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

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This British Standard supersedes BS 7942:2000, which is withdrawn.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

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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)
Operating pressure		
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
Operating temperature		
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.

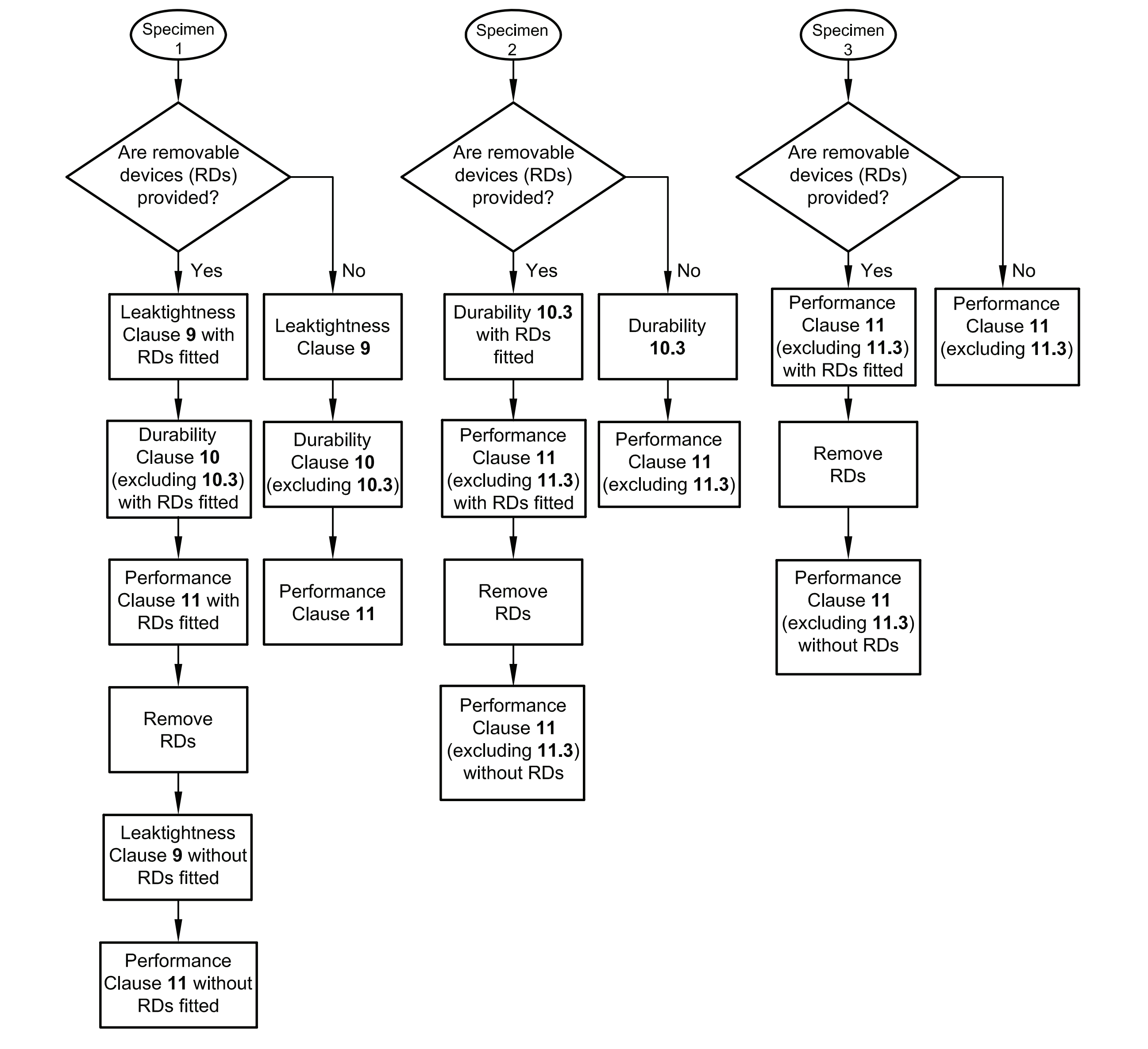
*NOTE This allows for the TMV designation (see Clause **12**) to be selected on site.*

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**



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

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

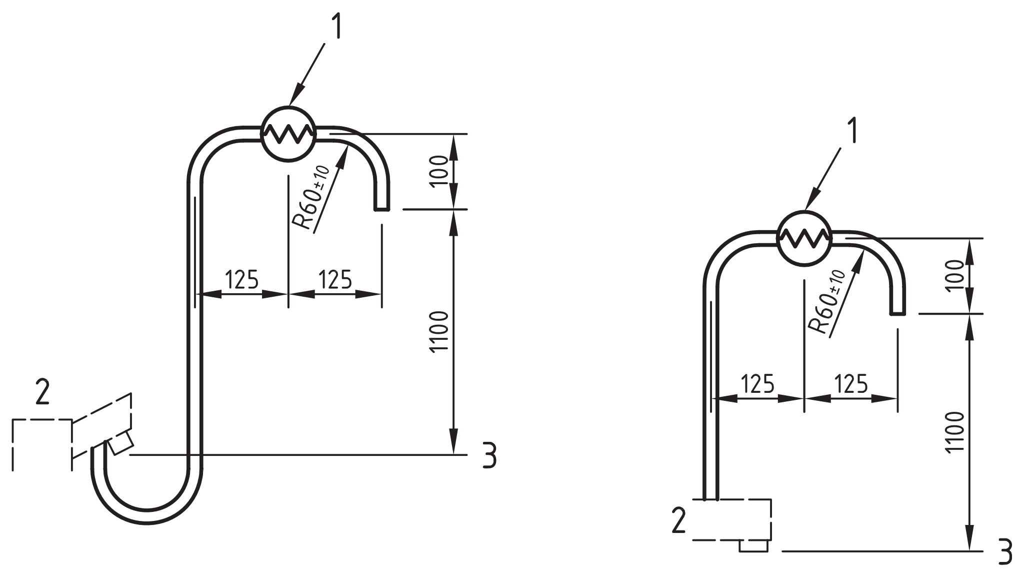
9.5.2.1 With the diverter in the flow-to-bath position, apply a flow pressure equal to the initial flow pressure set in accordance with Table 4 and Figure 2, as appropriate, for a duration of (60 ±5) s. Check for leakage at the shower outlet.

Table 4 **Test pressures and hydraulic resistances for diverters with automatic return**

Designation	Initial flow pressure MPa	Reduced flow pressure MPa	Hydraulic resistance
LP	0.08 ±0.004	0.02 ±0.001	Conforming to Figure 2 and calibrated to a flow rate of 9 L/min at a flow pressure of 0.02 MPa, referenced to the datum shown
HP	0.4 ±0.02	0.05 ±0.005	Calibrated to a flow rate of 15 L/min at a flow pressure of 0.3 MPa

Figure 2 **Hydraulic resistance for low pressure diverters with automatic return**

Dimensions in millimetres
Unspecified tolerance ±10%



a) Bottom connector

b) Top connector

Key

1 Hydraulic resistance

2 Diverter

3 Datum

9.5.2.2 Fit the hydraulic resistance in accordance with Table 4 and Figure 2 to the connection for the shower outlet.

9.5.2.3 Maintaining the flow pressure at the initial value for (60 ±5) s, put the diverter in the flow-to-shower mode. Observe the bath outlet and check for leakage.

9.5.2.4 With the diverter still in the flow-to-shower position, reduce the flow pressure to the reduced flow pressure appropriate for the designation, in accordance with Table 4. Check that the diverter is not dislodged. Maintain this flow pressure for (60 ±5) s and check for leakage at the bath outlet.

9.5.2.5 Turn off the water supply to the diverter. Check that the diverter returns to the flow-to-bath position.

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.

11.3 Test for flow rate and sensitivity of temperature control (Specimen 1)

11.3.1 TMVs having conventional (mechanical) temperature control

11.3.1.1 When three selected specimens, conforming to Clause **8**, are tested in accordance with Annex H, the flow rate recorded in **H.3** shall conform to Table 5 for the applicable designation of TMV. The sensitivity of the temperature control or adjustment shall be at least 5° per K or, in the case of a lever, at least 4 mm per K.

11.3.1.2 The specimens shall subsequently meet the requirements of **11.5** or **11.6**, where appropriate, and the requirements of **11.7**.

Table 5 **Flow rates**

Designation	Hot water supply		Cold water supply		Required mixed-water flow rate
	Pressure loss	Temp.	Pressure loss	Temp.	
	MPa	°C	MPa	°C	L/min
HP-B HP-S HP-W HP-D44, D46 (shower)	0.1 ±0.005	57 ±1	0.1 ±0.005	15 ±1	≥8
Above designations with suffix -E	0.1 ±0.005	57 ±1	0.1 ±0.005	15 ±1	<8
HP-T44, T46 HP-D44, D46 (bath fill)	0.1 ±0.005	57 ±1	0.1 ±0.005	15 ±1	≥15
LP-B LP-S LP-W LP-D44, D46 (shower)	0.02 ±0.001	57 ±1	0.02 ±0.001	15 ±1	≥8
Above designations with suffix -E	0.02 ±0.001	57 ±1	0.02 ±0.001	15 ±1	<8
LP-T44, T46 LP-D44, D46 (bath fill)	0.02 ±0.001	57 ±1	0.02 ±0.001	15 ±1	≥15

11.3.2 TMVs having electronic temperature control

11.3.2.1 For Category 1 TMVs, the temperature/time increase characteristic specified in Table 6 shall be a maximum of 1°C per second throughout the temperature range, when tested in accordance with **I.2**.

11.3.2.2 For Category 2 TMVs, each step change in temperature shall be 1°C maximum, when tested in accordance with **I.2**.

11.3.2.3 The flow rate for TMV designations shall conform to the required mixed-water flow rate given in Table 5 at all times.

11.3.2.4 The maximum distance for activation of the electronic temperature controller shall be 50 mm.

Table 6 **Mixed-water temperature settings for determination of flow rate and sensitivity**

Setting	Mixed-water temperature °C	Comments
1	T_{a-5}^{-3}	—
2	$T_a \pm 1$	—
3	T_{a+5}^{+3}	—
4	lesser of T_{a+9}^{+7} and T_{b+3}^{+1}	Only where actual setting is 3 $< T_b + 1$
5	T_{b+3}^{+1}	Only where actual setting is 4 $< T_b + 1$

NOTE T_a = the lowest maximum mixed-water temperature specified in Table 2 for the applications covered.
T_b = highest maximum mixed-water temperature specified in Table 2 for the applications covered.

11.3.2.5 The TMV shall have an in-built indicator to inform the user whether the temperature is increasing or decreasing when they are adjusting the mixed-water temperature as well as indicating its maximum and minimum temperature positions.

NOTE This indicator may be audible, visual or vibratory.

11.3.2.6 The specimens shall subsequently conform to **11.5** or **11.6**, as appropriate, and **11.7**.

11.4 Conditioning for thermal performance tests

*COMMENTARY ON **11.4***
*The purpose of the settings (see **11.4.1**) is to establish, at the outset of the test sequence, a mixed-water temperature and flow rate representative of, and appropriate for, the application with the supply pressure at a mid-value in the operating range.*

11.4.1 Settings

11.4.1.1 The initial settings for each designation (see Clause **12**) shall be in accordance with Table 7. These settings shall not be altered or further adjusted during any thermal performance test method, except where specified; for example after the initial setting, the flow rate shall not be readjusted except when conforming to **11.12**.

11.4.1.2 For a TMV intended for single point use, and having an integral atmospheric discharge nozzle, the flow rate shall be adjusted by means of the TMV's integral flow control, but where the TMV has a sequential control the flow rate cannot be adjusted independently of the temperature and therefore the flow rate results at the set temperature. In all other cases the flow rate shall be adjusted by means of the tap (6) (see **F.1**) in the discharge pipework. This adjustment shall be made with any integral flow control fully open.

11.4.1.3 For a TMV having a user-adjustable control, the mixed-water temperature setting given in Table 7 shall be the maximum temperature available. Having obtained the required settings, the means provided by the manufacturer for limiting the maximum mixed-water temperature (e.g. locking the mixed-water temperature adjustment, or otherwise rendering the adjustment tamper proof) shall be utilized. No further adjustment of the mixed-water temperature shall be made during the sequence of tests for a particular designation.

NOTE The outlet pressure is not measured in the thermal performance tests and so it is permissible to close the measuring line.

Table 7 **Initial settings for thermal performance tests**

	Hot supply		Cold supply		Mixed water	
Designation	**Flow pressure** MPa	**Temp.** °C	**Flow pressure** MPa	**Temp.** °C	**Flow rate** [A)] L/min	**Temp.** °C
HP-B	0.3 ±0.01	57 ±1	0.3 ±0.01	15 ±1	9.0 ±0.5	38^{0}_{-2}
HP-BE	0.3 ±0.01	57 ±1	0.3 ±0.01	15 ±1	Qs ±0.5 †	38^{0}_{-2}
LP-B	0.06 ±0.002	57 ±1	0.06 ±0.002	15 ±1	9.0 ±0.5	38^{0}_{-2}
LP-BE	0.06 ±0.002	57 ±1	0.06 ±0.002	15 ±1	Qs ±0.5 †	38^{0}_{-2}
HP-S HP-W	0.3 ±0.01	57 ±1	0.3 ±0.01	15 ±1	9.0 ±0.5	41^{0}_{-2}
HP-SE HP-WE	0.3 ±0.01	57 ±1	0.3 ±0.01	15 ±1	Qs ±0.5 †	41^{0}_{-2}
LP-S LP-W	0.06 ±0.002	57 ±1	0.06 ±0.002	15 ±1	9.0 ±0.5	41^{0}_{-2}
LP-SE LP-WE	0.06 ±0.002	57 ±1	0.06 ±0.002	15 ±1	Qs ±0.5 †	41^{0}_{-2}
HP-D44, D46	0.3 ±0.01	57 ±1	0.3 ±0.01	15 ±1	See *NOTE*	
HP-T44	0.3 ±0.01	57 ±1	0.3 ±0.01	15 ±1	20 ±1	44^{0}_{-2}
HP-T46	0.3 ±0.01	57 ±1	0.3 ±0.01	15 ±1	20 ±1	46^{0}_{-2}
LP-D44, D46	0.06 ±0.002	57 ±1	0.06 ±0.002	15 ±1	See *NOTE*	
LP-T44	0.06 ±0.002	57 ±1	0.06 ±0.002	15 ±1	20 ±1	44^{0}_{-2}
LP-T46	0.06 ±0.002	57 ±1	0.06 ±0.002	15 ±1	20 ±1	46^{0}_{-2}

† *Qs = the lowest flow rate recorded in **H.3**.*

[A)] It shall also be acceptable to record and use the maximum available flow rate.

NOTE For designations D44 and D46, the initial settings above are those appropriate for the outlet being tested, e.g. for HP-D44 use HP-T44 for the bath outlet and HP-S for the shower outlet.

11.5 Mixed-water temperature overshoot on operation of diverter (manual or automatic return)

11.5.1 When the specimens previously tested in accordance with Annex H or **I.2** and conditioned in accordance with **11.4** are tested in accordance with Annex J, the average duration of the transient temperature rise at or above each 1K temperature rise given in Table 8 for the appropriate application shall not exceed the values given in Table 8. Individual test results shall not exceed the permitted duration by more than 10%. No steady mixed-water temperature after stabilization shall differ from the actual initial setting of the outlet concerned by more than 2K.

Table 8 **Permitted duration of transient mixed-water temperature rise**

Rise in mixed-water temperature from actual initial setting K			**Duration** s	**Reference** (see *NOTE*) °C		
Bidet/Shower/ Washbasin	**Bath fill up to 44 °C**	**Bath fill up to 46 °C**		**Bidet**	**Shower/ Washbasin**	**Bath fill**
+2	+4	+2	10+	40	43	48
+3	+5	+3	6.30	41	44	49
+4	+6	+4	4.00	42	45	50
+5	+7	+5	2.50	43	46	51
+6	+8	+6	1.90	44	47	52
+7	+9	+7	1.20	45	48	53
+8	+10	+8	0.75	46	49	54
+9	+11	+9	0.50	47	50	55
+10	+12	+10	0.25	48	51	56

NOTE This temperature is the value corresponding to the permitted temperature rise above the maximum set mixed-water temperature.

11.5.2 The specimens shall subsequently conform to **11.7**.

11.6 Mixed-water temperature overshoot on operation of second outlet

11.6.1 When the specimens previously tested in accordance with Annex H or **I.2** and conditioned in accordance with **11.4** are tested in accordance with Annex K, the average duration of any transient temperature rise for the appropriate application shall not exceed the values given in Table 8. Individual test results shall not exceed 10% of the permitted duration.

11.6.2 The steady mixed-water temperature after stabilization shall not differ from the actual initial setting of the outlet concerned by more than 2K.

11.6.3 The specimens shall subsequently conform to **11.7**.

11.7 Mixed-water temperature overshoot starting from ambient temperature

When the specimens that have previously been tested in accordance with Annex H or **I.2** and Annex J or Annex K, as appropriate, and conditioned in accordance with **11.4** are tested in accordance with Annex L, the average duration of the transient temperature rise at or above each 1 K temperature rise given in Table 8 for the appropriate designation shall not exceed the values given in Table 8. Individual test results shall not exceed the permitted duration by more than 10%. No steady mixed-water temperature after stabilization shall differ from the actual initial setting by more than 2 K. The specimens shall subsequently conform to **11.8** or **11.9**, as appropriate.

11.8 Mixed-water temperature overshoot on adjustment of mixed-water temperature

11.8.1 TMVs having conventional (mechanical) temperature control

When the specimens having a user-adjustable control, previously tested in accordance with Annex L and conditioned in accordance with **11.4**, are tested in accordance with Annex M, the average duration of the transient temperature rise at or above each 1 K temperature rise given in Table 8 for the appropriate designation, shall not exceed the duration given in Table 8. Individual test results shall not exceed the permitted duration by more than 10%. No steady mixed-water temperature after stabilization shall differ from the actual initial setting by more than 2 K. The specimens shall subsequently conform to **11.9**.

11.8.2 TMVs having electronic temperature control

11.8.2.1 When the specimens having a user-adjustable control, previously tested in accordance with Annex L and conditioned in accordance with **11.4** are tested in accordance with **I.3**, the average duration of the transient temperature rise at or above each 1 K temperature rise shown in Table 8 for the appropriate designation shall not exceed the durations given in Table 8. Individual test results shall not exceed the permitted duration by more than 10%.

11.8.2.2 For each result the final mixed-water temperature shall not differ from the actual initial setting of the sample concerned by more than 2 K. The specimens shall subsequently conform to **11.9**.

11.9 Thermal shut-off

11.9.1 The specimens previously tested in accordance with Annex L or Annex M, as appropriate, and conditioned in accordance with **11.4** shall be tested in accordance with Annex O. When tested in accordance with Annex O, the average duration of the transient temperature rise at or above each 1 K temperature rise given in Table 8, for the appropriate designation, for cold water isolation and restoration and hot water restoration shall not exceed the values given in Table 8. Individual test results shall not exceed the permitted duration by more than 10%.

11.9.2 No steady state mixed-water temperature after restoration of either the hot or cold water supply shall differ from the actual initial setting by more than 2 K.

11.9.3 During the first 5 s after hot water isolation either:

a) the average volume of cold water discharged shall not exceed the appropriate values given in Table 9; or

b) the average reduction in mixed-water temperature shall not exceed the appropriate value given in Table 9.

11.9.4 Individual test results shall not exceed the permitted volume by more than 10% or the permitted temperature reduction by more than 0.5 K.

Table 9 **Leakage flow of cold water**

Application	During first 5 s after hot water isolation		During period 5 s to 35 s after hot water isolation
	Reduction in mixed-water temperature from actual initial setting	Discharge	Discharge
	K	L	L
Bidet	3	0.25	0.75
Shower/Washbasin	6	0.25	0.75
Bath fill ≤44 °C	9	0.5	1.5
Bath fill ≤46 °C	11	0.5	1.5

11.9.5 During the subsequent 30 s, the average volume of water discharged shall not exceed the value given in Table 9. Individual test results shall not exceed the permitted volume by more than 10%.

11.9.6 The specimens shall subsequently conform to **11.10**.

11.10 Temperature stability with changing water supply pressure

When the specimens previously tested in accordance with Annex O and conditioned in accordance with **11.4** are tested in accordance with Annex P, the average change in mixed-water temperature from the actual initial setting, following each change in supply pressure, shall not exceed the value given in Table 10 or less than 35 °C. Individual test results shall not exceed the permitted temperature change by more than 0.5 K. The specimens shall subsequently conform to **11.11**.

Table 10 **Changes in water supply pressure and permitted temperature change**

Change	Supply pressure MPa		Permitted change in mixed-water temperature from actual initial setting K			
	HP	LP	Bidet	Shower/ Washbasin	Bath fill up to 44 °C	Bath fill up to 46 °C
First	0.2 ±0.01	0.04 ±0.002	+2/–3	+2/–6	+2/–9	+2/–11
Second	0.1 ±0.005	0.02 ±0.001	+2/–3	+2/–6	+2/–9	+2/–11
Third [A)]	0.05 ±0.002	0.01 ±0.0005	±3	+3/–6	+3/–9	+3/–11
Fourth	0.3 ±0.01	0.06 ±0.002	±2	±2	±2	±2
Fifth	0.5 ±0.02	0.1 ±0.005	+2/–3	+2/–6	+2/–9	+2/–11
Sixth	0.3 ±0.01	0.06 ±0.002	±2	±2	±2	±2

A) This represents a condition outside the supply conditions for normal use.

11.11 Temperature stability with changing water supply temperature

When the specimens previously tested in accordance with Annex P and conditioned in accordance with **11.4** are tested in accordance with Annex Q, the change in mixed-water temperature from the initial setting, following each change in supply temperature, shall not exceed the value given in Table 11. The specimen shall subsequently conform to **11.12**.

Table 11 **Changes in water supply temperature and permitted temperature change**

Change	Supply temperature °C		Permitted temperature change K
	Hot water	**Cold water**	
First	Actual initial setting minus (5 ±1) K [A)]	Actual initial setting minus (8 ±1) K	2
Second	Actual initial setting plus (8 ±1) K	Actual initial setting plus (5 ±1) K	2
Third	Actual initial setting ±1 K	Actual initial setting ±1 K	2

A) This represents a condition outside the supply conditions for normal use.

11.12 Temperature stability at reduced flow rate

11.12.1 Specimens having a single sequential control with integral atmospheric discharge or having a flow rate less than 4.5 L/min (see **11.3**) and conditioned in accordance with **11.4** are exempt from **11.12.2**.

11.12.2 When the specimens, previously tested in accordance with Annex Q, are tested in accordance with Annex R, the average change in the mixed-water temperature from the initial setting, following reduction in flow rate, shall not exceed the values given in Table 12. Individual results shall not exceed the permitted temperature change by more than 0.5 K.

Table 12 **Reduced flow rates and permitted temperature change**

Application	Reduced flow rate L/min	Permitted temperature change K
Bidet/Shower/Washbasin	4 ±0.1	2
Bath fill	10 ±0.2	2

11.12.3 The average change in the mixed-water temperature from the initial setting, following restoration of supply pressure, shall not exceed 2 K. No individual result shall exceed 2.5 K.

12 Designation

12.1 TMVs shall be designated according to:

a) the intended operating pressure range (HP/LP); and

b) the intended application, in accordance with Table 13.

12.2 Where, for reasons of water conservation, a flow rate less than 8 L/min is required for the application, TMVs of -B, -S, and -W designations having a flow rate less than 8 L/min when tested in accordance with Annex H shall carry the designation suffix -E, to indicate an economy flow rate.

NOTE Where a TMV can be used for more than one application, the designation can include the final element of each application, e.g. TMV LP-BSW would be suitable for bidet, shower or washbasin applications in the low operating pressure range.

Table 13 **Designation codes**

Code	Operating pressure range	Application
HP-B	High pressure	Bidet
HP-S	High pressure	Shower
HP-W	High pressure	Washbasin
HP-T44	High pressure	Bath (≤44°C fill temp)
HP-T46	High pressure	Bath (≤46°C fill temp)
HP-D44	High pressure	Bath (≤44°C fill temp); Shower (≤41°C)
HP-D46	High pressure	Bath (≤46°C fill temp); Shower (≤41°C)
LP-B	Low pressure	Bidet
LP-S	Low pressure	Shower
LP-W	Low pressure	Washbasin
LP-T44	Low pressure	Bath (≤44°C fill temp)
LP-T46	Low pressure	Bath (≤46°C fill temp)
LP-D44	Low pressure	Bath (≤44°C fill temp); Shower (≤41°C)
LP-D46	Low pressure	Bath (≤46°C fill temp); Shower (≤41°C)

13 Marking

13.1 TMVs conforming to this British Standard shall be permanently and legibly marked on the product with the manufacturer's name or identification mark and unique model reference.[1)]

13.2 Where the marking is applied to a detachable part of the TMV, for example, a cap or index, this detachable part shall be attached to the TMV by means of a fixture that requires a tool other than a standard screwdriver to remove the part.

NOTE Examples of tools that can be used are allen keys or torx keys.

13.3 The durability of the marking shall be such that it cannot be removed or eroded by daily operation and maintenance. The marking shall be positioned so that it is visible and can be readily identified.

1) Marking BS 7942:2011 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

14 Installation and operating instructions

Installers of TMVs shall obtain installation, operating and maintenance instructions from the manufacturer, including, as a minimum:

a) information expanding on the designation of the TMV concerned (see Clause **12**);

b) information on the commissioning and routine in-service tests recommended (see Annex U);

c) information on the frequency of in-service tests and service work (see Annex V);

d) information on the need for additional backflow prevention devices (e.g. check valves), as recommended by the manufacturer;

e) information on the need for the inclusion of isolating valves to enable on-site tests to be carried out;

f) information regarding the selection and installation of TMVs not having user-adjustable controls for applications in which two or more outlets can discharge simultaneously when operated by two or more users at the same time;

NOTE 1 A TMV having a user-adjustable control is suitable for use with two or more outlets which do not discharge simultaneously (e.g. they are supplied through a diverter), provided that the mixed-water temperature adjustment is appropriate to each application.

g) guidance to the installer to check and ensure that a risk assessment has been carried out prior to the installation, for example, in accordance with the Department of Health document, *HTM 04-01: The control of legionella, hygiene, "Safe" hot water, cold water and drinking water systems (Part A and Part B)* [1];

NOTE 2 In particular, a TMV installed for washbasin use is considered a situation in which a risk assessment would highlight the need for a greater level of protection for the users.

h) guidance regarding the importance of avoiding multiple outlets, where the dead leg can aggravate the risk of bacterial growth, as advised in the Department of Health document, *HTM 04-01: The control of legionella, hygiene, "safe" hot water, cold water and drinking water systems (Part A and Part B)* [1];

i) information indicating the necessity to reset on site a TMV that is installed to have multiple designations (see Clause **12**), in order to be adapted to its other designations;

j) details of suitable outlet fittings (e.g. draw-off taps);

k) guidance regarding when and how a TMV incorporating an RD is to be removed (see Clause **7**), in situations where one is installed.

Annex A (normative) Apparatus and measurements for durability test on thermostat

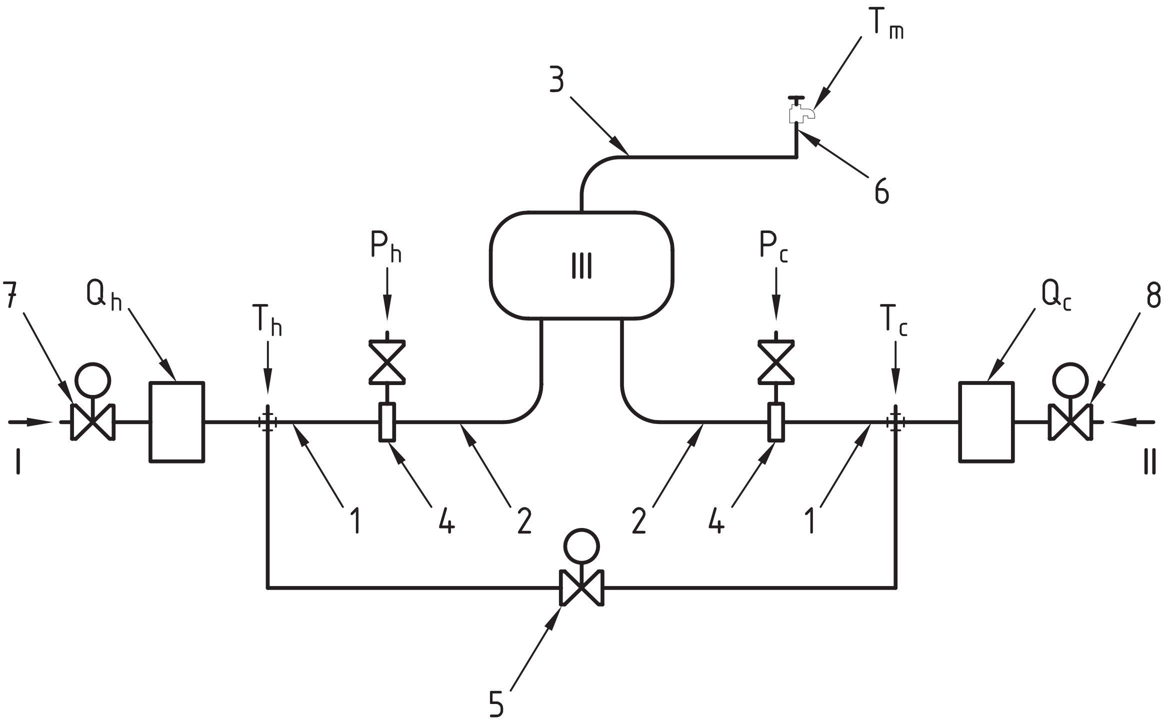
A.1 Test rig

A.1.1 General

Set up the test rig in accordance with Figure A.1 and **A.1.2** to **A.1.4**.

NOTE Where the test rig is supplied with recycled water, it should be prevented from deteriorating in quality during the test and it should be kept free from grease and debris.

Figure A.1 **Test rig for durability test on thermostat**



Key

I	Hot supply	1	Straight piping
II	Cold supply	2	Piping
III	TMV under test	3	Piping
		4	Pressure take-off tee
P_c	Cold water supply pressure	5	Quick-acting shut-off valve
P_h	Hot water supply pressure	6	Draw-off tap
Q_c	Flow meter (cold water)	7	Quick-acting shut-off valve
Q_h	Flow meter (hot water)	8	Quick-acting shut-off valve
T_c	Temperature measuring device (cold water)		
T_h	Temperature measuring device (hot water)		
T_m	Temperature measuring device (mixed water)		

A.1.2 Inlets

Incorporate the following into the inlet pipework:

a) three quick-acting shut-off valves, (5), (7) and (8) [see Figure A.1], having remote actuation, such as a solenoid valve, one in each supply and one in the cross-connecting arrangement, see **A.1.2**h);

b) two flow meters, (Q_h) and (Q_c) [see Figure A.1];

NOTE 1 The mixed-water flow rate may also be measured by determining the volume of discharge collected in a specified time, to an accuracy of 3%.

c) provision to accommodate two temperature measuring devices, (T_h) and (T_c) [see Figure A.1];

d) a branch to an arrangement for cross-connecting the supplies;

e) straight piping, (1) [see Figure A.1], of the same nominal bore as the inlet connection of the TMV and of length not greater than 260 mm between the temperature measuring devices and the pressure take-off tees, (4) [see Figure A.1];

f) two pressure take-off tees, (4) [see Figure A.1], in accordance with Figure A.2 and Table A.1 and of the same nominal size as the piping (1) and (2) [see Figure A.1]; the piping having square-cut tube ends, free from burrs and inserted to the full depth of dimension A) [see Figure A.2];

g) piping, (2) [see Figure A.1], of the same nominal bore as the inlet connection of the TMV under test and of length not greater than 310 mm;

NOTE 2 Pipe elbows and other fittings supplied with the TMV are considered to be part of the TMV, not part of the test rig.

h) an arrangement for cross-connecting the supplies through a branch containing a quick-acting shut-off valve, (5) [see Figure A.1]; and

i) mineral wool lagging having a thickness of at least 25 mm, or of equivalent insulating value over the whole length of both inlet pipes between the temperature measuring device and the inlet connection of the TMV.

A.1.3 Outlet

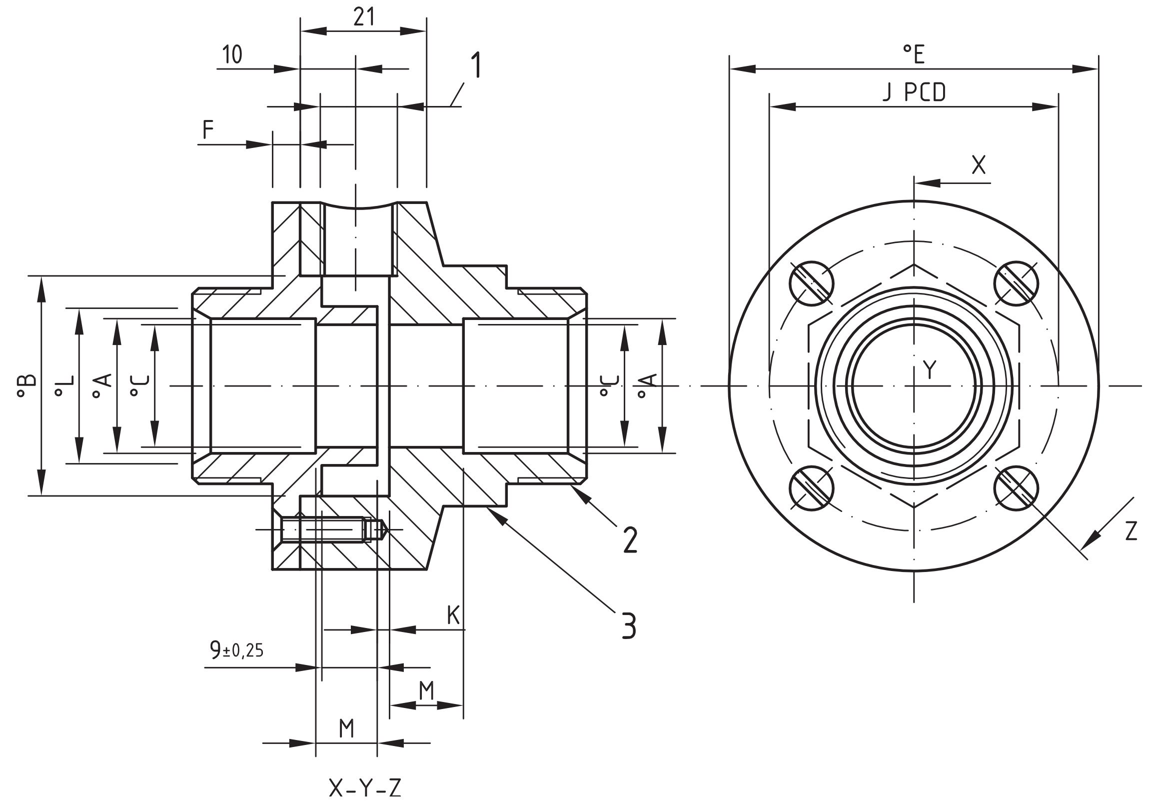
For TMVs not having an integral atmospheric discharge nozzle, fit outlet pipework having a total length between the TMV outlet connection and the inlet of the draw-off tap of not greater than 610 mm, incorporating:

a) a draw-off tap, (6) [see Figure A.1], of the same nominal size as the piping (3), with the discharge nozzle of the tap as the highest point of the outlet;

b) provision to accommodate a temperature measuring device, (T_m) [see Figure A.1].

NOTE Pipe elbows and other fittings supplied with the TMV are considered to be part of the TMV, not part of the test rig.

Figure A.2 **Pressure take-off tee**



a) Section X–Y–Z

Key

1 Female thread form A)

2 Pressure take-off tee end B)

3 Hexagon or spanner flats

NOTE Unspecified tolerance ±1.

A) The female thread form shall conform to BS EN ISO 228-1, G1/4.

B) The ends shall conform to BS EN 1254-2, Type A.

Table A.1 **Dimensions of pressure take-off tees**
Dimensions in millimetres

DN	**10**	**15**	**20**	**25**
A	10.2 ±0.05	15.2 ±0.05	22.25 ±0.05	28.25 ±0.05
B	18.5 ±0.5	25.5 ±0.5	35.5 ±0.5	46.5 ±0.5
C	9 ±0.05	13.85 ±0.05	20.6 ±0.1	26.6 ±0.1
E	42	49	59	70
F	4	4	4	4
J	30	37	47	58
K	0.5 ±0.1	0.6 ±0.1	0.7 ±0.1	0.9 ±0.1
L	13.5 ±0.5	18.5 ±0.5	25.5 ±0.5	32.5 ±0.5
M	3	5.5	9	12
Size of screws	M4×15	M4×15	M4×15	M5×15
Number of screws	4	4	4	4

A.1.4 Operating devices

Operate the quick-acting shut-off valves, (5), (7) and (8) [see Figure A.1], by means of a timing device in a defined cycle as follows.

a) Start with valves (7) and (8) [see Figure A.1] open and valve (5) closed.

b) At a period of (10 ±1) s after the rate of increase in the mixed-water temperature has reduced to not more than 1 K/s [see **A.2.3.3**], close valve (7) and open valve (5).

c) At a period of (15 ±1) s after the rate of decrease in the mixed-water temperature has reduced to not more than 1 K/s [see **A.2.3.3**], revert to **A.1.4**a).

d) At the frequency specified in **E.3.4**, when at stage (a), 20 s after the rate of increase in the mixed-water temperature has reduced to not more than 1 K/s [see **A.2.3.3**], close valve (8) [see Figure A.1]. After a further 60 s revert to **A.1.4**a).

A.2 Measurement of parameters

A.2.1 Pressure measurement

Measure the flow pressures of the hot water supply, using P_h, and the cold water supply, using P_c [see Figure A.1], with an accuracy of 1.0%.

A.2.2 Flow measurement

Measure the flow rates of hot water, using Q_h, and cold water, using Q_c, with an accuracy of 2.0%. Calculate the flow rate of mixed water as the sum of these two measurements or by using the method given in **A.1.2**b), Note.

A.2.3 Temperature measurement

A.2.3.1 Mounting

Check that the thermally sensitive part of the sensing elements is fully immersed. For the mixed-water temperature, rigidly mount the thermometer element in contact with the water outlet and arrange so that discharges pass over or along the full extent of the thermally sensitive part of element. Locate the thermally sensitive part of the element in air 40 mm to 50 mm from the end of the outlet.

A.2.3.2 Accuracy

Measure the temperature of the hot water using T_h, the cold water supply using T_c, and the mixed water using T_m, with an accuracy of 0.5 K.

A.2.3.3 Rate of temperature change

Determine the rate of temperature change referred to in **A.1.4** on the basis of the temperature change in each of two successive periods of 0.5 s.

Annex B (normative) Test for the durability of on/off flow control

B.1 Principle

The on/off flow control device is subjected to an accelerated cycle of operations in order to determine whether it remains leaktight.

B.2 Apparatus

B.2.1 *Test rig*, which:

a) operates the on/off device in its intended manner at an angular speed of 60°/s or a linear speed of 0.04 m/s, as appropriate;

b) operates the on/off flow control device to 90% to 95% of its travel from the closed position;

c) remains in the closed position for 4 s to 6 s;

d) is supplied with hot water at (65 ±2) °C at a pressure conforming to Table **B.1**;

e) is supplied with cold water at ≤30 °C at a pressure conforming to Table **B.1**.

NOTE Where the test rig is supplied with recycled water, it should be prevented from deteriorating in quality during the test and it should be kept free from grease and debris.

Table B.1 **Pressure of water supply for durability tests**

Designation	Water pressure MPa
LP	0.1 max.
HP	0.4 ±0.02

B.3 Test method

B.3.1 Connect the TMV to the test rig (**B.2.1**) and connect the water supplies so that either hot or cold water can be supplied to both inlets.

B.3.2 For TMVs having an independent user-adjustable control, set this control to the maximum temperature position for the designation under test.

B.3.3 Supply hot water to both inlets of the TMVs and adjust the flow pressure of the hot water supply so that the temperature of the water discharged from the TMV whilst the test rig is operating is, at its peak, not more than 2 K below the temperature of the water supplied.

B.3.4 With cold water supplied to both inlets of the TMV, adjust the flow pressure of the cold water supply so that the flow rate, or volume per cycle, is not less than when hot water is being supplied.

B.3.5 Set up a test cycle as follows.

a) Open the on/off flow control to 90% to 95% of maximum.

b) Leave in closed position for 4 s to 6 s.

B.3.6 Carry out 50 000 on/off cycles, supplying the test rig alternately with hot and cold water for (15 ±1) min each.

B.3.7 After 50 000 cycles, carry out the leaktightness tests given in **9.1** or **9.2** as appropriate and record the results.

Annex C (normative) Test for the durability of manual diverters

C.1 Principle

The diverter is subjected to an accelerated cycle of operations in order to determine whether it remains leaktight.

C.1.1 Apparatus

C.1.1.1 *Test rig*, which:

a) operates the diverter at a rate of (15 ±1) cycles per minute;

b) is supplied with hot water at (65 ±2) °C and at a pressure in accordance with Table **B.1**;

c) is supplied with cold water at not more than 30 °C and at a pressure in accordance with Table **B.1**.

NOTE Where the test rig is supplied with recycled water, it should be prevented from deteriorating in quality during the test and it should be kept free from grease and debris.

C.1.2 Test method

C.1.2.1 Connect the diverter of the TMV to the driving device of the test rig using a flexible coupling. Connect the supplies so that either hot or cold water can be supplied to both inlets.

C.1.2.2 For TMVs having independent user-adjustable control, set this control to the maximum temperature position.

C.1.2.3 With the on/off (flow) control open and with hot water supplied to both inlets of the TMV, adjust the flow pressure of the hot water supply so that the temperature of the water discharged from the TMV is, at its peak, not more than 2 K below the temperature of the water supplied, whilst the test rig is operating.

C.1.2.4 With the on/off (flow) control open and with cold water supplied to both inlets of the TMV, adjust the flow pressure of the cold water supply so that the flow rate is not less than when hot water is being supplied.

C.1.2.5 Set up a cycle consisting of a return movement between end positions.

C.1.2.6 Carry out 30 000 on/off cycles supplying the test rig alternately with hot and cold water for (15 ±1) min each.

C.1.2.7 Where a diverter having a manual control has an off (no flow) position which fulfils the function of the sole on/off control, 50 000 cycles shall be applied.

C.1.2.8 After the required number of cycles carry out the leaktightness tests given in **9.4** and, where the diverter has an off (no flow) position which fulfils the function of the sole on/off control, the leaktightness tests given in **9.1**. Record the results.

Annex D (normative) Test for the durability of diverters having an automatic return

D.1 Apparatus

D.1.1 *Test rig*, which:

a) operates the diverter to the flow-to-shower mode;

b) has a quick-acting solenoid valve in the common supply to the TMV;

c) is supplied with hot water at (65 ±2) °C, at a pressure in accordance with Table **B.1**;

d) is supplied with cold water at not more than 30 °C, at a pressure in accordance with Table **B.1**.

NOTE Where the test rig is supplied with recycled water, it should be prevented from deteriorating in quality during the test and kept free from grease and debris.

D.2 Test method

D.2.1 Arrange for the diverter of the TMV to be operated by the test rig (**D.1.1**). Connect the supplies so that either hot or cold water can be supplied to both inlets.

D.2.2 Fit the hydraulic resistance appropriate to the designation in accordance with Table 4 to the connection for the shower outlet.

D.2.3 Where the TMV under test has an independent user-adjustable control, set this control to the maximum temperature position.

D.2.4 Open the on/off flow control and supply hot water to both inlets of the TMV. Adjust the flow pressure of the hot water supply so that the temperature of the water discharged from the TMV is, at its peak, not more than 2 K below the temperature of the water supplied whilst the test rig is operating. Check that the flow rate is sufficient to maintain the diverter in the flow-to-shower position.

D.2.5 Open the on/off flow control and supply cold water to both inlets of the TMV. Adjust the flow pressure of the cold water supply so that the flow rate is not lower than the flow rate of the hot water supply.

D.2.6 Set up a test cycle as follows.

a) Set the diverter to the flow-to-bath position for (5 ±0.2) s.

b) Move the diverter to the flow-to-shower position for (5 ±0.2) s.

c) Shut off the water supply to the TMV using the quick-acting valve.

d) After the diverter has reverted to the flow-to-bath position, re-open the quick-acting valve.

D.2.7 Carry out 30 000 cycles, supplying the test rig alternately with hot and cold water for (15 ±1) min each.

D.2.8 After 30 000 cycles, carry out the leaktightness test in accordance with **9.5** and record the results.

Annex E (normative) Test for the durability of thermostat

E.1 Principle

The thermostat is subjected to an accelerated cycle of operations which is representative of normal operating conditions in order to determine whether the mixed-water temperature is maintained and also to pre-condition a specimen in preparation for the performance tests given in Annex H to Annex M and Annex O to Annex R.

*NOTE The most common exercise for the thermostat is in responding to a draw-off after a period of non-use (see **9.5**). The durability cycle represents a large number of these responses, which are unlikely to be able to exceed 25 per day, as cooling to ambient temperature would not then be achieved. Periodic thermal shut-offs are called for at a rate equivalent to approximately one every three months (2 500 cycles).*

E.2 Apparatus

E.2.1 *Test rig*, in accordance with Annex A.

E.3 Test method

E.3.1 Connect the TMV to the test rig in accordance with **A.1**.

NOTE Where the test rig is supplied with recycled water, it should be prevented from deteriorating in quality during the test and kept free from grease and debris.

E.3.2 Set the flow rate and mixed-water temperature in accordance with the settings given in Table E.1, using the given water supply pressures and temperatures.

NOTE 1 For a TMV intended for single point use, and having an integral atmospheric discharge nozzle, the flow rate can be adjusted by means of the TMV's integral flow control. In all cases the flow rate can be adjusted either by means of the tap (6) [see Figure A.1] in the discharge pipework (where used) or a throttling device, such as an orifice plate, fitted to the atmospheric discharge.

NOTE 2 Once the required settings have been obtained, the setting of the mixed-water temperature and flow rate should be prevented from being unintentionally adjusted during this test.

Table E.1 **Settings for thermostat durability test**

	Hot supply		**Cold supply**		**Mixed water**	
	Flow pressure	**Temp.**	**Flow pressure**	**Temp.**	**Flow rate**	**Temp.**
	MPa	°C	MPa	°C	L/min	°C
Initial setting	Within operating pressure range (see Table 1)	60 ±5	Equal to hot supply pressure ±10%	15 ±5	≥½ of available flow rate at applied flow pressure	Conforming to Table 7
For checking	Initial setting ±10%	Initial setting ±1 K	Equal to hot supply pressure ±10%	Initial setting ±1 K	Initial setting ±10%	Initial setting ±2 K

E.3.3 Comply with **A.1.4**, checking timings, recording the mixed-water temperature and starting the cyclic operation of the rig.

E.3.4 Implement the sequence specified in **A.1.4**d) at intervals of (2 500 ±100) cycles.

E.3.5 At intervals of 5 000 cycles (max.), check that the water supply pressures and temperatures and the mixed flow rate are within the limits given in Table E.1 for the initial setting. Where necessary, adjust the water supply pressures, temperatures and the mixed-water flow rate to the values given in Table E.1 for checking. Make no adjustment to the mixed-water temperature control unless, after adjustment of the other parameters, the mixed-water temperature is more than 1.5 K removed from the actual initial setting.

E.3.6 When, in order to carry out **E.3.4** or **E.3.5** at a convenient time, it becomes necessary to interrupt the cycle operation of the test rig, run the cycle operation for a minimum of 100 cycles before recommencing the test method.

E.3.7 After (30 000 ±200) cycles, carry out the process in accordance with **E.3.5**, then service the TMV in accordance with the manufacturer's instructions and carry out the performance tests given in Annex H to Annex M and Annex O to Annex R.

E.4 Expression of results

Record the mixed-water temperature against the limits given in Table E.1 and carry out additional testing in accordance with Annex S, where necessary (see **10.3**). Subsequently test the specimen's conformity to Clause **11**.

Annex F (normative) Apparatus for performance tests

F.1 Test rig

F.1.1 General

Set up the test rig in accordance with Figure F.1 and **F.1.2** and **F.1.3**.

F.1.2 Inlets

Incorporate the following into the inlet pipework:

a) a quarter turn spherical plug valve in each supply pipe;

b) a flow meter, (Q_h) and (Q_c) [see Figure F.1], in each supply pipe;

NOTE 1 Where the bleed valve(s) are open, invalid readings of the flow meters result.

c) provision to accommodate temperature measuring devices (T_h) and (T_c) [see Figure F.1];

d) a branch in each supply pipe to bleed valve, (8) [see Figure F.1];

e) straight piping, (1) [see Figure F.1], of the same nominal bore as the inlet connection of the TMV and of length (250 ±10) mm between the temperature measuring devices and the pressure take-off tees (4);

f) pressure take-off tees, (4) [see Figure F.1], conforming to Figure A.2 and Table A.1 and of the same nominal size as the piping, (1) [see Figure F.1]; the piping having square-cut ends, free from burrs and inserted to the full depth of dimension A [see Figure A.2];

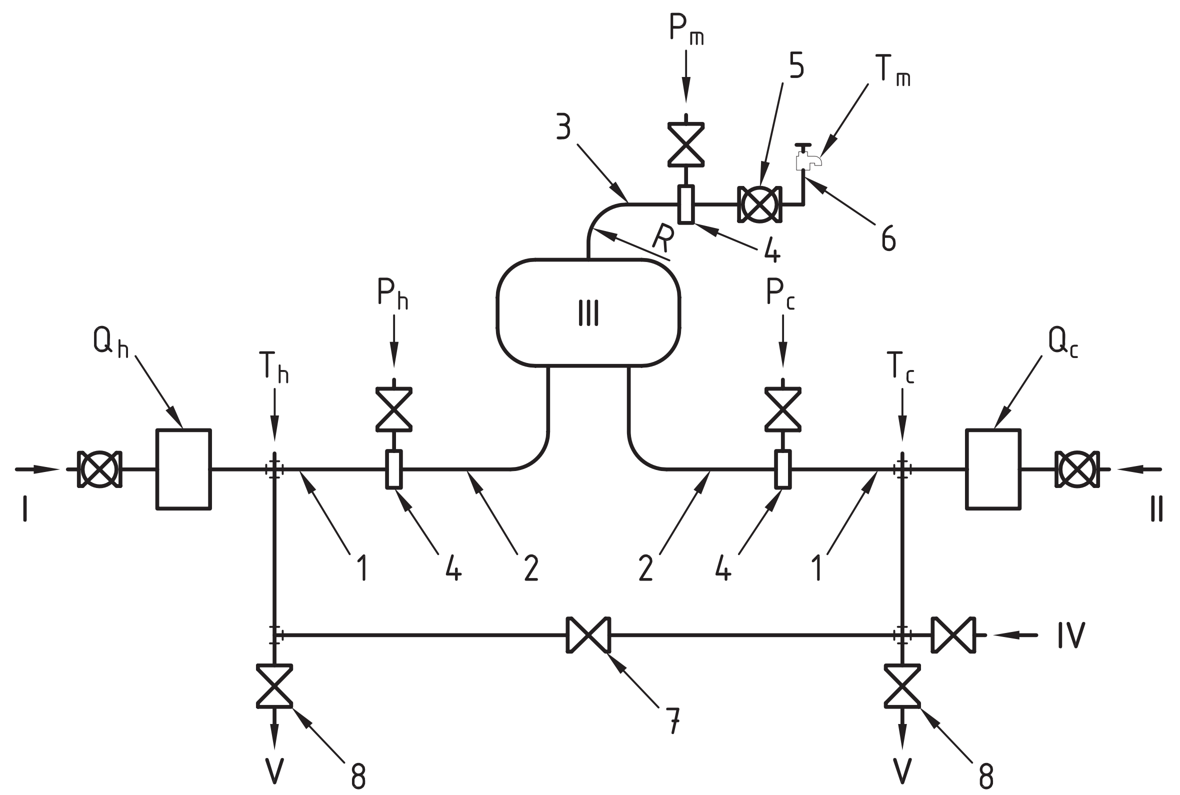
g) piping, (2) [see Figure F.1], of the same nominal bore as the inlet connection of the TMV under test and of length (300 ±10) mm and with all bends in the pipe having a radius that is ≥4 times the bore of the pipe, the sum of which do not exceed 90°;

NOTE 2 Pipe elbows and other fittings supplied with the TMV are considered to be part of the TMV, not part of the test rig.

h) an arrangement for cross-connecting the supplies through a branch containing valve, (7) [see Figure F.1], connected between the branches to bleed valves, (8) [see Figure F.1];

i) mineral wool lagging having a thickness of at least 25 mm, or of equivalent insulating value over the whole length of both inlet pipes between the temperature measuring device and the inlet connection of the TMV.

Figure F.1 **Test rig for performance tests**



Key

I	Hot supply	P_c	Cold water supply pressure	1	Straight piping
II	Cold supply	P_h	Hot water supply pressure	2	Piping
III	TMV under test	P_m	Mixed water supply pressure	3	Piping
IV	Cooling flow	Q_c	Flow meter (cold water)	4	Pressure take-off tee
V	Bleed	Q_h	Flow meter (hot water)	5	Spherical plug valve
		T_c	Temperature measuring device (cold water)	6	Draw-off tap
		T_h	Temperature measuring device (hot water)	7	Valve
		T_m	Temperature measuring device (mixed water)	8	Bleed valve

F.1.3 Outlet

Fit TMVs not having an integral atmospheric discharge nozzle with outlet pipework having a total length between the TMV outlet connection and the inlet of the draw off tap of (600 ±10) mm, and incorporate the following:

a) piping, (3) [see Figure F.1], between the TMV outlet connection and the pressure take-off tee of the same nominal bore as the outlet connection of the TMV under test and of length (300 ±10) mm, containing bends in the pipe having a radius that is ≥4 times the bore of the pipe, the sum of which do not exceed 90°;

NOTE Pipe elbows and other fittings supplied with the TMV are considered to be part of the TMV, not part of the test rig.

b) a pressure take-off tee, (4) [see Figure F.1], conforming to Figure A.2 and Table A.1 and of the same nominal size as the piping (3); the piping having square-cut ends, free from burrs and inserted to the full depth of dimension A [see Figure A.2];

c) a quarter turn spherical plug valve, (5) [see Figure F.1], of the same nominal size as the piping (3);

d) a draw-off tap, (6) [see Figure F.1], of the same nominal size as the piping (3) with the discharge nozzle of this tap as the highest point of the outlet; and

e) provision to accommodate a temperature measuring device, (T_m) [see Figure F.1].

F.2 Measurement of parameters

F.2.1 Pressure measurement

Measure the flow pressures of the hot water supply, (P_h) [see Figure F.1], the cold water supply, (P_c), and the mixed water, (P_m), with an accuracy of 1.0%.

F.2.2 Flow measurement

Measure the flow rates of hot water, using Q_h [see Figure F.1], and cold water, using Q_c with an accuracy of 2.0%. Calculate the flow rate of mixed water as the sum of these two measurements.

F.2.3 Temperature measurement

F.2.3.1 Mounting

Check that the thermally sensitive part of sensing elements is fully immersed. For the mixed-water temperature, rigidly mount the thermometer element in contact with the water outlet, and arrange it such that all discharges pass over or along the full extent of the thermally sensitive part of the element. Locate the thermally sensitive part of the element in air 40 mm to 50 mm from the end of the outlet.

F.2.3.2 Accuracy

Measure the temperature of the hot water supply using T_h [see Figure F.1], the cold water supply using T_c and the mixed water using T_m with an accuracy of 0.2 K.

F.2.3.3 Response time

Measure the mixed-water temperature with instrumentation having a total system response such that a change in reading equal to 90% of a step change is indicated in a time of (0.3 ±0.05) s. Verify this response time in accordance with Annex G.

F.2.4 Angular position

Measure the angular position of the temperature control with an accuracy of 0.5°. Measure linear movement with an accuracy of 0.5 mm.

F.2.5 Duration of transients

Measure the duration of transient events with an accuracy of 0.1 s.

Annex G (normative) Determination of thermometer response time

G.1 Principle

The response time of the complete water temperature measuring system given in Annex F for the mixed-water temperature is determined by plunging the sensor from air at ambient temperature into flowing water at a higher temperature and measuring the time taken for the reading of Celsius temperature to rise by 90% of the difference between the air and water temperatures.

NOTE 1 The measuring system consists of, for example, a sensor (thermometer element or thermocouple) together with all associated equipment necessary to obtain a reading of Celsius temperature.

NOTE 2 The method given is appropriate to the measurements of transient temperatures required by this standard and should provide repeatable results. However, the method should not be regarded as capable of measuring the absolute response time. To do this additional test equipment is needed.

G.2 Apparatus

G.2.1 *Water system*, which is capable of being adjusted both for temperature and flow rate and discharging into the atmosphere through a pipe or nozzle to produce a water stream of minimum dimension *A* and not less than 5×*D*,

where:

A is the smallest cross-section dimension of the water stream in air between the end of the pipe or nozzle and 100 mm from the end of the pipe or nozzle when the flow velocity in the pipe or nozzle is (1 ±0.1) m/s; and

D is the largest cross-section dimension of the immersed part of the thermometer element or sensor.

NOTE In general the cross-section dimensions of the water stream are approximately equal to the cross-section dimensions of the pipe or nozzle.

G.2.2 Measuring equipment, in accordance with Annex F

Synchronize the plunging of the sensor into water with the start of the time interval measurement in order to enable the response time to be determined.

NOTE 1 Where a data logging system is used the measured response time can be frequently over-estimated, but never under-estimated. Although a scan interval of 0.2 s is sufficiently fast to achieve the required accuracy of timing in ***F.2.5****, for the determination of thermometer response time this scan interval can over-estimate the response time by more than 10% in the range of permitted response times. A scan interval of 0.1 s should not over-estimate by more than 0.01 s and the possible error is reduced by more rapid scanning.*

NOTE 2 It can be sufficient to manually co-ordinate the plunging of the sensor into water and the start of timing. However, practice is necessary to achieve repeatable results.

G.3 Test method

G.3.1 Establish a flow of water in the pipe or nozzle having a velocity of (1 ±0.1) m/s, with the water stream discharging into the atmosphere in accordance with **G.2.1**.

G.3.2 Measure the air temperature, (T_a) [see Figure F.1], close to the water stream. Maintain the air temperature at a constant of ±0.2 K.

NOTE To achieve the required constancy of air temperature, a draught protected environment might be needed.

G.3.3 Adjust the temperature of the water stream in air, (T_w) [see Figure F.1], such that (T_w – T_a) = (20 ±2) K. Maintain the water stream temperature at a constant of ±0.2 K and keep the velocity in the pipe or nozzle at (1 ±0.1) m/s.

G.3.4 With the test sensor in air close to the water stream record the temperature which is indicated in association with its connected equipment (transmitter, amplifier, data logger, pen recorder, for example). Then simultaneously plunge the sensor into the water stream and commence timing with the attitude of the sensor within the water stream oblique to the flow and the tip of the sensor not more than 100 mm from the end of the pipe or nozzle insuring that the whole of the sensitive part of the sensor is immersed. Monitor the temperature indicated by the test sensor and its associated equipment until the indication is constant ±0.2 K.

G.3.5 From a graph of the indicated temperature versus time determine the response time, $\tau 90$, as the time taken to reach 90% of the indicated difference (T_w – T_a).

G.3.6 Repeat the test method **G.3.3** to **G.3.5** to give at least five consecutive measurements of $\tau 90$ all constant to within 10% of their average value.

NOTE With the exception of synchronization (co-ordination) errors, the errors inherent in the test method should tend to result in a larger value of response time than the absolute value. For this reason greater confidence can be placed in the smallest values measured, unless they are likely to be the result of synchronization error.

G.4 Results

Calculate the response time, $\tau 90$, as the average of the three smallest values of at least five consecutive measurements of $\tau 90$ which are constant to within 10% of their average value.

Annex H (normative) Test for flow rate and sensitivity of temperature control

H.1 Principle

Water flow rate and temperature are measured at different mixed-water temperature settings to determine the ease with which the mixed-water temperature and the mixed-water flow rate can be adjusted to the correct value for the intended application.

NOTE When a TMV is suitable for more than one application, this test can be conducted for all these in a single test where the range for a user-adjustable control can be set to provide all of the required mixed-water temperatures in one setting.

H.2 Test method

H.2.1 Connect the TMV to the test rig in accordance with Annex F.

H.2.2 Fully open any integral flow control. Where outlet pipework is required, also open fully the valve (5) and tap (6) [see Figure F.1]. Check that the bleed valves, (8), are closed.

H.2.3 For TMVs having user-adjustable control, adjust the maximum mixed-water temperature stop so that the full range of mixed-water temperatures required in this test is available. For TMVs having a pre-set value, access the mixed-water temperature adjustment.

H.2.4 With the pressure losses and supply temperatures in accordance with Table 6, set the temperature control/adjustment to give a mixed-water temperature equal to the first setting given in Table 6. Where outlet pipework is required, adjust the tap (6) to give the required pressure loss.

H.2.5 Measure and record the mixed-water flow rate and temperature and record the position of the temperature control/adjustment. Where outlet pipework is required, record the outlet pressure.

H.2.6 Set the temperature control/adjustment, maintaining the supply condition, to achieve each of the mixed-water temperatures given in Table 6. At each setting measure and record the mixed-water flow rate and temperature, and record the position of the temperature control. Where outlet pipework is required, record the outlet pressure.

H.3 Expression of results

Record the flow rates and the sensitivity of the temperature control/adjustment.

Annex I (normative) Tests for TMVs having electronic temperature adjustment

I.1 General

Annex I gives tests for TMVs that do not have a conventional temperature control for adjusting the mixed-water temperature, but that have Category 1 or Category 2 electronic temperature adjustment (see **5.2**). It is designed to be carried out in addition to those other tests that are applicable for the TMV to conform to this standard.

I.2 Flow rate and sensitivity of temperature control

I.2.1 Purpose

The purpose of the test is:

a) to determine the flow rate of the mixed water;

b) to determine the ease with which the mixed-water temperature can be adjusted to the correct value for the intended application;

c) to check that inadvertent operation of the electronic temperature control does not occur;

d) to check that there is indication of changing mixed water temperature when making adjustments.

Where a TMV is suitable for more than one designation, the test method given in **I.2.2** can be conducted for all designations in a single test, where the range of the user-adjustable control can be set to provide all of the required mixed-water temperatures in one setting.

I.2.2 Test method

I.2.2.1 Connect the TMV to the test rig (see **F.1**).

I.2.2.2 Fully open integral flow controls. Where outlet pipework is required, also fully open the valve (5) and the tap (6). Check that the bleed valves (8) are closed.

I.2.2.3 For TMVs having a user-adjustable control, adjust the maximum mixed-water temperature stop so that the full range of mixed-water temperatures required to carry out this test method is available. For TMVs having a pre-set value, access the mixed-water temperature adjustment.

I.2.2.4 For both Category 1 and Category 2 TMVs, record the maximum distance from the sensor at which any controller effects a temperature change.

I.2.2.5 With the pressure losses and supply temperatures specified in Table 6, set the temperature control/adjustment to give a mixed-water temperature equal to the first setting specified in Table 6.

I.2.2.6 Where outlet pipe work is required, adjust the tap (6) to give the required pressure loss.

I.2.2.7 Record the mixed-water flow rate and temperature and record the position of the temperature control/adjustment. Where outlet pipe work is required, record the outlet pressure.

I.2.2.8 For Category 1 TMVs, activate the temperature controller until the mixed-water temperature reaches the values equivalent to settings 2, 3, 4 or 5 in Table 6 as determined by the designation of the TMVs.

I.2.2.9 At each setting, record the mixed-water flow rate, the temperature and the time taken to reach that setting. Alternatively the total time taken for the temperature to move from first to the last setting can be measured and used to calculate the average time taken per position.

I.2.2.10 For Category 2 TMVs, set the temperature control/adjustment to give a mixed-water temperature equal to the first setting in Table 6. Activate the temperature controller one increment and measure the incremental change in the mixed-water temperature. Continue to activate the temperature controller in single incremental steps measuring flow rate and mixed-water temperature change at each setting, until the range determined by settings 1 to 5 in Table 6 and the designation of the TMV has been covered.

I.2.2.11 Where outlet pipework is required, record the outlet pressure.

I.2.2.12 For Category 1 and Category 2 TMVs, measure from the sensor the maximum distance required to activate the temperature adjustment, as appropriate.

I.2.3 Expression of results

I.2.3.1 Record the flow rates.

I.2.3.2 For Category 1 TMVs, record the flow rate at each of the mixed-water temperature settings determined by Table 6. Record the time taken to increase the mixed-water temperature from the value equivalent to setting 1 to settings 2, 3, 4 or 5 given in Table 6, as determined by the designation of the TMV. Alternatively the total time taken for the temperature to move from the first to the last setting can be measured so that an average time per setting can be calculated.

I.2.3.3 For Category 2 TMVs, record the temperature change for each incremental adjustment required to increase the mixed-water temperature from the value equivalent to setting 1 to setting 2, 3, 4 or 5 in Table 6, as determined by the designation of the TMV.

I.3 Mixed-water temperature overshoot on adjustment of mixed-water temperature

I.3.1 Purpose

The purpose of the test is to determine, for Type A TMVs, the characteristic of any transient rise in the mixed-water temperature which can occur when the mixed-water temperature setting is suddenly changed from a cool setting to the maximum setting.

I.3.2 Test method

I.3.2.1 Connect the TMV to the test rig (see **F.1**).

I.3.2.2 Starting from the initial setting (see Table 7), allow mixed water to flow for (120 ±5) s and then measure and record the mixed-water temperature.

I.3.2.3 Adjust the position of the temperature control to give a mixed-water temperature of (30 ±1) °C or to the lowest temperature available where it is greater than (30 ±1) °C.

I.3.2.4 After (180 ±15) s, rapidly manually adjust the temperature of the mixed water. For Category 1 TMVs this shall be done by activating the temperature controller until the mixed-water temperature reaches its maximum position. For Category 2 TMVs this is done by activating the temperature controller as quickly and as many times as is necessary for the mixed-water temperature to reach its maximum position.

I.3.2.5 Monitor and record the mixed-water temperature.

I.3.2.6 Repeat the test method to give three sets of results for each sample.

I.3.3 Expression of results

The transient temperature obtained shall be assessed to determine the duration at or above each 1 K temperature rise shown in Table 8 for the appropriate designation. For the three test results on each sample, calculate the average duration at each temperature rise. Transient temperature rises shall be referred to the mixed-water temperature existing at the start of each of the three tests.

NOTE An example of the assessment of test results is given in Annex N.

Annex J (normative) Test for mixed-water temperature overshoot on operation of diverter (manual or automatic return)

J.1 Principle

The characteristics of any transient rise in the mixed water temperature which can occur when the mixed water flow is diverted from one outlet to another are determined.

J.2 Test method

J.2.1 Connect the TMV to the test rig (see Annex F) and adjust the mixed-water temperature and flow rate at each outlet to the initial setting given in Table 7 for the appropriate designation.

J.2.2 Operate the diverter to the flow-to-shower position; allow mixed water to flow for (120 ±5) s and then measure and record the mixed-water temperature.

J.2.3 Return the diverter to the flow-to-bath position. Where necessary, manually re-set the outlet temperature to the appropriate bath fill designation. Allow mixed water to flow for (120 ±5) s and then measure and record the mixed-water temperature.

*NOTE It might be necessary to repeat steps **J.2.2**, **J.2.3** to maintain stable operation of the TMV and constant values of the bath and shower temperatures.*

J.2.4 Immediately and manually operate the diverter to the flow-to-shower position.

J.2.5 Monitor and record the mixed-water temperature until it has stabilized.

J.2.6 For diverters with automatic return close the flow control of the TMV. For manual diverters, allow the mixed water to flow for a further (120 ±5) s and then, immediately and manually, operate the diverter to the flow-to-bath position and where necessary, manually re-set the outlet temperature to the appropriate bath fill designation.

J.2.7 Monitor and record the mixed-water temperature until it has stabilized.

J.2.8 At intervals not exceeding 0.1 s, continuously monitor and record the mixed-water temperature until it has stabilized.

*NOTE Refer to **F 2.5** for the duration of transients.*

J.2.9 Repeat the test method to give three sets of results for each specimen.

J.3 Expression of results

Assess the transient temperature obtained during **J.2.5** and **J.2.7** to determine the duration at or above each 1K temperature rise shown in Table 8 for the appropriate application temperature. For the three test results on each sample calculate the average duration at each temperature rise. Refer transient temperature rises to the mixed-water temperature existing at the start of each of the three tests, at the appropriate outlets.

Annex K (normative) Test for mixed-water temperature overshoot on operation of second outlet

K.1 Principle

The characteristics of any transient rise in the mixed-water temperature which can occur during the operation of the second outlet of a TMV having two separately operating thermostatically controlled outlet mechanisms and sharing common inlets are determined.

K.2 Test method

K.2.1 Connect the TMV to the test rig (see Annex F) and after checking that the other outlet is closed, adjust the mixed-water temperature and flow rate at each outlet separately to the appropriate initial setting given for that application in Table 7. Set the lowest temperature application first and then the highest.

K.2.2 After a stabilization period of not less than 120 s, check that the initial conditions still conform to Table 7 for that application and record these values.

K.2.3 Within 120 s of recording the values in **K.2.2** for the highest temperature application, rapidly manually open the outlet appropriate to the lowest temperature application whilst monitoring the mixed-water temperature at both outlets.

K.2.4 When both mixed-water temperatures have stabilized, cease monitoring.

K.2.5 Within 120 s of the cessation of monitoring in **K.2.3**, rapidly manually close the outlet appropriate to the highest temperature application whilst monitoring the mixed-water temperature at the other outlet.

K.2.6 When the outlet temperature has stabilized, cease monitoring.

K.2.7 Within 120 s of the cessation of monitoring in **K.2.5**, rapidly manually open the outlet appropriate to the highest temperature application whilst monitoring the mixed-water temperature at both outlets.

K.2.8 When both mixed-water temperatures have stabilized, cease monitoring.

K.2.9 Within 120 s of the cessation of monitoring in **K.2.8**, rapidly manually close the outlet appropriate to the lowest temperature application whilst monitoring the mixed-water temperature at the other outlet.

K.2.10 When the outlet temperature has stabilized, cease monitoring.

K.2.11 At intervals not exceeding 0.1 s, continually monitor and record the mixed-water temperature until it has stabilized.

*NOTE Refer to **F.2.5** for transient temperature rises.*

K.2.12 Repeat the test method to give three sets of results for each specimen.

K.3 Expression of results

Assess the temperature transients obtained during **K.2.3**, **K.2.5**, **K.2.7**, and **K.2.9** to determine the duration of any temperature rise above the initial conditions recorded in **K.2.2** in accordance with the values shown in Table 8 for the appropriate application temperature. For the three test results on each sample calculate the average duration at each temperature rise. Refer transient temperature rises to the mixed-water temperature appropriate to the outlet existing at the start of each of the three tests.

Annex L (normative) Test for mixed-water temperature overshoot starting from ambient temperature

L.1 Principle

The characteristics of any transient rise in the mixed-water temperature which might occur when water is drawn off after a prolonged period of non-use are determined.

NOTE Over a period of several hours the installed TMV cools to ambient temperature. This commonly results in the thermostat adjusting the valve mechanism to fully open the hot water port, and thereby shut off the cold water port. Subsequently, as water is drawn off, the thermostat needs to respond quickly to limit the temperature of mixed water as hot water flows into the TMV.

L.2 Test method

L.2.1 Connect the TMV to the test rig, in accordance with Annex F, and adjust it to the initial setting given in Table 7 for the appropriate designation.

L.2.2 Allow mixed water to flow for (120 ±5) s and then measure and record the mixed-water temperature.

L.2.3 Close off the hot and cold water supply valves and open the valve (7) in the cross-over pipe (see Figure F.1). Supply both inlets with cold water at a temperature of (20 ±1) °C at a total flow rate not less than half the set flow rate given in Table 7.

L.2.4 After (300 ±15) s close off the mixed-water flow. For TMVs intended for single point use, and having an integral atmospheric discharge nozzle, this shall be achieved by closing the integral flow control. In all other cases close the valve (5) in the discharge pipework.

L.2.5 Close the valve (7) and restore the hot and cold water supplies, at the original pressures. Open the bleed valves (8) until the set supply temperatures are regained.

L.2.6 For TMVs intended for single point use and having an integral atmospheric discharge nozzle, rapidly manually open the integral flow control to the same position it was in to achieve the initial setting. In all other cases rapidly manually open the valve (5) in the discharge pipework.

L.2.7 At intervals not exceeding 0.1 s, continuously monitor and record the mixed-water temperature until it has stabilized.

*NOTE Refer to **F.2.5** for transient temperature rises.*

L.2.8 Repeat the test method to give three sets of results for each specimen.

L.3 Expression of results

Assess the temperature transient obtained to determine the duration at or above each 1 K temperature rise shown in Table 8 for the appropriate designation. For the three test results on each sample, calculate the average duration at each temperature rise. Refer transient temperature rises to the mixed-water temperature existing at the start of each of the three tests.

NOTE 1 For a summary of thermal performance requirements, see Annex T.

NOTE 2 An example of the assessment of the test results is given in Annex N.

Annex M (normative) Test for mixed-water temperature overshoot on adjustment of mixed-water temperature

M.1 Principle

For TMVs having a user-adjustable control, the characteristic of any transient rise in the mixed-water temperature which might occur when the mixed-water temperature setting is suddenly changed from a cool setting to the maximum setting is determined.

M.2 Test method

M.2.1 Connect the TMV to the test rig in accordance with Annex F and adjust to the initial setting given in Table 7 for the appropriate designation.

M.2.2 After allowing mixed water to flow for (120 ±5) s, measure and record the mixed-water temperature.

M.2.3 Adjust the position of the temperature control to give a mixed-water temperature of (30 ±1) °C or, where the lowest temperature available is greater than this, adjust the position of the temperature control to the lowest temperature available.

M.2.4 After (180 ±15) s, rapidly manually adjust the temperature control to the maximum temperature stop.

M.2.5 At intervals not exceeding 0.1 s, continuously monitor and record the mixed-water temperature until it has stabilized.

*NOTE Refer to **F.2.5** for transient temperature rises.*

M.2.6 Repeat the test method to give three sets of results for each specimen.

M.3 Expression of results

Assess the temperature transient obtained in order to determine the duration at or above each 1 K temperature rise shown in Table 8 for the appropriate designation. For the three test results on each sample, calculate the average duration at each temperature rise. Refer transient temperature rises to the mixed-water temperature existing at the start of each of the three tests.

NOTE 1 For information on summary of thermal performance requirements see Annex T.

NOTE 2 An example of the assessment of test results is given in Annex N.

Annex N (informative) Assessment of transient values

An example of a transient temperature variation is shown in Figure N.1. The following information is taken from the graph of data for a TMV of designation T44.

a) The duration at or above 48 °C = 1.99 s – 0.6 s = 1.39 s.

b) The duration at or above 49 °C = 1.73 s – 0.7 s = 1.03 s.

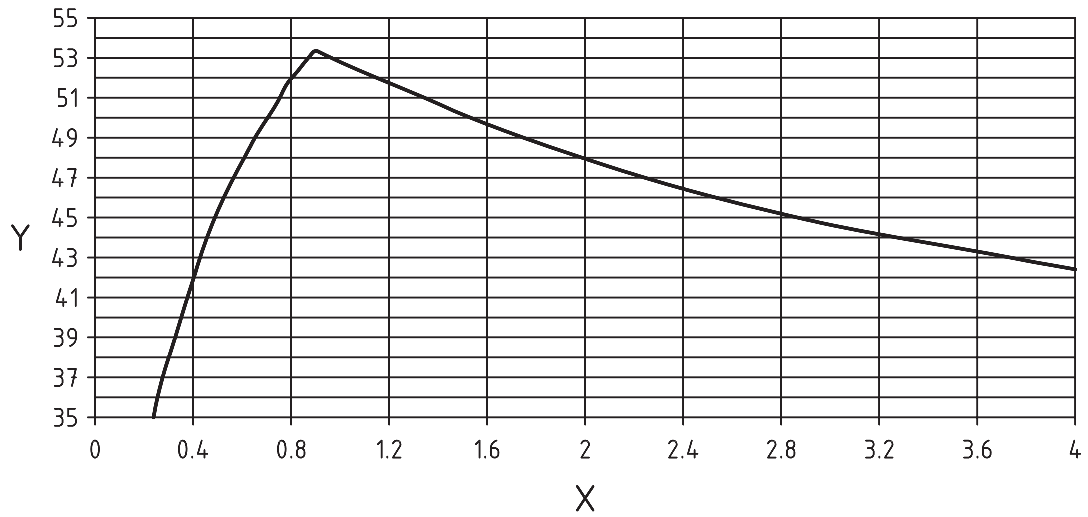
c) The duration at or above 50 °C = 1.52 – 0.7 s = 0.82 s.

d) The duration at or above 51 °C = 1.35 s – 0.75 s = 0.5 s.

e) The duration at or above 52 °C = 1.13 s – 0.8 s = 0.33 s.

f) The duration at or above 53 °C = <0.25 s.

Figure N.1 **Example of transient temperature variation**



Key

X Time (s)

Y Temperature (°C)

Annex O (normative) Test for thermal shut-off

O.1 Principle

O.1.1 In the event of complete and sudden failure of the cold water supply, the following are determined:

a) the characteristic of any transient rise in the mixed-water temperature which might occur;

b) the maximum rise in mixed-water temperature resulting from prolonging the supply failure.

O.1.2 In the event of complete and sudden restoration of the cold water supply following a supply failure, the following are determined:

a) the characteristic of any transient rise in the mixed-water temperature which might occur;

b) the steady temperature to which the mixed-water returns.

O.1.3 In the event of complete and sudden failure of the hot water supply it is verified either that the flow rate decays rapidly to an acceptable leakage rate or that the rate of reduction in mixed-water temperature is not excessive.

O.1.4 In the event of complete and sudden restoration of the hot water supply following a supply failure, the following are determined:

a) the characteristic of any transient rise in the mixed-water temperature which might occur;

b) the steady temperature to which the mixed-water returns.

O.2 Test method

O.2.1 Connect the TMV to the test rig in accordance with Annex F and adjust to the initial setting given in Table 7 for the appropriate designation.

O.2.2 Isolate any branched take-offs in the cold water supply line, including the cold water pressure measuring line. Also isolate the outlet pressure measuring line, where open.

O.2.3 Immediately isolate the cold water supply and, at intervals not exceeding 0.2 s, continuously monitor and record the mixed-water temperature.

O.2.4 Leave the cold water supply isolated for (900 ±45) s and then instantaneously restore the cold water supply to its original pressure. At intervals not exceeding 0.2 s monitor and record the mixed-water temperature until it has stabilized.

O.2.5 Re-connect the cold water pressure measuring line and, where necessary, restore the flow pressures. Record the mixed-water temperature.

O.2.6 Isolate any branched take-offs in the hot water supply line, including the hot water pressure measuring line. Also isolate the outlet pressure measuring line, where open.

O.2.7 Instantaneously isolate the hot water supply and simultaneously commence collection of the mixed-water discharge. Continuously monitor the mixed-water temperature. After (5 ±0.5) s, using a separate vessel collect the mixed-water discharge for a period of (30 ±0.5) s.

NOTE The collected volumes may be taken as the time integrated output of a rate of flow meter provided that the response time of the meter is taken into account.

O.2.8 Leave the hot water supply isolated for (300 ±15) s and then instantaneously restore the hot water supply at its original pressure. At intervals not exceeding 0.1 s, continuously monitor and record the mixed-water temperature until it has stabilized.

*NOTE Refer to **F.2.5** for transient temperature rises.*

O.2.9 Re-connect the hot water pressure measuring line and, where necessary, restore the flow pressures. Record the mixed-water temperature.

O.2.10 Repeat the test method to give three sets of results for each specimen.

O.3 Expression of results

O.3.1 Assess the transient temperature obtained for each cold water isolation, for each cold water restoration, and for each hot water restoration in order to determine the duration at or above each 1 K temperature rise given in Table 8 for the appropriate designation. For the three results of each of these tests calculate the average duration at each temperature rise. Refer transient temperature rises to the mixed-water temperature existing at the start of each of the three tests.

NOTE 1 For information on summary of thermal performance requirements, see Annex T.

NOTE 2 An example of the assessment of test results is given in Annex N.

NOTE 3 Where the water discharges in a cycle, i.e. the water increases in flow until the TMV reacts and flow stops, it is essential that each of the transient events conform, for the appropriate designation during the period of cold water isolation, to Table 8.

O.3.2 For the three test results for hot water isolation determine the average volume of water collected in the first 5 s after isolation of the hot water supply and also the average volume of water collected in the subsequent 30 s. Determine the minimum temperature of mixed-water during the first 5 s after isolation.

Annex P (normative) Test for temperature stability with changing water supply pressure

P.1 Principle

The following temperature changes are determined:

a) the change in mixed-water temperature when one supply pressure is varied over the whole operating pressure range whilst the other supply pressure remains constant;

b) the change in mixed-water temperature when one supply pressure is reduced to a very low value whilst the other supply pressure remains constant;

NOTE This represents an extreme supply starvation condition.

c) the steady temperature to which the mixed water returns when supply pressure is restored.

P.2 Test method

P.2.1 Connect the TMV to the test rig in accordance with Annex F and adjust to the initial setting given in Table 7 for the appropriate designation.

P.2.2 Within (20 ±5) s, adjust the cold water supply pressure in steps to the values given in Table 10.

P.2.3 Measure and record the mixed-water temperature after each pressure change.

P.2.4 After the sixth change of the cold water supply pressure, slowly adjust the hot water supply pressure in steps to the values shown in Table 10.

P.2.5 Measure and record the mixed-water temperature after each pressure change.

P.2.6 Repeat the test method to give three sets of results for each specimen.

P.3 Expression of results

For the three test results calculate, for each numbered pressure change, the average change in mixed-water temperature from the actual initial setting.

Annex Q (normative) Test for temperature stability with changing water supply temperature

Q.1 Principle

The following temperature changes are determined:

a) the change in mixed-water temperature when one supply temperature is varied over the whole operating temperature range whilst the other supply remains constant;

b) the steady temperature to which the mixed water returns when the supply temperature is restored.

Q.2 Test method

Q.2.1 Connect the TMV to the test rig in accordance with Annex F and adjust to the initial setting given in Table 7 for the appropriate designation.

Q.2.2 Adjust the cold water supply temperature to the values given in Table 11. Maintain each cold water temperature for a minimum 120 s.

Q.2.3 Record mixed-water temperature (120 ±5) s after each temperature change.

Q.2.4 After the third change of the cold water supply temperature, adjust the hot water supply temperature in steps to the values given in Table 11. Maintain each hot water temperature for a minimum of 120 s.

Q.2.5 Record mixed-water temperature (120 ±5) s after each temperature change.

Q.3 Expression of results

Record the individual results of the change in mixed-water temperature from the initial setting.

Annex R (normative) Test for temperature stability at reduced flow rate

R.1 Principle

The purpose of the test is to determine the following temperature changes for TMVs having a set flow rate, in accordance with Table 7, greater than the appropriate value in Table 12:

a) the change in mixed-water temperature when the flow rate is reduced to low value with unequal supply pressures;

b) the steady temperature to which the mixed water returns when the flow rate and supply pressures are restored.

R.2 Test method

R.2.1 Connect the TMV to the test rig in accordance with Annex F and adjust to the initial setting given in Table 7 for the appropriate designation.

R.2.2 Reduce the cold water supply pressure to between 80% and 85% of the set flow pressure.

R.2.3 Using tap (6), slowly reduce flow rate to the appropriate value given in Table 12 maintaining the flow pressures. Where the TMV incorporates an integral flow control which allows the flow rate to be adjusted independent of the temperature, operate this control to reduce the flow rate.

R.2.4 Measure and record the mixed-water temperature.

R.2.5 Restore the cold water supply pressure to the initial setting and then return the flow rate to the initial set value.

R.2.6 Measure and record the mixed-water temperature.

R.2.7 Reduce the hot water supply pressure to between 80% and 85% of the set flow pressure.

R.2.8 Using tap (6), slowly reduce flow rate to the appropriate value given in Table 12 maintaining the flow pressures. Where the TMV incorporates an integral flow control which allows the flow rate to be adjusted independent of the temperature, operate this control to reduce the flow rate.

R.2.9 Measure and record the mixed-water temperature.

R.2.10 Restore the hot water supply pressure to the initial setting and then return the flow rate to the initial set value.

R.2.11 Measure and record the mixed-water temperature.

R.2.12 Repeat the test method to give three sets of results for each specimen.

R.3 Expression of results

R.3.1 For the three test results of flow reduction having hot pressure greater than cold, calculate the average change in mixed-water temperature from the actual initial setting.

R.3.2 For the three test results of flow reduction having cold pressure greater than hot, calculate the average change in mixed-water temperature, from the actual initial setting.

Annex S (normative) Additional testing after failure to meet performance and durability requirements

S.1 Where only one of the three test samples initially selected does not conform to Clause **11**, and fails by margins less than or equal to those specified in Table S.1, a further two test samples shall be selected and tested for conformity to Clause **11**.

Table S.1 **Maximum margins of failure**

Requirement	Margin of failure
11.5; **11.6**; **11.7**; **11.8**; **11.9**	+10% on average duration of transient temperature rises.
11.5; **11.6**; **11.7**; **11.8**; **11.9**; **11.12**	0.3 K on each steady mixed-water temperature after restoration of initial supply conditions.
11.9	+10% on average leakage volume;
	0.5 K on average reduction in mixed-water temperature.
11.10; **11.11**; **11.12**	0.5 K on average change in mixed-water temperature.

S.2 Where the initial test sample has been subjected to the durability of thermostat test, in accordance with **10.3** and failed, also subject one of the two additional test samples to the durability of thermostat test.

S.3 Only where the two additional test samples conform to Clause **11** and the test sample subjected to the durability of thermostat test conforms to **10.3**, can the TMV under test be claimed to conform to this standard.[2)]

[2)] Marking BS 7942:2011 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

Annex T (informative) Summary of thermal performance requirements

Table T.1 **Summary of thermal performance requirements for each sample**

Clause no.	Value	Run 1	Run 2	Run 3	Requirement
11.5	Shower initial	T_0	T_2	T_4	T_0 as Table 7
11.5	Bath initial	T_1	T_3	T_5	T_1 as Table 7
11.5	Shower transient	δT_0	δT_2	δT_4	Av.{δT_0, δT_2, δT_4} as Table 8
	Shower final	T_2	T_4	T_6	T_2, T_4, T_6 each = T_0 ±2
11.5	Bath transient	δT_1	δT_3	δT_5	Av.{δT_1, δT_3, δT_5} as Table 8
	Bath final	T_3	T_5	T_7	T_3, T_5, T_7 each = T_1 ±2
11.6	Lower initial	T_0	T_6	T_{12}	T_0 as Table 7
	Higher initial	T_1	T_7	T_{13}	T_1 as Table 7
11.6	Lower transient	δT_0	δT_6	δT_{12}	Av.{δT_0, δT_6, δT_{12}} as Table 8
	Higher transient	δT_1	δT_7	δT_{13}	Av.{δT_1, δT_7, δT_{13}} as Table 8
	Lower final	T_2	T_8	T_{14}	T_2, T_8, T_{14} each = T_0 ±2
	Higher final	T_3	T_9	T_{15}	T_3, T_9, T_{15} each = T_1 ±2
11.6	Lower transient	δT_2	δT_8	δT_{14}	Av.{δT_2, δT_8, δT_{14}} as Table 8
	Lower final	T_4	T_{10}	T_{16}	T_4, T_{10}, T_{16} each = T_0 ±2
	Lower transient	δT_4	δT_{10}	δT_{16}	Av.{δT_4, δT_{10}, δT_{16}} as Table 8
	Higher transient	δT_3	δT_9	δT_{15}	Av.{δT_3, δT_9, δT_{15}} as Table 8
	Lower final	T_6	T_{12}	T_{18}	T_6, T_{12}, T_{18} each = T_0 ±2
	Higher final	T_5	T_{11}	T_{17}	T_5, T_{11}, T_{17} each = T_1 ±2
11.6	Higher transient	δT_5	δT_{11}	δT_{17}	Av.{δT_5, δT_{11}, δT_{17}} as Table 8
	Higher final	T_7	T_{13}	T_{19}	T_7, T_{13}, T_{19} each = T_1 ±2
11.7	Initial	T_0	T_1	T_2	T_0 as Table 7
11.7	Transient	δT_0	δT_1	δT_2	Av.{δT_0, δT_1, δT_2} as Table 8
	Final	T_1	T_2	T_3	T_1,T_2,T_3 each = T_0 ±2
11.8	Initial	T_0	T_1	T_2	T_0 as Table 7
11.8	Transient	δT_0	δT_1	δT_2	Av.{δT_0, δT_1, δT_2} as Table 8
	Final	T_1	T_2	T_3	T_1,T_2,T_3 each = T_0 ±2
11.9	Initial	T_0	T_2	T_4	T_0 as Table 7
11.9	Transient	δT_0	δT_2	δT_4	Av.{δT_0, δT_2, δT_4} as Table 8
11.9	Transient	δT_0	δT_2	δT_4	Av.{δT_0, δT_2, δT_4} as Table 8
11.9	Final	T_1	T_3	T_5	T_1,T_3,T_5 each = T_0 ±2
(11.9)	(Minimum)	(δT_1)	(δT_3)	(δT_5)	(Av.{δT_1, δT_3, δT_5} as Table 9)
11.9	Transient	δT_1	δT_3	δT_5	Av.{δT_1, δT_3, δT_5} as Table 8
11.9	Final	T_2	T_4	T_6	T_2,T_4,T_6 each = T_0 ±2
11.10	Initial	T_0	T_{12}	T_{24}	T_0 as Table 7
11.10	Change 1	T_1	T_{13}	T_{25}	Av.{(T_1–T_0),(T_{13}–T_0),(T_{25}–T_0)} as Table 10
	Change 2	T_2	T_{14}	T_{26}	Av.{(T_2–T_0),(T_{14}–T_0),(T_{26}–T_0)} as Table 10
	Change 3	T_3	T_{15}	T_{27}	Av.{(T_3–T_0),(T_{15}–T_0),(T_{27}–T_0)} as Table 10
	Change 4	T_4	T_{16}	T_{28}	Av.{(T_4–T_0),(T_{16}–T_0),(T_{28}–T_0)} as Table 10
	Change 5	T_5	T_{17}	T_{29}	Av.{(T_5–T_0),(T_{17}–T_0),(T_{29}–T_0)} as Table 10
	Change 6	T_6	T_{18}	T_{30}	Av.{(T_6–T_0),(T_{18}–T_0),(T_{30}–T_0)} as Table 10

Table T.1 **Summary of thermal performance requirements for each sample** *(continued)*

Clause no.	Value	Run 1	Run 2	Run 3	Requirement
11.10	Change 1	T_7	T_{19}	T_{31}	Av.{(T_7–T_0),(T_{19}–T_0),(T_{31}–T_0)} as Table 10
	Change 2	T_8	T_{20}	T_{32}	Av.{(T_8–T_0),(T_{20}–T_0),(T_{32}–T_0)} as Table 10
	Change 3	T_9	T_{21}	T_{33}	Av.{(T_9–T_0),(T_{21}–T_0),(T_{33}–T_0)} as Table 10
	Change 4	T_{10}	T_{22}	T_{34}	Av.{(T_{10}–T_0),(T_{22}–T_0),(T_{34}–T_0)} as Table 10
	Change 5	T_{11}	T_{23}	T_{35}	Av.{(T_{11}–T_0),(T_{23}–T_0),(T_{35}–T_0)} as Table 10
	Change 6	T_{12}	T_{24}	T_{36}	Av.{(T_{12}–T_0),(T_{24}–T_0),(T_{36}–T_0)} as Table 10
11.11	Initial	T_0	—	—	T_0 as Table 7
11.11	Change 1	T_1	—	—	(T_1–T_0) as Table 11
	Change 2	T_2	—	—	(T_2–T_0) as Table 11
	Change 3	T_3	—	—	(T_3–T_0) as Table 11
11.11	Initial	T_0	—	—	T_0 as Table 7
11.11	Change 1	T_1	—	—	(T_1–T_0) as Table 11
	Change 2	T_2	—	—	(T_2–T_0) as Table 11
	Change 3	T_3	—	—	(T_3–T_0) as Table 11
11.12	Initial	T_0	T_4	T_8	T_0 as Table 7
11.12	Low flow	T_1	T_5	T_9	Av.{(T_1–T_0),(T_5–T_0),(T_9–T_0)} as Table 12
11.12	Final	T_2	T_6	T_{10}	Av.{(T_2–T_0),(T_6–T_0),(T_{10}–T_0)} as Table 12
11.12	Low flow	T_3	T_7	T_{11}	Av.{(T_3–T_0),(T_7–T_0),(T_{11}–T_0)} as Table 12
11.12	Final	T_4	T_8	T_{12}	Av.{(T_4–T_0),(T_8–T_0),(T_{12}–T_0)} as Table 12

Annex U (informative) Recommendations on commissioning and in-service tests

U.1 Commissioning

U.1.1 Principle

Since the installed supply conditions are likely to differ from those applied in the laboratory tests, it is appropriate, following installation, to carry out some simple checks and tests on each TMV to provide a performance reference point for future in-service tests.

NOTE Where commissioning of the thermostatic mixing valve is carried out at inlet supply conditions not representative of usual (day-to-day) operating conditions, the resulting settings might lead to the valve supplying water at elevated temperatures.

U.1.2 Procedure

U.1.2.1 Check that:

a) the designation of the TMV is suitable for the intended application;

b) the supply pressures are within the range of operating pressures for the designation of the installed TMV; and

c) the supply temperatures are within the range permitted for the TMV and by guidance information on the prevention of bacterium such as legionella from growing, e.g. HTM 04.

U.1.2.2 Adjust the temperature of the mixed water in accordance with the manufacturer's instructions and the requirement of the application and then carry out the following sequence.

a) Record the temperature of the hot and cold water steady state supplies.

b) Record the temperature of the mixed water at the highest steady state draw-off flow rate.

c) Record the temperature of the mixed water at a lowest steady state draw-off flow rate, by measurement.

d) Isolate the cold water supply to the TMV and monitor the mixed-water outlet.

e) Record the maximum temperature achieved as a result of **U.1.2.2**d) and the final temperature.

f) Where there is no flow then restore the cold water supply and check that the final stabilized mixed-water temperature does not exceed the values given in Table U.1.

g) Where there is a flow of water from the mixed-water outlet, then 5 s after isolating the cold water, collect any discharging water into a measuring vessel for 60 s.

NOTE 1 The volume of water collected should total less than 120 ml.

h) Restore the cold water supply and verify that the final stabilized mixed-water temperature does not exceed the values given in Table U.1.

NOTE 2 Any rise in temperature of the mixed water above the values given in Table U.1 should occur only briefly.

i) Record the equipment used for the measurements.

Table U.1 **Recommended maximum continuous temperature during site tests**

Application	**Mixed-water temperature** °C
Bidet	40
Shower	43
Washbasin	43
Bath (44 °C fill)	46
Bath (46 °C fill)	48

U.2 In-service tests

U.2.1 Principle

The purpose of in-service tests is to regularly monitor and record the performance of the TMV. Deterioration in performance can indicate the need for service work on the TMV and/or the water supplies.

U.2.2 Test method

U.2.2.1 Carry out the test method **U.1.2.2**a) to **U.1.2.2**c) using the measuring equipment recorded in **U.1.2.2**f), or equipment to the same specifications. Where the mixed-water temperature has changed significantly from the previous test results (e.g. >1 K), record the change.

U.2.2.2 Before resetting the mixed-water temperature, check that:

a) in-line or integral strainers are clean;

b) in-line or integral check valves or other backflow prevention devices are in good working order; and

c) isolating valves are fully open.

U.2.2.3 With an acceptable mixed-water temperature, complete the test method **U.1.2.2**d) to **U.1.2.2**f).

U.2.2.4 Where at step **U.1.2.2**e) the final mixed-water temperature is greater than the values in Table U.1 and/or the maximum temperature exceeds the corresponding value from the previous test results by more than about 2 K, the need for service work is indicated.

NOTE In-service tests should be carried out as a minimum in accordance with Annex V.

Annex V (informative)

Frequency of in-service tests

V.1 In the absence of any other instruction or guidance on the means of determining the appropriate frequency of in-service testing, the test method given in **V.2** to **V.5** may be used.

V.2 Carry out the tests given in **U.2.2** 6 to 8 weeks after commissioning.

V.3 Carry out the tests given in **U.2.2** 12 to 15 weeks after commissioning.

V.4 Depending on the results of **V.2** and **V.3** follow one of a) to d), as appropriate.

a) Where no significant changes (e.g. 1 K) in mixed-water temperatures are recorded between commissioning and **V.2**, or between commissioning and **V.3**, the next in-service test can be deferred from 24 weeks to 28 weeks after commissioning.

b) Where small changes (i.e. 1 K to 2 K) in mixed-water temperatures are recorded in only one of these periods necessitating adjustment of the mixed-water temperature, then the next in-service test can be deferred from 24 weeks to 28 weeks after commissioning.

c) Where small changes (i.e. 1 K to 2 K) in mixed-water temperatures are recorded in both of these periods, necessitating adjustment of the mixed-water temperature, then carry out the next in-service test at 18 weeks or up to 21 weeks after commissioning;

d) Where significant changes (i.e. >2 K) in mixed-water temperatures are recorded in either of these periods, necessitating service work, then carry out the next in-service test at 18 weeks or up to 21 weeks after commissioning.

V.5 After the first two or three in-service tests, set the intervals of future tests to those which previous tests have shown can be achieved with no more than a small change in mixed-water temperature.

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For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 1111, *Sanitary tapware – Thermostatic mixing valves (PN 10) – General technical specification*

BS EN 1287, *Sanitary tapware – Low pressure thermostatic mixing valves – General technical specifications*

Other publications

[1] DEPARTMENT OF HEALTH. *Health Technical Memorandum 04-01: The control of legionella, hygiene, "safe" hot water, cold water and drinking water systems (Part A and Part B).* London: The Stationery Office, 2006.

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