

Australian Standard[®]

**Valves primarily for use in heated water
systems**

Part 2: Control valves



This Australian Standard® was prepared by Committee WS-026, Valves Primarily for Use in Warm and Hot Water Systems. It was approved on behalf of the Council of Standards Australia on 12 August 2005.
This Standard was published on 28 October 2005.

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 - NSW Health Department
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-

This Standard was issued in draft form for comment as DR 05265.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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Australian Standard[®]

Valves primarily for use in heated water systems

Part 2: Control valves

Originated as part of AS B271—1968.
Revised and redesignated as AS 1357—1972.
Revised and redesignated (in part) as AS 1357.2—1998.
Fourth edition 2005.
Reissued incorporating Amendment No. 1 (September 2006).
Reissued incorporating Amendment No. 2 (May 2009).

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Published by Standards Australia GPO Box 476, Sydney, NSW 2001, Australia
ISBN 0 7337 6960 8

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee WS-026, Valves Primarily for Use in Warm and Hot Water Systems, to supersede AS 1357.2—1998, *Valves primarily for use in warm and hot water systems Part 2: Control valves*.

This Standard incorporates Amendment No. 1 (September 2006), Amendment No. 2 (May 2009). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

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

The objective of this Standard is to provide manufacturers with design, materials and performance requirements for control valves that give reasonable protection to users against exposure to high or excessive fluctuations in water temperature.

The range of control valves in this Standard includes types to limit maximum water inlet pressures, provide vacuum relief, prevent excessive water storage temperature (in solar water heaters) and reduce the risk of scalding temperatures at delivery points.

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.

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STANDARDS AUSTRALIA

Australian Standard

Valves primarily for use in heated water systems

Part 2: Control valves

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out requirements for the design, construction, testing and performance of the following types of water valves and devices:

- (a) Vacuum relief valves.
- (b) Thermosiphon arrestor valves.
- (c) Primary temperature control valve.
- (d) Inlet pressure control valves.
- (e) Isolating valves.

The valves and devices specified in this Standard are primarily intended for use in a heated water service (see AS/NZS 3500.4).

1.2 APPLICATION

Compliance with this Standard shall be demonstrated in accordance with Appendix A.

1.3 REFERENCED DOCUMENTS

The documents referred to in this Standard are listed in Appendix B.

1.4 DEFINITIONS

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

1.4.1 Distortion

That which is obvious to the eye without resorting to dimensional checking.

1.4.2 Inlet pressure control valve

A valve designed to control the maximum supply pressure of the cold water to the inlet of a water heater.

NOTE: Typically, it may be a pressure-reducing valve, pressure-limiting valve or pressure ratio valve.

1.4.3 Manufacturer's recommended commissioning temperature

The temperature to which the tempering valve is set and checked following its installation within the limits specified by the manufacturer.

1.4.4 Pressure

1.4.4.1 *Opening pressure*

The pressure that first causes a valve to open.

1.4.4.2 *Closing pressure*

The pressure that first allows a valve to close.

1.4.4.3 *Set pressure*

The pressure at which a valve is designated to operate.

1.4.5 Rated capacity

1.4.5.1 *Expansion control valve*

The maximum rate of heat input to a water heater for which the pressure remains within defined limits, as the valve discharges the expanding water.

1.4.5.2 *Relief valve*

The rate at which heat energy can be safely dissipated by the discharge of hot water or steam through the valve.

1.4.6 Steady mixed water discharge temperature

A single temperature reading taken at 30 ± 5 s following an applied change in the water supply conditions.

1.4.7 Temperature

1.4.7.1 *Opening temperature*

The temperature at the inlet of a valve that first causes it to open.

1.4.7.2 *Closing temperature*

The temperature at the inlet of the valve that first allows it to close.

1.4.7.3 *Set temperature*

The temperature at which a valve is designated to operate.

1.4.8 Thermosiphon arrestor valve

Temperature-actuated valve, for use with a thermosiphoning solar water heater, which automatically controls the maximum temperature of stored water by arresting the thermosiphon flow at a predetermined temperature.

1.4.9 Transient mixed water discharge temperatures

The series of temperatures taken in 0.1 s intervals for the period 0 to 60 s immediately following an applied change in the water supply conditions.

1.4.10 Hot water supply temperature differential

The differential of the supply temperature of the hot water above the set temperature of the valve, which is required for efficient operation.

1.4.11 Manufacturer's specified temperature settings (maximum and minimum)

The outlet temperatures to which the primary temperature control valve can be set, as specified by the manufacturer.

1.4.12 Manufacturer's recommended maximum supply temperature

The maximum hot water supply temperature that the primary temperature control valve can accept continuously without permanent damage.

1.5 INSTRUMENTATION

Instrument requirements shall be in accordance with Appendix C.

1.6 MARKING

Valves and devices complying with this Standard shall be marked or supplied with the following information:

- (a) Manufacturer's name, trademark or symbol.
- (b) Name or model number of the valve or device.
- (c) Identification for traceability in the form of either—
 - (i) batch identification; or
 - (ii) individual serial number.
- (d) Mark of the certifying body.
- (e) The number of this Standard (i.e., AS 1357.2).
- (f) Identification of the inlet, drain, outlet or other special connections, or by an arrow indicating direction of flow.
- (g) Additional markings for valves as specified in the appropriate clause.

Unless otherwise specified, this information shall be permanently marked on the valve body (cast, stamped or engraved) or shown on a rating plate affixed to the valve. Transfers or paper-based labels are not acceptable for this purpose.

NOTE: Manufacturers making a statement of compliance with this Australian Standard on a product, packaging, or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

S E C T I O N 2 M A T E R I A L S

2.1 GENERAL

Materials used in the construction of valves and devices shall be suitable for the conditions of use, e.g., temperature, pressure, and compatibility with any adjacent component.

Where construction or attachment involves brazing, the materials shall be suitable for brazing.

2.2 CONTAMINATION OF WATER

Materials in contact with drinking water shall comply with AS/NZS 4020.

2.3 CORROSION-RESISTANT METALLIC MATERIALS

The parts of the valves in contact with water shall be made from corrosion-resistant materials. For the purpose of this Standard, the following materials are deemed to be corrosion-resistant:

- (a) Copper, as specified in Clause 2.4.
- (b) Copper alloy, as specified in Clause 2.5 and Clause 2.6.
- (c) Stainless steel, as specified in Clause 2.7.
- (d) Material for springs, as specified in Clause 2.10(c).
- (e) Other materials, as specified in Clause 2.10.

2.4 COPPER

Copper shall comply with the following:

- (a) *Wrought products* AS 2738.
- (b) *Tubular components* Copper pipe shall comply with AS 1432 or NZS 3501.

2.5 COPPER ALLOY

Copper alloy shall comply with the following:

- (a) *Castings* AS 1565 and have a lead content of less than 4.5%.
- (b) *Hot pressing* AS 1568.
- (c) *Rod for machined parts* AS 1567.
- (d) *Tubular components* Copper alloy pipe shall comply with AS 1572 alloy, designation C 26130. Where bent or stamped in the fabrication process, the pipe shall be sufficiently stress-relieved, so that it is capable of passing the mercurous nitrate test specified in AS 2136 after all fabrication processes are completed.

2.6 DEZINCIFICATION-RESISTANT (DR) COPPER ALLOY

Copper alloys in contact with water shall comply with AS 2345.

2.7 STAINLESS STEEL

Stainless steel shall comply with the following:

- (a) *Wrought components* ASTM A276, series 300, containing not less than 8% nickel and UNS S32750, S32304, S31803, S31500 duplex (ferritic-austenitic) stainless steels.
- (b) *Tubular components* ASTM A269 and UNS S32750, S32304, S31803, S31500 duplex (ferritic-austenitic) stainless steels.

2.8 DIAPHRAGM, MATERIALS, AND VALVE SEATS

Diaphragm materials and valve seats shall have corrosion-resistant properties and, where used in a hot water service, heat-resistant properties. Seat materials shall also have anti-adhesion properties for the conditions of intended application.

2.9 TEMPERATURE-SENSING PROBE

The outer casing of the temperature-sensing probe shall not show signs of deterioration on completion of the endurance testing.

2.10 OTHER COMPONENT MATERIALS

The following applies to materials for other components:

- (a) *Ceramics* Ceramic materials may be used.
- (b) *Filler metals* Filler metal shall be one of the following:
 - (i) Silver brazing alloy containing not more than 0.05% Cadmium, complying with AS 1167.1.
 - (ii) Copper-phosphorus brazing alloy complying with AS 1167.1 with a minimum of 1.8% silver.
 - (iii) Solder complying with the requirements of AS 1834.1 and having a maximum of 0.1% lead.
- (c) *Material for springs* Materials for springs shall comply with one of the following:
 - (i) Stainless steel, complying with the corrosion resistant property of Grade 304 of AS 2837.
 - (ii) Stainless steel to ASTM A313/A313M.
 - (iii) Nickel copper alloy (monel).

NOTE: Other grades may be used provided they meet the performance requirements of this Standard and have the equivalent corrosion resistant properties.
- (d) *Nickel-copper-iron* Nickel-copper-iron shall comply with one of the following:
 - (i) AS 2738, Alloy 713; or
 - (ii) ASTM B127, ASTM B163, ASTM B164 and ASTM B165.

SECTION 3 GENERAL DESIGN AND CONSTRUCTION

3.1 GENERAL

The body and component parts of valves and devices shall be designed and manufactured to perform their intended functions reliably so that, in the course of handling, installation, normal operation or maintenance, damage that would prevent their continued compliance with this Standard does not occur.

Unless otherwise specified, all valves shall be provided with a minimum of two parallel wrench flats.

NOTE: Guidelines for the acoustic evaluation of valves are given in Appendix D.

3.2 STRENGTH

3.2.1 Torque test

When tested in accordance with Appendix E of AS 1357.1, the valve under test shall be capable of withstanding, without permanent distortion or breakage, the applied torque, as appropriate. This test is not applied where elastomeric seals are used on connections for assembly of combination valve bodies.

3.2.2 Leakage

When valves are tested in sequence, first in accordance with Appendix E of AS 1357.1, and second in accordance with Appendix E of this Standard, there shall be no leakage from the valve body.

3.3 END CONNECTIONS

Valves shall be provided with end connections or adaptors with end connections, complying with AS 3688, where the end is intended to be connected to pipework.

3.4 COMPONENTS AND VALVE SEATS

Components and assemblies, including inserted valve seats, shall be positively secured by screw threads, riveting or other durable mechanical means.

3.5 REPAIR

The means of field repair for a valve shall be limited to the replacement of a pre-set cartridge assembly that contains all the operating components.

NOTE: The inclusion of all the operating components excludes the dismantling of any operating component.

3.6 INSTRUCTIONS

Valves shall be accompanied by comprehensive installation instructions in the English language.

SECTION 4 VACUUM RELIEF VALVES

4.1 GENERAL

Vacuum relief valves complying with this Standard are intended to protect water heaters from damage caused by vacuum.

In addition to the requirements of this Section, vacuum relief valves shall comply with the relevant requirements of Sections 1, 2 and 3.

NOTE: Vacuum relief valves are not intended to prevent backflow or back-siphonage.

4.2 DESIGN

A vacuum relief valve may be either a separate device or combined with another valve.

Vacuum relief valves are required to operate at—

- (a) continuous operating temperature not exceeding 85°C; and
- (b) temperatures under emergency conditions not exceeding 99°C

4.3 INLET AND OUTLET

4.3.1 Inlet

The inlet to a vacuum relief valve is defined as that part of the valve open to atmosphere.

4.3.2 Outlet connection

Except where fitted direct to, or integral with, the body of another valve, the outlet connection to a vacuum relief valve shall be not smaller than DN 15.

4.4 PROTECTION AGAINST BLOCKAGE

The inlet to a vacuum relief valve shall be shrouded.

4.5 FLOW PASSAGES

The cross-sectional area of any flow passage shall be not less than 7 mm² on the inlet side of the valve, and not less than 28 mm² on the outlet side of the valve.

4.6 OPENING PRESSURE TEST

When tested in accordance with Appendix F, the opening pressure shall be not less than atmospheric pressure by more than 3.5 kPa.

4.7 CLOSING PRESSURE TEST

When tested in accordance with Appendix E, the closing pressure shall be not greater than atmospheric pressure by more than 7 kPa.

4.8 AIR-PASSING CAPACITY TEST

When tested in accordance with Appendix F, the flow rate of air, under a differential pressure of 7 ± 0.5 kPa, shall be not less than 25 L/min.

4.9 RESISTANCE TO HOT WATER

The valves shall comply with the requirements of Clauses 4.6, 4.7 and 4.8, after exposure to water at 120 ± 2°C for 60 +5, -0 min in an autoclave.

4.10 MARKING

In addition to the general marking requirements of Clause 1.5, each valve shall be marked with the air-passing capacity, in litres per minute, e.g., 25 L/min.

SECTION 5 THERMOSIPHON ARRESTOR VALVES

5.1 GENERAL

Thermosiphon arrestor valves complying with this Standard are intended to seal only against the thermosiphon flow resulting in very low-pressure differentials.

In addition to the requirements of this Section thermosiphon arrestor valves shall also comply with the relevant requirements of Section 1, 2 and 3.

Thermosiphon arrestor valves are required to operate at—

- (a) continuous operating temperature not exceeding 85°C;
- (b) temperatures under emergency conditions not exceeding 99°C; and
- (c) continuous working pressure not exceeding 1400 kPa.

5.2 FLOW AREA

The net cross-sectional area of the seat orifice and total cross-sectional thermosiphon flow area, at any point between the inner ends of the inlet and the outlet of the valve body, shall be not less than 100 mm².

5.3 FLOW PASSAGE

The width of any flow passage of fixed cross-sectional area, excluding cold-water inlet passages, shall be not less than 3.5 mm.

5.4 CLOSING TEMPERATURE

When tested in accordance with Appendix K, the closing temperature of a thermosiphon arrestor valve shall be within ±4°C of the nominated temperature.

5.5 VALVE OPERATING CHARACTERISTICS

When tested in accordance with Appendix K, at a temperature 5°C below the actual closing temperature, the calculated flow area shall be not less than 100 mm².

5.6 ENDURANCE

After testing in accordance with Appendix H, the valve shall comply with the requirements of Clauses 5.4 and 5.5.

5.7 TEMPERATURE ENDURANCE

After testing in accordance with Appendix I, the valve shall comply with the requirements of Clauses 5.4 and 5.5.

5.8 MARKING

In addition to the general marking requirements of Clause 1.5, the valves shall be marked with the nominated temperature setting, in degrees Celsius.

SECTION 6 PRIMARY TEMPERATURE CONTROL VALVES

6.1 GENERAL

Primary temperature control valves complying with this Standard are intended to automatically temper a primary supply of hot water in order to limit the temperature of the water delivered to a downstream device or process up to DN 32. They may be either a separate valve or combined with another valve or valves.

In addition to the requirements of this Section, primary temperature control valves shall also comply with the relevant requirements of Sections 1, 2 and 3.

NOTES:

- 1 It is assumed that the maximum supply temperature and set temperatures will be negotiated between the valve supplier and the customer, to suit the intended application of the primary temperature control valve.
- 2 Primary temperature control valves are typically used after boilers, uncontrolled water heaters, solar water heaters, etc., to provide a controlled water temperature to down-stream controllers.
- 3 Primary temperature control valves are not to be used to directly supply water for ablutionary purposes.
- 4 For temperature control of water for ablutionary purposes see AS/NZS 3500.4.

6.2 INLET AND OUTLET CONNECTIONS

End connections shall comply with Clause 3.3.

Capillary connections shall not be used.

6.3 DESIGN REQUIREMENTS

Adjustable primary temperature control valves shall include tamper-resistant means to ensure that the maximum on-site temperature setting is not exceeded.

6.4 MIXED WATER DISCHARGE TEST—TEMPERED WATER RANGE

When tested in accordance with Appendix G, the temperature of the mixed water discharged from the valve shall not vary from the set temperature by more than $\pm 5^{\circ}\text{C}$ under steady state conditions.

Under transient conditions, a temperature of 5°C greater than the set temperature shall not be exceeded for a period greater than 15 s and a temperature of 10°C above the set temperature shall not be exceeded.

When tested in accordance with Paragraph G5, Appendix G, the volume of water collected from the mixed water discharge shall not exceed 1.0 L in the period from 6 to 66 s following cold water supply isolation.

For primary temperature control valves with a set temperature adjustment, the above tests shall be conducted at the manufacturer's stated maximum and minimum adjustable set temperatures.

6.5 ENDURANCE

When tested in accordance with Appendix H, the valve shall comply with the requirements of Clause 6.4.

6.6 MINIMUM FLOW REQUIREMENT

When tested in accordance with Appendix J, the flow from the outlet of the valve shall be not less than the manufacturer's nominated flow capacity, at a pressure differential of 100 kPa.

6.7 MARKING

In addition to the general marking requirement of Clause 1.5, each valve shall be marked with the following information:

- (a) For preset valves, the set temperature, in degrees Celsius.
- (b) For adjustable valves, the minimum and maximum set temperatures in degrees Celsius.
- (c) Appropriate identification of hot, cold and outlet connections.

The following markings shall appear on the valve or on the packaging:

- (i) The maximum supply temperature, in degrees Celsius.
- (ii) The manufacturer's nominated flow capacity, in litres per minute.

6.8 MANUFACTURER'S INSTRUCTIONS

The manufacturer's instructions, included with each primary temperature control valve, shall cover at least the following:

- (a) Name and address of the manufacturer and the relevant agent in the country of intended sale.
- (b) Full and comprehensive installation diagrams including the positioning, if necessary, of non-integral line strainers, cross-flow prevention devices (non-return valves) and isolating valves.

NOTE: Strainers and cross-flow prevention devices shall be installed downstream of any isolation valves and in the order strainer then cross-flow prevention device.

- (c) The maximum and minimum working pressure, in kilopascals, and details for the fitting of any necessary pressure control device where these pressures could be exceeded.
- (d) Full directions for the commissioning of the primary temperature control valve.
- (e) The minimum and maximum hot and cold water supply temperatures, in degrees Celsius, including the hot water supply temperature differential of the valve.
- (f) For preset valves, the set temperature, in degrees Celsius.
- (g) For adjustable valves, the minimum and maximum set temperatures, in degrees Celsius, and the method of adjustment.
- (h) Any operating limits the manufacturer has specified for the valve.
- (i) A statement that all valves must be commissioned and the mixed water discharge temperature must be set on site and verified with a thermometer.
- (j) Comprehensive instructions for the procedures that are to be carried out to verify the performance of the valve in service.
- (k) A cautionary statement that valves not installed and serviced in accordance with the manufacturer's instructions may result in unsafe performance.

SECTION 7 INLET PRESSURE CONTROL VALVES

7.1 GENERAL

Inlet pressure control valves complying with this Standard shall be one of the following:

- (a) Pressure-reducing valves.
- (b) Pressure-limiting valves.
- (c) Ratio valves.

In addition to the requirements of this Section, pressure control valves shall also comply with the relevant requirements of Sections 1, 2 and 3.

Inlet pressure control valves are required to operate at—

- (i) continuous operating temperature not exceeding 85°C;
- (ii) temperatures under emergency conditions not exceeding 99°C; and
- (iii) continuous working pressure of at least 1400 kPa.

7.2 OUTLET PRESSURE

When tested in accordance with Appendix L, the pressure at the outlet of the valve shall fall within the following limits, as appropriate:

- (a) *Pressure-reducing valves*—the greater of set pressure $\pm 10\%$ or set pressure ± 15 kPa.
- (b) *Pressure-limiting valves*—set pressure $+35\%$, -10% .
- (c) *Ratio valves*—the pressure calculated by dividing the applied inlet pressure by the specified ratio, $+35\%$, -10% .

A2 | When tested, adjustable valves shall achieve the applicable tolerance at both maximum and minimum settings.

7.3 SET OUTLET PRESSURES AND RATIOS

For non-adjustable valves, the nominal outlet pressure or ratio shall be specified by the manufacturer.

For adjustable valves, the maximum, minimum and factory preset pressures shall be nominated by the manufacturer.

NOTE: The preferred set pressures and ratios are as follows:

- (a) Pressure-reducing valves—50, 70, 100, 140, 175, 210, 350 and 500 kPa.
- (b) Pressure-limiting valves—350, 500 and 600 kPa.
- (c) Ratio valves—2:1 and 3:1.

7.4 FLOW RATES

When tested in accordance with Appendix M, the measured average flow rates shall be not less than the nominated flow rates.

7.5 ENDURANCE

After testing in accordance with Appendix N, the valve shall be retested in accordance with Clauses 7.2 and 7.4 and shall comply with Clause 7.2 and have a flow rate not less than 90% of the measured average flow rate previously determined by Clause 7.4.

7.6 MARKING

In addition to the general marking requirements of Clause 1.5, each inlet pressure control valve shall be marked with the following information:

A2

- (a) *Non-adjustable valves:*
 - (i) For pressure-limiting and pressure-reducing valves, the set pressure, in kilopascals; and for ratio valves, the specified ratio.
 - (ii) Maximum inlet pressure, in kilopascals.
 - (iii) Nominated flow rate in litres per minute.
 - (iv) Specified maximum operating temperature, in degrees Celsius.
- (b) *Adjustable valves:*
 - (i) The maximum and minimum outlet pressures, in kilopascals.
 - (ii) Maximum inlet pressure, in kilopascals.
 - (iii) Nominated flow rates in litres per minute at the maximum and minimum settings.
 - (iv) Specified maximum operating temperature, in degrees Celsius.

SECTION 8 ISOLATING VALVES

8.1 GENERAL

Isolating valves complying with this Standard are intended primarily for use in the installation of water heaters. They may be combined integrally with another valve or valve assembly that is intended to be fitted to the inlet of a water heater.

In addition to the requirements of this Section, isolating valves shall also comply with the relevant requirements of Sections 1, 2 and 3.

Isolating valves are required to operate at continuous working pressure of at least 1400 kPa.

8.2 MINIMUM FLOW AREA

The net cross-sectional area at any point within the valve body between the inner end of the inlet connection and the inner end of the outlet connection shall be not less than 75 mm².

8.3 WIDTH OF PASSAGES

The width of the flow passages between the inner ends of the inlet connection and the inner end of the outlet connection shall be not less than 3.5 mm.

8.4 STRENGTH OF OPERATING MECHANISM

When tested in accordance with Appendix O, isolating valves shall be capable of withstanding, without distortion or permanent deformation, the applied torque, as appropriate.

8.5 ENDURANCE

When tested in accordance with Appendix P, the valve assembly shall be capable of passing the following tests:

- (a) Test in accordance with Appendix E.
- (b) Test appropriate to the other valve or valve assembly, if any.
- (c) When combined with a non-return valve, the test as specified in Section 6 of AS 1357.1.

NOTE: Item (b) may be waived provided that it can be reliably demonstrated that the continued operation test does not affect the function of the other valve or valve assembly.

A1

SECTION 9 THERMAL SWITCHING VALVES

9.1 GENERAL

Thermal switching valves complying with this Standard are intended to automatically switch the flow of water from one inlet port to either of two outlet ports, depending upon the temperature of the inlet water.

In addition to the requirement of this Section, thermal switching valves shall also comply with the relevant requirements of Sections 1, 2 and 3.

Thermal switching valves shall operate at—

- (a) continuous operating temperature not exceeding 85°C;
- (b) temperatures under emergency conditions, not exceeding 99°C; and
- (c) continuous working pressure not exceeding 1400 kPa.

9.2 INLET AND OUTLET CONNECTIONS

End connections shall comply with Clause 3.3.

Capillary connections shall not be used.

9.3 DESIGN REQUIREMENTS

Thermal switching valves shall incorporate tamper-resistant means to ensure that the operating temperature is not adjusted inadvertently without the use of non-standard tools.

9.4 PERFORMANCE REQUIREMENTS

9.4.1 Flow capacity

When a thermal switching valve tested in accordance with Appendix V—

- (a) with the water temperature at the lower switching temperature, the flow rate to the cold outlet port shall be not less than the nominated water flow capacity.
- (b) with the water temperature at the upper switching temperature, the flow rate to the hot outlet port shall be not less than the nominated water flow capacity.

9.4.2 Leakage rate

When a thermal switching valve is tested in accordance with Appendix V—

- (a) with the water temperature at the lower switching temperature, the flow rate to the hot outlet port shall be not greater than the nominated leakage rate; and
- (b) with the water temperature at the upper switching temperature, the flow rate to the cold outlet port shall be not greater than the nominated leakage rate.

9.4.3 Switching time

When a thermal switching valve is tested in accordance with Appendix V—

- (a) the time taken for the flow rate from the cold outlet port to switch to the hot outlet port and fall below the nominated leakage rate shall be less than the nominated switching time; and
- (b) the time taken for the flow rate from the hot outlet port to switch to the cold outlet port and fall below the nominated leakage rate shall be less than the nominated switching time.

A1

9.5 ENDURANCE

When tested in accordance with Appendix W, a thermal switching valve shall comply with Clause 9.4.

9.6 MARKING

In addition to the requirements of Clause 1.5, each thermal switching valve shall be marked with the following:

- (a) The lower switching temperature, in degrees Celsius.
- (b) The upper switching temperature, in degrees Celsius.
- (c) Appropriate identification of the inlet, cold outlet and hot outlet connections.

9.7 MANUFACTURER'S INSTRUCTIONS

The manufacturer's instructions included with each thermal switching valve shall include the following:

- (a) Name and address of the manufacturer and the relevant agent in the country of intended sale.
- (b) Valve performance characteristics, including at least—
 - (i) the lower switching temperature, in degrees Celsius;
 - (ii) the upper switching temperature, in degrees Celsius;
 - (iii) the water flow capacity, in litres per minute;
 - (iv) the leakage rate, in litres per minute; and
 - (v) the switching time, in seconds.
- (c) Full and comprehensive installation instructions.
- (d) Any operating limits the manufacturer has specified for the valve.
- (e) Comprehensive instructions for the procedures that are to be carried out to verify the performance of the valve in service.

APPENDIX A
MEANS FOR DEMONSTRATING COMPLIANCE WITH THIS STANDARD
(Normative)

A1 SCOPE

This Appendix sets out the means by which compliance with this Standard is to be demonstrated by a manufacturer under the WaterMark product certification scheme.

A2 RELEVANCE

The long-term performance of plumbing systems is critical to the durability of building infrastructure, protection of public health and safety, and protection of the environment.

A3 PRODUCT CERTIFICATION

The purpose of product certification is to provide independent assurance of the claim by the manufacturer that products comply with this Standard.

The certification scheme serves to indicate that the products consistently conform to the requirements of this Standard.

The sampling and testing plan, as detailed in Paragraph A5 and Table A1, shall be used by the Conformity Assessment Body. Where a batch release testing program is required it shall be carried out as detailed in Paragraph A5 and Table A2, by the manufacturer.

A4 DEFINITIONS

A4.1 Batch release test

A test performed by the manufacturer on a batch of components, which is completed before the batch is released.

A4.2 Production batch

Clearly identifiable collection of units, manufactured consecutively or continuously under the same conditions, using material or compound to the same specification.

A4.3 Sample

One or more units of product drawn from a batch, selected at random without regard to quality.

NOTE: The number of units of product in the sample is the sample size.

A4.4 Sampling plan

A specific plan that indicates the number of units of components or assemblies to be inspected.

A4.5 Type test batch

Schedule of units of the same type, identical dimensional characteristics, all the same nominal diameter and wall thickness, from the same compound. The batch is defined by the manufacturer.

A4.6 Type testing (TT)

Testing performed to demonstrate that the material, component, joint or assembly is capable of conforming to the requirements given in the Standard.

A5 TESTING

A5.1 Type testing

Tables Q1, R1, S1, T1, and U1 of Appendices Q, R, S, T, and U, respectively set out the requirements for type testing and frequency of re-verification.

A5.2 Batch release testing

Table Q2, R2, S2, T2, and U2 of Appendices Q, R, S, T, and U, respectively set out the minimum sampling and testing frequency plans for a manufacturer to demonstrate compliance of product(s) to this Standard on an ongoing basis. However, where the manufacturer can demonstrate adequate process control to the certifying body, the frequency of the sampling and testing nominated by the manufacturer's quality plan and/or documented procedures shall take precedence for the purposes of WaterMark product certification.

A5.3 Retesting

In the event of a test failure, the products within the batch shall be tested at an appropriate acceptable quality level (AQL) and only those batches found to comply may be claimed and/or marked as complying with this Standard.

A6 SAMPLING AND FREQUENCY PLANS

The compliance sampling and frequency plans for each type of valve shall be as follows:

- (a) Vacuum relief valves Appendix Q.
- (b) Thermosiphon arrestor valvesAppendix R.
- (c) Primary temperature control valves Appendix S.
- (d) Inlet pressure control valvesAppendix T.
- (e) Isolating valves Appendix U.

APPENDIX B

REFERENCE DOCUMENTS

The following documents are referred to in this Standard:

AS

- 1167 Welding and brazing—Filler metals
- 1167.1 Part 1: Filler metal for brazing and braze welding
- 1349 Bourdon tube pressure and vacuum gauges
- 1357 Valves primarily for use in warm and hot water systems
- 1357.1 Part 1: Protection valves
- 1432 Copper tubes for plumbing, gasfitting and drainage applications
- 1565 Copper and copper alloys—Ingots and castings
- 1567 Copper and copper alloys—Wrought rods, bars and sections
- 1568 Copper and copper alloys—Forging stock and forgings
- 1572 Copper and copper alloys—Seamless tubes for engineering purposes
- 1834 Material for soldering
- 1334.1 Part 1: Solder alloys
- 2136 Method for detecting the susceptibility of copper and its alloys to stress corrosion cracking using the mercurous nitrate test
- 2345 Dezincification resistance of copper alloys
- 2738 Copper and copper alloys—Compositions and designations of refinery products, wrought products, ingots and castings
- 2837 Wrought alloy steels—Stainless steel bars and semi-finished products
- 3688 Water supply—Metallic fittings and end connectors

AS/NZS

- 3500 Plumbing and drainage
- 3500.0 Part 0: Glossary of terms
- 3500.4 Part 4: Heated water services
- 4020 Testing of products for use in contact with drinking water

NZS

- 3501 Specification for copper tubes for water, gas and sanitation

ASTM

- A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- A276 Standard Specification for Stainless Steel Bars and Shapes
- A313 Standard Specification for Stainless Steel Spring Wire
- B127 Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
- B163 Standard Specification for Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes
- B164 Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire

B165 Standard Specification for Nickel-Copper Alloy (UNS N04400)* Seamless Pipe and Tube

ISO

3822 Acoustics—Laboratory tests on noise emission from appliances and equipment used in water supply installations

3822.1 Part 1: Method of measurement

3822.2 Part 2: Mounting and operating conditions for draw-off taps and mixing valves

3822.3 Part 3: Mounting and operating conditions for in-line valves and appliances

3822.4 Part 4: Mounting and operating conditions for special appliances

APPENDIX C

INSTRUMENTATION

(Normative)

C1 GENERAL

Where applicable, the accuracy of the instrumentation used in the tests required by this Standard shall be not less than that specified in this Appendix.

C2 FLOWMETER (for use with air)

Flow rate range..... 0 L/min to 50 L/min

Accuracy ± 0.5 L/min

Response time <0.5 s

C3 FLOWMETER (for use with water)

Flow rate range..... 0 L/min to 15 L/min

Accuracy ± 0.5 L/min

Response time <1 s

C4 PRESSURE GAUGES (for use with water)

All gauges shall be test gauges complying with AS 1349.

C5 TEMPERATURE-INDICATING AND RECORDING DEVICES

Temperature range..... 0°C to 150°C

Accuracy $\pm 0.5\%$

Response time 0.1 s

C6 STOPWATCH

Accuracy ± 0.01 s

C7 TORQUE APPLICATOR

Capacity..... Not less than 120% of the test requirement

Accuracy $\pm 6\%$ of full scale

Graduation 1 N.m for equal to or less than 20 N.m full scale

..... 5 N.m for greater than 20 N.m full scale

APPENDIX D
MEASUREMENT OF NOISE EMISSION
(Informative)

D1 SCOPE

This Appendix provides guidelines to test methods for noise emission and acoustic evaluation of valves.

D2 SOUND PRESSURE LEVELS

D2.1 General

The sound pressure levels are used to specify the noise emission of valves resulting from water flow.

D2.2 Method

The method for the measurement of sound pressure levels of a valve is in accordance with ISO 3822.1 and the relevant mounting and operating conditions in accordance with—

- (f) ISO 3822.2, for point-of-use;
- (g) ISO 3822.3, for in-line; or
- (h) ISO 3822.4, for special appliances (including outlet fittings).

APPENDIX E
LEAKAGE TEST
(Normative)

E1 SCOPE

This Appendix sets out the method for testing valves for leakage.

E2 PRINCIPLE

The valve under test is mounted in a rig, subjected to a hydrostatic pressure test and then assessed for leaks.

E3 APPARATUS

The following apparatus is required:

- (a) Test rig for the leakage test.
- (b) Test pressure gauges each fitted with an air bleed attachment.
- (c) Water supply at ambient temperature and variable pressures (see Table E1).

E4 PROCEDURE

This test may be carried out at the available water temperature.

The procedure shall be as follows:

- (a) Ensure that the valve under test complies with the requirements of Clause 3.2.1.
- (b) Connect the valve under test to the water supply and purge the air from the test rig.
- (c) Hydrostatically test each type of valve in accordance with Table E1, as appropriate, for a period of 4 ± 1 min. Record the pressure and the duration of application.
- (d) Observe and record any leakage from the valve.

TABLE E1
HYDROSTATIC PRESSURE AND APPLICATION

Type of valve	Applied pressure*	Where applied	Special conditions
Vacuum relief	7 kPa and 2 000 kPa	At the outlet	—
Thermosiphon arrestor	7 kPa and 2 000 kPa	At the inlet	Supply and outlet closed
Temperature control	7 kPa and 2 000 kPa	Hot inlet	Cold inlet and mix outlet closed
Pressure-reducing	2 000 kPa	At the inlet	Outlet closed
	1.5 × set pressure	At the outlet	Inlet closed
Pressure-limiting	2 000 kPa	At the inlet	Outlet closed
	1 400 kPa	At the outlet	Inlet closed
Ratio	2 000 kPa	At the inlet	Outlet closed
	1 400 kPa	At the outlet	Inlet closed
Isolating	2 000 kPa	At the inlet	Valve closed, outlet open
Thermostatic circulating	2 000 kPa	At the inlet	Outlet closed

* Unless otherwise specified, all tolerances are ±5%.

E5 REPORT

The report shall include the following information for each test valve:

- (a) Manufacturer, model, type and size of valve.
- (b) Test pressure and duration of application.
- (c) Any leakage or other failure.
- (d) Compliance or non-compliance with the testing criteria in this Standard.
- (i) Reference to this test method, i.e., Appendix E, AS 1357.2.

APPENDIX F

OPENING PRESSURE AND AIR-PASSING CAPACITY TEST— VACUUM-RELIEF VALVES

(Normative)

F1 SCOPE

This Appendix sets out the method for determining the opening pressure and air-passing capacity of vacuum-relief valves.

F2 PRINCIPLE

The valve under test is mounted in a rig and a vacuum applied to test relief valve pressures.

F3 APPARATUS

The following apparatus is required:

- (a) Test rig for opening pressure and air-passing capacity of vacuum-relief valves. A typical test rig is shown in Figure F1.
- (b) Supply of water at ambient temperature.

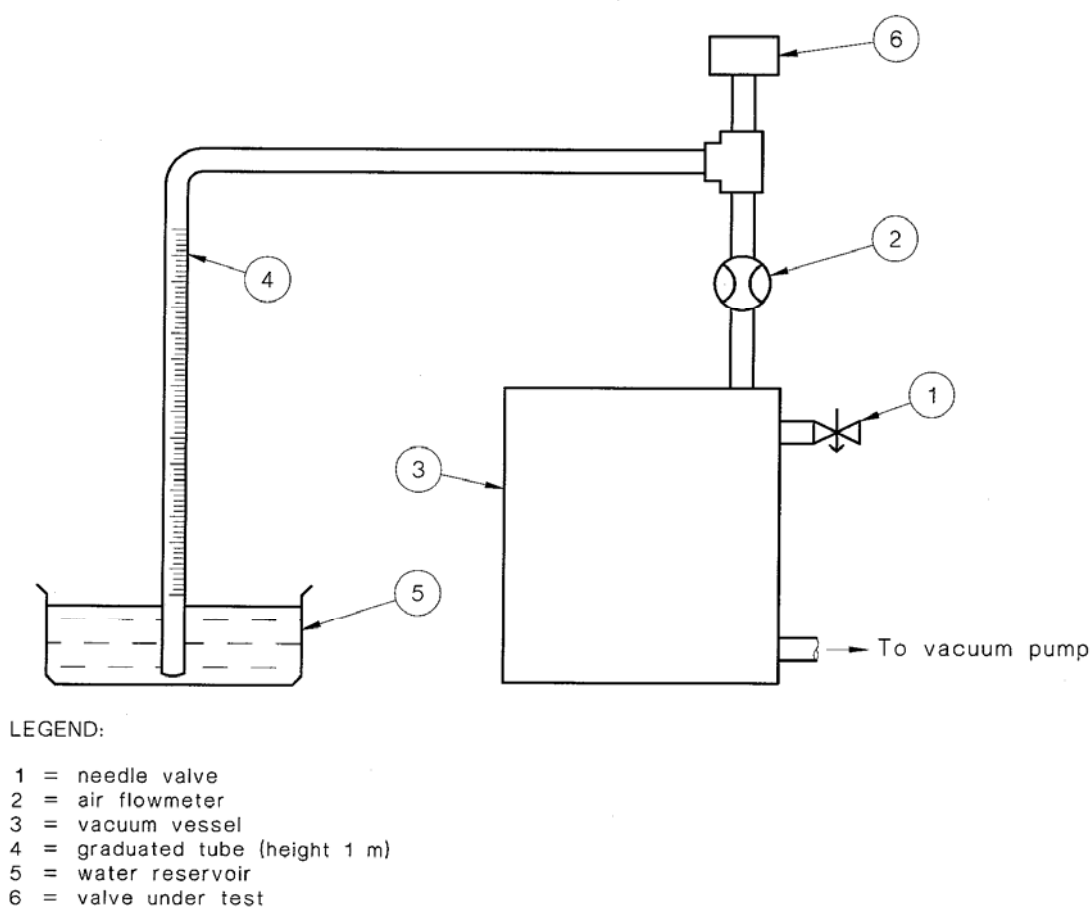


FIGURE F1 TYPICAL TEST RIG FOR VACUUM RELIEF VALVES

F4 PROCEDURE (Figure F1)

The procedure shall be as follows:

- (a) Install the valve under test (6) in the upright position on the test rig. Check for air leaks.
- (b) Open needle valve (1) fully and start vacuum pump.
- (c) Slowly close the needle valve (1) and observe the level of water in the graduated tube (4) when the air flowmeter (2) registers a positive flow. This indicates the opening pressure of the valve.
- (d) Record the level of water in the graduated tube (4).
- (e) Close the needle valve (1) slowly until the level of water in the graduated tube (4) rises to but does not exceed 700 mm above the level of the water in the reservoir. Maintain these conditions for not less than 1 min.
- (f) Record the flow rate of air through the air flowmeter (2) while maintaining the water column at 700 mm.

F5 REPORT

The report shall include the following information for each test valve:

- (a) Manufacturer, model, type and size of valve.
- (b) Opening pressure of the valve.
- (c) Level of the water in the graduated tube, the flow rate and the duration of the test period.
- (d) Compliance or non-compliance with the testing criteria in this Standard.
- (e) Reference to this test method, i.e., Appendix F, AS 1357.2.

APPENDIX G
TEMPERATURE STABILITY OF MIXED WATER TEST—
PRIMARY TEMPERATURE-CONTROL VALVE

(Normative)

G1 SCOPE

This Appendix sets out the method for testing, over a range of pressures, temperatures and flow rates, the temperature stability of mixed water from each primary temperature control valve. In addition, the test ensures the primary temperature control valve is capable of responding to a sudden shut-off of the cold water supply (thermal shut-off) and ensures transient rises in the mixed water discharge temperature, which may occur when water is drawn off after a prolonged period of non-use, are within specified limits.

G2 PRINCIPLE

The valve under test, mounted in accordance with the manufacturer's installation instructions, is held in a test rig and tested for temperature stability of mixed water flow.

G3 APPARATUS

The following apparatus is required:

- (a) Test rig for pressure drop, temperature variation, and outlet flow variation tests. A typical test rig is shown in Figure G1. The inlet piping shall include:
 - (i) A ball valve (7 and 8) or equivalent pipe in each supply pipe.
 - (ii) Flow meters (Q_h and Q_c). Alternatively, the mixed water outlet may be measured.
 - (iii) A temperature-measuring device (1) in each supply pipe.
 - (iv) An arrangement for cross-connecting the inlet supplies through a branch containing an isolation valve (5). The cross-connection pipework shall be located a maximum of 100 mm upstream of the temperature-measuring devices.
 - (v) Pressure take-off tee with pressure-measuring devices (4) in each supply.
 - (vi) The maximum pipework length between the temperature-measuring devices and the pressure-measuring devices shall be 250 ± 40 mm and between primary temperature control valve inlet and pressure-measuring devices shall be 500 ± 40 mm.

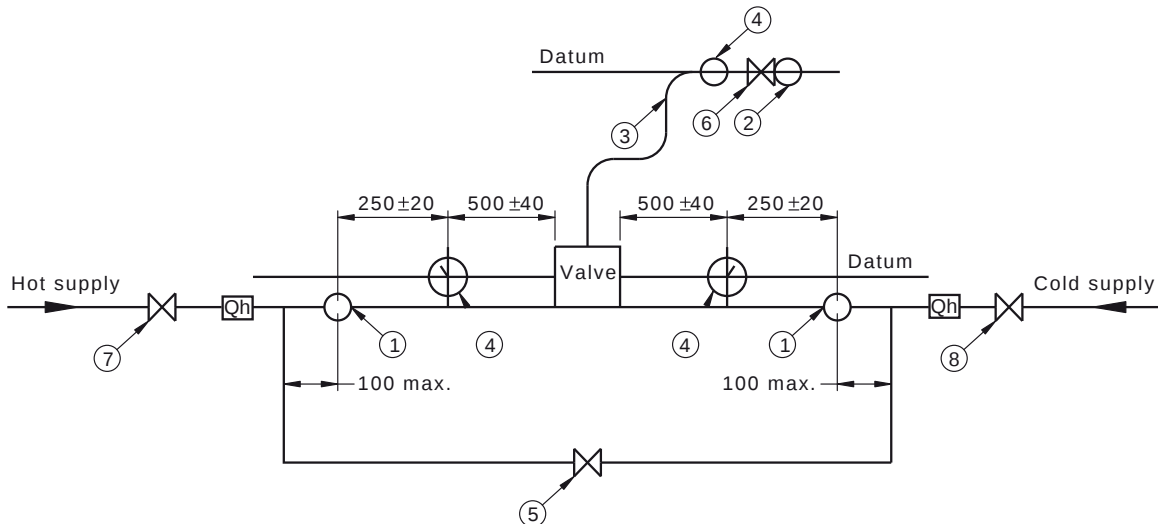
The outlet pipework shall include:

- (A) A total length of pipework between the primary temperature control valve outlet connection and the inlet of the draw off tap of $1,000 \pm 20$ mm. The pipework shall be AS 1432 Type B of the same nominal size as the valve.
 - (B) A draw-off tap (6) of the same nominal diameter as the outlet pipe. The discharge nozzle of this tap shall be the highest point of the outlet. The draw-off tap shall contain the temperature-measuring device (2).
- (b) A hot water blending device or an alternative hot water supply to vary the temperature of the hot water by $10 \pm 2^\circ\text{C}$ within 10 s, and which maintains the supply for the duration of the temperature variation test.

(c) Independent hot and cold water supplies with—

- (i) Temperature range as specified in the testing procedure; and
- (ii) A pressure range for the respective water supplies as specified in the testing procedure.

The pressures and temperatures of the hot and cold water supplies to the test rig shall be independently controllable and be capable of delivering hot and cold water within the tolerances stated for the duration of the test.



LEGEND:

- 1,2 = temperature-measuring device
- 3 = discharge pipe
- 4 = pressure-measuring device
- 5 = cross connection isolation ball valve
- 6 = isolation ball valve
- 7,8 = isolation ball valve

DIMENSIONS IN MILLIMETRES

FIGURE G1 TEMPERATURE STABILITY OF MIXED WATER TEST RIG

G4 PRESSURE DROP, TEMPERATURE VARIATION AND OUTLET FLOW VARIATION PROCEDURE

G4.1 General

Each valve shall be tested with the outlet flow rate at 12 ± 0.5 L/min.

Valves with adjustable temperature settings shall be tested at the manufacturer's specified minimum and maximum temperature settings, and subjected to combinations of hot and cold water at specified temperatures, dynamic pressures and flow rates as given in Tables G1, G2 and G3.

The procedure, with sequence as given in Tables G1, G2 and G3, shall be as follows:

- (a) Mount the valve under test oriented in accordance with the manufacturer's installation instructions in the test rig. The valve shall not be removed from the test rig for the duration of the test unless it is essential for the purpose of repairs to the test rig.

- (b) Set the temperature control of the valve under test to a position that ensures that there is a flow through both inlets. Purge air from test rig pipework and valve under test. Seal off any additional outlets, if applicable.
- (c) Adjust the temperatures and dynamic pressures of the hot and cold water supplies for the respective test in accordance with Table G1, G2 and G3, as applicable. With water flowing through the valve under test, complete final adjustments to the temperature control for the mixed water being discharged to the maximum or minimum recommended commissioning steady mixed water discharge set temperature as applicable, and required flow rate.

After these adjustments, the temperature control of the valve shall not be altered for the duration of each set of tests.

- (d) When pressures, temperatures and flow rates have been stabilized for not less than 30 s, observe and record the steady mixed water discharge set temperature as registered on the temperature-measuring device (2).

G4.2 Pressure drop test (concurrent with Paragraph G4.1 and Table G1)

The procedure shall be as follows:

- (a) Adjust the cold water supply to the nominal reduced pressure (see Table G1). If necessary, readjust the hot pressure to restore the hot inlet pressure to that stated.
- (b) Observe and record the steady mixed water discharge temperature after each adjustment.
- (c) Restore the incoming cold water supply to the initial pressure setting. Observe and record the steady mixed water discharge temperature and the discharge flow rate of the mixed water discharge.
- (d) Repeat Steps (c) and (d) of Paragraph G4.1 and Steps (a) to (c) above for balance of pressure drop testing in accordance with Table G1.
- (e) Analyse and correlate the temperature data with the criteria specified in Clause 6.4.

G4.3 Temperature variation test (concurrent with paragraph G4.1 and Table G2)

The procedure shall be as follows:

- (a) Complete Steps (c) and (d) of Paragraph G4.1.
- (b) Increase the temperature of the incoming hot water supply to set temperature plus hot water supply temperature differential, $99 \pm 1^\circ\text{C}$ or the manufacturer's recommended maximum supply temperature, whichever is the lower. If necessary, readjust the inlet pressures to restore the inlet pressures stated. Observe, monitor and record the temperature of the incoming hot water supply.
- (c) Observe and record the steady mixed water discharge temperature after each adjustment.
- (d) Restore to the initial hot water temperature, in not more than 10 s. Observe and record the steady mixed water discharge temperature and the discharge flow rate of the mixed water discharge.
- (e) Repeat Steps (d) and (e) of Paragraph G4.1, and Steps (a) to (d) above for the balance of temperature variation tests in accordance with Table G2.
- (f) Analyse and correlate the temperature data with the criteria specified in Clause 6.4.

G4.4 Outlet flow variation test (concurrent with paragraph G4.1 and Table G3)

The procedure shall be as follows:

- (a) Complete Steps G4.1 (c) and (d) of Paragraph G4.1.
- (b) Decrease the mixed water discharge flow rate to 6 ± 0.5 L/min. If necessary, readjust the inlet pressures to restore the inlet pressures stated.
- (c) Observe and record the steady mixed water discharge temperature after each adjustment
- (d) Increase the flow rate to 18 ± 0.5 L/min. If necessary, readjust the inlet pressures to restore the inlet pressures stated.
- (e) Observe and record the steady mixed water discharge temperature after each adjustment.
- (f) Restore to the initial flow rate and, if necessary, readjust the inlet pressures to restore the inlet pressures stated. Observe and record the steady mixed water discharge temperature and the discharge flow rate of the mixed water discharge.
- (g) Repeat Steps G4.1 (d) and (e) of Paragraph G4.1 and Steps (a) to (f) above for the balance of outlet flow variation tests in accordance with Table G3.
- (h) Analyse and correlate the temperature data with the criteria specified in Clause 6.4.

G5 THERMAL SHUT-OFF

Each valve shall be tested with the outlet flow rate at 12 ± 0.5 L/min.

Valves with adjustable temperature settings shall be tested at the manufacturer's specified minimum and maximum temperature settings.

The procedure, with sequence as given in Table G4, shall be as follows:

- (a) Mount the valve under test oriented in accordance with the manufacturer's installation instructions in the test rig. The valve shall not be removed from the test rig for the duration of the test unless it is essential for the purpose of repairs to the test rig.
- (b) Set the temperature control of the valve under test to a position that ensures that there is a flow through both inlets. Purge air from test rig pipework and valve under test. Seal off any additional outlets, if applicable
- (c) Adjust the temperatures and pressures of the hot and cold water supplies for the respective test in accordance with Table G4. For valves with a set temperature adjustment, adjust the valve to the manufacturer's specified minimum or maximum temperature setting as applicable.
- (d) After these adjustments, the temperature control of the valve shall not be altered for the duration of each set of tests.
- (e) When pressures, temperatures and flow rates have stabilized for not less than 30 s, observe and record the steady mixed water discharge set temperature as registered on the temperature-measuring device (2).
- (f) Isolate the cold water supply (valve 8) and collect the mixed water discharge for the period from 6 to 66 s after isolation.
- (g) Restore the incoming cold water supply and, if necessary, readjust the inlet pressures to restore the inlet pressures stated. Record the temperature of the steady mixed water discharge temperature.
- (h) Analyse and correlate the temperature data and mixed water discharge collected volume with the criteria specified in Clause 6.4.

G6 MIXED WATER TEMPERATURE OVERSHOOT ON STARTING FROM AMBIENT

Each valve shall be tested with the outlet flow rate at 12 ± 0.5 L/min.

Valves with adjustable temperature settings shall be tested at the manufacturer's specified minimum and maximum temperature settings.

The procedure, with sequence as given in Table G5, shall be as follows:

- (a) Mount the valve under test, oriented in accordance with the manufacturer's installation instructions, in the test rig. The valve shall not be removed from the test rig for the duration of the test unless it is essential for the purpose of repairs to the test rig.
- (b) Set the temperature control of the valve under test to a position that ensures that there is a flow through both inlets. Purge air from test rig pipework and valve under test. Seal off any additional outlets, if applicable.
- (c) Adjust the temperatures and pressures of the hot and cold water supplies for the respective test in accordance with Table G5. For valves with a set temperature adjustment, adjust the valve to the manufacturer's specified minimum or maximum temperature setting as applicable.
- (d) After these adjustments, the temperature control of the valve shall not be altered for the duration of each set of tests.
- (e) After pressures, temperatures and flow rates have stabilized for not less than 30 s, observe and record the steady mixed water discharge set temperature as registered on the temperature-measuring device (2).
- (f) Simultaneously isolate the hot water supply (valve 7) and open the cross-connection isolation valve (valve 5). Maintain cross-connection for 30 ± 5 s.
- (g) Begin recording the transient mixed water discharge temperature. Simultaneously restore the hot water supply and close the cross-connection isolation valve (valve 5). Observe, monitor and record the transient mixed water discharge temperature.
- (h) Analyse and correlate the temperature data with the criteria specified in Clause 6.4.

G7 REPORT

The report shall include the following information for each test valve:

- (a) The manufacturer, model and designation.
- (b) Completed data sheets (Tables G1, G2, G3, G4, and G5) and graphical record for Paragraph G6, including the following:
 - (i) The hot and cold water temperatures and pressures.
 - (ii) The discharge flow rates.
 - (iii) The steady mixed water discharge set temperature during each test.
 - (iv) The temperature rises and duration of such rises (where applicable) of the mixed water after, as follows:
 - (A) A nominal reduction in the pressure of the incoming cold water supply.
 - (B) A sudden increase in the temperature of the incoming hot water supply.
 - (C) A nominal decrease and increase in the mixed water outlet flow rate.
 - (D) A mixed water temperature overshoot on starting from ambient.

- (v) The volume of water collected from the mixed water discharge following cold water isolation.
- (vi) Items (i), (ii), (iii), (iv) (A), (iv) (B), (iv) (c) and (v) should be noted with Item (iv) (D) recorded graphically.
- (c) Compliance or non-compliance with the criteria specified in Clause 6.4.
- (d) Reference to this test method, i.e., Appendix G, AS 1357.2.

TABLE G1
TEMPERATURE STABILITY OF MIXED WATER TESTS RECORD SHEET—PRESSURE DROP TEST

Tests	Operating temperatures, °C		Dynamic pressures, kPa				Mixed water							Remarks
	Cold water supply 15 ±5°C	Hot water supply °C	Cold water supply ±2%		Hot water supply ±2%		Steady mixed water discharge set temperature (min. & max.) +0, −1°C	Discharge flow rate prior to sudden adjustment to cold water supply 12 ±0.5 L/min	After sudden reduction in the pressure of the cold water supply		After restoration of cold water supply			
									Nominated reduced dynamic pressure ±2% kPa	Steady mixed water discharge temperature	Steady mixed water discharge temperature	Discharge flow rate, L/min		
1 min.			100		100			90						
2			500		500			450						
3 max.			100		100			90						
4			500		500			450						

NOTE: Hot water supply temperature = the lesser of set temperature + hot water supply temperature differential, the manufacturer's recommended supply temperature, or 99°C

TABLE G2
TEMPERATURE STABILITY OF MIXED WATER TEST RECORD SHEET—TEMPERATURE VARIATION TEST

Tests	Operating temperatures, °C			Dynamic pressures, kPa		Mixed water						Remarks
	Cold water supply 15 ±5°C	Hot water supply ±2°C		Cold water supply 300 ±10 kPa	Hot water supply 300 ±10 kPa	Steady mixed water discharge set temperature (min. & max.) +0, −1°C	Discharge flow rate prior to sudden adjustment to cold water supply 12 ±0.5 L/min.	After sudden increase in the temperature of the hot water supply (actual plus 10 ±2°C)		After restoration of hot water supply temperature		
								Hot water supply temperature 0°C	Steady mixed water discharge temperature 0°C	Steady mixed water discharge temperature 0°C	Discharge flow rate L/min	
1 min.		X										
2		Y										
3 max.		Z										
4		Y										

NOTES:

- 1 X = Minimum manufacturer’s temperature setting + hot water supply temperature differential
- 2 Y = the lesser of set temperature + hot water supply temperature differential, the manufacturer’s recommended supply temperature, or 99°C.
- 3 Z = Maximum manufacturer's temperature setting + hot water supply temperature differential.

TABLE G3

TEMPERATURE STABILITY OF MIXED WATER TESTS RECORD SHEET—OUTLET FLOW VARIATION TEST

Tests	Operating temperatures, °C		Dynamic pressures, kPa		Mixed water								Remarks
	Cold water supply 15 ±5°C	Hot water supply °C	Cold water supply 300 ±10 kPa	Hot water supply 300 ±10 Kpa	Steady mixed water discharge set temperature (min. & max.) +0, −1°C	Discharge flow rate prior to sudden adjustment of discharge flow rate, 12 ±0.5 L/min.	After sudden decrease in the discharge flow rate to 6 ±0.5 L/min.		After sudden nominal increase in the discharge flow rate to 18 ±0.5 L/min.		After sudden restoration of discharge flow rate to 12 ±0.5 L/min.		
							Flow L/min.	Steady mixed water discharge temperature, °C	Flow L/min.	Steady mixed water discharge temperature °C	Flow L/min.	Steady mixed water discharge temp, °C	
1 min.													
2 max.													

NOTE: Hot water supply temperature = the lesser of set temperature + hot water supply temperature differential, the manufacturer's recommended supply temperature, or 99°C.

TABLE G4
THERMAL SHUT-OFF RECORD SHEET

Tests	Operating temperatures, °C		Dynamic pressures, kPa		Mixed water					Remarks
	Cold water supply 15 ±5°C	Hot water supply °C	Cold water supply 300 ±2 kPa	Hot water supply 300 ±2 kPa	Steady mixed water discharge set temperature (min. & max.) +0, −1°C	Discharge flow rate prior to sudden isolation of cold supply 12 ±0.5 L/min.	Volume collected after sudden isolation of cold supply	After sudden restoration of cold supply		
							Volume (L)	Steady mixed water discharge temperature	Discharge flow rate L/min.	
1 min.										
2 max.										

NOTE: Hot water supply temperature = the lesser of set temperature + hot water supply temperature differential, the manufacturer's recommended supply temperature, or 99°C.

TABLE G5
MIXED WATER TEMPERATURE OVERSHOOT ON STARTING FROM AMBIENT

Tests	Operating temperatures, °C		Dynamic pressures, kPa		Mixed water						Remarks
	Cold water supply 15 ±5°C	Hot water supply °C	Cold water supply 300 ±2 kPa	Hot water supply 300 ±2 kPa	Steady mixed water discharge set temperature (min. & max.) +0, −1°C	Discharge flow rate prior to cross connection 12 ±0.5 L/min.	Time that transient mixed water discharge temperature is 5°C above steady mixed water discharge set temperature (s)	Time that transient mixed water discharge temperature is 10°C above steady mixed water discharge set temperature (s)	After sudden restoration of cold supply		
									Steady mixed water discharge temperature	Discharge flow rate L/min.	
1 min.											
2 max.											

NOTE: Hot water supply temperature = the lesser of set temperature + hot water supply temperature differential, the manufacturer's recommended supply temperature, or 99°C.

APPENDIX H

ENDURANCE TEST—THERMOSIPHON ARRESTOR VALVES AND PRIMARY TEMPERATURE-CONTROL VALVES

(Normative)

H1 SCOPE

This Appendix sets out the method of testing—

- (a) thermosiphon arrestor valves for determination of first their closing temperature and second their flow area (at a temperature 5°C below the actual closing temperature);
- (b) primary temperature-control valves for determination of the temperature variation of the mixed water discharge; and
- (c) thermostatic circulation valves for determination of the closing temperature, after subjecting the temperature-actuating element to the requisite number of cycles in alternating cold water supply and hot water supply.

H2 PRINCIPLE

The valve under test is mounted in a rig and subjected to cyclic testing in water, alternating between a minimum and a maximum temperature.

H3 APPARATUS

The following apparatus is required:

- (a) Test rig for endurance test for thermosiphon arrestor valves and primary temperature-control valves. A typical test rig is shown in Figure H1, and an alternative arrangement shown in Figure H2.
- (b) Supply of hot water, at $85 \pm 5^\circ\text{C}$.
- (c) Supply of cold water, at $20 \pm 5^\circ\text{C}$.

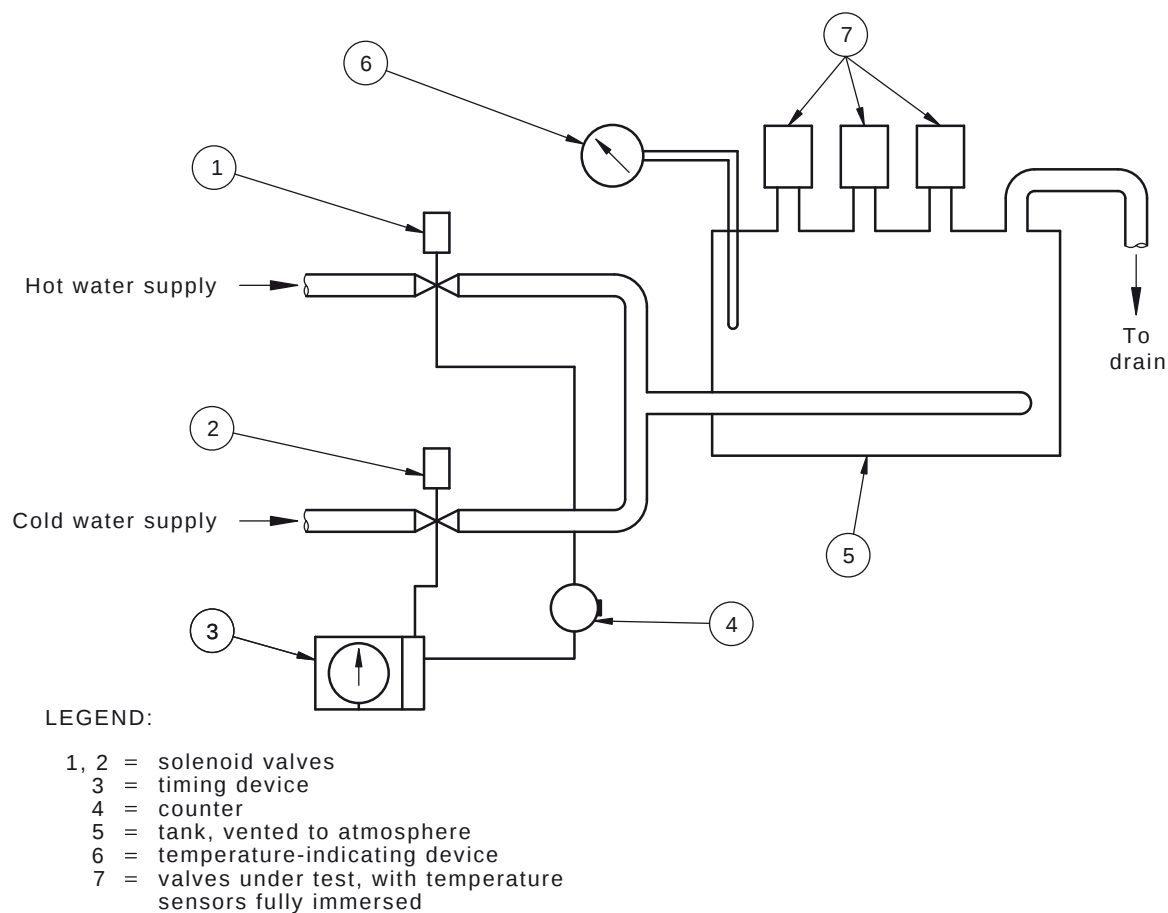


FIGURE H1 TYPICAL TEST RIG FOR THERMOSIPHON ARRESTOR VALVES AND PRIMARY TEMPERATURE-CONTROL VALVES—CONTINUOUS OPERATION

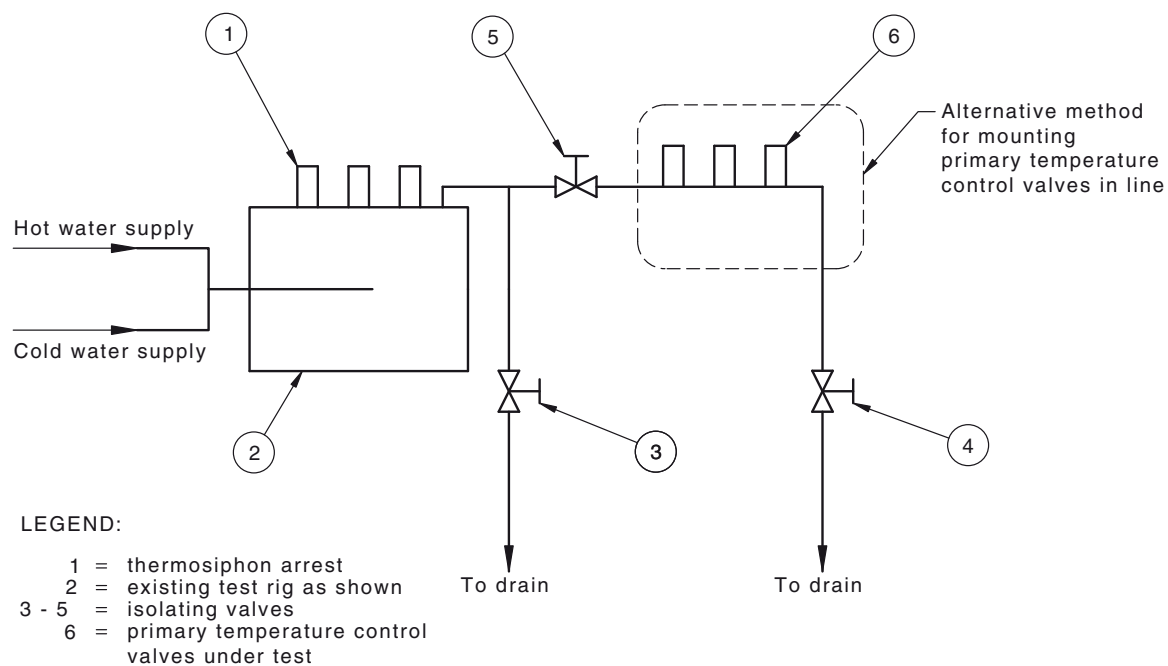


FIGURE H2 ALTERNATIVE ARRANGEMENT FOR MOUNTING PRIMARY TEMPERATURE-CONTROL VALVES IN LINE

H4 PROCEDURE

The procedure shall be as follows:

- (a) Install the valve under test with the temperature-sensing element fully immersed in water.
- (b) Connect the supply of cold water.
- (c) Connect the supply of hot water.
- (d) Start the timing device, then—
 - (i) increase the water temperature to $85 \pm 5^{\circ}\text{C}$ as shown on the temperature indicator (6), and maintain for 30 ± 5 s; and
 - (ii) decrease the water temperature to not more than 30°C , as shown on the temperature indicator (6), and maintain for 30 ± 5 s.
- (e) Repeat Step (d) for—
 - (i) thermosiphon arrestor valves, 10 000 +500, –0 cycles; or
 - (ii) primary temperature control or thermostatic circulation valves, 25 000 +1000, –0 cycles.
- (f) Retest the valve in accordance with the following:
 - (i) For primary temperature control valves Appendix G.
 - (ii) For thermosiphon arrestor valves Appendix K.

H5 REPORT

The report shall include the following information for each test valve:

- (a) Manufacturer, model, type and size of valve.
- (b) Results of Paragraph H4 (f).
- (c) Compliance or non-compliance with the testing criteria in this Standard.
- (d) Reference to this test method, i.e., Appendix H, AS 1357.2.

APPENDIX I

TEMPERATURE ENDURANCE TEST—THERMOSIPHON ARRESTOR VALVES

(Normative)

I1 SCOPE

This Appendix sets out the method of determining the compliance of thermosiphon arrestor valves with Clauses 5.5 and 5.6 after exposing the temperature element to 100 cycles of water alternating in temperature from $20 \pm 5^{\circ}\text{C}$ to $99 + 0, \pm 2^{\circ}\text{C}$ with each temperature being maintained for 10 ± 1 s.

I2 PRINCIPLE

The actuating element of the valve under test is alternatively immersed in water at high and low temperatures.

I3 APPARATUS

The following apparatus is required:

- (a) Open tank of water maintained at $20 \pm 5^{\circ}\text{C}$.
- (b) Open tank of water at a temperature of $99 + 0, -2^{\circ}\text{C}$.
- (c) Timing instrumentation.

I4 PROCEDURE

The procedure shall be as follows:

- (a) Alternately immerse the actuating element in each tank for a period of 10 s.
- (b) Repeat Step (a) 100 times.
- (c) Retest the valve in accordance with Appendix K.

I5 REPORT

The report shall include the following information for each test valve:

- (a) Manufacturer, model, type and size of valve.
- (b) Closing temperature, in degrees Celsius, and calculated flow area, in square millimetres, as tested in Paragraph I4 (c).
- (c) Compliance or non-compliance with the testing criteria in this Standard.
- (d) Reference to this test method, i.e., Appendix I, AS 1357.2.

APPENDIX J

FLOW MEASUREMENT—PRIMARY TEMPERATURE-CONTROL VALVES

(Normative)

J1 SCOPE

This Appendix sets out the method for testing a primary temperature control valve for flow rate for a pressure drop of 100 kPa, when set to maximum and minimum manufacturer's recommended set temperatures.

J2 PRINCIPLE

The valve under test, mounted in accordance with the manufacturer's installation instructions, is held in a test rig, and tested for flow rate.

J3 APPARATUS

The following apparatus is required:

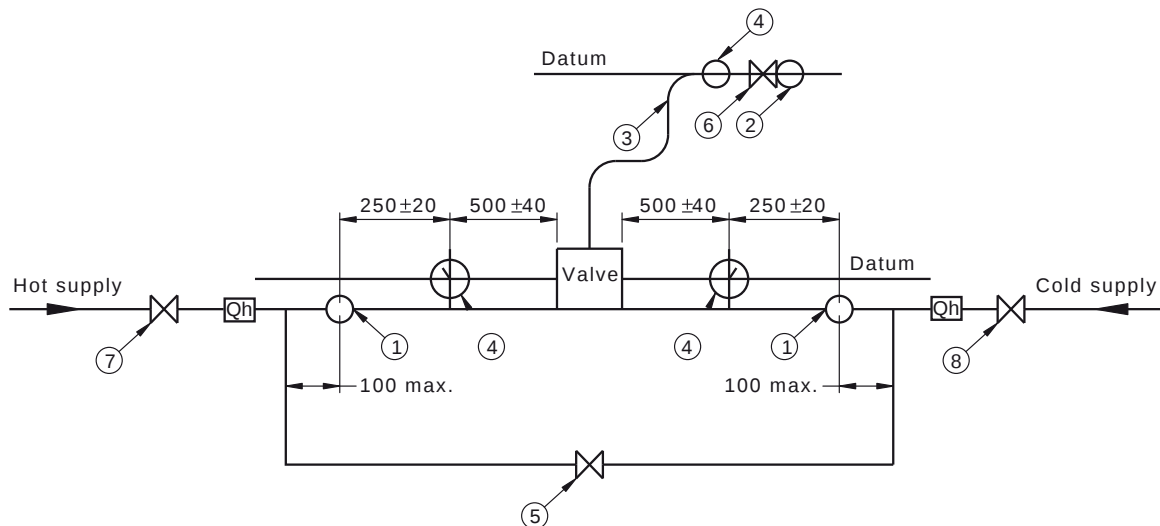
- (a) Test rig for pressure drop, temperature variation, outlet flow variation tests. A typical test rig is shown in Figure F1. The inlet piping shall include the following:
 - (i) A ball valve (7 and 8) or equivalent pipe in each supply pipe.
 - (ii) Flow meters (Q_h and Q_c). Alternatively, the mixed water outlet may be measured.
 - (iii) A temperature-measuring device (1) in each supply pipe.
 - (iv) An arrangement for cross-connecting the inlet supplies through a branch containing an isolation valve (5). The cross-connection pipework shall be located a maximum of 100 mm upstream of the temperature-measuring devices.
 - (v) Pressure take-off tee with pressure-measuring devices (4) in each supply.

The maximum pipework length between the temperature-measuring devices and the pressure-measuring devices shall be 250 ± 40 mm and between tempering valve inlet and pressure-measuring devices shall be 500 ± 40 mm.

The outlet pipework shall include the following:

- (A) A total length of pipework between the tempering valve outlet connection and the inlet of the draw-off tap of $1\,000 \pm 20$ mm. The pipework shall be AS 1432 Type B of the same nominal size as the valve.
 - (B) A draw-off tap (6) of the same nominal diameter as the outlet pipe. The discharge nozzle of this tap shall be the highest point of the outlet. The draw-off tap shall contain the temperature-measuring device (2).
 - (C) A pressure take-off tee with pressure-measuring device (4).
- (b) A hot water blending device or an alternative hot water supply to vary the temperature of the hot water by $10 \pm 2^\circ\text{C}$ within 10 s, and which maintains the supply for the duration of the temperature variation test.
 - (c) Independent hot and cold water supplies with—
 - (i) temperature range as specified in the testing procedure; and
 - (ii) a pressure range for the respective water supplies as specified in the testing procedure.

The pressures and temperatures of the hot and cold water supplies to the test rig shall be independently controllable and be capable of delivering hot and cold water within the tolerances stated for the duration of the test.



LEGEND:

- 1,2 = temperature-measuring device
- 3 = discharge pipe
- 4 = pressure-measuring device
- 5 = cross connection isolation ball valve
- 6 = isolation ball valve
- 7,8 = isolation ball valve

DIMENSIONS IN MILLIMETRES

FIGURE J1 TEMPERATURE STABILITY OF MIXED WATER TEST RIG

J4 FLOW RATE TESTING PROCEDURE

The procedure shall be as follows:

- (a) Mount the valve under test oriented, in accordance with the manufacturer's installation instructions, in the test rig. The valve shall not be removed from the test rig for the duration of the test unless it is essential for the purpose of repairs to the test rig.
- (b) Adjust the hot water supply to a pressure of 300 ± 10 kPa, and the temperature of the lesser of set temperature plus hot water supply temperature differential, the manufacturer's recommended supply temperature, or 99°C .
- (c) Adjust the cold water supply to a pressure of 300 ± 10 kPa, and a temperature of $15 \pm 5^\circ\text{C}$.
- (d) Set the temperature control of the valve under test to a position that ensures that there is a flow through both inlets. Purge air from the test rig pipework and valve under test. Seal off any additional outlets, if applicable.
- (e) Whilst maintaining the conditions of hot and cold inlet supplies as above, open the outlet isolation valve (6) and achieve a flow rate of 12 ± 0.5 L/min.
- (f) Set the temperature control of the valve to the manufacturer's specified maximum temperature setting.

- (g) Whilst maintaining the conditions of hot and cold inlet supplies as above, open the outlet isolation valve until an outlet pressure of 200 kPa is achieved.
- (h) When temperatures, pressures and flow rates have been stabilized for not less than 30 s, observe and record the outlet flow rate.
- (i) Repeat steps (a) to (h) for the manufacturer's specified minimum temperature setting.

J5 REPORT

The report shall include the following information for each test valve:

- (a) Manufacturer, model, type and size of valve.
- (b) Outlet flow rate as recorded in Paragraph J4 (h) for both the manufacturer's specified maximum and minimum temperature setting.
- (c) Compliance or non-compliance with Manufacturer's nominated flow capacity.
- (d) Reference to this test method, i.e., Appendix J, AS 1357.2.

APPENDIX K

CLOSING TEMPERATURE AND FLOW AREA TEST—THERMOSIPHON ARRESTOR VALVES

(Normative)

K1 SCOPE

This Appendix sets out the method of testing thermosiphon arrestor valves for the determination of their closing temperature and flow area at a temperature 5°C below the actual closing temperature.

K2 PRINCIPLE

The valve under test is mounted in a rig and subjected to heated liquid or water and the flow area calculated.

K3 APPARATUS

The following apparatus is required:

- (a) Test rig for closing temperature and flow area tests for thermosiphon arrestor valves. A typical test rig is shown in Figure K1.
- (b) Means of accurately measuring any movement of the valve closure member.

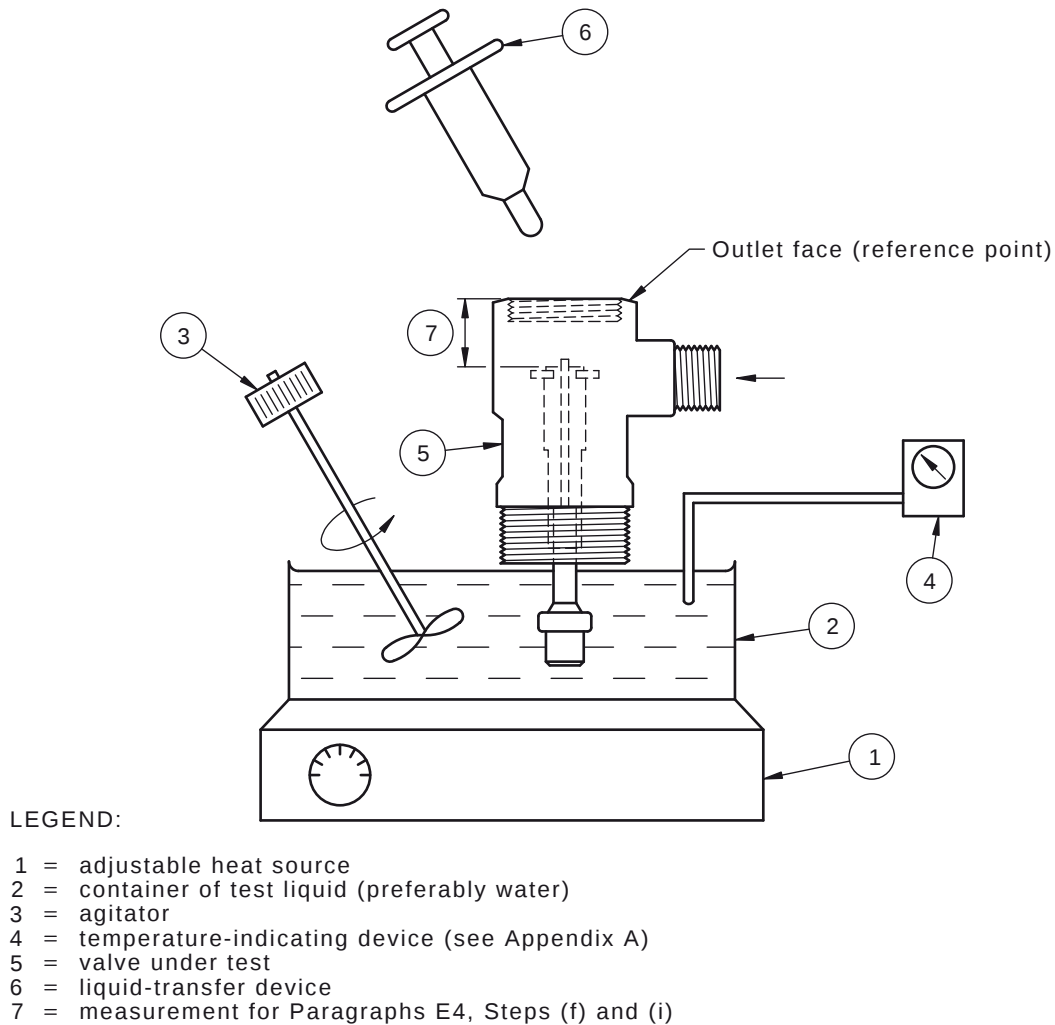


FIGURE K1 TYPICAL APPARATUS ARRANGEMENT FOR TESTING SET TEMPERATURE FOR THERMOSIPHON ARRESTOR VALVES

K4 PROCEDURE (see Figure K1)

The procedure shall be as follows:

- (a) Install the valve under test (5), with the actuating element fully immersed in the test liquid (2).
- (b) Energize the heat source (1) and start the agitator (3).
- (c) Slowly increase the temperature of the test liquid (2) at a rate not exceeding 1.5°C/min to a temperature 5°C below the claimed set temperature.
- (d) Continue the heating and agitating, periodically decanting test liquid from the transfer device (6) into the closure area of the valve under test.
- (e) When the transferred liquid is fully retained in the closure area (valve closing point), record the reading on the temperature-indicating device (4).
- (f) Maintain the test fluid temperature at the closing temperature and measure the distance of the valve closure member from a reference point and record this measurement (M1).
- (g) De-energize the heat source (1).

- (h) With the agitator (3) in operation, very slowly add cool test fluid to the fluid in the container until the temperature of the test fluid, as registered on the temperature-indicating device (4), is 5°C below the temperature recorded in Step (e).
- (i) Measure the distance of the valve closure member from the same reference point in Step (f) and record this measurement (M_2).
- (j) Calculate and record the flow area obtained in Step (h) from the following equation:

$$F = \pi D(M_2 - M_1) \quad \dots \text{K1}$$

where

F = total flow area, in square millimetres

D = diameter of flow orifice, in millimetres

M_2 = distance of valve closure (Step (i)), in millimetres

M_1 = distance of valve closure (Step (f)), in millimetres.

K5 REPORT

The report shall include the following information for each test valve:

- (a) Manufacturer, model, type and size of valve.
- (b) Temperature recorded in Paragraph K4 (e), in degrees Celsius.
- (c) Flow area calculated in Paragraph K4 (j), in square millimetres.
- (d) Compliance or non-compliance with the testing criteria in this Standard.
- (e) Reference to the test method, i.e., Appendix K, AS 1357.2.

APPENDIX L

OUTLET PRESSURE TEST—INLET PRESSURE CONTROL VALVES

(Normative)

L1 SCOPE

This Appendix sets out the method of testing inlet pressure control valves for the determination of their outlet pressure.

L2 PRINCIPLE

The valve under test is mounted in a rig and subjected to a water supply to test outlet pressures.

L3 APPARATUS

The following apparatus is required:

- (a) Test rig for outlet pressure test for inlet pressure control valves. A typical test rig is shown in Figure L1.
- (b) Water supply at ambient temperature and adjustable pressures.

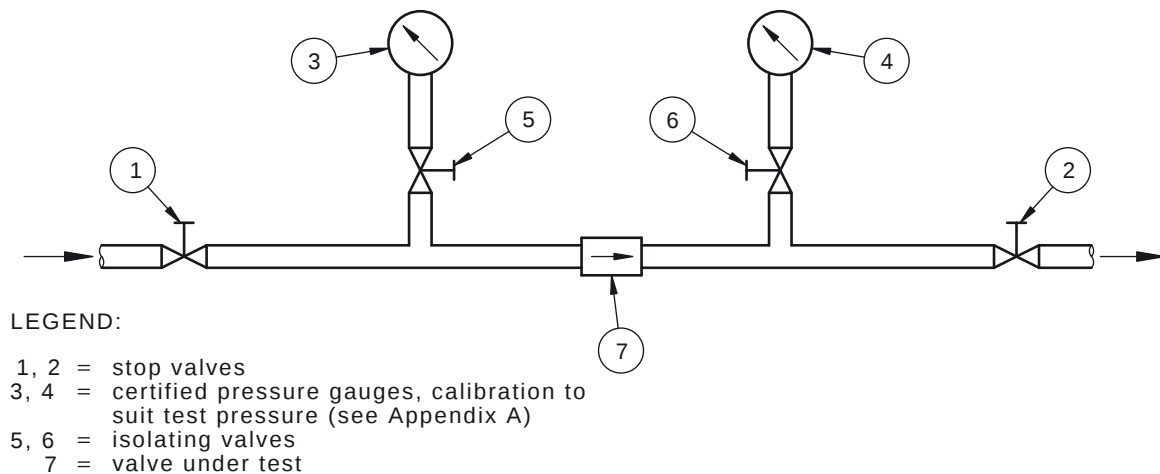


FIGURE L1 TYPICAL TEST RIG FOR INLET PRESSURE CONTROL VALVES

L4 PROCEDURE (see Figure L1)

The procedure shall be as follows:

- (a) Install the valve under test (7) and close stop valves (1, 2, 5 and 6).
- (b) Connect the adjustable pressure water supply to the inlet of stop valve (1).
- (c) Purge the air from the system by opening stop valve (1) and then venting through stop valve (2).
- (d) Open isolating valves (5 and 6).
- (e) Close stop valve (2).

- (f) Slowly increase the pressure to the maximum inlet pressure recommended by the manufacturer of the valve under test as registered on gauge (3), and record the pressure.
- (g) Maintaining the inlet pressure, record the pressure reading on gauge (4).
- (h) Open stop valve (2) and reduce the pressure.
- (i) Repeat Steps (e) and (h) to give a total of three readings.

L5 REPORT

The report shall include the following information for each test valve:

- (a) Manufacturer, model, type and size of valve.
- (b) For pressure-reducing and pressure-limiting valves, the three pressure readings obtained in Paragraph L4 (g), in kilopascals.
- (c) For ratio valves, the ratio calculated by dividing the inlet pressure by the outlet pressure rounded to the nearest whole number.
- (d) Compliance or non-compliance with the testing criteria in this Standard.
- (e) Reference to this test method, i.e., Appendix L, AS 1357.2.

APPENDIX M

FLOW RATE TEST—INLET PRESSURE CONTROL VALVES

(Normative)

M1 SCOPE

A2

This Appendix sets out the method of determining the flow rates of inlet pressure control valves.

M2 PRINCIPLE

The valve under test is mounted in a rig and subjected to water pressure and tested for flow rates.

M3 APPARATUS

The following apparatus is required:

- (a) Test rig for flow rate test for inlet pressure control valves. A typical test rig is shown in Figure M1.
- (b) Water supply at ambient temperature and adjustable pressures.

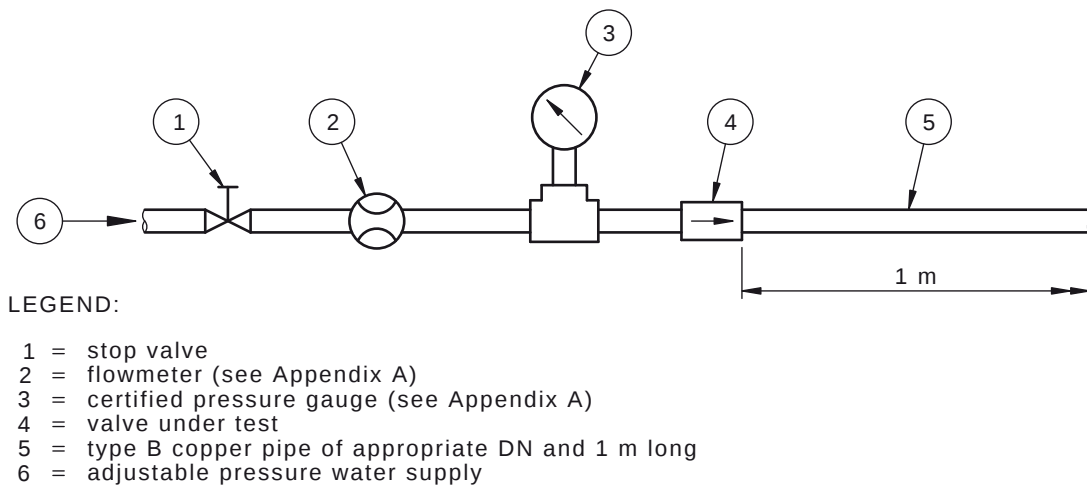


FIGURE M1 TYPICAL TEST RIG FOR DETERMINING FLOW RATE

M4 PROCEDURE (see Figure M1)

The procedure shall be as follows:

A2

- (a) Install the valve under test (4) in the test rig.
 - (i) For fixed set-pressure valves, proceed to Steps (b) to (e).
 - (ii) For adjustable valves, conduct the procedure in Steps (b) to (e) at both the maximum and the minimum pressure settings.
- (b) Open stop valve (1) and adjust the supply pressure to 700 ± 10 kPa as indicated by pressure gauge (3).
- (c) When the flow rate is stabilized, maintain for a minimum of 1 min, and record the flow rate.

- (d) Close stop valve (1).
- (e) Repeat Steps (b) and (d) to give a total of three readings.

M5 REPORT

The report shall include the following information for each test valve:

- A2 |
- (a) Manufacturer, model, type and size of valve.
 - (b) Average of the three flow rates recorded in Paragraph M4 (c), in litres per minute for each setting tested.
 - (c) Compliance or non-compliance with the testing criteria in this Standard.
 - (d) Reference to this test method, i.e., Appendix M, AS 1357.2.

APPENDIX N

ENDURANCE TEST—INLET PRESSURE CONTROL VALVES

(Normative)

N1 SCOPE

This Appendix sets out the method of determining the satisfactory continuous operation of inlet pressure control valves after 50 000 operations, as follows:

- (a) *For pressure-reducing valves*—a back pressure alternating from not more than 10% to $120 \pm 5\%$ of the set pressure.
- (b) *For pressure-limiting and ratio valves*—a downstream pressure alternating from not more than 10% of the set pressure to $1\,400 \pm 25$ kPa.

N2 PRINCIPLE

The valve under test is mounted in a rig and subjected to a pressure endurance test.

N3 APPARATUS

The following apparatus is required:

- (a) Test rig for endurance test for inlet pressure control valves. A typical test rig is shown in Figure N1.
- (b) Adjustable pressure water supply automatically cycled (hot, not more than 5°C below the manufacturer's specified operating temperature, or cold, as appropriate).

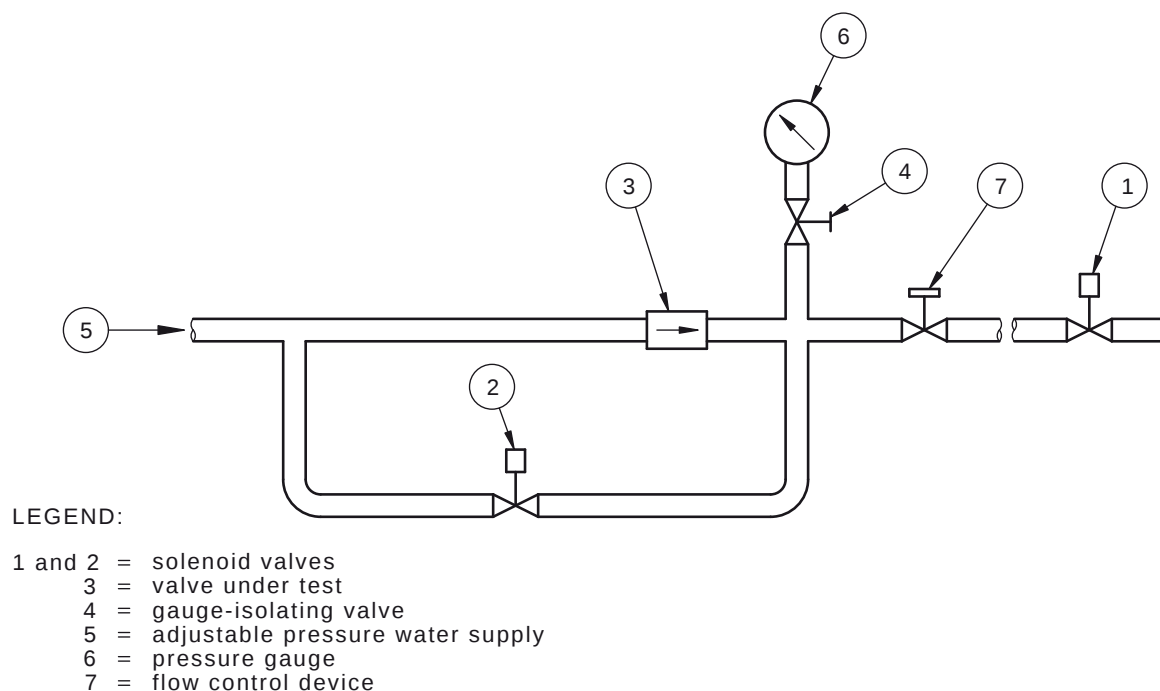


FIGURE N1 TYPICAL TEST RIG FOR INLET
PRESSURE CONTROL VALVES

N4 PROCEDURE (see Figure N1)

The procedure shall be as follows:

- (a) Install the valve under test (3) in the test rig and close all valves.
- (b) Adjust the inlet water pressure—
 - (i) for pressure-reducing valves, to 1.2 times the set pressure of the valve under test; or
 - (ii) for pressure-limiting valves and ratio valves, to 1400 ± 20 kPa.
- (c) Open valves (1), (2) and (4) and purge air from the test rig pipework and the valve under test.
- (d) Close valve (2).
- (e) Adjust flow through the valve under test to 5 ± 1 L/min.
- (f) Close valve (1) for 1 ± 0.5 s then open valve (2) for 1 ± 0.5 s and then close valve (2), open valve (1).

The set pressure and reverse pressure will be evident on gauge (6).

- (g) Repeat Step (f) for 50 000 cycles at a rate 20 ± 10 cycles per minute. Periodically during the cycling, check that the minimum and maximum pressures are being maintained by opening isolating valve (4).
- (h) After completion of the 50 000 cycles, retest the valve under test (3) in accordance with Appendices L and M.

N5 REPORT

The report shall include the following information for each test valve:

- (a) Manufacturer, model, type and size of valve.
- (b) Set pressure, in kilopascals, recorded in Paragraph N4 (h).
- (c) Flow rate, in litres per minute, recorded in Paragraph N4 (h).
- (d) Compliance or non-compliance with the testing criteria in this Standard.
- (e) Reference to this test method, i.e., Appendix N, AS 1357.2.

APPENDIX O

TORQUE TEST—ISOLATING VALVES

(Normative)

O1 SCOPE

This Appendix sets out the method for torque testing the opening and closing mechanism of each isolating valve.

O2 PRINCIPLE

The valve under test is held in a fixing jig, a torque is applied to the operating mechanism, initially in the direction of closing then in the direction of opening.

O3 APPARATUS

The following apparatus is required:

- (a) Fixing jig to secure the valve under test.
- (b) Torque applicator that is capable of measuring the required torque.
- (c) Suitable adaptor to permit application of the torque.

O4 PROCEDURE

The procedure shall be as follows:

- (a) Calculate the applied torque, as follows:

$$T = XD \quad \dots O1$$

where

T = applied torque, in Newton metres

X = factor specified in Table O1

D = diameter of the closing handle, in millimetres

- (b) Mount the valve under test in the fixing jig, close the operating mechanism and fit the adaptor to it.
- (c) Slowly apply the torque loading, as calculated in Step (a), to the adaptor in the direction of closing for 30 ± 5 s, and record the applied torque.
- (d) Fully open the operating mechanism of the valve under test.
- (e) Slowly apply the torque to the adaptor in the direction of opening for 30 ± 5 s, and record the applied torque.
- (f) Remove the valve under test from the fixing jig.
- (g) Retest the valve under test in accordance with Appendix E.
- (h) Disassemble the operating mechanism of the valve under test, visually inspect all components for cracking, breaking, part separation or other failures.

A2

A2

TABLE O1
FACTOR X FOR TORQUE CALCULATION

Nominal size of valve	Factor <i>X</i> N.m/mm	
DN	Screw-down pattern	Other pattern
15	0.25	0.15
20	0.30	0.20
25	0.35	0.25

O5 REPORT

The report shall include the following information for each test valve:

- (a) Manufacturer, model, type and size of valve.
- (b) Torque applied, in Newton metres.
- (c) Results from Paragraph O4 (f).
- (d) Results from Paragraph O4 (g).
- (e) Reference to this test method, i.e., Appendix O, AS 1357.2

APPENDIX P
ENDURANCE TEST—ISOLATING VALVES
 (Normative)

P1 SCOPE

This Appendix sets out the method for the endurance testing of each test-isolating valve.

P2 PRINCIPLE

The valve under test is held in a jig and the opening and closing mechanism is subjected to an endurance test.

P3 APPARATUS

A rig to support the test valve, and fully open and fully close the valve in continuous cycles, is required.

NOTE: This rig should apply a torque as specified in Table P1. The torque is to be applied at the fully open and fully closed positions in continuous cycles and complete a cycle within 10 s.

TABLE P1
APPLIED TORQUE FOR CONTINUOUS
OPERATION TEST

Nominal size of valve DN	Applied torque N.m
15	1.5 ±0.5
20	1.5 ±0.5
25	1.8 ±0.5

P4 PROCEDURE

The procedure shall be as follows:

- (a) Mount the valve under test in the test rig.
- (b) Couple the torque application means to the closing member of the valve.
- (c) Cycle the machine 1 000 times applying the torque as specified in Table P1.
- (d) At the conclusion of the test, remove the test valve from the test rig.
- (e) Retest the valve under test in accordance with Appendix E.

P5 REPORT

The report shall include the following information for each test valve:

- (a) Manufacturer, model, type and size of valve.
- (b) Results of Paragraph P4 (e), i.e., any leakage.
- (c) Any other failure.
- (d) Compliance or non-compliance with this Standard.
- (e) Reference to this test method, i.e., Appendix P, AS 1357.2.

APPENDIX Q

SAMPLING AND FREQUENCY PLANS FOR VACUUM RELIEF VALVES

(Normative)

This Appendix sets out the compliance sampling and frequency plans for vacuum relief valves. Type test are given in Table Q1 and batch release tests are given in Table Q2.

TABLE Q1

**MINIMUM SAMPLING AND TESTING FREQUENCY PLAN FOR VACUUM
RELIEF VALVES—TYPE TESTS**

Characteristic	Clause	Requirement	Test method	Frequency
Material properties	2.4/2.5/2.7/ 2.10	Materials	Review materials parts lists and compliance certificates	At any change in materials
	2.6	Materials—copper Alloy (DR)	AS 2345	
	2.2	Contamination of water	AS/NZS 4020	At change in materials or every 5 years, whichever occurs first
Design and construction	1.5 and 4.10	Marking	Visual inspection	At change in design
	3.2.1	Strength—torque	Appendix E of AS 1357.1	
	3.2.2	Strength—leakage	Appendix E/Appendix E of AS 1357.1	
	3.3	End connections	Relevant Standard	
	3.4	Components and valve seats	Visual inspection	
	3.5	Repair	Design review	
	3.6	Installation Instructions	Review of documentation	
	4.5	Flow passages	Measurement	
Performance	4.6	Opening pressure test	Appendix F	At change in design
	4.7	Closing pressure test	Appendix E	
	4.8	Air-passing capacity test	Appendix F	
	4.9	Resistance to hot water	Appendix E/F	

TABLE Q2
MINIMUM SAMPLING AND TESTING FREQUENCY PLAN FOR VACUUM
RELIEF VALVES—BATCH RELEASE TESTS

Characteristic	Clause	Requirement	Test method (see Note)	Frequency
Material properties	2.4/2.5/ 2.7/2.10	Materials	Review materials parts lists and compliance certificates	Once per batch
	2.6	Materials—copper alloy (DR)	AS 2345	
Design and construction	1.5 and 4.10	Marking	Visual inspection	Once per batch
	3.2.2	Strength—leakage	Appendix E/Appendix E of AS 1357.1	100%
	3.3	End connections	Relevant Standard	Once per batch
Performance	4.6	Opening pressure test	Appendix F	100%
	4.7	Closing pressure test	Appendix E	Once per batch

NOTE: The method used should be based on the relevant appendix, and reflect the intent of the particular method.

APPENDIX R

SAMPLING AND FREQUENCY PLANS FOR THERMOSIPHON ARRESTOR VALVES

(Normative)

This Appendix sets out the compliance sampling and frequency plans for thermosiphon arrestor valves. Type test are given in Table R1 and batch release tests are given in Table R2.

TABLE R1
MINIMUM SAMPLING AND TESTING FREQUENCY PLAN THERMOSIPHON
ARRESTOR VALVES—TYPE TESTS

Characteristic	Clause	Requirement	Test method	Frequency
Material properties	2.4/2.5/ 2.7/2.10	Materials	Review materials parts lists and compliance certificates	At any change in materials
	2.6	Materials—copper Alloy (DR)	AS 2345	
	2.2	Contamination of water	AS/NZS 4020	At change in materials or every 5 years, whichever occurs first
Design and construction	1.5 and 5.8	Marking	Visual inspection	At change in design
	3.2.1	Strength—torque	Appendix E of AS 1357.1	
	3.2.2	Strength—Leakage	Appendix E/Appendix E of AS 1357.1	
	3.3	End connections	Relevant Standard	
	3.4	Components and valve seats	Visual inspection	
	3.5	Repair	Design review	
	3.6	Installation Instructions	Review of documentation	
Performance	5.2	Flow area	Clause 5.2 Measurement	At change in design
	5.3	Flow passage	Clause 5.3 Measurement	
	5.4	Closing temperature	Appendix K	
	5.5	Valve operating characteristics	Appendix K	
	5.6	Endurance	Appendix H	
	5.7	Temperature endurance	Appendix I	

TABLE R2
MINIMUM SAMPLING AND TESTING FREQUENCY PLAN THERMOSIPHON
ARRESTOR VALVES—BATCH RELEASE TESTS

Characteristic	Clause	Requirement	Test method (see Note)	Frequency
Material properties	2.4/2.5/ 2.7/2.10	Materials	Review materials parts lists and compliance certificates	Once per batch
	2.6	Materials—copper alloy (DR)	AS 2345	
Design and construction	1.5 and 5.8	Marking	Visual inspection	Once per batch
	3.2.2	Strength—leakage	Appendix E/Appendix E of AS 1357.1	100%
	3.3	End connections	Relevant Standard	Once per batch
Performance	5.4	Closing temperature	Appendix K	100%

NOTE: The method used should be based on the relevant appendix, and reflect the intent of the particular method.

APPENDIX S

SAMPLING AND FREQUENCY PLANS FOR PRIMARY TEMPERATURE CONTROL VALVES

(Normative)

This Appendix sets out the compliance sampling and frequency plans for primary temperature control valves. Type test are given in Table S1 and batch release tests are given in Table S2.

TABLE S1
**MINIMUM SAMPLING AND TESTING FREQUENCY PLAN FOR PRIMARY
TEMPERATURE CONTROL VALVES—TYPE TESTS**

Characteristic	Clause	Requirement	Test method	Frequency
Material properties	2.4/2.5/ 2.7/2.10	Materials	Review materials parts lists and compliance certificates	At any change in materials
	2.6	Materials—copper alloy (DR)	AS 2345	
	2.2	Contamination of water	AS/NZS 4020	At change in materials or every 5 years, whichever occurs first
Design and construction	1.5 and 6.7	Marking	Visual inspection	At change in design
	3.2.1	Strength—torque	Appendix E of AS 1357.1	
	3.2.2	Strength—leakage	Appendix E/Appendix E of AS 1357.1	
	3.3	End connections	Relevant Standard	
	3.4	Components and valve seats	Visual inspection	
	3.5	Repair	Design review	
	3.6	Installation Instructions	Review of documentation	
	6.8	Manufacturer's instruction	Review of documentation	
Performance	6.4	Mixed water discharge test—tempered water range	Appendix G	At change in design
	6.5	Endurance	Appendix H	
	6.6	Minimum flow requirement	Appendix J	

TABLE S2
MINIMUM SAMPLING AND TESTING FREQUENCY PLAN PRIMARY
TEMPERATURE CONTROL VALVES—BATCH RELEASE TESTS

Characteristic	Clause	Requirement	Test method (see Note)	Frequency
Material properties	2.4/2.5/ 2.7/2.10	Materials	Review materials parts lists and compliance certificates	Once per batch
	2.6	Materials—copper Alloy (DR)	AS 2345	
Design and construction	1.5 and 6.7	Marking	Visual inspection	Once per batch
	3.2.2	Strength—Leakage	Appendix E/Appendix E of AS 1357.1	100%
	3.3	End connections	Relevant Standard	Once per batch
Performance	6.4	Mixed water discharge test—tempered water range	Appendix G	100%
	6.6	Minimum flow requirement	Appendix J	Once per batch

NOTE: The method used should be based on the relevant appendix, and reflect the intent of the particular method.

APPENDIX T

SAMPLING AND FREQUENCY PLANS FOR INLET PRESSURE CONTROL VALVES

(Normative)

This Appendix sets out the compliance sampling and frequency plans for inlet pressure control valves. Type test are given in Table T1 and batch release tests are given in Table T2.

TABLE T1

MINIMUM SAMPLING AND TESTING FREQUENCY PLAN INLET PRESSURE CONTROL VALVES—TYPE TESTS

Characteristic	Clause	Requirement	Test method	Frequency
Material properties	2.4/2.5/ 2.7/2.10	Materials	Review materials parts lists and compliance certificates	At any change in materials
	2.6	Materials—copper Alloy (DR)	AS 2345	
	2.2	Contamination of water	AS/NZS 4020	At change in materials or every 5 years, whichever occurs first
Design and construction	1.5 and 7.6	Marking	Visual inspection	At change in design
	3.2.1	Strength—torque	Appendix E of AS 1357.1	
	3.2.2	Strength—Leakage	Appendix E/Appendix E of AS 1357.1	
	3.3	End connections	Relevant Standard	
	3.4	Components and valve seats	Visual inspection	
	3.5	Repair	Design review	
	3.6	Installation Instructions	Review of documentation	
Performance	7.2	Outlet pressure	Appendix L	At change in design
	7.4	Flow rate	Appendix M	
	7.5	Endurance	Appendix N	

TABLE T2
MINIMUM SAMPLING AND TESTING FREQUENCY PLAN INLET PRESSURE
CONTROL VALVES—BATCH RELEASE TESTS

Characteristic	Clause	Requirement	Test method (see Note)	Frequency
Material properties	2.4/2.5/ 2.7/2.10	Materials	Review materials parts lists and compliance certificates	Once per batch
	2.6	Materials—copper alloy (DR)	AS 2345	Once per batch
Design and construction	1.5 and 7.6	Marking	Visual inspection	Once per batch
	3.2.2	Strength—leakage	Appendix E/Appendix E of AS 1357.1	100%
	3.3	End connections	Relevant Standard	Once per batch
Performance	7.2	Outlet pressure	Appendix M	100%

NOTE: The method used should be based on the relevant appendix, and reflect the intent of the particular method.

APPENDIX U

SAMPLING AND FREQUENCY PLANS FOR ISOLATING VALVES

(Normative)

This Appendix sets out the compliance sampling and frequency plans for isolating valves. Type test are given in Table U1 and batch release tests are given in Table U2.

TABLE U1

MINIMUM SAMPLING AND TESTING FREQUENCY PLAN ISOLATING VALVES—TYPE TESTS

Characteristic	Clause	Requirement	Test method	Frequency
Material properties	2.4/2.5/ 2.7/2.10	Materials	Review materials parts lists and compliance certificates	At any change in materials
	2.6	Materials—copper alloy (DR)	AS 2345	
	2.2	Contamination of water	AS/NZS 4020	At change in materials or every 5 years, whichever occurs first
Design and construction	1.5	Marking	Visual inspection	At change in design
	3.2.1	Strength—torque	Appendix E of AS 1357.1	
	3.2.2	Strength—leakage	Appendix E/Appendix E of AS 1357.1	
	3.3	End connections	Relevant Standard	
	3.4	Components and valve seats	Visual inspection	
	3.5	Repair	Design review	
	3.6	Installation Instructions	Review of documentation	
Performance	8.2	Minimum flow area	Clause 8.2 Measurement	At change in design
	8.3	Width of passages	Clause 8.3 Measurement	
	8.4	Strength of operating mechanism	Appendix O	
	8.5	Endurance	Appendix P	

TABLE U2
MINIMUM SAMPLING AND TESTING FREQUENCY PLAN ISOLATING
VALVES—BATCH RELEASE TESTS

Characteristic	Clause	Requirement	Test method (see Note)	Frequency
Material properties	2.4/2.5/ 2.7/2.10	Materials	Review materials parts lists and compliance certificates	Once per batch
	2.6	Materials—copper alloy (DR)	AS 2345	Once per batch
Design and construction	1.5	Marking	Visual inspection	Once per batch
	3.2.2	Strength—leakage	Appendix E/Appendix E of AS 1357.1	100%
	3.3	End connections	Relevant Standard	Once per batch

NOTE: The method used should be based on the relevant appendix, and reflect the intent of the particular method.

A1

APPENDIX V

TEST FOR FLOW CAPACITY, LEAKAGE RATE AND SWITCHING TIME—
THERMAL SWITCHING VALVE

(Normative)

V1 SCOPE

This Appendix sets out the method for testing the flow switching performance of a thermal switching valve.

V2 PRINCIPLE

The valve under test is supplied with water at the lower and upper switching temperatures, as specified by the manufacturer. For each supply temperature, the flow rate to the open outlet port and the leakage rate to the closed port are measured.

V3 APPARATUS

The following apparatus is required:

- (a) Test rig for thermal switching valve test, including—
 - (i) pressure gauge to measure water pressure at inlet of valve under test; and
 - (ii) pipework with same nominal size as outlet port, connected to each outlet port of valve under test and directed to waste.
- (b) Devices to measure the water flow rate from the outlets of valve under test.
- (c) Devices to measure time.
- (d) Supply of water at a temperature equal to the lower switching temperature of the valve under test ($-3, +0^{\circ}\text{C}$) and a pressure of 500 ± 50 kPa.
- (e) Supply of water at a temperature equal to the upper switching temperature of the valve under test ($-0, +3^{\circ}\text{C}$) and a pressure of 500 ± 50 kPa.

V4 PROCEDURE

The procedure shall be as follows:

- (a) Install the valve under test in the test rig, in accordance with the manufacturer's instructions.
- (b) Commence flowing water at the lower switching temperature to the test rig and purge all air from test rig.
- (c) Allow the water to run through the valve for 10 ± 2 s.
- (d) Record the rate of water flowing from the cold outlet (cold outlet maximum flow) and the rate of water flowing from the hot outlet (hot outlet leak rate)
- (e) Within a period of 2 ± 1 s, isolate the water supply at the lower switching temperature, and commence flowing water at the upper switching temperature to the test rig. Start time measurement from the moment the water supplies are changed.
- (f) Continue recording the time until the rate of water flowing from the cold outlet falls below the nominated leakage rate.
- (g) Wait for a period of 10 ± 2 s.

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- (h) Record the rate of water flowing from the hot outlet (hot outlet maximum flow) and the rate of water flowing from the cold outlet (cold outlet leak rate).
- (i) Within a period of 2 ± 1 s, isolate the water supply at the upper switching temperature, and commence flowing water at the lower switching temperature to the test rig. Start time measurement from the moment the water supplies are changed.
- (j) Continue recording the time until the rate of water flowing from the hot outlet falls below the nominated leakage rate.

V5 REPORT

The report shall include the following information:

- (a) Manufacturer, model, type and size of valve under test.
- (b) The nominated upper and lower switching temperatures.
- (c) The measured maximum flow rates from the cold and hot outlets.
- (d) The measured leakage rates from the cold and hot outlets.
- (e) The measured switching times.
- (f) Compliance or non-compliance with the requirements of this Standard.
- (g) Reference to this test method, i.e., Appendix V, AS 1357.2.

A1

APPENDIX W
ENDURANCE TEST—THERMAL SWITCHING VALVE
(Normative)

W1 SCOPE

This Appendix sets out the method for testing the endurance of a thermal switching valve.

W2 PRINCIPLE

The valve under test is alternately supplied with water at a temperature 5°C below the lower switching temperature and 5°C above upper switching temperature, for a total of 50 000 cycles. The flow performance of the valve is then verified.

W3 APPARATUS

The following apparatus is required:

- (a) Test rig for thermal switching valve test, including—
 - (i) pressure gauge to measure water pressure at inlet of valve under test;
 - (ii) solenoid valves, under the control of a cyclic timing device, to connect the inlet of the valve under test to either of the controlled temperature water supplies; and
 - (iii) needle valves, connected to each outlet port of valve under test and with outlets of needle valves directed to waste.
- (b) Water flow meter to measure the water flow rate into the inlet of the valve under test.
- (c) Supply of water at a temperature equal to 5°C less than the lower switching temperature of the valve under test (−5, +0°C) and a pressure of 500 ±50 kPa (cold supply).
- (d) Supply of water at a temperature equal to 5°C greater than the upper switching temperature of the valve under test (−0, +5°C) and a pressure of 500 ±50 kPa (hot supply).
- (e) Stopwatch or suitable timing device.

W4 PREPARATION FOR TESTING

The following steps shall be carried out before testing can commence:

- (a) Install the valve under test in the test rig, in accordance with the manufacturer's instructions.
- (b) Open both outlet valves fully.
- (c) Connect the hot and cold water supplies to the test rig and purge all air from test rig.
- (d) Open the solenoid valve on the low temperature supply and adjust the cold outlet valve to give a flow rate of 5 ±0.5 L/min or the water flow capacity of the valve under test, whichever is the smaller. Close the solenoid valve on the low temperature supply.
- (e) Open the solenoid valve on the high temperature supply and adjust the hot outlet valve to give a flow rate of 5 ±0.5 L/min or the water flow capacity of the valve under test, whichever is the smaller.

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- (f) Close the solenoid valve on the high temperature supply, open the solenoid valve on the low temperature supply and simultaneously start the stopwatch.
- (g) Record the time (t_C), until the flow switches to the cold outlet.
- (h) Close the solenoid valve on the low temperature supply, open the solenoid valve on the high temperature supply and simultaneously start the stopwatch.
- (i) Record the time (t_H), until the flow switches to the hot outlet.
- (j) Close all solenoid valves.

W5 ALTERNATE TEST METHOD

An alternate test method may be used where the valve under test is immersed fully and alternately in water as follows:

- (a) At a temperature equal to 5°C less than the lower switching temperature of the valve under test (−5, +0°C).
- (b) At a temperature equal to 5°C greater than the upper switching temperature of the valve under test (−0, +5°C).

W6 PROCEDURE

The procedure shall be as follows:

- (a) Open the solenoid valve on the low temperature supply.
- (b) Wait for a time $2 \times t_C$ then close the solenoid valve.
- (c) Open the solenoid valve on the high temperature supply.
- (d) Wait for a time $2 \times t_H$ then close the solenoid valve.
- (e) Repeat Steps (a) to (d) for 50 000 ±500 cycles.
- (f) Test the valve in accordance with Appendix V.

W7 ALTERNATE PROCEDURE

The alternate procedure shall be as follows:

- (a) Immerse the valve in the low temperature supply.
- (b) Wait for a time $2 \times t_C$.
- (c) In a period of 5 ±5 s transfer the valve to the high temperature supply.
- (d) Wait for a time $2 \times t_H$.
- (e) In a period of 5 ±5 s transfer the valve to the low temperature supply.
- (f) Repeat Steps (a) to (e) for 50 000 ±500 cycles.
- (g) Test the valve in accordance with Appendix V.

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W8 REPORT

The report shall include the following information:

- (a) Manufacturer, model, type and size of valve under test.
- (b) The actual flow rates set for hot and cold supplies, or the actual temperatures of the hot and cold supplies used to immerse the valve.
- (c) The actual times $2 \times t_C$ and $2 \times t_H$ used for the cyclic testing.
- (d) The actual number of cycles completed.
- (e) Reference to this test method, i.e., Appendix W, AS 1357.2.

AMENDMENT CONTROL SHEET**AS 1357.2—2005**

Amendment No. 1 (2006)

REVISED TEXT

SUMMARY: This Amendment applies to Section 9 (new), Appendices V (new) and W (new).

Published on 22 September 2006.

Amendment No. 2 (2009)

CORRECTION

SUMMARY: This Amendment applies to Clauses 7.2, 7.3, 7.4 and 7.6, and Appendices M and O.

Published on 8 May 2009.

NOTES

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NOTES

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ISBN 0 7337 6960 8