



Valves primarily for use in heated water systems

Part 1: Protection valves



AS 1357.1:2019

This Australian Standard® was prepared by WS-026, Valves primarily for use in Warm and Hot Water Systems. It was approved on behalf of the Council of Standards Australia on 10 December 2019.

This Standard was published on 20 December 2019.

The following are represented on Committee WS-026:

- Australian Building Codes Board
- Australian Chamber of Commerce and Industry
- Australian Industry Group
- Gas Appliance Manufacturers Association of Australia
- Institute of Healthcare Engineering
- Master Plumbers Association of NSW
- Master Plumbers Australia
- Plumbing Products Industry Group

This Standard was issued in draft form for comment as DR AS 1357.1:2018.

Keeping Standards up-to-date

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

www.standards.org.au

ISBN 978 1 76072 691 1



Valves primarily for use in heated water systems

Part 1: Protection valves

Originated as AS B271—1968.
Revised and redesignated as AS 1357—1972.
Revised in part and redesignated as AS 1357.1—1988.
Previous edition 2009.
Fifth edition 2019.

COPYRIGHT

© Standards Australia Limited 2019

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth).

Preface

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee WS-026, Valves Primarily for Use in Warm and Hot Water Systems, to supersede AS 1357.1—2009, *Valves for use in heated water systems, Part 1: Protection valves*.

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 the protection of valves.

Other Standards covering heated water system valves include the following:

AS 1357.2, *Valves primarily for use in heated water systems, Part 2: Control valves*

AS 4032.1, *Water supply — Valves for the control of heated water supply temperatures, Part 1: Thermostatic mixing valves — Materials design and performance requirements*

AS 4032.2, *Water supply — Valves for the control of heated water supply temperatures, Part 2: Tempering valves and end-of-line temperature-actuated devices*

AS 4032.3, *Water supply — Valves for the control of heated water supply temperatures, Part 3: Requirements for field testing, maintenance or replacement of thermostatic mixing valves, tempering valves and end-of-line temperature control devices*

AS 4032.4, *Water supply — Valves for the control of heated water supply temperatures, Part 4: Thermostatically controlled taps for the control of heated water supply temperatures*

The terms “normative” and “informative” are used in Standards 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.

Contents

Preface	ii
Section 1 Scope and general	1
1.1 Scope and application	1
1.1.1 Scope	1
1.1.2 Application	1
1.2 Normative references	1
1.3 Terms and definitions	2
1.4 Instrumentation	4
1.5 Marking	4
Section 2 Materials	5
2.1 General	5
2.2 Contamination of water	5
2.3 Corrosion-resistant metallic materials	5
2.4 Copper	5
2.5 Copper alloy	5
2.6 Dezincification-resistant (DR) copper alloy	5
2.7 Stainless steel	6
2.8 Diaphragm materials, and valve seats	6
2.9 Temperature-sensing probe	6
2.10 Other components	6
2.10.1 General	6
2.10.2 Plastics materials	7
Section 3 General design and construction	8
3.1 General	8
3.2 Strength	8
3.2.1 Torque test	8
3.2.2 Leakage test	8
3.3 End connections	8
3.4 Components and valve seats	8
3.5 Remanufactured valves	8
3.5.1 General	8
3.5.2 Critical components	8
3.5.3 Remanufacturing process	9
3.5.4 Packaging	9
3.6 Insulation of temperature/pressure-relief valves, temperature-relief valves, expansion control valves and combination high-pressure expansion non-return valves	9
3.7 Installation instructions	10
Section 4 Temperature/pressure-relief valves	11
4.1 General	11
4.2 Inlet and drain connections and flow dimensions	11
4.2.1 Size of connections	11
4.2.2 Inlet and drain connections	11
4.2.3 Provision for drainage	12
4.2.4 Total flow area	12
4.2.5 Width of passages	12
4.2.6 Minimum orifice	12
4.3 Valve seat and disc assemblies	13
4.4 Springs pressure-relief function	13
4.5 Testing	15
4.5.1 Selection of valves for type testing	15
4.5.2 Test schedule	15
4.5.3 Drain lines	16

4.6	Easing gear test.....	17
4.7	Auxiliary pressure-relief device.....	17
4.7.1	General.....	17
4.7.2	Rated capacity — Expansion-control function.....	17
4.7.3	Rated capacity — Temperature-relief function.....	17
4.8	Pressure-relief function.....	17
4.8.1	Set pressure.....	17
4.8.2	Preferred set pressures.....	17
4.8.3	Opening pressure test.....	18
4.8.4	Reseating pressure test.....	18
4.8.5	Rated capacity (expansion-relief) test.....	18
4.8.6	Endurance (pressure) test.....	18
4.9	Temperature-relief function.....	18
4.9.1	Set temperature.....	18
4.9.2	Opening temperature test.....	18
4.9.3	Reseating temperature test.....	18
4.9.4	Endurance (temperature-relief) test.....	18
4.9.5	Water discharge capacity (temperature-relief) test.....	19
4.9.6	Steam discharge capacity (temperature-relief) test.....	19
4.9.7	Reproducibility of thermal relief test.....	19
4.10	Marking.....	19
Section 5	Expansion control valves.....	20
5.1	General.....	20
5.2	Connections and flow dimensions.....	20
5.2.1	Size of connections.....	20
5.2.2	Inlet and drain connections and flow dimensions.....	20
5.2.3	Provision for drainage.....	21
5.2.4	Total flow area.....	21
5.2.5	Width of passages.....	21
5.2.6	Minimum orifice.....	21
5.3	Valve seat and disc assemblies.....	21
5.4	Springs.....	21
5.5	Testing.....	22
5.5.1	Selection of valve for type testing.....	22
5.5.2	Test schedule.....	22
5.6	Easing gear.....	22
5.7	Auxiliary pressure-relief device.....	23
5.7.1	General.....	23
5.7.2	Rated capacity — Expansion-control function.....	23
5.8	Expansion-control valve function.....	23
5.8.1	Preferred set pressures.....	23
5.8.2	Set pressure.....	23
5.8.3	Opening pressure test.....	23
5.8.4	Reseating pressure test.....	23
5.8.5	Endurance (pressure) test.....	24
5.8.6	Rated capacity test.....	24
5.9	Marking.....	24
Section 6	Non-return valves.....	25
6.1	General.....	25
6.2	Inlet and outlet connections.....	25
6.2.1	General.....	25
6.2.2	Width of passages.....	25
6.3	Testing.....	25
6.3.1	Selection of valves.....	25
6.3.2	Test schedule.....	25
6.4	Flow rate and closing pressure.....	25
6.4.1	Flow rate test.....	25

6.4.2	Closing pressure test	25
6.5	Endurance test	26
6.6	Orientation	26
6.7	Marking	26
Section 7	Temperature-relief valves	27
7.1	General	27
7.2	Inlet and drain connections and flow dimensions	27
7.2.1	Size of connections	27
7.2.2	Inlet and drain connections	27
7.2.3	Provision for drainage	27
7.2.4	Total flow area	28
7.2.5	Width of passages	28
7.2.6	Minimum orifice	28
7.3	Valve seat and disc assemblies	28
7.4	Springs	29
7.5	Testing	29
7.5.1	Selection of valves for type testing	29
7.5.2	Test schedule	29
7.5.3	Drain lines	30
7.6	Easing gear test	30
7.7	Auxiliary pressure-relief device	31
7.7.1	General	31
7.7.2	Rated capacity temperature-relief function	31
7.8	Temperature-relief function	31
7.8.1	Set temperature	31
7.8.2	Opening temperature test	31
7.8.3	Reseating temperature test	31
7.8.4	Endurance (temperature-relief) test	31
7.8.5	Water discharge capacity (temperature-relief) test	32
7.8.6	Steam discharge capacity (temperature-relief) test	32
7.8.7	Reproducibility of thermal-relief test	32
7.9	Pressure setting	32
7.10	Marking	32
Section 8	Combination high pressure expansion non-return valves (HPNR)	33
8.1	General	33
8.2	Connections and flow dimensions	33
8.2.1	Size of connections	33
8.2.2	Inlet and drain connections and flow dimensions	33
8.2.3	Provision for drainage	33
8.2.4	Width of passages	33
8.2.5	Minimum orifice	34
8.3	Valve seat and disc assemblies	34
8.4	Springs	34
8.5	Testing	34
8.5.1	Selection of valve for type testing	34
8.5.2	Test schedule	34
8.6	Easing gear	35
8.7	Expansion control valve function	35
8.7.1	Preferred set pressure	35
8.7.2	Set pressure	35
8.7.3	Opening pressure test	35
8.7.4	Reseating pressure test	35
8.7.5	Endurance (pressure) test	35
8.7.6	Rated capacity test	36
8.7.7	Non-return closing pressure test	36
8.7.8	Non-return flow rate test	36
8.7.9	Non-return endurance test	36

8.8	Marking.....	36
Section 9	Leak-protection devices.....	37
9.1	General.....	37
9.2	Design.....	37
9.2.1	Resetting mechanism.....	37
9.2.2	Manual trip.....	37
9.2.3	Activation mechanism.....	37
9.3	Performance requirements and test methods.....	37
9.3.1	Closing test.....	37
9.3.2	Endurance test.....	37
9.4	Marking.....	37
Appendix A	(normative) Demonstrating conformity to this Standard.....	38
Appendix B	(informative) Not used.....	40
Appendix C	(normative) Instrumentation — Accuracy.....	41
Appendix D	(informative) Measurement of noise emission.....	43
Appendix E	(normative) Torque test.....	44
Appendix F	(normative) Leakage test.....	46
Appendix G	(normative) Easing gear test for temperature/pressure-relief valves, temperature-relief valves and expansion-control valves.....	48
Appendix H	(normative) Auxiliary pressure-relief devices test.....	50
Appendix I	(normative) Rated expansion capacity test for temperature/pressure-relief valves and expansion-control valves.....	53
Appendix J	(normative) Water discharge capacity test for temperature-pressure-relief valves and temperature-relief valves.....	55
Appendix K	(normative) Opening pressure test and reseating pressure test for temperature/pressure-relief valves and expansion-control valves.....	58
Appendix L	(normative) Endurance (pressure) test for temperature/pressure-relief valves and expansion-control valves.....	61
Appendix M	(normative) Opening and reseating temperature tests for temperature/ pressure-relief valves and temperature-relief valves.....	63
Appendix N	(normative) Endurance (temperature-relief) test for temperature/pressure- relief valves and temperature-relief valves.....	65
Appendix O	(normative) Steam discharge capacity test for temperature/pressure-relief valves and temperature-relief valves.....	68
Appendix P	(normative) Flow rate test for non-return valves.....	71
Appendix Q	(normative) Closing pressure test for non-return valves.....	73
Appendix R	(normative) Endurance test for non-return valves.....	75
Appendix S	(normative) Sampling and frequency plans for temperature/pressure-relief valves.....	77
Appendix T	(normative) Sampling and frequency plans for expansion control valves.....	80
Appendix U	(normative) Sampling and frequency plans for non-return valves.....	82
Appendix V	(normative) Sampling and frequency plans for temperature-relief valves.....	83
Appendix W	(normative) Sampling and frequency plans for combination high-pressure expansion non-return (HPNR) valves.....	85
Appendix X	(normative) Sampling and frequency plans for leak-protection devices.....	87
Appendix Y	(normative) Closing test for leak-detection devices.....	88

Appendix Z (normative) Endurance test for leak-detection devices	89
Bibliography	91

NOTES

Australian Standard®

Valves primarily for use in heated water systems

Part 1: Protection valves

Section 1 Scope and general

1.1 Scope and application

1.1.1 Scope

This Standard sets out requirements for the design, construction, testing and performance of the following types of valves, within the range of DN 15 to DN 50:

- (a) Temperature/pressure-relief valves.
- (b) Expansion-control valves.
- (c) Non-return valves.
- (d) Temperature-relief valves.
- (e) Combination high-pressure expansion non-return valves (HPNR).
- (f) Leak-protection devices.

The valves specified in this Standard are primarily intended for use in warm and hot water systems that are required to operate at —

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

NOTE For valves used with water heaters that are intended to operate at temperatures above 99 °C (e.g. hot water boilers), see AS 1271.

1.1.2 Application

Means for demonstrating conformance to this Standard shall be as specified in [Appendix A](#).

1.2 Normative references

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

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

AS 1349, *Bourdon tube pressure and vacuum gauges*

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

AS 1565, *Copper and copper alloys — Ingots and castings*

AS 1572, *Copper and copper alloys — Seamless tubes for engineering purposes*

AS 1722.2, *Pipe threads of Whitworth form, Part 2: Fastening pipe threads*

AS 1834.1, *Material for soldering, Part 1: Solder alloys*

AS 2345, *Dezincification resistance of copper alloys*

AS 2738, *Copper and copper alloys — Compositions and designations of refinery products, wrought products, ingots and castings*

AS 2837, *Wrought alloy steels — Stainless steel bars and semi-finished products*

AS 3558.5, *Methods of testing plastics and composite materials sanitary plumbing fixtures, Method 5: Determination of degradation by ultraviolet light*

AS 3688, *Water supply — Metallic fittings and end connectors*

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

AS/NZS 1567, *Copper and copper alloys — Wrought rods, bars and sections*

AS/NZS 1568, *Copper and copper alloys — Forging stock and forgings*

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

AS/NZS 4020, *Testing of products for use in contact with drinking water*

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

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 6957, *Copper alloys — Ammonia test for stress corrosion resistance*

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*

ASTM A276/A276M, *Standard Specification for Stainless Steel Bars and Shapes*

ASTM A313/A313M, *Standard Specification for Stainless Steel Spring Wire*

ASTM B127, *Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip*

ASTM B163, *Standard Specification for Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes*

ASTM B164, *Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire*

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

1.3 Terms and definitions

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

1.3.1

auxiliary pressure-relief device

pressure-operated device forming part of an expansion control valve, temperature-relief valve or temperature/pressure relief valve, which in the event of blockage of the drain outlet provides —

- (a) expansion relief (expansion-control valves);
- (b) safety relief (temperature-relief valves); or
- (c) expansion and safety relief (temperature/pressure-relief valves)

1.3.2**distortion**

that which is obvious to the eye without resorting to dimensional checking

1.3.3**pressure**

Note 1 to entry: All pressures referred to in this document are gauge pressures and not absolute pressures.

1.3.3.1**opening pressure**

pressure that first causes a valve to open

1.3.3.2**reseating pressure**

pressure that first allows a valve to close

1.3.3.3**set pressure**

pressure at which a valve is designated to operate

1.3.4**normative**

forming an integral part of the Standard

1.3.5**rated capacity****1.3.5.1****expansion control valve**

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

1.3.5.2**relief valve**

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

1.3.6**temperature****1.3.6.1****opening temperature**

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

1.3.6.2**reseating temperature**

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

1.3.6.3**set temperature**

temperature at which a valve is designated to operate

1.3.7**manufacturer's specification**

documented record of the product's attributes, issued by —

- (a) the original manufacturer in the case of a new valve; or
- (b) the manufacturer in the case of a remanufactured valve whose specifications supersede the original valve's specifications

1.3.8**reconditioned component**

component that is rendered suitable for normal service by acceptable reconditioning techniques

1.3.9**replacement components**

new components that are sourced from an original equipment or replacement manufacturer and produced in accordance with the manufacturer's specification for the valve model

1.3.10**shall**

indicates that a statement is mandatory

1.3.11**should**

indicates a recommendation

1.4 Instrumentation

The accuracy requirements for instruments in this Standard shall be in accordance with [Appendix C](#).

1.5 Marking

Each valve conforming to this Standard shall be marked with the following information:

- (a) The manufacturer's name, trademark or symbol. In the case of a remanufactured valve, the original manufacturer's name, trademark or symbol and licence number shall be removed.
- (b) Name or model number of the valve or device.
- (c) Identification for traceability in the form of either of the following:
 - (i) Batch identification.
 - (ii) Individual serial number.
- (d) Number of this Standard, i.e. AS 1357.1.
- (e) Identification of the inlet, drain, outlet or other special connections, or by an arrow indicating direction of flow.
- (f) Additional markings for valves as specified in the appropriate clause.
- (g) In the case of a remanufactured valve, the words "remanufactured valve" in a prominent position immediately adjacent to the model number or name and with a minimum text height of 3 mm.

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.

NOTE 1 The intention is to achieve permanency of the marking for the life of the product, or at least 5 years under normal conditions of use.

NOTE 2 Manufacturers making a statement of conformance with this Australian Standard on a product, packaging, or promotional material related to that product are advised to ensure that such conformance is capable of being verified.

Section 2 Materials

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 be in accordance 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 2.10.1\(c\)](#).
- (e) Other materials, as specified in [Clause 2.10](#).

2.4 Copper

Copper shall be in accordance with the following:

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

2.5 Copper alloy

Copper alloy shall be in accordance with the following:

- (a) *Castings* — AS 1565 and have a lead content of less than 4.5 %.
- (b) *Hot pressing* — AS/NZS 1568.
- (c) *Rod for machined parts* — AS/NZS 1567.
- (d) *Tubular components* — Copper alloy tubes in accordance with AS 1572 alloy designation C26130. Where bent or stamped in the fabrication process, the pipe shall be sufficiently stress-relieved, so that it is capable of passing the stress corrosion test specified in ISO 6957:1988 Clause 8, using a test solution of pH 9.5 without prior pickling, after all fabrication processes are completed.

NOTE ISO 6957 requires that the entire component is tested before any coating or plating operation.

2.6 Dezincification-resistant (DR) copper alloy

Copper alloys in contact with water shall be in accordance with AS 2345.

2.7 Stainless steel

Stainless steel shall be in accordance with the following:

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

Suitability of these materials shall be established by the test method specified in the appropriate appendix.

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 components

2.10.1 General

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, in accordance with AS/NZS 1167.1.
 - (ii) Copper-phosphorus brazing alloys in accordance with AS/NZS 1167.1 with a minimum of 1.8 % silver.
 - (iii) Solder in accordance with the requirements of AS 1834.1 and having a maximum of 0.1 % lead.
- (c) *Material for springs* — Materials for springs shall be one of the following:
 - (i) Stainless steel, in accordance with the corrosion-resistant property of grade 304 of AS 2837.
 - (ii) Stainless steel in accordance with 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 be in accordance with either of the following items:
 - (i) AS 2738, alloy 713.

- (ii) ASTM B127, ASTM B163, ASTM B164 and ASTM B165.

2.10.2 Plastics materials

2.10.2.1 General

Under hydrostatic pressure, plastics materials shall be able to demonstrate suitability at the maximum operating pressure and temperature for the intended life of the product.

2.10.2.2 UV resistance

For outdoor applications, the plastic material formulation shall be stabilized by suitable ultraviolet light stabilizers.

The materials of plastics components that are designed to be exposed to direct sunlight, when installed, shall not crack, craze or exhibit signs of any defect when tested to the conditions specified in AS 3558.5.

Section 3 General design and construction

3.1 General

The body and component parts of valves 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 conformance 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](#), the valves under test shall be capable of withstanding, without permanent distortion, the applied torque, as appropriate. This test is not applicable where elastomeric seals are used on connections for assembly of combination valve bodies.

3.2.2 Leakage test

When valves are tested in accordance with [Appendix E](#) and [Appendix F](#) respectively, there shall be no leakage from the valve body.

3.3 End connections

End connections shall conform to the following requirements:

- (a) *Threaded* — All threaded end connections shall be in accordance with AS 3688 with the exception of pipe stops.
- (b) *Compression* — Compression end connections shall be in accordance with AS 3688.

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 Remanufactured valves

3.5.1 General

Under the conditions of this Clause, reconditioned and re-used components may be used to manufacture valves to this Standard. The main component that would be reconditioned is the valve body and reconditioning would normally be undertaken on the valve seat. Other components may be considered for reconditioning where, after the reconditioning, the quality of the component will meet the requirements of this Standard.

3.5.2 Critical components

Critical components of the valve shall be replaced by new components. For the purposes of this Standard, the following are critical components:

- (a) Springs.
- (b) Thermal actuators.

- (c) Elastomeric components (e.g. o-rings, gaskets, seals and diaphragms).

3.5.3 Remanufacturing process

3.5.3.1 General

The following procedures shall be adhered to:

- (a) The used valve shall be totally disassembled.
- (b) The non-re-usable components including the critical components, as defined in this Standard, shall be discarded.
- (c) All components to be re-used shall be thoroughly cleaned, inspected and/or tested to determine whether they conform to the manufacturer's specification.
- (d) Components that do not conform to the manufacturer's specification shall be reconditioned or discarded.
- (e) Replacement components shall be selected as required.
- (f) The valve shall be assembled to the manufacturer's specification.

3.5.3.2 Valve body

The valve body shall be pressure-tested to the requirements of [Appendix F](#) to ensure that the body is structurally sound.

All threaded connections shall be cleaned and verified as conforming to [Clause 3.3](#). Where deviation is found, the thread may be reconditioned.

3.5.3.3 Valve seat

The valve seat shall be inspected to the manufacturer's specifications. Where the valve seat requires reconditioning it shall be done in accordance with defined procedures.

3.5.4 Packaging

Remanufactured valves shall be individually packaged. The words "THIS IS A REMANUFACTURED VALVE AND CONTAINS RECONDITIONED COMPONENTS" shall be clearly visible on or through the packaging. These words shall be in a prominent position, immediately adjacent to the model number or name and with a minimum text height of 8 mm.

3.6 Insulation of temperature/pressure-relief valves, temperature-relief valves, expansion control valves and combination high-pressure expansion non-return valves

The following applies:

- (a) Insulation suitable for use with the valves shall be supplied or specified in the manufacturer's instructions. The insulation shall cover the maximum surface area of the valve without impeding the operation or connection of the valve.
- (b) Tests may be conducted on the valves with or without the insulation in place.
- (c) The valve insulation material shall have a minimum R-value of x

$$x = K \frac{A_t}{A_c}$$

where

x = minimum R-value ($\text{m}^2\cdot\text{K}/\text{W}$)

K = $0.2 \text{ m}^2\cdot\text{K}/\text{W}$

A_t = total body area of the valve excluding connections (m^2)

A_c = covered area of the valve (m^2)

The following shall be taken into account in the calculation:

- (i) Any part of the body relating to inlet, outlet or drain connections is excluded for the calculation.
- (ii) The covered area is the internal surface area of the insulation less the area of the holes where the auxiliary pressure relief valve and easing gear protrude.
- (d) The insulation shall not impede the operation of the valve.
- (e) Installation instructions for the valve shall take into consideration fitting of the insulation.

3.7 Installation instructions

Valves shall be accompanied by comprehensive installation instructions in the English language, which shall include instructions on fitting of insulation and connection to adjoining insulation to ensure the valve operates correctly and is effectively connected to the adjoining insulation.

Where insulation is required and is not supplied with the valve, the specification for this insulation shall be included in the instructions.

Section 4 Temperature/pressure-relief valves

4.1 General

In addition to the requirements of this Section, temperature/pressure-relief valves shall also conform to the relevant requirements of [Sections 2](#) and [3](#).

Temperature/pressure relief valves shall be constructed so that failure of any part will not obstruct discharge from the valves. In addition, they shall be designed for automatic reseating under normal conditions.

Once installed, any part of the valve that extends inside the inner wall of the water heater shall be protected from build-up of deposits that may lead to valve failure.

NOTE 1 Conformance with this requirement may be established by confirming that valve failure does not occur after —

- (a) exposing the valve to conditions that are representative of normal use for a period of time consistent with normal use; or
- (b) exposing the valve to conditions that are demonstrated to accelerate the build-up of anode deposits for an appropriate period of time.

A spindle shall not be fitted with a stuffing box or packed gland.

NOTE 2 A typical arrangement of a temperature/pressure-relief valve is shown in [Figure 4.1](#).

The rated capacity of temperature/pressure-relief valves shall be the lowest of the values determined in accordance with [Clauses 4.8.5](#), [4.9.5](#) and [4.9.6](#). A valve with a rated capacity exceeding 10 kW shall be not smaller than DN 20, and a drainage connection of a valve with a rated capacity exceeding 46 kW shall be not smaller than DN 25.

4.2 Inlet and drain connections and flow dimensions

4.2.1 Size of connections

Inlet and drain connections of a valve shall be not smaller than DN 15.

4.2.2 Inlet and drain connections

4.2.2.1 Inlet connections

Inlet connections shall —

- (a) be of the same size as the nominal size of the valve;
- (b) with the temperature probe in position, have a minimum total flow area through the full length not less than that given in Column 3 of [Table 4.1](#); and
- (c) be threaded with a tapered external thread in accordance with AS ISO 7.1 Series R.

4.2.2.2 Drain connections

Drain connections shall —

- (a) for valves of DN 15 size, be of the same nominal size as the size of the valve inlet;
- (b) for valves of DN 20 size and above be not greater in size than one size larger than the size of the valve inlet;

- (c) have a minimum total flow area through the full length not less than that given in Column 2 of [Table 4.1](#);
- (d) be threaded with a parallel internal thread in accordance with AS ISO 7.1 Series Rp, AS 1722.2 Series G or ISO 228-1 Series G; or of "push on" type in accordance with AS 3688:2016 Clause 10.2.2, incorporating a mechanical release ring to allow for the drain line to be removed; and
- (e) have a shoulder or stop to prevent a copper tube of the same nominal size as the drain connection protruding into the mechanism of the valve.

4.2.3 Provision for drainage

The drain outlet from the valve shall be designed so that the mating face of the seat and valve disc shall be not lower than the centre-line of the outlet thread by more than dimension "X" specified in Column 4 of [Table 4.1](#), to ensure positive drainage when the valve is installed upright.

Valves designed for horizontal installations only shall have positive drainage.

4.2.4 Total flow area

The minimum total flow area at any cross-section within the valve body shall be not less than that given in Column 3 of [Table 4.1](#) from the downstream side of the inlet connection up to the orifice and not less than that given in Column 2 of [Table 4.1](#) from the orifice to the upstream side of the drain connection.

In determining total flow areas, any area in a corner that would not be included in a circle of 5 mm in diameter, and with its sides tangential to the sides of the flow area, shall not be included (see [Figure 4.1\(b\)](#)).

4.2.5 Width of passages

The minimum cross-section dimensions of any flow passage shall be as follows:

- (a) The lip of the disc holder shall not protrude beyond the sealing face of the disc by more than 0.5 mm (see [Figure 4.1\(d\)](#)).
- (b) The width of the flow-way between the valve body wall and the valve disc holder over its range of movement shall be not less than 5 mm (see [Figure 4.1](#)) and the minimum dimensions of the flow area below the lip of the disc holder in the fully open position shall be not less than 5 mm (see [Figure 4.1](#)).
- (c) The width of the flow-way between the walls of the orifice and any part of a temperature probe or push rod extending through the orifice shall be not less than 3 mm (see [Figure 4.1](#)).
- (d) The dimensions between the lower edge of the orifice and any part of the probe or push rod, which is larger than that part extending through the orifice, shall be not less than 5 mm (see [Figure 4.1](#)).
- (e) All other flow passages shall be not less than 5 mm.

4.2.6 Minimum orifice

The diameter of the relief valve orifice shall be not less than 11 mm.

Table 4.1 — Minimum dimensions for temperature pressure relief valves

1	2	3	4
Nominal size DN	Minimum total flow area		Dimension "X" Figure 4.1 (Clause 4.2.3)
	Drain connections (Clause 4.2.2.2) mm ²	Inlet connections (Clause 4.2.2.1) mm ²	
15	130	95	3
20	250	205	6
25	450	360	9
32	800	650	12
40	1 080	850	15

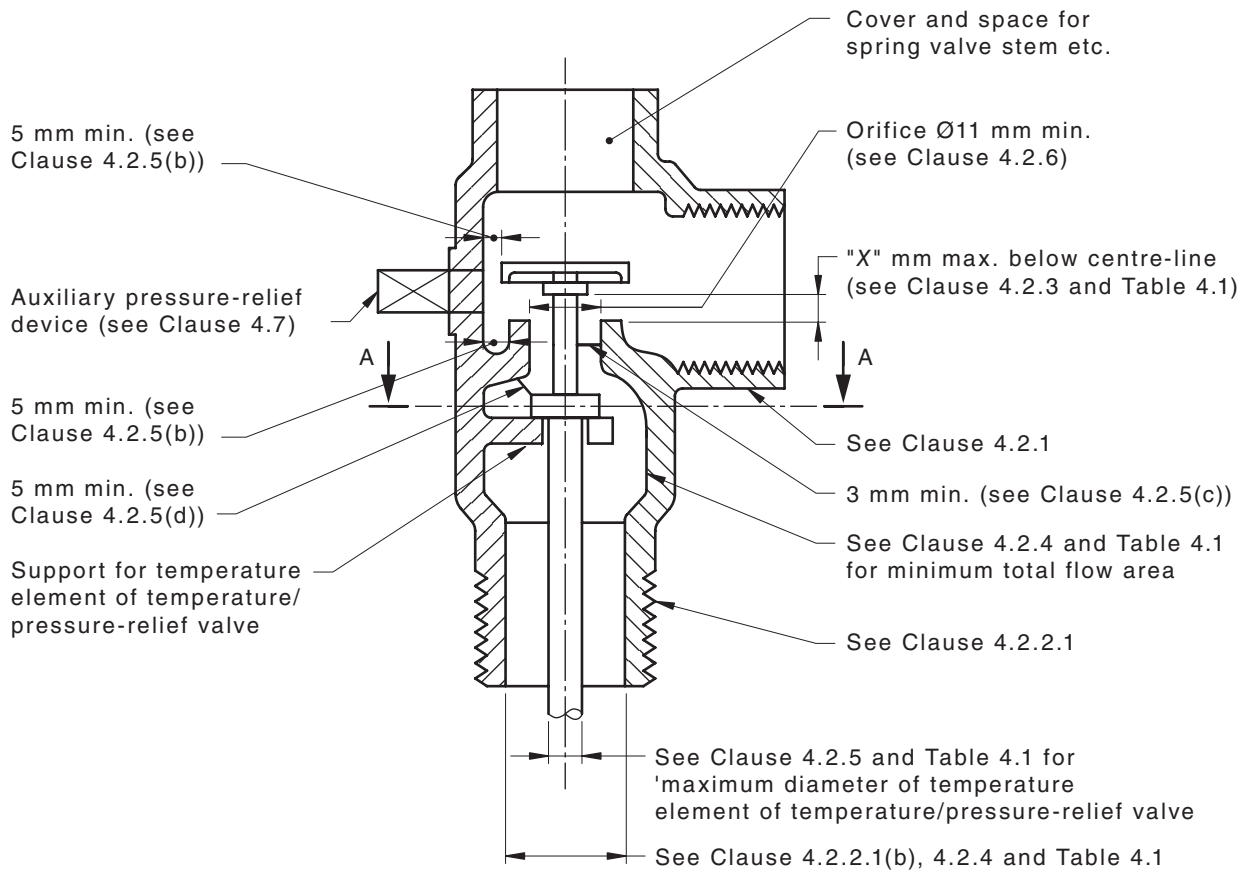
4.3 Valve seat and disc assemblies

Where a separate seat is fitted to the valve body, it shall not be displaced during any or all tests carried out in accordance with this Standard.

Wing or similar guides shall not be used on the water or inlet side of the valve (see [Figure 4.1\(c\)](#)).

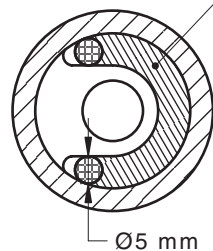
4.4 Springs pressure-relief function

Springs governing the pressure relief function shall have a smooth finish and shall be protected against contact with discharged water by membranes or seals. Seals shall be non adjustable. Packed glands shall not be used.

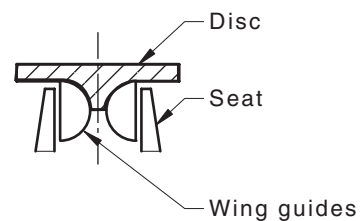


(a) Axial section - Valve open

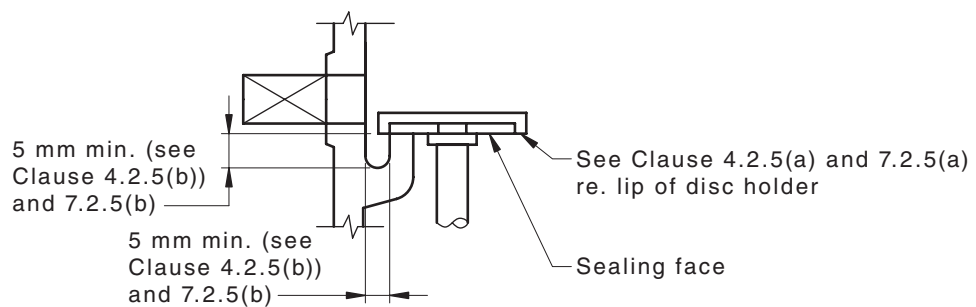
Cross-hatched area only to be considered in determining minimum body passages (see Clauses 4.2.4, 5.2.4 and 7.2.4)



(b) Section A-A



(c) Non-permissible wing guides (see Clauses 4.3 and 7.3)



(d) Axial section - Valve closed

Figure 4.1 — Typical arrangement of temperature/pressure relief valve

4.5 Testing

4.5.1 Selection of valves for type testing

Valves of each design and size shall be submitted for type testing, subject to the following:

- (a) Where a valve is tested with the centre-line of the inlet connection horizontal, testing with the centre-line vertical is not necessary, but not vice versa.
- (b) Valves with optional features, such as hot water take off connections or extended inlet connections, are considered to be of the same design as the basic valve for the purpose of all tests other than Tests 1 and 3.
- (c) For valves of different size, which incorporate —
 - (i) identical easing gear design;
 - (ii) identical spring design for the same pressure setting; and
 - (iii) identical temperature probe design for temperature operation,
 Tests 2, 7, 10 and 13 on one size of valve render unnecessary these tests on the other size of valve.
- (d) For valves of different size with identical auxiliary pressure-relief devices, Test 4 needs to be carried out on only one size of valve.

4.5.2 Test schedule

Valves shall be tested in accordance with the schedule given in [Table 4.2](#) (Tests 1 to 14). The following shall apply:

- (a) *Test 1* — Three valves of each design, size and maximum set pressure shall be used.
- (b) *Test 2* — For conformance with —
 - (i) [Clause 4.6\(a\)](#), three valves of each combination of design, size and set pressure shall be tested. The three valves used in Test 1 shall be used; and
 - (ii) [Clause 4.6\(b\)](#), three valves used in Test 1 only shall be used.
- (c) *Test 3* — The valves used in Test 1 shall be used.
- (d) *Test 4* — Three valves of each combination of rating and set pressure shall be used except that in the case of valves with auxiliary pressure relief devices that are separately attachable, one valve of each combination of rating and set pressure may be used plus sufficient relief devices to complete the series of tests. The samples shall include those valves from Tests 1, 2 and 3.
- (e) *Tests 5 to 7* — Three valves of each combination of design, size and set pressure shall be subjected to all three tests. All valves tested previously shall be included.
- (f) *Tests 8 and 9* — Three valves of each combination of design, size and set pressure shall be tested. These valves may be either those used in Tests 1 to 7 or new valves. If new valves are used, they shall be first submitted to Tests 5 and 6.
- (g) *Test 10* — Three valves of each design and maximum set pressure shall be used. They shall be the same valves used in Tests 8 and 9.
- (h) *Tests 11 to 13* — Three valves of each design, size and set pressure shall be subjected to all three tests. These valves shall be the same valves as those submitted to Tests 8 and 9.

- (i) *Test 14* — Three valves of each combination of design, size and set pressure, which have not been subjected to any of the preceding tests, shall be used, with the temperature probes rendered inoperative.
- (j) *Test 15* — The valves that have passed Tests 11, 12 and 13 shall be submitted to this test. In the event of any variation in the area of any part of the discharge flow way of the device, the device having the smallest cross-sectional discharge area shall be used for this test.

Table 4.2 — Schedule of tests

Test No.	Description	Clause
1	Torque test	3.2.1
2	Easing gear test	4.6
3	Leakage test	3.2.2
4	Auxiliary pressure-relief device test	4.7
5	Opening pressure test	4.8.3
6	Reseating pressure test	4.8.4
7	Endurance (pressure) test (including repeat of Tests 5 and 6)	4.8.6
8	Opening temperature test	4.9.2
9	Reseating temperature test	4.9.3
10	Endurance (temperature relief) test (including repeat Tests 8 and 9)	4.9.4
11	Water discharge capacity (temperature-relief) test	4.9.5
12	Steam discharge capacity (temperature-relief) test	4.9.6
13	Reproducibility of thermal relief test (including repeat of Tests 8 and 9)	4.9.7
14	Rated capacity test	4.8.5
15	Water discharge capacity (temperature) auxiliary pressure relief	4.7.3

4.5.3 Drain lines

Where methods of test require drain lines to be fitted, the drain lines shall —

- (a) be of the same nominal size as the outlet of the valve;
- (b) be of copper tube Type B in accordance with AS 1432; and
- (c) conform to the dimensional requirements of [Table 4.3](#).

Table 4.3 — Drain lines — Details

Nominal size of valve DN	Drain line			
	Nominal size DN	Length m	Number of 90° bends	Radius of bend
15	15	9	3	3D
20	20	9	3	3D
25	25	9	3	3D
32	32	9	3	3D
40	40	9	3	3D
50	50	9	3	3D
Key D = actual outside diameter of drain line.				

4.6 Easing gear test

The valve shall be fitted with an easing gear to positively lift the valve disc off its seat.

When the valve is tested in accordance with [Appendix G](#) —

- (a) the positive lift-distance of the valve shall be not less than 1 mm; and
- (b) the valve shall positively seal and remain sealed when the easing gear is suddenly released from the maximum open position.

4.7 Auxiliary pressure-relief device

4.7.1 General

An auxiliary pressure-relief device shall be fitted to the body on the discharge side of the valve and shall conform to the following:

- (a) It shall have the centre-line of the device not closer to the face of the valve seat than the centre-line of the drain connection to ensure positive drainage when the valve is installed upright.
- (b) It shall not discharge towards the easing gear.
- (c) It shall be of such design and construction that no part can be expelled during operation.
- (d) When tested in accordance with [Appendix H](#), it shall operate to discharge water at temperatures of 20 ± 5 °C and 85 ± 5 °C within the following limits:
 - (i) Not less than 50 % of the set pressure of the valve to which it is fitted or 500 kPa, whichever is the lesser pressure.
 - (ii) Not greater than 110 % of the set pressure of the valve to which it is fitted.

4.7.2 Rated capacity — Expansion-control function

When tested in accordance with [Appendix I](#), the water discharge rate from the device shall be not less than 15 mL/min per kilowatt rating of the valve to which the device is fitted, with the pressure at the inlet to the valve not exceeding 110 % of the set pressure of the valve.

4.7.3 Rated capacity — Temperature-relief function

When tested in accordance with [Appendix J](#), the calculated water discharge capacity shall be not less than the rated discharge capacity of the valve.

Where the diameters of the inlet orifices of auxiliary pressure-relief devices vary over a range of valves, with no other design variation, this test shall be conducted on valves fitted with an auxiliary pressure-relief device having the smallest diameter inlet orifice.

4.8 Pressure-relief function

4.8.1 Set pressure

The maximum value of set pressure shall be 1400 kPa.

4.8.2 Preferred set pressures

The following are the preferred values of set pressure: 60 kPa, 100 kPa, 150 kPa, 250 kPa, 500 kPa, 850 kPa, 1000 kPa, 1200 kPa and 1400 kPa.

4.8.3 Opening pressure test

When tested in accordance with [Appendix K](#), the opening pressure shall not exceed the greater of —

- (a) set pressure plus 5 %; or
- (b) set pressure plus 14 kPa.

4.8.4 Reseating pressure test

When tested in accordance with [Appendix K](#), the reseating pressure shall be no less than the following:

- (a) For valves of 850 kPa set pressure and above, 90 % of the set pressure.
- (b) For valves of less than 850 kPa set pressure —
 - (i) 85 % of the set pressure; or
 - (ii) set pressure minus 14 kPa,whichever is the lower value.

4.8.5 Rated capacity (expansion-relief) test

When tested in accordance with [Appendix I](#), the rated capacity of the valve under test shall be determined as the greater of —

- (a) 110 % of the set pressure; or
- (b) set pressure plus 14 kPa.

4.8.6 Endurance (pressure) test

When tested in accordance with [Appendix L](#), the valve shall conform to the requirements of [Clauses 4.8.3](#) and [4.8.4](#).

4.9 Temperature-relief function

4.9.1 Set temperature

The maximum set temperature shall be 99 °C.

4.9.2 Opening temperature test

When tested in accordance with [Appendix M](#), the temperature at which the valve starts to open shall be not less than 93 °C or more than 99 °C.

4.9.3 Reseating temperature test

When tested in accordance with [Appendix M](#), the temperature at which the valve reseats shall be not less than 70 °C.

4.9.4 Endurance (temperature-relief) test

When tested in accordance with [Appendix N](#), the valve shall conform to the requirements of [Clauses 4.9.2](#) and [4.9.3](#) respectively.

4.9.5 Water discharge capacity (temperature-relief) test

When tested in accordance with [Appendix J](#), the calculated water discharge capacity shall be not less than the rated discharge capacity of the valve.

4.9.6 Steam discharge capacity (temperature-relief) test

When tested in accordance with [Appendix O](#), the calculated steam discharge capacity shall be not less than the rated discharge capacity of the valve.

4.9.7 Reproducibility of thermal relief test

After completion of Tests 11 and 12, the valve shall conform to the requirements of [Clauses 4.9.2](#) and [4.9.3](#).

4.10 Marking

In addition to the general marking requirements given in [Clause 1.5](#), each valve shall be marked with the following information:

- (a) Set pressure, in kilopascals.
- (b) Set temperature, in degrees Celsius.
- (c) Rated capacity, in kilowatts, to the nearest 0.1 kW.
- (d) Horizontal use only, for valves designed for horizontal installations only.

Section 5 Expansion control valves

5.1 General

In addition to the requirements of this Section, expansion control valves shall conform to the relevant requirements of [Sections 2](#) and [3](#).

Expansion control valves shall be constructed so that failure of any part will not obstruct discharge from the valves.

Expansion control valves shall be automatically reseating.

A spindle shall not be fitted with a stuffing box or packed gland.

Expansion control valves may be combined with another valve or valves. In this application, the thread of the inlet connection to the expansion control valve may be varied provided all other requirements of [Table 5.1](#) are observed.

5.2 Connections and flow dimensions

5.2.1 Size of connections

Inlet and drain connections of a valve shall be not smaller than DN 15. A valve with a rated capacity exceeding 20 kW shall be not smaller than DN 20.

5.2.2 Inlet and drain connections and flow dimensions

5.2.2.1 Inlet connections

Inlet connections shall —

- (a) be of the same size as the nominal size of the valve;
- (b) have a net cross-sectional clear flow-way area through the full length not less than that given in Column 2 of [Table 5.1](#); and
- (c) be threaded with a tapered external thread in accordance with AS ISO 7.1 Series R.

5.2.2.2 Drain connection

Drain connections shall —

- (a) for valves of DN 15 size, be of the same nominal size as the size of the valve inlet;
- (b) for valves of DN 20 size and above, be not greater in size than one size larger than the size of the valve inlet;
- (c) have a minimum net cross-sectional area through the full length not less than that given in Column 2 of [Table 5.1](#);
- (d) be threaded with a parallel internal thread in accordance with AS ISO 7.1 Series Rp, AS 1722.2 Series G or ISO 228-1 Series G; or of “push on” type in accordance with AS 3688:2016 Clause 10.2.2, incorporating a mechanical release ring to allow for the drain line to be removed; and
- (e) have a shoulder or stop to prevent a copper tube of the same nominal size as the drain connection protruding into the mechanism of the valve.

5.2.3 Provision for drainage

The drain outlet from the valve shall be designed so that the mating face of the seat and valve disc shall be not lower than the centre-line of the outlet thread by more than dimension “X” specified in Column 5 of [Table 5.1](#).

5.2.4 Total flow area

The total flow area at any cross section within the valve body between the inner end of the inlet connection and the valve orifice, and between the valve orifice and the inner end of the drain connection, shall be not less than the value given in Column 3 of [Table 5.1](#).

When the total flow area is divided into two or more flow passages in parallel, the net flow area of any body passage shall be not less than that given in Column 4 of [Table 5.1](#).

In determining total flow areas, any area in a corner that would not be included in a 5 mm diameter circle with its sides tangential to the sides of the flow area shall not be included (see [Figure 4.1\(b\)](#)).

5.2.5 Width of passages

The minimum cross sectional dimension of the flow area below the lip of the disc holder or any other flow passage shall be not less than 5 mm.

Table 5.1 — Minimum dimensions of flow passages for expansion control valves

1	2	3	4	5
Nominal size of valve	Minimum internal cross-sectional area of inlet and drain connections	Minimum total flow area (Clause 5.2.4)	Minimum flow area of any body passage (Clause 5.2.4)	Dimension “X” Figure 4.1 (Clause 5.2.3)
DN	mm ²	mm ²	mm ²	mm
10 (see Note)	48	340	170	3
15	130	340	170	3
20	250	340	170	6
25	450	560	280	9
32	800	970	480	12
40	1 080	1 320	660	15

NOTE DN 10 size is applicable only to HPNR valves in [Section 8](#).

5.2.6 Minimum orifice

The diameter of the valve orifice shall be not less than 11 mm.

5.3 Valve seat and disc assemblies

Where a separate seat is fitted to the valve body, it shall not be displaced during any or all tests carried out in accordance with this Standard.

5.4 Springs

Springs governing the expansion valve function shall have a smooth finish and shall be protected against contact with discharge water by membranes or seals. Stuffing boxes or packed glands shall not be used.