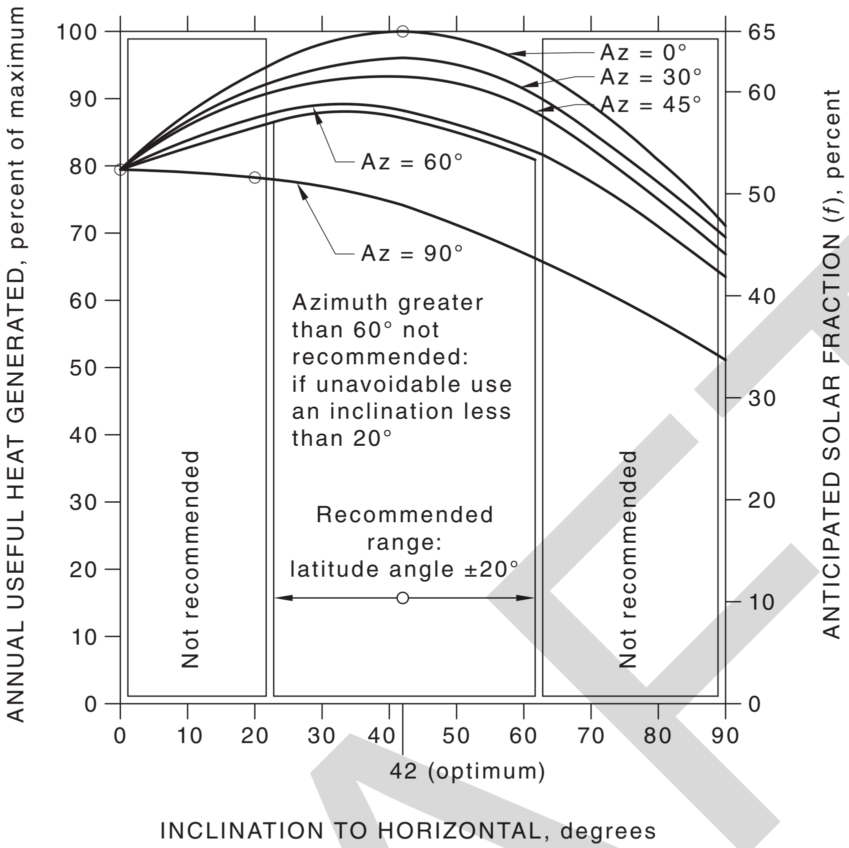
The curves are indicative for the highland areas of New South Wales, A.C.T. and Victoria

FIGURE I4 CANBERRA—LATITUDE 35°S



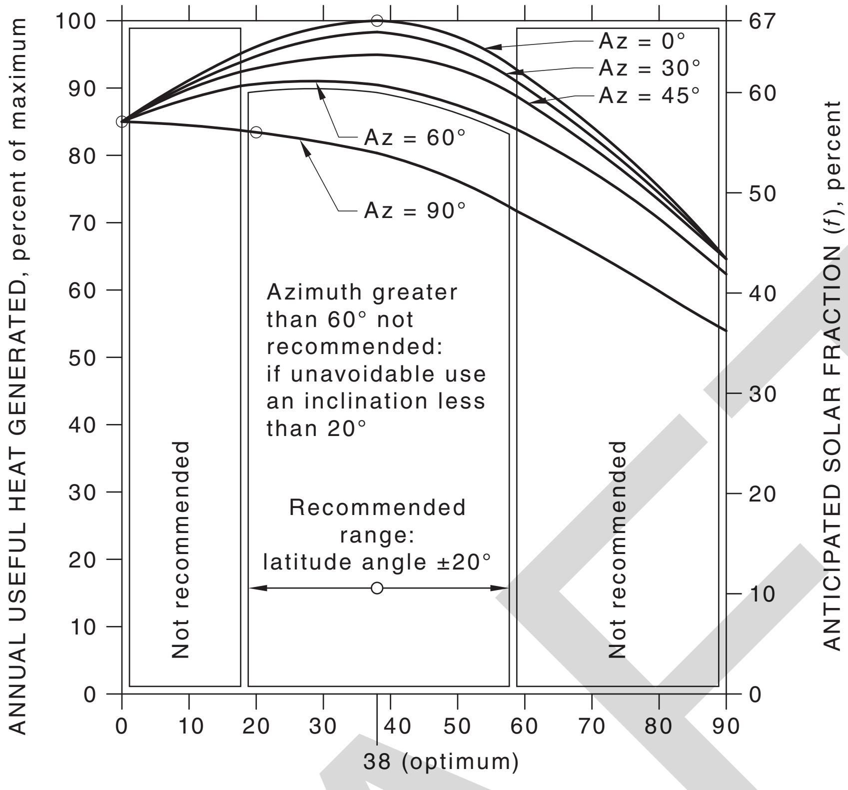
The curves are indicative for the coastal areas of northern (monsoonal) Australia

FIGURE I5 DARWIN—LATITUDE 12°S



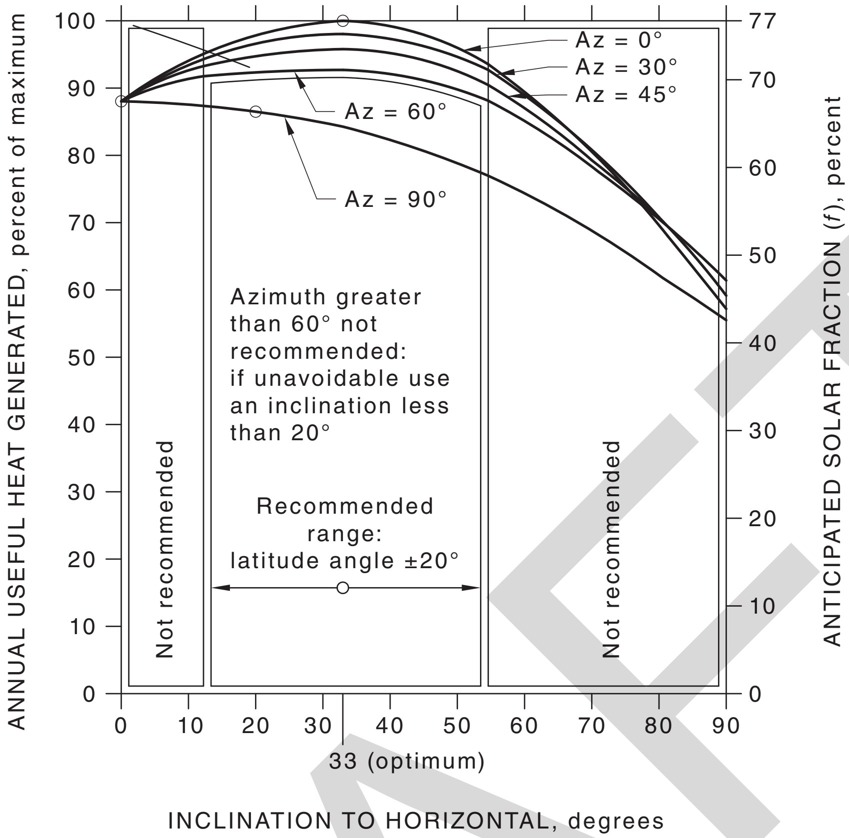
The curves are indicative for the coastal areas of southern Tasmania

FIGURE I6 HOBART—LATITUDE 43°S



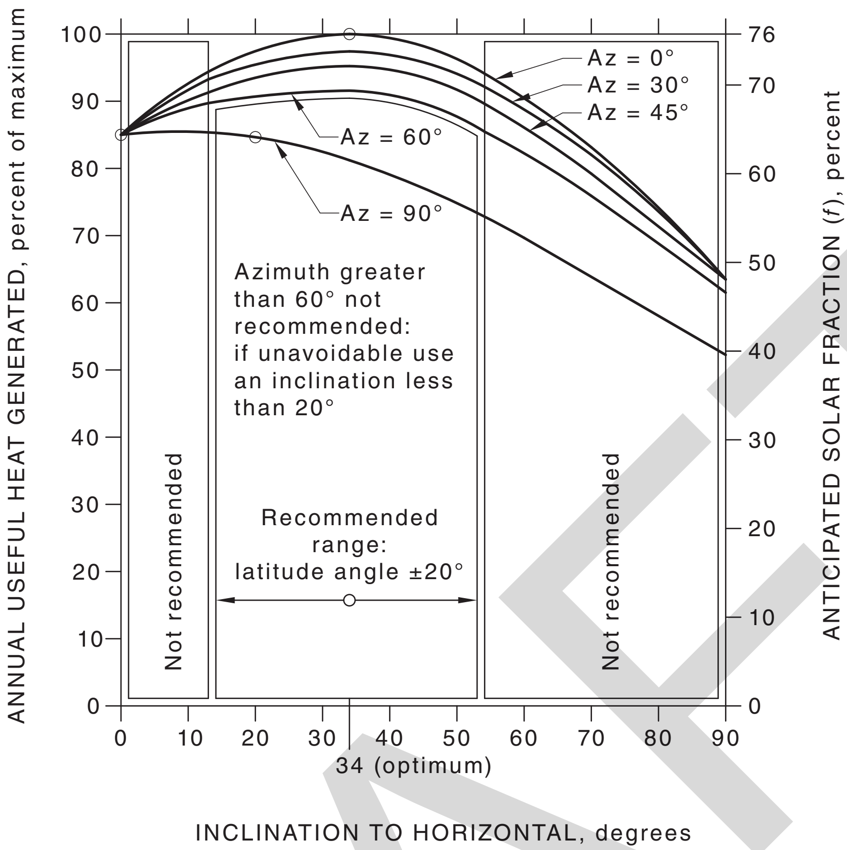
The curves are indicative for the coastal areas of southern Victoria

FIGURE I7 MELBOURNE—LATITUDE 38°S



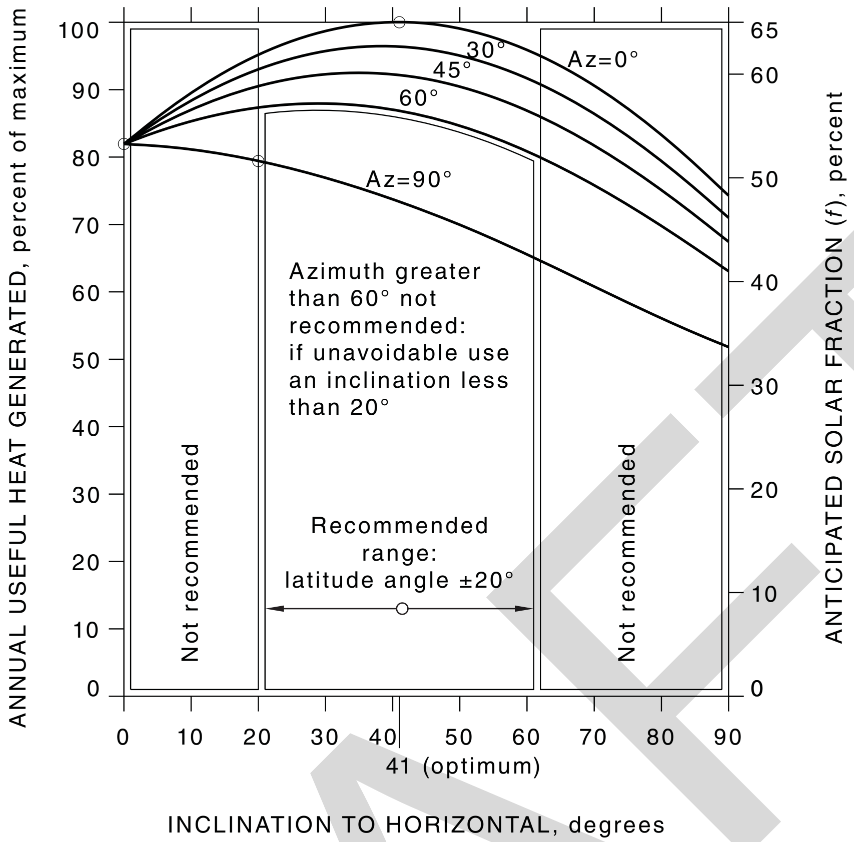
The curves are indicative for the coastal areas of southern Western Australia

FIGURE I8 PERTH—LATITUDE 32°S



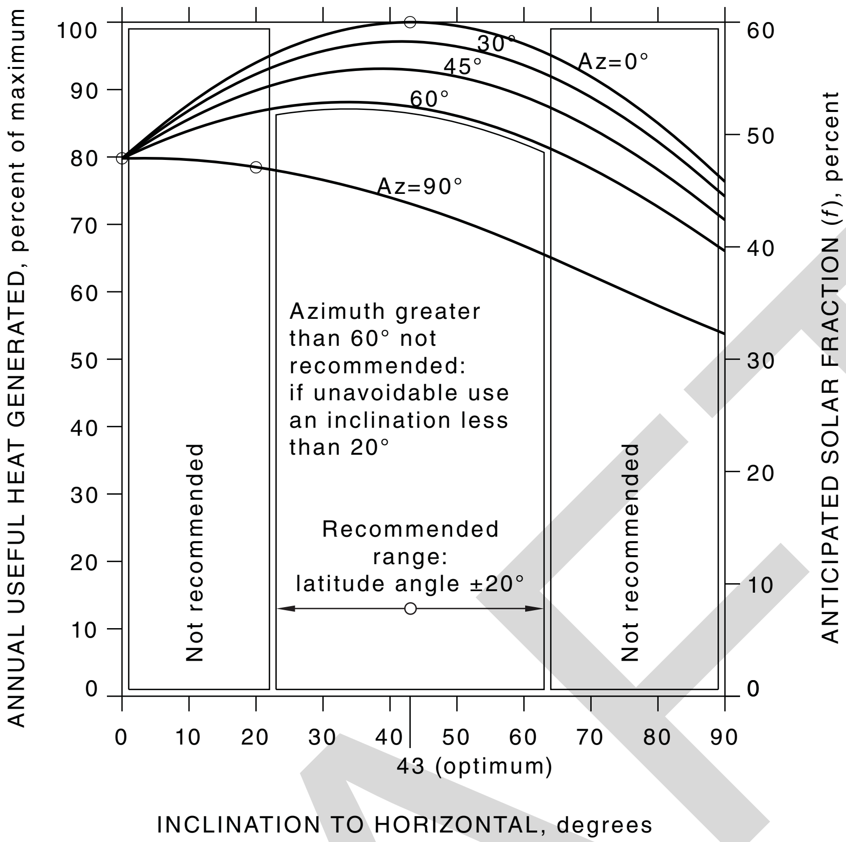
The curves are indicative for the coastal areas of New South Wales

FIGURE I9 SYDNEY—LATITUDE 34°S



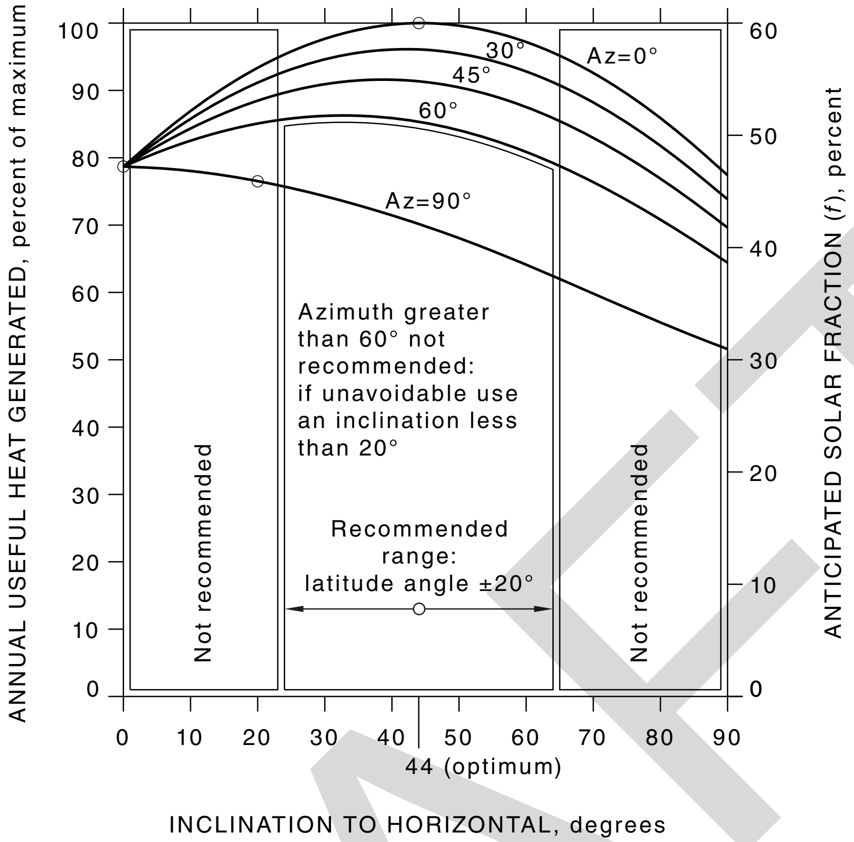
The curves are indicative for coastal areas of the northern North Island

FIGURE I10 AUCKLAND—LATITUDE 37°S



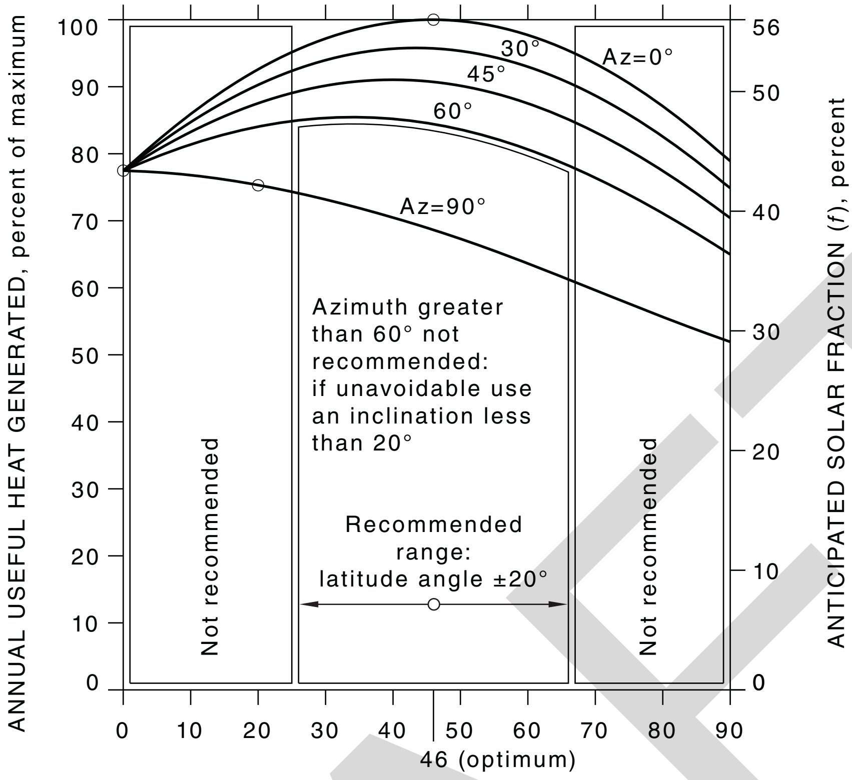
The curves are indicative for coastal areas of the southern North Island

FIGURE I11 WELLINGTON—LATITUDE 41°S



The curves are indicative for coastal areas of the northern South Island

FIGURE I12 CHRISTCHURCH—LATITUDE 43.5°S



The curves are indicative for coastal areas of the southern South Island

FIGURE I13 DUNEDIN—LATITUDE 45.9°S

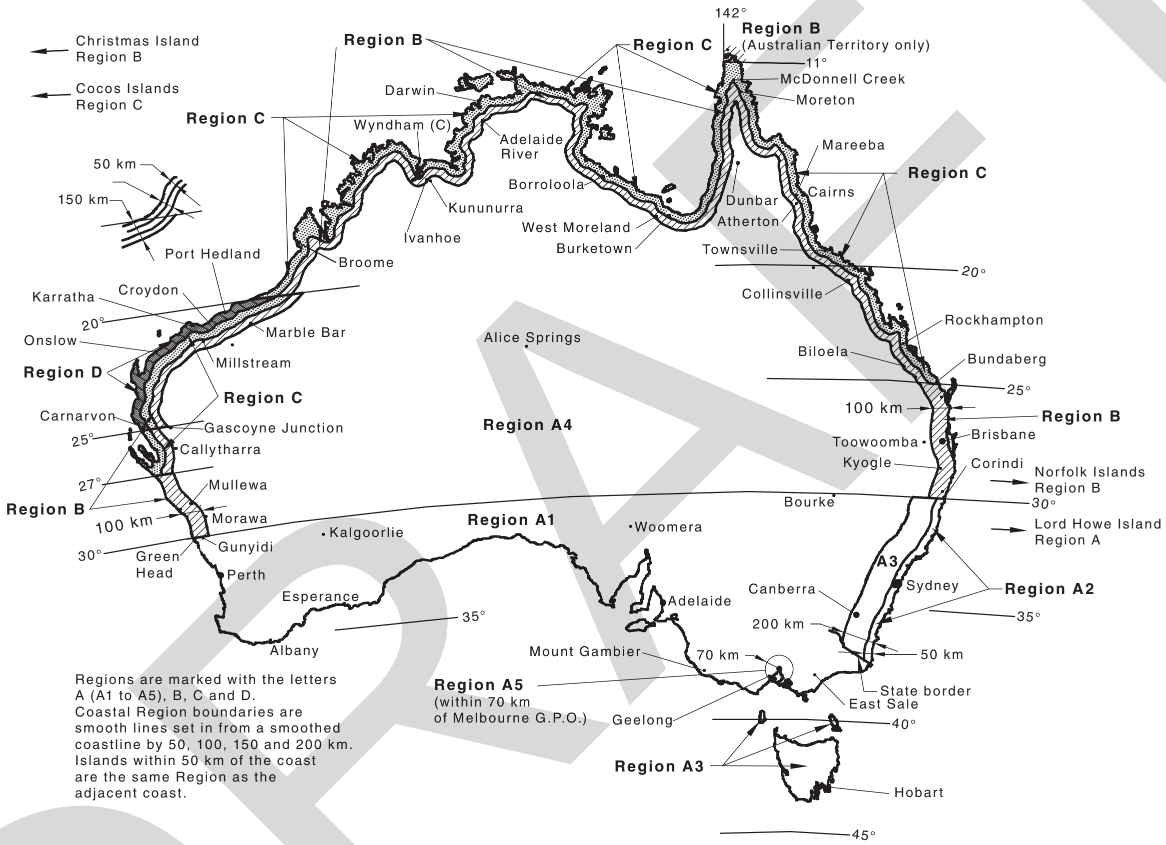
APPENDIX J

MAP OF REGIONAL BASIC DESIGN WIND SPEEDS

(Informative)

Figures J1 and J2 are provided as a guide only to the nature of a locality with regard to basic wind speeds.

NOTE: For details of the design of structures to withstand these wind velocities, reference should be made to AS/NZS 1170.2.



Regions	Wind velocity, m/s		
	V_s	V_p	V_u
A	38	41	50
B	38	49	60
C	45	57	70
D	50	69	85

FIGURE J1 AUSTRALIA WIND AREAS

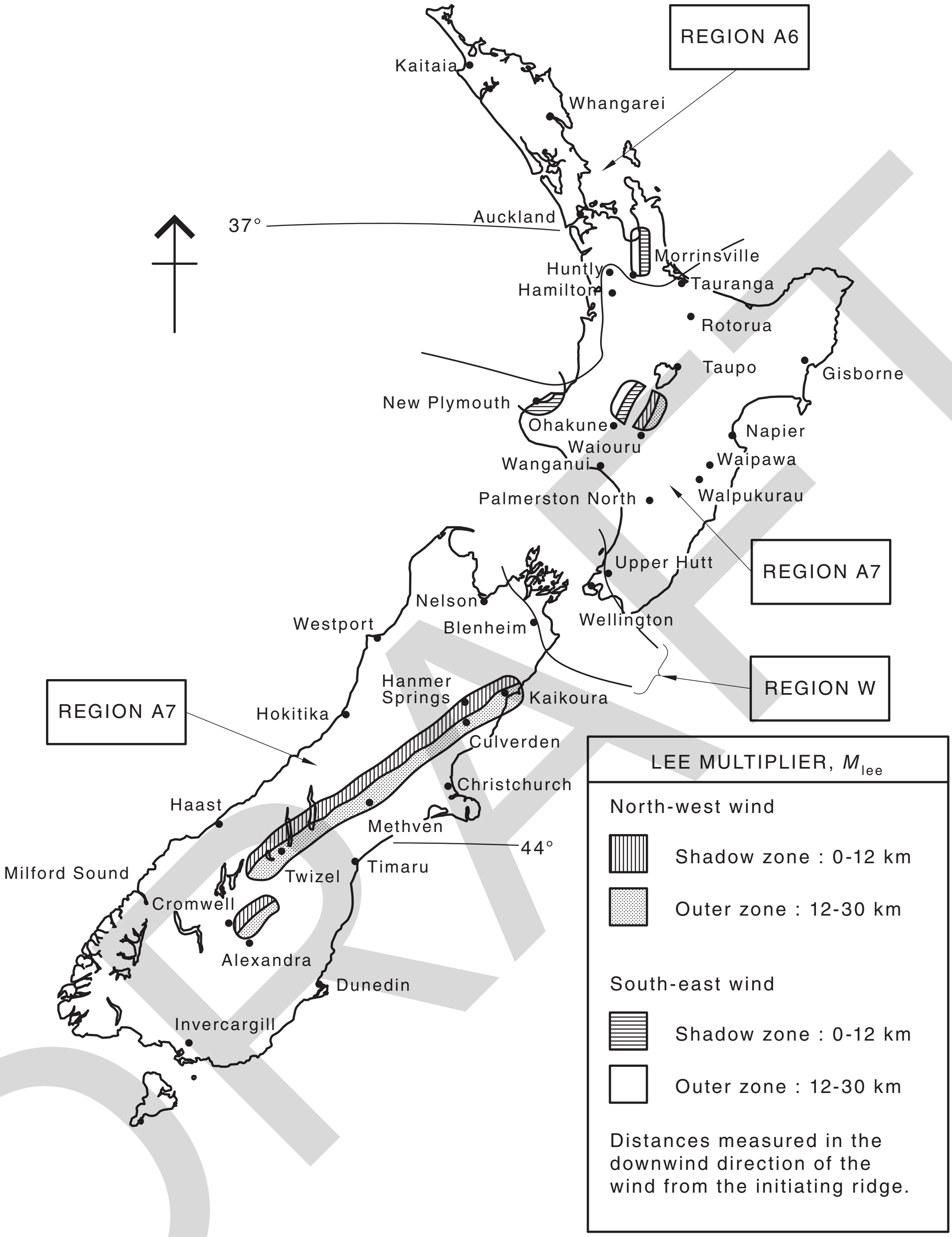


FIGURE J2 NEW ZEALAND WIND AREAS

APPENDIX K

AUSTRALIAN CLIMATE REGIONS

(Normative)

K1 SCOPE

This Appendix sets out the climate regions for Australia to define the requirements for energy efficiency.

K2 CLIMATE ZONES

The climate region boundaries shall be based on climatic data in accordance with the climate zones in the NCC.

NOTES:

1 Maps defining the NCC climate regions for each State and Territory are available on the ABCB website at http://www.abcb.gov.au.

2 To access the current maps, search for 'climate zones' on the ABCB website.

Table L1 provides the conversion from the NCC climate zones.

TABLE K1

CLIMATE REGIONS AND CLIMATE ZONES

Climate region	NCC climate zone	Description
A	1	Hot and humid summer warm winter
	2	Warm and humid summer mild winter
	3	Hot and dry summer warm winter
	5	Warm temperate
B	4	Hot and dry summer cool winter
	6	Mild temperate
C	7	Cool temperate
	8	Alpine

APPENDIX L

NEW ZEALAND CLIMATE REGIONS

(Normative)

L1 SCOPE

This Appendix sets out the climate regions for New Zealand, as outlined in Figure L1, to define the requirements for energy efficiency.

The climate region boundaries shall be based on climatic data taking into account territorial authority boundaries, providing for three regions (see Figure L1).

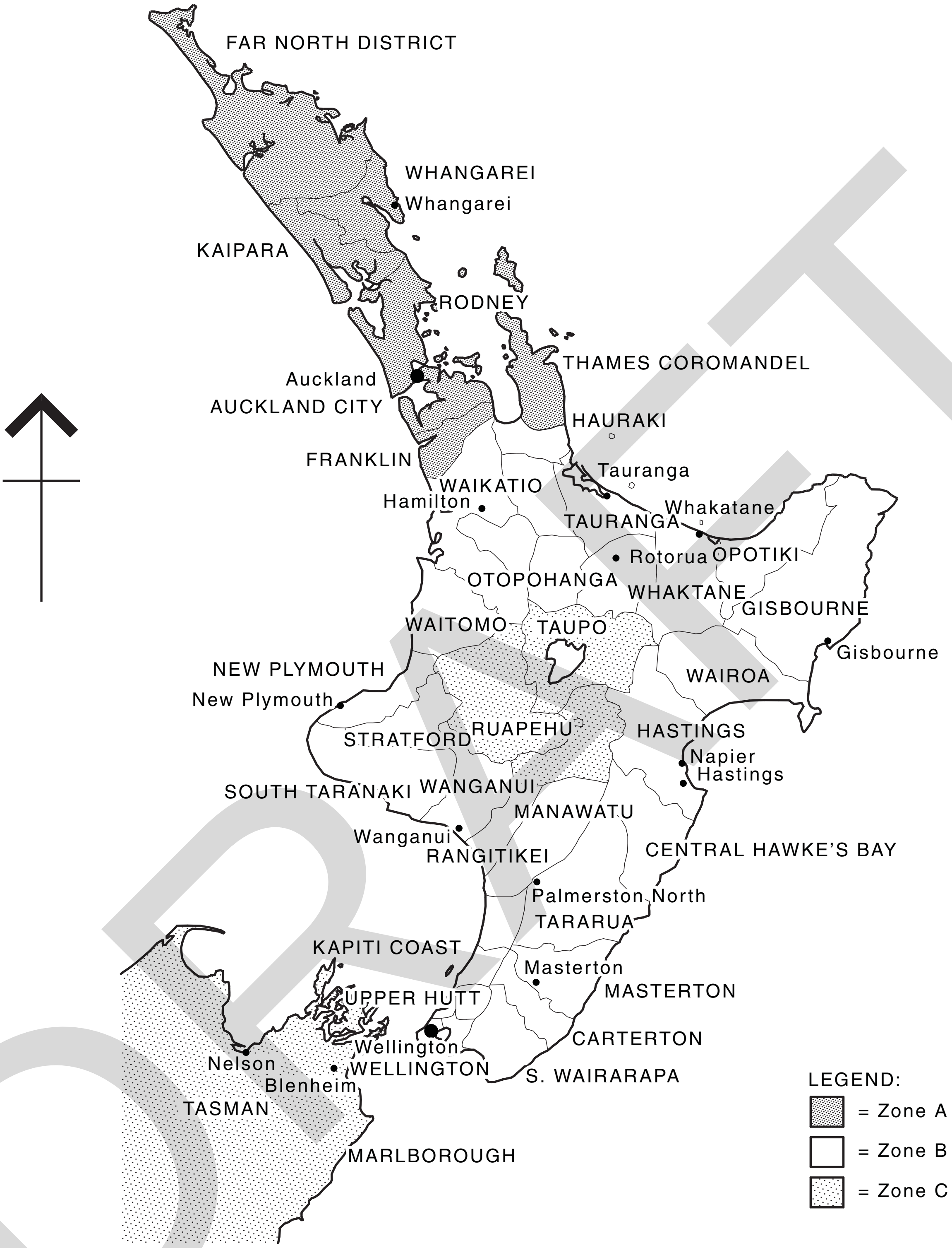


FIGURE L1 NEW ZEALAND CLIMATE REGIONS

L2 CLIMATE REGIONS

Region A comprises the Coromandel District, Franklin District and all districts north of these.

Region B comprises the remainder of the North Island excluding Taupo District, Ruapehu District and the northern part of the Rangitikei District.

Region C comprises the remainder of the country, i.e. Taupo District, Ruapehu District, northern part of the Rangitikei District, the South Island and all other islands not in Region A.

L3 FROST AREAS

Table L3 shows the frost days throughout regions of New Zealand.

TABLE L3

FROST DAYS

Mean number of days of ground frost (see Note)													
Location	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
KAITAIA	0	0	0	0	0	0	0	0	0	0	0	0	1
WHANGAREI	0	0	0	0	1	3	4	2	1	0	0	0	11
AUCKLAND	0	0	0	0	1	3	4	2	1	0	0	0	10
TAURANGA	0	0	0	1	5	9	12	9	4	2	1	0	42
ROTORUA	0	0	0	2	8	12	14	11	7	3	1	0	57
TAUPO	1	1	1	3	8	12	16	14	9	7	3	1	69
HAMILTON	0	0	1	3	8	11	14	11	7	3	1	0	63
NEW PLYMOUTH	0	0	0	0	1	4	4	3	1	0	0	0	15
MASTERTON	0	0	1	2	8	11	13	12	8	5	2	1	60
GISBORNE	0	0	0	0	3	8	9	8	3	1	0	0	33
NAPIER	0	0	0	0	3	7	7	7	3	1	0	0	29
PALMERSTON NORTH	0	0	0	1	4	8	10	8	4	2	1	0	38
WELLINGTON	0	0	0	0	1	2	3	3	1	0	0	0	10
WANGANUI	0	0	0	0	0	1	3	2	0	0	0	0	7
WESTPORT	0	0	0	0	2	6	8	6	2	0	0	0	26
HOKITIKA	0	0	0	2	5	12	15	12	5	2	1	0	54
MILFORD SOUND	0	0	0	1	7	14	16	13	5	2	1	0	56
NELSON	0	0	1	4	12	18	21	17	10	4	1	0	88
BLENHEIM	0	0	0	1	6	15	16	13	6	2	0	0	60
KAIKOURA	0	0	0	0	2	6	8	6	4	1	0	0	27
MT COOK	1	1	3	9	19	22	24	23	14	8	3	1	140
CHRISTCHURCH	0	0	0	2	9	16	16	15	9	3	1	0	70
LAKE TEKAPO	1	1	5	11	21	25	27	25	16	9	5	3	149
TIMARU	0	0	2	5	12	21	23	19	12	5	3	0	100
DUNEDIN	0	0	0	2	6	13	16	12	7	3	1	0	58
QUEENSTOWN	0	0	1	5	13	21	24	21	14	7	3	0	107
ALEXANDRA	1	2	3	10	19	26	27	26	19	12	6	2	148
INVERCARGILL	1	2	3	6	9	16	18	16	11	6	4	2	94
CHATHAM ISLAND	0	0	0	0	0	1	1	1	1	0	0	0	4

NOTE: Data are mean monthly values of the number of days with ground frosts for the 1971–2000 period for locations

APPENDIX M

OPERATION AND MAINTENANCE

(Informative)

M1 SCOPE

This Appendix provides the guidelines for the operation and maintenance of a heated water system.

M2 GENERAL

In order to ensure maximum performance and length of operation, water heaters should be inspected periodically.

M3 MAINTENANCE OF HEATED WATER SERVICES

Heated water services should be maintained in accordance with the following:

(a) *Water treatment units* Where installed, water treatment units should be inspected periodically to ensure proper operation.

(b) *Water vessels and tanks* All vessels and tanks should be inspected and cleaned periodically, and in accordance with any requirements of the regulatory authority.

NOTE: The frequency of periodic cleaning depends upon the quality of the supply water, design, materials of construction and the pipe system. Combinations of materials giving rise to corrosion should be avoided.

(c) *Valves* The following valves should be inspected periodically to ensure proper operation:

(i) Temperature/pressure-relief valves.

(ii) Expansion control valves.

(iii) Thermostatic mixing valves.

(iv) Tempering valves.

(v) Other associated valves/devices.

(d) The requirements of AS/NZS 3666.2, where applicable.

APPENDIX N

PROVISION FOR EXPANSION AND CONTRACTION

(Normative)

N1 SCOPE

This Appendix sets out tables, formulae and calculations to allow for expansion and contraction in acceptable heated water pipes.

N2 GENERAL

All materials used in plumbing services pipe work experience length change due to the change in temperature.

If the pipe work is locked into position and does not allow for thermal movement, related stress in the material will eventuate which can cause premature failure.

The following problems can occur:

(a) Failure of the piping from over stressing in particular at fabricated junctions or branches.

(b) Leakage at location where the material has reached its stress point.

(c) Distortion in the piping or connected equipment.

The design and installation of pipe work material should take into consideration each material type, the method of installation and the change in temperature.

Thermal length changes shall be calculated based on the difference between the coldest temperature in the pipe work (i.e. during installation of the system, or when the system is not in operation) and the highest temperature during operation.

N3 CALCULATING THERMAL LENGTH CHANGE

To calculate the thermal length change of a pipe section, Equation N3 shall be used for a range of temperature differentials:

$$X = L \times (T_2 - T_1) \times \alpha \qquad \text{. . . N3}$$

where

X = Thermal length change (mm)

L = Length of pipe section (m)

T1 = Coldest temperature (°C)

T2 = Highest temperature (°C)

α = Coefficient of thermal expansion (mm/(m*K), [these are shown in Table N3(A)]

TABLE N3(A)

COEFFICIENTS OF THERMAL EXPANSION FOR COMMON PIPE MATERIALS

Metals		Plastics	
Materials	**Coefficient α mm/(m*K)**	**Materials**	**Coefficient α mm/(m*K)**
Copper	0.0177	PE-X	0.15
Stainless Steel	0.0159	PB	0.13
		PP-R	0.15
		PE-X/AL/PE-X and PE-X/Al/PE	0.02

NOTE: For some constructions of PE-X/AL/PE-X and PE-X/Al/PE pipes and multi-layer pipes or composite pipes there are different values of α. The manufacturer of the composite and multi-layer piping system declares which value of α has to be used.

Table N3(B) shows expansion in length per metre run of pipe for selected temperature increases.

TABLE N3(B)

RATES OF THERMAL EXPANSION FOR COMMON PIPE MATERIALS mm/m

Change in temperature °C	Copper	Stainless steel	PE-X	PB	PP-R	PE-X/Al/PE-X and PE-X/Al/PE
10	0.18	0.16	1.5	1.3	1.5	0.2
20	0.35	0.32	3.0	2.6	3.0	0.4
30	0.53	0.48	4.5	3.9	4.5	0.6
40	0.71	0.64	6.0	5.2	6.0	0.8
50	0.89	0.80	7.5	6.5	7.5	1.0
60	1.06	0.95	9.0	7.8	9.0	1.2
70	1.24	1.11	10.5	9.1	10.5	1.4
80	1.42	1.27	12.0	10.4	12.0	1.6
90	1.59	1.43				
100	1.77	1.59				

N4 PROVISION FOR EXPANSION

Provisions for expansion should be considered when designing tube runs and fixing points, by allowing freedom of movement at bends, branches and tees.

The easiest and most common method of accommodating expansion is to provide an offset or change in direction and allowing the tube to move. This requires that the tube shall not be fixed within a certain distance of the end. Figure N4 provides a demonstration of an offset to accommodate expansion.

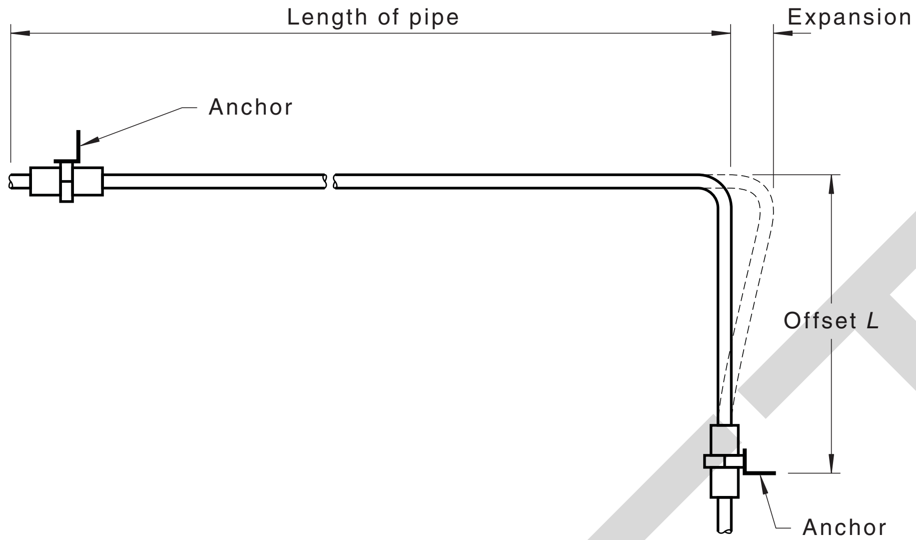


FIGURE N4 OFFSET TO ACCOMMODATE EXPANSION

This figure is reproduced [with modification] with permission of International Copper Association of Australia.

N5 CALCULATING THE OFFSET LENGTH *L*

The length of the offset *L* can be calculated from the Equation N5:

$$L_{\text{Offset}} = C \times \sqrt{(d \times X)} \qquad \text{. . . N5}$$

where

L_{Offset} = Offset length (mm)

C = Material constant in accordance with Table N5

d = Pipe outer diameter (mm)

X = Expansion or thermal length change as determined by Equation N3 (mm) or from Table N3(B)

NOTE: The length of pipe section *L* is the length between the anchor point and the offset bend.

The calculated values shall be rounded up to the next 5 mm step.

TABLE N5

VALUES OF MATERIAL CONSTANT (*C*)

Material	*C*
Copper, stainless steel	61.2
PE-X	12
PB	10
PP-R	20
PVC-C	34
PE-X/Al/PE-X and PE-X/Al/PE*	30

* For some constructions of PE-X/AL/PE-X and PE-X/AL/PE pipes or composite pipes there are different values of *C*.
The manufacturer of the PE-X/AL/PE-X and PE-X/AL/PE piping system declares which value of *C* has to be used.

Different materials require different offset allowances due to their physical properties.

Example 1

A 6 m length of DN 50 hot water copper pipe experiences a temperature change of 50°C. The copper pipe is fixed at one end and has a 90° elbow on the other. What is the offset length required to provide allowance for thermal expansion and contraction?

From Table N3(B) the 6 m length of copper tube will expand 6 × 0.89 mm = 5.34 mm

Alternatively from Equation N3, $X = L \times (T_2 - T_1) \times \alpha$

$X = 6 \times 50 \times 0.0177 = 5.31$ mm

From Equation N5, $L_{\text{Offset}} = C \times \sqrt{(d \times X)}$

$L_{\text{Offset}} = 61.2 \times \sqrt{(50.8 \times 5.34)}$

$L_{Offset} = 1005$ mm

Example 2

A 14 m length of hot water PE-X pipe DN 50 (OD 63 mm) experiences a temperature change of 50°C. The PE-X pipe is fixed at one end and has a 90° elbow on the other. What is the offset length required to provide allowance for thermal expansion and contraction?

From Table N3(B) the 14 m length of PE-X pipe will expand 14 × 7.5 mm = 105 mm

Alternatively from Equation N3, $X = L \times (T_2 - T_1) \times \alpha$

$X = 14 \times 50 \times 0.15 = 105$ mm

From Equation N5, $L_{\text{Offset}} = C \times \sqrt{(d \times X)}$

$L_{\text{Offset}} = 12 \times \sqrt{(63 \times 105)}$

$L_{Offset} = 980$ mm

N6 OFFSETS IN BENDS WITH TWO ANCHOR POINTS

A change in direction may be used to accommodate the thermal length changes from two directions. In this case, offsets must be provided on both sides of the bend. The combined length of both offsets shall not exceed the maximum spacing distance of brackets and clips in accordance with Table 4.4.4.

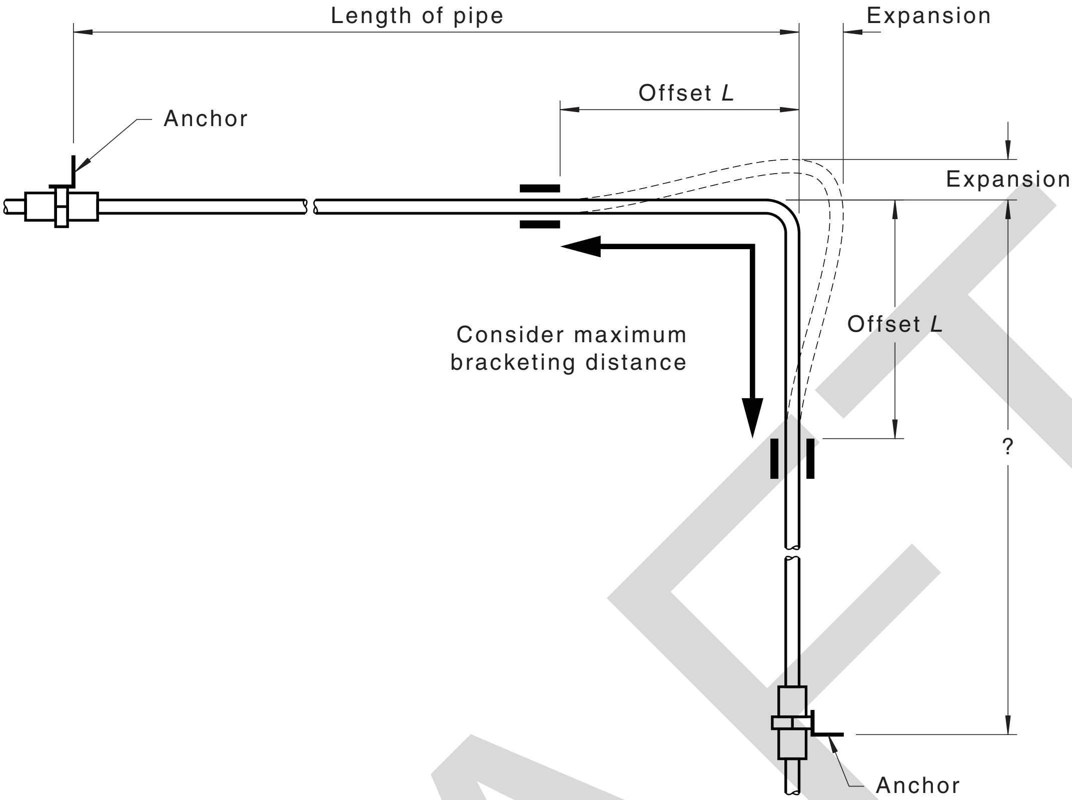
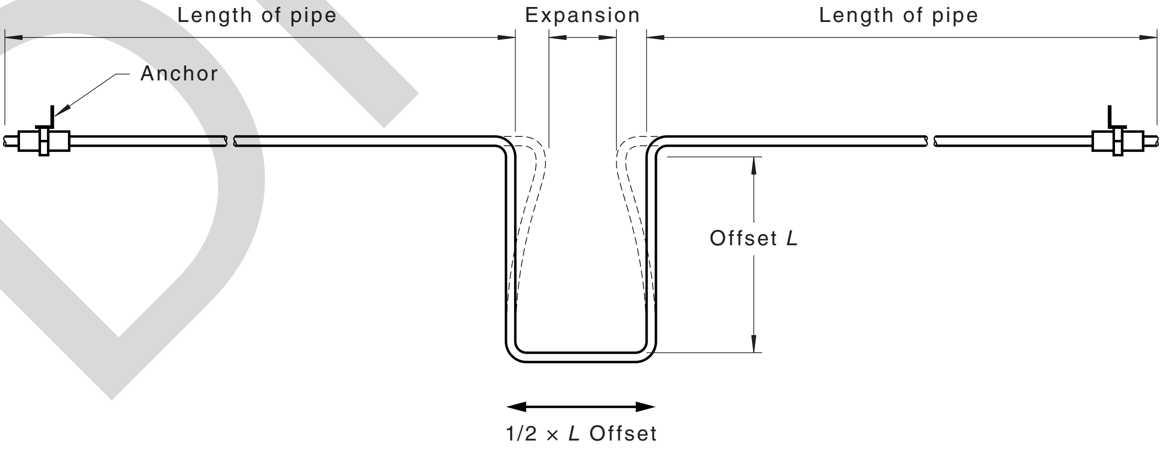


FIGURE N6 OFFSET TO ACCOMMODATE EXPANSION FROM TWO DIRECTIONS

N7 EXPANSION LOOPS

Long pipe sections may need to be split up in sub-sections by installing more than one anchor point. Between any two anchor points a provision for thermal movement should be created, i.e. by installing an expansion loop or U-bend. Expansion loops and U-bends should be located near the centre of the length of pipe and placed horizontally. This is to avoid formation of water troughs in or between two expansion loops where the water stagnates when the system is drained and to avoid forming air locks at the top of the loops.



NOTE: The length of pipe *L* is the length between the anchor point and the offset bend.

FIGURE N7 EXPANSION LOOP

N8 CALCULATING THE OFFSET LENGTH L FOR AN EXPANSION LOOP OR U-BEND

Because the expansion loop or U-bend consists of two offsets back to back, half of the expansion is accommodated by each side of the U-bend. Therefore, when using Equation N5, the expansion or thermal length change (X) is half of the expansion that the entire length of pipe experiences.

> ***Example 3***
>
> *A 6 storey building has a 18 metre stainless steel hot water riser pipe DN 50 (OD 54 mm) to a storage tank at the top of the building that can experience a temperature change of 50°C. The stainless steel riser is fixed at both ends but provision has been made for a horizontal expansion loop to be place between the middle floors of the building. What is the offset length for the expansion loop in order to provide allowance for thermal expansion and contraction?*
>
> *From Table N3(B) the 18 meter length of stainless steel pipe will expand a total of*
>
> 18×0.80 *mm* $= 14.34$ *mm*
>
> *Alternatively from Equation N3,* $X = L \times (T_2 - T_1) \times \alpha$
>
> $X = 18 \times 50 \times 0.0159 = 14.31$ *mm*
>
> *Half of this expansion will be accommodated by each side of the expansion loop so we will use half of this expansion distance (7.17 mm) when we use Equation N5 to calculate the offset.*
>
> *From Equation N5,* $L_{\text{Offset}} = C \times \sqrt{(d \times X)}$
>
> $L_{\text{Offset}} = 61.2 \times \sqrt{(54 \times 7.17)}$
>
> $L_{Offset} = 1205$ *mm*

N9 BRANCH OFF-TAKES

Branch off-takes from hot water pipes require an offset *L* to accommodate thermal length changes of the main pipe. Within the offset length movement of the branch off-take shall not be restricted by brackets, floors, walls or other services.

Offset *L*2 is calculated using Equations N3 and N5. The thermal length change is calculated using the length of pipe between anchor point and branch off-take. The required offset lengths is calculated based on the outer diameter of the branch off-take.

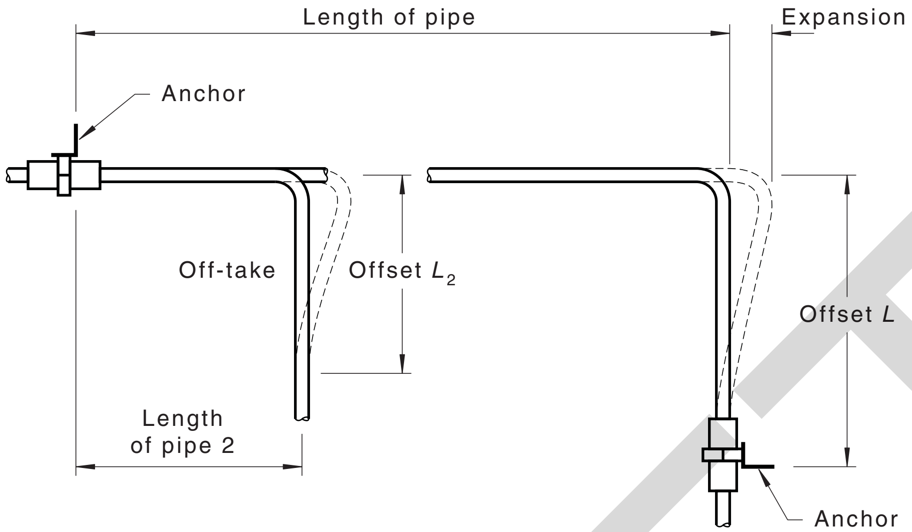


FIGURE N9 EXPANSION OFFSET FOR BRANCH OFF-TAKE

Example 4

As an extension of Example 1 for a DN 50 hot water copper pipe, there is now a DN 25 (OD 25.4) branch off-take 4 m from the nearest anchor point. What is the offset length required in the branch off-take to provide allowance for thermal expansion and contraction in the main line?

From Table N3(B) the 4 m length of copper tube will expand 4 × 0.89 mm = 3.56 mm

Alternatively from Equation N3, $X = L \times (T_2 - T_1) \times \alpha$

$$X = 4 \times 50 \times 0.0177 = 3.54 \text{ mm}$$

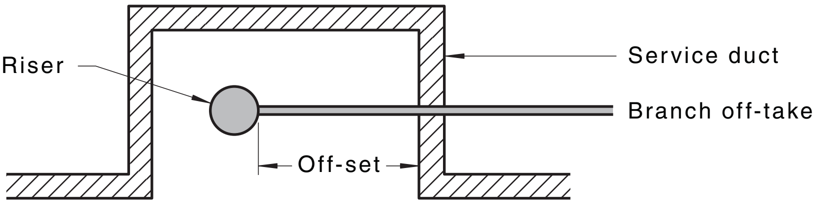
From Equation N5, $L_{\text{Offset}} = C \times \sqrt{(d \times X)}$

$$L_{\text{Offset}} = 61.2 \times \sqrt{(25.4 \times 3.56)}$$

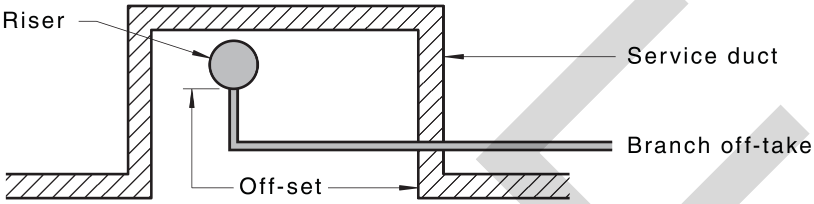
$$L_{\text{Offset}} = 585 \text{ mm}$$

N10 BRANCH OFFTAKES IN DUCTS

Movement of branch offtakes in ducts shall not be restricted by brackets, floors, walls or other services within the Offset length. Offsets can be installed straight or bent, refer to Figure N10.



a) Straight off-set in duct—Plan view



b) Bent off-set in duct—Plan view

Note: Additional clearance may be provided for expansion where the pipe passes through the wall of the service duct provided it does not contravene fire regulations

FIGURE N10 EXPANSION OFFSETS IN DUCTS

APPENDIX O

ESTIMATION OF PROBABLE SIMULTANEOUS DEMAND FOR RESIDENTIAL BUILDINGS FROM THE TOTAL OF LOADING UNITS

(Informative)

TABLE O1

PROBABLE SIMULTANEOUS DEMAND (PSD) FOR A CIRCULATORY HEATED WATER SYSTEM IN RESIDENTIAL BUILDINGS

No. of loading units	Flow rate L/s	No. of loading units	Flow rate L/s	No. of loading units	Flow rate L/s
100	1.20	650	2.75	1800	4.90
150	1.35	700	2.85	2000	5.25
200	1.45	750	2.95	2200	5.50
250	1.60	800	3.05	2400	5.75
300	1.70	850	3.20	2600	6.00
350	1.85	900	3.30	2800	6.35
400	2.00	950	3.40	3000	6.70
450	2.15	1000	3.50	3500	7.25
500	2.35	1200	3.80	4000	7.75
550	2.50	1400	4.20	4500	8.40
600	2.60	1600	4.60	5000	9.00

APPENDIX P

SIZING OF EXPANSION VESSELS IN MAINS PRESSURE SYSTEMS

(Normative)

This Appendix sets out a method to calculate expansion vessel volume in mains pressure systems (check with manufacturer if their method differs to Equations P1 to P3 or for closed loop or solar systems):

(a) Calculate the expanded water volume.

$$V_{expanded}\ (L) = TSV \times EF \quad \text{. . . P1}$$

where

TSV = Total system volume (L): the total volume of all heated water in the system including water heaters and storage tanks. Where the temperature in dead leg branch lines is not maintained, for example, not heat traced, the volume of water contained in the branch lines can be excluded.

EF = Water expansion factor: the amount that water will expand per litre when heated from its coldest to hottest temperature, see Table P1.

(b) Calculate the maximum allowed system pressure.

$$P_{high}\ (\text{kPa}) = 0.85 \times P_{max} \quad \text{. . . P2}$$

where

P_{max} (kPa) = Temperature and pressure relief valve or pressure relief valve setting: the lowest relief valve setting of all relief valves in a system, e.g. a water heater may have a pressure relief valve setting of 850 kPa and the storage tank may have a temperature and pressure relief valve setting of 1000 kPa. P_{max} would be 850 kPa.

(c) Determine the water supply pressure P_{low} (kPa).

where

P_{low} (kPa) = Water supply pressure (kPa): the maximum water supply pressure to the system. This will be the pre-charge pressure that the expansion vessel will need to be set at.

(d) Calculate the acceptance factor (AF).

$$AF = (P_{high} - P_{low}) / (P_{high} + 100\ \text{kPa}) \quad \text{. . . P3}$$

If the AF is greater than 0.5, use 0.5.

(e) Calculate the total tank volume.

$$\text{Total tank volume (L)} = V_{expanded} / AF \quad \text{. . . P4}$$

(f) Select a tank with equal or greater volume than that calculated.

(g) Pre-charge the expansion vessel to the pressure determined in (c) above.

Example

A building is serviced by a gas water heater and a storage tank with a storage capacity of 325 L. The flow and return circuit is to be run in Type B copper and the sum of all flow lines is 45 m of diameter 40 mm pipe and the return line is 12 m of diameter 25 mm pipe. The temperature in the branch lines is not maintained. The system is supplied with heated water at 65°C and the coldest water temperature in winter is 10°C. Incoming supply pressure to the building is 500 kPa.

1. Determine the total system volume (TSV).

From supplier tables it is determined that the total volume of fluid in the pipe work is 50 L. The storage tank volume is 325 L. Checking with the supplier, it is determined the water heater volume is relatively small, and an allowance of 10 L is to be made.

Therefore TSV = 50 + 325 + 10 = 385 L.

2. Determine the expansion factor (EF).

Hot temperature = 65°C, cold temperature = 10°C. From Table P1, 65°C is not shown. Use 70°C hot and cross reference against 10°C cold.

EF = 0.0201

3. Calculate the expanded water volume.

Vexpanded = 385 × 0.0201 = 7.74 L

4. Calculate the maximum allowed system pressure (Phigh).

From supplier literature or rating plate data, the water heater relief valve setting is 850 kPa and the storage tank is 1000 kPa. Therefore use 850 kPa.

Phigh = 0.85 × 850 = 723 kPa.

5. Determine water supply pressure (Plow).

Given as 500 kPa.

6. Calculate the AF.

AF = (Phigh – Plow) / (Phigh + 100 kPa).

AF = (723 − 500) / (723 + 100) = 0.27. As this is less than 0.5, use 0.27.

7. Calculate the total tank volume.

Total tank volume (L) = 7.74 / 0.27 = 28.7 litres.

8. Select a tank with a capacity at least 29 L.

9. Pre-charge the expansion tank to a pressure of 500 kPa.

TABLE P1

WATER EXPANSION FACTOR (EF)

Expansion of 1 L of water when raised from T1 (cold) to T2 (hot)											
°		T2 (Hot) °C									
		4	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
T1 (Cold)	**4**	0	0.0003	0.0018	0.0043	0.0078	0.0121	0.0171	0.0227	0.0290	0.0356
	10		0	0.0015	0.0041	0.0075	0.0118	0.0168	0.0224	0.0287	0.0356
	20			0	0.0026	0.0060	0.0103	0.0153	0.0209	0.0272	0.0340
	30				0	0.0035	0.0077	0.0127	0.0183	0.0245	0.0314
	40					0	0.0042	0.0092	0.0148	0.0210	0.0278
	50						0	0.0049	0.0105	0.0167	0.0235
	60							0	0.0055	0.0117	0.0185
	70								0	0.0061	0.0129
	80									0	0.0067
	90										0

BIBLIOGRAPHY

AS

1357 Valves primarily for use in heated water systems (series)

1361 Electric heat-exchange water heaters—For domestic applications

2239 Galvanic (sacrificial) anodes for cathodic protection

4032 Water supply—Valves for the control of heated water supply temperatures

4032.3 Part 3: Requirements for field-testing, maintenance or replacement of thermostatic mixing valves, tempering valves and end-of-line temperature control devices

AS/NZS

1170 Structural design actions

1170.2 Part 2: Wind loads

3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

3666 Air-handling and water systems of buildings—Microbial control

3666.2 Part 2: Operation and maintenance

5263 Gas appliances

5263.1.2 Part 1.2: Gas fired water heaters for hot water supply and/or central heating

NZS

4305 Energy efficiency—Domestic type hot water systems

4608 Control valves for hot water systems

BS

5422 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range –40°C to +700°C

H1/AS1

'Compliance Document for New Zealand Building Code, Clause H1', Energy Efficiency, 3rd ed, Department of Building and Housing, New Zealand Government, 2011

'Australian Solar Radiation Data Handbook', 4th ed, Australian and New Zealand Solar Energy Society (ANZSES) 2006

Guidance on use of rainwater tanks, 3rd ed, Department of Health, Australian Government, 2010

*** END OF DRAFT ***

NOTES

REFERENCE COPY ONLY

Draft for Public Comment

Australian/New Zealand Standard

This following part of Public Comment DR 3500.4:2017 is for reference only.

This reference copy has been prepared using an automated tool to indicate key differences between the current edition of AS/NZS 3500.4:2015 (as amended) and Public Comment DR 3500.4:2017.

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Readers should make their own assessment of the differences between the current edition of AS/NZS 3500.4:2015 (as amended) and Public Comment DR 3500.4:2017.

Public Comment DR 3500.4:2017 in the first part of this PDF document without changes indicated is the official version for comment.

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee WS-014, Plumbing and Drainage, to supersede AS/NZS 3500.4:2015.

The objective of this Standard is to provide solutions to comply with—

(a) the National Construction Code (NCC), Volume Three—Plumbing Code of Australia (PCA), and

(b) the New Zealand Building Code (Clause G12 Water Supplies).

This Standard is part of a series of Standards for plumbing and drainage, as follows:

AS/NZS
3500 Plumbing and drainage
3500.0 Part 0: Glossary of terms
3500.1 Part 1: Water services
3500.2 Part 2: Sanitary plumbing and drainage
3500.3 Part 3: Stormwater drainage
3500.4 Part 4: Heated water services (this Standard)
~~3500.5 Part 5: Housing installations~~

The objective of this revision of to update requirements relating to plastic pipes in direct sunlight, circulatory heated water, thermostatically controlled taps and clarification for jointing methods.

~~The revision includes following changes:~~

~~(i) Clarification of the requirements for the installation of solar water heaters.~~

~~(ii) Meet the ABCB protocol for the development of NCC Referenced Documents.~~

~~This revision includes alignment with the requirements of the Plumbing Code of Australia and changes to the velocity requirements for circulatory heated water systems.~~Some materials and products used in a heated water service are provided with instructions for installation and use. ~~Whilst~~ While not a requirement of this Standard, or acceptable as an alternative to the requirements of this Standard, ~~compliance~~ conformance with these instructions generally ensures that—

(A) the material or product is fit for the application;

(B) the performance of the system is not degraded;

(C) the durability of the material or product is not impaired; and

(D) the manufacturer's warranty remains valid.

PROVISION FOR REVISION

This Standard necessarily deals with existing conditions, but is not intended to discourage innovation or to exclude materials, equipment and methods that may be developed in future. Revisions will be made from time to time in view of such developments and amendments to this edition will be made only when absolutely necessary.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to figures and tables are deemed to be requirements of this Standard.

Notes used in this Standard are of an advisory nature only and are used to give explanation or guidance to the user on recommended considerations or technical procedures, or to provide an informative cross-reference to other documents or publications. Notes to clauses in this Standard do not form a mandatory part for ~~compliance~~ conformance with this Standard.

This Standard 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 Standard.

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STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Plumbing and drainage

Part 4: Heated water services

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out 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 Standard 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: 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 4552)/NZS 5263.1.2.

(c) Instantaneous (continuous flow) water heaters.

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

NOTE: Appendix N M provides guidelines for the operation and maintenance of heated water services.

1.2 APPLICATION

1.2.1 Australia

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

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 Standard shall be read in conjunction with the New Zealand Building Code in New Zealand. This Standard may be used for compliance with the New Zealand Building Code-, Paragraph 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 are the normative documents referenced in this Standard are listed in Appendix A.

NOTE: D—ocuments referenced for informative purposes are listed in the Bibliography.

AS

1074	Steel tubes and tubulars for ordinary service	
1345	Identification of the contents of pipes, conduits and ducts	
1379	Specification and supply of concrete	
1397	Continuous hot-dip metallic coated steel sheet and strip—Coatings of zinc and zinc alloyed with aluminium and magnesium	
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3498	Authorization requirements for plumbing products—Water heaters and hot-water storage tanks	
3600	Concrete structures	
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3795	Copper alloy tubes for plumbing and drainage applications	
4032	Water supply—Valves for the control of heated water supply temperatures	
4032.1	Part 1:	Thermostatic mixing valves—Materials design and performance requirements
4032.2	Part 2:	Tempering valves and end-of-line temperature-actuated devices
4087	Metallic flanges for waterworks purposes	
4176	Multilayer pipes for pressure applications	
4176.1	Part 1:	Multilayer piping systems for hot and cold water plumbing applications—General (ISO 21003-1:2008, MOD)
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4176.3	Part 3:	Multilayer piping systems for hot and cold water plumbing applications—Fittings (ISO 21003-3:2008, MOD)
4176.5	Part 5:	Multilayer piping systems for hot and cold water plumbing applications—Fitness for purpose of the systems (ISO 21003-5:2008, MOD)
4176.7	Part 7:	Multilayer piping systems for hot and cold water plumbing applications—Assessment of conformity (ISO/TS 21003-7:2008, MOD)
4809	Copper pipe and fittings—Installation and commissioning	
5082	Polybutylene (PB) plumbing pipe systems—Metric series	
5082.1	Part 1:	Metric polybutylene (PB) pipes for hot and cold water applications
5082.2	Part 2:	Mechanical and fusion jointing systems
5200	Plumbing and drainage products	
5200.053	Part 053:	Stainless steel pipes and tubes for pressure applications

AS/NZS

1167	Welding and brazing—Filler metals	
1167.1	Part 1:	Filler metal for brazing and braze welding

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1167.2	Part 2:	Filler metal for welding
1260	PVC-U pipes and fittings for drain, waste and vent applications	
2280	Ductile iron pipes and fittings	
2492	Cross-linked polyethylene (PE-X) pipes for pressure applications	
2537	Mechanical jointing fittings for use with crosslinked polyethylene (PE-X) for pressure applications (series)	
2544	Grey iron pressure fittings	
2642	Polybutylene (PB) plumbing pipe systems	
2642.2	Part 2:	Polybutylene (PB) pipe for hot and cold water applications
2642.3	Part 3:	Mechanical jointing fittings for use with polybutylene (PB) pipes for hot and cold water applications
2712	Solar and heat pump water heaters—Design and construction	
2878	Timbers—Classification into strength groups	
3500	Plumbing and drainage	
3500.0	Part 0:	Glossary of terms
3500.1	Part 1:	Water services
4020	Testing of products for use in contact with drinking water	
4129	Fittings for polyethylene (PE) pipes for pressure applications	
4234	Heated water systems—Calculation of energy consumption	
4331	Metallic flanges (series)	
4671	Steel reinforcing materials	
AS ISO		
7	Pipe threads where pressure-tight joints are made on the threads—	
7.1	Part 1:	Dimensions, tolerances and designation
ISO		
15874	Plastics piping systems for hot and cold water installations—Polypropylene (PP)	
15874.2	Part 2:	Pipes
15874.3	Part 3:	Fittings
NZS		
3109	Concrete construction	
3124	Specification for concrete construction for minor works	
3501	Specification of copper tubes for water, gas and sanitation	
3631	New Zealand timber grading rules	
3640	Chemical preservation of round and sawn timber	
4603	Installation of low pressure thermal storage electric water heaters with copper cylinders (open-vented systems)	
4607	Installation of thermal storage electric water heaters: valve-vented systems	
4613	Domestic solar water heaters	
4614	Installation of domestic solar water heating systems	
5807	Code of practice for industrial identification by colour, wording or other coding	

NZS/BS

21	Pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)
3601	Specification for carbon steel pipes and tubes with specified room temperature properties for pressure purposes

ASTM

D2846	Standard Specification for Chlorinated Poly(Vinyl Chloride) Plastic Hot-and Cold-Water Distribution Systems

ABCB

NCC	National Construction Code

MIBE

NZBC	New Zealand Building Code (G1, Personal hygiene; G12, Water supplies)

1.4 DEFINITIONS

For the purpose of this Standard the definitions given in AS/NZS 3500.0 and those below apply.

1.4.1 Container

The vessel, including fittings, in which the heated water is stored.

NOTE: A container is sometimes referred to as a storage container, cylinder or tank.

1.4.2 Integral solar water heater

A solar water heating system in which the container and collector are constructed as a single unit.

1.5 PLASTICS ABBREVIATIONS

The following plastics abbreviations are used in this Standard:

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

Where rainwater is used in heated water systems, it is particularly important consumers are made aware of the advice from enHealth (see ~~the document~~Environmental Health Committee, 'Guidance on ~~Use of Rainwater Tanks'~~ use of rainwater tanks', 3rd ed, 2010 and the manufacturers of items forming part of, or connected to, the heated water system.

1.7 ~~EQUIVALENT~~ PIPE SIZES

For sizing based on internal diameter see Appendix C.

Where the nominal size of a pipe or fitting is specified in this Standard, an equivalent pipe size, appropriate to the material being used, shall be selected from ~~Table 1.7~~Tables 1.7(A) and 1.7(B) respectively.

TABLE 1.7(A)
PIPE SIZE CONVERSION FOR CIRCULATORY SYSTEM
~~EQUIVALENT PIPE SIZES~~

Specified nominal size	Acceptable equivalent size						
	Copper		Stainless steel	PE-X	PB	PP-R	PE-X/AL/PE-X PE-X/AL/PE
DN	AS 1432	NZS 3501					
10	10	10	10	12	~~15*1820~~1	12	10
15	15	15	15	16	6 (15)*	16	15
18	18	—	18	20	16 (18)	20	20
					20 (22)		
20	20	20	20	25	~~2228~~25	25	20
25	25	25	25	32	(22)	32	25
32	32	32	32	40	32 (28)	40	32
					40		
40	40	40	40	50	50	50	50
50	50	50	50	63	63	63	—63

* ~~No size smaller than 15 in~~ Sizes in brackets are for pipe in accordance with AS/NZS 2642.2.

TABLE 1.7(B)
PIPE SIZE CONVERSION FOR CIRCULATORY SYSTEMS

Specified nominal size	Acceptable equivalent size						
	Copper		Stainless steel	PE-X	PB	PP-R	PE-X/AL/PE-X PE-X/AL/PE
DN	AS 1432	NZS 3501					
15	15	15	15	16	16 (15)	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	
90	90	90	80	90	90	90	
100	100	100	90	110	110	110	

125 150	125 150	125 150	100 125	125 160	125 140	140 160	

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

NOTE: The acceptable equivalent sizes are determined from internal pipe diameters and the maximum water velocity requirements of Clause 1.8.

1.8— VELOCITY REQUIREMENTS

The maximum water velocity in piping shall be in accordance with Table 1.8.

TABLE 1.8
MAXIMUM ALLOWABLE ~~FLOW~~ VELOCITIES

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

NOTES:

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

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.

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.

1.9 WATER TEMPERATURE

1.9.1 Storage temperature

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

(a) store water at a temperature of not less than 60°C; or

(b) utilize water heater(s) ~~complying~~ conforming with AS 3498 (Australia only).

1.9.2 Sanitary fixtures delivery temperature

All new heated water installations shall deliver heated water not exceeding—

(a) 45°C at the outlet of sanitary fixtures used primarily for personal hygiene purposes for the aged, the sick, children or people with disabilities in healthcare and aged care buildings, early childhood centres, primary and secondary schools and nursing homes or similar facilities for the aged, the sick, children or people with disabilities; and

(b) 50°C at the outlet of sanitary fixtures used primarily for personal hygiene purposes for all other situations.

NOTES:

1 Sanitary fixtures used for personal hygiene purposes include showers, baths, handbasins and bidets.

2 Temperature limits are required to minimize the risk of scalding. At greatest risk from scalding are children, the aged, the sick and people with disabilities, particularly those in institutional care.

3 For Australia, 'healthcare building' means a building whose occupants or patients undergoing medical treatment generally need physical assistance to evacuate the building during an emergency, and includes—

(a) a public or private hospital;

(b) a nursing home or similar facility for sick or disabled persons needing full-time care; or

(c) a clinic, day surgery or procedure unit where the effects of the predominant treatment administered involve patients becoming non-ambulatory and requiring supervised medical care on the premises for some time after the treatment.

4 For Australia, 'aged care building' means a building for residential accommodation of aged persons who, due to varying degrees of incapacity associated with the ageing process, are provided with personal care services and 24 h staff assistance to evacuate the building during an emergency.

1.9.3 Solutions for control of delivery temperatures

~~The~~ For control of delivery temperatures the following shall apply:

(a) Where a maximum delivery temperature of 45°C is required, all sanitary fixtures used primarily for personal hygiene purposes shall be supplied ~~from a thermostatic mixing valve complying with AS 4032.1 and adjusted to an outlet temperature not exceeding 45°C at each outlet supplied from the thermostatic mixing valve.~~ from—

(i) a thermostatic mixing valve conforming with AS 4032.1 and adjusted to an outlet temperature not exceeding 45°C at each outlet supplied from the thermostatic mixing valve; or

(ii) a thermostatically controlled tap conforming with AS 4032.4 and adjusted to an outlet temperature not exceeding 45°C at each outlet supplied from the thermostatically controlled tap.

(b) Where a maximum delivery temperature of 50°C is required, all sanitary fixtures used primarily for personal hygiene purposes shall be supplied from—

(i) a thermostatic mixing valve ~~complying~~ conforming with AS 4032.1 and adjusted to an outlet temperature not exceeding 50°C at each outlet supplied from the thermostatic mixing valve;

(ii) a tempering valve ~~complying~~ conforming with AS 4032.2 and adjusted to an outlet temperature not exceeding 50°C at each outlet supplied from the tempering valve; or

(iii) a water heater ~~complying~~ conforming with AS 3498 and marked with the following:

THIS APPLIANCE DELIVERS WATER NOT EXCEEDING 50°C IN ACCORDANCE WITH AS 3498.

NOTE: Temperature control devices require routine maintenance and performance testing. For information on maintenance, ~~see~~ refer to AS 4032.3.

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 AUTHORIZATION

Materials and products used in Australia for plumbing and drainage installations shall have been authorized in accordance with the National Construction Code. In New Zealand–, product authorization is not required.

NOTE: A database of authorized products is available from the ABCB at www.abcb.gov.au.

2.3 SELECTION AND USE OF MATERIALS AND PRODUCTS

Materials and products for use in contact with heated water shall ~~comply~~ conform with the hot water exposure requirements of AS/NZS 4020. Linings and coatings shall ~~comply~~ conform with AS/NZS 4020 at a surface area to volume ratio less than that nominated in the ~~compliance~~ conformance report.

The products and materials used shall be selected to ensure that they are fit for their intended purpose.

The pipes and fittings shall be selected from those listed in Appendix ~~C~~B.

Factors that shall be taken into account include, but are not limited to—

(a) the type of usage likely to occur;

(b) the nature and temperature of the water to be conveyed and the risk of corrosion, degradation and leaching;

(c) the nature of the environment, the ground and the possibility of chemical attack therefrom;

(d) the physical and chemical characteristics of the materials and products;

(e) compatibility of materials and products;

(f) the pressure rating of pipes and fittings at elevated temperatures; and

(g) accessibility for inspection, service, repair and replacement.

NOTES:

1 Information on some of the items listed above may be obtainable from the manufacturer or supplier of the product or material.

2 Plastics pipe and fittings are classified according to nominal working pressure (PN) at 20°C.

2.4 LIMITATIONS ON USE OF PIPES AND FITTINGS

2.4.1 General

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: 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 Standard.

(e) Copper pipe in accordance with AS 1432 shall only be of Types A, B or Type C.

(f) Soft solder jointing shall not be used.

2.4.2— Metallic pipes and fittings

Metallic pipes and fittings shall ~~comply~~ conform with the following:

(a) ~~Fittings~~ Stainless steel (SS) pipes shall be used in conjunction with ~~Stainless steel (SS) shall be either copper alloy compression type and be~~ dezincification resistant (DR) ~~or SS capillary type manufactured from grade 304 or 316 complying with ASTM A268/268M.~~copper alloy fittings or stainless steel fittings conforming with AS 3688.

(b) ~~Copper~~ Fittings used to join copper and copper alloy pipes ~~and fittings~~ shall conform with AS 3688 and be installed in accordance with the installation requirements of AS 4809. Copper pipe shall conform with AS 1432.

2.4.3 Plastics pipes and fittings

Plastics pipes and fittings shall ~~comply~~ conform with the following:

(a) Plastics pipes shall be in accordance with Appendix ~~C~~B.

(b) ~~Where~~ When installed, plastics pipes and fittings ~~are subject to~~ shall be protected from direct sunlight~~, they shall be installed in accordance with the specific product installation Standard for that pipe material.~~.

NOTE: Examples of protection include sleeving with metal or plastics pipe or conduit, lagging or painting with UV resistant paint.

(c) Plastics pipes and fittings shall not be used between the isolation valve and the inlet to a water heater.

(d) Plastics pipes and fittings shall not be used within 1 m of the outlet of a water heater.

NOTE:~~where~~ Where a water heater is fitted with a temperature control valve, plastics pipes and fittings may be used immediately downstream of the temperature control valve.

(e) Plastics pipes shall not be used to support isolation valves, non-return valves and equipment used to connect water heaters.

(f) 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.

(g) Plastics pipes and fittings shall not be used between an uncontrolled heat source and a heated water tank.

(h) Plastics pipes and fittings shall not be used for the drain lines from temperature/pressure-relief valves.

2.5 SAFE TRAY AND SAFE WASTE MATERIALS

2.5.1 Safe tray

Safe trays shall be fabricated from—

(a) 0.60 mm thick galvanized steel sheet ~~complying~~ conforming with AS 1397 and having a minimal nominal zinc coating mass of 275 g/m^2; or

(b) other materials not inferior to Item (a), under the conditions of use.

2.5.2 Safe wastes

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

(a) PVC-U ~~complying~~ conforming with AS/NZS 1260.

(b) Galvanized steel pipe ~~complying~~ conforming with AS 1074 or NZS/BS 3601.

(c) Seamless copper pipe (min. 0.9 mm thickness) ~~complying~~ conforming with AS 1432 or NZS 3501.

(d) Sheet steel (min. 0.6 mm thickness) ~~complying~~ conforming with AS 1397.

2.6 JOINTS

2.6.1 Flanged joints

Flanged joints shall ~~comply~~ conform with—

(a) AS/NZS 2280 and AS/NZS 2544 for ductile iron and grey cast iron; or

(b) AS 2129 or AS/NZS 4331 or AS 4087 and be appropriate for the test pressure requirements of Section 9.

2.6.2 Elastomeric seals

Materials used for elastomeric seals shall ~~comply~~ conform with AS 1646.

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

2.6.3 Silver brazing alloy

2.6.3.1 *Copper and copper alloys*

Silver brazing alloys for capillary jointing of copper and copper alloy pipes and fittings shall ~~comply~~ conform with the requirements for silver or copper phosphorus brazing alloys of AS~~-~~/NZS 1167.1 and contain a minimum of 1.8% silver and a maximum of 0.05% cadmium.

2.6.3.2 *Stainless steels*

Silver brazing alloys for capillary jointing of stainless steel pipes and fittings shall ~~comply~~ conform with the requirements of AS~~-~~/NZS 1167.1 and contain a minimum of 38% silver and a maximum of 0.05% cadmium.

~~2.6.4 Soft solders~~

~~Soft solder shall—~~

~~(a) not contain more than 0.1% lead by weight;~~

~~(b) only be used for jointing copper or copper alloy pipes to capillary fittings of the long engagement type complying with AS 3688; and~~

~~(c) not be used with coiled annealed pipes.~~

~~NOTE: The chemical composition of water in some areas may preclude the use of soft solder joints.~~

2.6.4~~2.6.5~~ 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 and ~~complying~~ conforming with AS/NZS 1167.2.

~~2.6.6 Roll-grooved joints~~

~~Roll-grooved joints shall comply with AS 3688.~~

2.7 CONCRETE AND MORTAR

2.7.1 Concrete mix

Ready-mixed concrete shall ~~comply~~ conform with AS 1379 and shall have a minimum characteristic compressive strength of 20 MPa as defined in AS 3600 or NZS 3109 and NZS 3124.

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.

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

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

2.7.3 Chemical admixtures

Chemical admixtures used in concrete shall ~~comply~~ conform with AS 1478.1.

2.7.4 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.

2.7.5 Steel reinforcement

Steel reinforcing materials used in concrete structures shall ~~comply~~ conform with AS/NZS 4671.

2.8 MISCELLANEOUS MATERIALS

2.8.1 Timber

Timber exposed to the weather shall be of durability Class 2 ~~complying~~ conforming with AS/NZS 2878 or NZS 3631, or treated in accordance with AS 1604 or NZS 3640.

2.8.2 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.

NOTES:

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

2 For ~~A~~ a typical installation of a thermostatic mixing valve, see Figure 3.3.

(b) Integral stop tap/valves and cross-flow valves shall ~~comply~~ conform with AS 4032.1.

(c) There shall be no branch line offtake between a non-integral isolating valve and the inlet to the thermostatic mixing valve except in multiple installations~~[~~, see Item (e)~~]~~.

(d) Thermostatic mixing valves shall be supported, independent of all piping.

(e) 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.

(f) Each thermostatic mixing valve and each associated valve, pressure control or temperature control shall be readily accessible.

(g) The nominal size of the connecting piping and associated valves shall be not less than the nominal size of the thermostatic mixing valve.

NOTE: For sizing of pipes, ~~see~~ refer to AS/NZS 3500.1.

(h) 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.

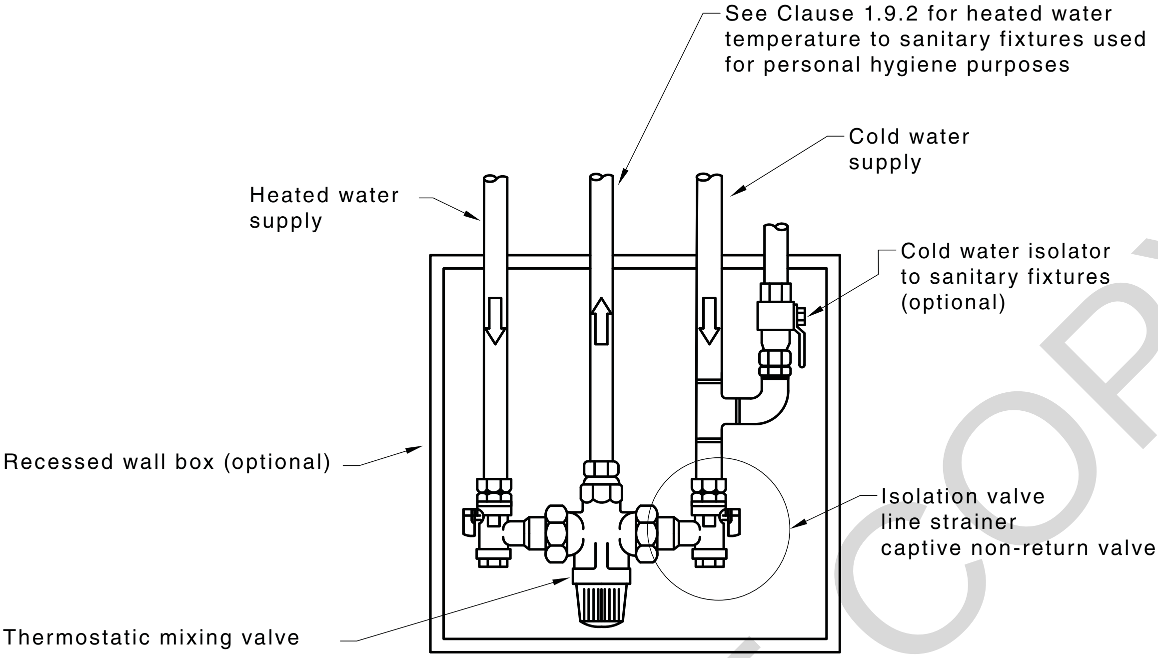


FIGURE 3.3 TYPICAL INSTALLATION OF THERMOSTATIC MIXING VALVE

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.

> ***C4.1*** *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 PROXIMITY TO ELECTRICAL CABLES AND GAS PIPES

4.2.1 General

Where electrical conduits, wires, cables or consumer gas pipes, drains and other services are in existence, pipes shall be installed in accordance with the requirements of Clause 4.2.2.

4.2.2 Electrical cables, gas pipes and other services

4.2.2.1 *Above- and below-ground pipework*

Above-ground 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.

4.2.2.2 *Above-ground pipework*

Above-ground pipework associated with heated water services shall not be installed within 100 mm of electrical cables, gas pipes or other services.

4.2.2.3 *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.

4.2.2.4 *Below ground—Communications services*

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

4.2.2.5 *Below ground—Crossover*

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.

4.3 METHODS OF JOINTING

4.3.1 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* Care shall be taken so that pipes or fittings are not 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.

(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; and

  (iii) copper tees shall not be fabricated from pipe of thickness less than Type C of AS 1432.

4.3.2 Compression-type fittings

Compression fittings shall ~~comply~~ conform with AS 3688 or AS/NZS 4129. Plastics nuts shall not be used to connect any pipe to a cold water storage tank that supplies water to a water heater.

~~4.3.3 Capillary fittings~~

~~Capillary fittings complying with AS 3688 may be used to join pipes.~~

4.3.3 Joining of copper and copper alloy pipes

Fittings used to join copper and copper alloy pipes shall conform with AS 3688 and be installed in accordance with the installation requirements of AS 4809. Copper pipes shall conform with AS 1432.

4.3.4 Silver brazing

4.3.4.1 *Joints*

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

4.3.4.2 *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.

4.3.5~~4.3.6~~

~~4.3.5 Soft soldering~~

~~A compatible flux shall be used when making joints using soft soldering.~~

NOTE: The chemical composition of the water in some areas may preclude the use of soft solder joints.**Flanged joints**

Flanged joints shall be appropriate for the test pressure requirements of Section 9 and shall be attached to the pipe by the following means:

(a) Silver brazing in accordance with Clause 2.6.3 for copper alloy to copper or copper alloy pipes or fittings.

(b) Set screws for cast iron pipes and fittings.

(c) For stainless steel pipes larger than DN 25, flanged joints fabricated by rolling or welding to the pipe a stub flange of the same gauge and wall thickness as the pipe, having a diameter conforming to dimensions 'F' in AS 2129. A mild steel backup flange complying conforming with AS 2129 shall be fitted, and a gasket, not less than 3 mm thick, shall be inserted.

Flange joints below ground shall be protected against corrosion in accordance with Clause 4.9.

4.3.64.3.7 Roll-grooved joints

Roll-grooved joints shall conform with AS 3688.

NOTE: Roll-grooved joints may be used above ground or below ground.

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

(a) manufactured from stainless steel in accordance with ASTM A268/A268M or copper tubes in accordance with AS 1432;

(a) (b)protected against corrosion with each assembled copper joint protected with a petrolatum based wrapping system; and

(b) (c)external to a building and not under concrete.

4.3.74.3.8 Jointing of stainless steel pipe and fittings

4.3.7.14.3.8.1 *Jointing of piping, up to and including DN 25*

Joints not larger than DN 25 shall be made by using mechanically jointed compression fittings complying or press-fit end connectors conforming with AS 3688 or using silver-brazed stainless steel capillary joints. Silver brazing alloys shall comply conform with Clause 2.6.3.2.

4.3.7.24.3.8.2 *Jointing of piping larger than DN 25*

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

(a) butt-welded 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; or.

(b) have flanged Flanged joints, fabricated by rolling or welding to the pipe, a stub flange of the same wall thickness as the pipe, having a diameter conforming to dimension 'F' in AS 2129 or AS/NZS 4331, with mild steel backup flange complying conforming with AS 2129 or AS/NZS 4331 fitted, and a gasket not less than 3 mm thick inserted.

(c) Stainless steel press-fit end connectors.

NOTE: Jointing should be carried out by suitably trained personnel.

4.4 SUPPORT AND FIXING ABOVE GROUND

4.4.1 General

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

4.4.2 Brackets, clips and hangers

Brackets, clips and hangers shall be—

(a) formed from a suitable 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.

4.4.3 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.

4.4.4 Spacing

Water services shall be supported and fixed at the intervals specified in Table 4.4.4.

TABLE 4.4.4

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	1.50	0.50	1.00
15	1.50	0.60	1.20
16	—	0.60	1.20
18	1.50	0.60	1.20
20	1.50	0.70	1.40
22	—	0.70	1.40
25	2.00	0.75	1.50
32	2.50	0.85	1.70
40	2.50	0.90	1.80
50	3.00	1.05	2.10
63	—	1.10	2.20
65	3.00	1.20	2.40
75	—	1.30	2.60
80	3.00	1.35	2.70
90	3.00	1.40	2.80
100	3.00	1.50	3.00
110	—	1.50	3.00
125	3.00	1.70	3.40
140	—	1.70	3.40
150	3.00	2.00	4.00
160	—	2.00	4.00

NOTE: Due to water pressure effects, additional brackets, clips or hangers (~~complying~~ conforming with Clause 4.4.2) may be required to prevent movement.

4.4.5 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 4.4.3(b).

4.5 LOCATION OF PIPING

4.5.1 Concealed piping

4.5.1.1 *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 4.5.1.1(A) and Table 4.5.1.1.

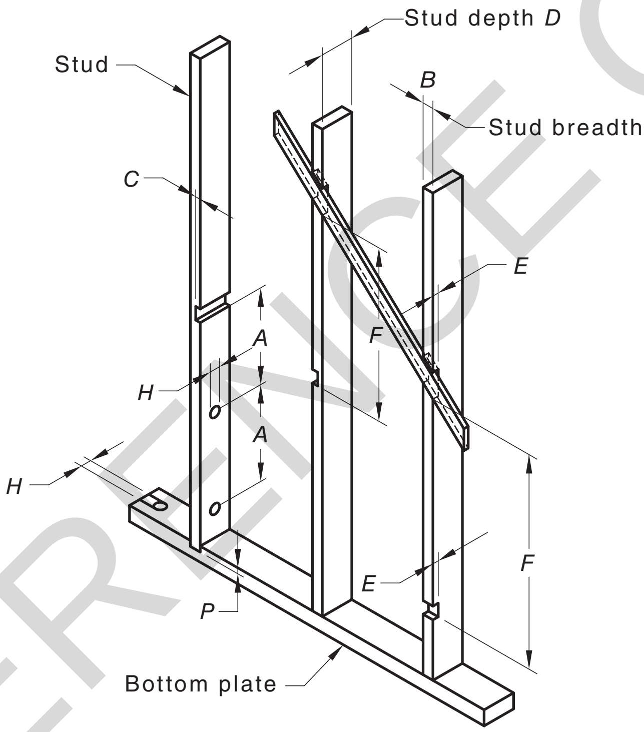
   (ii) Where unlagged pipes are used, a collar of lagging material or a neutral cure silicone sealant shall be used to fill the annular space.

(b) *Timber beams, bearers and joists* Holes or notches made in timber beams, bearers and joists in floors shall be in accordance with Figure 4.5.1.1(B).

(c) *Metal framework* Holes drilled in metal studs or plates shall be accurately sized to enable suitable grommets, lagging or a short sleeve of oversize pipe firmly secured in the framework to be inserted around the pipe to ensure no direct contact between the pipe and framework but allowing free longitudinal movement of the pipe through the grommet, lagging or sleeve.

NOTE: 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.

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



NOTE: For definitions of symbols, see Table 4.5.1.1.

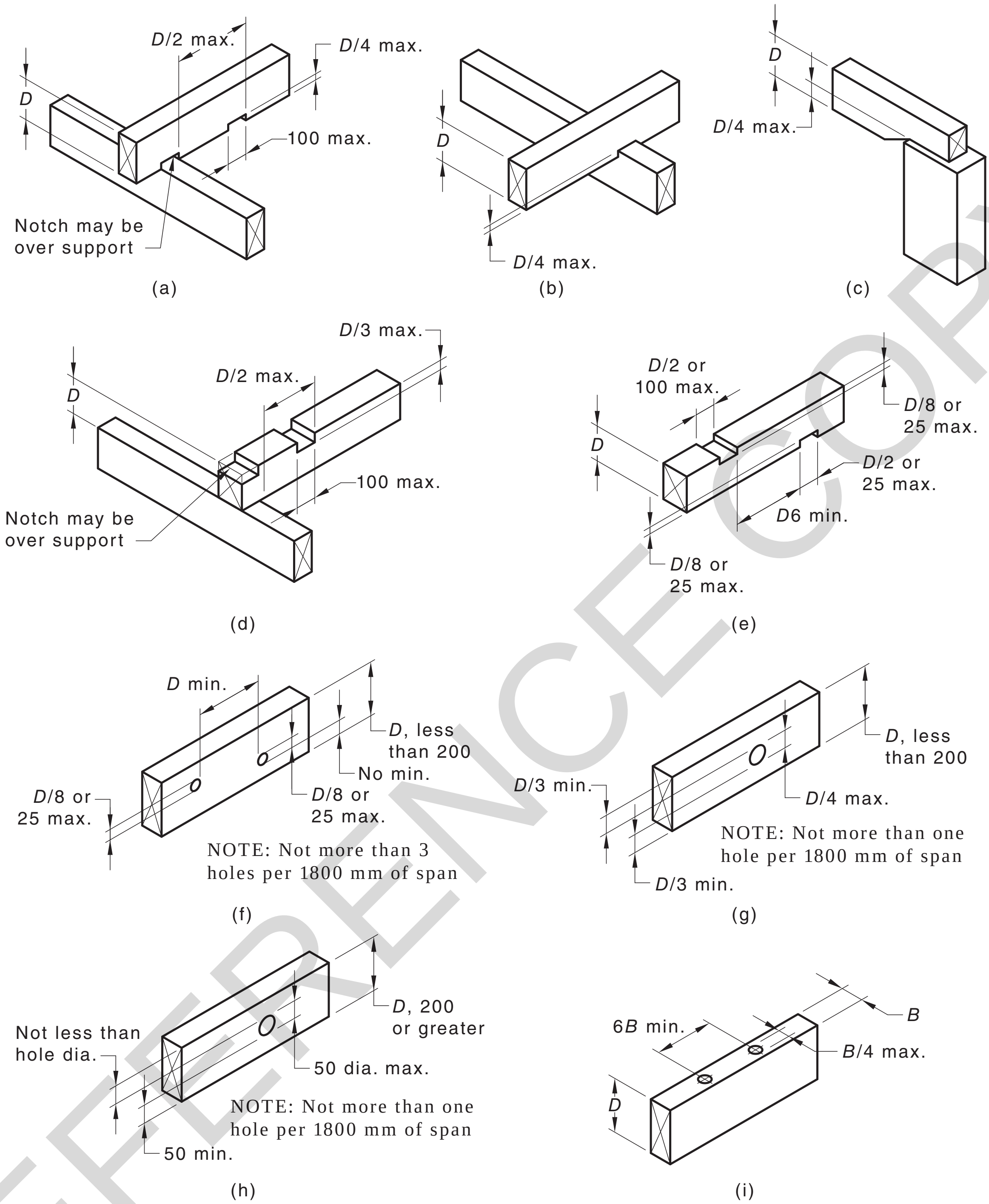
FIGURE 4.5.1.1(A) NOTCHING OF WALL STUDS

TABLE 4.5.1.1

HOLES AND NOTCHES IN STUDS AND PLATES

Symbol	Definition	Limits	
		Notched	Not notched
A	Distance between holes and/or notches in stud breadth	Min. 3*D*	Min. 3*D*
H	Hole diameter (studs and plates)	Max. 25 mm (wide face only)	Max. 25 mm (wide face only)
C	Notch into stud breadth	Max. 10 mm	Max. 10 mm
E	Notch into stud depth	Max. 20 mm (for diagonal cut in bracing only) (see Note)	Not permitted (see Note)
F	Distance between notches in stud depth	Min. 12*B*	N/A
P	Trenches in plates	3 mm max.	

NOTE: A horizontal line of notches up to 25 mm may be provided for the installation of baths.



DIMENSIONS IN MILLIMETRES

FIGURE 4.5.1.1(B) NOTCHES, CUTS AND HOLES IN BEAMS, BEARERS, JOISTS, RAFTERS

4.5.1.2 *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) Conduits shall ~~comply~~ conform with the requirements of the NCC or New Zealand Building Code, as applicable.

(d) Adequate allowance shall be made for expansion and contraction in accordance with Clause 4.12.3.

(e) Pipes shall not be embedded or cast into concrete structures.

4.5.1.3 *Under concrete slabs*

Water service pipes located beneath concrete slabs on ground level shall ~~comply~~ conform with 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 and measures shall be taken to protect the exposed pipe from damage.

(c) Any piping that penetrates the slab shall be at right angles to the surface of the slab and shall 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.

4.5.2 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.

4.5.3 Floor or roof penetrations

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

4.5.4 Provision for movement of encased piping

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

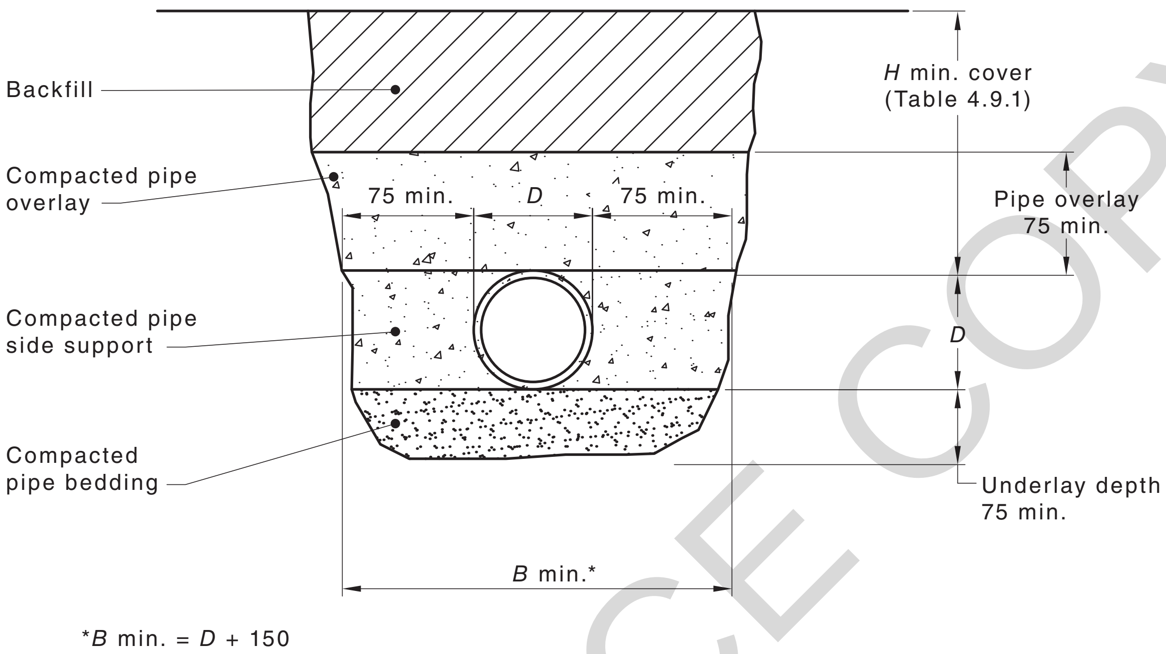
4.6 BEDDING AND BACKFILL

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: For a typical installation in a trench, see Figure 4.6.

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, providing the soil is compatible with copper and stainless steel and free from rock and rubble.



DIMENSIONS IN MILLIMETRES

FIGURE 4.6 TYPICAL INSTALLATION IN A TRENCH

4.7 CONTAMINATED AREAS—INSTALLATION

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

(a) is laid through a watertight, corrosion-resistant conduit of length and strength adequate to protect the water service; or

(b) is 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.

4.8 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) continuously wrapping 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.

4.9 DEPTH OF COVER

4.9.1 Depth of cover in public areas

Where heated water services are installed below ground in public areas, the minimum cover shall ~~comply~~ conform with Table 4.9.1.

TABLE 4.9.1

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

4.9.2 Depth of cover in private areas

Where heated water services are installed below ground in private property, the minimum cover shall ~~comply~~ conform with Table 4.9.2.

TABLE 4.9.2

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.

4.10 PROTECTION AGAINST FREEZING

4.10.1 Requirement for protection

In areas where the ambient temperature frequently falls below 0°C, care shall be taken to avoid the likelihood of the water service being damaged by water freezing within the pipes.

NOTE: See also Section 8.

4.10.2 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.

4.10.3 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 4.10.5(B) or Table 8.2.2, as appropriate.

NOTE: Consideration should be made for thermal expansion and contraction of the roof material.

4.10.4 Pipes located inside buildings

4.10.4.1 *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.

4.10.4.2 *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.

4.10.4.3 *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.

4.10.5 Insulation of piping and fittings

Where it is necessary to install piping in areas where temperatures are likely to fall below freezing (see Clause 4.10.4.1), the pipes and fittings shall be surrounded by an appropriate thickness of insulation.

NOTES:

1 Typical examples of materials and minimum thicknesses for insulation of various thermal conductivity ranges are given in Tables 4.10.5(A) and 4.10.5(B) respectively.

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

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 4.10.5(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
Foamed PVC nitrile rubber	0.040
Loose vermiculite (exfoliated)	0.06–0.07
Pre-insulated copper pipe	0.070–0.075

TABLE 4.10.5(B)

TYPICAL EXAMPLES OF MINIMUM THICKNESSES FOR THERMAL INSULATION TO PREVENT FREEZING OF WATER IN PIPES

Pipe size	Minimum thickness required, mm				
	Thermal conductivity of insulating material, W/m.K				
DN	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.

4.11 COLD WATER PIPING AND STORAGE TANKS

4.11.1 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.

4.11.2 Cold water storage tank

4.11.2.1 *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 ~~complying~~ conforming with Clause 2.3 and having equivalent strength and durability to copper sheet of 0.55 mm thickness.

(b) For metal tanks, they shall be—

(i) reinforced along the upper edges to prevent distortion of the tank;

(ii) welded, brazed or soft-soldered at all joints;

(iii) 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 an outlet of brass or other suitable material threaded in accordance with AS ISO 7.1 or NZS/BS 21. 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 ~~complying~~ conforming with AS 1910.

(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 ~~complying~~ conforming with AS 1397.

NOTE: Typical installations of water tanks are shown in Figures 5.4.5 and 5.5.1.

4.11.2.2 *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.

NOTES:

1 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.

2 In New Zealand~~-~~, allowance has to be made for seismic restraint (see NZBC~~-~~, Clause G12 Water supplies).

4.11.2.3 *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.

4.11.2.4 *Cold water storage tank overflow*

Each cold water storage tank shall be fitted with an overflow ~~complying~~ conforming with 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 so constructed that with the float valve discharging at its maximum flow, with water pressure of 700 kPa and with all service outlets closed, no spillage shall occur 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.

4.11.2.5 *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 4.12.5(c).

4.11.3 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 ~~complying~~ conforming with Clause 5.4.3. Where the tank is mounted on the water heater, a water heater safe tray ~~complying~~ conforming with 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.

4.11.4 Support for separately mounted cold water storage tanks

4.11.4.1 *Platform*

Each separately mounted cold water storage tank shall be supported on a platform ~~complying~~ conforming with Clause 5.5.

4.11.4.2 *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.

4.12 INSTALLATION OF HEATED WATER SERVICES

4.12.1 Design and installation

Water flow velocities in heated water piping shall be in accordance with Clause 1.8.

C4.12.1 *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.

NOTES:

1 ~~For guidance, typical~~ Minimum rates of flow are given in ~~Appendix D~~Table 10.2.2.

2 Preferred sizes of pipes are given in Appendix ~~E~~D.

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 pumped circulation should be considered.

4 For gradients requirements, see Clause 4.12.4.

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

4.12.2 Identification

In other than domestic or residential buildings, where water services are installed in ducts, accessible ceilings and exposed in basements or plant rooms, they shall be identified in accordance with AS 1345 or NZS 5807.

4.12.3 Provision for expansion

4.12.3.1 *General*

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

(a) have free length of piping around the bend or along the branch sufficient to prevent overstressing the pipe and allow for thermal expansion;

(b) have a clear space to allow movement for expansion as calculated; or

(c) have expansion loops, or offsets located at or near midpoint in straight lengths that exceed 18 m, or have expansion joints fitted; and

(d) have expansion loops and offsets placed horizontally to avoid forming air locks at the top of the loops and to ensure circulation of the water.

4.12.3.2 *Expansion allowance for copper pipework*

The allowance for expansion and contraction in copper pipes shall be in accordance with Table 4.12.3.2.

TABLE 4.12.3.2

CHANGE IN LENGTH OF COPPER PIPES DUE TO TEMPERATURE CHANGES

Pipe length, m	Change in length, mm								
	Temperature change, °C								
	20	30	40	50	60	70	80	90	100
≤3	2	2	3	3	4	4	5	5	6
>3 ≤5	2	3	4	5	6	7	8	8	9
>5 ≤9	4	5	7	8	10	12	13	15	16
>9 ≤12	5	7	9	11	13	15	17	20	22
>12 ≤15	6	8	11	14	16	19	22	24	27
>15 ≤20	8	11	15	18	22	25	29	32	36
>20 ≤25	9	14	18	23	27	31	36	40	45

4.12.3.3 *Expansion of fixed offsets in copper pipework*

An offset to allow for Rates of thermal expansion in copper pipework shall be made in accordance with Table 4.12.3.3.for common pipe materials, calculations for and examples of offsets and expansion loops are given in Appendix N.

4.12.4

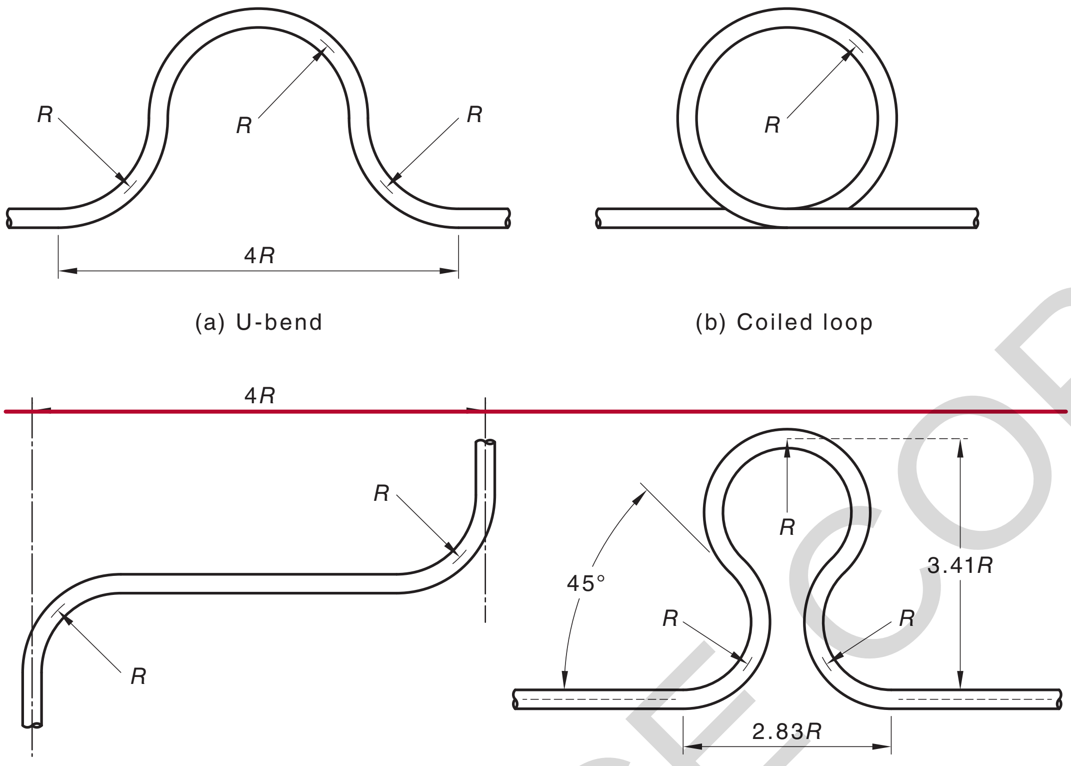
TABLE 4.12.3.3

ALLOWANCE FOR EXPANSION

Run length m	Minimumfree lengthof offset mm	Minimum clearance to obstruction(for 60°C temp. rise) mm
≤4.5>4.5>9 ≤9≤18	6009001200	51020

4.12.3.4 *U-bends, coiled loops, offsets and lyre bends in copper pipework*

Where expansion loops or bends are used to provide allowance for thermal expansion in copper pipes, the required radii shall be in accordance with Figure 4.12.3.4.



(a) U-bend (b) Coiled loop

(c) Offset bend (d) Lyre bend

millimetres

Expansion	Radii for expansion loops or bends (*R*)									
	DN 15	DN 20	DN 25	DN 40	DN 50	DN 65	DN 80	DN 90	DN 100	DN 125
10152 0	18022 0250	21027 0300	25029 0380	32037 0430	3504105 10	4004405 60	4305006 20	4705406 70	5106007 10	5606507 90
25304 0	30032 0340	35037 0430	40043 0490	50053 0620	5506107 20	6306607 70	6807408 70	7307809 20	8108401 000	9109501 130
50607 0	40045 0460	48053 0560	55063 0660	68076 0790	7808809 10	8809601 020	1000106 01130	1050116 01220	1150126 01320	1300135 01450
80901 00	51061 0680	61064 0760	71074 0840	86092 0990	9901020 1120	1120115 01190	1220125 01340	1320135 01420	1410143 01470	1530155 01570

NOTE: For pipe sizes DN 18 and DN 32, the next larger pipe size shall be used.

FIGURE 4.12.3.4 PROVISION FOR EXPANSION IN HEATED WATER PIPING

—Gradient

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

(a) *Mains pressure or pressure-limiting valve-controlled reticulation*—rise or fall as required subject to the requirements of Clause 4.12.5.

(b) *Reducing valve-controlled reticulation*—rise and fall as required subject to the provisions of Table 4.12.4.

(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 4.12.4

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

4.12.5 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.

4.12.6 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.

4.12.7 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 ~~complying~~ conforming with Clause 5.12; or

(b) an automatic air elimination device suitable for that purpose.

4.12.8 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 Section 8.

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.

NOTES:

1 For water chemistry requirements, see Clause 1.6 and for recommendations for water analysis, see Appendix ~~B~~A.

2 For information on the suitability of the anode, reference should be made to the water heater manufacturer.

5.2.2 Working pressure

Water heaters shall be installed so that the maximum rated working pressure is not exceeded during normal operation. Reference shall be made to the heater label for the relevant information.

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.

NOTES:

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

2 For cold water storage tank-fed water heaters, see Clause 4.12.5.

5.3.3 Ventilation and fluing

Fuel-burning water heaters shall be located so that the correct ventilation and fluing can be provided.

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 ~~complying~~ conforming with Clause 5.4.3. The safe trays shall be drained by safe wastes ~~complying~~ conforming with 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 5.9.3(f) and Figures 5.9.3(A) to 5.9.3(D).

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 ~~complying~~ conforming with Clause 5.4.3 and safe wastes ~~complying~~ conforming with 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 ~~comply~~ conform with the requirements of Clause 2.5.1. 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 ~~comply~~ conform with 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 ~~comply~~ conform with the following:

(i) Where discharging outside the building, it shall discharge to a point within the property boundaries, which 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.

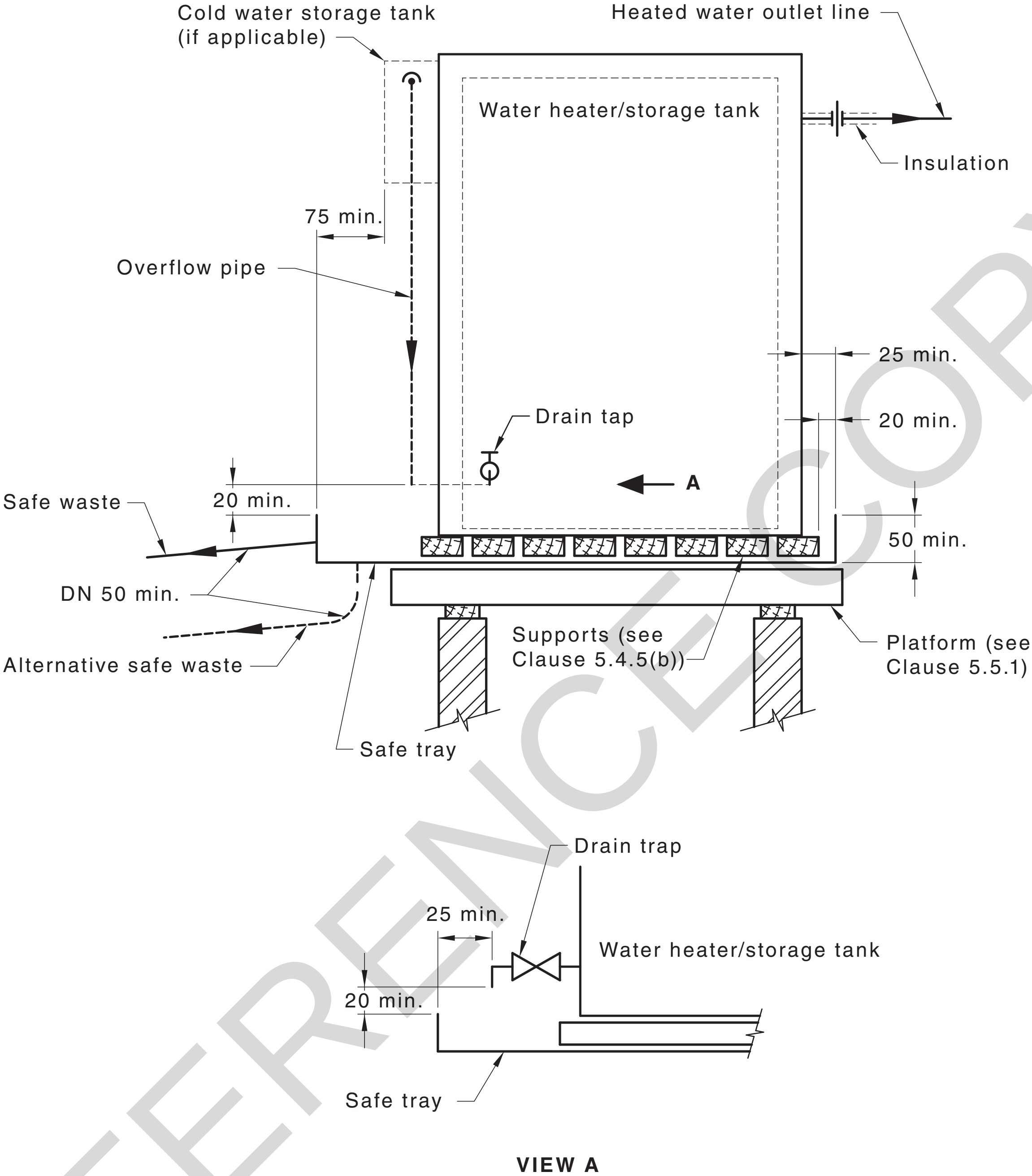
5.4.5 Placement of water heater or cold water storage tank on a safe tray

The water heater or cold water storage tank shall be placed on a safe tray and shall ~~comply~~ conform with 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: A typical installation of a safe tray, including position of water heater or cold water storage tank, is shown in Figure 5.4.5.



DIMENSIONS IN MILLIMETRES

FIGURE 5.4.5 TYPICAL INSTALLATION OF A SAFE TRAY AND POSITION OF WATER HEATER OR COLD WATER STORAGE TANK

5.5 SUPPORT

5.5.1 Support of water storage tanks installed in a roof

Storage water heaters and cold water storage tanks installed in a roof space shall be placed on a safe tray that is supported by a platform of hardwood or other suitable and not less durable material, and ~~complying~~ conforming with the following requirements:

(a) The safe tray shall drain to its safe waste.

(b) The safe tray shall be placed so that the load of the water heater or cold water storage tank is supported by one or more loadbearing walls that are vertically continuous to a solid foundation, a concrete slab or similar support of comparable strength, and shall be in accordance with the following:

(i) Where the platform is placed over one wall only, it shall be placed centrally over the wall, and any ceiling joist that is subjected to additional stress shall cross the wall at right angles. The capacity of the water heater or cold water storage tank, or both, supported by the platform shall not exceed 450 L.

(ii) Where the load is carried by beams or bearers spanning two walls, no ceiling joists shall carry any of the load, except where immediately over a wall.

(iii) Where the load is carried on loadbearing walls supported on piers, the water heater or cold water storage tank shall be placed centrally above a solid pier that supports the wall immediately under the water heater or cold water storage tank, or the load shall be transmitted to a designed floor beam or bearer supported by two piers not more than 2 m apart.

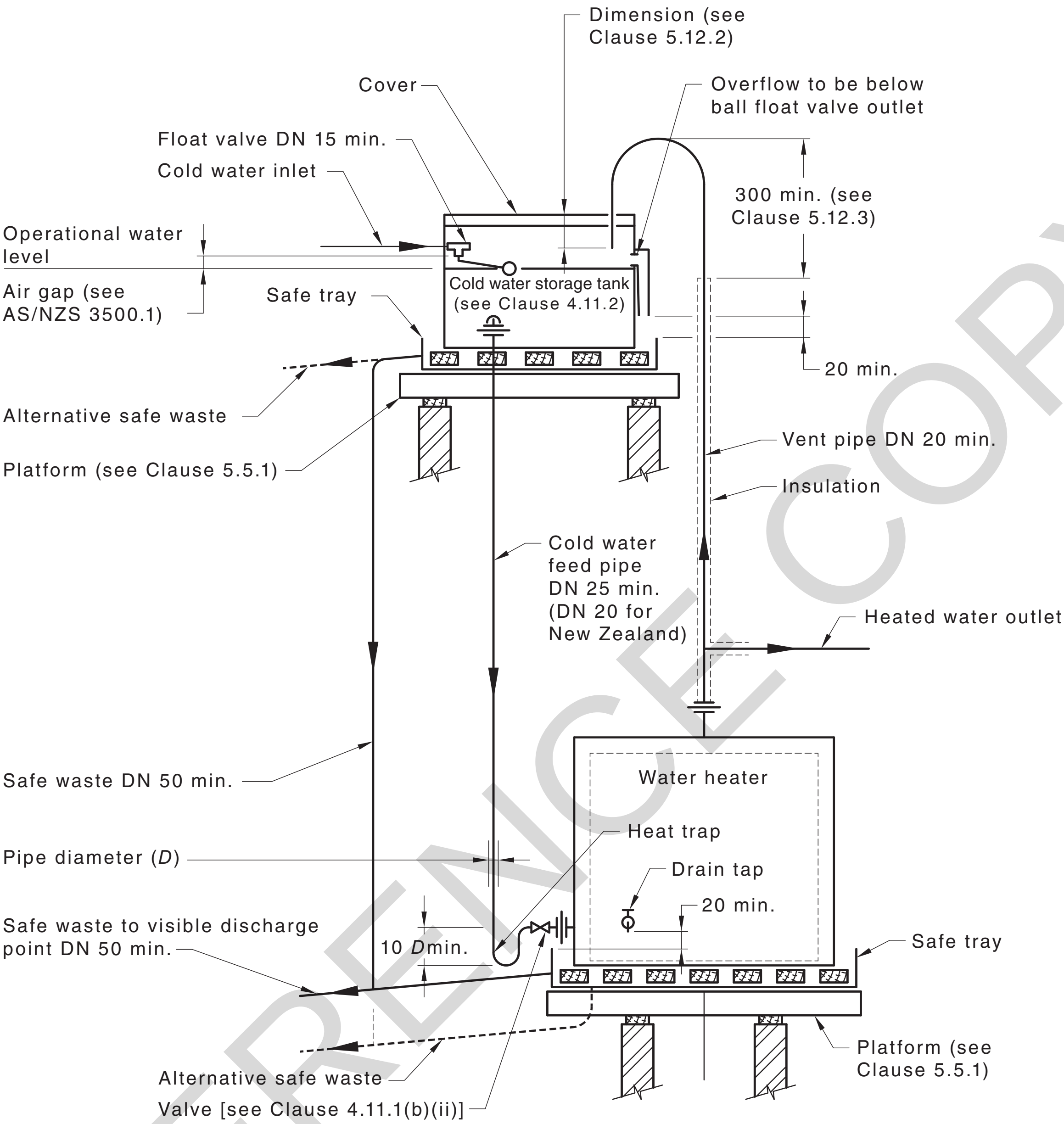
(c) Where the roof is constructed from trusses, the platform supporting a water storage tank shall not be supported from any part of the trusses unless the trusses are specifically designed to carry the load of the water storage tank.

NOTES:

1 These requirements do not preclude the load or part of the load from being carried on a beam or bearer that spans an opening in a wall. As such, the wall immediately above the opening is not subjected to additional stress and the load is distributed over at least 0.6 m of vertical continuous wall on either side of the opening.

2 For typical installation of water tank in roof space, see Figure 5.5.1.

3 For typical platform construction, see Figure 5.5.3.



DIMENSIONS IN MILLIMETRES

FIGURE 5.5.1 TYPICAL INSTALLATION IN ROOF SPACE OF COLD WATER STORAGE TANK-FED WATER HEATER WITH SEPARATELY MOUNTED COLD WATER STORAGE TANK

5.5.2 Support of water heaters or water storage tanks installed above a roof

Storage water heaters (other than solar water heaters) and cold water storage tanks installed above a roof shall be supported on a platform that is not less durable than timber ~~complying~~ conforming with Clause 2.8.1 and the following:

(a) The clearance between the lowest part of the platform and the roof shall be not less than 75 mm.

(b) The load shall be distributed over two walls continuous to a solid foundation without any stress being placed on the roof structure.

(c) The support shall have structural members that penetrate the roof, flashed or rendered watertight in a manner that will allow for expansion.

NOTE: In cyclone-prone areas, further regulatory requirements may also apply.

5.5.3 Support of water heaters or water storage tanks installed other than in a roof space or above a roof

Storage water heaters and cold water storage tanks installed other than in a roof space or above a roof shall be floor-mounted, or supported, as follows:

(a) By brackets or hangers, designed to withstand the applied load.

(b) On a level, stable and impervious base designed and located to avoid ponding and made of—

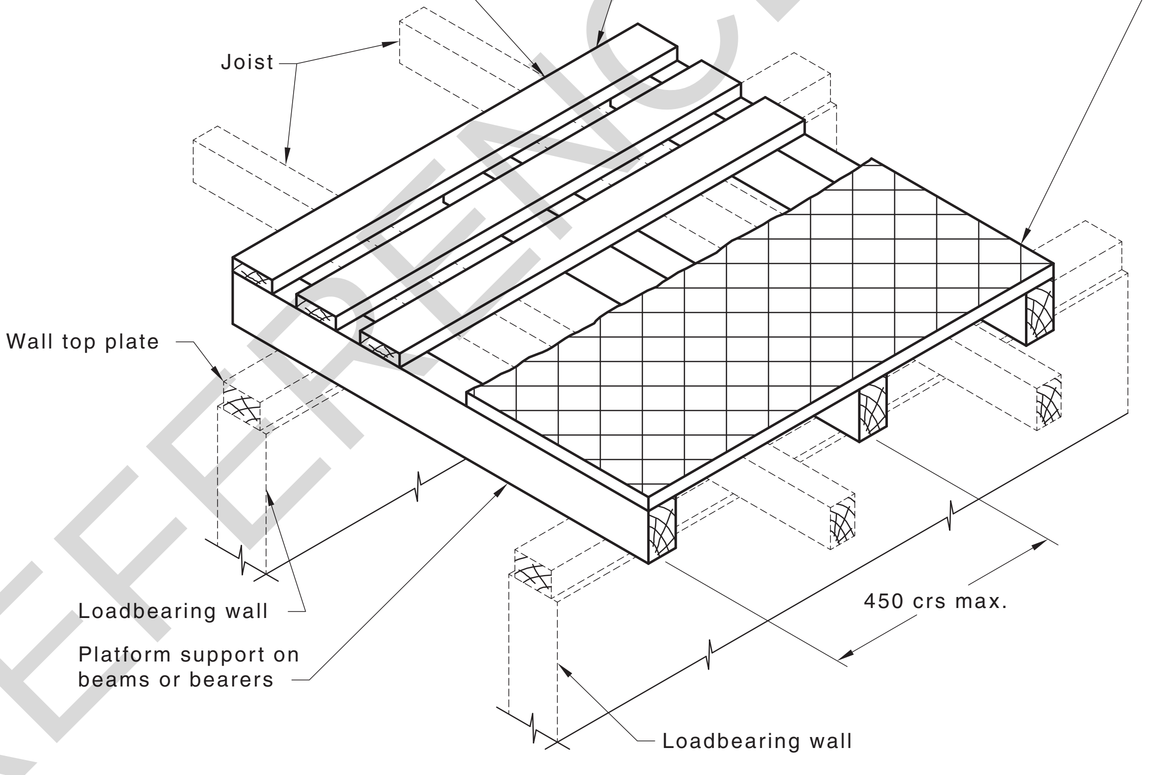
(i) bonded brick or concrete cast in situ, having a thickness of not less than 75 mm; or

(ii) pre-cast concrete having a thickness of not less than 50 mm.

(c) On a platform of timber, or other suitable and not less durable material. Where such a platform is located at or near ground level, it shall be supported so that a clearance of not less than 100 mm is maintained from the surrounding ground.

NOTE: A typical platform construction is shown in Figure 5.5.3.

(d) In a recess in a wall structure able to withstand the applied load.



DIMENSIONS IN MILLIMETRES

FIGURE 5.5.3 TYPICAL CONSTRUCTION OF A PLATFORM

5.5.4 Seismic restraints

In New Zealand–, cold water storage tanks and hot water container assemblies shall be restrained against movement in accordance with NZS 4603 or NZS 4607.

NOTE: For a typical arrangement for seismic restraint of storage water heaters, see Figure 5.5.4.

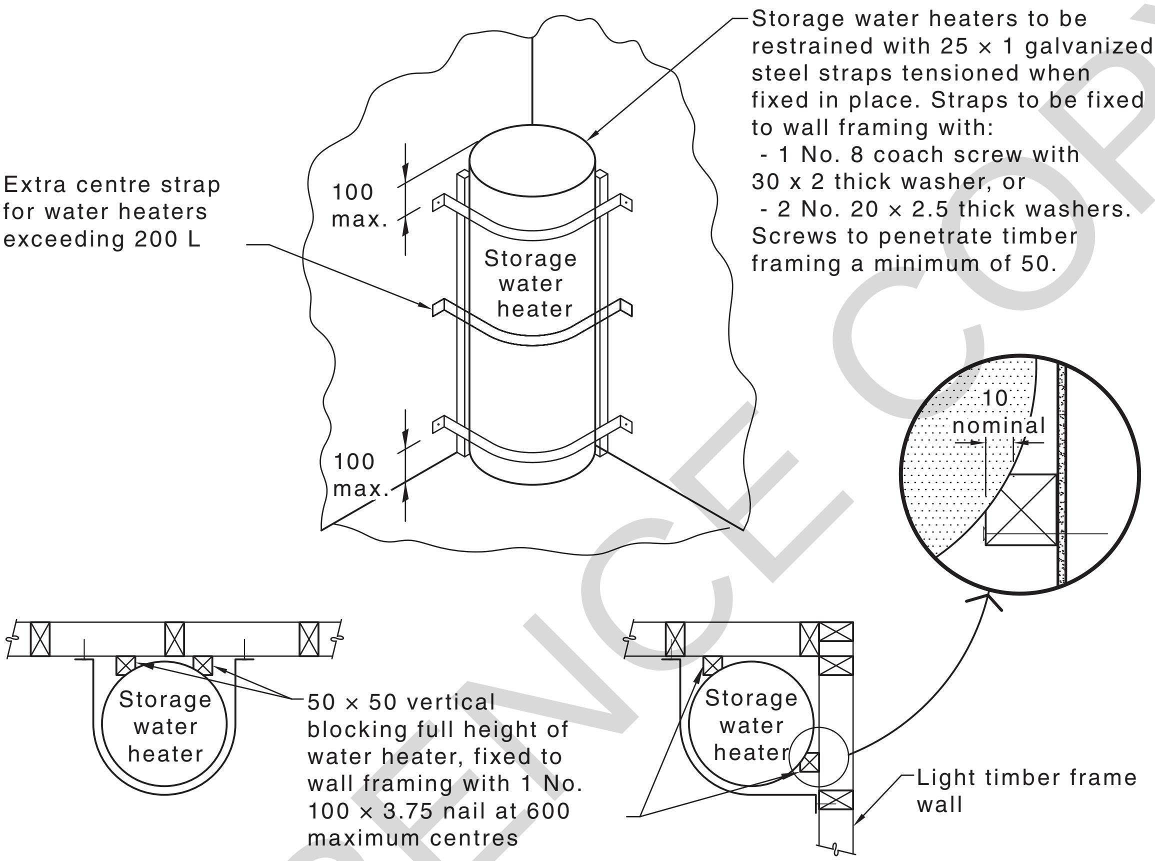


FIGURE 5.5.4 TYPICAL ARRANGEMENT FOR SEISMIC RESTRAINT OF STORAGE WATER HEATERS LESS THAN 350 L (NEW ZEALAND ONLY)

5.6 CORROSION PREVENTION AND WEATHER PROTECTION

5.6.1 Water heater base—Corrosion avoidance

Water heaters located on surfaces that may become wet shall be installed to allow free air circulation between the surface and the base of the water heater except where the base of the water heater is constructed from a material that protects against corrosion.

5.6.2 Weather protection of externally installed water heaters

Water heaters installed externally shall be—

(a) of a type designed for external installation; or

(b) protected by a weatherproof enclosure.

NOTE: A water heater or enclosure ~~complying~~ conforming with the above requirements may not necessarily be suitable for extreme conditions, such as sustained freezing temperature or for salt-laden or corrosive atmospheres. For installations under such conditions, reference should be made to the water heater manufacturer.

5.7 CONNECTIONS TO WATER HEATERS

Unions or similar couplings shall be provided for the connections of any service pipe to the inlet or outlet of the water heater.

5.8 PRESSURE RELIEF AND VENTING OF WATER HEATERS AND CONTAINERS

~~The~~ For the pressure relief and venting of water heaters and containers the following requirements apply:

(a) The storage container of a vented storage water heater shall be fitted with a free and unobstructed vent open to the atmosphere at all times.

(b) A vented heat exchange water heater shall be fitted with a vent and protective devices as required in AS 3498.

(c) An unvented storage water heater shall be fitted with a temperature/pressure-relief valve.

(d) An unvented pressure water container, not designed to withstand a full vacuum, shall be fitted with a vacuum-relief valve.

NOTES:

1 Where the water supply is scaling in nature, an expansion control valve or expansion vessel should be incorporated in the installation of an unvented water heater, otherwise the temperature/pressure-relief valve may become blocked due to the deposition of calcium carbonate from the heated water that is relieved during thermal expansion. See ~~Figure~~ Figures 5.9.3(C) and ~~Figure~~ 5.9.3(D)(a).

2 For instantaneous water heaters see also Clause 5.9.1 for valve requirements.

3 In New Zealand only, when the valve set pressure is not greater than 120 kPa, a pressure-relief valve may be used in lieu of a temperature/pressure-relief valve.

4 In New Zealand~~-~~, expansion control valves or an expansion vessel are required to be fitted to all unvented (i.e. valve vented) cylinders.

5 A vacuum-relief valve is usually incorporated in the pressure-relief valve on a container that is not designed to withstand a full vacuum.

6 In New Zealand, ‘valve vented’, describes water heaters that are vented by valves rather than by an open vent pipe.

7 See Clause 5.10.3(b)(ii) for location and capacity of expansion vessels.

5.9 VALVES AND EXPANSION VESSEL

5.9.1 General

The valves and expansions vessels used in the installation of water heaters shall ~~comply~~ conform with Tables 5.9.1(A) and 5.9.1(B).

~~5.9.2 Required set pressure of valves (for unvented water heaters)~~

~~The required set pressure of expansion control valves and inlet-pressure-control valves shall be determined from the set pressure of the temperature and pressure-relief valve supplied with the water heater with reference to Table 5.9.1(B).~~

5.9.3 Installation of valves

Valve installations shall

(a) have the isolating valve in a position readily accessible from floor or finished surface level;

(b) have the cold water supply valves (where fitted) in the sequence isolating valve, line strainer, pressure control valve, non-return valve, expansion control valve or as a combined unit;

(c) have unobstructed access for maintenance or replacement and meet the requirements of Items (c) and (d) of Clause 5.3.2;

(d) have no heat applied to any valve that has screwed pipe connections;

(e) have no other valve, tap or shut-off device between the temperature/pressure-relief valve or pressure-relief valve and the water heater;

(f)except for the heater isolating valves required in Clause 5.10.2(h) for multiple installations, have no other valve, tap or shut-off device between any expansion control valve and the inlet to the water heater;

(g) have the temperature/pressure-relief valves fitted in the position identified on the water heater; and

(h) be protected from freezing in accordance with Clause 4.10.

NOTES:

1 For typical sequence of valve installation, see Figure 5.9.3(A).

2 For typical valve installations, see Figures 5.9.3(B) to 5.9.3(E).

TABLE 5.9.1(A)

VALVE AND FITTING REQUIREMENTS FOR WATER HEATERS

Valves and fittings	Valves and fittings required							
		Unvented water heater		Vented water heater				
	Instantaneous water heaters	Mains pressure [see Figures 5.9.3(B) and 5.9.3(C)]	Unvented reduced pressure [see Figure 5.9.3(D)(a)]	Vented reduced pressure [see Figure 5.9.3(D)(b)]	Reduced pressure uncont. heat source	Free outlet water heater	Side-fed water heater	Heat exchange water heater [see Figure 5.9.3(B)]
Isolating valve	Yes†	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Non-return valve	N/A	Yes	Yes	Yes	Yes	Yes	N/A	Yes
Pressure-limiting valve	As required by Table 5.9.1(B)	As required by Table 5.9.1(B)		N/A		N/A	N/A	As required Table 5.9.1(B)
Pressure-reducing valve	N/A	N/A	Yes	Yes	Yes	N/A	N/A	N/A
Expansion control valve ~~(Australia~~or expansion vessel (Australia only)	N/A	See Note 1 of Clause 5.8	See Note 1 of Clause 5.8	N/A	N/A	N/A	N/A	Yes
Expansion control valve or expansion vessel (New Zealand only)	N/A	Yes	Yes	N/A	N/A	N/A	N/A	Yes
Temperature/ pressure-relief valve*	N/A	Yes	Yes	N/A	N/A	N/A	N/A	N/A

~~‡~~ * In New Zealand~~-~~, where the valve set pressure is not greater than 120 kPa, a pressure-relief valve may be used in lieu of a temperature/pressure-relief valve.

† Isolating valves shall provide full flow.

LEGEND:

N/A = Not applicable

NOTES:

1 This Table is not applicable to a water heater fed from a remote cold water storage tank.

2 For Australian valve requirements, see AS 1357 and for New Zealand valve requirements, see NZS 4608.

TABLE 5.9.1(B)

SET PRESSURES FOR VALVES

Temperature/ pressure-relief valve or pressure-relief valve setting kPa	Without expansion control valve: Maximum mains pressure kPa	Without expansion control valve: Inlet valve maximum setting kPa	With expansion control valve: Exp. control valve setting kPa	With expansion control valve: Maximum mains pressure kPa	With expansion control valve: Inlet valve maximum setting kPa	Inlet pressure control valve type required
Open vent	N/A	35	N/A	N/A	N/A	Pressure reducing
56	N/A	45	46	N/A	35	Pressure reducing
74	N/A	65	65	N/A	55	Pressure reducing
Open vent	N/A	76	N/A	N/A	N/A	Pressure reducing
80	N/A	65	65	N/A	50	Pressure reducing
85	N/A	70	70	N/A	55	Pressure reducing
100	N/A	85	85	N/A	70	Pressure reducing
115	N/A	100	100	N/A	85	Pressure reducing
120	N/A	110	110	N/A	100	Pressure reducing
130	N/A	115	115	N/A	100	Pressure reducing
150	N/A	130	130	N/A	115	Pressure reducing
180	N/A	160	160	N/A	140	Pressure reducing
215	N/A	195	195	N/A	175	Pressure reducing
500	400	350	400	350	300	Pressure limiting
700	550	450	550	450	350	Pressure limiting
850	680	500	700	550	450	Pressure limiting
1000	800	600	850	680	500	Pressure limiting
1200	960	600	1000	800	600	Pressure limiting
1400	1120	600	1200	960	600	Pressure limiting
N/A	N/A	N/A	1400	1100	600	Pressure limiting

NOTE: Where the maximum mains pressure is likely to be exceeded, inlet pressure-control valve shall be used.

5.9.2 Required set pressure of valves (for unvented water heaters)

The required set pressure of expansion control valves, expansion vessels and inlet-pressure-control valves shall be determined from the set pressure of the temperature and pressure-relief valve supplied with the water heater with reference to Table 5.9.1(B).

5.9.3 Installation of valves and expansion vessels

Valve and expansion vessel installations shall—

(a) have the isolating valve in a position readily accessible from floor or finished surface level;

(b) have the cold water supply valves (where fitted) in the sequence isolating valve, line strainer, pressure control valve, non-return valve, expansion control valve or expansion vessel or as a combined unit;

(c) have unobstructed access for maintenance or replacement and meet the requirements of Items (c) and (d) of Clause 5.3.2;

(d) have no heat applied to any valve that has screwed pipe connections;

(e) have no other valve, tap or shut-off device between the temperature/pressure-relief valve or pressure-relief valve and the water heater;

(f) except for the heater isolating valves required in Clause 5.10.2(h) for multiple installations, have no other valve, tap or shut-off device between any expansion control valve or expansion vessel and the inlet to the water heater;

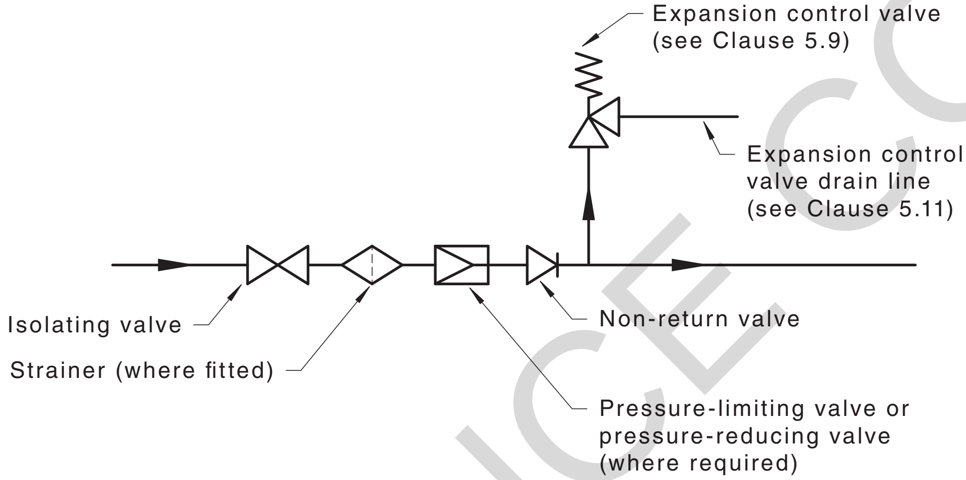
(g) have the temperature/pressure-relief valves fitted in the position identified on the water heater; and

(h) be protected from freezing in accordance with Clause 4.10.

NOTES:

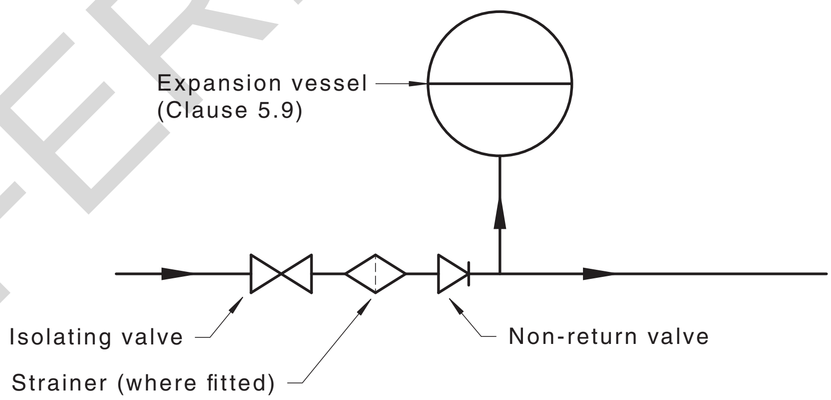
1 For typical sequence of valve installation, see Figure 5.9.3(A).

2 For typical valve installations, see Figures 5.9.3(B) to 5.9.3(E).



(a) Typical assembly incorporating a pressure-limiting or pressure-reducing valve usig expansion control valve

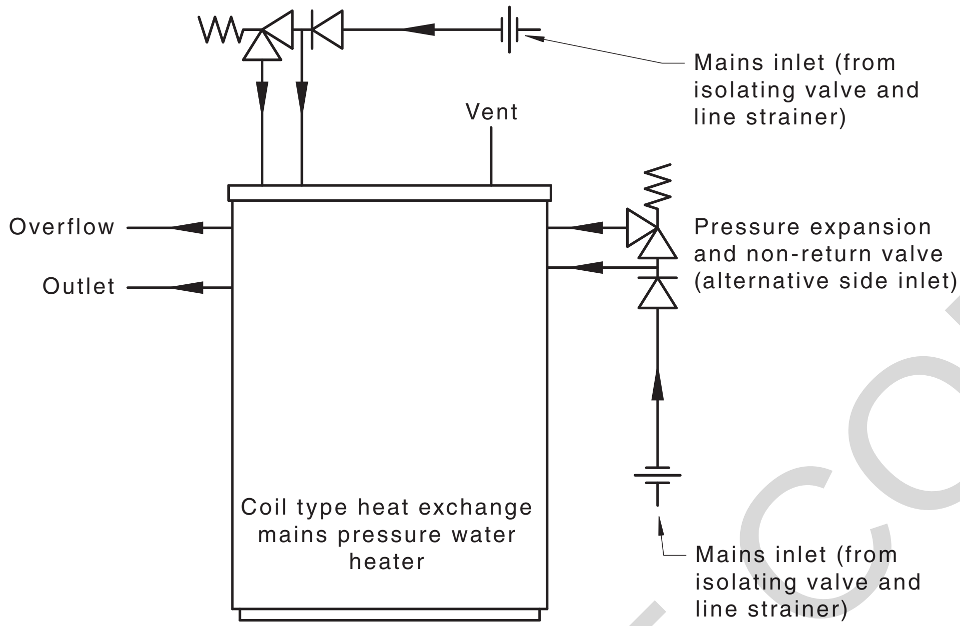
Note: Expansion control valve may be combined with the pressure-limiting valve



(b) Typical assembly with no pressure-limiting or pressure-reducing valve using an expansion vessel

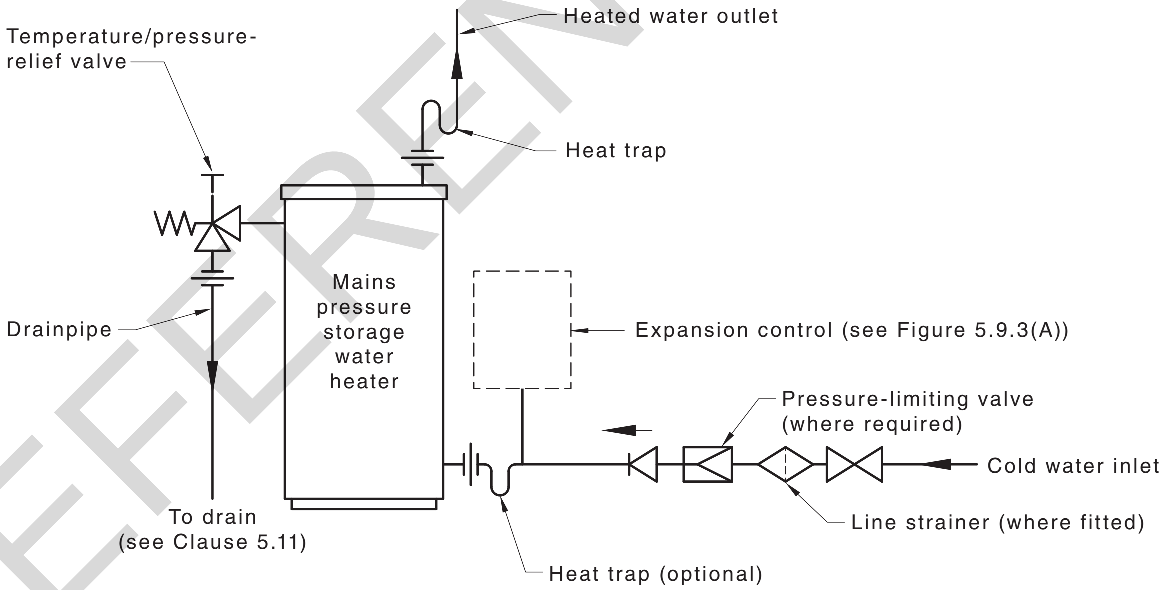
NOTE: Expansion control valve may be combined with the pressure-limiting valve.

FIGURE 5.9.3(A) TYPICAL INSTALLATION OF VALVES



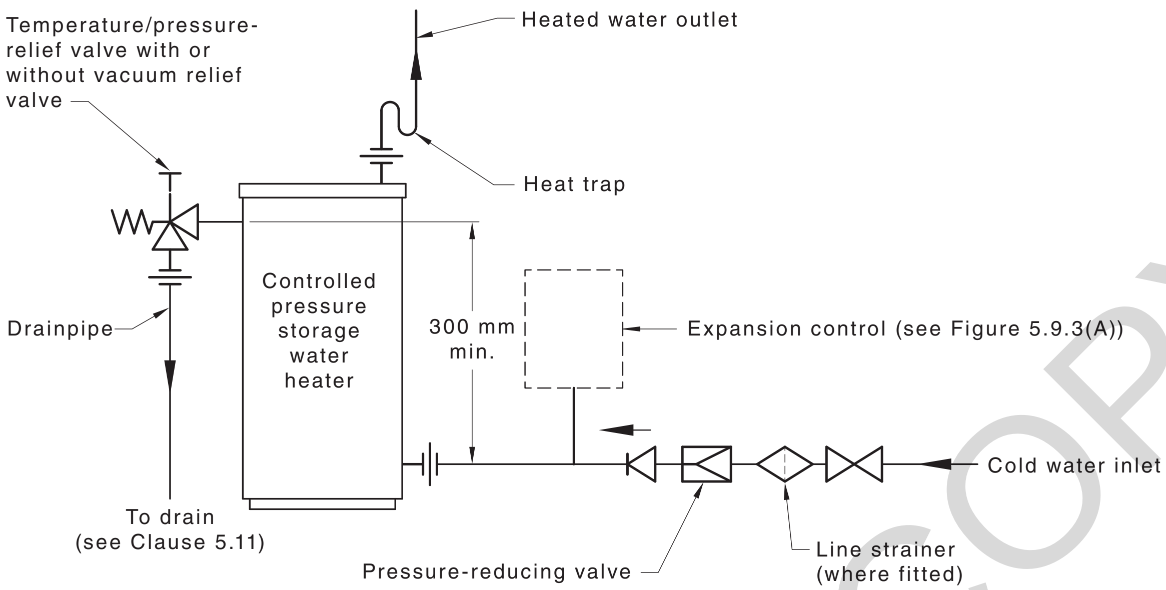
NOTE: Expansion control valve may be combined with the pressure-limiting valve.

FIGURE 5.9.3(B) TYPICAL INSTALLATION OF A HEAT EXCHANGE MAINS PRESSURE WATER HEATER FITTED WITH A COMBINATION EXPANSION CONTROL VALVE AND NON-RETURN VALVE

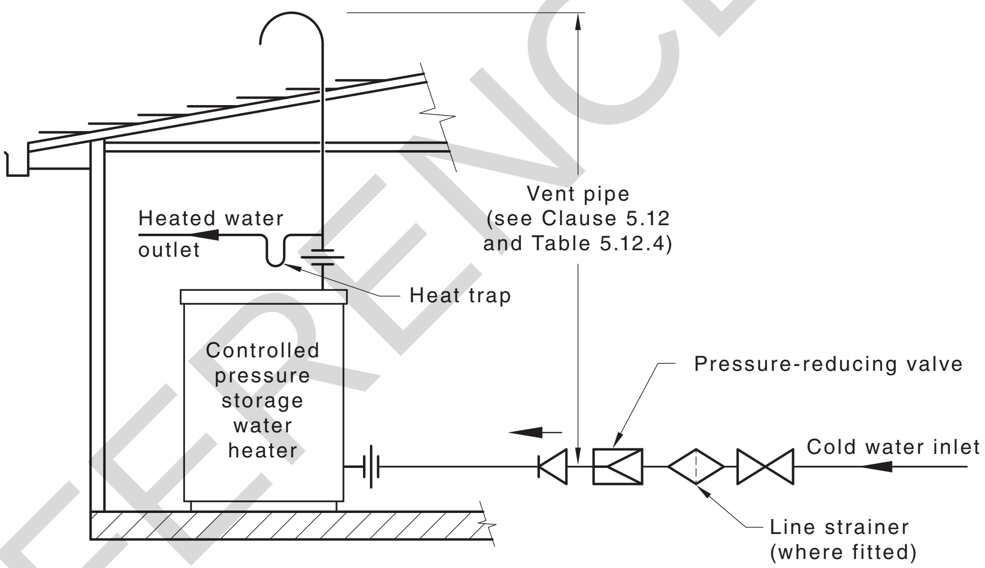


~~NOTE: Expansion control valve may be combined with the pressure-limiting valve.~~

FIGURE 5.9.3(C) TYPICAL INSTALLATION OF A MAINS PRESSURE STORAGE WATER HEATER

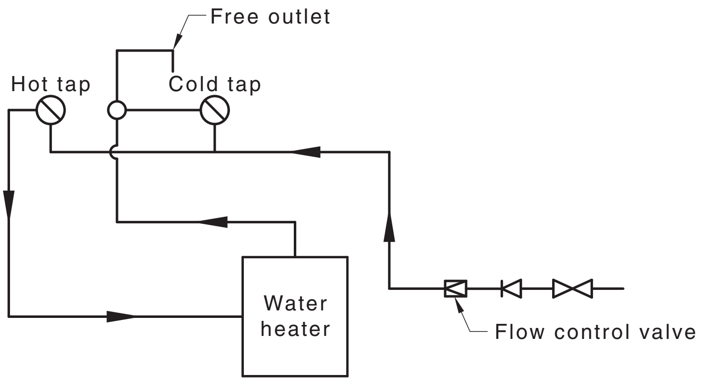


(e) With temperature/pressure-relief and vacuum-relief valves



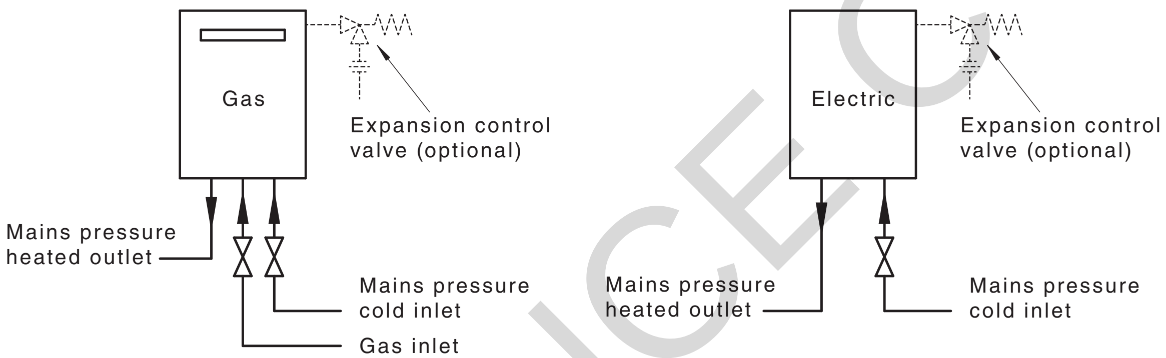
(f) With vent pipe

FIGURE 5.9.3(D) TYPICAL INSTALLATION OF A PRESSURE WATER HEATER CONTROLLED WITH A PRESSURE-REDUCING VALVE

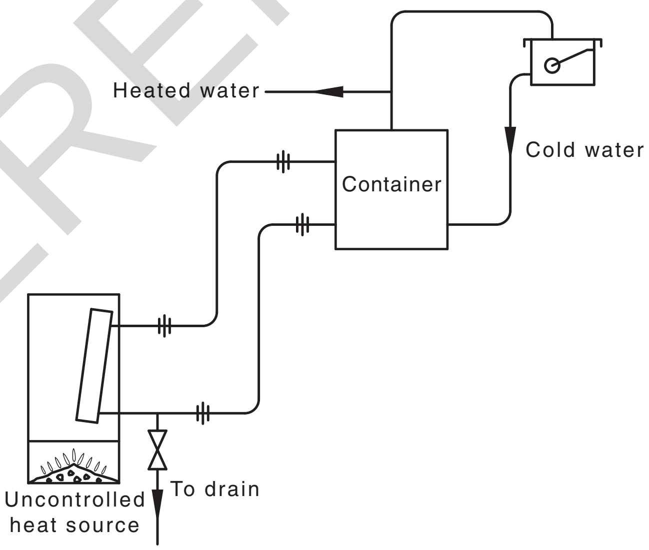


(g) Free outlet under-sink water heater

NOTE: For expansion control, where installed in conjunction with a heated water vessel, see Figure 5.9.3(A)



(h) Instantaneous water heater



(i) Uncontrolled water heater

NOTE: For expansion control, where installed in conjunction with a heated water vessel see Figure 5.9.3(A).

FIGURE 5.9.3(E) TYPICAL WATER HEATER ARRANGEMENTS

5.10 MULTIPLE INSTALLATIONS OF PRESSURE-TYPE STORAGE WATER HEATERS

5.10.1 General

Where large volumes of hot water are required over a short period, several pressure-type storage water heaters may be combined into one service.

Each water heater shall be fitted with temperature/pressure-relief valve(s) in accordance with Table 5.9.1(A).

In all such installations, access shall be provided in front of each water heater for the servicing and removal of any one water heater without the need to disconnect any others.

5.10.2 Balanced flow conditions

Banks of storage water heaters shall be installed in accordance with the following to ensure similar resistance to flow through all the heaters in the bank and that each delivers similar volumes of hot water at a similar temperature:

(a) The water heaters shall be of the same storage capacity and energy input capacity, with the same nominal temperature setting and be connected in parallel.

(b) The cold water service to the inlet header shall enter the bank from the opposite end to that from which the heated water service leaves the outlet header.

NOTE: For typical arrangements, see Figures 5.10.2(A) and 5.10.2(B).

(c) The heated water return in a recirculation system shall connect to the cold water header, and enter the bank from the opposite end to that from which the heated water service leaves the outlet header.

(d) Inlet and outlet headers shall be of the same nominal size and length and the same shape with identical connections. The size of the headers shall be either the nominal size or the minimum size, as given in Table 5.10.2, whichever is the larger.

(e) All inlet branch pipes shall be of the same nominal size and be of the same length and shape.

(f) All outlet branch pipes shall be of the same nominal size and be of the same length and shape.

(g) Where a hot water return header is installed, all return branch pipes shall be of the same nominal size and be of the same length and shape, i.e. balanced.

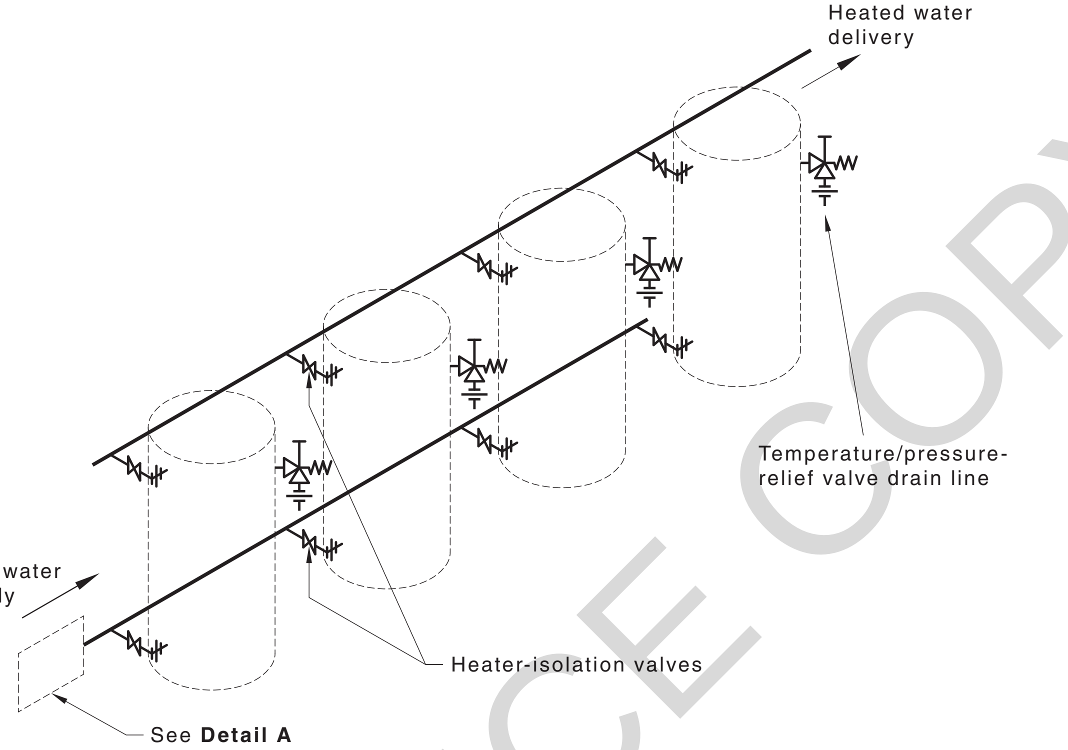
(h) Heater-isolation valves shall be fitted to inlet, outlet and return branch pipes. These valves shall be full-way gate valves or ball valves and be of the same nominal size as the pipe to which they are fitted.

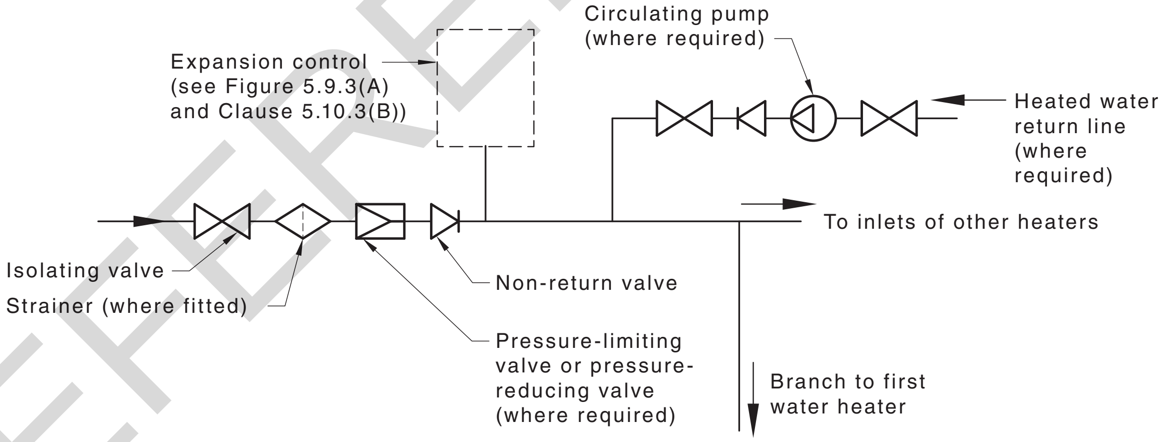
(i) Offtakes shall not be connected to any branch pipe or any intermediate part of the headers.

TABLE 5.10.2

HEADER SIZES FOR MULTIPLE INSTALLATIONS

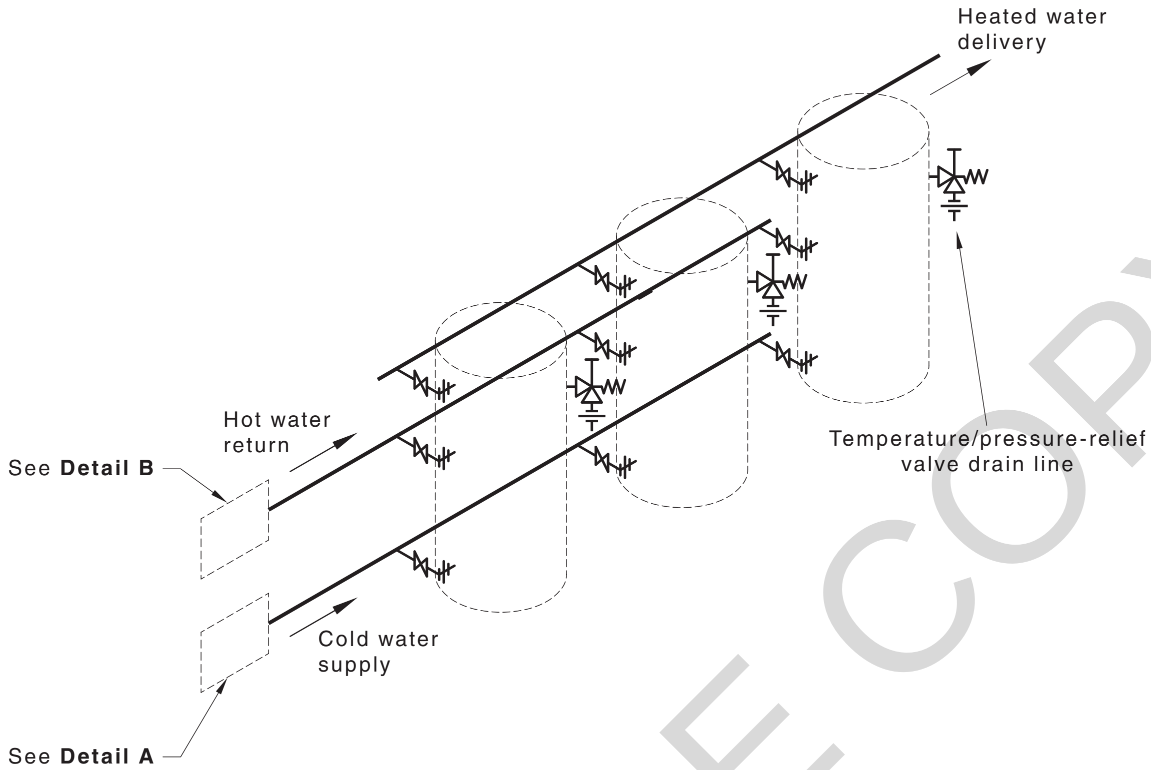
Number of heaters in bank	Nominal size of headers	Minimum size of headers DN
2	Same pipe size as branch pipes	20
3–5	One pipe size larger than branch pipes	25
6–10	Two pipe sizes larger than branch pipes	32
11–15	Three pipe sizes larger than branch pipes	40

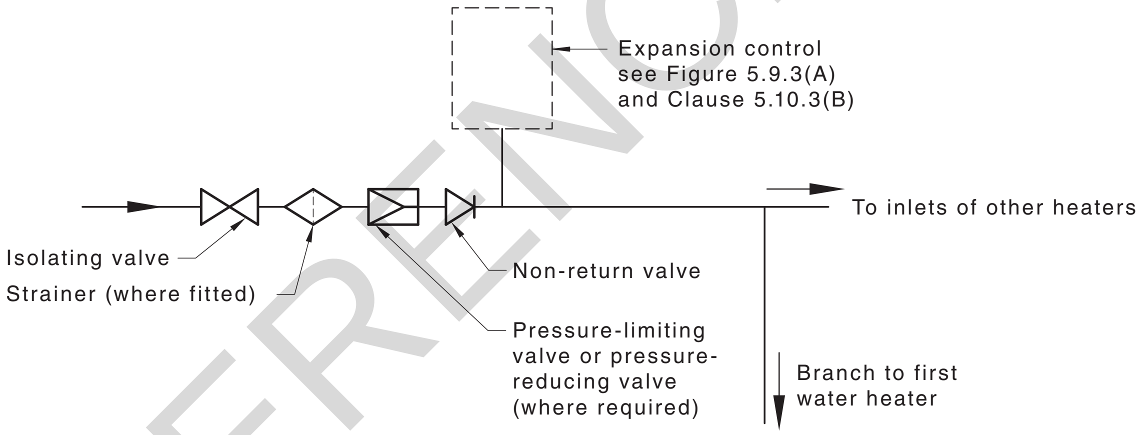




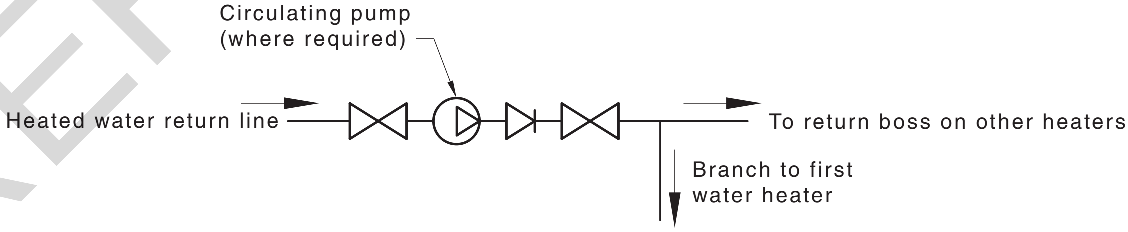
DETAIL A

FIGURE 5.10.2(A) TYPICAL IN-LINE ARRANGEMENT OF MULTIPLE STORAGE WATER HEATERS





DETAIL A



DETAIL B

FIGURE 5.10.2(B) TYPICAL ALTERNATIVE ARRANGEMENT OF HEATED WATER RETURN LINE FOR CIRCULATING HEATED WATER SERVICE

5.10.3 Positioning and sizing of control valves on the cold water supply

Where fitted, control valves installed for water heaters in a multiple configuration shall meet the following requirements:

(a) *Inlet-pressure-control valves* Inlet-pressure-control valves shall be installed between the cold water supply isolating valve and the branch to the first water heater. Where two or more inlet-pressure-control valves are fitted in parallel, they shall be of the same pressure setting.

(b) *Cold water expansion control valves and expansion vessels* One or more expansion control valves shall be installed immediately after the cold water isolation valve and the non-return valve assembly to each bank of heaters~~. The total kilowatt rating of the expansion control valves shall be not less than the total kilowatt rating of all the heaters in the bank.~~ as follows:

  (i) The total kilowatt rating of the expansion control valves shall be not less than the total kilowatt rating of all the heaters in the bank.

  (ii) The expansion vessel shall have a capacity at least twice the thermal expansion of the total volume of water in the system for the greatest temperature rise, being the difference between the coldest temperature in the pipe work (i.e during installation of the system, or when the system is not in operation) and the highest temperature during operation.

  (iii) The expansion vessel shall be set to maintain a pressure within the system that is between the inlet pressure after any pressure reducing/limiting valves and 85% of the pressure relief valve setting.

  (iv) The expansion vessel shall be designed for the maximum operating temperature of the system.

  NOTE: The expansion vessel should be located in the cold water supply immediately downstream from the system main isolating valve, non-return valve and pressure reducing or limiting valve, if installed.

For rates of thermal expansion, methods for sizing expansion vessels and examples, see Appendix P.

5.11 TEMPERATURE/PRESSURE-RELIEF VALVE AND EXPANSION CONTROL VALVE DRAIN LINES

5.11.1 Size and material

For other than the expansion control valve fitted to heat exchange water heaters, every temperature/pressure-relief valve and expansion control valve shall be fitted with a drain line that shall—

(a) be of a diameter not smaller than the nominal size of the valve outlet;

(b) have a length in accordance with Table 5.11.1; and

(c) be of copper piping.

NOTE: It may be necessary to have the valve drain line discharge into a tundish when the distance to the point of final discharge is greater than the maximum given in the ~~Table~~table.

TABLE 5.11.1

LENGTHS AND CHANGES OF DIRECTION

Maximum relief drain length m	Maximum numbers of changes of direction (greater than 45°)
9	3
8	4
7	5
6	6

5.11.2 Interconnection of drain lines

5.11.2.1 *Individual water heaters*

The drain lines from the outlet of the temperature/pressure-relief valve and the expansion control valve on an individual water heater may be joined together subject to the following:

(a) Interconnection is limited to the drain lines from the outlets of one temperature/pressure-relief valve and one expansion control valve (, see Clauses 5.8(c) and 5.10.3(b)).

(b) Installation of the drain lines complies conforms with Clause 5.11.3.

NOTE: Some regulatory authorities may not permit interconnection of drain lines.

5.11.2.2 *Multiple relief valves*

Except for drain lines complying conforming with Clause 5.11.2.1, the drain lines from multiple relief valves shall not be interconnected. Where multiple relief valves discharge over a tundish on a common drain line, the common drain line shall be sized in accordance with Clause 5.11.5.

5.11.3 Installation

Drain lines from temperature/pressure-relief valves, expansion control valves and tundishes shall be installed as follows:

(a) There shall be no tap, valve or other restrictions in any line.

(b) Each line shall fall continuously from the valve to the point of discharge.

(c) Drain lines from expansion control or temperature/pressure-relief valves shall not discharge into a safe tray.

(d) The point of discharge from each drain line shall be located so that the release of steam or hot water does not cause a nuisance, is readily discernible and incurs no risk of damage to the building or injury to persons.

(e) Where a drain line terminates outside a building, the end of the line shall be—

(i) not lower than 75 mm or higher than 300 mm above an overflow relief gully or disconnector gully;

(ii) not lower than 75 mm or higher than 300 mm above a gravel pit not less than 100 mm in diameter;

(iii) over a tundish in accordance with Item (h) below; or

(iv) not lower than 200 mm or higher than 300 mm above an unpaved surface.

NOTE: Where discharges from valves may adversely affect slabs and footings of buildings, the drain lines should discharge away from the building. Further guidance is provided in the National Construction Code (NCC).

(f) Where the drain line from the expansion control valve on a heat exchange water heater is directed into the water storage container, there shall be a minimum air gap of 20 mm, except where the valve and associated drain lines are supplied as an integral part of the water heater.

(g) Where a water heater is externally located, the drain line from the relief valve shall be terminated so as to discharge water away from the operator during operation of the valve.

(h) Where discharging over a tundish or gully, drain lines shall have an air gap of a size at least twice the diameter of the drain line.

(i) Where installed, plastics drain lines shall be—

(i) continuously supported;

(ii) fixed and secured in accordance with Clause 4.4;

(iii) protected from UV if exposed to direct sunlight; and

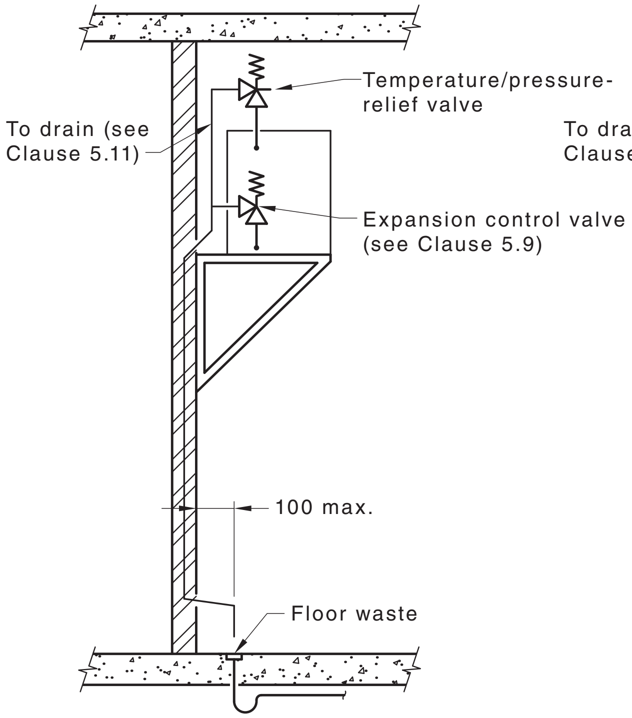
(iv) installed with a suitable allowance for thermal movement.

NOTES:

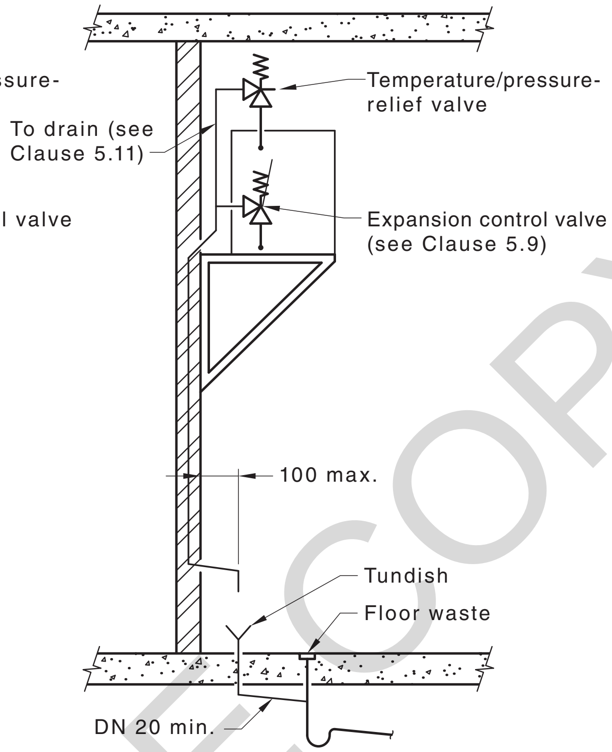
1 Typical installations of drain lines are illustrated in Figure 5.11.3(A) and ~~Figure~~ 5.11.3(B).

2 Ponding should be avoided.

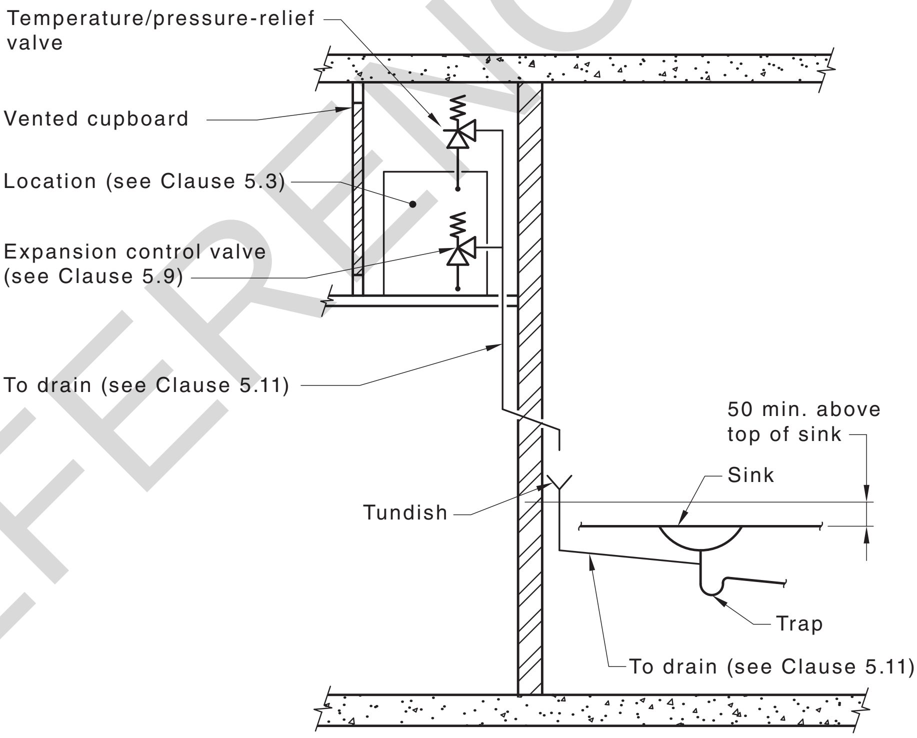
3 As the function of the temperature/pressure-relief valve on this water heater is to discharge high temperature water under certain conditions, the pipework downstream of the relief valve should be capable of carrying water exceeding 93°C. Failure to observe this precaution may result in damage to pipework and property.



(a) Elevated heater, discharge over floor waste



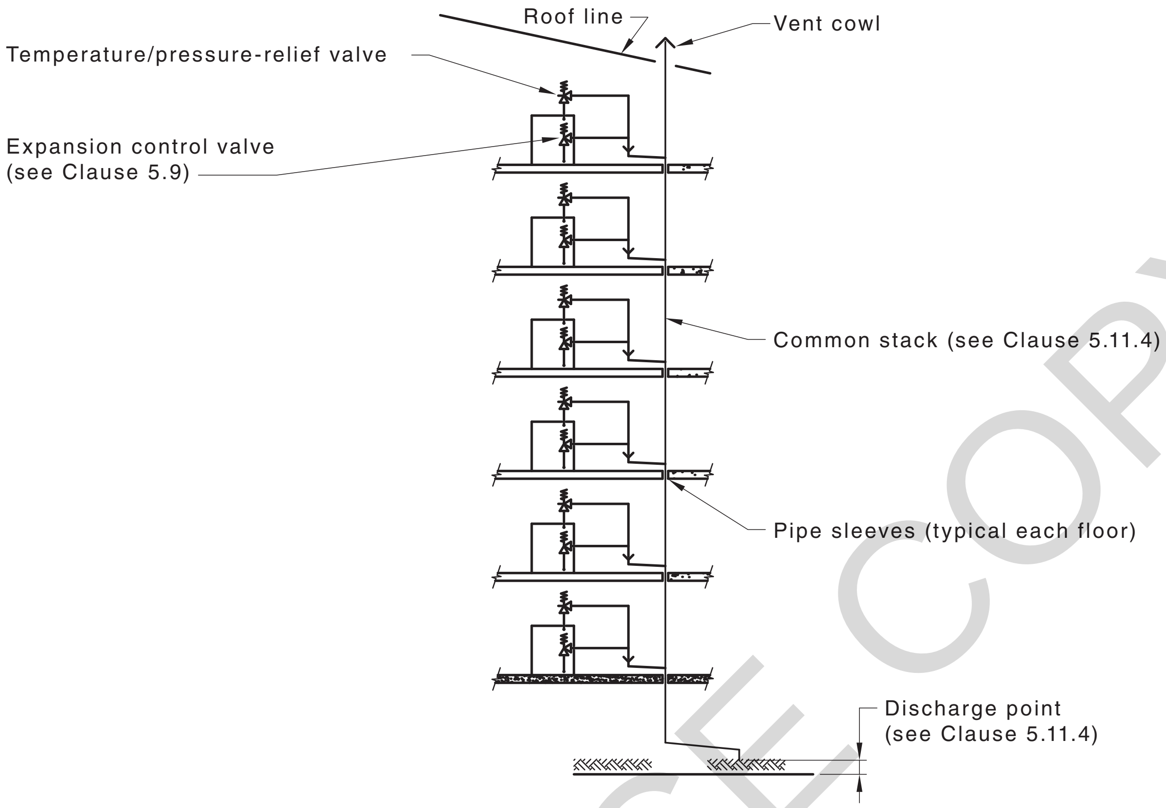
(b) Alternative discharge into tundish fixed adjacent to heater and waste taken to nearest floor waste



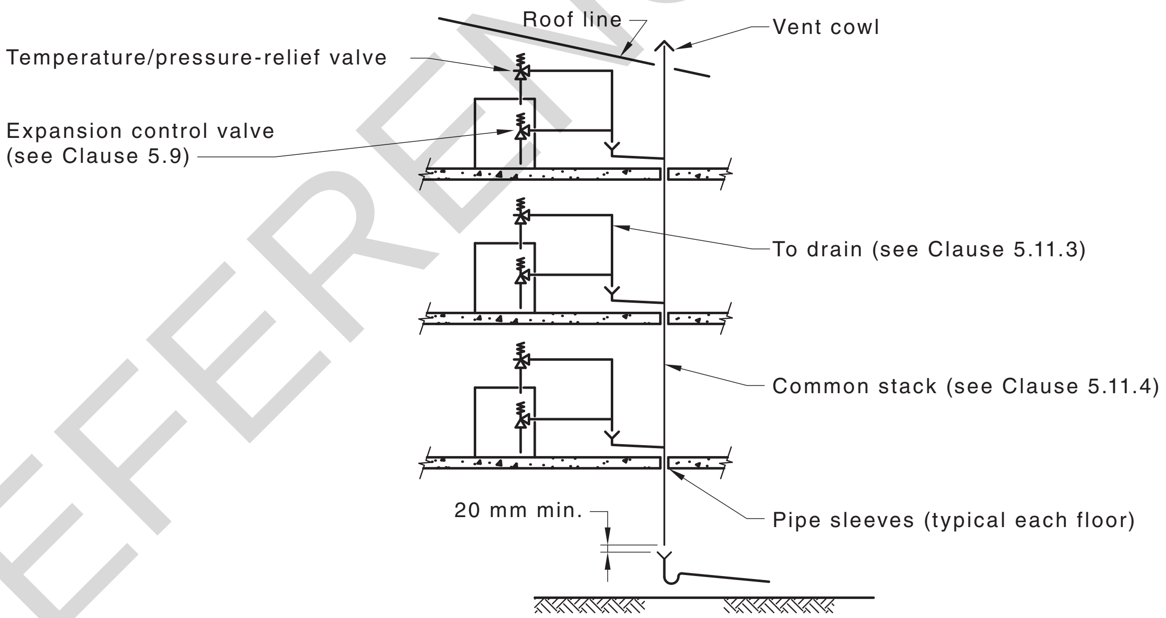
(c) Heater located in vented cupboard, discharge to kitchen sink waste

DIMENSIONS IN MILLIMETRES

FIGURE 5.11.3(A) TYPICAL RELIEF DRAINAGE



(a) Common stack discharge over ground, stormwater drain or gully



(b) Common stack discharge to a soil or waste stack

FIGURE 5.11.3(B) TYPICAL TEMPERATURE/PRESSURE-RELIEF VALVE DRAIN LINES—COMMON STACK DISCHARGE METHODS

5.11.4 Common stack discharge

Where individual water heaters are installed in a multistorey building, the relief drain lines may discharge into a common stack, provided the following criteria are met:

(a) The discharge from the common stack is to a tundish, having a discharge line that is not less than the size of the common stack, directly connected to a fixture trap, and installed in connection with any adjacent soil or waste stack.

(b) The discharge point of the common stack is such that any discharge is readily visible and does not cause any nuisance.

(c) The common stack is vented by extending the pipe upwards, above the roof level.

5.11.5 Tundish drain lines

The drain line from any tundish shall be not less than one size larger than that of the largest drain line discharging into the tundish. Tundish drain lines shall ~~comply~~ conform with Clause 5.11.3.

5.11.6 Areas subject to freezing

In areas where water pipes are prone to freezing, the drain line from any valve shall be insulated and not exceed 300 mm in length. It shall discharge into a tundish through an air gap of not less than 75 mm and not more than 150 mm measured from the outlet of the drain line to the rim of the tundish.

5.12 VENT PIPES

5.12.1 Installation

5.12.1.1 *Storage water heaters*

Each vented storage water heater shall be fitted with a vent pipe of copper not smaller than DN 20 and shall—

(a) have no tap, valve, sharp change of direction or other restrictions in the pipe;

(b) rise continuously from the point of connection; and

(c) have any roof or wall penetration rendered waterproof with due allowance made for expansion.

5.12.1.2 *Heat exchange water heaters and boiling water units*

Where required, vent pipes shall be installed for heat exchange type water heaters and boiling water units.

NOTE: The venting requirements for heat exchange type water heaters and boiling water units may be product specific.

5.12.2 Termination of vent pipe

Vent pipes installed on a water heater shall—

(a) when over a cold water storage tank, be turned downward and discharge into the cold water storage tank by passing through the lid, finishing not lower than the outlet of the float valve and not discharging over the float valve assembly;

(b) when taken through a roof, have the open end of the pipe point upwards or be turned downwards and if projecting more than 1 m above the roof, be supported; and

NOTE: For a typical treatment, see Figure 5.9.3(D)(b).

(c) in locations subject to freezing conditions, vent pipes shall be insulated to at least 300 mm above the working water level.

5.12.3 Cold water storage tank-fed water heaters (other than side-fed types)

When fitted in conjunction with a cold water storage tank, vent pipes shall rise to a height not less than 80 mm above the static water level in the tank for every 1 m between the overflow water level in the feed tank and the base of the heater, or 300 mm, whichever is the greater.

5.12.4 Vented storage water heaters, inlet pressure-controlled

When installed in conjunction with a water heater fitted with a pressure-reducing valve, a vent pipe shall rise to a height above the outlet of the pressure-reducing valve in accordance with Table 5.12.4, and be in accordance with ~~the following equation~~Equation 5.12.4:

$$H = \frac{SP}{10} + 1 \qquad \ldots 5.12.4$$

where

H = the height of vent pipe, in metres, to the nearest 0.5 m

SP = set outlet pressure of the reducing valve, in kilopascals~~.~~

TABLE 5.12.4

HEIGHT FOR VENT PIPES ABOVE A PRESSURE-REDUCING VALVE

Pressure-reducing valve setting kPa	Height of vent pipe m
25	3.5
30	4.0
35	4.5
45	5.5
50	6.0
70	8.0

SECTION 6 INSTALLATION OF SOLAR WATER HEATERS

6.1 SCOPE OF SECTION

This Section covers the installation of solar water heating systems with fixed orientation and inclination used either in single-unit or in multiple-unit installations. It is applicable to the following types of solar heated water systems which include collectors with either flat plate or evacuated tube absorbers:

(a) Systems with the solar collector remote from the heated water container, with both components supplied as a complementary and packaged system and with primary circuit piping arranged to suit site conditions.

(b) Custom-built systems where the solar collector is connected to an existing remote heated water container or new container not sold packaged with the collector, and with primary circuit piping arranged to suit site conditions.

(c) Close-coupled or integral solar water heaters.

6.2 APPLICATION OF SECTION (NEW ZEALAND ONLY)

For the installation of solar water heaters in New Zealand, NZS 4613 and NZS 4614 shall apply.

6.3 GENERAL INSTALLATION REQUIREMENTS

6.3.1 Sizing and solar performance

The performance of particular system configurations and installations, particularly packaged systems, shall be determined using the methods given in AS/NZS 4234.

NOTES:

1 For recommendations for the installation of unrated solar heated water supply systems, see Appendix ~~F~~E.

2 The ratio of container volume to collector area should be in the range 40–90 L per square metre of collector area.

3 Collector area and container size will affect system performance.

6.3.2 Location

The components of the system shall be located so as to maximize solar gain and minimize energy losses, and shall be positioned to facilitate maintenance and the choice of a suitable route for piping between the container and the collector.

NOTES:

1 For placement of water heater, see Clause 5.3.1.

2 Recommendation on the installation of close-coupled and integral solar heated water systems on roofs are given in Appendix ~~G~~F.

3 For suggested component sizes, see Appendix ~~H~~G.

4 ~~Information~~ For information on effect of inclination and orientation on system performance ~~is given in~~ , see Appendix ~~J~~I.

C6.3.2 Environmental factors of solar radiation for the area, local consideration of dust, hail, frost, shade and wind, and the aspects of both the quality of water used and the consumer habits, with regard to heated water usage, will affect both the performance and the service life of the unit. Performance will also be affected by storage container size and time of day when supplementary heating is applied.

Where geographical locations are less than ideal, improved performance of a system may be achieved by the installation of either an additional collector(s) or higher performing collectors.

6.3.3 Structural integrity

The collective weight of collector(s), any associated filled container and their mounting frames shall not exceed the loading prescribed for the roof.

Where systems are supported on roof battens crossing rafters or trusses the battens shall be continuous across not less than three rafters or trusses.

Supporting battens and their fixing to each rafter or truss shall be in accordance with the requirements of the NCC.

NOTES:

1. Mounting frames, support rails or brackets that are used to support and/or orientate a roof-mounted system or system components should be supported on rafters or trusses spaced at a maximum of 1200 mm centres.
2. Where mounting frames are used for orientation and connection to the roof structure, the mounting frame and its attachments should be suitable for local wind conditions, specially in cyclonic regions, where local advice should be sought.
3. A map of regional basic design wind speeds is shown in Appendix ~~K~~J.
4. Verification of frames or components as to their structural suitability may be required by the regulatory authority.
5. The weight of the container and collector full of water should be considered in the design of the roof structure and supports.
6. Installation of a container on an existing roof will require that the roof structure is adequate for the load of the container and collector. Where the roof is considered to have inadequate strength to support the container and collector, the roof structure will need to be strengthened prior to installation.

6.3.4 Water hardness and dissolved solids

Where the Saturation Index (SI) of the water exceeds +0.4, collectors shall not be charged with water, unless they are covered by an opaque material, until required for use.

NOTE: Water supplies with high total dissolved solids content may have a detrimental effect on some collectors. Advice should be sought from the manufacturer as to the suitability of a particular product intended to be used with water of high total dissolved solids (generally in excess of 500 mg/L).

6.3.5 Collector circuit

The collector circuit shall utilize a direct system or indirect system, as defined under ‘solar water heater’ in AS/NZS 3500.0.

6.3.6 Flow and return pipes and fittings

Piping used between the collector and the container shall be a minimum of DN 15 copper or stainless steel.

Plastics pipes and fittings shall not be used between the collector and the container except as specified in Clause ~~2.4.3(e~~2.4.3(f).

Thermal insulation shall be in accordance with Section 8.

6.3.7 Corrosion resistance

All materials shall ~~comply~~ conform with the following:

(a) Materials that are jointed directly to, or in contact with, other materials shall have chemical and galvanic compatibility with those materials to prevent corrosion or other deterioration that would impair their function during their intended service life.

(b) All brackets, fixing straps, support rails, mounting frames and fixings used for the external installation of solar water heaters and their components shall be manufactured from hot dip galvanized mild steel, grades 304, 316 or 430 stainless steel or a material of equivalent strength and corrosion resistance.

(c) Where components are fabricated from welded mild steel they shall be hot dip galvanized after fabrication.

(d) Containers installed externally shall ~~comply~~ conform with Clause 5.6.

6.3.8 Entrapped air

All piping shall be installed to eliminate air from the heat transfer fluid circuit.

NOTES:

1 For thermosiphon systems, this may be achieved if the pipes connecting the collector and the storage container rise continuously from the collector to the storage container.

2 In a thermosiphon system, the circulation pipe from the top of the collectors to the entry point in the container should have an average upward slope of not less than 1 in 7. The minimum upward slope at any point should be not less than 1 in 20, unless the pipe is vented at that point.

6.3.9 Over-temperature protection

Over-temperature protection shall be provided in accordance with AS/NZS 2712.

6.3.10 Pressure and temperature relief

Relief valves shall have a relief capacity—

(a) not less than the total output power of the collectors at 99°C and 1100 W/m^2 and 50°C effective ambient, plus that of any supplementary heater; or

(b) in accordance with AS/NZS 2712.

NOTE: The design of the system should be such that the temperature of the water in the container does not activate any supplementary energy safety cut-outs under normal conditions of operation.

6.3.11 Drain lines

Drain lines for temperature and pressure-relief and expansion control valves shall be installed in accordance with Clause 5.11.

Copper pipe used for drain lines crossing a metal roof shall be fully insulated with UV resistant weatherproof lagging to prevent corrosion of the metal surface.

6.3.12 Unintentional circulation

The plumbing installation shall be designed—

(a) to minimize unintentional circulation of heated water through the collector;

(b) prevent reverse thermosiphoning from containers with electrical or gas heating; and

(c) prevent thermosiphon circulation from wetbacks to the collectors.

NOTE: This may be achieved through the use of—

3 a heat trap in accordance with Items (b) and (c) of Clause 8.4; or

4 a non-return valve.

6.3.13 Mounting

Rails or angles used for the support of collectors, containers or mounting frames shall be installed across the slope of the roof and fixed through the upper profile of the roof sheeting into the supporting battens.

Support rails used on tiled roofs shall be securely fixed to fixing straps. Fixing straps that are used to restrain collectors and/or containers on tiled roofs shall pass beneath the tiles and be securely fixed directly to the rafters or trusses with a minimum of three screws 40 mm long per fixing strap.

NOTE: A reference to tiles and tiled roofs in this Section is a reference to cement, terracotta or other composite tiles.

6.3.14 Supplementary heating

Supplementary heating equipment shall be provided and it shall have thermal capacity to supply heated water requirements in accordance with AS/NZS 2712.

6.3.15 Penetrations through roof cladding

Penetrations through the roof cladding of structural supports, fixings, pipes and wiring shall be—

(a) through the upper profile of roof tiling or through the upper rib of metal sheeting;

(b) flashed or sealed around the penetrating member using purpose made sealing washers or boots, with allowance made for thermal expansion; and

(c) installed in a manner that will not prevent rainwater flow across the roof, trap debris or cause ponding.

All metal swarf shall be removed from the roof and guttering on completion of the installation.

6.4 INSTALLATION OF SOLAR WATER HEATER STORAGE CONTAINERS

6.4.1 General

Storage containers for solar water heaters shall be located in accordance with Clause 5.3 and shall be installed in accordance with relevant requirements of Clauses 5.4 to 5.12.

6.4.2 Thermosiphon systems

For thermosiphon systems where the collector is remote from the container, the top of the collectors shall be not less than 150 mm (measured vertically) below the bottom of the container.

6.4.3 Support

Containers of close-coupled or integral systems mounted directly onto or above a roof structure shall be supported in accordance with Clause 6.3.

NOTE: A typical installation of a close-coupled solar water heater is shown in Figure 6.4.3.

Containers located remotely from the collectors and those located in roof spaces shall be supported in accordance with Clause 5.5.

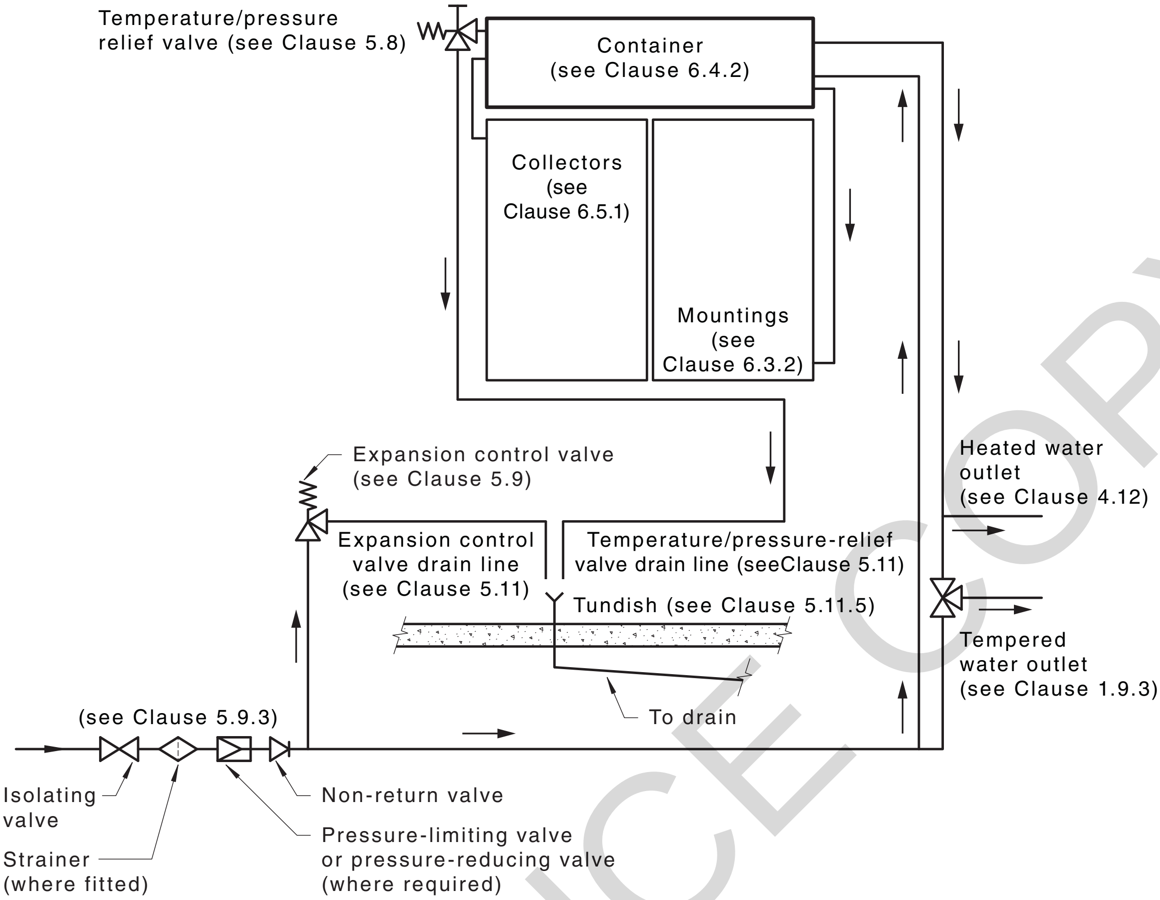


FIGURE 6.4.3 TYPICAL INSTALLATION OF CLOSE-COUPLED SOLAR WATER HEATER

6.4.4 Safe trays

Where containers are installed in roof spaces, cupboards, or are otherwise concealed, they shall be placed on a safe tray in accordance with Clause 5.4.

6.4.5 Auxiliary water heating

A solar water heater provided with auxiliary water heating shall ~~comply~~ conform with the following:

(a) Only connection points in the container or in fittings or components intended for this purpose shall be used.

(b) The temperature/pressure-relief valve or expansion control valve shall ~~comply~~ conform with Clause 5.9.

(c) The installation of auxiliary heating by uncontrolled heat sources shall ~~comply~~ conform with Clause 7.2.

(d) For systems with remote containers, an auxiliary heating connection shall not be made to the primary circuit flow and return lines.

6.5 INSTALLATION OF COLLECTORS

6.5.1 Positioning

6.5.1.1 *Shade*

Collectors shall be located so that they are clear of shade for not less than 3 hours either side of solar noon at any time during the year. Partial shading by small objects, such as chimneys, flues and TV antennas, is permissible during this period.

NOTES:

1 Nominal times to be clear of shade would be between 9 am and 3 pm standard time.

2 Information on estimation of shading of collectors is given in Appendix ~~I~~H.

6.5.1.2 *Orientation*

Collectors shall be installed so that they face no more than 45° east or west of true north.

NOTES:

1 In general, better performance will be achieved the closer the collectors are placed to true north.

2 True north should not be confused with a compass reading of magnetic north. The difference between true north and magnetic north is known as magnetic declination. Where a magnetic compass is used, it is important to adjust for magnetic declination from true north.

3 Examples of magnetic declination adjustments are given in Table 6.5.1.2.

TABLE 6.5.1.2

EXAMPLES OF MAGNETIC DECLINATION

Location	Angle of declination (degrees east or west of magnetic north)
Adelaide	8.1 East
Alice Springs	4.5 East
Auckland	19.3 East
Brisbane	10.6 East
Cairns	6.5 East
Canberra	12.2 East
Christchurch	23.3 East
Darwin	3.10 East
Hobart	14.5 East
Invercargill	25.1 East
Melbourne	11.3 East
Perth	1.4 West
Sydney	12.3 East
Wellington	22.1 East

6.5.1.3 *Inclination*

Collectors shall be inclined at an angle within 20° of the local latitude angle.

For thermosiphon systems, the minimum inclination angle shall be 10°.

NOTES:

1 The optimum inclination angle is the latitude of the site (for example, an inclination angle of 27° for the city of Brisbane would be optimum). However, inclination within 20° of the latitude angle will only reduce efficiency minimally. Inclination between 10° and 45° from the horizontal is generally suitable, depending on site location.

2 Improved winter performance may be obtained by an angle of inclination greater than the latitude angle while improved summer performance is obtained from an angle of inclination less than the latitude angle.

3 Examples of local latitudes of major cities are given in Table 6.5.1.3.

4 Data on the effect on system performance of changes in orientation and inclination is provided in Appendix JI.

TABLE 6.5.1.3

EXAMPLES OF LOCATION LATITUDES

Location	Latitude, degrees
Darwin	12
Brisbane	27
Perth	32
Sydney	34
Adelaide	35
Canberra	35
Auckland	37
Melbourne	38
Devonport	41
Wellington	41
Hobart	43
Christchurch	43.5
Invercargill	46

6.5.1.4 *Provision for removal of collector*

Collectors shall be installed with fittings that will enable their removal without disturbing adjacent piping or collectors.

6.5.2 Precautions

6.5.2.1 *Avoidance of damage*

The collector shall be securely covered with an opaque material during installation and commissioning to prevent solar gain and to avoid collector damage or burn hazards.

6.5.2.2 *Frost-prone areas*

Collectors used in frost-prone areas shall be—

(a) marked ‘passed test to frost level 1’ or ‘passed test to frost level 2’ in accordance with AS/NZS 2712; or

(b) protected by a frost protection system or device in accordance with AS/NZS 2712.

6.5.2.3 *Hail-prone areas*

In areas where hailstones in excess of 15 mm diameter are experienced, collectors shall—

(a) ~~comply~~ conform with the impact resistance requirements of AS/NZS 2712; or

(b) be fitted with suitable impact guards.

6.6 SOLAR WATER HEATERS WITH REMOTE CONTAINERS

6.6.1 Pumps and controllers

Circulating pumps and controllers supplied with, or as an integral part of, a packaged system shall ~~comply~~ conform with the requirements of AS/NZS 2712.

Where circulating pumps and controllers are not supplied as an integral part of a packaged system, they shall be installed in accordance with Clause 6.6.2.

NOTE: A typical installation is shown in Figure 6.6.1.

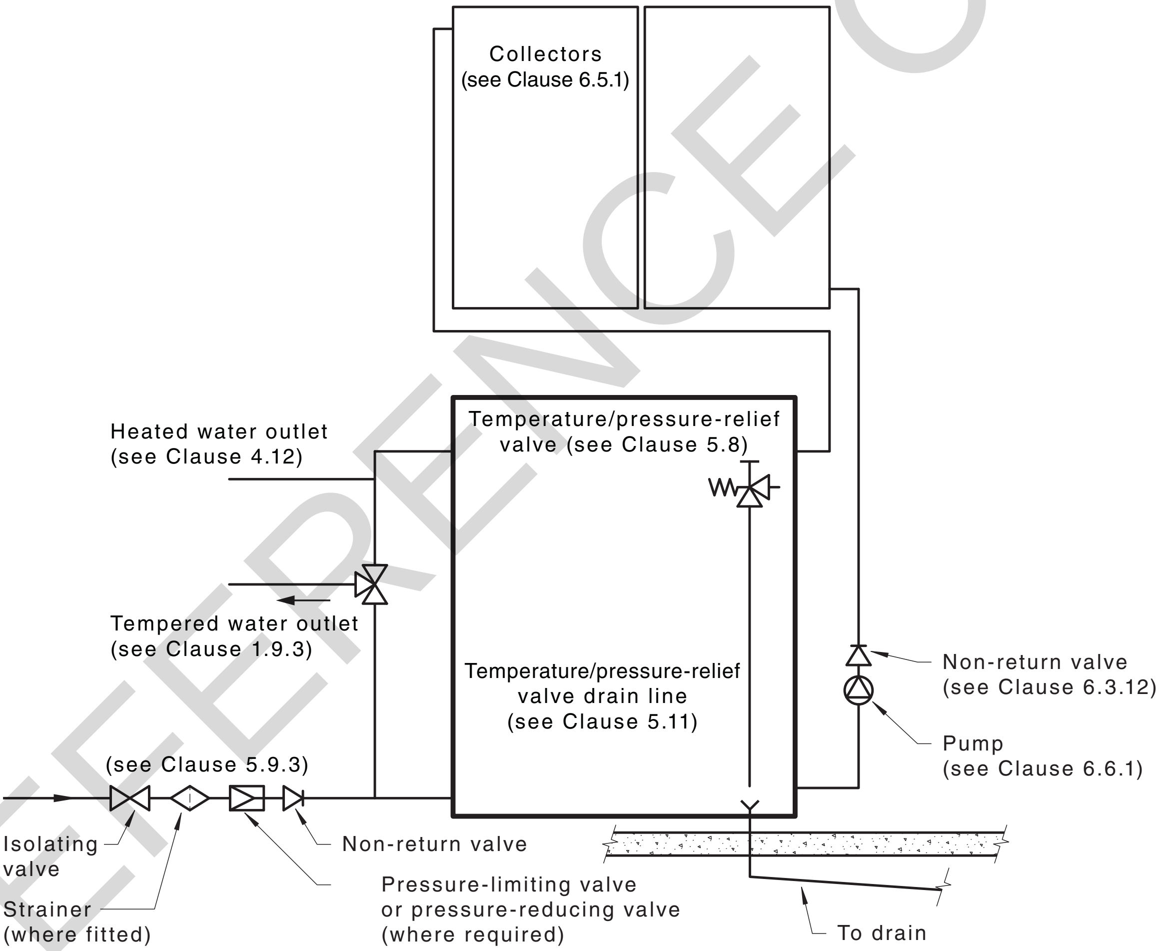


FIGURE 6.6.1 TYPICAL INSTALLATION OF A SOLAR WATER HEATER WITH REMOTE CONTAINER AND FORCED CIRCULATION

6.6.2— Pump and controller installation

The pump and controller installation shall ~~comply~~ conform with the following requirements:

(a) The primary circulating pump shall be installed to draw the colder water from the lower section of the container and to circulate this water through the collectors and return the heated water to the container at a point higher than the draw-off point.

(b) For packaged systems, only connection points in the container, or in fittings or components supplied with the system, shall be used for the cold water supply from the container and hot water return to the container.

(c) The pump shall be fixed to the building structure or the container, or otherwise rigidly supported and the piping system arranged so that no perceptible vibration is transmitted to either the collector or the building.

(d) Pumps and pump controls shall be fitted and connected in an accessible location to facilitate removal for servicing and maintenance.

(e) If mounted outdoors, the pump and pump controls shall be resistant to or protected against the ingress of water and dust.

(f) Where an exposed-gland pump is used inside a building, it shall be installed above a safe tray that drains to the outside of the building or suitable outfall in accordance with Clause 5.4.4.3(d).

(g) Pump controllers shall be mounted in a position that enables any 'pump running' indicator to be prominent.

NOTES:

1 Where pumped circulation is part of a freeze protection mechanism, the pump should be connected to an uninterruptible electricity supply wherever possible.

2 Valves that will allow routine maintenance to be performed without draining the container should be provided

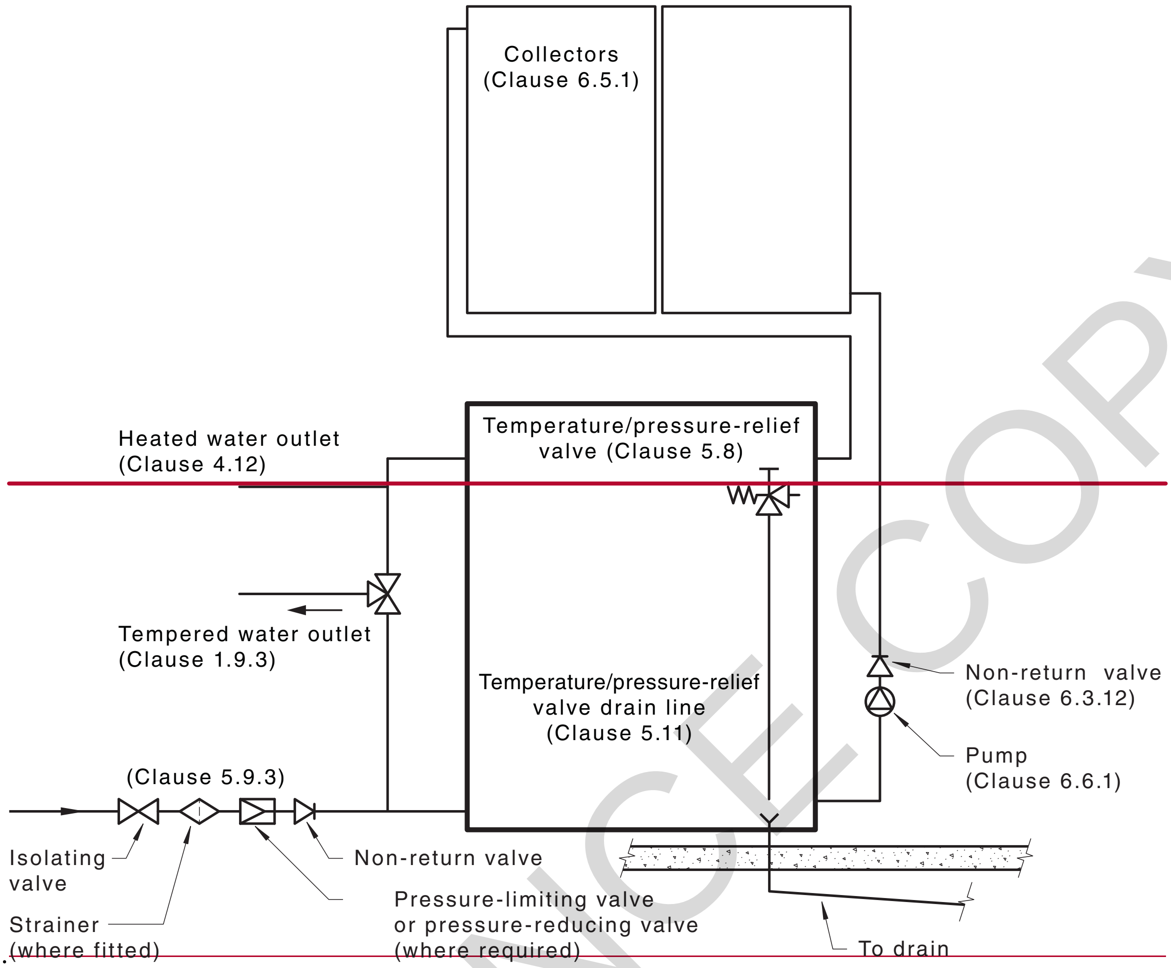


FIGURE 6.6.1 TYPICAL INSTALLATION OF A SOLAR WATER HEATER WITH REMOTE CONTAINER AND FORCED CIRCULATION

SECTION 7 — UNCONTROLLED HEAT SOURCES

7.1 SCOPE OF SECTION

This Section sets out requirements for heated water systems that use uncontrolled heat sources.

7.2 WATER HEATERS WITH UNCONTROLLED ENERGY SOURCE

7.2.1 Installation

The installation of water heaters with an uncontrolled heat input shall ~~comply~~ conform with the following:

(a) Thermosiphon water heaters connected to slow combustion stoves or room heaters with water-heating coils, wetback boilers, or the like, shall—

   (i) have no valves fitted or connected to the primary flow and return pipes between the water heater and the heat source;

   (ii) have the primary flow and return pipes of a minimum nominal diameter relative to the length, as given in Figure 7.2.1;

   (iii) have the primary flow and return pipes rise or fall in a continuous gradient;

   (iv) have the primary flow and return pipes insulated so as not to present a hazard and, where exposed to the weather, have the insulation waterproofed;

   (v) have the primary flow and return pipes installed in accordance with Figure 7.2.1;

   (vi) have no dissimilar metals in the primary flow and return lines;

   (vii) have no elbows fitted in or to the primary flow and return lines; and

   (viii) have the flow and return line connections made only with unions or similar type couplings.

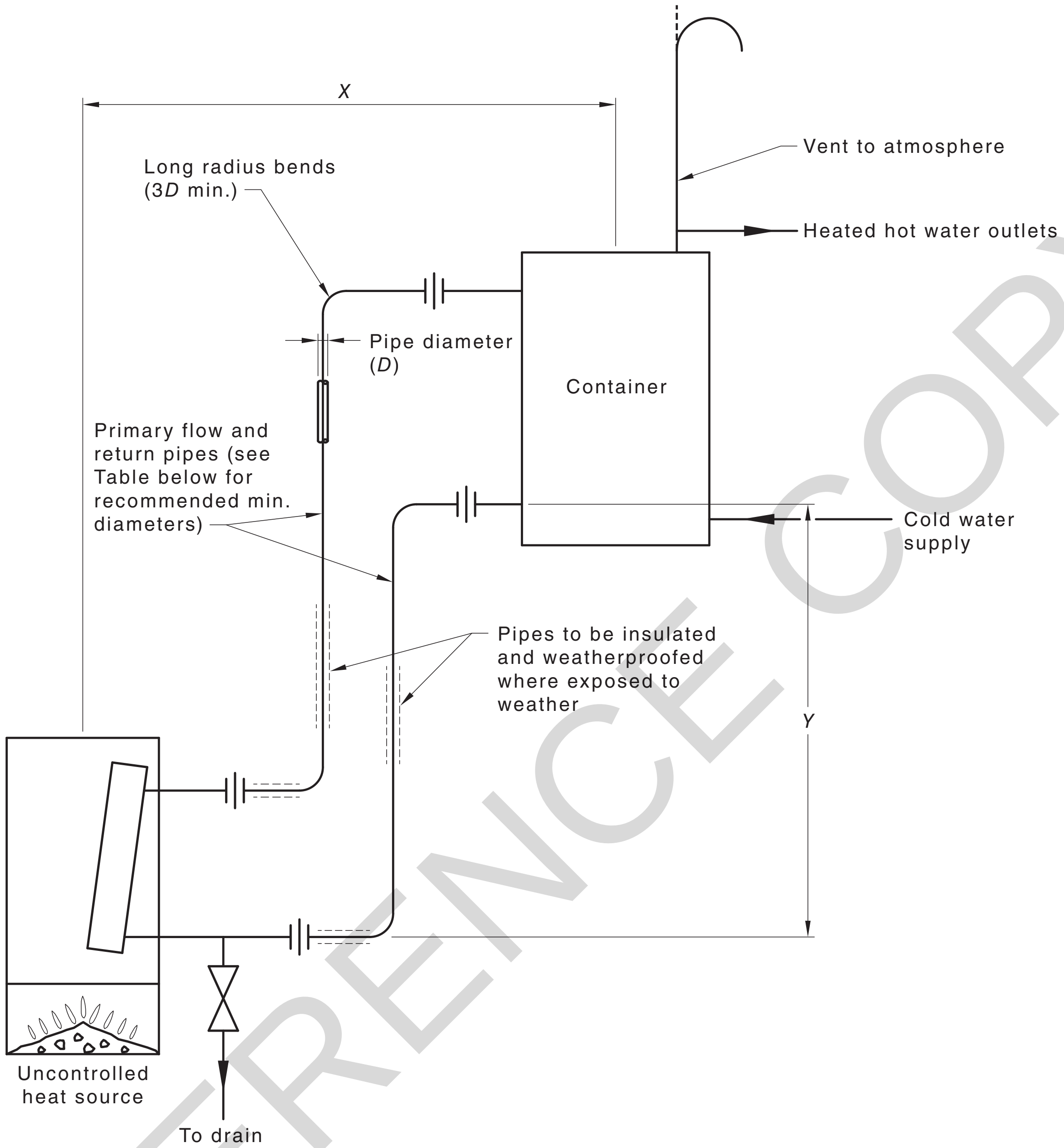
(b) Thermosiphon water heaters specified in Item (a), and direct-fired water heaters, shall—

   (i) be vented to atmosphere with a vent pipe in accordance with Clause 5.12, as appropriate;

   (ii) be installed so that the maximum working pressure measured at the base of the water container does not exceed 50 kPa; and

   (iii) be fitted with a tempering valve.

   NOTE: For the purpose of this Clause, solar hot water systems fitted with a thermosiphon arrester, a heat dump valve, or a differential pump controller with a high limit cut-out are considered as having a controlled heat source.



Y	**Minimum nominal diameter~~,~~ DN**				
	~~*X*,~~ *X* **m**				
m	**2**	**4**	**6**	**8**	**10**
1	20	20	25	32	32
2	20	20	25	32	32
3	20	20	20	25	32
4	18	20	20	25	25
5	18	20	20	20	25
6	18	18	20	20	25

NOTE: Dimensions *X* and *Y* are true horizontal and vertical distances, respectively.

FIGURE 7.2.1 PIPE COORDINATES—THERMOSIPHON SYSTEMS

7.2.2 Supplementary external heating

Supplementary heating connection shall not be made into the primary circuit flow or return piping.

7.2.3 Provision for drainage

A drain point to which a hose may be attached shall be provided at the system's lowest point.

SECTION 8 ENERGY EFFICIENCY

8.1 SCOPE OF SECTION

This Section specifies energy efficiency requirements for heated water installations.

In New Zealand, it applies to all systems supplying hot water to sanitary fixtures except where individual storage vessels exceed 700 L in capacity.

NOTES:

1 This Section does not apply to central heating systems.

2 The provisions in this Section are to assist in the reduction of greenhouse gas emissions by arranging heated water services to use energy efficiently.

8.2 THERMAL INSULATION

8.2.1 Piping associated with storage water heaters

Piping shall be thermally insulated to achieve a minimum R-value as given in Table 8.2.1 for the climate regions identified in Appendix ~~L~~ K for Australia and Appendix ~~M~~ L for New Zealand, as follows:

(a) The inlet and outlet pipes, including valves, for a storage water heater, for at least the first 500 mm or, where an external heat trap is fitted, to a point 150 mm down the heat trap vertical leg closest to the water heater.

(b) All relief valves fitted directly to a storage water heater.

(c) The primary flow and return pipes, including valves, between an auxiliary heater and a storage water heater.

(d) All vent pipes to 300 mm above the maximum operating water level of the heated water system.

(e) On multiple installations, the whole heated water manifold, including valves, to a point at least 500 mm past the heated water outlet branch from the last water heater.

(f) On a solar water heater installation, the pipework between a solar pre-heater and an in-line supplementary water heater.

The insulation installed in accordance with the above shall be installed so as not to impede the operation of the valves.

NOTES:

1 Care should be taken to ensure the continuity of insulation at wall and roof penetrations. Insulation should be carried through roof penetrations into the ceiling area.

2 In New Zealand, refer to Document H1/AS1 and NZS 4305.

3 All exposed heated and cold water piping to and from externally mounted water heaters in frost-prone areas may require additional insulation to prevent freezing.

TABLE 8.2.1

MINIMUM THERMAL INSULATION—PIPING ASSOCIATED WITH STORAGE WATER HEATERS

	Internal locations	External locations			
	All climate regions	Climate region A	Climate region B	Climate region C (*except alpine areas and as in Note 3)	Climate region C alpine areas (see Note 4)
Pipe	0.3	0.3	0.6	0.6*	1.0
Valve	0.2	0.2	0.2	0.2	0.2

NOTES:

1 An external location of a building is an unenclosed area and includes—

(a) an open sub-floor area of a building; and

(b) the area of a building located under an open veranda or carport.

2 The total R-values specified in this Table may be achieved for most heated water piping materials by using the following insulation:

(a) 9 mm of closed cell polymer, R = 0.2.

(b) 13 mm of closed cell polymer, R = 0.3.

(c) 25 mm of closed cell polymer, R = 0.6.

(d) 38 mm of closed cell polymer, R = 1.0.

3 Where the length of the piping to or from the water heater is exposed in an external location for more than 1 m, the minimum thermal insulation in Region ‘C’ shall be R 1.0.

4 Alpine areas are areas in ~~NSW~~New South Wales, ~~ACT~~ Australian Capital Territory and Victoria higher than 1200 m above Australian Height Datum, and in Tasmania higher than 900 m above Australian Height Datum.

8.2.2 Other piping for heated water systems

Heated water system piping shall be thermally insulated in accordance with Table 8.2.2 for the climate regions identified in Appendix ~~L~~ K for Australia and Appendix ~~M~~ L for New Zealand.

Where piping is required to be thermally insulated, valves in the line of pipe shall be insulated to a minimum total R-value of 0.2.

NOTE: See Note 2(a) of Table 8.2.1.

TABLE 8.2.2

MINIMUM THERMAL INSULATION—HEATED WATER PIPING

System	Location of piping to be insulated	Minimum total R-values		
		Climate region A	Climate region B	Climate region C
Non-circulating heated water piping	All heated water piping that is buried or is within a conduit encased within a concrete floor slab	0.3	0.3	0.3
	All external piping from the water heater to the primary kitchen sink	0.3	0.6	1.0
	All external piping with trace heating including 500 mm along any branch off the trace-heated line	0.3	0.6	1.0
	All internal piping with trace heating, including 500 mm along any branch off the trace-heated line	0.3	0.3	0.3
Circulating heated water piping	All heated water piping that is buried or is within a conduit encased within a concrete floor slab (except for piping that is part of a floor heating system)	~~0.3~~0.6	~~0.3~~0.6	~~0.3~~0.6
	All external flow and return piping, including 500 mm along any branch from the flow and return piping	~~0.3~~0.6	0.6	1.0
	All internal flow and return piping, including 500 mm along any branch from the flow and return piping	~~0.3~~0.6	~~0.3~~0.6	~~0.3~~0.6

NOTES:

1 An external location of a building is an unenclosed area and includes—

(a) an open sub-floor area of a building; and

(b) the area of a building located under an open veranda or carport, or the like.

2 The total R-values specified in this Table may be achieved for most heated water piping materials by using the following insulation:

(a) 13 mm of closed cell polymer, R = 0.3.

(b) 25 mm of closed cell polymer, R = 0.6.

(c) 38 mm of closed cell polymer, R = 1.0.

3 Total R-values for insulation materials are calculated using the following:

(a) R-value: the thermal resistance (m^2.K/W) of a component calculated by dividing its thickness by its thermal conductivity.

(b) Total R-value: the sum of the R-values of the individual component layers in a composite element including the air space and associated surface resistances.

4 Circulating heated water piping includes piping on solar water heating systems.

8.3 PROTECTION OF INSULATION

8.3.1 Insulation exposed to the weather

Where insulation is exposed to the weather, it shall be of a weather-resistant type or surrounded by a weather-resistant enclosure.

8.3.2 Protection of thermal insulation on buried piping

Thermal insulation on buried piping shall be protected as follows:

(a) All absorptive insulation material shall be effectively protected against moisture penetration by an outer cover made of a durable waterproof material.

(b) Where insulation is cut for joining purposes, the joint shall be wrapped with a durable inert waterproof tape.

8.4 HEAT TRAPS

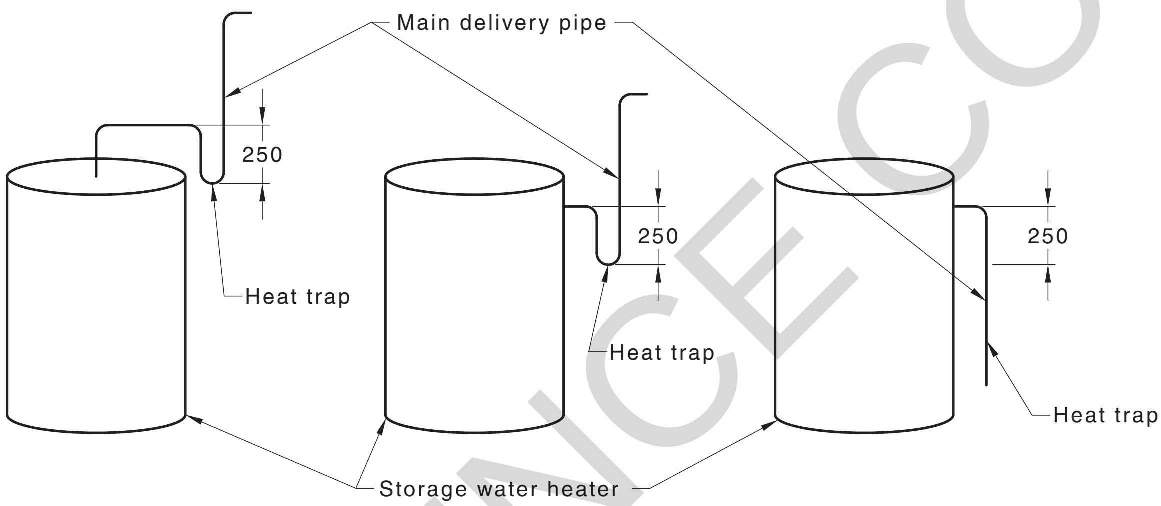
Heat traps shall be included in new and replacement non-circulatory installations ~~and shall comply with the following~~as follows:

(a) All storage water heaters shall have a heat trap within 1 m from the outlet of the water heater and before the first branch.

NOTE: For typical configurations, see Figure 8.4.

(b) The heat trap shall have a vertical drop of 250 mm from the outlet level of the storage water heater if the heat trap is not an integral part of the water heater.

NOTE: Where a heat trap is integral with the storage water heater and this is indicated by the permanent marking on the water heater, an external heat trap is not required.



NOTE: Heat traps to be within 1 m from the outlet of unvented storage water heaters.

DIMENSIONS IN MILLIMETRES

FIGURE 8.4 ~~EXTERNAL HEAT TRAPS—TYPICAL~~ TYPICAL CONFIGURATIONS OF EXTERNAL HEAT TRAPS

8.5 —CONTAINER FOR STORAGE OF HEATED WATER

Any container used to store heated water shall be thermally insulated to a minimum total R-value of 1.0 unless it is—

(a) a water heater; or

(b) marked as ~~complying~~ conforming with AS 3498 or AS/NZS 2712.

NOTE: This Clause applies to a container that is not included in the authorization of water heaters and other heated water storage tanks covered by the Minimum Energy Performance Scheme (MEPS).

8.6 R-VALUE CALCULATIONS

The total R-value of a pipe fitted with a single layer of insulation may be calculated approximately as follows:

$$R = \frac{x_i}{k_i} + \frac{x_p}{k_p}$$

where

R = total thermal resistance, in square metre kelvin per watt (m^2 K/W)

x_i = thickness of insulation, in metres (m)

k_i = thermal conductivity of insulation material, watt per metre kelvin (W/m K)

x_p = thickness of pipe wall, in metres (m)

k_p = thermal conductivity of pipe material, watt per metre kelvin (W/m K)

SECTION 9 TESTING AND COMMISSIONING

9.1 SCOPE OF SECTION

This Section specifies requirements for testing and commissioning a heated water service.

NOTE: All fixtures, appliances, water tanks, storage water heaters and other equipment, which may be damaged during pressure testing, should be isolated before testing.

9.2 FLUSHING

Prior to hydrostatic testing, the piping system shall be cleaned and flushed to remove foreign matter. The flushing shall continue until the flushed water runs completely clear. After flushing, each line strainer shall be inspected and cleaned as necessary.

NOTE: For special conditions for thermostatic mixing valves, see Clause 3.3.

9.3 TESTING

When all draw-off points are closed, those pipes that are subjected to pressure shall be hydrostatically tested in accordance with the following:

(a) The completed heated water reticulation, excluding the storage container or water heater, shall not leak when tested with water at ambient temperature at a pressure of 1500 kPa for a period of not less than 30 min. Prior to testing, the heating medium shall be isolated.

NOTE: It may be necessary to disconnect fixtures, appliances and valves in order to prevent damage during testing.

(b) Testing shall be carried out on all piping prior to being insulated or concealed in ducts, chases or trenches.

(c) The complete system, including valves, pumps and other equipment, shall be tested under normal working conditions for a period of not less than 48 h. The system shall be checked visually for leaks.

(d) All safe trays and safe wastes shall be tested with water to ensure that they do not leak under full flow conditions.

(e) All drain pipes from expansion control and temperature/pressure-relief valves, air eliminator valves and all vent pipes shall be tested with water to ensure that they are unobstructed and are open to the atmosphere.

9.4 COMMISSIONING

The heated water service shall be commissioned in accordance with the following:

(a) Where an expansion vessel is fitted adjust the pre-charge pressure to equal the water supply pressure and each vessel shall be labelled with a water and fade resistant label affixed to the vessel, stating the pre-charge pressure.

(b) ~~(a)~~The system shall be charged with water prior to the heating medium being applied to the heater.

(c) ~~(b)~~All air shall be fully purged from the system.

(d) ~~(c)~~The following items shall be checked for correct operation, as applicable:

(i) Leakage from each temperature/pressure-relief valve, pressure-relief valve and expansion control valve.

(ii) Stored water temperature in accordance with Clause 1.9.1 or the water heater is certified to AS 3498.

(iii) Hot water delivery temperature limitation.

(iv) Water level in a gravity-type system.

(v) Inlet isolating valve, fully open.

(vi) Flow rate at outlet points.

~~(vii) Pump.~~

~~(viii)Flow and return temperatures.~~

(vii) Temperature at outlet points.

(viii) Pumps.

(ix) Air eliminator valves.

(x) ~~(ix)~~Inlet pressures where a reduced pressure valve is installed.

(xi) ~~(x)~~Vibration, noise or water hammer.

(xii) ~~(xi)~~Each multiple heater unit shall be checked for operation, individually.

(e) For a circulating heated water system on completion of Item (c) the following items shall be checked and adjusted for correct operation, as applicable:

(i) Flow and return temperatures at the water heater or heated water storage vessel.

(ii) Temperature, flow rate and velocity at each balancing valve.

(iii) Velocity of heated water relating to the return pipework.

(iv) Thermal insulation has been installed correctly.

(v) Circulating pump(s) operation.

(vi) Velocity measurement at the inlet or outlet of the circulating pump(s).

(vii) Joints are not leaking when at full operating pressures and temperatures.

(viii) Repeat checks 24 hours after commissioning to confirm system operation.

(f) On completion of Item (e) each balancing valve shall be labelled with a water and fade resistant label affixed to the valve, with the following information:

(i) Identification number.

(ii) Valve size.

(iii) Design flow rate.

(iv) Actual flow rate at completion of commissioning.

9.5 HEATED WATER CIRCULATING SYSTEM DIAGRAM

Where a circulating heated water system is installed, there shall be water, fade and weather resistant diagram(s) that conform with the following:

(a) A diagram shall be permanently affixed in a prominent location adjacent to the circulation pumps.

(b) The diagram shall be not less than A3 in size and not more than A1 in size.

NOTE: Where a single diagram cannot appropriately represent the size and or complexity of the building or buildings consideration should be given to the provision of multiple block plans.

(c) The diagram shall display a diagrammatic layout of the circulatory heated water piping and the water heating plant.

NOTE:A typical diagram is shown in Figure 9.5.

(d) The diagram shall include a schematic diagram showing the following:

(i) The source and size of the cold water supply to the water heating plant.

(ii) Water heating plant capacity, recovery rate and fuel source.

(iii) The pressure and flow of the cold water supply to the water heating plant.

(iv) Expansion valves, expansion vessels and relief valves.

(v) Temperature setting for pipe system over temperature alarm.

(vi) Circulation pump configuration including valves.

(vii) Circulation pump activation.

(viii) Pressure and flow duties of circulation pumps.

(ix) For circulation pumps with adjustable speed setting the speed setting used for commissioning.

(x) The maximum flow and velocity for each section and pipe size as used for commissioning.

(xi) Pressure zones, maximum and minimum pressures.

(xii) Balancing valves size, type, identification number and location.

(xiii) Pipe material.

(xiv) Pipe sizes.

(xv) Location of isolation valves.

(xvi) Location of expansion loops, offsets and fittings.

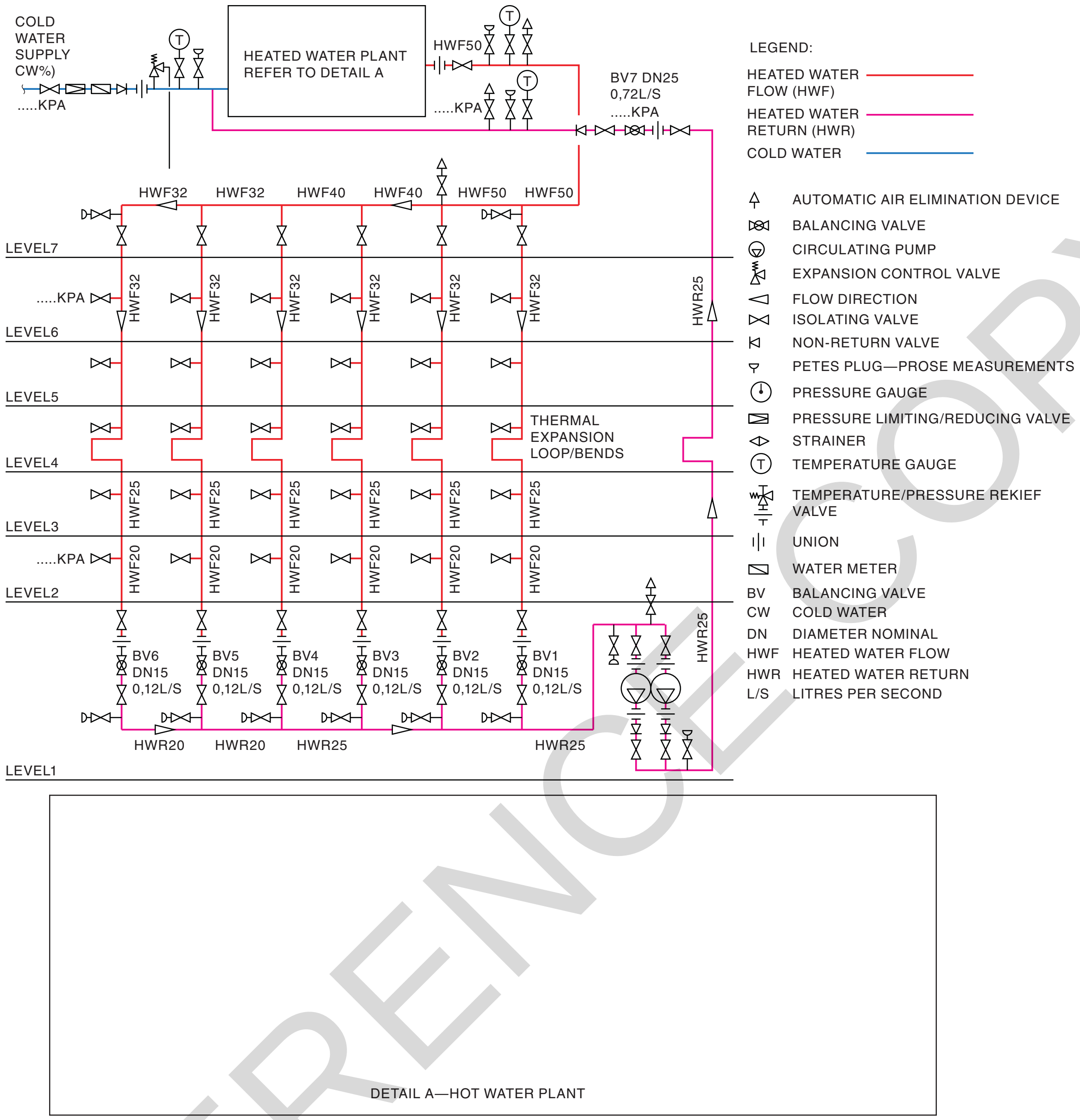
(e) The diagram shall include—

(i) the year of installation of the circulatory piping system;

(ii) any alterations or extensions to the system beyond the original installation date;

(iii) the name of the contractor who installed or modified the system; and

(iv) the name of the commissioning agent who commissioned the system.



SYSTEM INFORMATION

AUSTRALIAN STANDARD: AS/NZS 3500.4 2015
YEAR OF INSTALLATION/MODIFICATION:....................................
DATE OF COMMISSIONING:...
MATERIAL: COPPER TYPE B/PPR/STAINLESS STEEL 316
CIRCULATING PUMP OPERATION: DUAL-DUTY/STANDBY
AUTOMATIC CHANGE OVER 24 HR
CIRCULATING PUMP SPEED SETTING: SPEED 3

CIRCULATING PUMPS DUTY 0,72L/S @ * M/H (Each pump)
HOT WATER HEATER PLANT CAPACITY/RECOVERY:
2,400 LIRES 1ST HOUR & 900 LITRES RECOVERY
BALANCING VALVE TYPE:..
TOTAL NUMBER OF BALANCING VALVES: 7
HEATING PLANT EBERGY SOURCE; NATURAL GAS

COMMISSIONING AGENT INFORMATION	**INSTALLER INFORMATION**
INSTALLER NAME:.................................. PLUMBING PTY LTC ADDRESS:.. ABN:.. CONTRACTORS LICENCE NUMBER:..	INSTALLER NAME:.................................. PLUMBING PTY LTC ADDRESS:.. ABN:.. CONTRACTORS LICENCE NUMBER:..

FIGURE 9.5 TYPICAL CIRCULATORY HEATED WATER DIAGRAM

9.6~~9.5~~ OPERATING INSTRUCTIONS

Operating instructions including an electronic copy of the diagram shall be made available to the owner or occupier of the premises.

~~APPENDIX A~~

~~NORMATIVE REFERENCES~~

~~(Normative)~~

SECTION 10 SIZING AND INSTALLATION OF CIRCULATORY HEATED WATER RETICULATION

10.1 SCOPE OF SECTION

This Section sets out minimum requirements for the sizing and installation of forced circulation heated water reticulation installations, where the delivery temperature flowing from a water heater, bank of water heaters or a heated water storage vessel shall be no less than 60°C and shall not exceed 65°C. The return water temperature to the water heater, bank of heaters or heated water storage vessel shall be no less than 55°C.

10.2 FLOW REQUIREMENTS

10.2.1 General

The circulatory heated water reticulation system shall be sized to meet the Probable Simultaneous Demand (PSD) requirements of the fixtures connected to the heated water installation.

NOTE: See Appendix O as a guide to determine the PSD from estimated Loading Units (LU's) for residential buildings.

10.2.2 Flow rates

The flow rates to fixtures, appliances, taps and valves shall be not less than the flow rates specified in Table 10.2.2.

The maximum flow rate from a shower, basin and kitchen sink or laundry outlet shall not exceed 9 L/min.

TABLE 10.2.2

FLOW RATES AND LOADING UNITS FOR HEATED WATER

Fixture/appliance	Flow rate L/s	Flow rate L/min	Loading units
Bath	0.15	9	4
Basin (standard outlet)	0.10	6	1
Spray tap	0.03	1.8	0.5
Shower (heated water in a mixed flow)	0.10	6	2
Sink (standard tap)	0.12	7	3
Sink (aerated tap)	0.10	6	2
Laundry trough	0.12	7	3
Washing machine/dishwasher	0.10	6	2

NOTES:

1 Flow rates and loading units are applicable to domestic applications. For commercial applications refer to the technical specifications of the fixture outlet.

2 In the case of valves and appliances where test information indicates that they will function satisfactorily with a flow rate less than that shown in this Table, the tested flow rate may be substituted and the loading units adjusted accordingly.

3 This Table does not make allowance for commercial fixtures.

10.2.3 Loading units

Loading units are factors that take into account the flow rate, length of time in use and frequency of use of the fixture or appliance. Loading units for fixtures/appliances shall be in accordance with Table 10.2.2.

10.2.4 Continuous demand outlets

The flow rate from outlets connected to the heated water reticulation system which have a continuous demand shall not be included in the summary of loading units.

The flow rate from continuous demand fixtures shall be added to the estimated flow rate determined from the loading units summary.

NOTE: Examples of continuous demand include commercial washing machines and commercial kitchens.

10.2.5 Probable simultaneous demand (PSD)

The PSD shall be determined by adding up the total connected loading units in the system and applying a suitable diversity factor to the total connected loading units and then adding the flow rates from any continuous flow fixtures to the flow rates determined from the diversity factor applied to the loading units.

NOTES:

1 See Appendix O for examples of flow rates determined from the total of loading units.

2 The PSD for commercial premises should be derived in consultation with the building owner.

10.2.6 Probable simultaneous flow rate (PSFR)

Conversion of loading units to probable simultaneous flow rates (PSFRs) for branch piping within dwellings is given in Table 10.2.6.

NOTES:

1 A method for sizing piping within dwellings is shown in Appendix D of AS/NZS 3500.1.

2 Flow rates may be used to estimate the minimum size of piping within dwellings.

TABLE 10.2.6

PROBABLE SIMULTANEOUS FLOW RATES (PSFRs)

Loading units	PSFR L/s	Loading units	PSFR L/s	Loading units	PSFR L/s
1	0.09	21	0.39	41	0.55
2	0.12	22	0.40	42	0.56
3	0.14	23	0.41	43	0.57
4	0.16	24	0.42	44	0.58
5	0.18	25	0.43	45	0.58
6	0.20	26	0.43	46	0.59
7	0.22	27	0.44	47	0.60
8	0.24	28	0.45	48	0.60
9	0.25	29	0.46	49	0.61
10	0.26	30	0.47	50	0.62
11	0.28	31	0.48	51	0.62
12	0.29	32	0.49	52	0.63
13	0.30	33	0.49	53	0.64

(continued)

TABLE 10.2.6 (*continued*)

Loading units	PSFR L/s	Loading units	PSFR L/s	Loading units	PSFR L/s
14	0.31	34	0.50	54	0.64
15	0.33	35	0.51	55	0.65
16	0.34	36	0.52	56	0.65
17	0.35	37	0.52	57	0.66
18	0.36	38	0.53	58	0.67
19	0.37	39	0.54	59	0.67
20	0.38	40	0.55	60	0.68

10.3 PRESSURE REQUIREMENTS

10.3.1 Available pressure

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

10.3.2 Pressure at outlets

The minimum working pressure at the furthermost or most disadvantaged fixture or outlet shall be not less than 50 kPa (5 m head), at the flow rate specified in Table 10.2.2.

NOTES:

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

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

10.3.3 Pressure losses

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

10.3.4 Maximum pressure within buildings

Provision shall be made to ensure that the maximum static pressure at any heated water outlet within a building does not exceed 500 kPa.

NOTE: Pressure above 500 kPa can cause damage from water hammer, reduced life of appliances, taps, pipes and fittings and cause excessive noise in the system.

10.3.5 Pressure differential

10.3.5.1 *General*

Any dynamic pressure differential between the heated water and cold water shall not cause temperature fluctuations at a tap outlet.

10.3.5.2 *Maximum differential*

Where heated water is mixed with cold water at a mixing valve or combined tap the dynamic pressure differential between the heated and cold water supplies shall not exceed 10%.

10.3.6 Pressure booster pumps

10.3.6.1 *General*

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

10.3.6.2 *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.

> ***C10.3.6.2*** *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.*

10.4 VELOCITY REQUIREMENTS

10.4.1 General

Other than for Clause 10.4.2, the maximum water flow velocity at any point in the circulatory piping shall be as specified in Table 1.8.

10.4.2 Circulating pumps

10.4.2.1 *General*

Circulating pumps installed in a heated water service shall conform with testing for use in contact with drinking water to AS/NZS 4020, see Clause 2.3.

10.4.2.2 *Return pipe*

The internal diameter of the return pipe shall not be less than 10 mm.

The maximum velocity in the return pipe shall be 1.0 m/s.

10.4.2.3 *Sizing circulating pumps*

Friction and head losses shall be calculated along the hydraulically most disadvantaged pipe run. Include losses at all check valves, water heaters and other associated equipment. The pump shall be sized to achieve the required flow rate to maintain a circuit temperature drop of no greater than 5°C.

NOTE: The circulating pump is only required to overcome the head losses when all outlets are closed and the system is operating at the flow rate to achieve the temperature drop.

> ***C10.4.2.3*** *Increasing thermal insulation and locating circulating heated water pipes into warmer ambient air temperature will reduce heat loss and increase efficiency of the system.*

10.4.3 Velocity, pressure and temperature

10.4.3.1 *General*

Velocities, pressures and temperatures associated with water flowing through forced secondary circuits shall not exceed the limits specified for the materials and components in the system.

10.5 EXPANSION OF HEATED WATER

10.5.1 General

Any allowance at the water heater for relieving pressure increase caused by the heating of water shall include the capacity of the secondary flow and return piping.

NOTE: See Clause 5.8.

10.6 AIR ELIMINATION

10.6.1 General

All circulatory heated water piping shall be designed and installed to eliminate air that can become entrained.

10.6.2 Air elimination valves

Automatic air elimination devices shall be installed—

(a) at the highest point or points of the circulatory piping;

(b) on the secondary flow adjacent to the water heater or bank of water heaters;

(c) in an accessible location; and

(d) with a connected drain delivering over a tundish.

Automatic air elimination devices shall not be installed on the suction side immediately prior to the pump.

> ***C10.6.2*** *Trapped air in circulatory heated water pipe systems can lead to increased corrosion of pipes as well as cause column separation which causes water hammer, pressure surges and cavitation.*
>
> *Water hammer is caused by sudden changes in velocity. Trapped air leading to column separation and fast acting valves or tapware can be causes of water hammer within heated water pipework. Piping should be designed so that entrapped air is automatically removed and pipes are sized to minimize the effect of pressure shock.*
>
> *Cavitation is the formation of vapour bubbles within a liquid that can occur due to rapid drop in pressure. When a vapour bubble collapses it generates an immediate pressure shock wave of several thousand kPa and extreme temperatures. Vapour bubbles that collapse near a pipe wall or surface will over time cause significant damage to the piping material. Cavitation damage is more likely to occur in heated water piping systems at higher water temperatures due to a reduced vapour pressure of the liquid. As the temperature of water increases and the pressure decreases the ability of a liquid to contain dissolved gases reduces and vapour bubbles form. The damage to pipes typically occur when vapour bubbles are present and the pressure of the system increases, forcing the vapour bubbles to implode. Heated water plant located on the roof tops of high-rise buildings with the piping system circulating down throughout the building are particularly susceptible to these actions. Where the heated water plant is located within the basement of high-rise buildings it is the return pipe that becomes susceptible to damage. Central heated water systems should be designed and installed to eliminate the damaging effects of cavitation.*

10.7 LOCATION OF CIRCULATORY PIPING

10.7.1 General

Flow and return heated water piping that services more than one apartment, dwelling or secure area shall be located in the common property, subject to the limitations of Clause 4.5.

10.7.2 Branch offtakes

Circulatory piping shall be located so that dead leg branch offtakes are as close as practicable to the most frequently used outlet point or points serviced by a branch.

NOTE: See also Clause 4.12.1.

10.7.3 Proximity to cold water piping

Flow and return heated water pipe systems shall be designed so as to prevent unintentional transfer of heat to any cold water service.

NOTE: This may be achieved through one or more of—

(a) installing circulating heated water pipes in separate duct to cold water services;

(b) additional thermal insulation to the heated water pipes;

(c) applying thermal insulation to the cold water pipes; or

(d) ventilating the duct to expel warmed air.

10.8 ISOLATING VALVES

10.8.1 General

The flow within circulating piping including branches shall be controlled by means of isolating valves.

10.8.2 Location

Isolating valves shall be installed in the following locations:

(a) At the outlet and return connections to a water heater or heated water storage vessel subject to the limitations of Clause 5.10.

(b) At branch offtakes.

(c) At branch offtakes and returns from and to the main flow and return piping for both vertical and horizontal sub flow and return circuits.

(d) At branch offtakes serving any individual apartment, dwelling or secure area and be accessible by the individual apartment, dwelling or secure area occupier.

(e) At the inlet to any heated water meter.

(f) At the inlet to each air elimination valve.

(g) At each testable backflow prevention device.

(h) At each pressure-limiting or pressure reduction valve.

(i) At the delivery side and suction side to each pumping apparatus.

10.8.3 Multiple apartments, dwellings and secure areas

An isolation valve installed on a branch serving an individual apartment, dwelling or secure area shall be accessible by the individual occupier from common property.

The isolation of flow and return piping to any individual apartment, dwelling or secure area shall not limit the supply to any other area.

10.8.4 Maintenance

Isolating valves shall be installed so they are accessible.

10.9 BALANCING VALVES

10.9.1 General

Balancing valves shall be installed to control the temperature within a circulating heated water system by dynamically adjusting the flow rate in a branch or circuit.

10.9.2 Commissioning

Balancing valves shall be commissioned, see Clause 9.4.

APPENDIX A

AS 1074	Steel tubes and tubulars for ordinary service	
1167	Welding and brazing—Filler metals	
1167.1	Part 1:	Filler metal for brazing and braze welding
1345	Identification of the contents of pipes, conduits and ducts	
1379	Specification and supply of concrete	
1397	Continuous hot-dip metallic coated steel sheet and strip—Coatings of zinc and zinc alloyed with aluminium and magnesium	
1432	Copper tubes for plumbing, gasfitting and drainage applications	
1478	Chemical admixtures for concrete, mortar and grout	
1478.1	Part 1:	Admixtures for concrete
1528	Tubes (stainless steel) and tube fittings for the food industry	
1528.1	Part 1:	Tubes
1604	Specifications for preservative treatment (all parts)	
1646	Elastomeric seals for water works purposes	
1910	Water supply—Float control valves for use in hot and cold water	
2129	Flanges for pipes, valves and fittings	
3498	Authorization requirements for plumbing products—Water heaters and hot- water storage tanks	
3600	Concrete structures	
3688	Water supply—Metallic fittings and end connectors	
3795	Copper alloy tubes for plumbing and drainage applications	
4032	Water supply—Valves for the control of hot water supply temperatures	
4032.1	Part 1:	Thermostatic mixing valves—Materials design and performance requirements
4032.2	Part 2:	Tempering valves and end-of-line temperature-actuated devices
4087	Metallic flanges for waterworks purposes	
AS 4176	Multilayer pipes for pressure applications	
4176.1	Part 1:	Multilayer piping systems for hot and cold water plumbing applications—General
4176.2	Part 2	Multilayer piping systems for hot and cold water plumbing applications—General Multilayer piping systems for hot and cold water plumbing applications—Pipes
4176.3	Part 3	Multilayer piping systems for hot and cold water plumbing applications—Fittings
4176.5	Part 5	Multilayer piping systems for hot and cold water plumbing applications—Fitness for purpose of the systems
AS 4176.7	Part 7	Multilayer piping systems for hot and cold water plumbing applications—Assessment of conformity
4809	Copper pipe and fittings—Installation and commissioning	
5082	Polybutylene (PB) plumbing pipe systems—Metric series	
5082.1	Part 1:	Metric polybutylene (PB) pipes for hot and cold water applications

~~5082.2 Part 2: Mechanical and fusion jointing systems~~

~~5200 Plumbing and drainage products~~
~~5200.053 Part 053: Stainless steel pipes and tubes for pressure applications~~

~~AS/NZS~~
~~1167 Welding and brazing—Filler metals~~
~~1167.2 Part 2: Filler metal for welding~~

~~1260 PVC-U pipes and fittings for drain, waste and vent applications~~

~~2280 Ductile iron pressure fittings~~

~~2492 Cross-linked polyethylene (PE-X) pipe for hot and cold water applications~~

~~2537 Mechanical jointing fittings for use with crosslinked polyethylene (PE-X) for pressure applications (series)~~

~~2544 Grey iron pressure fittings~~

~~2642 Polybutylene (PB) plumbing pipe systems~~
~~2642.2 Part 2: Polybutylene (PB) pipe for hot and cold water applications~~
~~2642.3 Part 3: Mechanical jointing fittings for use with polybutylene (PB) pipes for hot and cold water applications~~

~~2712 Solar and heat pump water heaters—Design and construction~~

~~2878 Timbers—Classification into strength groups~~

~~3500 Plumbing and Drainage~~
~~3500.0 Part 0: Glossary of terms~~
~~3500.1 Part 1: Water services~~

~~4020 Testing of products for use in contact with drinking water~~

~~4129 Fittings for polyethylene (PE) pipes for pressure applications~~

~~4234 Heated water systems—Calculation of energy consumption~~

~~4331 Metallic flanges (all parts)~~

~~4671 Steel reinforcing materials~~

~~AS ISO~~
~~7 Pipe threads where pressure-tight joints are made on the threads—~~
~~7.1 Part 1: Dimensions, tolerances and designation~~

~~NZS~~
~~3109 Concrete construction~~

~~3124 Specification for concrete construction for minor works~~

~~3501 Specification of copper tubes for water, gas and sanitation~~

~~3631 New Zealand timber grading rules~~

~~3640 Chemical preservation of round and sawn timber.~~

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

~~4607 Installation of thermal storage electric water heaters: valve-vented systems~~

~~4613 Domestic solar water heaters~~

~~4614 Installation of domestic solar water heating systems~~

~~5807 Code of practice for industrial identification by colour, wording or other coding~~

NZS/BS

21 Pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)

3601 Specification for carbon steel pipes and tubes with specified room temperature properties for pressure purposes

ISO

15874 Plastics piping systems for hot and cold water installations—Polypropylene (PP)

15874-2 Part 2: Pipes

15874-3 Part 3: Fittings

ASTM

D2846 Standard Specification for Chlorinated Poly(Vinyl Chloride) Plastic Hot-and Cold-Water Distribution Systems

A268 Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service

ABCB

NCC National Construction Code

MIBE

NZBC New Zealand Building Code (G1, Personal hygiene; G12, Water supplies)

WATER ANALYSIS

(Informative)

A1B1 WATER ANALYSIS

Water analysis should be performed by an accredited analytical laboratory.

NOTE: When heated, some waters may produce excessive scaling due to the deposition of calcium carbonate. This type of scaling can eventually lead to the blockage of valves, pipes and specially tubes in solar collectors.

A2B2 CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS (TDS)

The selection of anode should be made, based on the conductivity of the water.

NOTES:

1 The concentration of the total dissolved solids affects the conductivity.

2 Anode selection should be made in accordance with the manufacturer's recommendation or, in the absence of such a recommendation, see Table B2A2.

TABLE B2A2

ANODE SELECTION

Anode material*		
TDS, mg/L		
0–50	50–400	>400
M1	M2	A5

* See Refer to AS 2239.

APPENDIX BAPPENDIX C

ACCEPTABLE PIPES AND FITTINGS

(Normative)

The following pipes and fittings are This Appendix sets out the acceptable solutions for pipes and fittings, subject to the limitations of Clause 2.4, as follows:

(a) Copper pipes and fittings in accordance with AS 1432 (Type Types A, B and C only) or NZS 3501 (water pipes).

(b) Copper alloy pipes in accordance with AS 3795.

(c) Copper and copper alloy fittings in accordance with AS 3688.

(d) Polybutylene (PB) pipes in accordance with AS/NZS 2642.2 or AS 5082.1 and fittings in accordance with AS/NZS 2642.3 or AS 5082.2.

(e) Cross-linked polyethylene (PE-X) pipes in accordance with AS/NZS 2492 and fittings in accordance with AS/NZS 2537 series.

(f) Polypropylene random copolymer (PP-R) pipes in accordance with ISO 15874-2 and fittings in accordance with ISO 15874-3.

(g) Multilayer pipes and fittings in accordance with AS 4176.1, AS 4176.2, AS 4176.3, AS 4176.5 and AS 4176.7.

(h) Chlorinated polyvinyl chloride (PVC-C) fittings in accordance with ASTM D2846.

(i) Stainless steel (SS) pipes in accordance with AS 5200.053 and fittings in accordance with AS 3688.

APPENDIX CAPPENDIX D

TYPICAL RATES OF FLOW

(Informative)

Typical flow rates of hot water demand at the outlet of fixtures are as follows:

(a) Bath 0.3 L/s.

(b) Shower 0.1 L/s.

INTERNAL PIPE SIZES

(Normative)

This Appendix sets out the internal diameter for different nominal diameters (DN), pipe materials and types, standard dimension ratios (SDRs) or pressure classes, as marked on the pipe.

For multilayer pipes, the internal diameters shall be specified by the pipe supplier, see Tables C1 to C3.

TABLE C1

(c) Handbasin 0.1 L/s.

(d) Kitchen sink 0.2 L/s.

(e) Washing machine 0.2 L/s.

(f) Laundry trough 0.2 L/s.

These values are for calculation purposes and are not necessarily the minimum that may be supplied (see AS/NZS 3500.1).

INTERNAL DIAMETERS FOR COPPER PIPES AND TUBES

DN	Copper (Australia only)			Copper (New Zealand only) mm
	Type A mm	Type B mm	Type C mm	
10	7.5	7.7	8.1	9.5
15	10.7	10.9	11.3	12.7
18	13.4	13.8	14.1	—
20	16.2	17.0	17.2	19.0
25	22.1	23.0	23.6	25.4
32	28.5	29.3	—	31.8
40	34.8	35.7	—	38.1
50	47.5	48.4	—	50.8
65	60.2	61.1	—	63.5
80	72.1	72.9	—	76.2
90	85.8	85.6	—	88.9
100	97.5	98.3	—	101.6
125	122.9	123.7	—	127.0
150	147.1	148.3	—	152.4
200	197.9	199.1	—	188.5

TABLE C2

INTERNAL DIAMETERS FOR STAINLESS STEEL PIPES AND TUBES

DN	Stainless steel pipes in accordance with ASME B36.19M		Stainless steel tubes in accordance with EN 10312
	Schedule 5S mm	Schedule 10S mm	Series 2 mm
15	18.0	17.1	13.0
18	—	—	16.0
20	23.4	22.5	19.6
25	30.1	27.9	25.6
32	38.9	36.6	32.0
40	45.0	42.7	39.0
50	57.0	54.8	51.0
65	68.8	66.9	72.1
80	84.7	82.8	84.9
100	110.1	108.2	104.0
125	135.8	134.5	—
150	162.8	161.5	—
200	213.6	211.6	—

TABLE C3

INTERNAL DIAMETERS FOR POLYOLEFIN PIPES

	PE-X, PP-R, PB (metric)		
DN/OD	SDR 11 mm	SDR 9 mm	SDR 7.4 mm
16	13.1	12.3	11.9
20	16.5	15.7	14.7
25	20.7	19.7	18.3
32	26.5	25.1	23.5
40	33.0	31.4	29.4
50	41.2	39.3	36.7
63	52.0	49.4	46.4
75	62.1	58.6	55.1
90	74.5	70.7	66.3
110	91.0	86.4	80.8
125	103.4	98.2	92.0
140	115.9	109.9	102.9
160	132.3	125.7	117.1
180	148.9	141.5	132.5
200	165.4	157.0	147.2

NOTES:

1 Standard dimension ratio (SDR)—Plastic pipes may be categorized by their SDR value. It is the ratio of the nominal outside diameter of the pipe to its nominal wall thickness, SDR = DN/T. SDR values are printed onto pipes and can be obtained from the pipe manufacturer.

2 Values were calculated from the values for maximum outside diameter and minimum wall thickness as specified in the respective pipe product Standards as follows:

(a) AS 1432 .... Copper (Australia only).

(b) NZS 3501 .... Copper (New Zealand only).

(c) AS/NZS 2492 .... PE-X.

(d) AS 5082.1 .... PB (metric series).

(e) AS/NZS 2642.2 .... PB (imperial series).

(f) ISO 15874.2 .... PP-R.

(g) AS 5200.053 .... Stainless Steel.

APPENDIX D~~APPENDIX E~~

PREFERRED SIZES OF PIPE FOR NON-CIRCULATORY TYPICAL SINGLE-STOREY HOUSEHOLD INSTALLATIONS

(Informative)

Feed	Minimum internal diameters of pipe mm			
	Heater operating head~~,~~ kPa			
	Less than 85	85 to 170	In excess of 170	
			Storage	Instantaneous
From heater to first branch	15.0	12.5	12.5	15.0
A branch to kitchen sink or washbasin	10.0	10.0	10.0	10.0
A branch to kitchen sink and laundry	10.0	10.0	10.0	10.0
A branch to bathroom and one other room	15.0	12.5	10.0	10.0
A branch to bathroom only, all pipe in bathroom	12.5	10.0	10.0	10.0

NOTE: The above are recommended sizes only. Individual installations may require larger piping to give the flow rates detailed in ~~Appendix D~~Table 10.2.2.

APPENDIX E~~APPENDIX F~~

RECOMMENDATIONS FOR THE INSTALLATION OF UNRATED SOLAR HEATED WATER SUPPLY SYSTEMS

(Informative)

E1~~F1~~ GENERAL

A custom-built system, which may comprise components that are manufactured by different manufacturers and are not specifically designed for use with each other, may not perform in a predictable manner nor be rated. Such systems commonly result from the addition of a new component to an existing component, e.g. solar collectors added to an existing hot water system. However, it is possible to avoid fundamental design mistakes in such systems, and the recommendations ~~set out~~ provided in this Appendix embody what is considered good practice in order to obtain a reasonable solar contribution.

E2~~F2~~ VOLUMETRIC STORAGE CAPACITY

The volumetric storage capacity of the container should be not less than the anticipated average daily consumption of the household.

For increased solar performance, a volumetric storage capacity of 1.5 to 2.0 times the anticipated average daily consumption of the household is recommended (see also Appendix ~~H~~G).

For systems using off-peak supplementary electric heating, the volumetric storage capacity of the container should be not less than 1.5 times the anticipated average daily consumption of the household.

E3~~F3~~ RECOMMENDED OPERATING TEMPERATURE

The solar hot water system ~~shall~~ needs to incorporate supplementary heating. For the purpose of obtaining an acceptable solar contribution, such supplementary heating (whether integral or remote) should be suitable for operation at 60°C nominal temperature.

E4~~F4~~ TEMPERATURE/PRESSURE-RELIEF VALVE

The temperature/pressure-relief-valve should be sized to allow for the energy input of the collectors at 99°C.

E5~~F5~~ COLLECTOR/CONTAINER SIZE RATIO

E5.1~~F5.1~~ Normal conditions

The collector aperture should be related to the volume of the container and to the location of the installation as indicated in Table ~~H1~~G1, Appendix ~~H~~G.

NOTE: Slightly less collector aperture will be required for collectors with selective surfaces. Care has to be taken to prevent excessive hot water temperatures with selective surface collectors.

Reference should also be made to Clauses 6.5.2.2 and 6.5.2.3.

E5.2~~F5.2~~ Non-optimum conditions

Where the operation of the collector is adversely affected by shade, inclination, orientation, excessive dust, smog, cloud, or the like, the size of the collector should be increased to compensate.

E6~~F6~~ COMPONENTS

Where a system is made up of components that have not been tested as a packaged system in accordance with AS/NZS 2712, the individual components should ~~comply~~ conform with AS/NZS 2712.

E7~~F7~~ CLAIMED PERFORMANCE

Claimed performance of a custom-built system may be related to a tested packaged system where the components have been individually tested and the ratio of collector aperture area to volume of the container are similar for the custom built system and tested packaged system.

APPENDIX F~~APPENDIX G~~

RECOMMENDATIONS FOR THE INSTALLATION OF CLOSE-COUPLED AND INTEGRAL SOLAR HEATED WATER SUPPLY SYSTEMS ON ROOFS

(Informative)

F1~~G1~~ GENERAL

The installation of a close-coupled or integral solar heated water supply system, which includes a container as well as collectors, on the roof of a building will impose additional loading on the roof structure. Care should be taken to ensure that the roof and building structure are capable of accepting this additional load. The recommendations ~~set out~~ provided in this Appendix are intended as a basic guide to a practice that has been found satisfactory in non-cyclonic areas.

F2~~G2~~ SUPPORT

F2.1~~G2.1~~ 'With pitch' installations

Solar heated water supply systems mounted directly onto a roof structure, i.e. 'with pitch' installations (see Figure ~~G1~~F2.1), should be arranged so that their weight is distributed evenly over as many roof rafters as possible. Roof struts supporting underpurlins that are affected by the additional load should be directly supported from loadbearing walls or appropriately designed strutting beams.

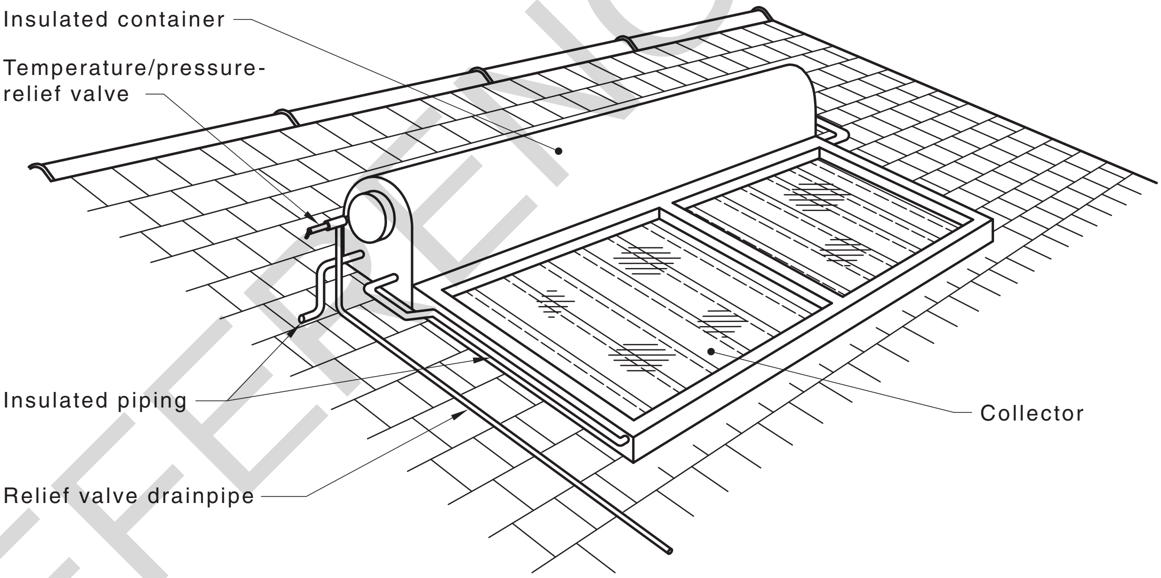


FIGURE ~~G1~~ F2.1 'WITH PITCH' INSTALLATION

F2.2G2.2 'Against pitch' installations

Solar heated water supply systems mounted on frames above roof structures at angles opposed to the roof pitch, i.e. 'against pitch' installations (see Figure G2F2), and which cause point loads, should have the container point loads taken through the roof membrane and be directly supported from loadbearing walls or appropriately designed strutting beams.

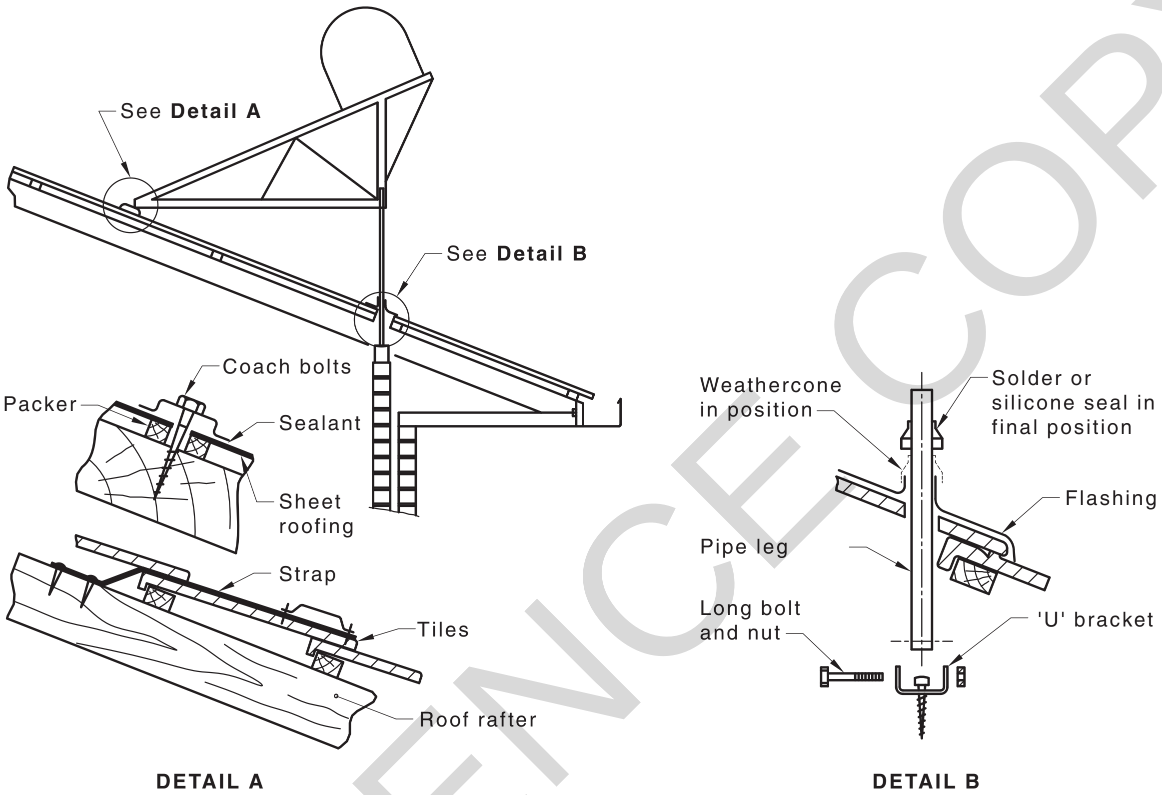


FIGURE G2 F2.2 'AGAINST PITCH' INSTALLATION

F2.3G2.3 'Cross-pitch' installations

Solar heated water supply systems mounted on frames above roofs across the pitch of the roof, i.e. 'cross-pitch' installations (see Figure G3F2.3), and which cause point loads, should be arranged so that one side of the system is directly supported from a loadbearing wall; the other side of the system should be directly supported from a strutting beam taking the load to not less than two timber studs at each end of the beam.

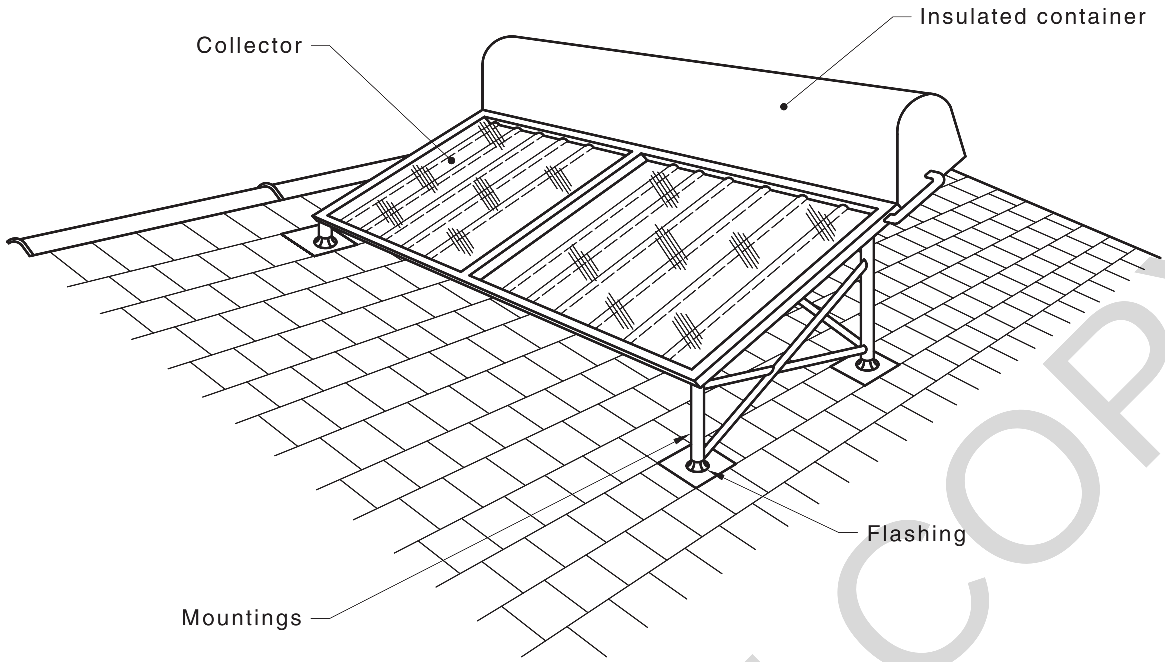


FIGURE ~~G3~~ F2.3 CROSS-PITCH INSTALLATION

F3~~G3~~ POINTS TO NOTE

When installing close-coupled and integral solar water heaters, it is necessary to observe the following precautions:

(a) The internal structure of the existing roof and the soundness of the roof timbers should be checked. Based on these observations or the recommendations of an engineer's report, additional strengthening may be required.

(b) Containers should not be placed in the middle of the roof over a large room.

(c) Where possible, the container should be located towards the apex of the roof and over bathroom or laundry areas, where the internal roof structures are usually supported from internal walls.

(d) Particular attention should be paid to installations on sheet-clad roofs. The generally wider timber spacings may require each rafter affected by the additional load to be strengthened or provided with additional support.

(e) On roofs where it is not possible to make an internal inspection, or where inspection reveals marginal agreement with the recommendations of this Standard, a further check should be made with the building authority prior to proceeding with the installation.

(f) Where a secondary metallic tile roofing has been installed over the initial roof cladding, any fixings that can be made to the roof members, should be made to the original roof structure and not to any secondary roofing members.

APPENDIX GAPPENDIX H

SOLAR HEATED WATER SUPPLY SYSTEMS—SUGGESTED COMPONENT SIZES (CUSTOM-BUILT SYSTEMS)

(Informative)

G1H1 GENERAL

The data ~~presented~~ provided in this Appendix should be read in conjunction with the text of the Standard.

G2H2 ANTICIPATED SOLAR FRACTION

The anticipated solar fraction (*f*) listed in Table ~~H1~~ G2 is for typical solar heated water supply systems installed in houses and incorporating a well-designed flat plate collector with a well-insulated container having a draw-off capacity not less than 80% container storage volume. However, the values for storage container capacity and collector area do not necessarily relate to any particular commercially available close-coupled systems. All data presented in this Appendix correspond to the average requirements of a four-person household.

TABLE ~~H1~~G2

SUGGESTED COMPONENT SIZES (CUSTOM-BUILT SYSTEMS)

1	2	3	4	5
Location	Collector		Container storage	Anticipated solar fraction (*f*)
	Angle of inclination	Area		
	~~Degrees~~degrees	m^2	L	~~Percent~~percent
Adelaide	35 (35)	4	315	74
Alice Springs	32 (24)	4	315	94
Auckland	35 (37)	4	360	65
Brisbane	29 (27)	4	315	81
Christchurch	35 (43.5)	4	360	60
Canberra	33 (35)	4	315	67
Darwin	15 (12)	3	270	97
Hobart	42 (43)	5	360	65
Invercargill	20 (40)	4	360	56
Melbourne	38 (38)	5	360	67
Perth	33 (32)	4	315	77
Sydney	34 (34)	4	315	76
Wellington	35 (41)	4	360	60

NOTES:

1 Column 2—Nominal angle of inclination of flat plate collector to horizontal (see Clause 6.5.1.3). Latitude angle is shown in parentheses.

2 Column 3—Collector aperture area, expressed in square metres. This area is for optimum conditions of collector inclination and orientation. For non-optimum conditions, the solar fraction will be reduced (see Appendix J) and a greater area may be required.

3 Column 5—Anticipated average annual solar energy fraction (*f*) expressed as a percentage of total hot water energy delivered, i.e.—

$$f = \frac{E_{wh} - E_p}{E_{wh}} \times 100$$

where

E_{wh} = hot water energy delivered at water heater outlet (mass × specific heat capacity × temperature differential)

E_p = total supplementary energy purchased for water heating

4 The actual solar fraction will vary with household hot water use patterns and with weather variations from year to year. The figures given should be accurate to within 5% for normal situations.

G3~~H3~~ SOLAR RADIATION DATA

Basic solar radiation data is given in Figures ~~H1~~ G3(A) and ~~H2~~ G3(B) for Australia and Figure ~~H3~~ G3(C) for New Zealand.~~For more comprehensive details of solar radiation, reference should be made in Australia to the *Australian Solar Radiation Data Handbook Edition 4*, published by the Australian and New Zealand Solar Energy Society (ANZSES), and, in New Zealand, to the National Institute of Water and Atmospheric Research (NIWA), Wellington.~~

NOTE: For more comprehensive details of solar radiation, reference should be made in Australia to ‘Australian Solar Radiation Data Handbook’, 4th ed, and, in New Zealand to the National Institute of Water and Atmospheric Research (NIWA), Wellington.

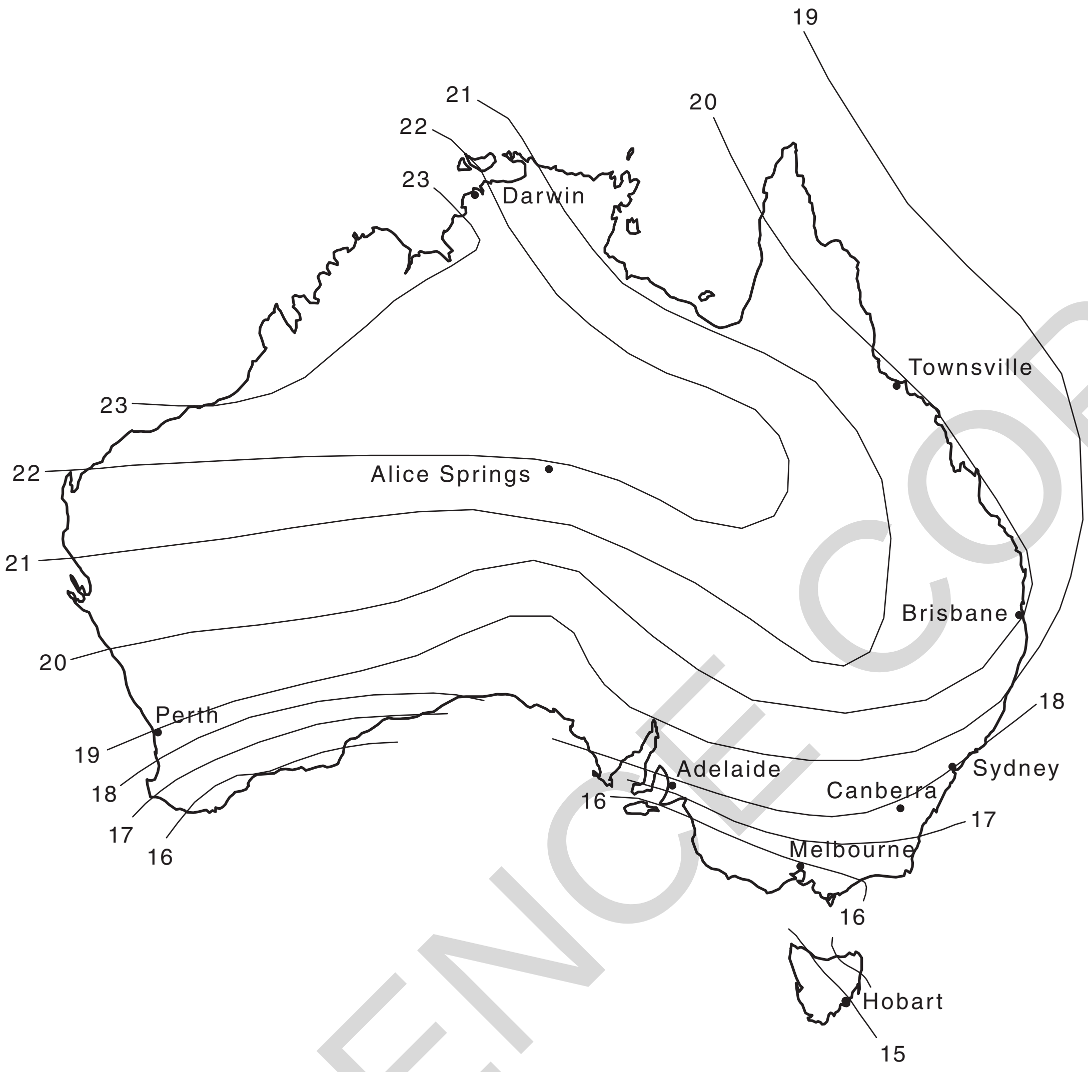


FIGURE ~~H1~~ G3(A) CONTOURS OF ANNUAL MEAN DAILY SOLAR RADIATION ON A HORIZONTAL SURFACE (MJ/m^2.d)

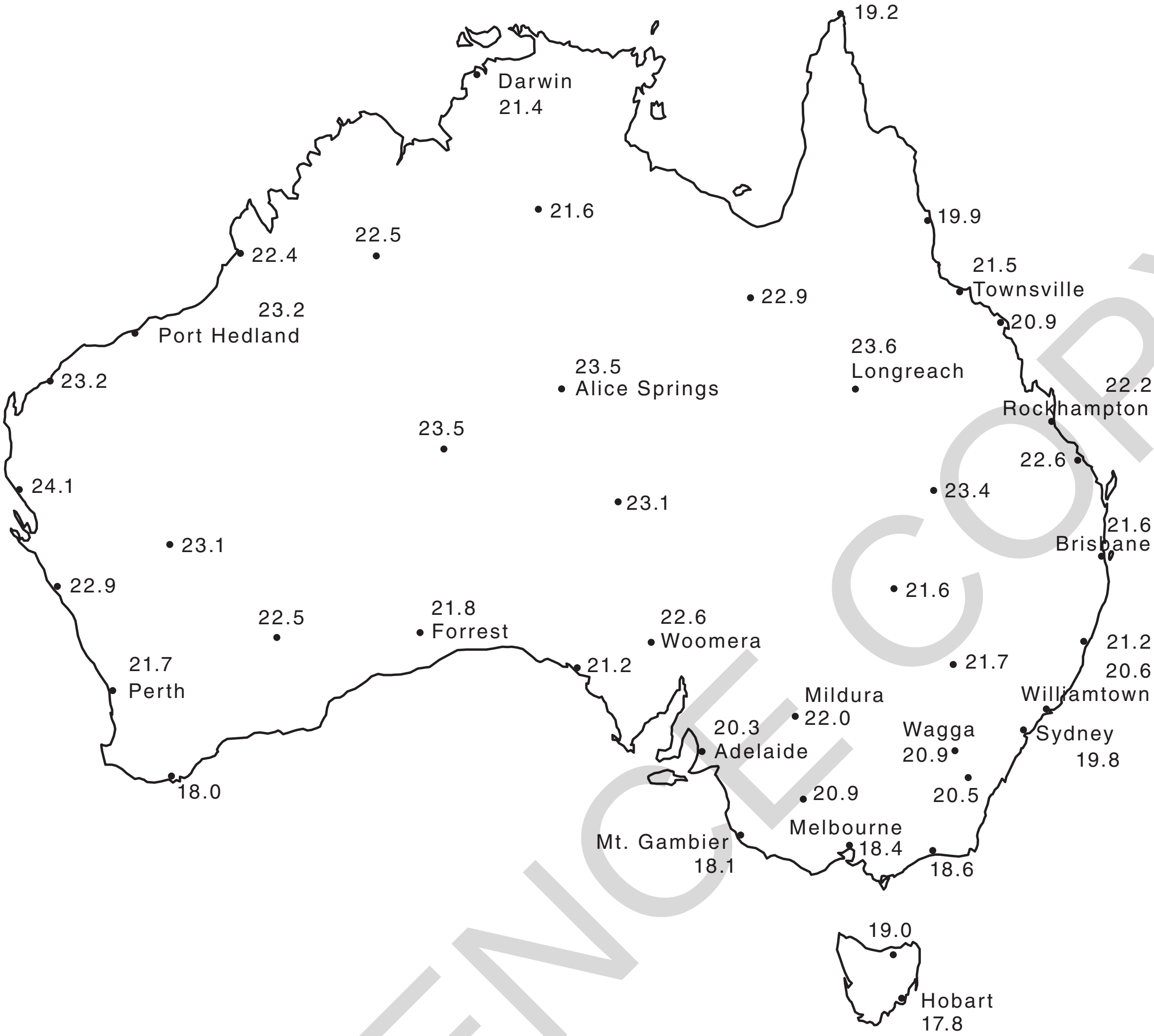


FIGURE ~~H2~~ G3(B) ANNUAL MEAN DAILY SOLAR RADIATION ON A NORTH FACING SURFACE INCLINED AT THE LATITUDE ANGLE (MJ/m^2.d)

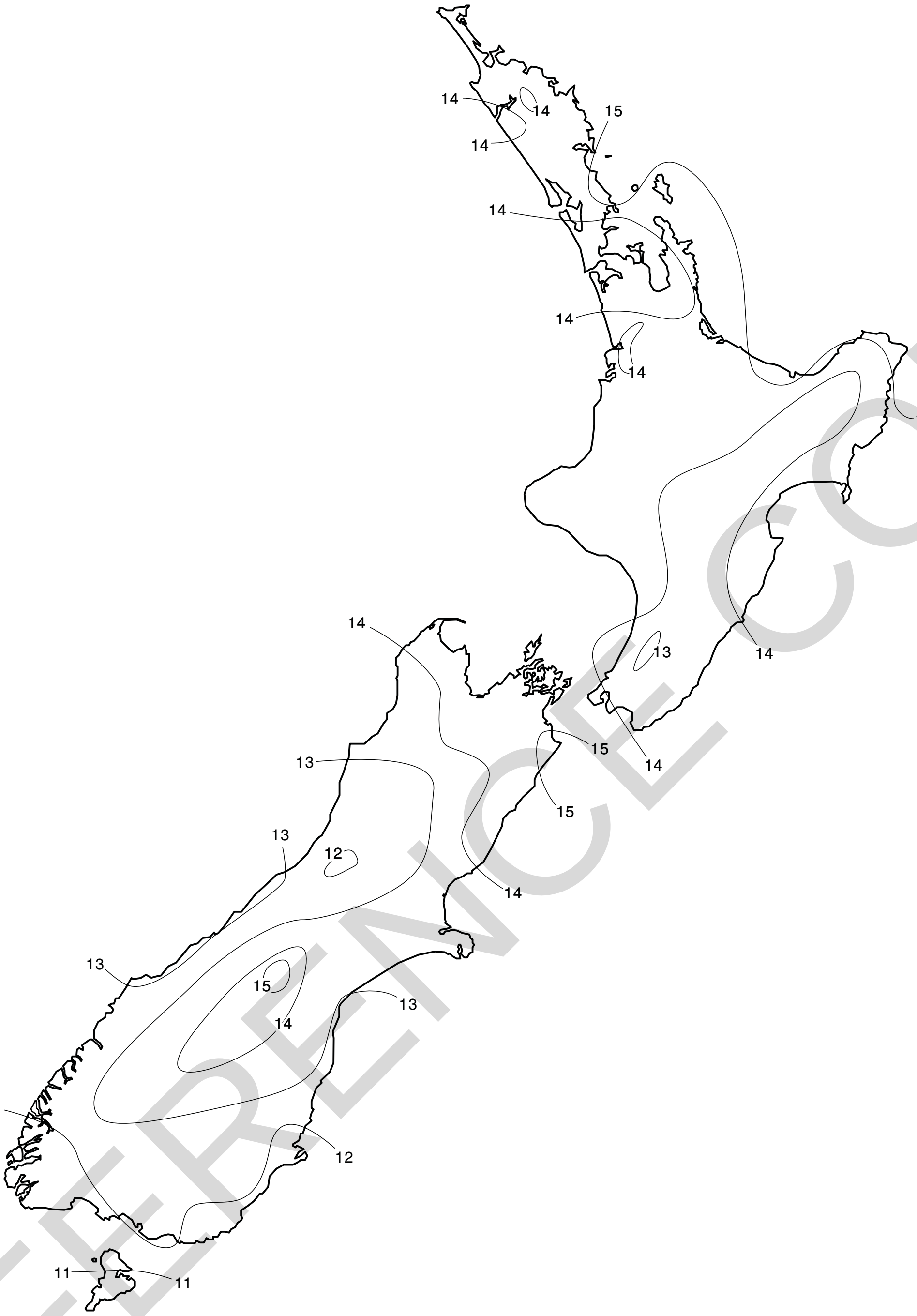


FIGURE ~~H3~~ G3(C) CONTOURS OF ANNUAL MEAN DAILY SOLAR RADIATION ON A HORIZONTAL SURFACE (MJ/m^2.d)

APPENDIX H~~APPENDIX I~~

ESTIMATION OF SHADING OF COLLECTORS

(Informative)

H1~~I1~~ GENERAL

In order to be able to assess whether or not collectors will be subject to shading during the year, it is necessary to know the solar altitude for the installation location when the sun is at its lowest, i.e. in mid-winter. As most of the useful solar radiation is received within 3 h either side of solar noon for any system installed at or near the recommended orientation and inclination, any significant shading of collectors in these hours, i.e. 9~~.00 a.m.~~ am to 3~~.00 p.m.~~ pm standard time, will affect the performance of such a system, and should be avoided in locating the unit. Table ~~I1~~ H1 lists the solar altitude at mid-winter for various locations in Australia and New Zealand. By checking the solar altitude, as observed at the lower edge of the collectors, the installer can determine whether or not nearby buildings, trees or other obstructions will cast a shadow on the collector. For example, if a building, observed from the base of the collectors, is above the mid-winter solar altitude, then that building will cast a shadow on the collectors.

TABLE ~~I1~~H1

SOLAR ALTITUDE AT MID-WINTER

City	Latitude~~,~~ degrees	Solar altitude~~,~~ degrees		
		~~9.00 a.m.~~9 am	Noon	~~3.00 p.m.~~3 pm
Darwin	12	33.5	54.5	33.5
Brisbane	27	23.4	39.5	23.4
Perth	32	19.8	34.5	19.8
Sydney	34	18.3	32.5	18.3
Adelaide	35	17.6	31.5	17.6
Canberra	35	17.6	31.5	17.6
Auckland	37	16.1	29.5	16.1
Melbourne	38	15.4	28.5	15.4
Devonport	41	13.2	25.6	13.7
Wellington	41	13.2	25.5	13.2
Hobart	43	11.7	23.6	11.7
Christchurch	43.5	11.2	23.0	11.2
Invercargill	46	9.0	20.0	9.0

H2~~I2~~ SUN LOCATOR

The mid-winter solar altitude may be checked using a commercial 'sun locator'; however, a simple solar altitude sight may be constructed from the diagram in Figure ~~I1~~ H2(A) for Australia and Figure ~~I2~~ H2(B) for New Zealand. The diagram may be glued to cardboard, or preferably reproduced to a larger scale on cardboard, and then cut out and assembled. An assembled sight is shown in Figure ~~I3.~~H2(C).

The solar altitude sight is used by aligning the arrow due north, using a compass or map, and with the base of the sight horizontal, sighting the 9~~.00 a.m.~~ am, noon and 3~~.00 p.m.~~ pm positions of the winter sun, from a viewpoint near the base of the solar collectors. Any objects that can be seen above the sight will cast a shadow on the collector in winter. The use of the solar altitude sight is shown in Figure ~~I3~~H2(C).

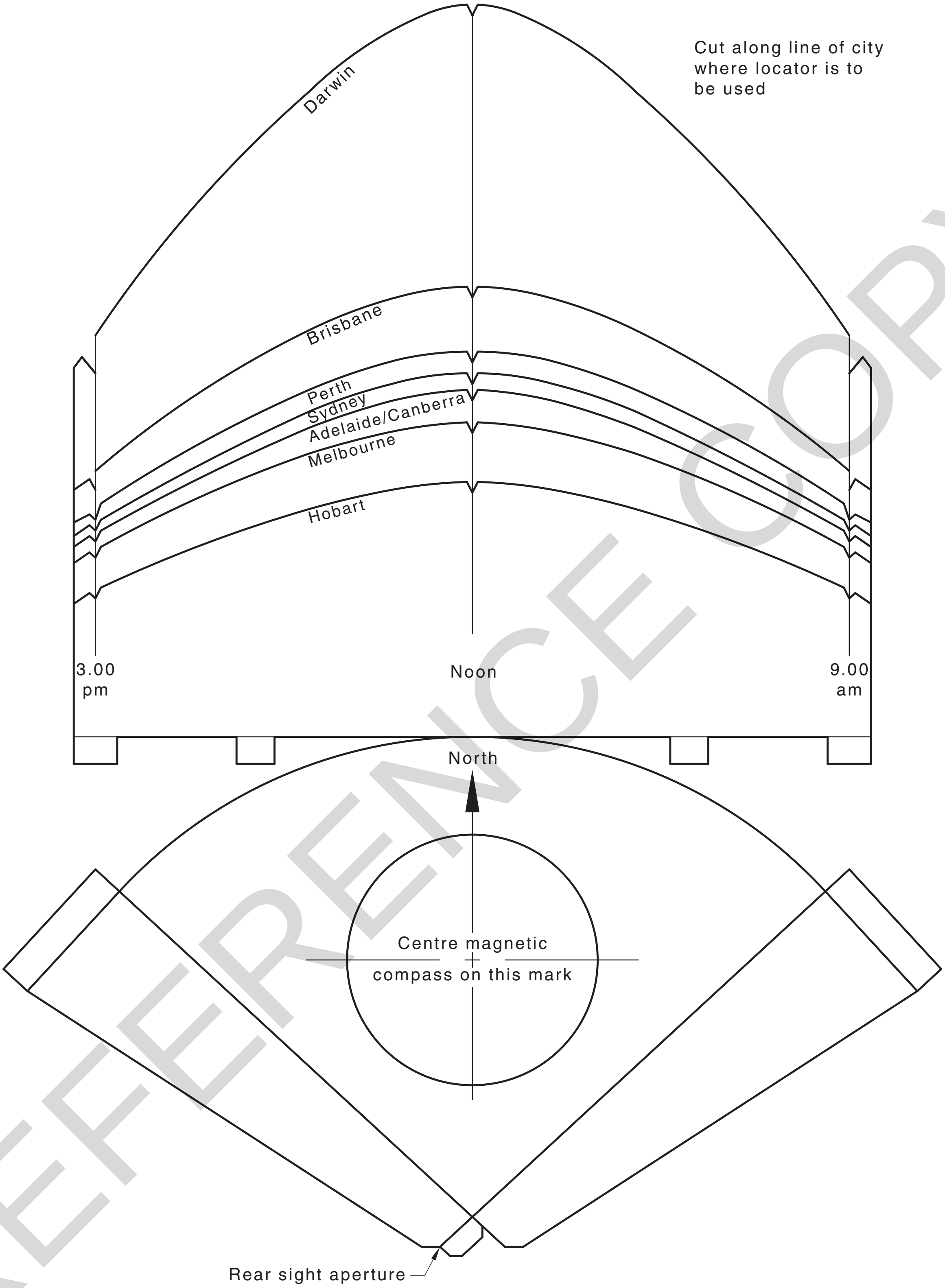


FIGURE ~~I1~~ H2(A) MID-WINTER SOLAR ALTITUDE SIGHT (AUSTRALIA)

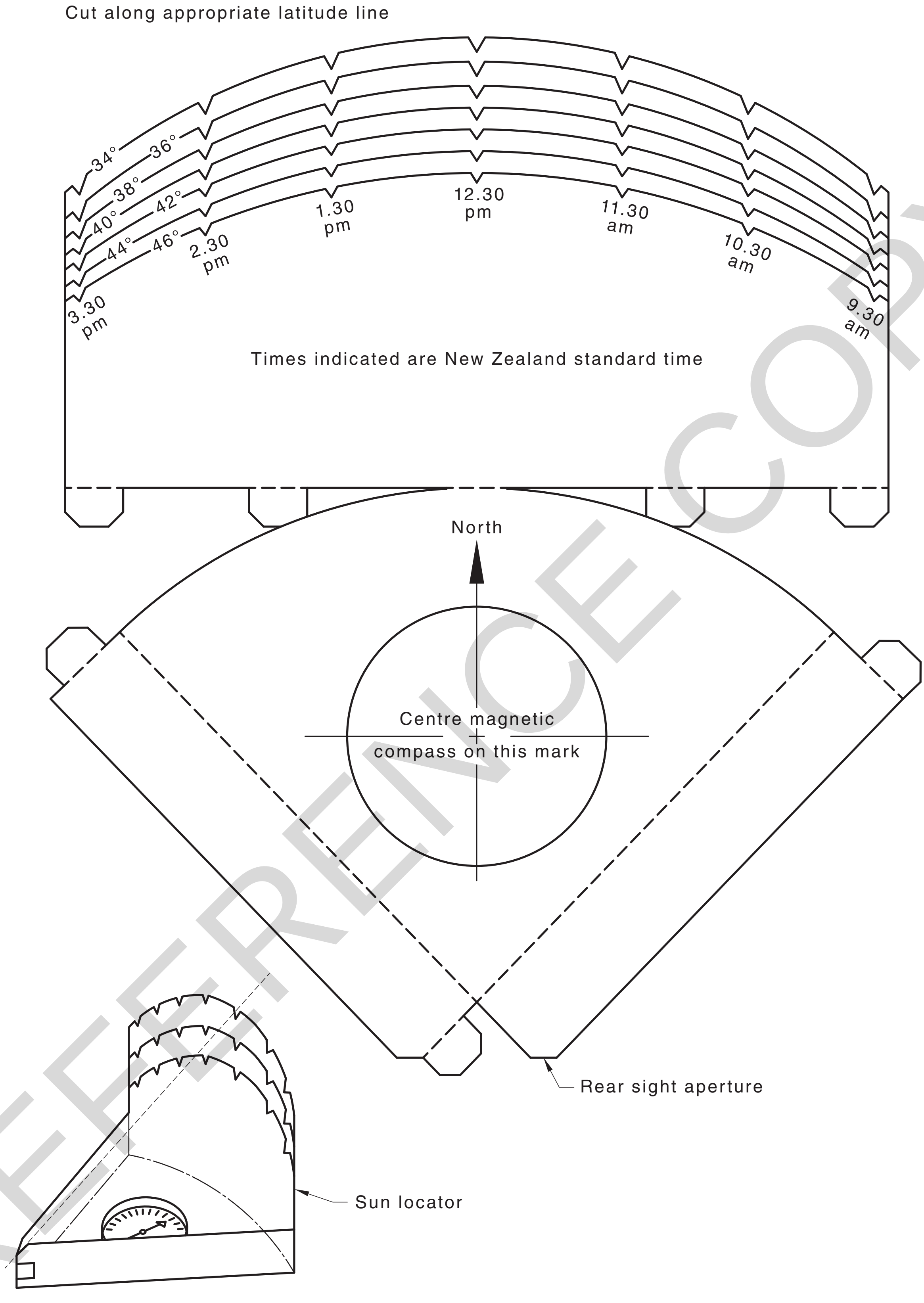


FIGURE ~~I2~~ H2(B) MID-WINTER SOLAR ALTITUDE SIGHT (NEW ZEALAND)

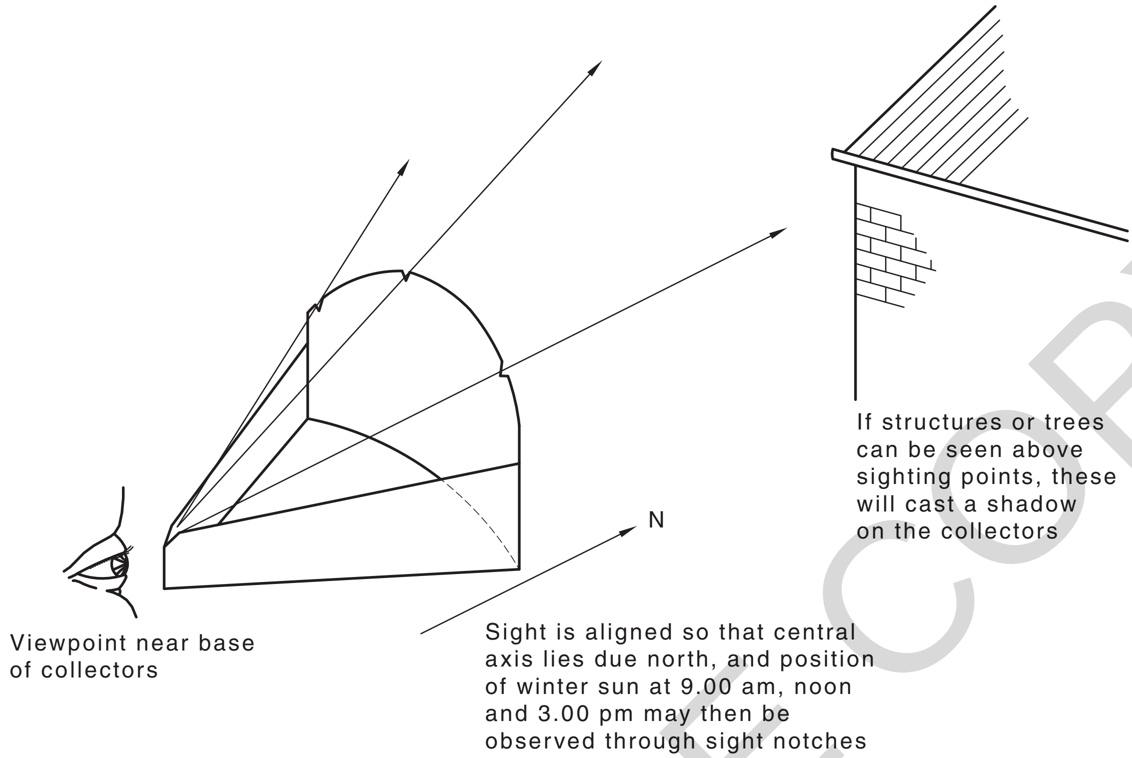


FIGURE ~~I3~~ H2(C) USE OF SOLAR ALTITUDE SIGHT

H3~~I3~~ APPROXIMATE METHOD OF DETERMINING SOLAR ALTITUDE

In the absence of a solar altitude sight, the mid-winter solar altitude can be estimated by eye, using the fact that a closed fist extended at arm's length from the head subtends approximately 10° at the eye (see Figure ~~I4~~H3), as follows:

(a) Select a viewpoint close to the lower edge of the collectors, and face due north.

(b) Extend one arm with the index finger in line between your eye and the true horizon.

(c) Make a closed fist with your other hand, place it upright on top of the extended index finger; this gives a solar altitude of 10°.

(d) Place the second fist on top of the first, which gives 20°, and so on. Then, using Table ~~I1~~H1, estimate the altitude of the noon sun in mid-winter and note any likely shading.

(e) Repeat this procedure facing N-E and N-W to estimate the mid-winter solar altitude at 9~~.00 a.m.~~ am and 3~~.00 p.m.~~ pm, respectively, using the data from Table ~~I1~~H1.

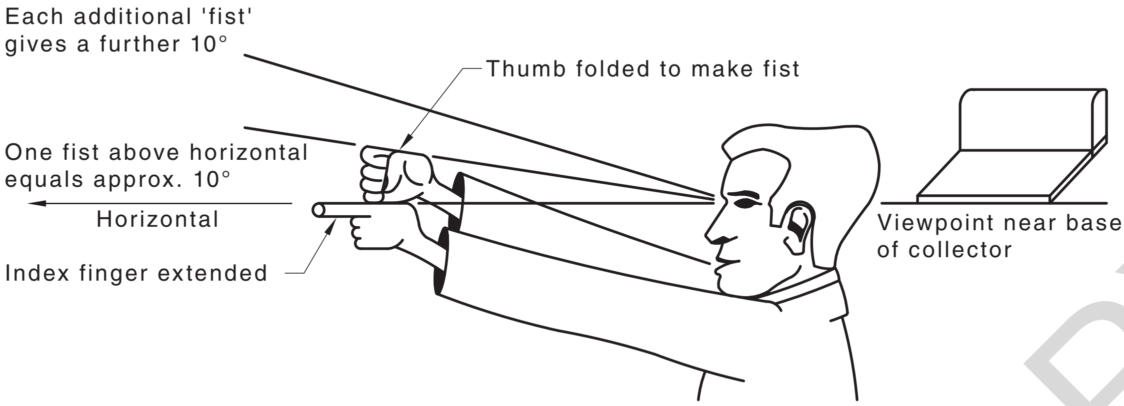


FIGURE ~~I4~~ H3 ‘FIST’ METHOD OF ESTIMATING SOLAR ALTITUDE

APPENDIX I

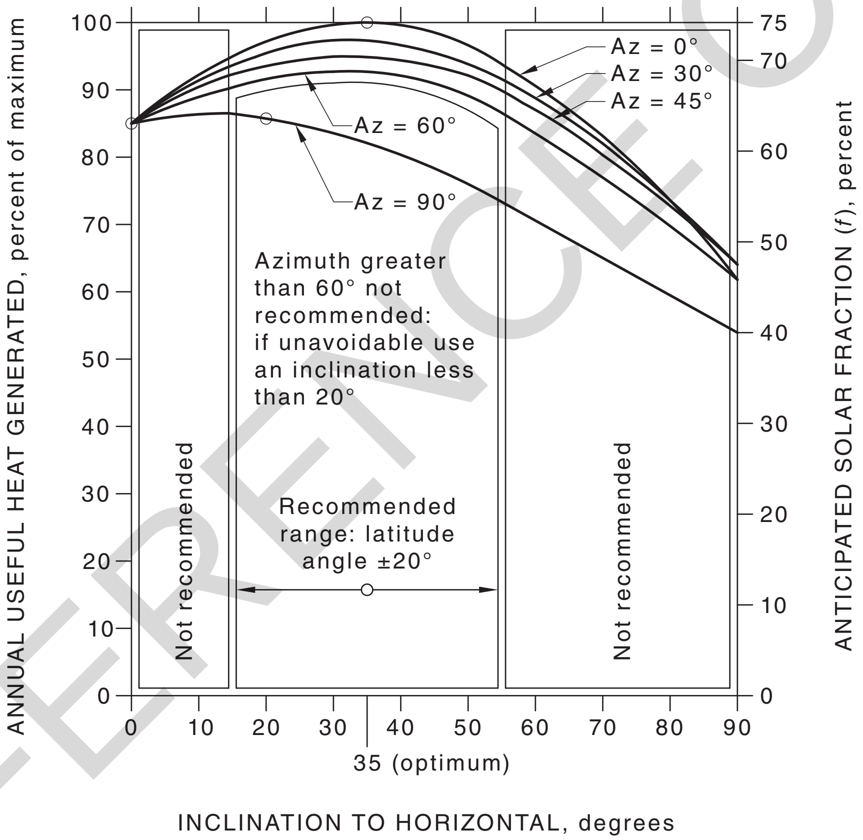
EFFECT OF INCLINATION AND ORIENTATION ON SYSTEM PERFORMANCE

(Informative)

~~APPENDIX J~~

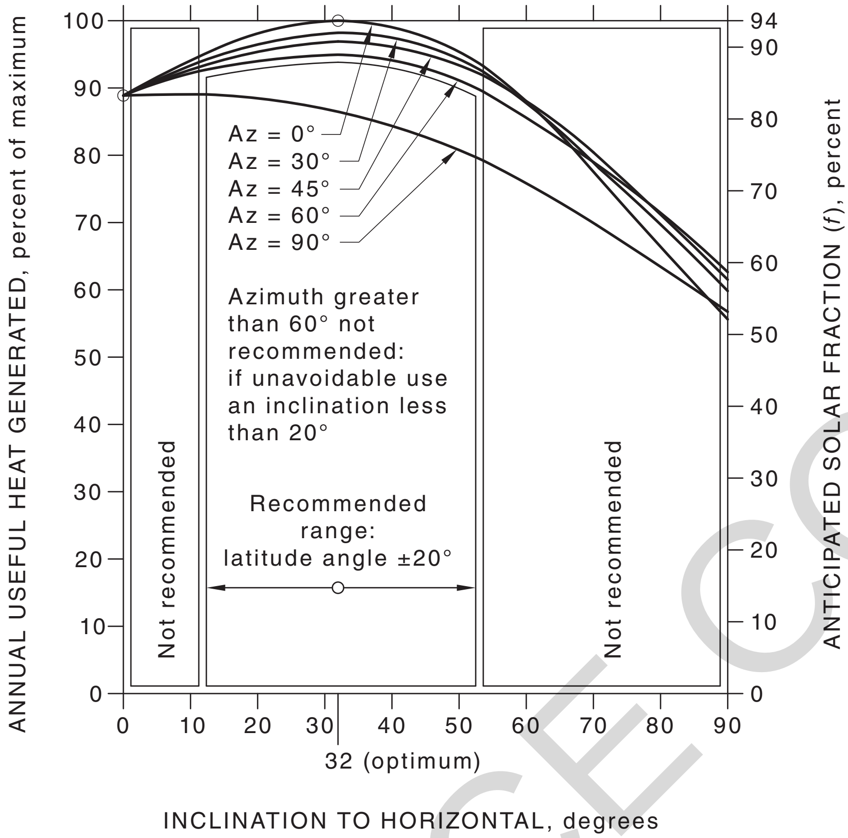
This Appendix provides a series of figures (Figures ~~J1 to J9~~ I1 to I9 for Australia, and ~~J10 to J13~~ I10 to I13 for New Zealand) showing the effect on system performance of variations in collector inclinations for different orientations of the collector. The graphs were plotted using data generated by the 'Sunbear' solar simulation program with radiation data appropriate for each area.

Figures are provided for a variety of locations, and relate to the suggested component sizes for those locations given in Table ~~H1~~G1, Appendix ~~H~~G.



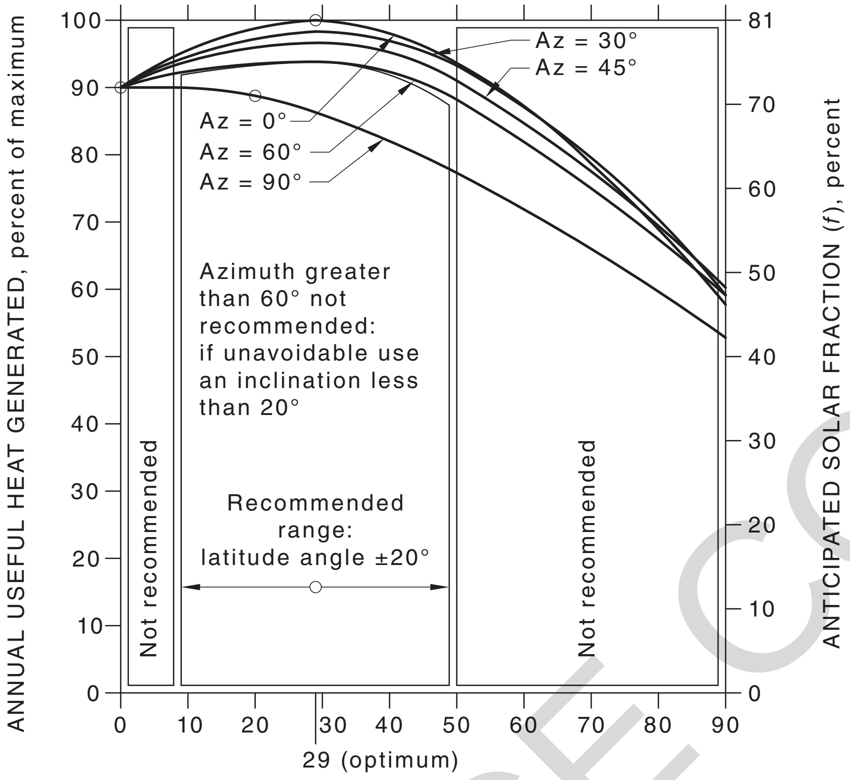
The curves are indicative for the coastal areas of eastern South Australia

FIGURE ~~J1~~ I1 ADELAIDE—LATITUDE 35°S



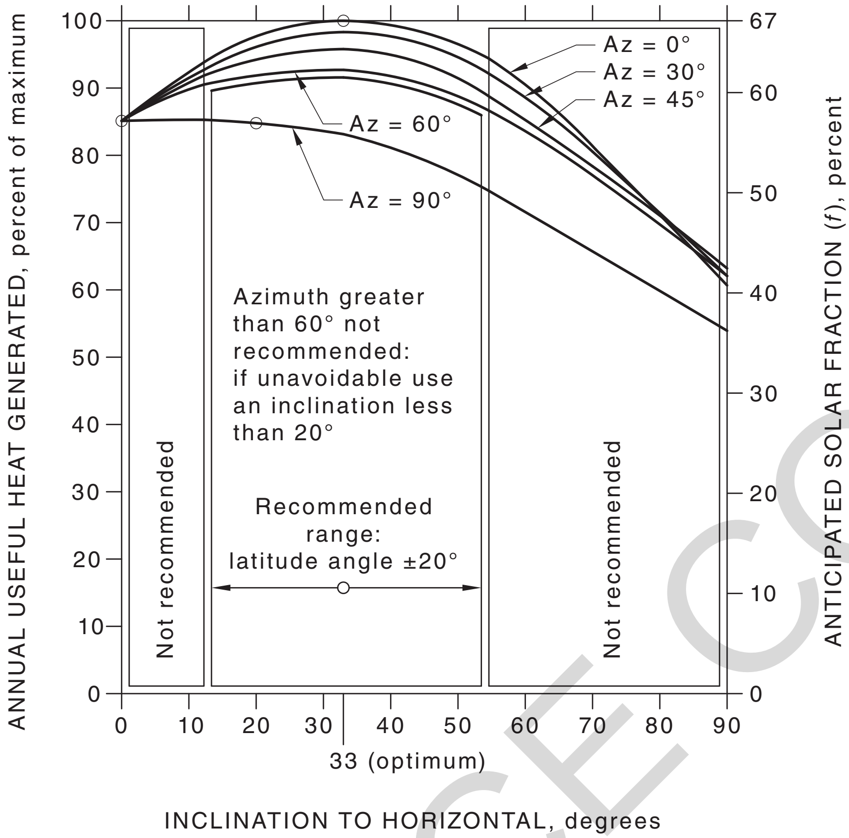
The curves are indicative for the inland areas of central Australia

FIGURE ~~J2~~ I2 ALICE SPRINGS—LATITUDE 24°S



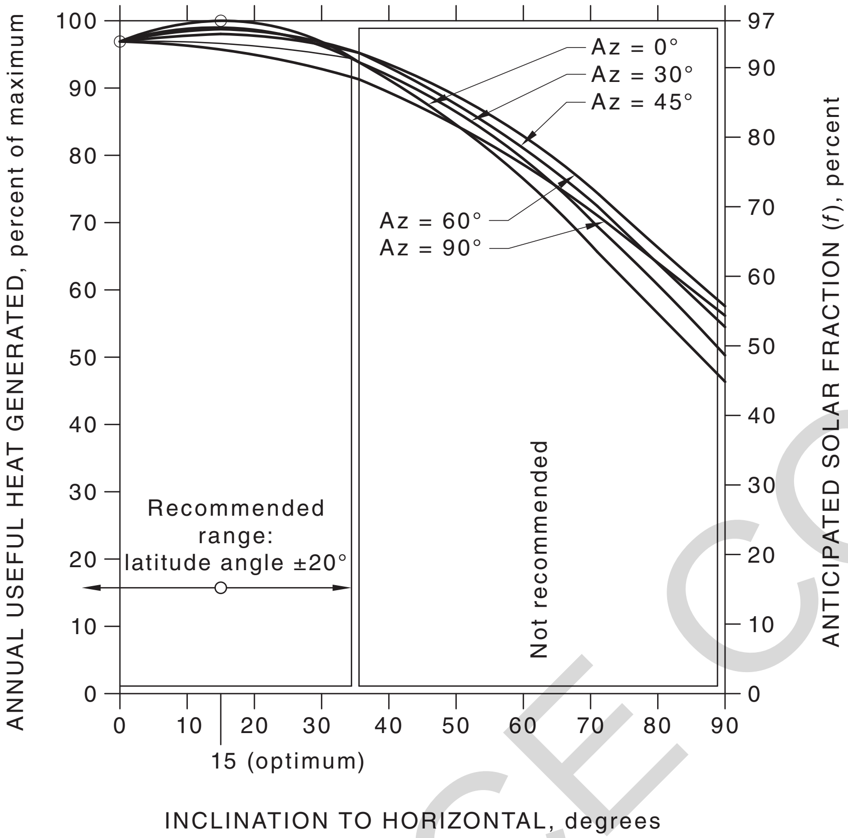
The curves are indicative for the coastal areas of southern Queensland and northern New South Wales

FIGURE ~~J3~~ I3 BRISBANE—LATITUDE 27°S



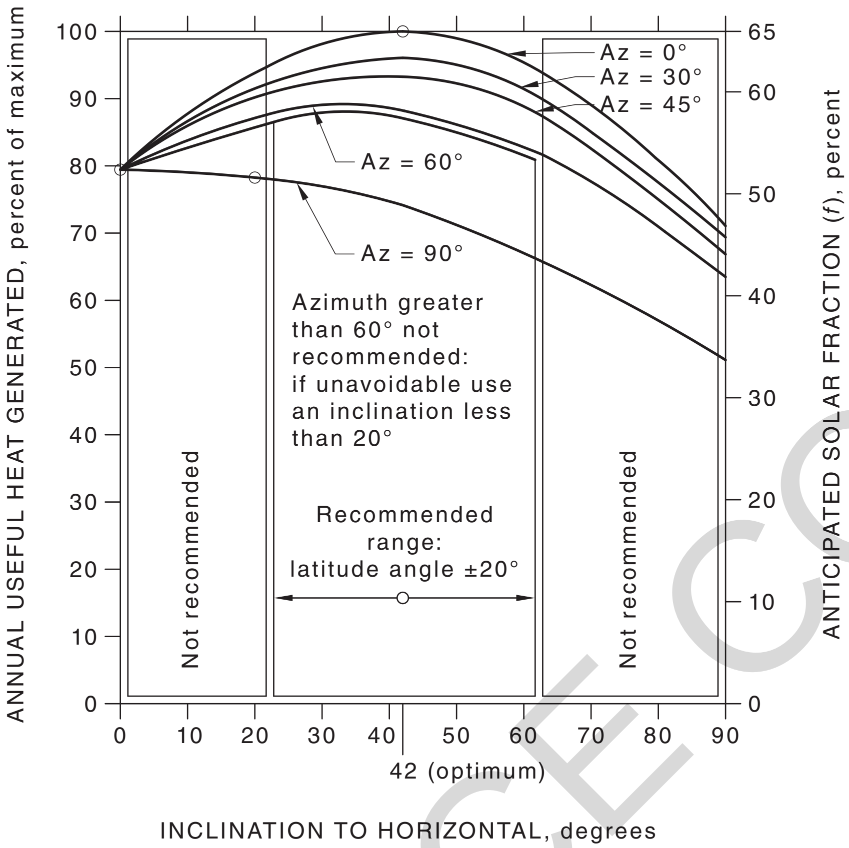
The curves are indicative for the highland areas of New South Wales, A.C.T. and Victoria

FIGURE ~~J4~~ I4 CANBERRA—LATITUDE 35°S



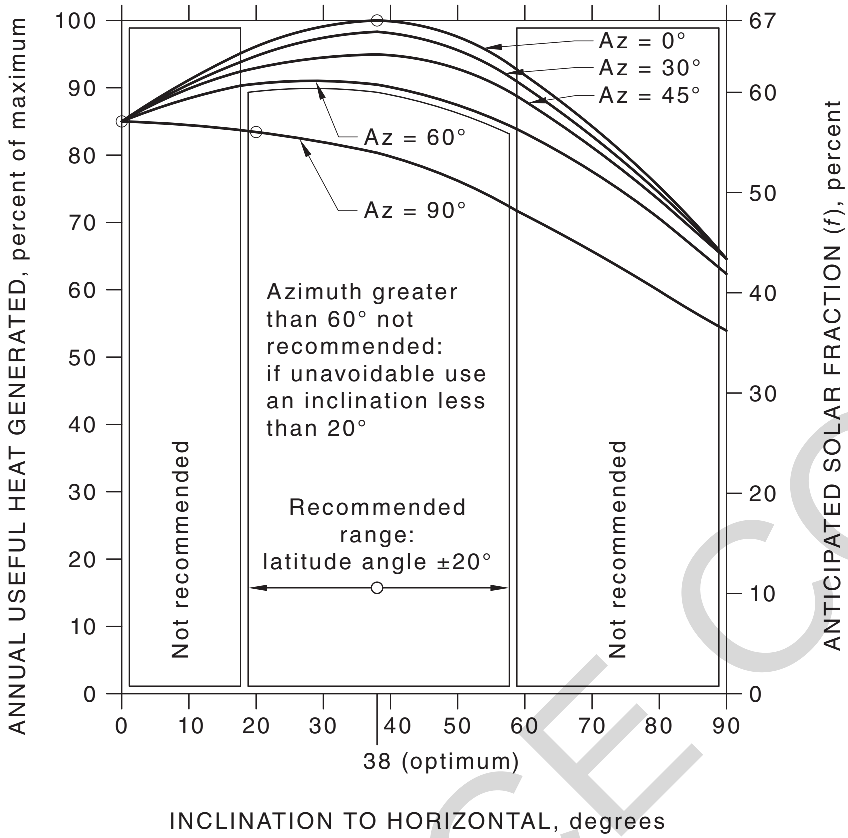
The curves are indicative for the coastal areas of northern (monsoonal) Australia

FIGURE ~~J5~~ I5 DARWIN—LATITUDE 12°S



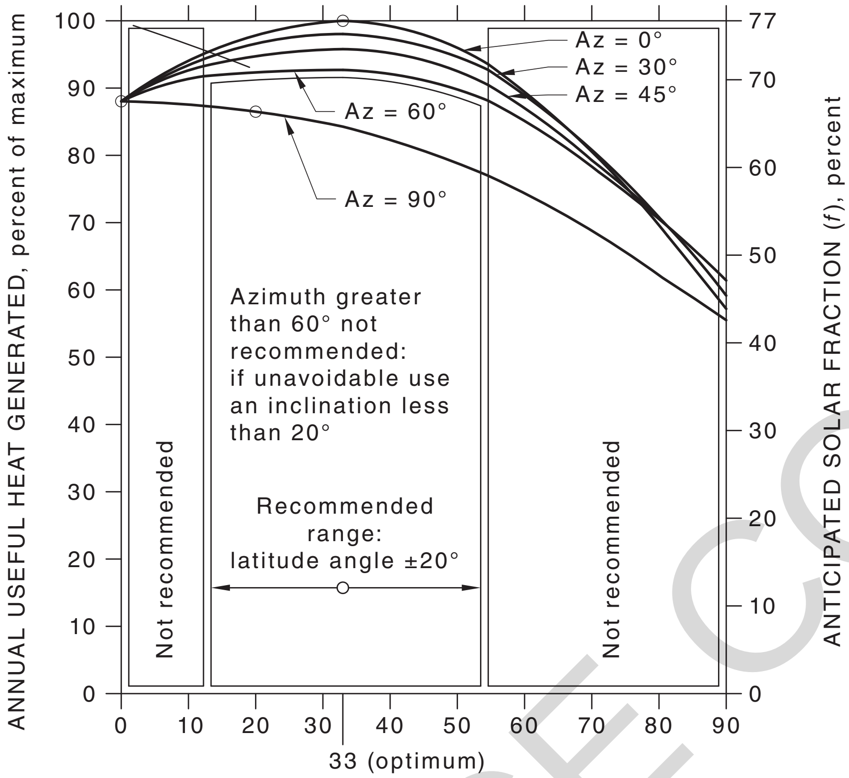
The curves are indicative for the coastal areas of southern Tasmania

FIGURE ~~J6~~ I6 HOBART—LATITUDE 43°S



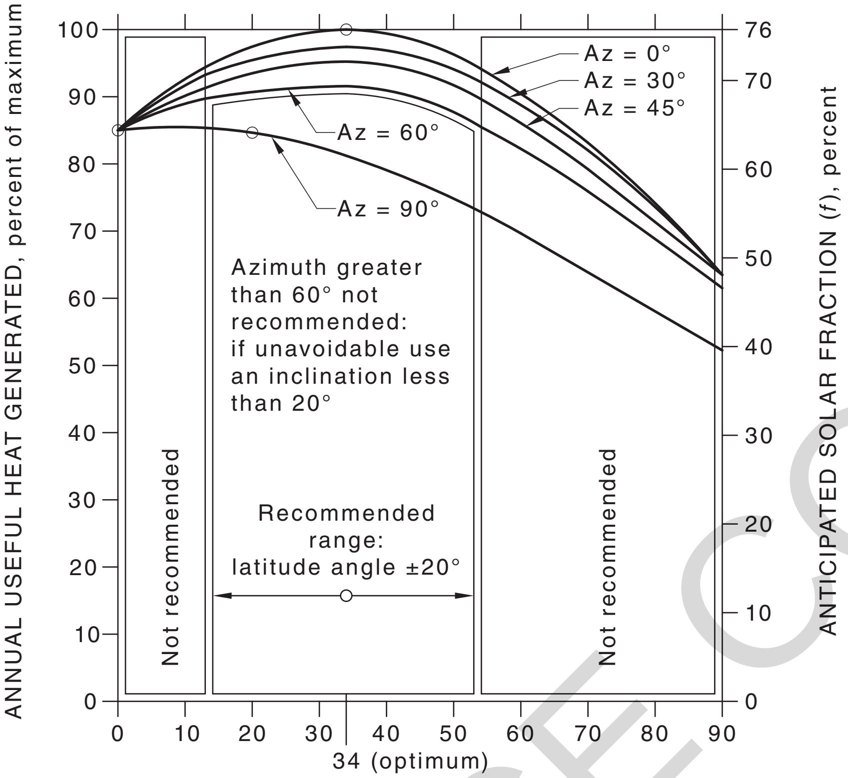
The curves are indicative for the coastal areas of southern Victoria

FIGURE ~~J7~~ I7 MELBOURNE—LATITUDE 38°S



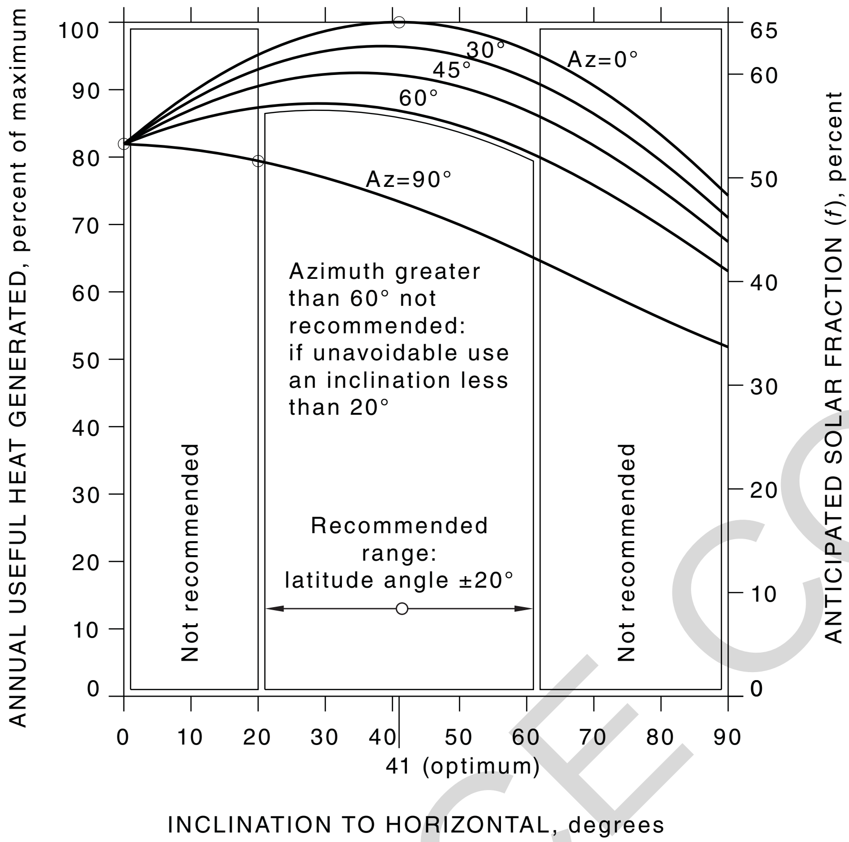
The curves are indicative for the coastal areas of southern Western Australia

FIGURE ~~J8~~ I8 PERTH—LATITUDE 32°S



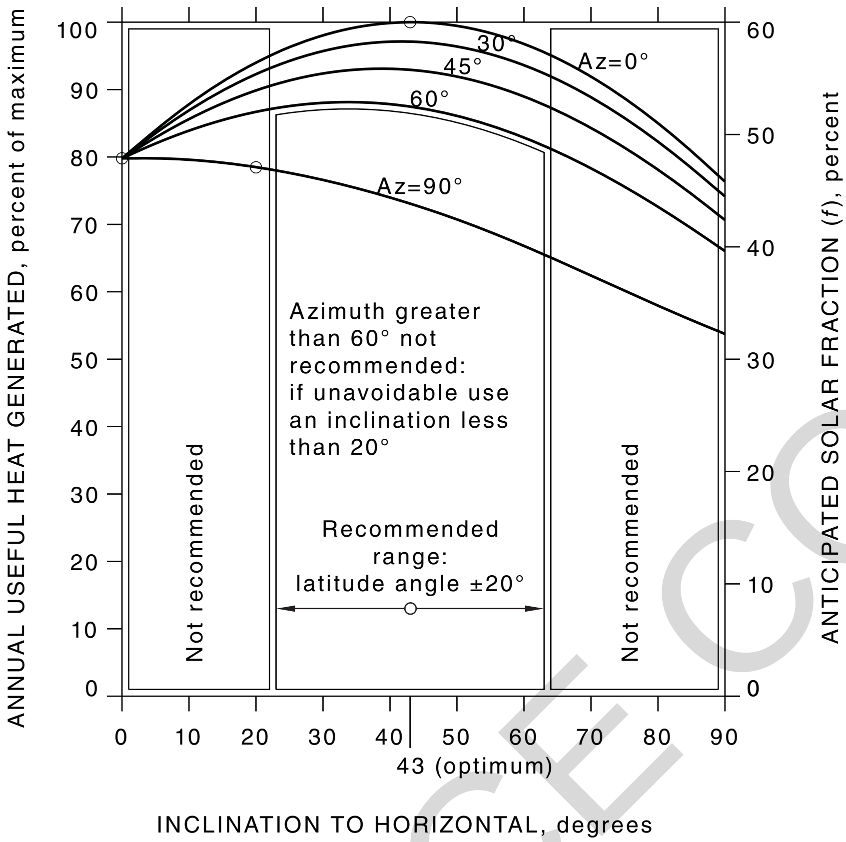
The curves are indicative for the coastal areas of New South Wales

FIGURE ~~J9~~ I9 SYDNEY—LATITUDE 34°S



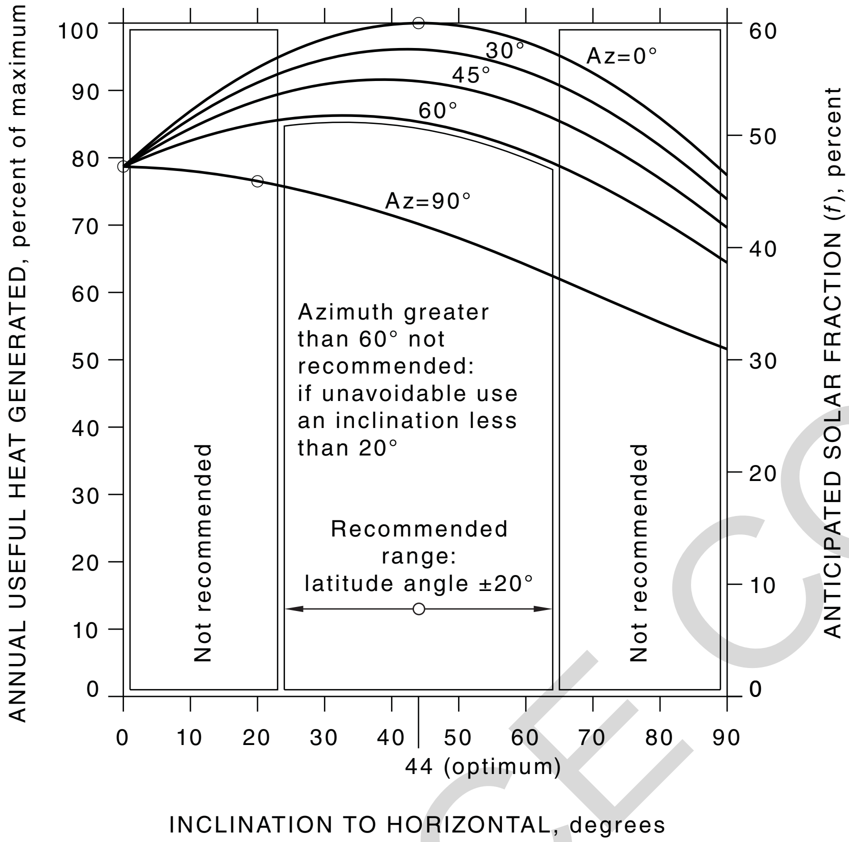
The curves are indicative for coastal areas of the northern North Island

FIGURE ~~J10~~ I10 AUCKLAND—LATITUDE 37°S



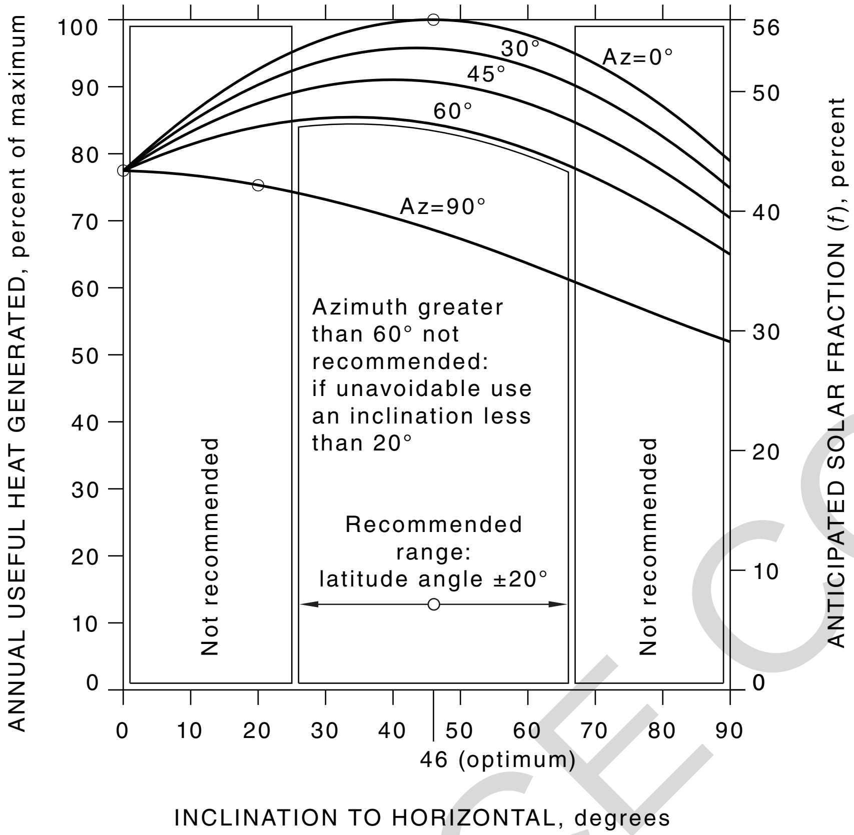
The curves are indicative for coastal areas of the southern North Island

FIGURE ~~J11~~ I11 WELLINGTON—LATITUDE 41°S



The curves are indicative for coastal areas of the northern South Island

FIGURE ~~J12~~ I12 CHRISTCHURCH—LATITUDE 43.5°S



The curves are indicative for coastal areas of the southern South Island

FIGURE ~~J13~~ I13 DUNEDIN—LATITUDE 45.9°S

APPENDIX J

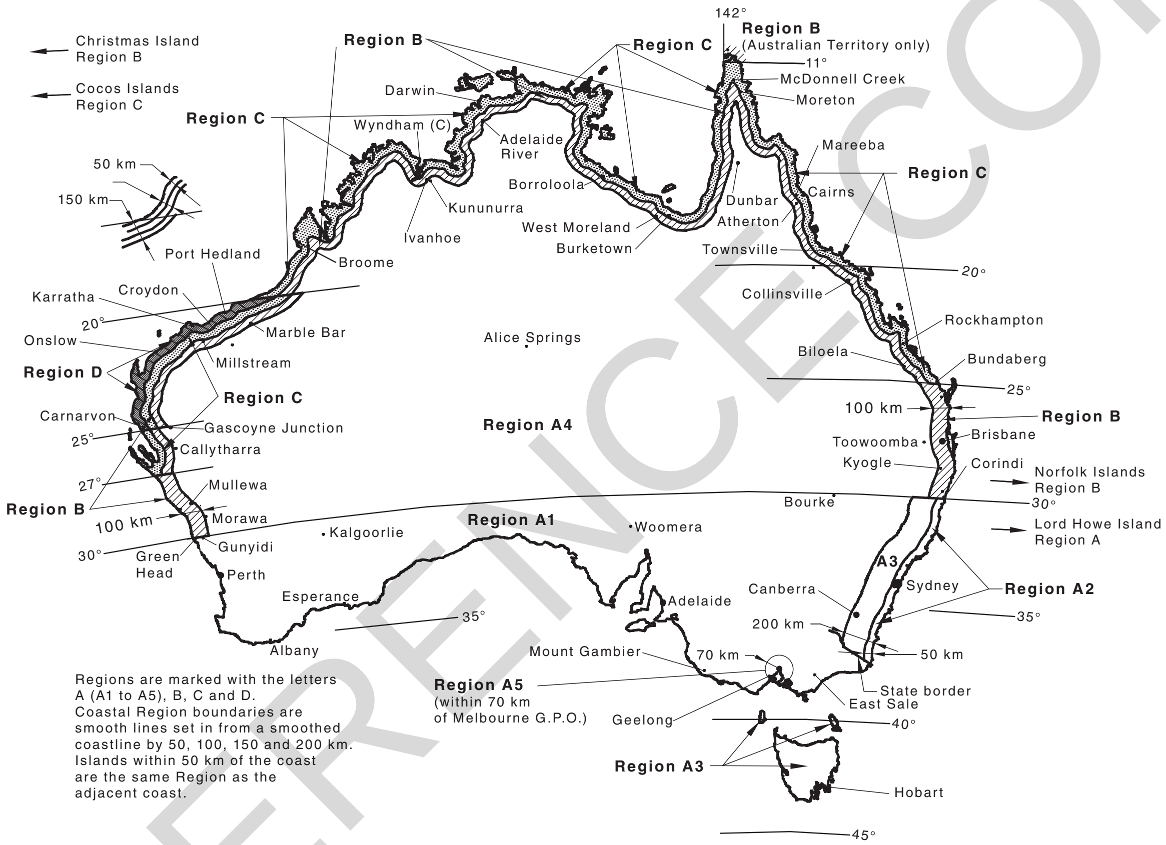
MAP OF REGIONAL BASIC DESIGN WIND SPEEDS

(Informative)

~~APPENDIX K~~

Figures ~~K1~~ J1 and ~~K2~~ J2 are provided as a guide only to the nature of a locality with regard to basic wind speeds.

NOTE: For details of the design of structures to withstand these wind velocities, reference should be made to AS/NZS 1170.2.



Regions	Wind velocity, m/s		
	V_s	V_p	V_u
A	38	41	50
B	38	49	60
C	45	57	70
D	50	69	85

FIGURE ~~K1~~ J1 AUSTRALIA WIND AREAS

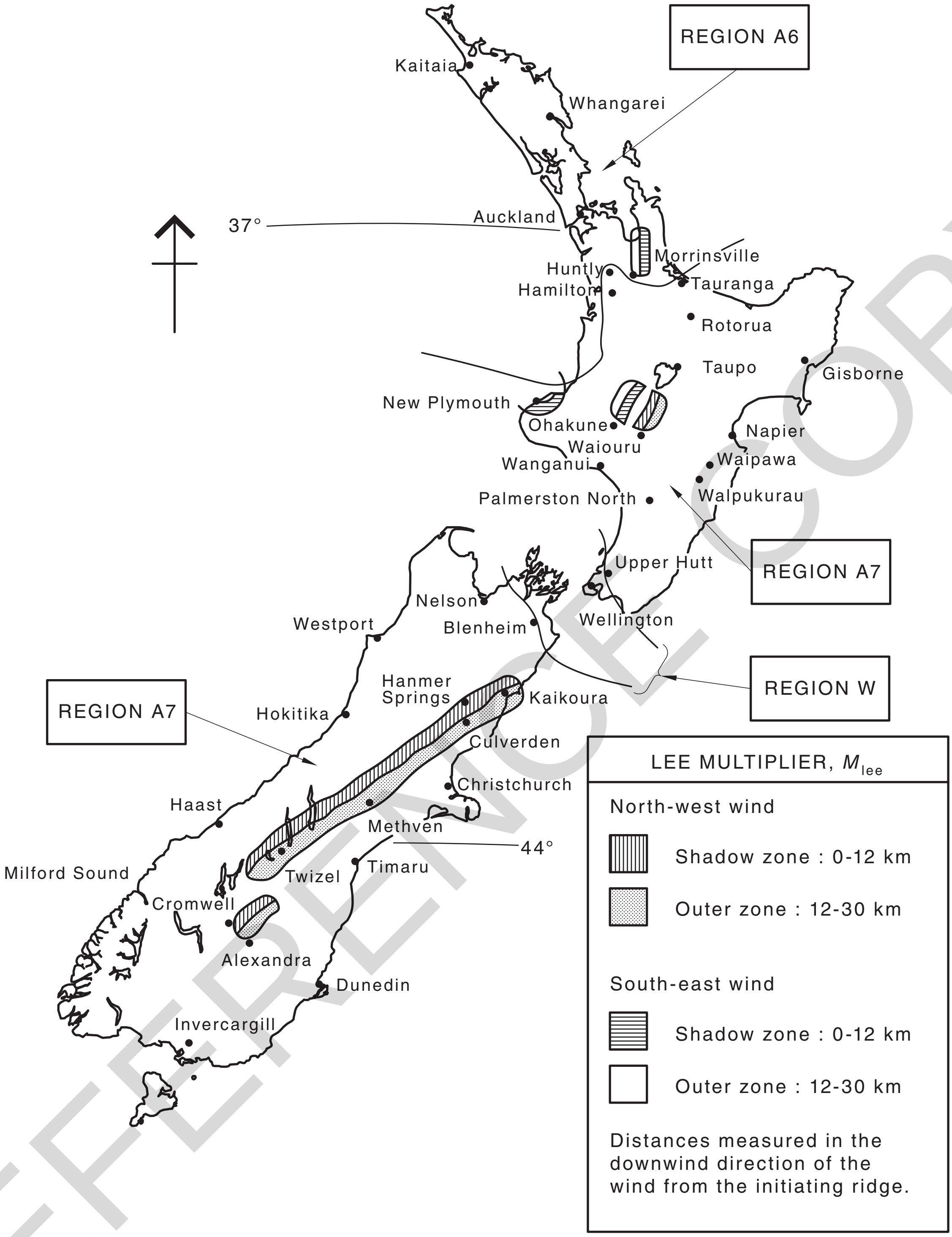


FIGURE ~~K2~~ J2 NEW ZEALAND WIND AREAS

APPENDIX KAPPENDIX L

AUSTRALIAN CLIMATE REGIONS

(Normative)

K1L1 SCOPE

This Appendix sets out the climate regions for Australia to define the requirements for energy efficiency.

K2L2 CLIMATE ZONES

The climate region boundaries are shall be based on climatic data in accordance with the climate zones in the NCC.

NOTES:

1 Maps defining the NCC climate regions for each State and Territory are available on the ABCB website at http://www.abcb.gov.au.

2 NOTE:To access the current maps, search for 'climate zones' on the ABCB website.

Table L1 provides the conversion from the NCC Climate Zonesclimate zones.

TABLE L1K1

CLIMATE REGIONS AND CLIMATE ZONES

Climate region	NCC Climate climate zone	Description
A	1	Hot and humid summer warm winter
	2	Warm and humid summer mild winter
	3	Hot and dry summer warm winter
	5	Warm temperate
B	4	Hot and dry summer cool winter
	6	Mild temperate
C	7	Cool temperate
	8	Alpine

APPENDIX L~~APPENDIX M~~

NEW ZEALAND CLIMATE REGIONS

(Normative)

L1~~M1~~ SCOPE

This Appendix sets out the climate regions for New Zealand, as outlined in Figure ~~M1~~L1, to define the requirements for energy efficiency.

The climate region boundaries ~~are~~ shall be based on climatic data taking into ~~consideration~~ account territorial authority boundaries, providing for ~~3~~ three regions (see Figure ~~M1~~L1).

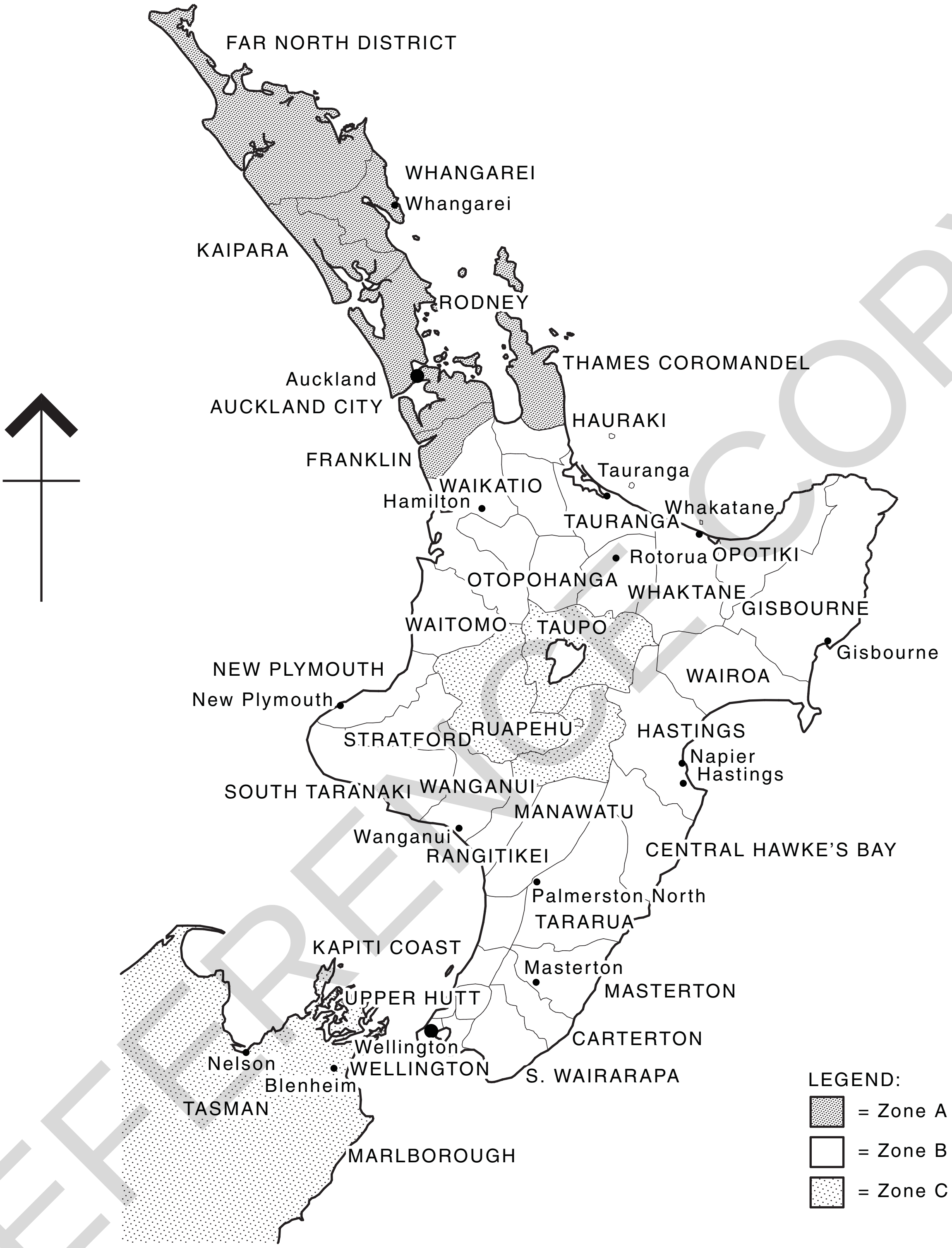


FIGURE ~~M1~~ L1 NEW ZEALAND CLIMATE REGIONS

L2~~M2~~ CLIMATE REGIONS

Region A comprises the Coromandel District, Franklin District and all districts north of these.

Region B comprises the remainder of the North Island excluding Taupo District, Ruapehu District and the northern part of the Rangitikei District.

Region C comprises the remainder of the country, i.e. Taupo District, Ruapehu District, northern part of the Rangitikei District, the South Island and all other islands not in Region A.

L3~~M3~~ FROST AREAS

Table ~~M1~~ L3 shows the frost days throughout regions of New Zealand.

TABLE ~~M1~~L3
FROST DAYS

Mean number of days of ground frost (see Note)													
Location	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
KAITAIA	0	0	0	0	0	0	0	0	0	0	0	0	1
WHANGAREI	0	0	0	0	1	3	4	2	1	0	0	0	11
AUCKLAND	0	0	0	0	1	3	4	2	1	0	0	0	10
TAURANGA	0	0	0	1	5	9	12	9	4	2	1	0	42
ROTORUA	0	0	0	2	8	12	14	11	7	3	1	0	57
TAUPO	1	1	1	3	8	12	16	14	9	7	3	1	69
HAMILTON	0	0	1	3	8	11	14	11	7	3	1	0	63
NEW PLYMOUTH	0	0	0	0	1	4	4	3	1	0	0	0	15
MASTERTON	0	0	1	2	8	11	13	12	8	5	2	1	60
GISBORNE	0	0	0	0	3	8	9	8	3	1	0	0	33
NAPIER	0	0	0	0	3	7	7	7	3	1	0	0	29
PALMERSTON NORTH	0	0	0	1	4	8	10	8	4	2	1	0	38
WELLINGTON	0	0	0	0	1	2	3	3	1	0	0	0	10
WANGANUI	0	0	0	0	0	1	3	2	0	0	0	0	7
WESTPORT	0	0	0	0	2	6	8	6	2	0	0	0	26
HOKITIKA	0	0	0	2	5	12	15	12	5	2	1	0	54
MILFORD SOUND	0	0	0	1	7	14	16	13	5	2	1	0	56
NELSON	0	0	1	4	12	18	21	17	10	4	1	0	88
BLENHEIM	0	0	0	1	6	15	16	13	6	2	0	0	60
KAIKOURA	0	0	0	0	2	6	8	6	4	1	0	0	27
MT COOK	1	1	3	9	19	22	24	23	14	8	3	1	140
CHRISTCHURCH	0	0	0	2	9	16	16	15	9	3	1	0	70
LAKE TEKAPO	1	1	5	11	21	25	27	25	16	9	5	3	149
TIMARU	0	0	2	5	12	21	23	19	12	5	3	0	100
DUNEDIN	0	0	0	2	6	13	16	12	7	3	1	0	58
QUEENSTOWN	0	0	1	5	13	21	24	21	14	7	3	0	107
ALEXANDRA	1	2	3	10	19	26	27	26	19	12	6	2	148
INVERCARGILL	1	2	3	6	9	16	18	16	11	6	4	2	94
CHATHAM ISLAND	0	0	0	0	0	1	1	1	1	0	0	0	4

NOTE: Data are mean monthly values of the number of days with ground frosts for the 1971–2000 period for locations

APPENDIX MAPPENDIX N

OPERATION AND MAINTENANCE

(Informative)

M1N1 SCOPE

This Appendix sets out provides the guidelines for the operation and maintenance of a heated water system.

M2N2 GENERAL

In order to ensure maximum performance and length of operation, water heaters should be inspected periodically.

M3N3 MAINTENANCE OF HEATED WATER SERVICES

Heated water services should be maintained in accordance with the following:

(a) *Water treatment units* Where installed, water treatment units should be inspected periodically to ensure proper operation.

(b) *Water vessels and tanks* All vessels and tanks should be inspected and cleaned periodically, and in accordance with any requirements of the regulatory authority.

NOTE: The frequency of periodic cleaning depends upon the quality of the supply water, design, materials of construction and the pipe system. Combinations of materials giving rise to corrosion should be avoided.

(c) *Valves* The following valves should be inspected periodically to ensure proper operation.:

(i) Temperature/pressure-relief valves.

(ii) Expansion control valves.

(iii) Thermostatic mixing valves.

(iv) Tempering valves.

(v) Other associated valves/devices.

(d) The requirements of AS/NZS 3666.2, where applicable.

APPENDIX N

PROVISION FOR EXPANSION AND CONTRACTION

(Normative)

N1 SCOPE

This Appendix sets out tables, formulae and calculations to allow for expansion and contraction in acceptable heated water pipes.

N2 GENERAL

All materials used in plumbing services pipe work experience length change due to the change in temperature.

If the pipe work is locked into position and does not allow for thermal movement, related stress in the material will eventuate which can cause premature failure.

The following problems can occur:

(a) Failure of the piping from over stressing in particular at fabricated junctions or branches.

(b) Leakage at location where the material has reached its stress point.

(c) Distortion in the piping or connected equipment.

The design and installation of pipe work material should take into consideration each material type, the method of installation and the change in temperature.

Thermal length changes shall be calculated based on the difference between the coldest temperature in the pipe work (i.e. during installation of the system, or when the system is not in operation) and the highest temperature during operation.

N3 CALCULATING THERMAL LENGTH CHANGE

To calculate the thermal length change of a pipe section, Equation N3 shall be used for a range of temperature differentials:

$$X = L \times (T_2 - T_1) \times \alpha \quad \text{. . . N3}$$

where

X = Thermal length change (mm)

L = Length of pipe section (m)

T1 = Coldest temperature (°C)

T2 = Highest temperature (°C)

α = Coefficient of thermal expansion (mm/(m*K), [these are shown in Table N3(A)]

TABLE N3(A)

COEFFICIENTS OF THERMAL EXPANSION FOR COMMON PIPE MATERIALS

Metals		Plastics	
Materials	**Coefficient α mm/(m*K)**	**Materials**	**Coefficient α mm/(m*K)**
Copper	0.0177	PE-X	0.15
Stainless Steel	0.0159	PB	0.13
		PP-R	0.15
		PE-X/AL/PE-X and PE-X/Al/PE	0.02

NOTE: For some constructions of PE-X/AL/PE-X and PE-X/Al/PE pipes and multi-layer pipes or composite pipes there are different values of α. The manufacturer of the composite and multi-layer piping system declares which value of α has to be used.

Table N3(B) shows expansion in length per metre run of pipe for selected temperature increases.

TABLE N3(B)

RATES OF THERMAL EXPANSION FOR COMMON PIPE MATERIALS mm/m

Change in temperature °C	Copper	Stainless steel	PE-X	PB	PP-R	PE-X/Al/PE-X and PE-X/Al/PE
10	0.18	0.16	1.5	1.3	1.5	0.2
20	0.35	0.32	3.0	2.6	3.0	0.4
30	0.53	0.48	4.5	3.9	4.5	0.6
40	0.71	0.64	6.0	5.2	6.0	0.8
50	0.89	0.80	7.5	6.5	7.5	1.0
60	1.06	0.95	9.0	7.8	9.0	1.2
70	1.24	1.11	10.5	9.1	10.5	1.4
80	1.42	1.27	12.0	10.4	12.0	1.6
90	1.59	1.43				
100	1.77	1.59				

N4 PROVISION FOR EXPANSION

Provisions for expansion should be considered when designing tube runs and fixing points, by allowing freedom of movement at bends, branches and tees.

The easiest and most common method of accommodating expansion is to provide an offset or change in direction and allowing the tube to move. This requires that the tube shall not be fixed within a certain distance of the end. Figure N4 provides a demonstration of an offset to accommodate expansion.

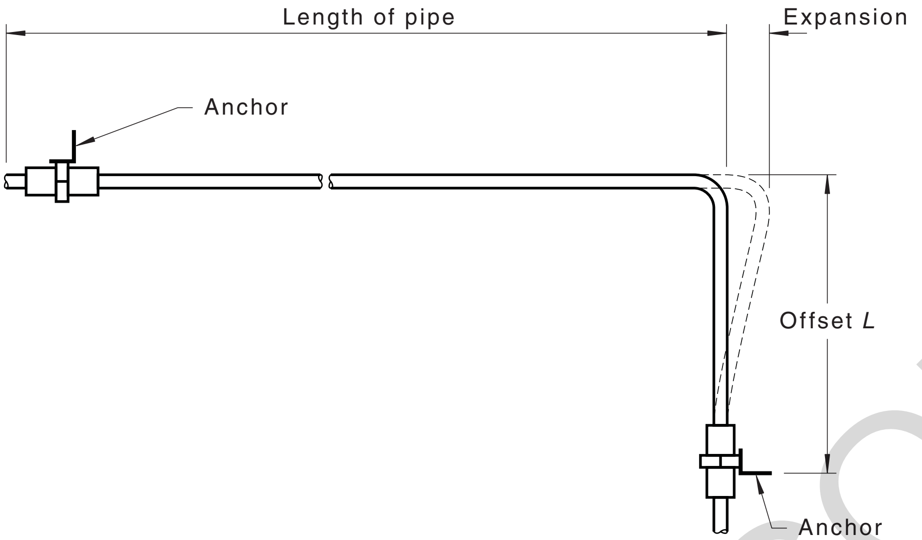


FIGURE N4 OFFSET TO ACCOMMODATE EXPANSION

N5 CALCULATING THE OFFSET LENGTH *L*

The length of the offset *L* can be calculated from the Equation N5:

$$L_{\text{Offset}} = C \times \sqrt{(d \times X)} \quad \text{. . . N5}$$

where

L_{Offset} = Offset length (mm)

C = Material constant in accordance with Table N5

d = Pipe outer diameter (mm)

X = Expansion or thermal length change as determined by Equation N3 (mm) or from Table N3(B)

NOTE: The length of pipe section *L* is the length between the anchor point and the offset bend.

The calculated values shall be rounded up to the next 5 mm step.

TABLE N5

VALUES OF MATERIAL CONSTANT (*C*)

Material	*C*
Copper, stainless steel	61.2
PE-X	12
PB	10
PP-R	20
PVC-C	34
PE-X/Al/PE-X and PE-X/Al/PE*	30

* For some constructions of PE-X/AL/PE-X and PE-X/AL/PE pipes or composite pipes there are different values of *C*.
The manufacturer of the PE-X/AL/PE-X and PE-X/AL/PE piping system declares which value of *C* has to be used.

Different materials require different offset allowances due to their physical properties.

Example 1

A 6 m length of DN 50 hot water copper pipe experiences a temperature change of 50°C. The copper pipe is fixed at one end and has a 90° elbow on the other. What is the offset length required to provide allowance for thermal expansion and contraction?

From Table N3(B) the 6 m length of copper tube will expand 6 × 0.89 mm = 5.34 mm

Alternatively from Equation N3, $X = L \times (T_2 - T_1) \times \alpha$

$X = 6 \times 50 \times 0.0177 = 5.31$ mm

From Equation N5, $L_{Offset} = C \times \sqrt{(d \times X)}$

$L_{Offset} = 61.2 \times \sqrt{(50.8 \times 5.34)}$

$L_{Offset} = 1005$ mm

Example 2

A 14 m length of hot water PE-X pipe DN 50 (OD 63 mm) experiences a temperature change of 50°C. The PE-X pipe is fixed at one end and has a 90° elbow on the other. What is the offset length required to provide allowance for thermal expansion and contraction?

From Table N3(B) the 14 m length of PE-X pipe will expand 14 × 7.5 mm = 105 mm

Alternatively from Equation N3, $X = L \times (T_2 - T_1) \times \alpha$

$X = 14 \times 50 \times 0.15 = 105$ mm

From Equation N5, $L_{Offset} = C \times \sqrt{(d \times X)}$

$L_{Offset} = 12 \times \sqrt{(63 \times 105)}$

$L_{Offset} = 980$ mm

N6 OFFSETS IN BENDS WITH TWO ANCHOR POINTS

A change in direction may be used to accommodate the thermal length changes from two directions. In this case, offsets must be provided on both sides of the bend. The combined length of both offsets shall not exceed the maximum spacing distance of brackets and clips in accordance with Table 4.4.4.

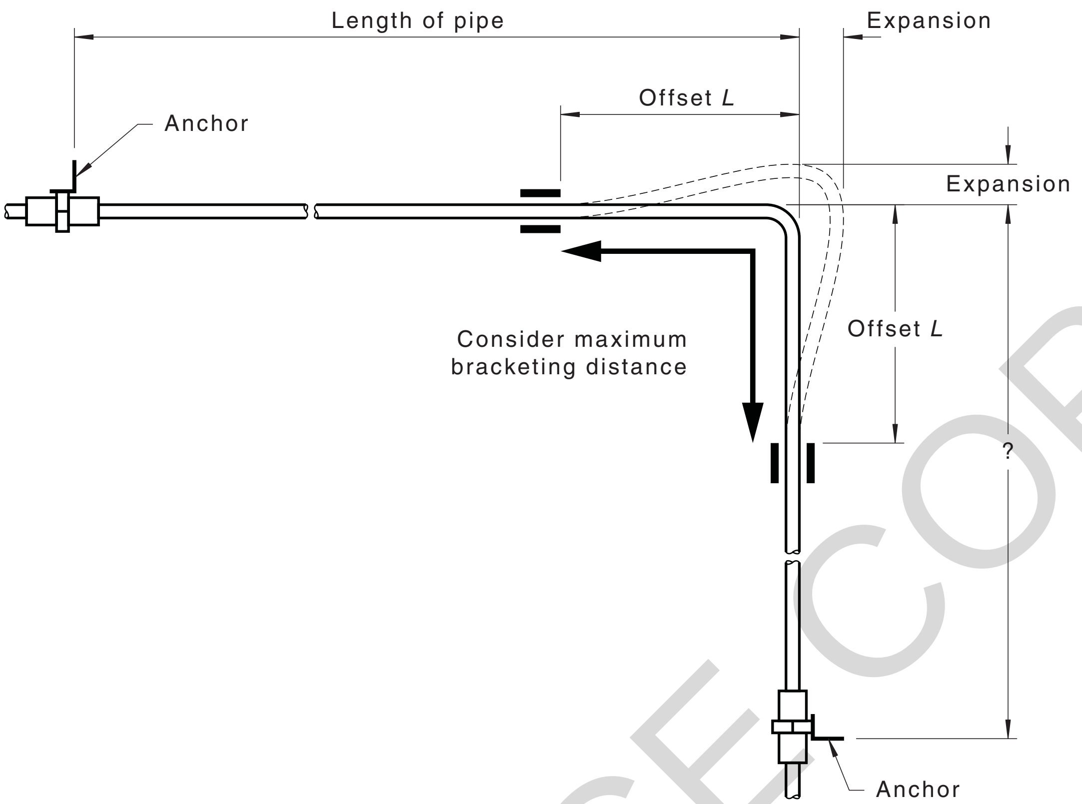
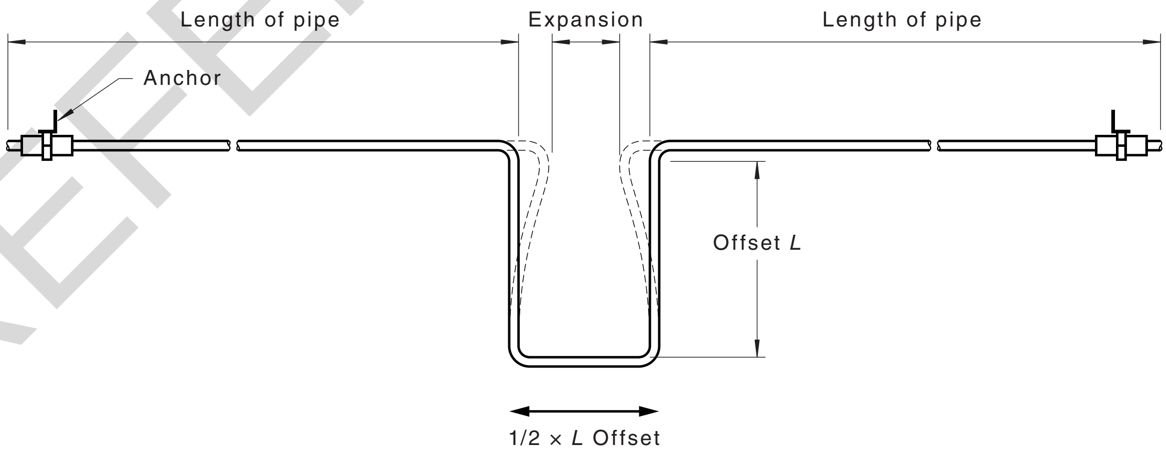


FIGURE N6 OFFSET TO ACCOMMODATE EXPANSION FROM TWO DIRECTIONS

N7 EXPANSION LOOPS

Long pipe sections may need to be split up in sub-sections by installing more than one anchor point. Between any two anchor points a provision for thermal movement should be created, i.e. by installing an expansion loop or U-bend. Expansion loops and U-bends should be located near the centre of the length of pipe and placed horizontally. This is to avoid formation of water troughs in or between two expansion loops where the water stagnates when the system is drained and to avoid forming air locks at the top of the loops.



NOTE: The length of pipe L is the length between the anchor point and the offset bend.

FIGURE N7 EXPANSION LOOP

N8 CALCULATING THE OFFSET LENGTH L FOR AN EXPANSION LOOP OR U-BEND

Because the expansion loop or U-bend consists of two offsets back to back, half of the expansion is accommodated by each side of the U-bend. Therefore, when using Equation N5, the expansion or thermal length change (X) is half of the expansion that the entire length of pipe experiences.

Example 3

A 6 storey building has a 18 metre stainless steel hot water riser pipe DN 50 (OD 54 mm) to a storage tank at the top of the building that can experience a temperature change of 50°C. The stainless steel riser is fixed at both ends but provision has been made for a horizontal expansion loop to be place between the middle floors of the building. What is the offset length for the expansion loop in order to provide allowance for thermal expansion and contraction?

From Table N3(B) the 18 meter length of stainless steel pipe will expand a total of

18 × 0.80 mm = 14.34 mm

Alternatively from Equation N3, $$X = L \times (T_2 - T_1) \times \alpha$$

$$X = 18 \times 50 \times 0.0159 = 14.31 \text{ mm}$$

Half of this expansion will be accommodated by each side of the expansion loop so we will use half of this expansion distance (7.17 mm) when we use Equation N5 to calculate the offset.

From Equation N5, $$L_{\text{Offset}} = C \times \sqrt{(d \times X)}$$

$$L_{\text{Offset}} = 61.2 \times \sqrt{(54 \times 7.17)}$$

$$L_{Offset} = 1205 \text{ mm}$$

N9 BRANCH OFF-TAKES

Branch off-takes from hot water pipes require an offset *L* to accommodate thermal length changes of the main pipe. Within the offset length movement of the branch off-take shall not be restricted by brackets, floors, walls or other services.

Offset *L2* is calculated using Equations N3 and N5. The thermal length change is calculated using the length of pipe between anchor point and branch off-take. The required offset lengths is calculated based on the outer diameter of the branch off-take.

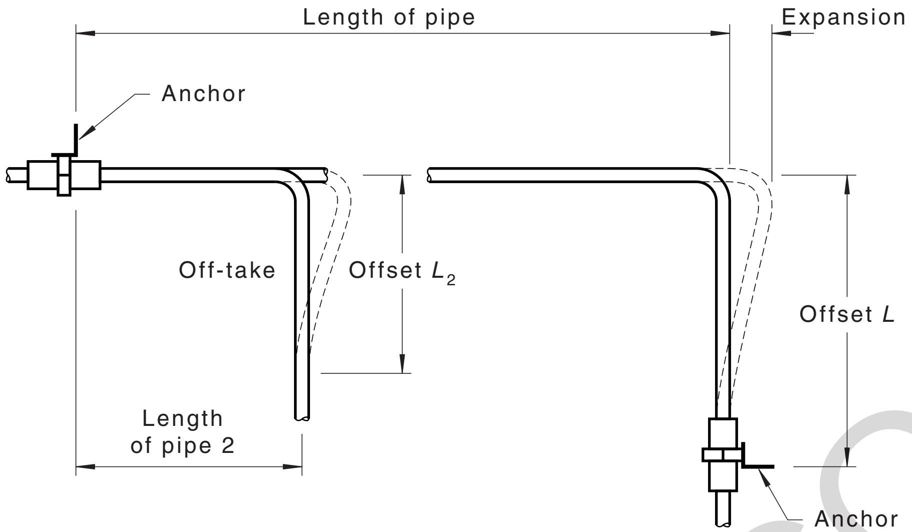


FIGURE N9 EXPANSION OFFSET FOR BRANCH OFF-TAKE

Example 4

As an extension of Example 1 for a DN 50 hot water copper pipe, there is now a DN 25 (OD 25.4) branch off-take 4 m from the nearest anchor point. What is the offset length required in the branch off-take to provide allowance for thermal expansion and contraction in the main line?

From Table N3(B) the 4 m length of copper tube will expand 4 × 0.89 mm = 3.56 mm

Alternatively from Equation N3, $X = L \times (T_2 - T_1) \times \alpha$

$X = 4 \times 50 \times 0.0177 = 3.54$ *mm*

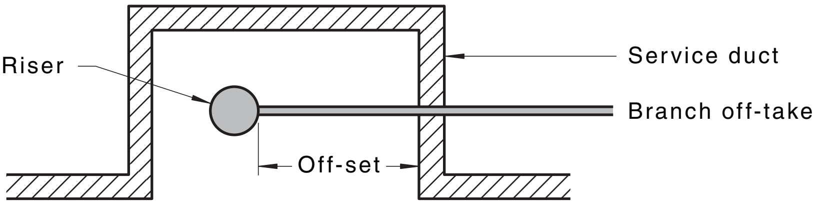
From Equation N5, $L_{\text{Offset}} = C \times \sqrt{(d \times X)}$

$L_{\text{Offset}} = 61.2 \times \sqrt{(25.4 \times 3.56)}$

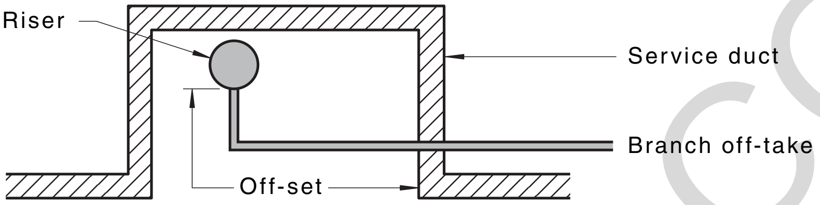
$L_{\text{Offset}} = 585$ *mm*

N10 BRANCH OFFTAKES IN DUCTS

Movement of branch offtakes in ducts shall not be restricted by brackets, floors, walls or other services within the Offset length. Offsets can be installed straight or bent, refer to Figure N10.



a) Straight off-set in duct—Plan view



b) Bent off-set in duct—Plan view

Note: Additional clearance may be provided for expansion where the pipe passes through the wall of the service duct provided it does not contravene fire regulations

FIGURE N10 EXPANSION OFFSETS IN DUCTS

APPENDIX O

ESTIMATION OF PROBABLE SIMULTANEOUS DEMAND FOR RESIDENTIAL BUILDINGS FROM THE TOTAL OF LOADING UNITS

(Informative)

TABLE O1

PROBABLE SIMULTANEOUS DEMAND (PSD) FOR A CIRCULATORY HEATED WATER SYSTEM IN RESIDENTIAL BUILDINGS

No. of loading units	Flow rate L/s	No. of loading units	Flow rate L/s	No. of loading units	Flow rate L/s
100	1.20	650	2.75	1800	4.90
150	1.35	700	2.85	2000	5.25
200	1.45	750	2.95	2200	5.50
250	1.60	800	3.05	2400	5.75
300	1.70	850	3.20	2600	6.00
350	1.85	900	3.30	2800	6.35
400	2.00	950	3.40	3000	6.70
450	2.15	1000	3.50	3500	7.25
500	2.35	1200	3.80	4000	7.75
550	2.50	1400	4.20	4500	8.40
600	2.60	1600	4.60	5000	9.00

APPENDIX P

SIZING OF EXPANSION VESSELS IN MAINS PRESSURE SYSTEMS

(Normative)

This Appendix sets out a method to calculate expansion vessel volume in mains pressure systems (check with manufacturer if their method differs to Equations P1 to P3 or for closed loop or solar systems):

(a) Calculate the expanded water volume.

$V_{expanded}$ *(L)* = TSV × EF . . . P1

where

TSV = Total system volume (L): the total volume of all heated water in the system including water heaters and storage tanks. Where the temperature in dead leg branch lines is not maintained, for example, not heat traced, the volume of water contained in the branch lines can be excluded.

EF = Water expansion factor: the amount that water will expand per litre when heated from its coldest to hottest temperature, see Table P1.

(b) Calculate the maximum allowed system pressure.

P_{high} (kPa) = 0.85 × P_{max} . . . P2

where

P_{max} (kPa) = Temperature and pressure relief valve or pressure relief valve setting: the lowest relief valve setting of all relief valves in a system, e.g. a water heater may have a pressure relief valve setting of 850 kPa and the storage tank may have a temperature and pressure relief valve setting of 1000 kPa. P_{max} would be 850 kPa.

(c) Determine the water supply pressure P_{low} (kPa).

where

P_{low} (kPa) = Water supply pressure (kPa): the maximum water supply pressure to the system. This will be the pre-charge pressure that the expansion vessel will need to be set at.

(d) Calculate the acceptance factor (AF).

AF = (P_{high} − P_{low}) / (P_{high} + 100 kPa) . . . P3

If the AF is greater than 0.5, use 0.5.

(e) Calculate the total tank volume.

Total tank volume (L) = $V_{expanded}$ / AF . . . P4

(f) Select a tank with equal or greater volume than that calculated.

(g) Pre-charge the expansion vessel to the pressure determined in (c) above.

Example

A building is serviced by a gas water heater and a storage tank with a storage capacity of 325 L. The flow and return circuit is to be run in Type B copper and the sum of all flow lines is 45 m of diameter 40 mm pipe and the return line is 12 m of diameter 25 mm pipe. The temperature in the branch lines is not maintained. The system is supplied with heated water at 65°C and the coldest water temperature in winter is 10°C. Incoming supply pressure to the building is 500 kPa.

1. Determine the total system volume (TSV).

From supplier tables it is determined that the total volume of fluid in the pipe work is 50 L. The storage tank volume is 325 L. Checking with the supplier, it is determined the water heater volume is relatively small, and an allowance of 10 L is to be made.

Therefore TSV = 50 + 325 + 10 = 385 L.

2. Determine the expansion factor (EF).

Hot temperature = 65°C, cold temperature = 10°C. From Table P1, 65°C is not shown. Use 70°C hot and cross reference against 10°C cold.

EF = 0.0201

3. Calculate the expanded water volume.

Vexpanded = 385 × 0.0201 = 7.74 L

4. Calculate the maximum allowed system pressure (Phigh).

From supplier literature or rating plate data, the water heater relief valve setting is 850 kPa and the storage tank is 1000 kPa. Therefore use 850 kPa.

Phigh = 0.85 × 850 = 723 kPa.

5. Determine water supply pressure (Plow).

Given as 500 kPa.

6. Calculate the AF.

AF = (Phigh – Plow) / (Phigh + 100 kPa).

AF = (723 – 500) / (723 + 100) = 0.27. As this is less than 0.5, use 0.27.

7. Calculate the total tank volume.

Total tank volume (L) = 7.74 / 0.27 = 28.7 litres.

8. Select a tank with a capacity at least 29 L.

9. Pre-charge the expansion tank to a pressure of 500 kPa.

TABLE P1

WATER EXPANSION FACTOR (EF)

Expansion of 1 L of water when raised from T1 (cold) to T2 (hot)											
°		T2 (Hot) °C									
		4	10	20	30	40	50	60	70	80	90
T1 (Cold)	4	0	0.0003	0.0018	0.0043	0.0078	0.0121	0.0171	0.0227	0.0290	0.0356
	10		0	0.0015	0.0041	0.0075	0.0118	0.0168	0.0224	0.0287	0.0356
	20			0	0.0026	0.0060	0.0103	0.0153	0.0209	0.0272	0.0340
	30				0	0.0035	0.0077	0.0127	0.0183	0.0245	0.0314
	40					0	0.0042	0.0092	0.0148	0.0210	0.0278
	50						0	0.0049	0.0105	0.0167	0.0235
	60							0	0.0055	0.0117	0.0185
	70								0	0.0061	0.0129
	80									0	0.0067
	90										0

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~~4552~~ ~~Gas-fired water heaters for hot water supply and/or central heating~~

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1170 Structural design actions

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3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

3666 Air-handling and water systems of buildings—Microbial control

3666.2 Part 2: Operation and maintenance

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~~HB~~

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*** END OF DRAFT ***

PREPARATION OF JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

Joint Australian/New Zealand Standards are prepared by a consensus process involving representatives nominated by organizations in both countries drawn from all major interests associated with the subject. Australian/New Zealand Standards may be derived from existing industry Standards, from established international Standards and practices or may be developed within a Standards Australia, Standards New Zealand or joint technical committee.

During the development process, Australian/New Zealand Standards are made available in draft form from the publisher the publisher SAI Global at http://www.saiglobal.com and Standards New Zealand at www.standards.govt.nz

Standards are made available for comment so that all interests concerned with the application of a proposed Standard are given the opportunity to submit views on the requirements to be included. Comment submitted on this draft Australian/New Zealand Standard will be considered a future Joint Technical Committee composed of major interests associated with the subject.

The following interests are represented on the committee responsible for this draft Australian/New Zealand Standard:

Association of Hydraulic Services Consultants Australia

Australian Building Codes Board

Australian Industry Group

Australian Stainless Steel Development Association

International Copper Association of Australia

Master Plumbers Australia

Master Plumbers, Gasfitters and Drainlayers New Zealand

Plastics Industry Pipe Association of Australia

Plastics New Zealand

Plumbers, Gasfitters and Drainlayers Board

Plumbing Distributors Association of New Zealand

Plumbing Products Industry Group

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