

BS 7942:2011



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Thermostatic mixing valves for use in care establishments – Requirements and test methods

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Contents

Foreword *iii*

0	Introduction	1
1	Scope	1
2	Normative references	2
3	Terms and definitions	2
4	TMV materials	4
5	Classifications	4
6	Backflow prevention devices	4
7	Removable devices (RDs)	4
8	Specimens and test sequences	5
9	Leaktightness	6
10	Durability	11
11	Performance	11
12	Designation	19
13	Marking	20
14	Installation and operating instructions	21

Annexes

Annex A (normative)	Apparatus and measurements for durability test on thermostat	22
Annex B (normative)	Test for the durability of on/off flow control	26
Annex C (normative)	Test for the durability of manual diverters	27
Annex D (normative)	Test for the durability of diverters having an automatic return	28
Annex E (normative)	Test for the durability of thermostat	29
Annex F (normative)	Apparatus for performance tests	30
Annex G (normative)	Determination of thermometer response time	33
Annex H (normative)	Test for flow rate and sensitivity of temperature control	35
Annex I (normative)	Tests for TMVs having electronic temperature adjustment	35
Annex J (normative)	Test for mixed-water temperature overshoot on operation of diverter (manual or automatic return)	38
Annex K (normative)	Test for mixed-water temperature overshoot on operation of second outlet	39
Annex L (normative)	Test for mixed-water temperature overshoot starting from ambient temperature	40
Annex M (normative)	Test for mixed-water temperature overshoot on adjustment of mixed-water temperature	41
Annex N (informative)	Assessment of transient values	42
Annex O (normative)	Test for thermal shut-off	43
Annex P (normative)	Test for temperature stability with changing water supply pressure	44
Annex Q (normative)	Test for temperature stability with changing water supply temperature	45
Annex R (normative)	Test for temperature stability at reduced flow rate	46
Annex S (normative)	Additional testing after failure to meet performance and durability requirements	47
Annex T (informative)	Summary of thermal performance requirements	48
Annex U (informative)	Recommendations on commissioning and in-service tests	49
Annex V (informative)	Frequency of in-service tests	51
Bibliography		52

List of figures

- Figure 1 – Specimen test sequences 5
Figure 2 – Hydraulic resistance for low pressure diverters with automatic return 10
Figure A.1 – Test rig for durability test on thermostat 22
Figure A.2 – Pressure take-off tee 24
Figure F.1 – Test rig for performance tests 31
Figure N.1 – Example of transient temperature variation 42

List of tables

- Table 1 – TMV general use conditions 1
Table 2 – Mixed-water temperature 2
Table 3 – Test pressures for manual diverters 9
Table 4 – Test pressures and hydraulic resistances for diverters with automatic return 10
Table 5 – Flow rates 13
Table 6 – Mixed-water temperature settings for determination of flow rate and sensitivity 14
Table 7 – Initial settings for thermal performance tests 15
Table 8 – Permitted duration of transient mixed-water temperature rise 16
Table 9 – Leakage flow of cold water 18
Table 10 – Changes in water supply pressure and permitted temperature change 18
Table 11 – Changes in water supply temperature and permitted temperature change 19
Table 12 – Reduced flow rates and permitted temperature change 19
Table 13 – Designation codes 20
Table A.1 – Dimensions of pressure take-off tees 24
Table B.1 – Pressure of water supply for durability tests 26
Table E.1 – Settings for thermostat durability test 29
Table S.1 – Maximum margins of failure 47
Table T.1 – Summary of thermal performance requirements for each sample 48
Table U.1 – Recommended maximum continuous temperature during site tests 50

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 52, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 January 2011. It was prepared by Technical Committee B/504, *Water supply*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 7942:2000, which is withdrawn.

Information about this document

This British Standard has been developed to complement the existing TMV standards, BS EN 1111 and BS EN 1287, where a particular risk of scalding exists to the user.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its methods are expressed as a set of instructions, a description, or in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

0 Introduction

Users of hot water for ablutionary purposes in care establishments are often susceptible to injury by scalding. It has been recognized that the risk of this occurring can be attenuated by the use of thermostatic mixing valves (TMVs). This British Standard has been developed so that the likelihood of TMVs emitting scalding hot water and harming users in care establishments can be significantly reduced. BS 7942 therefore focuses specifically on the requirements for TMVs used in care establishments and not on requirements for TMVs used in normal domestic situations with a less vulnerable user profile. TMVs used in normal domestic situations are covered by other standards such as BS EN 1111 and BS EN 1287.

The test methods given in BS 7942 are based on the worst-case supply conditions likely to occur in a care establishment.

1 Scope

This British Standard specifies performance and material requirements and gives test methods for three types of TMV, of nominal size up to and including DN25, for use in care establishments. The TMVs covered by this standard are those which are suitable for the hot and cold water supply pressures and temperatures given in Table 1, and those which are suitable for the applications given in Table 2.

Annex A to Annex E give the apparatus and test methods for the durability of TMVs, Annex F to Annex M and Annex O to Annex S give the apparatus and test methods for the performance of TMVs. Annex N gives an assessment of transient values, Annex T gives a summary of thermal performance requirements and Annex U and Annex V give recommendations for commissioning and in-service tests.

Table 1 TMV general use conditions

Pressure/temperature range	High pressure (HP)	Low pressure (LP)
<i>Operating pressure</i>		
Maximum static water pressure (MPa)	1.0	1.0
Flow pressure, hot and cold (MPa)	0.1 to 0.5	0.02 to 0.1
<i>Operating temperature</i>		
Hot supply temperature (°C)	55 to 65	55 to 65
Cold supply temperature (°C)	5 to 20	5 to 20

Table 2 Mixed-water temperature

Application	Designation ^{A)}	Mixed-water temperature (at point of discharge) °C max.
Bidet	HP-B, BE; LP-B, BE	38
Shower	HP-S, SE; LP-S, SE	41
Washbasin	HP-W, WE; LP-W, WE	41
Bath (44 °C fill)	HP-T44; LP-T44	44
Bath (46 °C fill)	HP-T46; LP-T46	46
Bath and shower mixer (44 °C bath fill)	HP-D44 ;LP-D44	41 (shower); 44 (bath)
Bath and shower mixer (46 °C bath fill)	HP-D46; LP-D46	41 (shower); 46 (bath)

NOTE For washbasins, washing is assumed to take place under running water.

^{A)} A TMV with a diverter designation (D) has the capability to change and control the mixed-water outlet temperature in line with the temperatures defined above when the supply path is changed from bath to shower or shower to bath.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 6920-1, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 1: Specification*

BS 6920-2 (all sections), *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 2: Methods of test*

BS 6920-3, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 3: High temperature tests*

BS 6920-4, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 4: Method for the GCMS identification of water leachable organic substances*

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

3.1 backflow prevention devices

3.1.1 associated backflow prevention device

valve or mechanism that prevents water from flowing in the opposite direction to that which it is intended and that is not built into a TMV but is designed for use with it

3.1.2 integral backflow prevention device

valve or mechanism built into a TMV that prevents water from flowing in the opposite direction to that which it is intended

3.2 care establishment

hospital, nursing home, or residential care home in which staff take care of patients, elderly persons and/or persons with special needs

NOTE Users of TMVs in care establishments (e.g. patients, residents), by virtue of their physical and/or mental condition, are deemed to be at greater risk of injury while using hot water for domestic purposes than persons without such conditions using hot water in their own dwellings.

3.3 check valve

valve that prevents water from flowing in the opposite direction to that which it is intended

NOTE This is a type of backflow prevention device (see 3.1).

3.4 cross flow

situation which occurs when hot water flows down a cold water supply pipe or when cold water flows down a hot water supply pipe

3.5 integral atmospheric discharge

outlet designed as an integral part of the valve that directs water to the intended receptacle without the addition of outlet accessories

NOTE An example of an integral atmospheric discharge is a spout.

3.6 isolating valve

valve that closes off the flow of water

3.7 mixed-water temperature overshoot

temporary increase in delivered water temperature following an adjustment to the temperature control or the beginning of water flow through a valve

3.8 pre-set value

mixed-water temperature set to a fixed value, with no user-adjustable control

NOTE The fixed value is set on commissioning of the installation.

3.9 pressure take-off tee

mechanical joint having three openings that measures pressure in the water without adversely affecting the flow

3.10 quick-acting shut-off valve

valve used to rapidly stop water from flowing through it

3.11 removable device (RD)

device that increases the pressure of water flowing into a TMV by its presence and that can be removed when necessary

NOTE Including or removing an RD can help a TMV to operate effectively.

3.12 single sequential flow control

water flow control where the motion of the controller simultaneously adjusts water flow rate and temperature

3.13 solenoid valve

electromechanical valve that allows and prevents the flow of water

3.14 thermostatic mixing valve (TMV)

valve having one or more outlets that mixes hot and cold water and automatically controls the temperature of the mixed water to a user-selected or pre-set value

NOTE Where provision for controlling the flow rate between no flow and maximum flow is included in the TMV, this can be by means of a different motion of the temperature control or by a separate control.

3.15 user-adjustable control

control on a TMV that allows the mixed-water temperature setting to be adjusted between a predetermined maximum and a lower value by the user

NOTE The predetermined maximum is set on commissioning of the installation.

4 TMV materials

Non-metallic materials used in TMVs shall conform to BS 6920 (all parts).

5 Classifications

5.1 TMVs shall be classified as:

- a) Type A: having both flow control and a user-adjustable control;
- b) Type B: having both flow control and a pre-set value; or
- c) Type C: not having flow control but having a pre-set value.

5.2 TMVs having electronic temperature adjustment be classified as:

- a) Category 1: having a mixed-water temperature control which produces a progressive temperature increase/decrease over the duration of its activation; or
- b) Category 2: having a mixed-water temperature control which increases/decreases temperature by a predetermined step each time it is activated.

5.3 TMVs classified as having electronic temperature adjustment shall be configured to indicate temperature adjustment to the user.

NOTE The indication of electronic temperature adjustment is normally visual but can also be audible/vibratory.

6 Backflow prevention devices

TMVs shall be provided with either integral backflow prevention devices or associated backflow prevention devices.

NOTE Associated backflow prevention devices should be fitted in the water supply to the TMV.

7 Removable devices (RDs)

Where RDs (e.g. flow rate regulators) are incorporated into the TMV design, the TMV shall be supplied with the devices fitted.

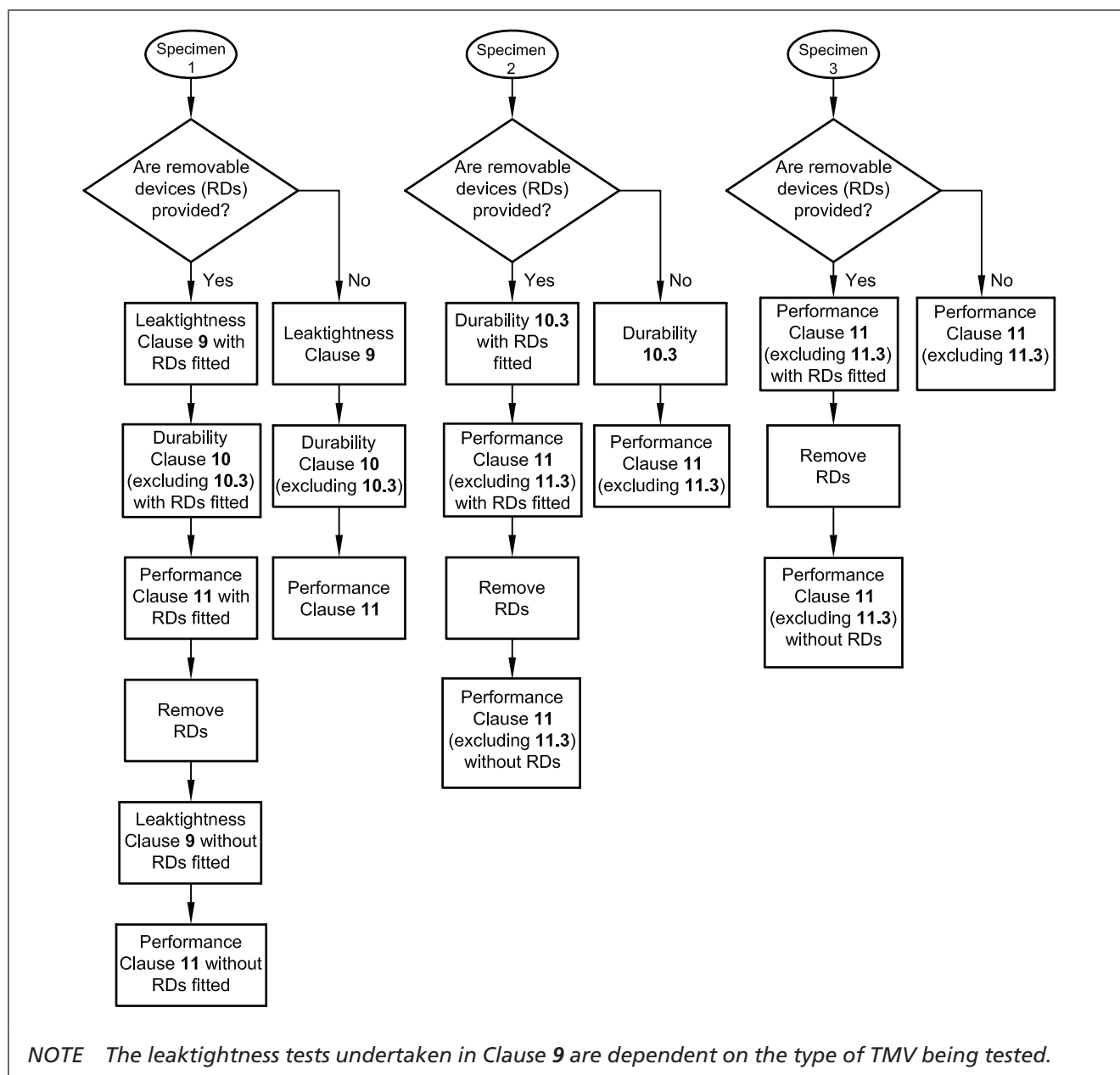
NOTE This allows for the TMV designation (see Clause 12) to be selected on site.

8 Specimens and test sequences

8.1 Description of test sequences

Three specimens of each type of TMV (see 5.1) shall be selected at random and tested. The specimens shall be tested in accordance with the sequences Specimen 1, Specimen 2 and Specimen 3, as shown in Figure 1.

Figure 1 Specimen test sequences



8.2 Fitting of backflow prevention devices to specimens

For the tests specified in Clause 9, Clause 10 and Clause 11, the TMV shall be fitted with the backflow prevention devices (such as check valves) required in use. These shall be integral backflow prevention

devices, or associated backflow prevention devices supplied with the TMV, or as specified by the manufacturer.

Where backflow prevention devices are not fitted to the specimens, they shall be fitted in the connected pipe work as closely as practicable to the TMV.

8.3 Test sequences for specimens

The performance test methods given in Annex H to Annex M and Annex O to Annex R shall be carried out on the specimens in accordance with Clause 11 and the following.

- a) Where two applications are served by two separately operating mechanisms that control the thermostatic temperature adjustment in the valve and that share common supply connections, each operating mechanism shall be tested as though it were a separate TMV.
- b) Specimen 1 only shall be tested for flow rate in accordance with 11.3.
- c) Specimen 2 shall be tested for all designations specified by the manufacturer.
- d) For TMVs with designations D44 and D46, Specimen 1 and Specimen 3 shall be tested for conformity to 11.4 to 11.12 for all applications specified by the manufacturer; in all other cases Specimen 1 and Specimen 3 shall be tested for conformity to 11.4 to 11.12 for the application in each operating pressure range with the highest mixed-water temperature setting of those applications with the lowest flow rate.

9 Leaktightness

NOTE The leaktightness tests undertaken in Clause 9 are dependent on the type of TMV being tested.

9.1 TMVs of Type A or Type B having independent on/off flow control

9.1.1 Leaktightness upstream of the obturator, and at the obturator

9.1.1.1 Requirement

When the specimen is tested in accordance with 9.1.1.2, there shall be no leakage or seepage through the walls of the TMV upstream of the obturator and there shall be no leakage at the obturator. The specimen shall subsequently conform to 9.1.2.

9.1.1.2 Test method

With the outlet(s) open and the on/off (flow) control closed, apply a static water pressure of (1.6 ± 0.05) MPa simultaneously to both inlets of the TMV for (60 ± 5) s while the temperature control is adjusted over its full range. Record any leakage or seepage through the walls upstream of the obturator. Record any leakage past the obturator.

9.1.2 Cross flow between inlets

9.1.2.1 Requirement

When the specimen which has been tested in accordance with 9.1.1.2 is tested in accordance with 9.1.2.2, there shall be no leakage or seepage at the end of the unconnected inlet or at the outlet. The specimen shall subsequently conform to 9.1.3.

9.1.2.2 Test method

With the outlet(s) open, the cold water inlet open and unconnected, and the on/off (flow) control closed, apply a static water pressure of (0.4 ± 0.02) MPa to the hot water inlet for (60 ± 5) s while the temperature control is adjusted over its full range. Repeat the test with the cold water inlet pressurized and the hot water inlet open and unconnected. Record any leakage or seepage at either the outlet or the unconnected inlet.

9.1.3 Leaktightness downstream of the obturator

9.1.3.1 Requirement

When the specimen which has been tested in accordance with 9.1.2.2 is tested in accordance with 9.1.3.2, there shall be no leakage or seepage. The specimen shall subsequently meet the requirements of 9.4 or 9.5, as appropriate.

9.1.3.2 Test method

With the outlet(s) plugged and the on/off flow control open, apply a static water pressure of (0.4 ± 0.02) MPa simultaneously to both inlets of the TMV for (60 ± 5) s while the temperature control is adjusted over its full range. Repeat the procedure with a static water pressure of (0.02 ± 0.005) MPa. Record any leakage or seepage.

9.2 Type A TMVs having single sequential flow control

9.2.1 Leaktightness upstream of the obturator, and of the obturator

9.2.1.1 Requirement

When the specimen is tested in accordance with 9.2.1.2, there shall be no leakage or seepage through the walls of the TMV upstream of the obturator and there shall be no leakage at the obturator. The TMV shall subsequently meet the requirements of 9.2.2.

9.2.1.2 Test method

With the outlet(s) open and the control in the flow-closed position, apply a static water pressure of (1.6 ± 0.05) MPa simultaneously to both inlets of the specimen for (60 ± 5) s. Record any leakage or seepage through the walls upstream of the obturator. Record any leakage or seepage past the obturator.

9.2.2 Cross flow between inlets

9.2.2.1 Requirement

When the specimen which has been tested in 9.2.1 is tested in accordance with 9.2.2.2, there shall be no leakage or seepage at the end of the unconnected inlet not at the outlet. The specimen shall subsequently meet the requirements of 9.2.3.

9.2.2.2 Test method

With the outlet(s) open, the cold water inlet open and unconnected and the control in the flow-closed position, apply a static water pressure of (0.4 ± 0.02) MPa to the hot water inlet for (60 ± 5) s. Repeat the test with the cold water inlet pressurized and the hot water inlet open and unconnected. Record any leakage or seepage at either the outlet or the unconnected inlet.

9.2.3 Leaktightness downstream of the obturator

9.2.3.1 Requirement

When the specimen which has been tested in 9.2.2 is tested in accordance with 9.2.3.2, there shall be no leakage or seepage. The specimen shall subsequently meet the requirements of 9.4.1 or 9.5.1, as appropriate.

9.2.3.2 Test method

With the outlet(s) plugged and the flow control in an open position, apply a static water pressure of (0.4 ± 0.02) MPa simultaneously to both inlets of the TMV for (60 ± 5) s while the control is adjusted over the temperature adjustment range. Repeat the procedure with a static water pressure of (0.02 ± 0.005) MPa. Record any leakage or seepage.

9.3 Type C TMVs

9.3.1 Leaktightness of the TMV

9.3.1.1 Requirement

When the selected specimen is tested in accordance with 9.3.1.2, there shall be no leakage or seepage. The TMV shall subsequently meet the requirements of 9.3.2.

9.3.1.2 Test method

With the outlet(s) plugged, apply a static water pressure of (1.6 ± 0.05) MPa simultaneously to both inlets of the TMV for (60 ± 5) s while the temperature control is adjusted over its full range. Record any leakage or seepage.

9.3.2 Cross flow between inlets

NOTE For this test, backflow prevention devices supplied with the TMV for connection to the inlet should be connected.

9.3.2.1 Requirement

When the specimen which has been tested in accordance with 9.3.1 is tested in accordance with 9.3.2.2 there shall be no leakage or seepage at the end of the unconnected inlet.

9.3.2.2 Test method

With the outlet(s) plugged and the cold water inlet open and unconnected, apply a static water pressure of (0.4 ± 0.02) MPa to the hot water inlet for (60 ± 5) s while the temperature control is adjusted over its full range. Repeat the test with the cold water inlet pressurized and the hot water inlet open and not connected. Record any leakage or seepage at the unconnected inlet.

9.4 TMVs having manual diverters

9.4.1 Requirement

When the specimen, which has been tested in accordance with 9.1 or 9.2, as appropriate, is tested in accordance with 9.4.2, there shall be no leakage at the unselected (open) outlets.

9.4.2 Test method

9.4.2.1 With one outlet plugged, and the plugged outlet selected, apply the static water pressure simultaneously to both inlets, as appropriate, for the designation given in Table 3 for (60 ± 5) s.

Table 3 Test pressures for manual diverters

Designation	Static water pressure
	MPa
LP	0.2 ± 0.01
HP	0.4 ± 0.02

9.4.2.2 Repeat the test with a static water pressure of (0.02 ± 0.005) MPa. Repeat the procedure for each outlet and record any leakage at the unselected (open) outlet(s).

9.5 TMVs having diverters with automatic return

9.5.1 Requirement

When the specimen, which has been tested in accordance with 9.1 or 9.2, as appropriate, is tested in accordance with 9.5.2, the diverter shall not dislodge. The diverter shall be returned to the flow-to-bath position and there shall be no leakage at the shower or bath outlet point.

9.5.2 Test method

9.5.2.1 With the diverter in the flow-to-bath position, apply a flow pressure equal to the initial flow pressure set in accordance with Table 4 and Figure 2, as appropriate, for a duration of (60 ± 5) s. Check for leakage at the shower outlet.

9.5.2.6 Disconnect the hydraulic resistance and reapply the reduced flow pressure. Check for leakage at the shower outlet. Record any leakage at points **9.5.2.1**, **9.5.2.3**, **9.5.2.4** and **9.5.2.6** of procedure. Record dislodgement of the diverter in **9.5.2.4** and the position of the diverter in **9.5.2.5**.

10 Durability

10.1 Durability of on/off flow control on Type A and Type B TMVs

When a previously untested Type A or Type B TMV specimen is tested in accordance with Annex B, there shall be no deformation or compound fracture of any component that prevents the completion of this test. The TMV shall subsequently be tested in accordance with **9.1.1** or **9.2.1** and conform to the leaktightness requirements of **9.1.1.1** or **9.2.1.1**, as appropriate.

10.2 Durability of diverters

10.2.1 Manual diverters

When the specimen is tested in accordance with Annex C, there shall be no deformation, compound fracture, blocking of the mechanism or leakage. Subsequently, the TMV shall be tested in accordance with **9.4.2** and conform to the leaktightness requirements of **9.4.1**.

10.2.2 Diverters having an automatic return

When the specimen is tested in accordance with Annex D, there shall be no deformation, compound fracture or blocking of the mechanism or leakage. Subsequently the TMV shall be tested in accordance with **9.5.2** and conform to the leaktightness requirements of **9.5.1**.

10.3 Durability of thermostat

When the specimen is tested in accordance with Annex E, the mixed-water temperature shall remain within the limits given in Table E.1, and the TMV shall subsequently conform to Clause 11. Where the specimen fails to conform to Table E.1, additional testing shall be carried out, in accordance with Annex S.

When the TMV is designed for use with multiple applications, the durability of the thermostat shall be tested at the application representing the highest operating pressure range, the highest flow rate and the highest mixed-water temperature setting of the applicable designations.

11 Performance

11.1 General

The TMV shall be installed on the test rig in accordance with Annex F, and be commissioned in accordance with the manufacturer's instructions.

NOTE Throughout the tests given in Annex H, Annex I, Annex J, Annex K, Annex L and Annex M and Annex O, Annex P, Annex Q and Annex R, care

should be taken to prevent unintentional adjustment of the water supply flow pressures and water supply temperatures from the setting limits specified.

11.2 Sequence of tests

11.2.1 General

The procedures and tests (see 11.2.2 for test exemptions) given in Annex H, Annex I, Annex J, Annex K, Annex L and Annex M and Annex O, Annex P, Annex Q and Annex R shall be carried out in the following sequence:

- a) flow rate and sensitivity of temperature control (Annex H; see 11.3 for requirement);
- b) conditioning for thermal performance tests (see 11.4);
- c) mixed-water temperature overshoot on operation of diverter (manual or automatic return) (Annex J; see 11.5 for requirement);
- d) mixed-water temperature overshoot on operation of second outlet (Annex K; see 11.6 for requirement);
- e) mixed-water temperature overshoot on starting from ambient (Annex L; see 11.7 for requirement);
- f) mixed-water temperature overshoot on adjustment of mixed-water temperature (Annex M or I.3; see 11.8 for requirements);
- g) thermal shut-off (Annex O; see 11.9 for requirement);
- h) stability of mixed-water temperature with changing supply pressure (Annex P; see 11.10 for requirement);
- i) stability of mixed-water temperature with changing supply temperature (Annex Q; see 11.11 for requirement);
- j) stability of mixed-water temperature at reduced flow rate (Annex R; see 11.12 for requirement).

11.2.2 Test exemptions

The applicability of some of the tests is determined by the configuration of the controls of the TMV and therefore the following exemptions shall apply:

- a) Type B and Type C TMVs are exempt from the requirements of 11.8;
- b) TMVs having single sequential flow control and integral atmospheric discharge are exempt from the requirements of 11.12;
- c) TMVs having a flow rate of less than 4.5 L/min, when tested in accordance with Annex H, are exempt from the requirements of 11.12;
- d) TMVs not having a diverter are exempt from the requirements of 11.5;
- e) TMVs in which two applications are not served by two separately operating mechanisms sharing common supply connections are exempt from the requirements of 11.6;
- f) in the event of a failure, re-testing shall be carried out in accordance with Annex S.