BRITISH STANDARD

BS EN 1111:1999

Sanitary tapware — Thermostatic mixing valves (PN 10) — General technical specification

The European Standard EN 1111:1998 has the status of a British Standard

ICS 91.140.70

National foreword

This British Standard is the English language version of EN 1111:1998.

The UK participation in its preparation was entrusted by Technical Committee B/504, Water supply, to Subcommittee B/504/8, Terminal fittings, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 35 and a back cover.

Amendments issued since publication

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EUROPEAN STANDARD

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EUROPÄISCHE NORM

EN 1111

May 1998

ICS 91.140.70

Descriptors: sanitary valves, mixing valves, thermostatic valves, specifications, classifications, designation, dimensions, leaktightness, performance evaluation, hydraulic properties, mechanical properties, acoustic properties, tests, fatigue tests, marking

English version

Sanitary tapware — Thermostatic mixing valves (PN 10) — General technical specification

Robinetterie sanitaire — Mitigeurs thermostatiques (PN 10) — Spécifications techniques générales

Sanitärarmaturen — Thermostatische Mischer (PN 10) — Allgemeine technische Spezifikation

This European Standard was approved by CEN on 7 May 1998.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization

Comité Européen de Normalisation

Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 1111:1998 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 164, Water supply, the Secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 1998, and conflicting national standards shall be withdrawn at the latest by November 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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Introduction

In respect of potential adverse effects on the quality of water intended for human consumption, caused by the product covered by this standard:

1) this standard provides no information as to whether the product may be used without restriction in any of the Member state of the EU or EFTA;

2) it should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

1 Scope

This European Standard specifies:

— the dimensional, leaktightness, mechanical and hydraulic performance, mechanical endurance and acoustic characteristics with which thermostatic mixing valves shall comply;

— the procedures for testing these characteristics.

It is applicable:

— to thermostatic mixing valves intended for use on sanitary appliances in washrooms (toilets, bathrooms etc.) and in kitchens;

— to PN 10 thermostatic mixing valves used under the pressure and temperature conditions given in Table 1.

This standard allows for the use of thermostatic mixing valves to supply a single outlet or a small number of outlets in a "domestic" application (e.g. one valve, controlling a shower, bath, basin, bidet) but excludes valves specifically designed for supplying a large number of outlets (i.e. for institutional use).

2 Normative references

This European Standard incorporates by dated or undated references provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 31, *Pedestal wash basins — Connecting dimensions.*

EN 32, *Wall hung wash basins — Connecting dimensions.*

EN 35, *Pedestal bidets over rim supply only — Connecting dimensions.*

EN 36, *Wall hung bidets over rim supply only — Connecting dimensions.*

EN 111, *Wall hung hand rinse basins — Connecting dimensions.*

EN 200, *Sanitary tapware — General technical specifications for single taps and mixer taps (Nominal size 1/2) PN 10 — Minimum flow pressure of 0,05 MPa (0,5 bar).*

EN 232, *Baths — Connecting dimensions.*

EN 246, *Sanitary tapware — General specifications for flow rate regulators.*

EN 248, *Sanitary tapware — General technical specifications for electrodeposited nickel chrome coatings.*

EN 695, *Kitchen sinks — Connecting dimensions.*

prEN 1717, *Protection against pollution of potable water in drinking water installations and general requirements of devices to prevent pollutions by backflow.*

prEN ISO 3822-1, *Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 1: Method of measurement.*
(ISO/DIS 3822-1:1995)

EN ISO 3822-2, *Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 2: Mounting and operating conditions for draw-off taps and mixing valves.*
(ISO 3822-2:1995)

EN ISO 3822-3, *Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 3: Mounting and operating conditions for in-line valves and appliances.*

EN ISO 3822-4:1997, *Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 4: Mounting and operating conditions for special appliances.*

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

Table 1 — Conditions for the use of thermostatic mixing valves

	Limits of use	Recommended limits for correct operation
Dynamic pressure	0,05 MPa (0,5 bar) min.	0,1 MPa ≤ P ≤ 0,5 MPa (1 bar ≤ P ≤ 5 bar)
Static pressure	1 MPa (10 bar) max.	—
Hot water temperature	T ≤ 90 °C	55 °C ≤ T ≤ 65 °C
Cold water temperature		T ≤ 25 °C
NOTE Thermostatic mixing valves intended for use at flow pressure below those in this table are covered by prEN 1287.		

3 Definition

For the purposes of this standard the following definition applies:

thermostatic mixing valve

a valve, with one or more outlets, which mixes hot and cold water and automatically controls the mixed water to a user selected temperature. The flow rate between no flow and maximum flow conditions can be effected either by the same control device or a separate flow control device, where fitted

4 Classification

This classification covers the following types of thermostatic mixing valves:

Type 1 — Single control: Thermostatic mixing valves with a single control device for regulating flow rate and temperature;

Type 2 — Dual control: Thermostatic mixing valves with two separate control devices for regulating flow rate and temperature;

Type 3 — Single sequential control: Thermostatic mixing valves with a single control which operates through a predetermined sequence of flow and temperature. It shall have a shut-off device;

Type 4 — Thermostatic mixing valves without flow control device;

Type 5 — Other: Thermostatic mixing valves with special control devices.

5 Designation

The thermostatic mixing valves covered by this standard are designated as follows:

— its nominal size (1/2 or 3/4) (see Table 4), with or without diverter (see Table 2);

— type of body (see Table 2);

— type of nozzle (see Table 2);

— the sanitary appliance on which it is to be used (Table 2);

— the method of mounting (see Table 2);

— its acoustic group and flow rate classes (clause **14**);

— the reference to this standard, EN 1111;

— in the case of a thermostatic bath/shower mixing valve, the flow rate shall be designated by both flow rate classes. The first for the bath outlet, the second for the shower outlet.

EXAMPLE

Thermostatic mixing valve 1/2, with diverter, visible body, fixed nozzle outlet, bath/shower, horizontal mounting, group I class C/B EN 1111.

Table 2 — Designation

Diverter	with or without diverter
Type of body	two hole, single hole, visible or concealed
Type of nozzle	fixed/moveable outlet, no nozzle outlet
Intended use	basin, bidet, sink, bath or shower
Mounting method	horizontal or vertical surfaces

6 Marking/Identification

6.1 Marking

Thermostatic mixing valves complying with this standard shall be permanently and legibly marked with:

— the mark or name of the manufacturer;

— the acoustic group and flow rate class or classes.

In the case of a thermostatic bath/shower mixing valve, both flow rate classes shall be marked, the first for the bath outlet, the second for the shower outlet.

6.2 Identification

The temperature control device for the valve shall be identified:

— by means of a scale and/or symbols;

— and/or by colours (cold water blue, hot water red).

Thermostatic mixing valves shall be legibly marked with the colour red on the hot water inlet and the colour blue on the cold water inlet. Those with interchangeable supplies need not be marked.

7 Materials

7.1 Chemical and hygienic characteristics

All materials in contact with water intended for human consumption shall present no health risk up to a temperature of 90 °C. They shall not cause any deterioration in water intended for human consumption with regard to food quality, appearance, odour or taste.

Within the recommended limit given in clause **1** for correct operation, the materials shall not be subject to any deterioration which might compromise the operation of the thermostatic mixing valve. Pressurized parts shall withstand the limits of use set in Table 1. Material with inadequate corrosion resistance shall be given additional protection.

7.2 Exposed surface condition and quality of coating

Visible chromium plated surfaces and Ni-Cr coatings shall comply with the requirements of EN 248.

8 Dimensional characteristics

8.1 General comment on drawings

The design and construction of components without defined dimensions permits various design solutions to be adopted by the manufacturer.

Special cases are covered in **8.5**.

8.2 Thermostatic mixing valves mounted on horizontal surfaces

The standardized dimensions of thermostatic mixing valves:

— firstly, guarantee their mounting and interchangeability on sanitary appliances complying with EN 31, EN 32, EN 35, EN 36, EN 111, EN 232 and EN 695;

— secondly, give the various options for connection with the water supply.

8.2.1 ***Single-hole thermostatic mixing valve — Visible body (see Table 3)***

8.2.1.1 *Without spray attachment [see Figure 1a)]*

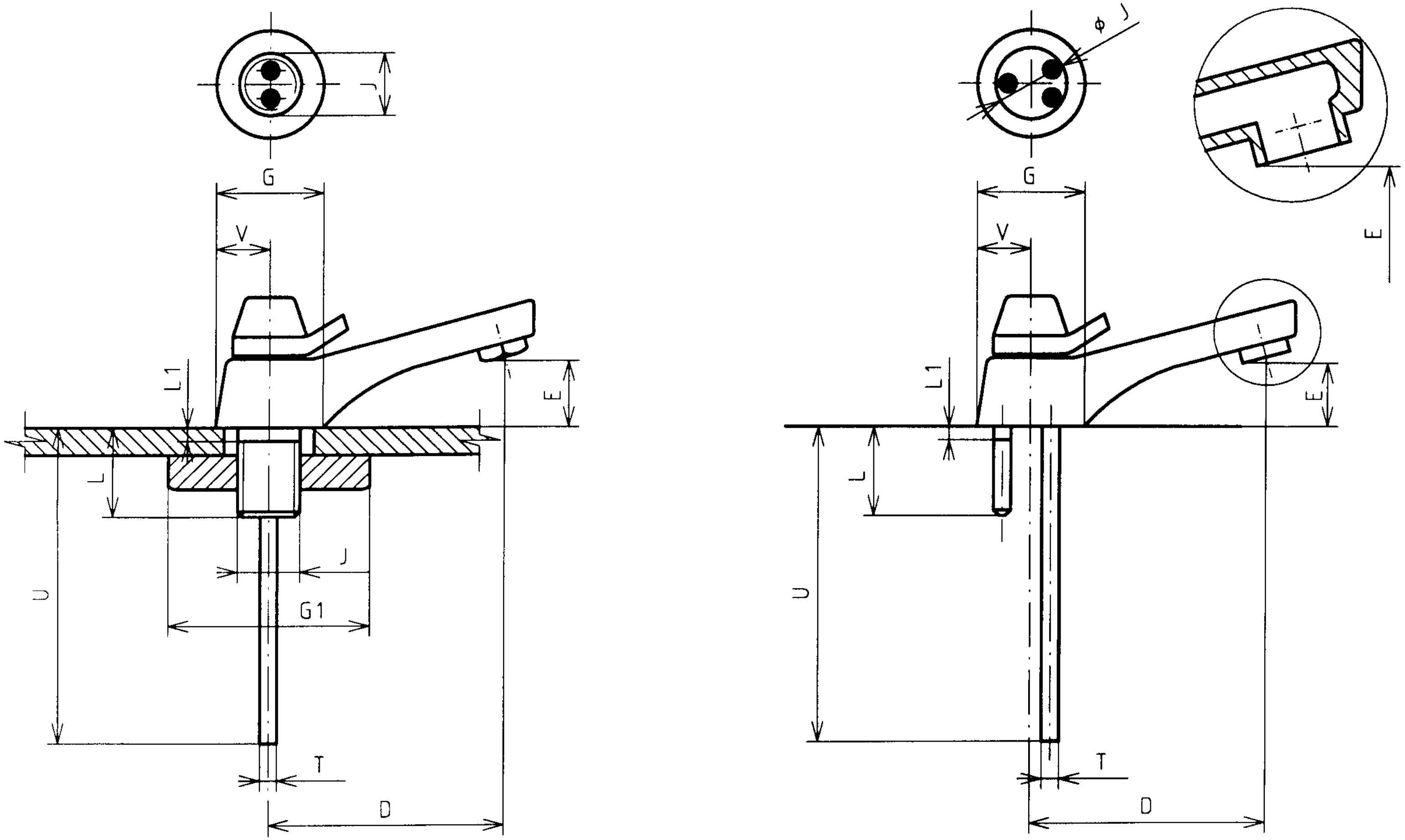


Figure 1a) — Single-hole thermostatic mixing valve without spray attachment

8.2.1.2 *With spray attachment [see Figures 1b) and 1c)].*

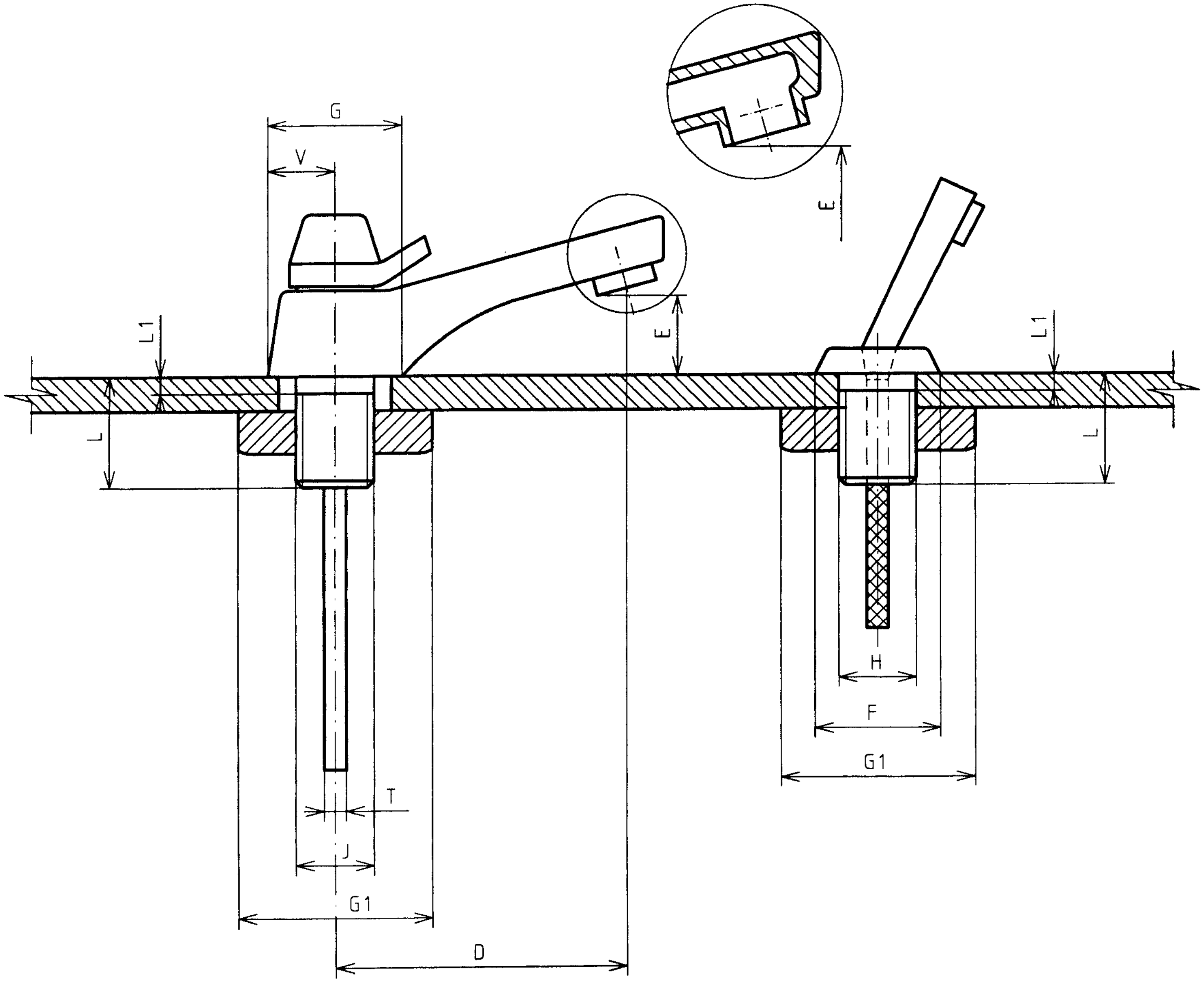


Figure 1b) — Single hole thermostatic mixing valve with remote spray attachment

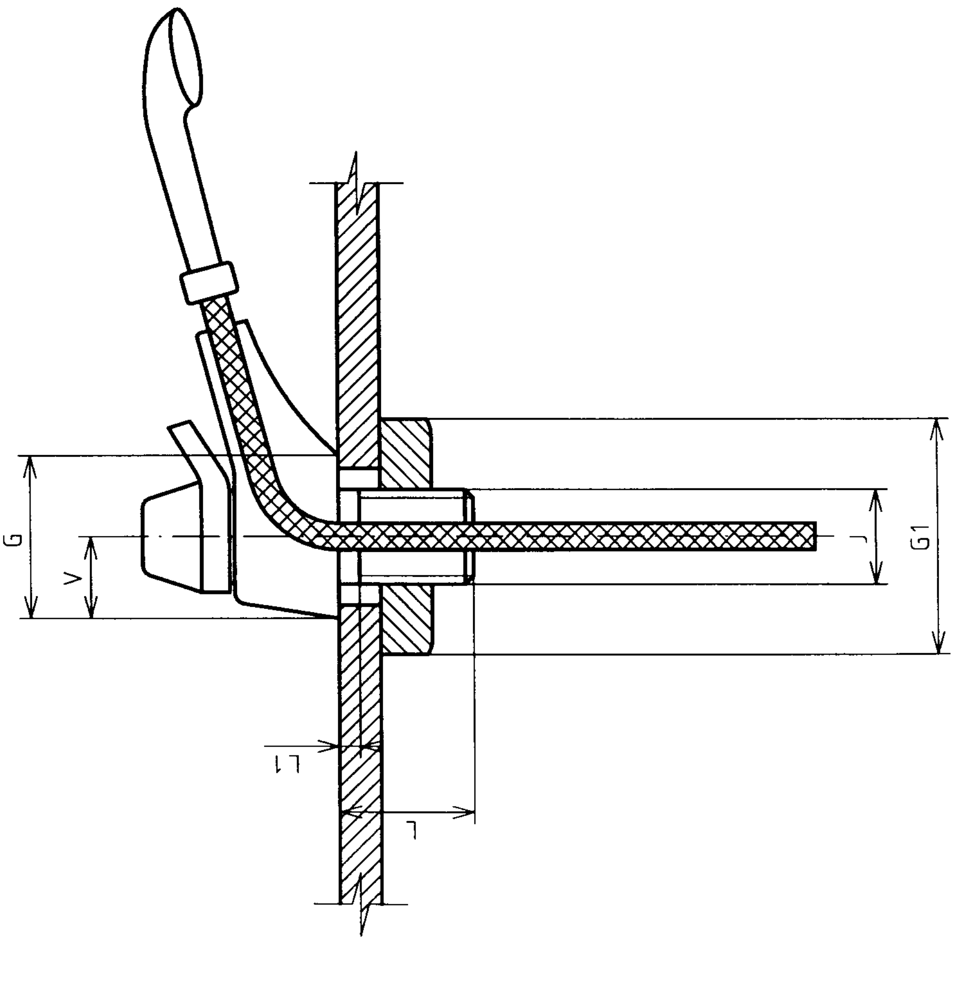


Figure 1c) — Single hole thermostatic mixing valve with integral spray attachment

8.2.1.3 *Flexible hoses for water supply*

Dimensions in millimetres

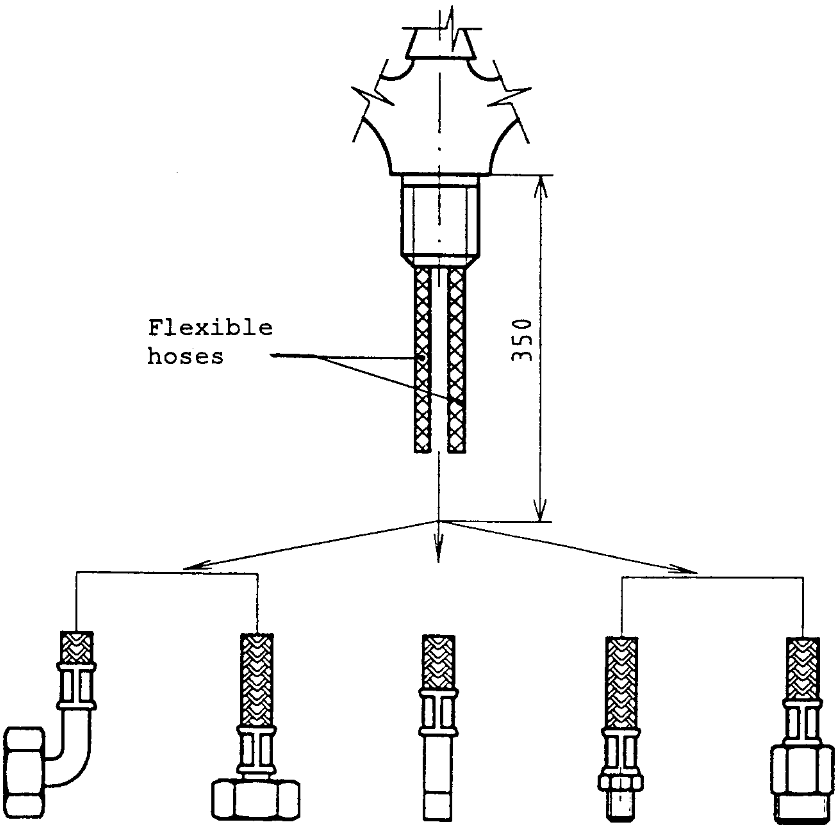


Figure 2 — Flexible hoses for water supply

NOTE 1 Flexible hoses for water supply can be used with the thermostatic mixing valves shown in Figures 1a), 1b), 1c), 5 and 6. The inlet connections shown are typical examples only. Other methods of connection to the supply are permissible.

NOTE 2 Supply hoses should comply with the requirements of draft standard, *("Flexible hoses for water supply")* (WI 00164121).

Table 3 — Single hole visible body thermostatic mixing valves with or without spray attachment [see Figures 1a), 1b), 1c)]. Thermostatic mixing valves with remote outlet (see Figures 5 and 6)

Dimension	Values mm	Comments
D	100 min.	Dimension from the centre of outlet, as supplied i.e, orifice with or without flow rate regulator
E	25 min.	Dimension from lowest point of the outlet orifice to the mounting surface
F	42 min. wash-basin, bidet, sink, bath	Smallest dimension of the remote spray attachment base
G	45 min.	Smallest dimension of the thermostatic mixing valve base
G1	External diameter: 50 max.	Clamping washer
H	29 max.	Shank diameter of remote spray attachment
J	33,5 max.	The two inlet pipes and retention stud shall be contained in a circle of diameter J.
L and L1	Dimensions which allow thermostatic mixing valves to be fitted on to supports of thickness between 1 mm and 18 mm	
T	Copper tube ø 10 external Hose	Plain or G 3/8 male or female thread or G 1/2 male or female thread Plain end exterior ø 10 or with G 3/8 male or female thread or G 1/2 male or female thread
U	350 min.	
V	35 max. for baths 32 max. for wash-basins, bidets and sinks	Projection of thermostatic mixing valve base to rear measured from axis of diameter J
NOTE Dimensions J,T and U are not fixed for baths and are left to the discretion of the manufacturer.		

8.2.2 ***Two-hole thermostatic mixing valve with visible body mounted on horizontal surface (see Table 4 and Figure 3)***

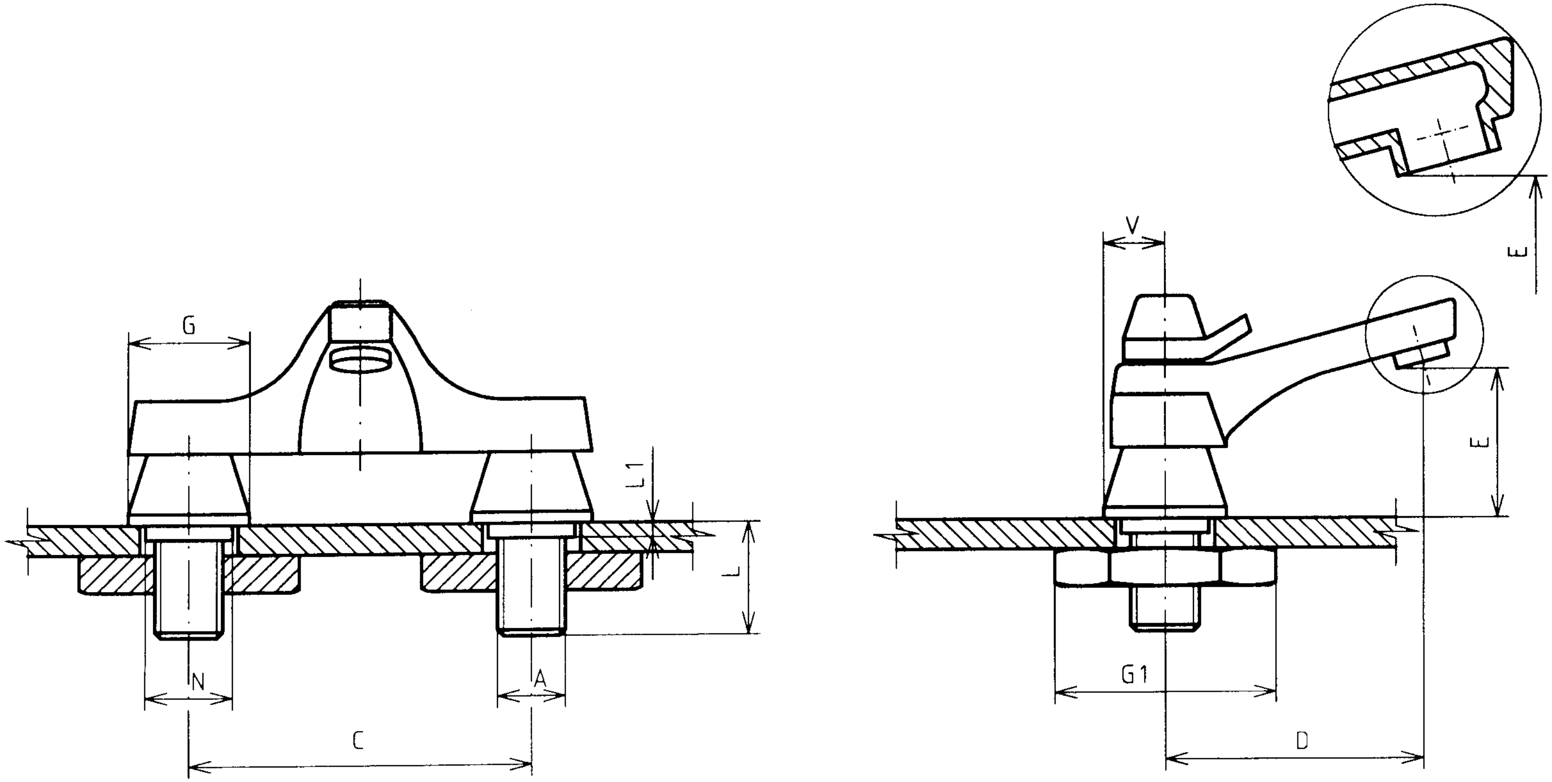


Figure 3 — Two-hole thermostatic mixing valve with visible body on horizontal surface

Table 4 — Two-hole thermostatic mixing valves with visible body on horizontal surface

Dimension	Values mm	Comments
A	G 1/2 B G 3/4 B	See ISO 228-1
C	200 + 3,5/-1 Wash-basin/bidet/sink 150 ± 1 Bath	
D	100 min.	Dimension from the centre of outlet orifice, as supplied i.e. with or without flow rate aerator
E	25 min.	Dimension from lowest point of the outlet orifice to the mounting surface
G	42 min. Wash-basin/bidet/sink 45 min. Bath	Smallest dimension of base
G1	External diameter: 50 max.	Clamping washer
L and L1	Dimensions which shall allow thermostatic mixing valves to be fitted on to supports of thickness between 1 mm and 18 mm and connection with the water supply	
N	24 max.	
V	35 max. for baths 32 max. for wash-basins, bidets and sinks	Projection of thermostatic mixing valve base to rear, measured from axis of diameter A

8.2.2.1 *Dimensions of connecting ends (see Figure 4 and Table 5)*

If the connecting ends are machined to accept a supply tube the dimensions shall be as given in Table 5 (e.g. type 1 or type 2).

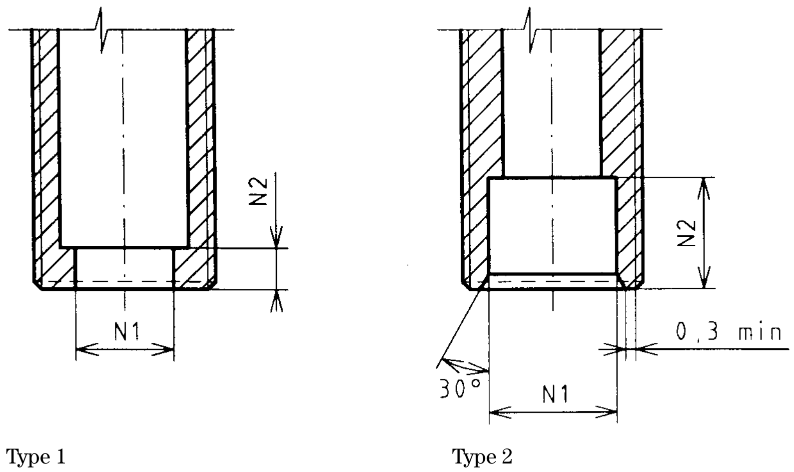


Figure 4 — Dimensions of connecting ends

Table 5 — Dimensions of connecting ends

Dimension	Values mm	
	type 1	type 2
N1	$12{,}3\ ^{+0{,}2}_{0}$	15,2 ± 0,05
N2	5 min.	13 min. with a 30° chamfer and a flat of 0,3 min. at the entry to the bore

8.2.3 ***Thermostatic mixing valve with remote outlet (see Table 3)***

8.2.3.1 *With separate spray attachment (see Figure 5)*

8.2.3.2 *With separate nozzle outlet (see Figure 6)*

8.2.4 ***Thermostatic mixing valve remotely mounted from sanitary appliance***

The design, execution, and dimensions are left to the discretion of the manufacturer. The connecting threads shall comply with ISO standards.

If the air gap, dimension E ≥ 25 mm, is not complied with, a suitable backflow protection device in accordance with prEN 1717 is required.

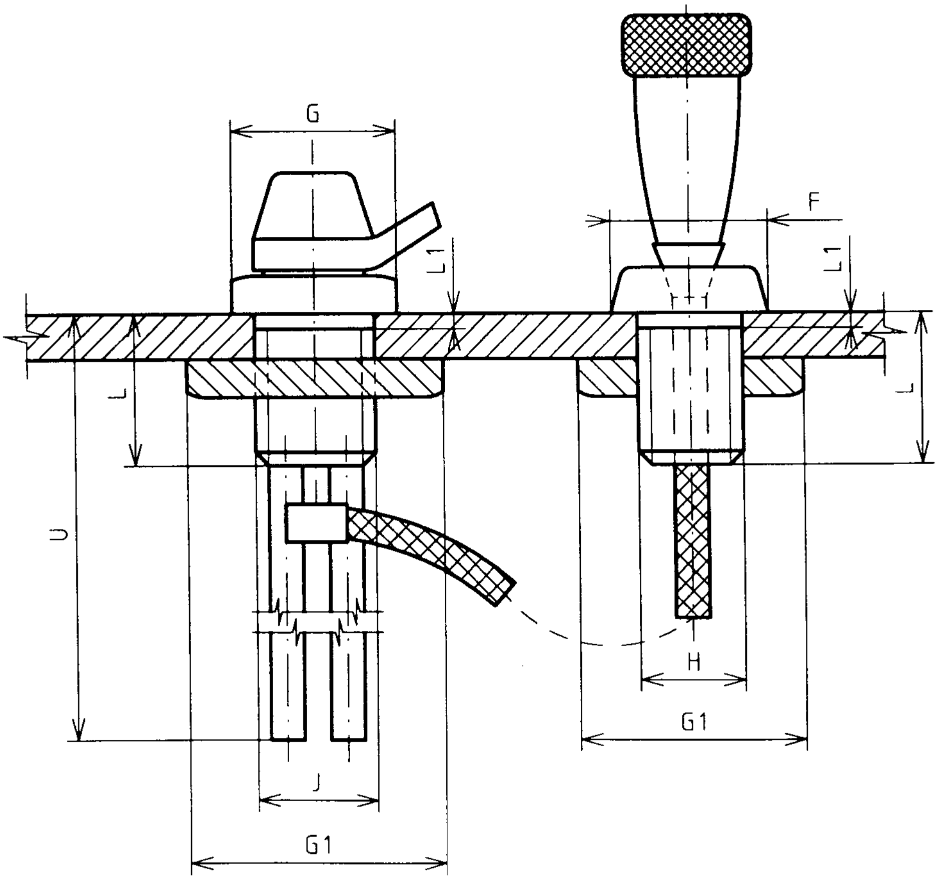


Figure 5 — Thermostatic mixing valve with remote spray attachment

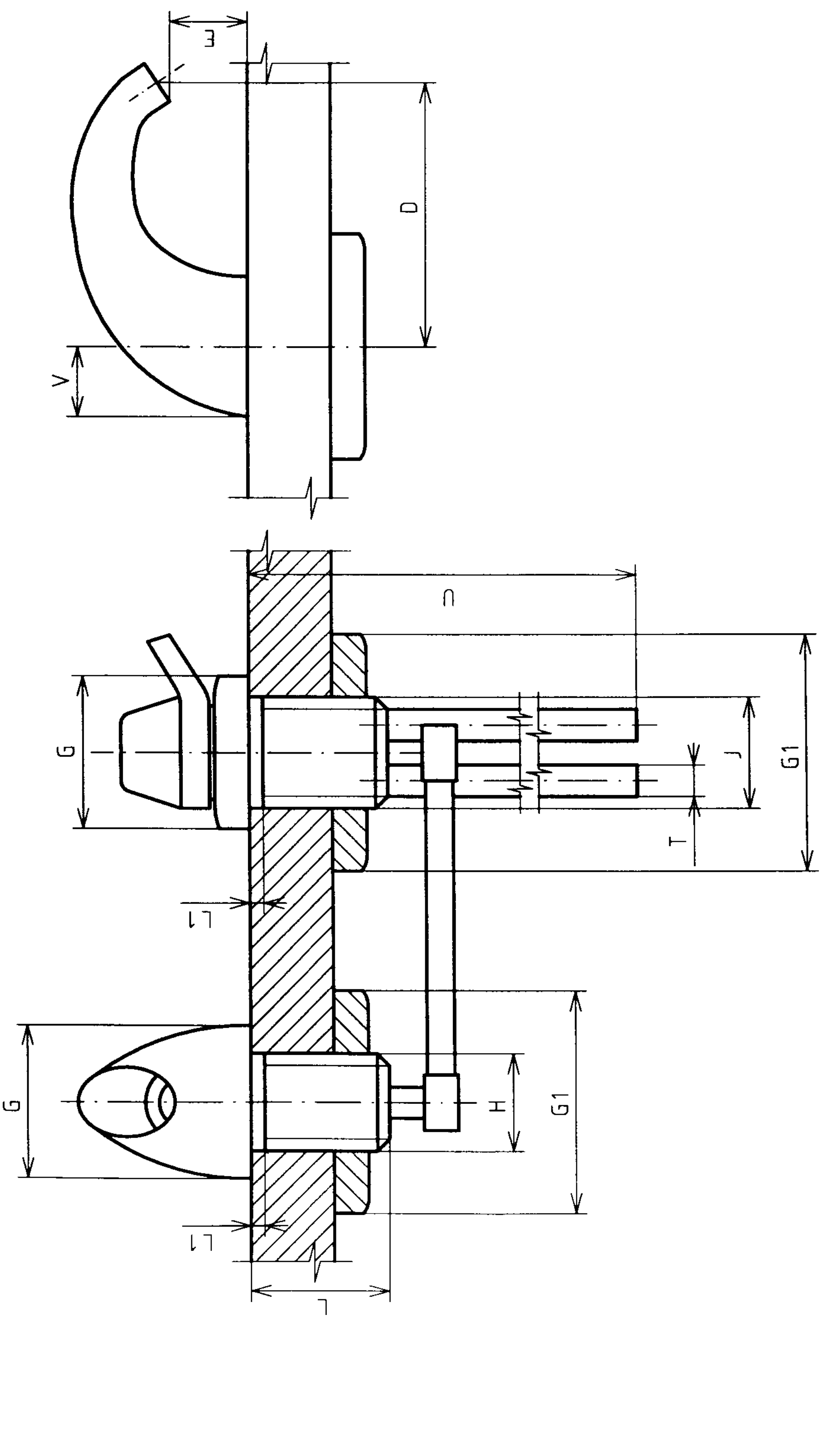


Figure 6 — Thermostatic mixing valve with separate nozzle outlet

8.3 Thermostatic mixing valves mounted on vertical surfaces

The specified dimensions of thermostatic mixing valves define different configurations for connection to the water supply.

8.3.1 ***Two holes thermostatic mixing valve with visible body***

8.3.1.1 *With straight unions (see Figure 7)*

8.3.1.2 *With eccentric unions (see Figure 8)*

8.3.1.3 *With captive nuts (see Figure 9)*

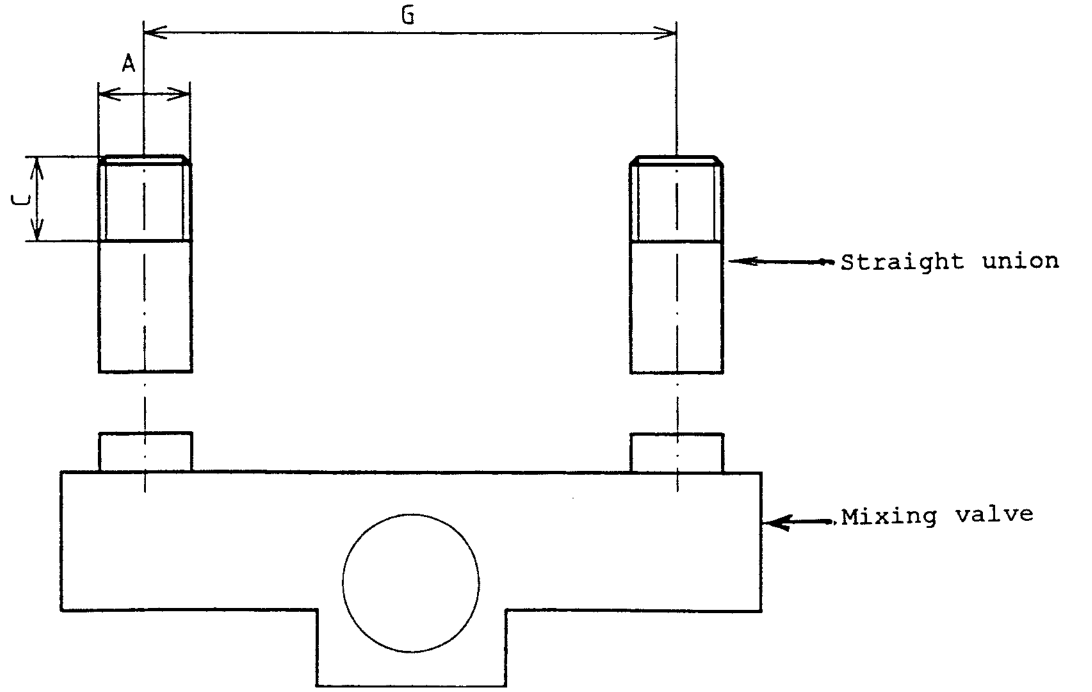


Figure 7 — Thermostatic mixing valve with straight unions

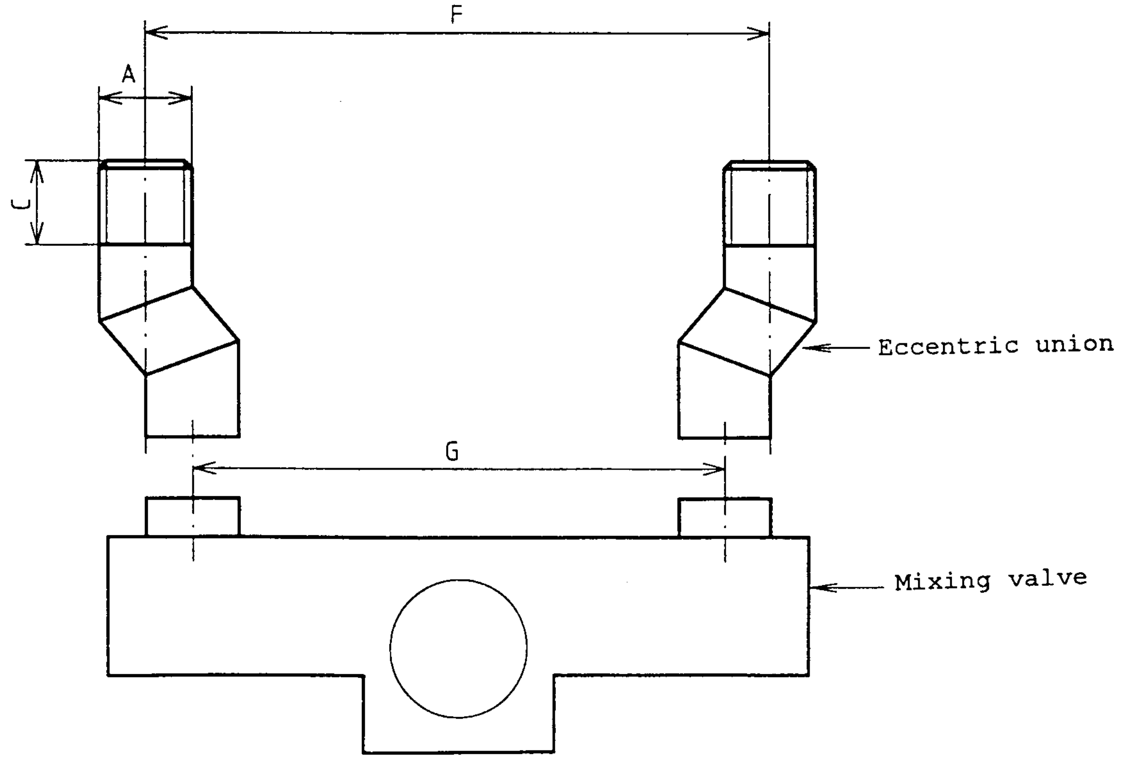


Figure 8 — Thermostatic mixing valve with eccentric unions

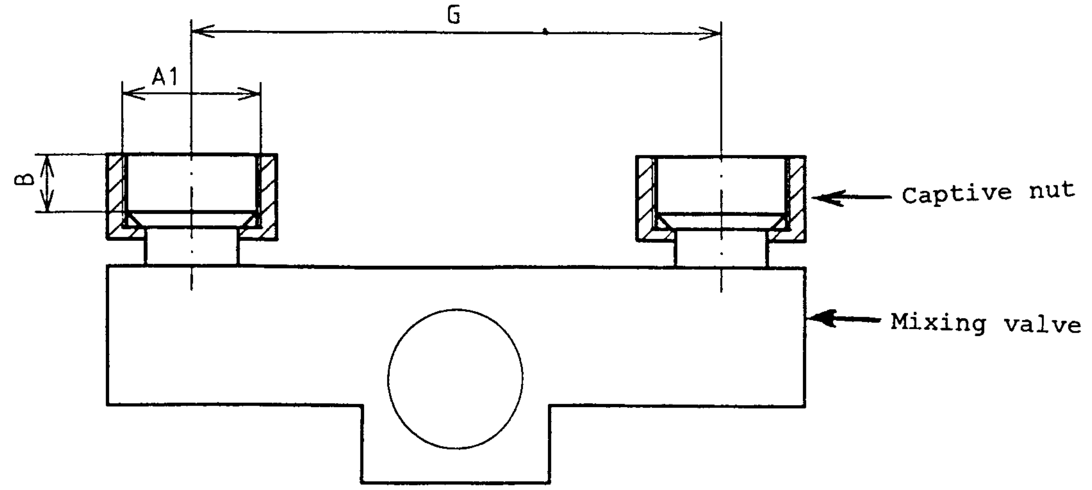


Figure 9 — Thermostatic mixing valve with captive nuts

Table 6 — Connection dimensions (see Figures 7, 8 and 9)

Dimension	Values mm	Comments
A*)	G 1/2 B or G 3/4 B	ISO 228-1
A1	G 3/4	ISO 228-1
B	9 min.	Useful thread length (excluding washer)
C	15 min.	Useful thread length
F	140 to 160	Extension of this range is permitted
G	150 ± 1	
*) It is permitted to serrate or knurl this thread to assist the retention of sealing tape or compounds. In such cases the lower limit deviation on the basic major diameter indicated in ISO 228-1 may be increased to −0,35 mm.		
NOTE the use of deformable washers is permitted.		

8.3.2 ***Outlet dimension (see Figure 10 and Table 7)***

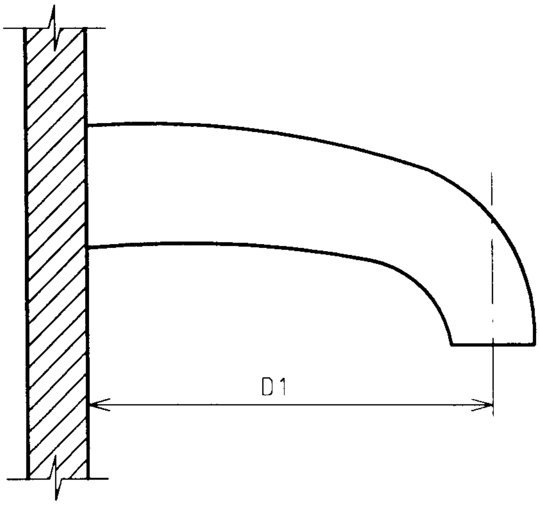


Figure 10 — Outlet dimension

Table 7 — Outlet dimension

Dimension	Values mm	Comments
D1	115 min.	The actual manufacturing dimension shall be such that the thermostatic mixing valve can fulfil its function depending on the sanitary appliance for which it is intended

8.3.3 ***Thermostatic mixing valves with concealed or single hole body***

The design, execution and dimensions are left to the discretion of the manufacturer. The connecting threads shall comply with ISO 228-1.

8.4 Dimensions of water outlets

8.4.1 ***Nozzle outlets for use with flow rate regulators***

When nozzle outlets are used with flow rate regulators:

a) conforming with EN 246, dimensions are indicated in Tables 8 and 9;

b) not conforming with EN 246, those thermostatic mixing valves are covered by **8.5**.

In order to ensure interchangeability of flow rate regulators, the manufacturing tolerances chosen for the connecting threads of the outlets shall be compatible with those of the standard connecting threads of the flow rate regulators.

8.4.1.1 *With internal thread (see Figure 11 and Table 8)*

8.4.1.2 *With external thread (see Figure 12 and Table 9)*

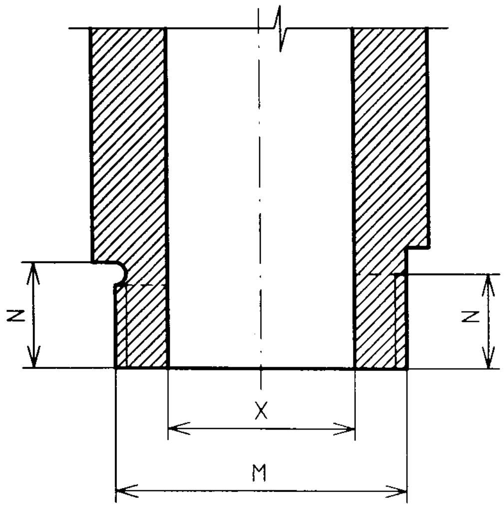


Table 8 — Dimensions for nozzle outlet

Dimensions in millimetres

M	M 22 × 1 – 6 g
X	14 min. to 17 max.
N	4,5 min.

Figure 11 — Nozzle outlet for flow rate regulator with internal thread

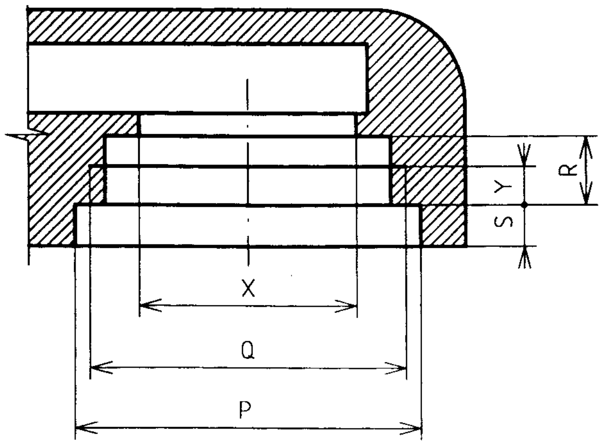


Table 9 — Dimensions for nozzle outlet

Dimensions in millimetres

Q	M 24 × 1 – 6 H	M 28 × 1 – 6 H
P	ø 24,2 min.	ø 28,3 min.
R	4,5 ± 0,2	6 ± 0,2
S	1,5 to 4,5	3,5 to 9,5
X	14 min. to 17 max.	15 min. to 19 max.
Y	3 min.	4,5 min.

Figure 12 — Nozzle outlet for flow rate regulator with external thread

8.4.2 ***Shower outlet connection (see Figures 13, 14 and Table 10)***

8.5 Special cases

8.5.1 ***Special thermostatic mixing valves for installation on horizontal surfaces***

Thermostatic mixing valves intended for special applications e.g. for installation on sanitary appliances not conforming with European Standards or where dimensional interchangeability is not a requirement etc., may incorporate dimensional deviations, provided:

— all other requirements of this standard are satisfied;

— secure fixing to the mounting surface is provided with all fixing holes covered and watertight connections to the supplies achieved;

— water shall be delivered without undue splashing:

— the air gap dimension E ≥ 25 mm. If E is less than 25 mm an additional backflow prevention device is necessary in accordance with prEN 1717;

— the manufacturer's literature including the installation instructions supplied with the tapware shall indicate clearly that this tapware is a special case.

8.5.2 ***Special thermostatic mixing valves for installation on vertical surfaces***

Thermostatic mixing valves with a visible body intended for special applications, or where dimensional interchangeability is not a requirement etc., may incorporate dimensional deviations, provided:

— all other requirements of this standard are satisfied;

— secure fixing and watertight connections to the water supply are achieved and if connection to the pipes is by means of a thread, this shall comply with ISO 228-1;

— the manufacturer's literature, including the installation instructions supplied with the tapware, shall indicate clearly that this tapware is a special case.

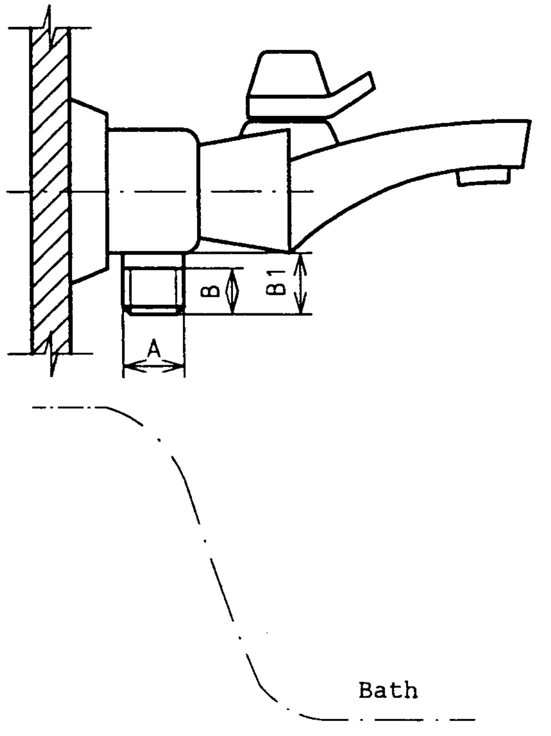


Figure 13 — Downward shower outlet

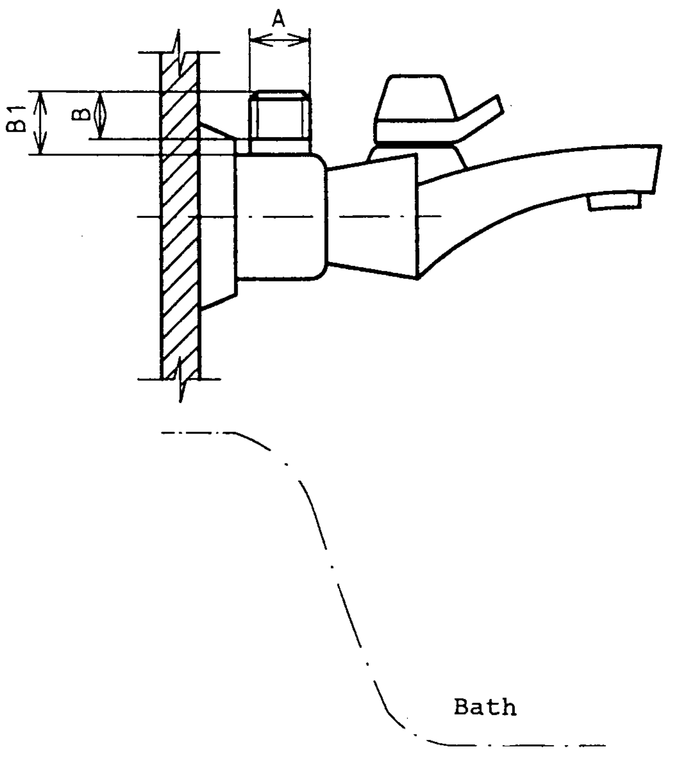


Figure 14 — Upward shower outlet

Table 10 — Shower outlet dimensions

Dimension	Values mm	Comments
B	7,5 min.	Connecting thread for shower hoses Useful thread length
B1	9,5 min.	Free length for connecting nut
A	G 1/2 B*) or G 3/4 B	ISO 228-1
*) Preferred dimension. There shall be sufficient space between the wall and the shower connection to allow tightening, release and appropriate directional adjustment of the shower connection.		

9 Leaktightness characteristics

9.1 General

The tests described are type tests (laboratory tests) and not quality control tests carried out during manufacture.

This clause specifies test methods for verifying the leaktightness of thermostatic mixing valves and gives the corresponding requirements.

9.2 Test methods

9.2.1 *Principle*

This consists of checking, under cold water pressure, the leaktightness of:

a) the obturator (see **9.3** and **9.4**) if provided;

b) the complete thermostatic mixing valve (see **9.3** and **9.5**);

c) diverter with manual control (see **9.6**) or automatic return (see **9.7**) if provided.

Where a diverter with automatic return is regarded as performing an anti-pollution function it shall comply with special requirements (see clause **15**).

9.2.2 *Apparatus*

A hydraulic test circuit capable of supplying the static and dynamic pressures required and of maintaining them throughout the duration of the test.

9.3 Leaktightness of the thermostatic mixing valve upstream of the obturator and of the obturator

In the case of thermostatic mixing valves without obturator (type 4, clause **4**) the outlet orifice shall be artificially closed.

9.3.1 *Procedure*

— connect the two water supplies to the thermostatic mixing valve;

— with the outlet orifice open and the obturator closed, apply a water pressure of (1,6 ± 0,05) MPa [(16 ± 0,5) bar] to the thermostatic mixing valve for (60 ± 5) s for the full operating range of the temperature control device.

In the case of a single sequential thermostatic mixing valve (type 3, clause **4**) the control valve shall be left in the flow closed position.

9.3.2 *Requirements*

a) verification of leaktightness upstream of the obturator:

for the duration of the test there shall be no leakage or seepage through the walls;

b) verification of leaktightness of the obturator:

for the duration of the test there shall be no leakage at the obturator.

9.4 Leaktightness of the obturator of the thermostatic mixing valve. Cross-flow between hot and cold water

In the case of thermostatic mixing valves without obturator (type 4, clause **4**) the outlet shall be artificially closed.

In the case of a single sequential thermostatic mixing valve (type 3, clause **4**) the flow control shall be left in the flow closed position.

9.4.1 *Procedure*

— connect one inlet of the thermostatic mixing valve to the test circuit;

— with the outlet orifice open and the obturator closed, apply a water pressure of (0,4 ± 0,02) MPa [(4 ± 0,2) bar] to the thermostatic mixing valve for (60 ± 5) s for the full operating range of the temperature control device;

— repeat the test, reversing the water supply connection to the other inlet.

9.4.2 *Requirements*

For the duration of the test there shall be no leakage or seepage at the outlet (not applicable to thermostatic mixing valves without obturator) or at the end of the unconnected inlet.

Check valves shall comply with the standard to be elaborated (prEN 1717).

9.5 Leaktightness of the thermostatic mixing valve downstream of the obturator

9.5.1 *Procedure*

— connect the two water supplies to the thermostatic mixing valve;

— with the outlet orifice closed and the obturator open apply a water pressure of (0,4 ± 0,02) MPa [(4 ± 0,2) bar] to the thermostatic mixing valve for (60 ± 5) s, for the full operating range of the temperature control device;

— repeat the test with a water pressure of (0,02 ± 0,005) MPa [(0,2 ± 0,05) bar] for (60 ± 5) s.

9.5.2 ***Requirement***

For the duration of the test there shall be no leakage or seepage.

9.6 Leaktightness of the manual diverter of the thermostatic mixing valve

9.6.1 ***Procedure***

— connect the thermostatic mixing valve, in its position of use, to the test circuit;

— put the diverter in the bath position, with the bath outlet artificially closed and the shower outlet open;

— apply a static water pressure of (0,4 ± 0,02) MPa [(4 ± 0,2) bar] for (60 ± 5) s. Check that leaktightness is obtained on the shower outlet;

— gradually reduce to a static water pressure of (0,02 ± 0,005) MPa [(0,2 ± 0,05) bar] and maintain for (60 ± 5) s. Check that leaktightness is obtained on the shower outlet;

— put the diverter in the shower position with the shower outlet artificially closed and the bath outlet open;

— apply a static water pressure of (0,4 ± 0,02) MPa [(4 ± 0,2) bar] for (60 ± 5) s. Check that leaktightness is obtained on the bath outlet;

— gradually reduce to a static water pressure of (0,02 ± 0,005) MPa [(0,2 ± 0,05) bar] and maintain for (60 ± 5) s. Check that leaktightness is obtained on the bath outlet.

9.6.2 ***Requirement***

For the duration of the test there shall be no leakage at the outlet points indicated.

9.7 Leaktightness of the thermostatic mixing valve diverter with automatic return

9.7.1 ***Procedure***

— connect the thermostatic mixing valve, in its position of use, to the test circuit with the outlets fully open;

— connect the hydraulic resistance *A* to the shower outlet (see **14.3.3**).

NOTE *A* is a resistance which, tested alone at a dynamic pressure of 0,3 MPa, gives a flow rate = 0,25 l/s;

— put the diverter in the bath position and apply a dynamic water pressure of (0,4 ± 0,02) MPa [(4 ± 0,2) bar] for (60 ± 5) s. Check that leaktightness is obtained on the shower outlet;

— put the diverter in the shower position. Check that leaktightness is obtained on the bath outlet;

— with the diverter still in the shower position, reduce the dynamic pressure to a value of (0,05 ± 0,005) MPa [(0,5 ± 0,05) bar]. Check that the diverter is not dislodged. Maintain this pressure for (60 ± 5) s and check that leaktightness is obtained on the bath outlet;

— turn the water off. Check that the diverter returns to the bath position;

— re-apply the dynamic pressure of (0,05 ± 0,005) MPa [(0,5 ± 0,05) bar] for (60 ± 5) s. Check that leaktightness is obtained on the shower outlet.

9.7.2 ***Requirement***

For the duration of the test there shall be no leakage.

9.8 Summary of requirements

A summary of requirements is shown in Table C.1 (see annex C).

10 Hydraulic operating characteristics

10.1 General

The tests described are type tests (laboratory tests) and not quality control tests carried out during manufacture.

This clause specifies a test method, the aim of which is to determine the following characteristics at specified pressures on the two supplies (cold water and hot water):

a) the flow rate (see **10.5**) (using hot and cold water);

b) the sensitivity (see **10.6**) (using hot and cold water);

c) safety with cold water failure (see **10.7**);

d) temperature stability:

— with changing inlet pressure (see **10.8**);

— with changing inlet temperature (see **10.9**).

10.2 Test method

The tests for verifying the requirements from **10.5** and **10.6** are carried out either on the basis of a series of curves or representative test values for different functions of thermostatic mixing valves.

10.3 Apparatus

This comprises:

— two supply circuits (hot water and cold water) (see Figure 15);

— one test circuit (see Figure 16).

10.3.1 ***Supply circuits***

Each circuit comprises:

— a temperature regulating device (not shown) for adjusting:

— the temperature of the cold water to a value between 10 °C and 15 °C;

— the temperature of the hot water to a value between 50 °C and 65 °C;

— a device (1) for obtaining the required pressures;

— piping (2) of appropriate cross-section for the flow to be obtained;

— a device (3) for measuring the flow rate.

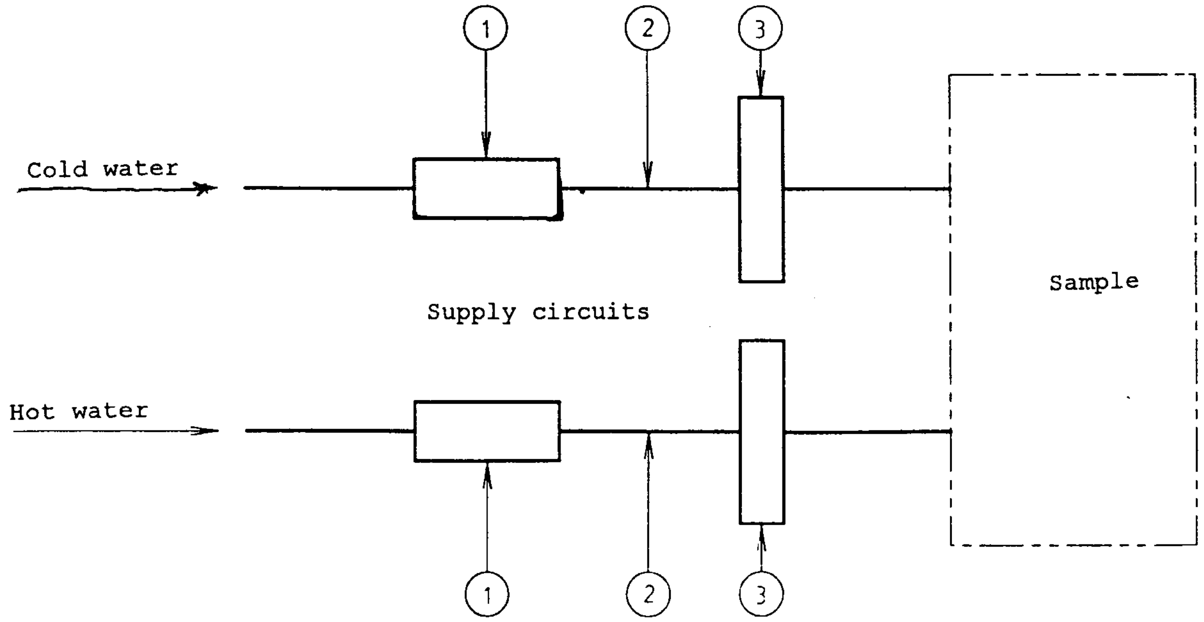


Figure 15 — Supply circuits

10.3.2 ***Test circuit (see Figure 16)***

Each hot water or cold water supply to the thermostatic mixing valve comprises:

- — piping made from a rigid metal tube of diameter and length in accordance with the dimensions in Table 11 comprising:
  - — a device for connecting this piping to the supply circuit;
  - — a pressure take-off tee;
  - — a temperature probe;
  - — a connection to the reinforced flexible pipe;
- — a reinforced flexible pipe, 500 mm long, of minimum internal diameter equal to that of the metal tube, with a device at the end for connection to the thermostatic mixing valve;
- — a temperature probe for the water at the thermostatic mixing valve outlet;
- — a device without backlash for automatic or non-automatic operation at a rate of approximately 0,5°/s or 0,8 mm/s of the temperature and flow rate adjustment devices of the thermostatic mixing valve;
- — equipment for measuring:
  - — pressure (measurement accuracy ±1 % of the measured values);
  - — flow rates (measurement ±2 % of the measured values);
  - — temperatures (measurement accuracy ±0,5 °C of the measured values);
  - — movement (G) of the temperature control device.

NOTE The various parameters Q_C, Q_H, Q_M and G can be recorded continuously.

Q_C is the quantity of cold water;

Q_H is the quantity of hot water;

Q_M is the quantity of mixed water.

Dimensions in millimetres

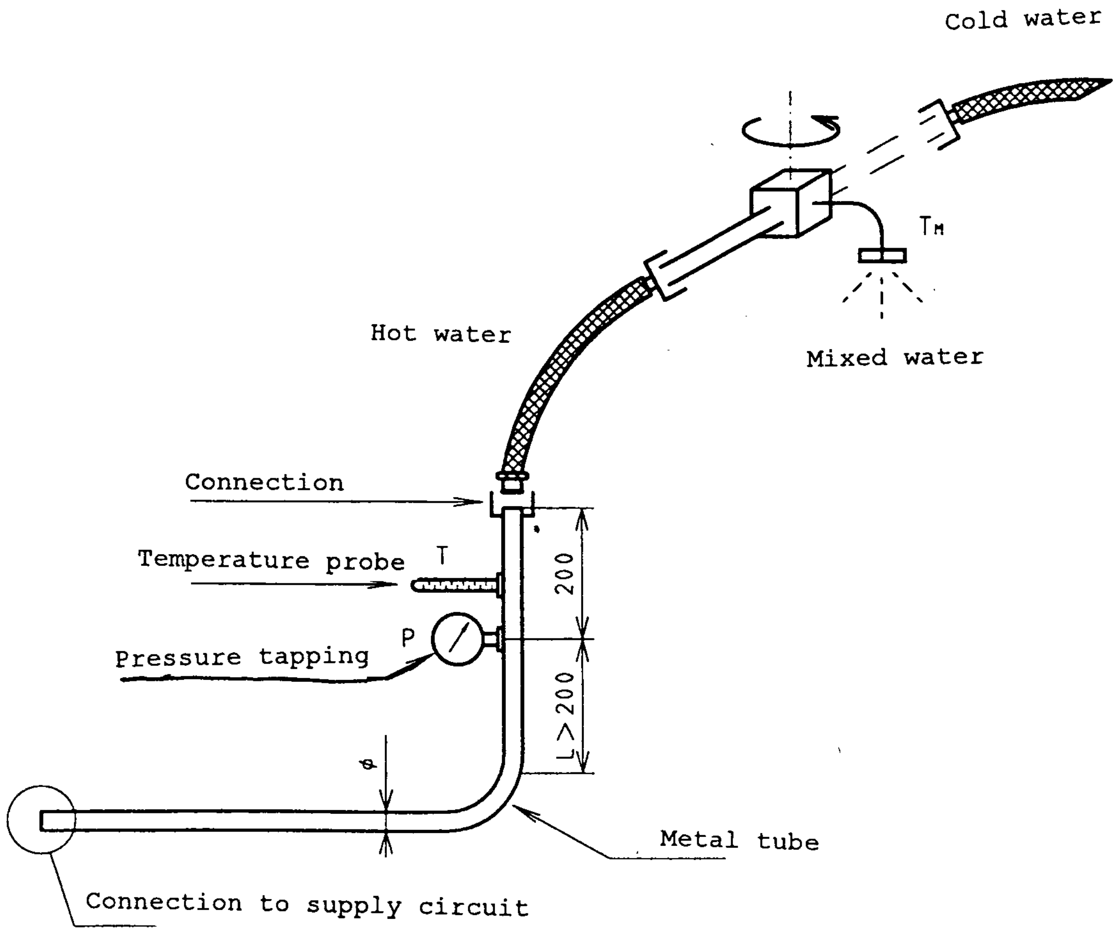


Figure 16 — Test circuit

10.3.3 ***Pipework***

Material: There is no specific requirement for the nature of the tubes, provided that they are metal.

The internal surface shall be smooth.

Dimensions: In addition to the dimensions given in Figure 16, the dimensions given in Table 11 shall be observed:

Table 11 — Connecting dimensions

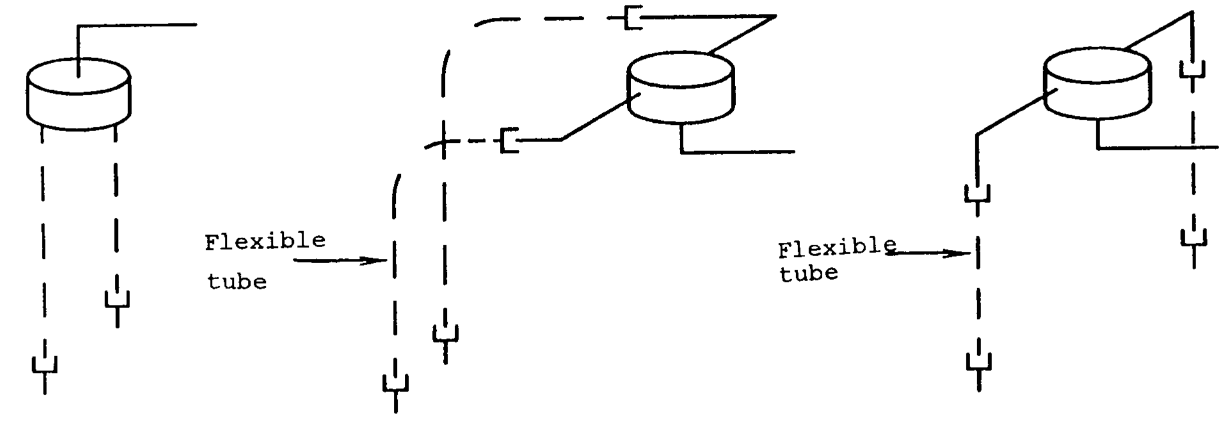
Connecting dimension of thermostatic mixing valve	Internal diameter ø mm	Union nut
1/2	13 min.	G 1/2
3/4	20 min.	G 3/4

10.3.4 ***Pressure take-off tees***

Pressure take off tees shall be of the individual pressure tapping type or the annular slit type (see annex A).

10.3.5 ***Mounting of thermostatic mixing valve***

Depending on the type of thermostatic mixing valve, one of the mounting arrangements shown in Figure 17 shall be used:



NOTE For thermostatic mixing valves which cannot be connected directly to the union nut of the test circuit, intermediate connecting pieces shall be used which give minimum pressure losses.

Figure 17 — Mounting of thermostatic mixing valve

10.4 Procedure

— connect both supplies of the thermostatic mixing valve to the test circuit, using the appropriate inlet connection method shown in Figure 17. Deformable inlet connections shall be mounted in a straight position;

— fit the automatic operating device to the temperature control device;

— for thermostatic mixing valves with a flow rate control device which is separate from the temperature control device, set it at maximum flow position. For single control thermostatic mixing valves, set the flow rate control device to the position providing maximum flow rate;

— on the cold water side, supply the thermostatic mixing valve with water at a temperature T of between 10 °C and 15 °C constant to ±1 °C;

— adjust the pressure P to (0,3 ± 0,02) MPa [(3 ± 0,2) bar], with the thermostatic mixing valve open;

— repeat the operations for the hot water supply, with the water at a temperature T of between 60 °C and 65 °C, constant to ±1 °C, so that ΔT = 50 K;

— adjust the pressure P to (0,3 ± 0,02) MPa [(3 ± 0,2) bar], with the flow control open.

When these adjustments have been made, return the flow control device to the off position, with the thermostatic mixing valve under pressure.

10.5 Determination of flow rate

10.5.1 *Principle*

To determine the flow rate of the thermostatic mixing valve under test at a dynamic reference pressure of $0{,}3\,^{+0{,}02}_{0}$ MPa ($3\,^{+0{,}2}_{0}$ bar), applied to the hot and cold water supplies, for the full extent of the temperature control range.

The measurement is made of the maximum available flow rate going from cold to hot and then from hot to cold. Where the thermostatic mixing valve has standard accessories (aerators, showers etc.) the measurement is carried out replacing these by a hydraulic resistance equivalent with a calibrated flow rate, as defined in **14.3.3**.

Where the thermostatic mixing valve has more than one outlet, each shall comply with the hydraulic requirements.

10.5.2 *Procedure*

— operate the temperature control device at a pressure of $0{,}3\,^{+0{,}02}_{0}$ MPa ($3\,^{+0{,}2}_{0}$ bar), with any flow rate control fully open;

— for various temperatures measure the flow rates Q_m of mixed water ($Q_m = Q_c + Q_h$) (at least the five indicated).

Full cold position (not applicable for single sequential thermostatic mixing valves type 3, clause **4**):

34 °C;

38 °C;

42 °C.

Full hot position.

10.5.3 *Requirements*

The flow rate measured at $0{,}3\,^{+0{,}02}_{0}$ MPa ($3\,^{+0{,}2}_{0}$ bar) shall, depending on the type of appliance for which the thermostatic mixing valve is intended, be at least equal to:

— 0,33 l/s (20 l/min) for baths;

— 0,20 l/s (12 l/min) for wash basins, bidets, sinks and showers.

For water economy, thermostatic mixing valves can be fitted with a special water saving aerator and can be approved if a flow rate of 12 l/min is achieved with one of the hydraulic resistance's defined in **14.3.3**.

NOTE For tapware for wash-basins, sinks and bidets fitted with special equipment such as:

— flexible inlet hose;

— pull out shower spray;

— backflow prevention device;

— water economy device;

a minimum flow rate of 0,15 l/s (9 l/min) is accepted subject to the minimum operating pressure being greater than 1 bar.

On the basis of the results of the tests carried out in accordance with **10.5.2**:

1) for wash-basins, bidets and sinks and showers, verify that the flow rates are not less than the values specified in this clause for the five defined temperatures;

2) for baths, verify that between 34 °C and 42 °C the flow rate is greater than or equal to 20 l/min (0,33 l/s).

10.6 Sensitivity

10.6.1 ***Principle***

To determine the sensitivity of the movement of the temperature control device within the reference range of 34 °C to 42 °C.

10.6.2 ***Procedure***

— operate the temperature control device at a rate of approximately 0,5° angular/s or 0,8 mm/s with a pressure of 0,3 $^{+0,02}_{0}$ MPa (3 $^{+0,2}_{0}$bar) and measure the mixed water temperature as a function of the movement of the temperature control device with any flow rate control being fully open;

— in the event of linear movement, take the measurement at the end of the control device (for levers);

— when the temperature control device reaches the end of its movement return the device to its starting position;

— if there is any doubt about the curve, repeat the test manually, with the appliance mounted in its normal installation position and compare the results;

— the most favourable result is used.

10.6.3 ***Evaluation of results***

On the basis of the measurements carried out in **10.6.2** plot the curves of mean mixed water temperature *T* as a function of the movement *G* of the temperature control device.

From the curves obtained in this way, determine the two values of ranges G1 and G2 for the mixed water temperature zone between 34 °C and 42 °C.

Verify that the smaller of these two values G1 and G2 complies with the requirements of **10.6.4**.

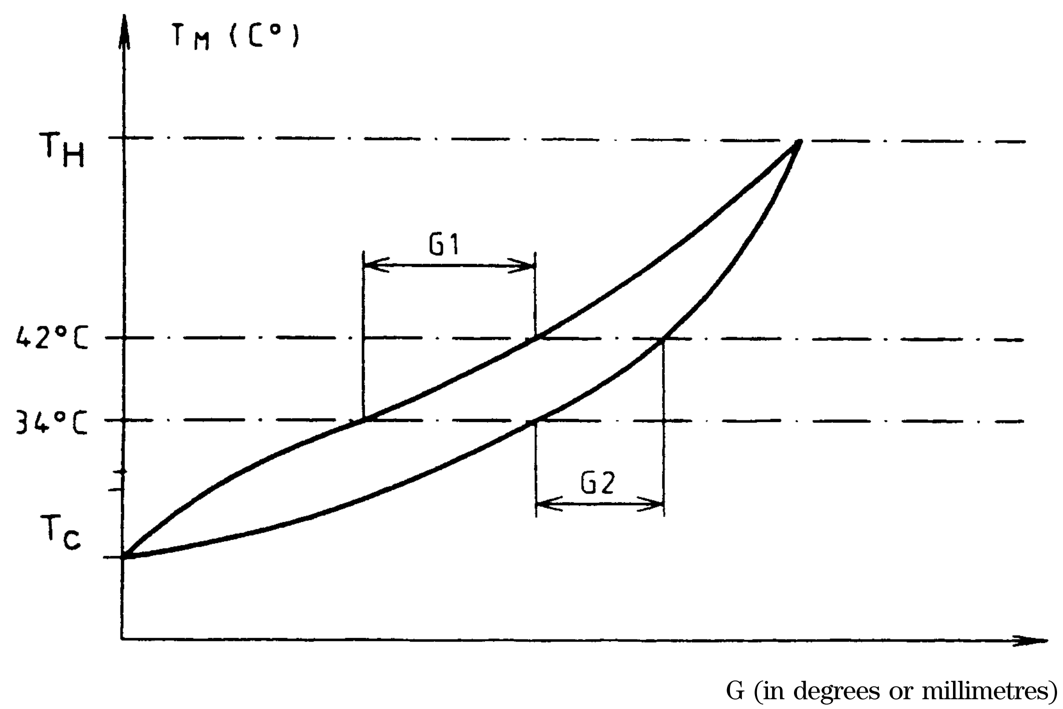


Figure 18 — Sensitivity curve

10.6.4 ***Requirements***

The adjustment range shall be such that the minimum linear movement of the temperature control device required for a variation of 8 K in the reference range is at least equal to 10 mm for sinks and 12 mm for baths, wash-basins, bidets, showers. Specially designed thermostatic mixing valves which do not meet the requirements of linear movement with set values, can be accepted in accordance with the standard, if the verified sensitivity is judged to be equivalent to the requirements of the standard.

In the case of a bath/shower thermostatic mixing valve, the measurement will be made for the shower outlet only.

Manufacturers are given a period of five years from acceptance of the draft standard at the formal vote stage to ensure that their product complies with this requirement.

10.7 Test for safety with cold water failure

10.7.1 ***Principle***

This test covers the ability of the thermostatic mixing valve to react to the instantaneous isolation of the cold water supply to limit the discharge of hot water.

10.7.2 ***Procedure***

— connect the thermostatic mixing valve to the test apparatus shown in Figure 16;

— connect a flow resistance of Class A to the outlet (see **14.3.3**) in the case of a bath/shower thermostatic mixing valve to the shower outlet;

— open the hot and cold water supplies to the thermostatic mixing valve;

— with any flow control open to maximum flow, adjust both inlet supply pressures to 0,3 $^{+0,02}_{0}$ MPa (3 $^{+0,2}_{0}$ bar);

— adjust the temperature control device to give a blend water temperature at the outlet of (38 ± 1) °C;

— isolate the cold water supply to the thermostatic mixing valve. Collect the water for the first (5 ± 0,5) s discharged from the thermostatic mixing valve outlet in an insulated vessel to measure its volume and temperature;

— after the initial period of (5 ± 0,5) s continue to collect in a separate insulated vessel, the water discharged from the thermostatic mixing valve outlet for a period of (30 ± 0,5) s and measure its volume;

— restore the cold water supply to the thermostatic mixing valve at a pressure of 0,3 $^{+0,02}_{0}$ MPa (3 $^{+0,2}_{0}$ bar) and record the temperature of the mixed water after stabilization.

10.7.3 ***Requirements***

— volume of water collected during the first five seconds shall be 200 ml;

— if the volume of water collected during the first five seconds > 200 ml the temperature shall not exceed 42 °C;

— the volume of water collected during the second collection period of 30 s shall be a maximum of 300 ml;

— the deviation from the set temperature of mixed water after restoration of the cold water and stabilization shall not exceed 2 K.

10.8 Test for temperature stability with changing inlet pressure

10.8.1 ***Principle***

To determine the ability of the thermostatic mixing valve to maintain the set temperature when the cold inlet pressure is altered.

10.8.2 ***Procedure***

— connect the thermostatic mixing valve to the test apparatus shown in Figure 16;

— fittings which provide 12 l/min or 9 l/min, fix a resistance Class A (see **14.3.3**);

— fittings which provide 20 l/min, fix a resistance Class C (see **14.3.3**);

— open the hot and cold water supplies to the thermostatic mixing valve;

— with any flow control device fully open, adjust both inlet pressures to 0,3 $^{+0,02}_{0}$ MPa (3 $^{+0,2}_{0}$ bar);

— adjust the temperature control device whilst maintaining inlet pressures to give a mixed water temperature at the outlet of (38 ± 1) °C;

— gradually reduce the inlet pressure of the cold water supply to 0,25 $^{+0,02}_{0}$ MPa (2,5 $^{+0,2}_{0}$ bar) whilst maintaining the hot supply pressure at 0,3 $^{+0,02}_{0}$ MPa (3 $^{+0,2}_{0}$ bar) and monitor the mixed water temperature at the outlet until it stabilizes;

— record the stabilized temperature;

— restore the cold water inlet pressure to 0,3 $^{+0,02}_{0}$ MPa (3 $^{+0,2}_{0}$ bar) whilst maintaining the hot inlet pressure at 0,3 $^{+0,02}_{0}$ MPa (3 $^{+0,2}_{0}$ bar) and record the mixed water temperature after stabilization.

10.8.3 ***Requirement***

The deviation of the temperature of the mixed water from the set value after pressure reduction and stabilization shall not exceed 2 K.

The deviation of the temperature of the mixed water from the set value after cold water pressure restoration and stabilization shall not exceed 2 K.

10.9 Test for temperature stability with changing inlet temperature

10.9.1 ***Principle***

To determine the ability of the thermostatic mixing valve to maintain the mixed outlet temperature when the hot inlet supply temperature is altered.

10.9.2 ***Procedure***

— connect the thermostatic mixing valve to the test apparatus shown in Figure 16;

— fittings which shall provide 12 l/min or 9 l/min, fit a resistance Class A (see **14.3.3**);

— fittings which shall provide 20 l/min, fit a resistance Class C (see **14.3.3**);

— open the hot and cold water supplies to the thermostatic mixing valve;

— with any flow control device fully open adjust both inlet supply pressures to $0{,}3\,^{+0{,}02}_{\ \ 0}$ MPa ($3\,^{+0{,}2}_{\ \ 0}$ bar) and maintain throughout the test;

— adjust the temperature control device to give a mixed water temperature at the outlet of (38 ± 1) °C;

— gradually reduce the temperature at the hot water inlet by (10 ± 1) °C and monitor the mixed water temperature until it has stabilized;

— record the variation of the mixed water after it has stabilized;

— restore the temperature at the hot water inlet to its original value (±1 °C) and record the mixed water temperature after it has stabilized.

10.9.3 ***Requirement***

The deviation of the temperature of the mixed water from the set value after temperature reduction and stabilization shall not exceed 2 K.

The deviation of the temperature of the mixed water from the set value after temperature restoration and stabilization shall not exceed 2 K.

11 Mechanical performance under pressure

11.1 General

The test described is a type test (laboratory test) and not a quality control test carried out during manufacture.

The principle of the test is to detect any deformation of the thermostatic mixing valve which might occur under the action of a high cold water pressure. The test is carried out upstream and downstream of the obturators.

11.2 Apparatus

Use a hydraulic test circuit capable of supplying the required pressure and of maintaining them for the duration of the test.

11.3 Testing of mechanical performance of the thermostatic mixing valve upstream of the obturator in the closed position.

11.3.1 ***Procedure***

Apply a static water pressure of (2,5 ± 0,05) MPa [(25 ± 0,5) bar] to both inlets simultaneously for (60 ± 5) s.

In the case of thermostatic mixing valves (type 4, clause **4**) without obturator the outlet orifice shall be artificially closed.

11.3.2 ***Requirement***

For the duration of the test, there shall be no permanent deformation of the thermostatic mixing valve.

11.4 Testing of mechanical performance of the thermostatic mixing valve downstream of the obturator — Obturators in the open position

11.4.1 ***Procedure***

With the obturator in the open position, apply a dynamic water pressure of (0,4 ± 0,02) MPa [(4 ± 0,2) bar] for (60 ± 5) s, this pressure being measured at the point of connection of the thermostatic mixing valve to the pipework.

The test is carried out on the thermostatic mixing valve as supplied. For thermostatic mixing valves with a removable flow rate regulator at the outlet, the test is carried out with and without the flow rate regulator.

11.4.2 ***Requirement***

For the duration of the test, there shall be no permanent deformation of the thermostatic mixing valve.

Table 12 — Test conditions for mechanical performance

Pressure applied	Position of obturator	Outlet orifice	Cold water test		Requirement
			Test conditions		
			Pressure	Duration s	
Upstream of the obturator	Closed	Open	Static (2,5 ± 0,05) MPa (25 ± 0,5) bar	60 ± 5	No permanent deformation
Downstream of the obturator	Open	Open	Dynamic (0,4 ± 0,02) MPa (4 ± 0,2) bar	60 ± 5	No permanent deformation

12 Mechanical endurance characteristics

12.1 General

The tests described are type tests (laboratory tests) and not quality control tests carried out during manufacture.

This clause specifies a test method to verify the mechanical endurance of the following elements of the thermostatic mixing valve:

a) the on/off flow control device as described and already approved in accordance with EN 200;

b) other on/off flow control devices (see **12.2**);

c) any diverter mechanism in accordance with **12.3**;

d) any swivel nozzle if provided in accordance with **12.4**.

12.2 Endurance (life) test for other on-off flow control devices of thermostatic mixing valves

12.2.1 *Principle*

This test consists of subjecting the other flow control devices (type b) of **12.1** to a specific number of opening and closing movements under specified cold and hot water conditions.

12.2.2 *Apparatus*

A suitable test rig for operating the devices in line with their normal function. The speed of operation of the control devices is to be set at 60 °/s angular velocity (i.e. 0,017 s/degree of angle). For linear movement the velocity shall be 0,04 m/s.

Due to the diversity of product design and especially for single sequential control thermostatic mixing valves it will be necessary for the test house and manufacturer to liaise and to produce a valid test apparatus and agree detailed test specifications.

12.2.3 *Procedure*

— connect the thermostatic mixing valve to a suitable test apparatus designed to operate the on-off devices to within 90 % to 95 % of their intended travel;

— supply hot water at a temperature of (65 ± 2) °C and cold water at a max. of 30 °C to the valve under test;

— with the thermostatic mixing valve open, adjust the water pressure of the two supply circuits to a value of (0,3 ± 0,05) MPa [(3 ± 0,5) bar] and, with the exception of the single sequential thermostatic mixing valve, set the temperature control device to a mean temperature position of 38 °C.

Subject the thermostatic mixing valve to 50 000 on/off cycles.

12.2.4 *Requirement*

During the test no failure of any component part shall occur.

After 50 000 on/off cycles, verify the leaktightness of the thermostatic mixing valve by the application of the test given in **9.3** to **9.5**.

12.3 Mechanical endurance of diverters of thermostatic mixing valves

12.3.1 *General*

This subclause specifies two methods of test for mechanical endurance of diverters of thermostatic mixing valves: one for manual diverters and one for diverters with automatic return and gives the corresponding requirements.

12.3.2 *Requirements*

During the test, no deformation, component fracture, blockage of the mechanism, leakage from the nozzle or shower/shower head or the diverter control joint shall be noted.

At the end of the test, check the leaktightness:

— in the conditions specified in **9.6** for manual diverters;

— in the conditions specified in **9.7** for diverters with automatic return.

12.3.3 ***Test method***

12.3.3.1 *Principle*

The principle of the test is to subject the diverter to a specified number of operations, with the thermostatic mixing valve being supplied alternately with cold water, and with hot water at (65 ± 2) °C (thermal shocks), in order to test its behaviour over a period of time, taking into account temperature.

12.3.3.2 *Apparatus*

12.3.3.2.1 *Manual diverter*

— automatic machine ensuring alternating movement of the diverter at a rate of (15 ± 1) returns per minute;

— supply circuits comprising a pump or a similar device by means of which the required static pressure can be obtained for cold water ≤ 30 °C and hot water at (65 ± 2) °C.

12.3.3.2.2 *Diverter with automatic return*

— mechanism for moving the diverter to the shower/shower head position under the conditions defined in **9.7**;

— supply circuits identical to those defined in **12.3.3.2.1** but also comprising an automatic quick action valve to cut off the supply to the thermostatic mixing valve under test.

12.3.3.3 *Procedure*

12.3.3.3.1 *Manual diverter*

Mount the thermostatic mixing valve, as supplied onto the machine and connect both inlets to the supply circuits.

Connect the drive device to the diverter lever by means of a flexible component.

With the thermostatic mixing valve closed, adjust the water pressure on the supply circuits to a value of (0,4 ± 0,02) MPa [(4 ± 0,2) bar].

With the temperature control device set to full hot position adjust the flow rate to 0,066 l/s to 0,100 l/s (4 l/min to 6 l/min). This flow adjustment shall be made by means of the independently operating on/off control device or in the absence of this device by partially obstructing the outlet.

Subject the diverter to an endurance test of 30 000 cycles, each cycle comprising a return movement between the extreme positions.

Throughout the test, supply the thermostatic mixing valve alternately at both inlets with cold water for 15 min ± 30 s, then hot water for 15 min ± 30 s and so on.

Throughout the test, record any incidence of leaks, deformations, fracture, etc.

After 30 000 cycles, check the leaktightness of the diverter as defined in **9.6**.

12.3.3.3.2 *Diverter with automatic return*

Fit to the shower outlet a hydraulic resistance of Class A as described in **14.3.3**.

Mount the thermostatic mixing valve, as supplied onto a support and connect both inlets to the supply circuits.

With the thermostatic mixing valve closed, adjust the water pressure on the supply circuits to a value not greater than (0,4 ± 0,02) MPa [(4 ± 0,2) bar].

With the temperature control device set to full hot position adjust the flow rate to 0,066 l/s to 0,100 l/s (4 l/min to 6 l/min). This flow adjustment shall be made by means of the independently operating on/off control device or in the absence of this device by partially obstructing the outlet.

Subject the diverter to an endurance test of 30 000 cycles, one cycle being defined as follows:

— with the diverter in the “flow to bath” position, allow a flow of water for (5 ± 0,2) s through the spout;

— move the diverter to the “flow to shower” position and allow a flow of water for (5 ± 0,2) s through the shower outlet;

— cut off the supply to the thermostatic mixing valve by means of the quick acting valve, allow the diverter to return to the “flow to bath” position then reopen the supply.

Throughout the test, supply the thermostatic mixing valve alternately at both inlets with cold water for 15 min ± 30 s then hot water for 15 min ± 30 s.

Throughout the test, record any incidence of leaks, blockage, non actuation of diverter, etc.

After 30 000 cycles, check the leaktightness of the diverter as defined in **9.7**.

12.4 Mechanical endurance of swivel nozzles of thermostatic mixing valves

12.4.1 ***General***

This subclause specifies a method of testing the mechanical endurance of swivel nozzles of the thermostatic mixing valves and gives the corresponding requirements.

12.4.2 ***Test method***

12.4.2.1 *Principle*

The principle of the test is to reciprocate the nozzle of the thermostatic mixing valve, with both inlets fed with cold water for a specific number of cycles, in order to test its behaviour over a period of time.

12.4.2.2 *Apparatus*

An automatic machine for reciprocating the nozzle at a rate of (15 ± 1) backwards and forwards motions per minute.

A cold water supply circuit (15 °C to 30 °C) with a pump or a similar device supplying the static pressure required.

A load concentrated at the nozzle outlet of:

— 1 kg $_{-10}^{0}$ g if the projection of the nozzle is less than or equal to 200 mm (see dimension D Table 3);

— a load giving a bending moment of 2 $_{-0,2}^{0}$ Nm if the projection of the nozzle is greater than 200 mm.

12.4.2.3 *Procedure*

Mount the thermostatic mixing valve on the machine and connect both inlets to the supply circuit. If the nozzle has a flow rate regulator, leave it in position and verify there is no obstruction during the test.

From the end of the swivel nozzle, suspend a mass as defined in **12.4.2.2**.

Connect the drive device of the automatic machine to the swivel nozzle.

With the thermostatic mixing valve closed, adjust the water pressure in the supply circuit to a value between 0,2 MPa and 0,4 MPa (2 bar and 4 bar).

With the temperature control device set to a temperature position equivalent to 38 °C, adjust the flow rate to a value between 0,066 l/s to 0,1 l/s (4 l/min to 6 l/min) obstructing the outlet.

This flow adjustment shall be made by means of the independently operating on/off control device or in the absence of this device by partially obstructing the outlet.

Subject the swivel nozzle to a test of 80 000 cycles, each cycle comprising a reciprocating movement through an arc of 110° or, if there is a stop, over 90 % of the theoretical travel.

During the test, move the nozzle smoothly at as steady a speed as possible at a rate of 15 $_{-1}^{0}$ backwards and forwards motions per minute.

12.4.3 ***Requirement***

During the test, there shall be no deformation, fracture of the swivel nozzle or by the device connecting it to the body or any leakage of the assembly.

At the end of the test, leaktightness shall be verified in accordance with the requirements of **9.5**.

13 Torsional resistance characteristics of the operating control of the thermostatic mixing valve

13.1 General

The test described is a type test (laboratory test) and not a quality control test carried out during manufacture.

This test shall be carried out on different samples from those that have undergone the mechanical endurance test (see clause **12**).

This clause specifies a test method for verifying the resistance of the control device to the stresses of opening, closing and pivoting (temperature adjustments) and gives the corresponding requirements.

13.2 Test method

13.2.1 ***Principle***

The principle of the test consists of subjecting the control device, for all specified directions of operation, to a given torque in order to verify its strength.

13.2.2 ***Apparatus***

This comprises either a torque wrench (2 % accuracy) adapted to the control device (cross top, lever or other) or a lever arm and instrument for measuring the applied force.

Care shall be taken to avoid the intervention of shear forces.

13.2.3 ***Procedure***

The thermostatic mixing valve, fitted with its control device, shall not be supplied with water during the test.

The test is carried out at ambient temperature.

The test does not apply for thermostatic mixing valves where there are no fixed stop positions.

a) Flow rate control: Gradually apply over a period of 4 s to 6 s and maintain for 5 min a torque of (6 ± 0,6) Nm to the flow control device in the closing direction of travel.

b) Temperature control: Gradually apply over a period of 4 s to 6 s and maintain for 5 min a torque of 3 $_{-5}^{0}$ Nm to the end of the temperature control device both in the direction of cold water and separately in the direction of hot water.

13.2.4 ***Requirements***

After the test, there shall be no visible deformation of any component or any deterioration in operation with regard to leaktightness, flow rate and sensitivity.

After inspection, it shall be verified by means of tests that the requirements for leaktightness, flow rate and sensitivity are complied with **9.3**, **9.4**, **9.5**, **10.5** and **10.6**.

14 Acoustic characteristics

14.1 General

The tests described are type tests (laboratory tests) and not quality control tests carried out during manufacture.

This clause specifies the test method for classifying thermostatic mixing valves by acoustic group (I, II or not classified) and where applicable an indication of the flow rate class (A, S, B, C or D) used to determine the acoustic group.

14.2 Procedure

14.2.1 ***Mounting and operating conditions for thermostatic mixing valves***

These conditions are given in EN ISO 3822-2 (draw-off thermostatic mixing valves of type 1, 2 and 3) and EN ISO 3822-3 (in line thermostatic mixing valves type 4 , clause **4**).

14.2.2 ***Test method***

14.2.2.1 *General*

The tests are carried out in accordance with the specifications of prEN ISO 3822-1, EN ISO 3822-2, and EN ISO 3822-3.

14.2.2.2 *Special cases*

In principle only the test at 0,3 MPa (3 bar) is used for determining the acoustic group of thermostatic mixing valves.

If necessary, tests at different pressures can be carried out in accordance with national regulations, where these exist, and in accordance with current national criteria.

14.3 Requirements

14.3.1 ***Expression of results***

The results of the measurements taken in accordance with EN ISO 3822 are expressed by the acoustic level of the thermostatic mixing valve L_{ap} in dB (A).

NOTE L_{ap} = 45 dB (A) − D_s.

14.3.2 ***Determination of acoustic groups***

Depending on the values of L_{ap} obtained at 0,3 MPa (3 bar), a thermostatic mixing valve is classified in the following acoustic groups:

Table 13 — Acoustic groups

Group	L_{ap} dB (A)
I	$L_{ap} \leq 20$
II	$20 < L_{ap} \leq 30$
Not classified	$L_{ap} > 30$

14.3.3 ***Flow rate classes (thermostatic mixing valves type 1, 2, 3)*** (see clause **4**)

If a thermostatic mixing valve has a flow rate regulator and/or a shower attachment outlet, the measurement is carried out without these fittings as these are subject to special acoustic measurements. The tests are then carried out, replacing these fittings by a hydraulic resistance with calibrated flow rate in accordance with annex A of EN ISO 3822-4:1997 and where necessary with adapters in accordance with annexes B and C of EN ISO 3822-4:1997.

Hydraulic resistances tested alone are defined in five classes as a function of their calibrated flow rate at 0,3 MPa (3 bar):

Class A q = 0,25 l/s;

Class S q = 0,33 l/s;

Class B q = 0,42 l/s;

Class C q = 0,50 l/s;

Class D q = 0,63 l/s.

A thermostatic mixing valve is allocated to the flow rate class which corresponds to the flow rate of the hydraulic resistance with calibrated flow rate with which it is tested.

A thermostatic mixing valve, with no fittings, is tested as found with the flow rate obtained at a pressure of 0,3 MPa (3 bar).

15 Protection against pollution of drinking water

A thermostatic mixing valve fitted with a flexible outlet hose shall be equipped with an anti-pollution device in accordance with prEN 1717.

Annex A (informative)
Examples of pressure take-off tees

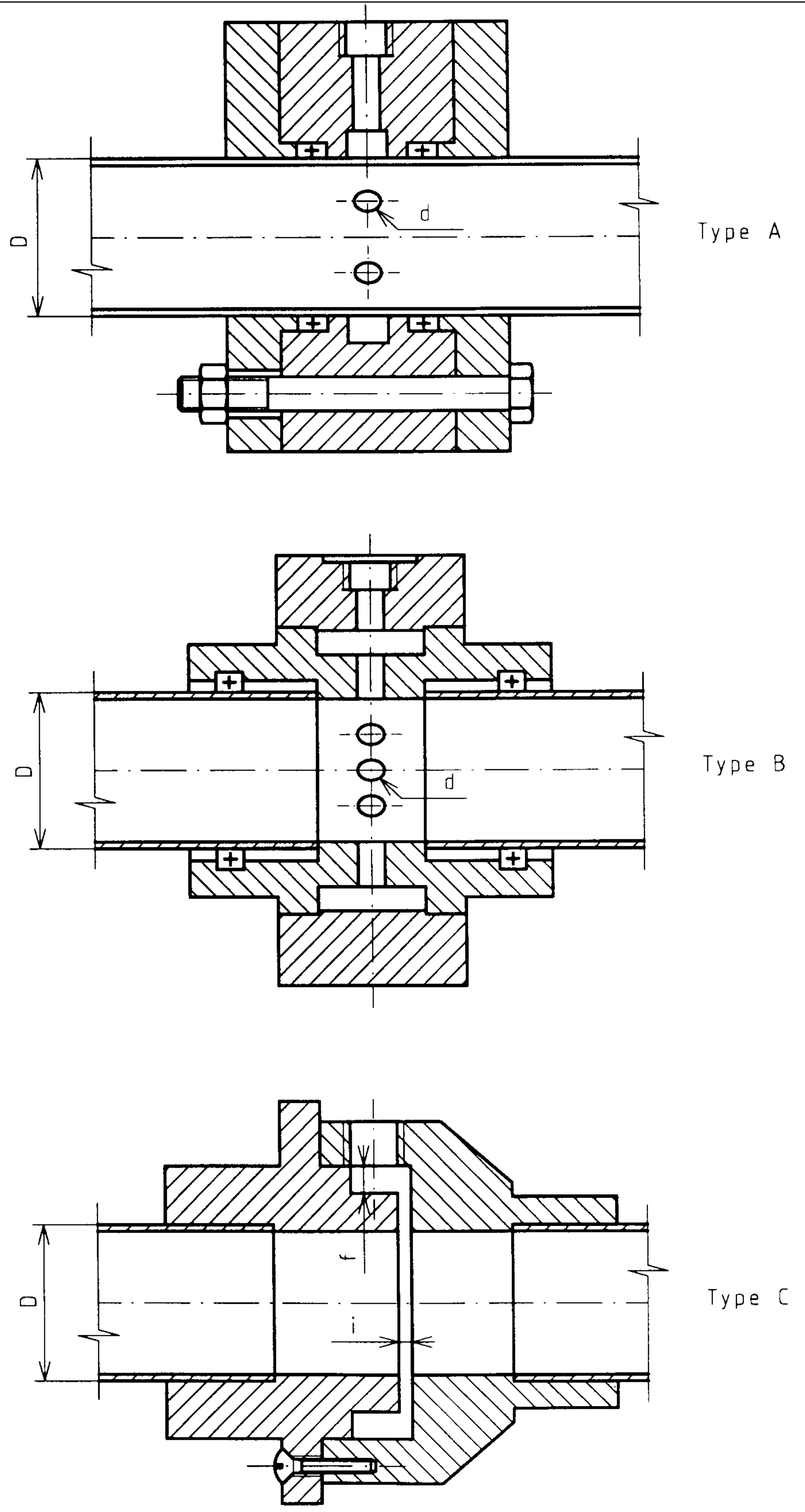


Figure A.1 — Examples of pressure take-off tees

Recommendation for the design of pressure take-off tees

Figure A.1 shows three examples of pressure take-off tees giving equivalent results:

— individual: types A and B;

— annular slit: type C.

Requirements relating to the design and manufacture of pressure take-off tees are given in ISO 5167-1:1997.

The main principles are:

individual type:

— the axis of the pressure orifices shall intersect the axis of the piping (or the casing) and be perpendicular to it;

— the opening of the orifice shall be circular and the edges flush with the wall of the piping (or the casing) with an angle as sharp as possible. Slight rounding at entry is permitted (radius ≤ 1/10 diameter of the pressure orifice);

— the diameter of the pressure orifice shall be less than 0,1 D (D: internal diameter of the tube or casing);

— there shall be an even number (at least 4) of the pressure orifices. The angles formed by the arcs of the pressure orifices shall be approximately equal;

— the area of the free cross-section of the annular chamber of the casing shall be greater than or equal to half the total area of the orifices connecting the chamber to the piping;

annular slit:

— the thickness f of the annular slit shall be equal to or greater than twice the width i of the slit;

— the area of the free section of the annular chamber should be equal to or greater than half the total area of the annular slit connecting the chamber to the piping;

— all surfaces coming into contact with the fluid measured shall be clean and well finished;

— the width of the annular slit shall be nominally 1 mm.

Annex B (informative)

Acoustic classification (example)

Thermostatic mixing valve with nozzle

If the nozzle is fitted with a flow rate regulator, the thermostatic mixing valve is classed:

— as a function of acoustic group I or II;

— as a function of the hydraulic resistance class used for testing:

— D, C or B for bath thermostatic mixing valves;

— D to A for other thermostatic mixing valves. However, unless otherwise requested by the manufacturer, the test will generally start with resistance A.

If the nozzle is not fitted with a flow rate regulator, the thermostatic mixing valve is classified as a function of acoustic group I or II.

Thermostatic mixing valves with shower or shower head outlet

The thermostatic mixing valve is classified:

— as a function of acoustic group I or II;

— as a function of the hydraulic resistance class used for testing: D, C, B, S or A.

Thermostatic mixing valves with nozzle and shower or shower head outlet

If the nozzle is fitted with a flow rate regulator, the thermostatic mixing valve is classified:

— as a function of the acoustic group obtained on both outlets if the results are identical;

— or as a function of the most unfavourable acoustic group if the results are different.

Taking into account:

— the hydraulic resistance class used for testing the nozzle: D, C or B ;

— the hydraulic resistance class used for testing the shower/shower head D, C, B, S or A.

NOTE If the classes are identical on both, only the letter of the class in question is given.

EXAMPLES

A thermostatic mixing valve, the acoustic group of which is I on the nozzle with resistance C, and I on the shower with resistance A, is classified I-C-A.

A thermostatic mixing valve, the acoustic group of which is II on the nozzle with resistance B and I on the shower with resistance B, is classified II B:

— if the nozzle is not fitted with a flow rate regulator, the thermostatic mixing valve is classified solely on the basis of the most unfavourable acoustic group;

— a thermostatic mixing valve of a given flow class can not be fitted with a fitting (flow rate regulator, shower fitting) of a higher class;

— a thermostatic mixing valve of a given flow class can be fitted with fittings of a lower flow class, on condition that it satisfies the requirements of **14.3.3**.

Annex C (informative)
Summary of leaktightness tests

Table C.1 — Summary of leaktightness tests

Operating feature	Leaktightness of	Connection to test circuit	Position of obturator	Outlet orifice	Position of temp. control	Test pressure	Duration	Requirements	
Mixing valve and obturator	Mixing valve upstream of obturator and of obturator	Both inlets	closed	open	Full operating range	(1,6 ± 0,05) MPa (16 ± 0,5) bar Static pressure	(60 ± 5) s	No leakage through walls or at obturator	
	Obturator cross flow	Single inlet one side then other	closed	open	Full operating range	(0,4 ± 0,02) MPa (4 ± 0,2) bar Static pressure	(60 ± 5) s	No leakage at outlet orifice or unconnected inlet	
	Mixing valve downstream of obturator	Both inlets	open	closed	Full operating range	(0,4 ± 0,02) MPa (4 ± 0,2) bar static pressure (0,02 ± 0,005) MPa* (0,2 ± 0,05) bar	(60 ± 5) s (60 ± 5) s	No leakage No leakage	
Manual diverter	Shower outlet	Both inlets	Obturators open diverter to bath	Bath outlet closed artificially shower outlet open		(0,4 ± 0,02) MPa (4 ± 0,2) bar (0,02 ± 0,005) MPa* (0,2 ± 0,05) bar Static pressure	(60 ± 5) s (60 ± 5) s	No leakage at shower outlet	
	Bath outlet	Both inlets	Obturators open diverter to shower	Shower outlet closed artificially		(0,4 ± 0,02) MPa (4 ± 0,2) bar (0,02 ± 0,005) MPa* (0,2 ± 0,05) bar Static pressure	(60 ± 5) s (60 ± 5) s	No leakage at bath outlet	
Diverter with automatic return	Shower outlet	Both inlets	Obturators open diverter to bath	Both outlets open		(0,4 ± 0,02) MPa (4 ± 0,2)bar Dyn, pressure	(60 ± 5) s	No leakage at shower outlet	1) No dislodged diverter
	Bath outlet	Both inlets	Obturators open diverter to shower	Both outlets open		(0,4 ± 0,02) MPa (4 ± 0,2) bar Dyn, pressure	(60 ± 5) s	No leakage at bath outlet	2) Shut water off
	Bath outlet (1), (2), (3)	Both inlets	Obturators open diverter still in position	Both outlets open		(0,05 ± 0,005) MPa (0,5 ± 0,05) bar Dyn, pressure	(60 ± 5) s	No leakage at bath outlet	3) Automatic return in bath position fast closing water position
	Shower outlet	Both inlets	Obturators open diverter to bath	Both outlets open		(0,05 ± 0,005) MPa (0,5 ± 0,05) bar Dyn, pressure	(60 ± 5) s	No leakage at shower outlet	

* Additional test carried out if leaktightness is obtained by one or more toroidal seals.

Annex D (informative)

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