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ASSE 1016-2017/ASME A112.1016-2017/ CSA B125.16-17 (R2021)

Performance Requirements for

Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations

ANSI Approved: October 2021
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Sanitary Engineering ASSE Prevention Rather Than Cure

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Preface

This is the second edition of ASSE 1016/ASME A112.1016/CSA B125.16, *Performance requirements for automatic compensating valves for individual showers and tub/shower combinations*. It supersedes the previous edition published in 2011.

This Standard is considered suitable for use with conformity assessment within the stated scope of the Standard.

This Standard was prepared by the ASSE/ASME/CSA Harmonization Task Group on Plumbing Fittings, under the jurisdiction of the ASME A112 Main Committee, the ASSE Product Standards Committee, and the CSA Technical Committee on Plumbing Fittings. The CSA Technical Committee operates under the jurisdiction of the CSA Strategic Steering Committee on Construction and Civil Infrastructure.

This Standard will be submitted for formal approval by the ASME Standards Committee on Plumbing Materials and Equipment, the ASSE Product Standards Committee and the CSA Technical Committee. This Standard was approved as an American National Standard by the American National Standards Institute on January 6, 2017.

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ASSE Foreword

This Foreword is not part of the Standard; however, it is offered to provide background information.

Several suggestions received from persons having had a disturbing experience with shower valves which were potentially hazardous allowing sudden surges of high temperature water to flow from the shower head prompted the initiation of the ASSE 1016 standard in 1973. Documents and field experiences relating to the behavioural characteristics of different classes of devices were studied and evaluated, and from this, the standard text was developed. Since that time, extensive research has been conducted toward the development of this standard in its current form.

This harmonized Standard was developed in response to an industry request for a harmonized set of requirements between ASSE 1016-2005 and Clause 5.10 of ASME A112.18.1-2005/CSA B125.1-05. In recognition of energy and water efficiency requirements, which have further reduced the maximum flow rate requirements in certain areas, testing requirements to address the performance of shower valves rated for shower heads and body sprays rated at less than 9.5 L/min (2.5 GPM) flow rates were needed to be addressed.

In 2005 the CSA/ASME Joint Harmonization Task Group formed a task force FT-05-24 to accomplish this end. The TF was joined by members of ASSE and their historical 1016 Working Group. The first meeting was held on August 30, 2007.

The shower control valves covered by this Standard are only those which will, in cases of changes to the incoming water supply pressure or temperature, reduce the risk of scalding and thermal shock by protecting the bather from exposure to such changes in water temperature that produce these effects.

These devices generally have one cold water inlet connection, one hot water inlet connection, and a mixed water outlet connection(s).

This Standard provides engineers, designers, manufacturers, health authorities, inspection agencies and others with a set of minimum performance requirements for such individual automatic compensating valves.

Recognition is made of the time volunteered by members of the Joint Harmonization Task Group and Task Force, the ASME members, ASSE members and CSA members and of the support of the manufacturers who also participated in the meetings for this standard.

The Standard does not imply ASME, ASSE, or CSA's endorsement of a product which conforms with these requirements.

This Standard is considered suitable for use with conformity assessment within its stated scope.

It is recommended that these devices be installed consistent with local codes.

ASSE 1016-2017/ ASME A112.1016-2017/ CSA B125.16-17
Performance requirements for automatic compensating valves for individual showers and tub/shower combinations

Section I

1 Scope

1.1
This Standard applies to automatic compensating valves intended to be installed at the point of use, where the user has access to flow or final temperature controls, and where no further mixing occurs downstream of the device.

Note: *In this Standard, automatic compensating valves are also referred to as devices.*

1.2
This Standard covers automatic compensating valves intended to control the water temperature to wall or ceiling mounted

a) hand-held showers;
b) shower heads;
c) body sprays either in individual shower or tub/shower combination fittings; and
d) tub spouts when part of tub/shower combination fittings.

1.3
In this Standard, "shall" is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; "should" is used to express a recommendation or that which is advised but not required; and "may" is used to express an option or that which is permissible within the limits of the Standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

1.4

SI units are the units of record in Canada. In this Standard the inch/pound units are shown in parentheses.

The values stated in each measurement system are equivalent in application; however, each system is to be used independently. Combining values from the two measurement systems can result in non-conformance with this Standard.

All references to gallons are to U.S. gallons.

Section II

2 Reference publications and definitions

2.1 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

ASME (The American Society of Mechanical Engineers)/CSA Group

ASME A112.18.1-2012/CSA B125.1-12
Plumbing supply fittings

ASSE International

Plumbing Dictionary Sixth Edition — 2007

2.2 Definitions

In addition to the definitions in ASME A112.18.1/CSA B125.1 and in the ASSE *Plumbing Dictionary*, the following definitions shall apply in this Standard:

Automatic compensating valve — a water-mixing valve that is supplied with hot and cold water and that provides a means of automatically maintaining the water temperature selected for an outlet.
Note: *Automatic compensating valves are used to reduce the risk of scalding and thermal shock.*

Combination pressure-balancing and thermostatic compensating valve (Type T/P) — a compensating valve that senses inlet supply hot and cold water pressures before mixing, senses the water temperature at the outlet, and compensates for pressure and thermal variations to maintain the water temperature at the outlet.

Pressure-balancing compensating valve (Type P) — a compensating valve that senses inlet supply hot and cold water pressures and compensates for variations in the inlet supply pressures to maintain the water temperature at the outlet.

Thermostatic compensating valve (Type T) — a compensating valve that senses the water temperature at the outlet and compensates for thermal variations to maintain the water temperature at the outlet.

Initial outlet set temperature — the average of the values of the mixed temperature measured at the outlet for the 10 s immediately preceding the temperature change measured at the outlet resulting from a pressure or temperature change.

Point-of-use — the final outlet of the water supply system just prior to discharge to atmosphere.

Temperature limit setting — an adjustable means to limit the maximum setting of the device towards the hot position limiting the maximum discharge temperature.

Thermal shock — a rapid change in the outlet water temperature that is felt by the user and is sufficient to produce a potentially hazardous reaction.

User — an individual who can adjust the outlet water temperature at the point of use while he or she is in contact with the outlet water.

Section III

3 Design and general requirements

3.1 Types of devices

3.1.1

The types of devices covered by this Standard and the type-specific requirements that they shall meet are

a) Type P, Clause 4.6.7;
b) Type T, Clause 4.6.8; and
c) Type T/P, Clause 4.6.9.

3.1.2

Devices covered by this Standard shall comply with all the applicable requirements of this Standard and also comply with the applicable requirements of ASME A112.18.1/CSA B125.1.

3.2 Accessible designs

Devices intended for use in accessible designs shall comply with the requirements in Clause 4.6 of ASME A112.18.1/CSA B125.1.

3.3 Minimum rated flow

Devices shall comply with the requirements in this Standard when tested at the manufacturer's minimum rated flow or 9.5 L/min (2.5 gpm), whichever is lower.

3.4 Pressure

Devices shall be designed for a rated pressure between 140 and 860 kPa (20 and 125 psi).

3.5 Temperature

3.5.1

Devices shall be designed to be the final temperature control.

3.5.2
Devices shall be adjustable from the cold position up to at least 38 °C (100 °F) with hot water inlet temperatures ranging from 49 to 82 °C (120 to 180 °F) and cold water inlet temperatures ranging from 4 to 27 °C (40 to 80 °F).

3.5.3
Devices shall
a) be equipped with an adjustable means to limit the setting towards the hot position;
b) be capable of limiting the maximum outlet temperature to 49 °C (120 °F) or the manufacturer's stated maximum outlet temperature, whichever is less; and
c) maintain an outlet temperature within ±2.0 °C (±3.6 °F) from the set temperature in accordance with Clause 4.6.

3.6 Servicing
The internal parts of concealed devices shall be accessible from the finished wall line for inspection, repairs, or replacement.

Section IV

4 Performance requirements and test methods

4.1 General
Tests shall be conducted on the same specimen, in the order listed in this Standard.

4.2 Conditioning

4.2.1 Preconditioning
Before testing, specimens shall be conditioned at ambient laboratory conditions for not less than 12 h.

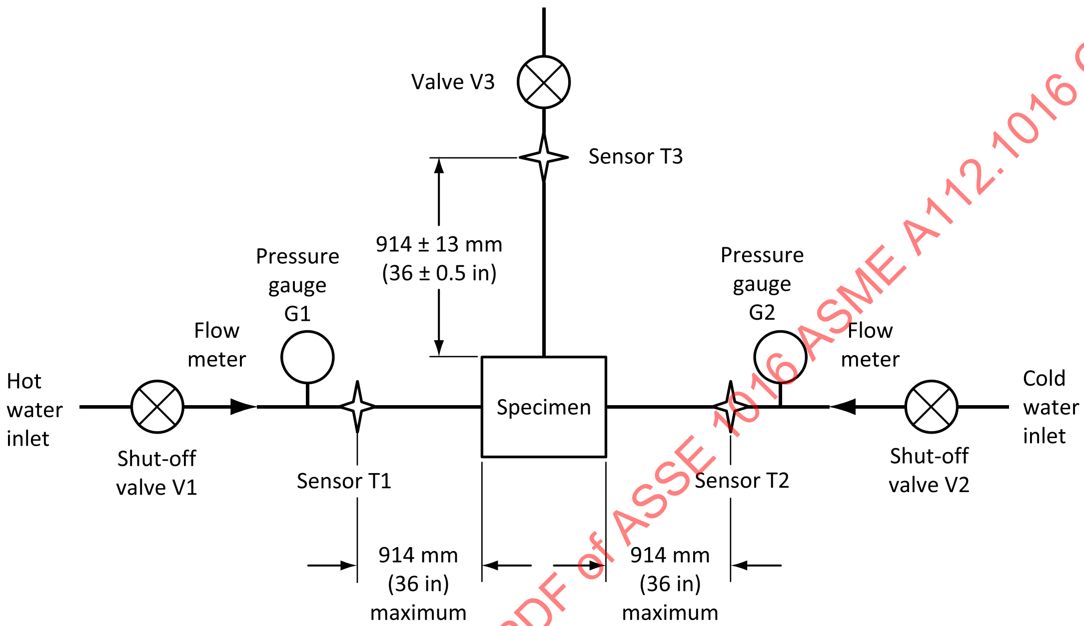
4.2.2 High-temperature conditioning

4.2.2.1 Purpose
The purpose of the high-temperature conditioning is to determine if the device can withstand the maximum temperatures specified in Clause 3.5.

4.2.2.2 Procedure
Specimens shall be conditioned as follows:
a) Set up the specimen in accordance with Figure 1, with shut off valves V1 and V2 and valve V3 in the full open position.
b) Establish and maintain an equal flowing pressure of 310 ± 14 kPa (45 ± 2 psi) on both the hot and cold water supplies.
c) Set the hot water temperature to 82 +0, –6 °C (180 +0, –10 °F).
d) Set the cold water temperature to 10 ± 3 °C (50 ± 5 °F).
e) Adjust the outlet temperature to the maximum allowable outlet temperature, not exceeding 49 °C (120 °F).

f) Adjust valve V3 to reduce the flow rate to 9.5 ± 1.0 L/min (2.5 ± 0.3 gpm) or the manufacturer's minimum rated flow ±10%.
g) Allow the water to flow through the specimen for 5 min.

Figure 1
Set-up for high-temperature conditioning, pressure and temperature variation, and water supply pressure loss tests
(See Clauses 4.2.2.2, 4.4.2.2, 4.6.2, 4.6.3, 4.7.2.1, 4.8.2, and 4.9.2.)



4.3 Working pressure test

4.3.1 Purpose
The purpose of this test is to determine if the device can withstand pressures between 140 and 860 kPa (20 and 125 psi).

4.3.2 Procedure with the valves closed
The device shall be tested in accordance with Clause 4.3.4 with the device's valve in the closed position. The specimen shall be subjected to the pressures specified in Clause 4.3.1, for 5 min each.

4.3.3 Procedure with the outlet(s) blocked
The device shall be tested in accordance with Clause 4 with the device's valve in the fully open position. The outlet(s) shall then be blocked and the specimen shall be subjected to the pressures specified in Clause 4.3.1, for 5 min each.

4.3.4 Test temperatures and pressures

4.3.4.1
The test shall be conducted in an ambient environment of 20 ± 5 °C (68 ± 9 °F). The device shall be brought to equilibrium test temperatures by running water through it.

4.3.4.2

Test temperatures and pressures shall be as follows:

a) 140 ± 14 kPa and 10 ± 6 °C (20 ± 2 psi and 50 ± 10 °F);
b) 860 ± 14 kPa and 10 ± 6 °C (125 ± 2 psi and 50 ± 10 °F);
c) 140 ± 14 kPa and 66 ± 6 °C (20 ± 2 psi and 150 ± 10 °F); and
d) 860 ± 14 kPa and 66 ± 6 °C (125 ± 2 psi and 150 ± 10 °F).

4.3.5 Performance requirements

Leakage or other failures of the seals shall result in the rejection of the device.

4.4 Maximum operating torque or force adjustment test

4.4.1 Purpose

The purpose of this test is to determine the maximum torque or force required to adjust the device.

4.4.2 Procedure

4.4.2.1

The tests specified in Clause 5.5 of ASME A112.18.1/CSA B125.1 shall be conducted.

4.4.2.2

After the tests specified in Clause 4.4.2.1, the following tests shall be conducted:

a) Set up the specimen as specified in Items a) to f) of Clause 4.6.3. See Figure 1.
b) Move the adjusting mechanism of the specimen (e.g., handle(s) or lever(s)) through its full operating range. The force shall be applied at the extreme end of the adjusting mechanism.
c) Record the maximum operating torque or force.

4.4.3 Performance requirements

A maximum operating torque or force to adjust the device exceeding the requirements specified in ASME A112.18.1/CSA B125.1 shall result in the rejection of the device.

4.5 Life cycle tests

4.5.1 Purpose

The purpose of these tests is to determine if there is any deterioration in the performance of the device upon completion of the following cycles of operation:

a) The operating control test shall simulate the intended operating motion of the device.
b) The internal elements test shall simulate inlet pressure and temperature changes.

4.5.2 Procedure — Operating controls

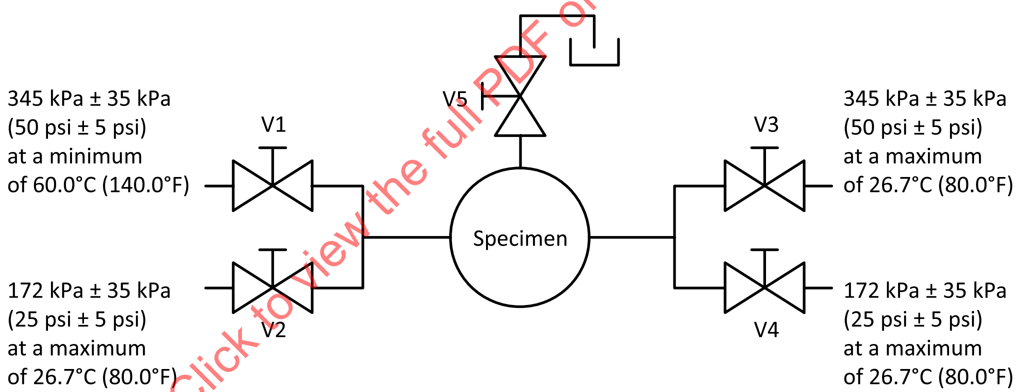
The life cycle test for operating controls shall be conducted as follows:

a) Set up and test the specimen in accordance with the set-up and conditions specified in Figure 2 with valves V1 and V3 and the device's valve fully open. This test shall simulate the intended operating motion of the device without impacting the end stops, except as agreed to by the manufacturer.
b) Prior to starting the test, the following conditions shall be established and maintained for 1 min:
   i) 345 ± 35 kPa (50 ± 5 psi) flowing pressure as measured at the inlets;

ii) 40 ± 3 °C (105 ± 5 °F) measured at the outlet;
iii) A minimum flow of 4.5 L/min (1.2 gpm) by adjusting valve V5; and
iv) the device's maximum outlet temperature adjusted to 49 +0, –6 °C (120 +0, –10 °F) using the device's temperature limit stop adjustment.

c) The temperature and volume control mechanism(s) shall be tested for 20,000 cycles of the control dial, handle, or knob, cycled at a constant rate between 5 and 20 cycles per minute, as specified in Items i) to iv). The packing nut may be tightened once during the life cycle test to stop leakage. The testing shall be conducted as follows:
   i) Single-handle mixing valves of the cycling type: the control shall be operated from full-off to the full-on cold, position through full-on mixed to the full-on hot position, through full-on mixed to the full-on cold position, and back to the off position, to complete one cycle.
   ii) Single-control mixing valves with combined volume and temperature control: the control shall be adjusted to operate the volume control from off to the full-on 40 ± 3 °C (105 ± 5 °F) position, to the full-on cold position, to the full-on hot limit stop position, to the 40 ± 3 °C (105 ± 5 °F) position, to the off position, to complete one cycle.
   iii) Devices with a separate volume control: the volume control shall be turned full-on, the temperature control dial shall be turned through its full operating range and back, the volume control shall be turned off to complete one cycle.
   iv) Single-handle mixing valves that only have temperature control: the testing laboratory shall provide a shut-off valve, and the device shall be tested in accordance with Clause 4.5.2 c) iii).

Figure 2
Set-up for life cycle test for automatic compensating valves
(See Clauses 4.5.2 and 4.5.3.)



4.5.3 Procedure — Internal elements

The life cycle test for internal elements shall be conducted as follows:

a) Set up and test the specimen in accordance with the set-up and conditions specified in Figure 2 with valves V1, V3, and the device's valve fully open.

b) Before starting the test, establish and maintain for 1 min the following conditions:
   i) 345 ± 35 kPa (50 ± 5 psi) flowing pressure as measured at the inlets;
   ii) 40 ± 3 °C (105 ± 5 °F) measured at the outlet; and
   iii) A minimum flow of 4.5 L/min (1.2 gpm) by adjusting valve V5.

c) Change the conditions to those described in Step 1 of Table 1 and maintain for 4 s, then change the conditions to Step 2 in Table 1 and maintain for 4 s. Return to the beginning conditions in Step 1 to complete one cycle.

d) Test the internal elements for 80,000 cycles in accordance with Table 1.

Table 1
Life cycle test for the control mechanism
(See Clause 4.5.3.)

	Valve 1	Valve 2	Valve 3	Valve 4	Duration
Step 1	Open	Closed	Closed	Open	4 s
Step 2	Closed	Open	Open	Closed	4 s

4.5.4 Working pressure

The device shall be retested in accordance with Clause 4.3.

4.5.5 Maximum torque or operating force

The device shall be retested in accordance with Clause 4.4.

4.5.6 Failure criteria

During the test, leakage or the need to tighten the packing nut more than once shall result in a rejection of the device.

During the test specified in Clause 4.5.4, any leakage shall result in the rejection of the device.

During the test specified in Clause 4.5.5, an operating torque or force that exceeds 120% of the requirements of Clause 4.4 shall result in the rejection of the device. Accessible designs shall not exceed the requirements specified in Clause 4.4.

4.6 Pressure and temperature variation test

4.6.1 Purpose

The purpose of this test is to determine if the outlet water temperature at the point-of-use is maintained within a set temperature range.

4.6.2 Data gathering, all types of devices (see Figure 1)

Data shall be gathered as follows:

a) The temperature-recording device shall be started 10 s before the step changes.

b) Temperature measurements shall be taken at temperature sensors T1, T2, and T3 with measuring equipment capable of detecting a 63.2% step change within 0.3 s with a frequency rate of 20 Hz (one value every 0.05 s) for 25 ± 5 s unless otherwise specified in this Standard. See Annex A.

c) The outlet temperature measurements at sensor T3 shall be averaged every 0.25 s.

d) Temperature sensors T1, T2, and T3 shall be located as follows:

   i) temperature sensors T1, T2, and T3, within the flow stream in Type K or Type L copper water tube;

   ii) temperature sensors T1 and T2, within 914 mm (36 in) of the device; and

   iii) temperature sensor T3, within 914 ± 13 mm (36 ± 0.5 in) from the outlet of the device. The outlet tube shall be the same size as the outlet connection size of the device.

Notes:

1) *For verifying the time constant of the temperature-measuring equipment, see Annex A.*

2) *Data can be gathered in formats similar to those depicted in Figures B.1 to B.5.*

4.6.3 Procedure — All types of devices (see Figure 1)

Controllers with pressure feedback loops shall not be active during the tests, but may be used to set the test parameters.

Note: *Controllers with pressure feedback loops interact with the specimen and result in inaccurate test results.*

The pressure and temperature variation test shall be conducted as follows:

a) Set up the specimen as shown in Figure 1, with valves V1, V2, and V3 and the device's valve in the fully open position.
b) Adjust and maintain the hot and cold water flowing pressures directly upstream of the inlet connections to a flowing pressure of 310 ± 14 kPa (45 ± 2 psi), as measured by gauges G1 and G2.
c) Adjust the temperatures at temperature sensors T1 and T2 so that there is a temperature differential of 44 to 56 °C (80 to 100 °F) between the hot water temperature [minimum of 60 °C (140 °F)] and the cold water temperature [maximum of 21 °C (70 °F)]. After the hot water and cold water inlet temperatures are established, maintain the inlet temperatures at ±1 °C (±2 °F).
d) Adjust the device so that the outlet temperature at temperature sensor T3 (point of use outlet) is 40.5 ± 0.5 °C (105.0 ± 1.0 °F).
e) Adjust valve V3 so that the device delivers 9.5 ± 1.0 L/min (2.5 ± 0.3 gpm) and maintain the conditions established in Items b) to d) or, if the manufacturer's minimum rated flow is less than 9.5 ± 1.0 L/min (2.5 ± 0.3 gpm), adjust valve V3 to the manufacturer's minimum rated flow +1.0, –0.0 L/min (+0.3, –0.0 gpm) and maintain the conditions established in Items b) to d).

   Note: *Adjustments in Items b) to e) are an iterative process.*
f) Flow water through the device for 1 min.
g) Record the initial outlet set temperature.

4.6.4 Procedure — Type P devices

The pressure changes specified in this Section shall be accomplished in less than 1 s. In addition to the procedures specified in Clauses 4.6.2 and 4.6.3, the following test procedure shall be conducted:

a) Decrease the hot water flowing pressure by 50% to 155 ± 14 kPa (22.5 ± 2 psi). Observe and record the temperature changes at the outlet temperature sensor T3 for 25 ± 5 s.
b) Restore the conditions as described in Clause 4.6.3. Increase the hot water flowing pressure by 50% to 465 ± 14 kPa (67.5 ± 2 psi). Observe and record the temperature changes at the outlet temperature sensor T3 for 25 ± 5 s.
c) Restore the conditions as described in Clause 4.6.3. Decrease the cold water flowing pressure by 50% to 155 ± 14 kPa (22.5 ± 2 psi). Observe and record the temperature changes at the outlet temperature sensor T3 for 25 ± 5 s.
d) Restore the conditions as described in Clause 4.6.3. Increase the cold water flowing pressure by 50% to 465 ± 14 kPa (67.5 ± 2 psi). Observe and record the temperature changes at the outlet temperature sensor T3 for 25 ± 5 s.

4.6.5 Procedure — Type T devices

The pressure changes specified in this Section shall be accomplished in less than 1 s. In addition to the procedures specified in Clauses 4.6.2 and 4.6.3, the following test procedure shall be conducted:

a) Decrease the hot water flowing pressure by 20% to 248 ± 14 kPa (36 ± 2 psi). Observe and record temperature changes at the outlet temperature sensor T3 for 25 ± 5 s.
b) Restore conditions as described in Items a) to g) of Clause 4.6.3. Increase the hot water flowing pressure by 20% to 372 ± 14 kPa (54 ± 2 psi). Observe and record the temperature changes at the outlet temperature sensor T3 for 25 ± 5 s.

c) Restore conditions as described in Items a) to g) of Clause 4.6.3. Decrease the cold water flowing pressure by 20% to 248 ± 14 kPa (36 ± 2 psi). Observe and record the temperature changes at the outlet temperature sensor T3 for 25 ± 5 s.
d) Restore conditions as described in Items a) to g) of Clause 4.6.3. Increase the cold water flowing pressure by 20% to 372 ± 14 kPa (54 ± 2 psi). Observe and record the temperature changes at the outlet temperature sensor T3 for 25 ± 5 s.
e) Restore conditions as described in Items a) to g) of Clause 4.6.3. Increase the hot water supply temperature by 14 ± 0.5 °C (25 ± 1 °F) at a rate of 3 ± 0.5 °C (5 ± 1 °F) per minute. Observe and record the temperature changes at the outlet temperature sensor T3 for 25 ± 5 s.

4.6.6 Procedure — Type T/P devices

Type T/P devices shall be tested in accordance with Clauses 4.6.4 and 4.6.5.

4.6.7 Performance requirements — Type P devices

When tested in accordance with Clause 4.6.4, an outlet temperature variation exceeding ±2.0 °C (±3.6 °F) from the initial outlet set temperature at the outlet temperature sensor T3 shall result in a rejection of the device.

4.6.8 Performance requirements — Type T devices

When tested in accordance with Clause 4.6.5, the temperature change from the initial outlet set temperature shall not

a) within the initial 5 s following a temperature change at sensor T3,
   i) exceed +3.0 °C (+5.4 °F) for more than 1.5 s (see Figures B.1 and B.3); and
   ii) exceed –5.0 °C (–9.0 °F) for more than 1 s (see Figures B.2 and B.3); and
b) after the initial 5 s following a temperature change at sensor T3, exceed ±2.0 °C (±3.6 °F) (see Figure B.3).

4.6.9 Performance requirements — Type T/P devices

When tested in accordance with Clause 4.6.6, an outlet temperature variation exceeding ±2.0 °C (±3.6 °F) from the initial outlet set temperature at the outlet temperature sensor T3 shall result in a rejection of the device.

4.7 Water supply failure test — All types

4.7.1 Purpose

The purpose of the water supply failure test is to determine if the device automatically reduces the discharge flow to reduce the risk of scalding and thermal shock of the user when the water supply is suddenly interrupted.

4.7.2 Procedure

4.7.2.1

The specimen shall be set up as shown in Figure 1 and in accordance with the conditions specified in Items a) to f) of Clause 4.6.3.

4.7.2.2

After the device flows for 1 min at the parameters specified in Clause 4.7.2.1, the following tests shall be conducted:

a) Close the cold water supply valve within 1 s (cold water supply failure test). Continuously record the outlet temperature at sensor T3 and flow rate for 5 s after the cold water supply valve has been fully closed.
b) Re-establish the initial test parameters specified in Clause 4.7.2.1.
c) Repeat the test by closing the hot water supply valve within 1 s (hot water supply failure test). Continuously record the outlet temperature at sensor T3 and flow rate for 5 s after the hot water supply valve has been fully closed.

4.7.3 Performance requirements

When tested in accordance with Clause 4.7.2, failure of the device to reduce the flow to 1.9 L/min (0.5 gpm) or 30% of the manufacturer's minimum rated flow, whichever is less, within 5 s, shall result in a rejection of the device.

During the procedure specified in Clause 4.7.2.2 a) (i.e., the cold water supply failure test), failure of the device to reduce the flow to 1.9 L/min (0.5 gpm) or 30% of the manufacturer's minimum rated flow, whichever is less, prior to the water temperature at sensor T3 exceeding 49 °C (120 °F) shall result in a rejection of the device.

4.8 Mechanical temperature limit stop test

4.8.1 Purpose

The purpose of the mechanical temperature limit stop test is to ensure that the temperature control that stops against a limit stop can maintain its set position.

4.8.2 Procedure

The mechanical temperature limit stop test shall be conducted as follows:

a) Set up the specimen in accordance with Figure 1.
b) Pressurize the hot and cold water inlets to 310 ± 14 kPa (45 ± 2 psi).
c) Flow water through the device at a rate of 9.5 ± 1.0 L/min (2.5 ± 0.3 gpm) or the manufacturer's minimum rated flow ±10%, whichever is less.
d) Set the cold inlet temperature at 10 ± 3 °C (50 ± 5 °F).
e) Set the hot inlet temperature at 82 +0, –6 °C (180 +0, –10 °F).
f) Set the limit stop to an outlet temperature of 46 +0, –3 °C (115 +0, –5 °F), or the manufacturer's specified maximum temperature, whichever is less.
g) Set the device at the full hot position, flow for 1 min, and measure and record the outlet temperature at sensor T3.
h) Apply a torque of 5.1 N•m (45.0 lbf•in) to the temperature control (handle or valve stem) for 20 ± 5 s.
i) While applying the torque specified in Item h) and for 1 min after, measure and record the outlet temperature at sensor T3.

4.8.3 Performance requirements

When tested in accordance with Clause 4.8.2, the device shall be rejected if

a) the outlet temperature measured in Clause 4.8.2 i) exceeds the outlet temperature recorded in Clause 4.8.2 g) by 2.0 °C (3.6 °F); or

b) there are any observable fractures in the limit stop.

4.9 Outlet temperature and flow capacity test

4.9.1 Purpose

The purpose of the outlet temperature and flow capacity test is to determine compliance with the design requirements of Clauses 3.3 and 3.5.

4.9.2 Procedure for all devices (see Figure 1)

The outlet temperature and flow capacity test shall be conducted as follows:

a) Set up the specimen as shown in Figure 1, with valves V1, V2, and V3 in the fully open position.

b) Set the hot and cold water flowing pressures directly upstream of the inlet connections to 310 ± 14 kPa (45 ± 2 psi), as measured by gauges G1 and G2.

c) After the hot water and cold water inlet temperatures are established in Item e) i) to iv) of this Clause, maintain these inlet temperatures within ±1.0 °C (±2.0 °F) without exceeding the limits specified in Item e) i) to iv) of this Clause.

d) Adjust valve V3 so that the device delivers 9.5 ± 1.0 L/min (2.5 ± 0.3 gpm) and maintain the conditions established in Items b) to d) of this Clause, or if the manufacturer's minimum rated flow is less than 9.5 ± 1.0 L/min (2.5 ± 0.3 gpm), adjust valve V3 to the manufacturer's minimum rated flow +1.0, –0.0 L/min (+0.3, –0.0 gpm) and maintain the conditions established in Items b) to d) of this Clause.

   Note: *Adjustments in Items b) to d) are an iterative process.*

e) The temperature limit stop and the valve V3 may be readjusted to conduct the following tests:

   i) Set the cold inlet temperature to 10 ± 3 °C (50 ± 5 °F) and the hot inlet temperature to 49 +0, –3 °C (120 +0, –5 °F). Set the device to the full cold position and then adjust the device to an outlet temperature of 38 +3, –0 °C (100 +5, –0 °F). Flow for 1 min and record the outlet temperature and flow.

   ii) Set the cold inlet temperature to 10 ± 3 °C (50 ± 5 °F) and the hot inlet temperature to 82 +0, –6 °C (180 +0, –10 °F). Set the device to the full cold position and then adjust the device to an outlet temperature of 38 +3, –0 °C (100 +5, –0 °F). Flow for 1 min and record the outlet temperature and flow. Set the temperature limit stop to a maximum outlet temperature of 49 °C (120 °F). Set the device at the full hot position, flow for 1 min, and record the outlet temperature.

   iii) Set the cold inlet temperature to 27 +0, –6 °C (80 +0, –10 °F) and the hot inlet temperature to 82 +0, –6 °C (180 +0, –10 °F). Set the device to the full cold position and then adjust the device to an outlet temperature of 38 +3, –0 °C (100 +5, –0 °F). Flow for 1 min and record the outlet temperature and flow. Set the temperature limit stop to a maximum outlet temperature of 49 °C (120 °F). Set the device at the full hot position, flow for 1 min, and record the outlet temperature.

   iv) Set the cold inlet temperature to 27 +0, –6 °C (80 +0, –10 °F) and the hot inlet temperature to 49 +0, –3 °C (120 +0, –5 °F). Maintain a minimum outlet temperature of 38 +3, –0 °C (100 +5, –0 °F). Flow for 1 min and record the outlet temperature and flow.

4.9.3 Performance requirements

When tested in accordance with Clause 4.9.2, the device shall be rejected if it

a) fails to flow a minimum of 8.5 L/min (2.3 gpm) or the manufacturer's minimum rated flow;

b) cannot be adjusted to a minimum of 38 °C (100 °F) outlet water temperature; or

c) cannot limit the outlet temperature to a maximum of 49 °C (120 °F).

4.10 Hydrostatic pressure test

4.10.1 Purpose

The purpose of this test is to determine if any leakage occurs at a hydrostatic pressure of 3,450 kPa (500 psi).

4.10.2 Procedure

With the outlet(s) blocked and seating member(s) fully open, the device's body shall be pressurized to 3,450 ± 35 kPa (500 ± 5 psi) for 1 min with water at ambient temperature.

4.10.3 Performance requirements

When tested in accordance with Clause 4.10.2, any leakage shall result in a rejection of the device.

Section V

5 Markings, packaging, and installation instructions and included literature

5.1 Markings

5.1.1 General

Devices covered by and complying with this Standard shall be marked with

a) the name of the manufacturer, trademark, or other mark known to identify the manufacturer or, in the case of private labelling, the name, trademark, or other mark of the customer for whom the device was manufactured;
b) the model; and
c) the type of the device (e.g., Type P, Type T, or Type T/P).

5.1.2 Visibility of markings

Markings shall be clear, permanent, and visible after installation (e.g., during field servicing).

5.1.3 Temperature control setting identification

Devices shall have identifiable control settings

a) in which the settings are indicated by words (e.g., "cold", "warm", or "hot"), numbers, or graphically (e.g., colour coding); and
b) that indicate the direction or means of adjustment to change the temperature.

5.2 Installation and maintenance instructions

5.2.1 Instructions

Manufacturer's instructions for installation, adjustment, and maintenance of the device shall be packaged with each device.

If the device is not equipped with an integral shut-off, the instructions shall provide a warning to install check valves on the inlets.