NZS 4617:1989

TEMPERING (3-PORT MIXING) VALVES

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COMMITTEE REPRESENTATION

This Standard was prepared under the supervision of the Mechanical, Electrical and General Divisional Committee (50/-) for the Standards Council, established under the Standards Act 1965.

The Tempering Valve Committee (46/12) was responsible for the preparation of the Standard and consisted of representatives of the following organizations:

Building Research Association of New Zealand
Department of Health
Electrical Development Association
Ministry of Energy
New Zealand Manufacturing Engineers' Federation
New Zealand Society of Master Plumbers and Gasfitters

In addition to the above representation, Mr K. Healy was co-opted to assist in the committee's work.

ACKNOWLEDGEMENT

The financial contribution made by the Ministry of Energy towards the preparation of this Standard is gratefully acknowledged.

REVIEW OF STANDARDS

Suggestions for improvements of this Standard will be welcomed. They should be sent to the Director, Standards Association of New Zealand, Private Bag, Wellington.

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AMENDMENTS

Date of issue	*Description*

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FOREWORD

This performance specification has been prepared as a guide for manufacturers and users of tempering valves to ensure that the valves meet an acceptable standard of safety and operation.

Tempering valves are designed to prevent scalding from excessively hot water whilst permitting water to be stored at temperatures above 60 °C which minimizes the risk of legionella multiplication.

A maximum set temperature of 55 °C has been chosen upon recommendation from the Department of Health and is based upon the fact that it only takes one second exposure to hot water at 70 °C to cause a full thickness skin burn on the average adult, 6 seconds at 60 °C and 30 seconds at 55 °C.

As a comparison, most people take a bath in water of 38 °C, and find water at 40 °C too hot. Water at a temperature of 50 to 55 °C is used in the kitchen to wash greasy dishes and pots.

A tolerance of +5 -3 °C has been permitted as it is within obtainable manufacturing limits, and is still relatively safe.

The committee emphasizes that the valves must be installed according to the manufacturer's instructions. If this is not done correctly the increased safety inherent in a valve which is manufactured to comply with this Standard may be negated.

It should be particularly noted that installations with wet-backs or solar units installed have the ability to produce boiling water in the hot water heater and it is strongly recommended to install a tempering valve in such installations to prevent scalding to hot water users and damage to appliances using hot water.

Where a tempering valve is installed with a concurrent raising of the water storage temperature a slight increase in energy consumption will occur due to the increased thermal losses from the storage water heater.

RELATED DOCUMENTS

Reference is made in this Standard to the following:

NEW ZEALAND STANDARD

NZS 3501:1976 Copper tubes for water, gas and sanitation

AUSTRALIAN STANDARD

AS 2345:1980 An accelerated laboratory test method for assessment of the susceptibility of brass to dezincification

BRITISH STANDARDS

BS 1780:1985* Bourdon tube pressure and vacuum gauges

BS 2779:1986* Pipe threads for tubes and fittings where pressure-tight joints are not made on the threads

* Endorsed as suitable for use in New Zealand.

The users of this Standard should ensure that their copies of the above-mentioned New Zealand Standards or of overseas Standards endorsed as suitable for use in New Zealand are the latest revisions or include the latest amendments. Such amendments are listed in the annual SANZ Catalogue which is supplemented by lists contained in the monthly magazine *Standards* issued free of charge to committee and subscribing members of SANZ.

NEW ZEALAND STANDARD

TEMPERING (3-PORT MIXING) VALVES

1 SCOPE

This Standard covers the requirements for tempering valves for storage hot water systems particularly in domestic situations, where hot water poses a hazard. These valves are intended to prevent scalding in locations such as homes, schools, motels and residential premises, where ideally all hot water outlets should be sourced from a tempering valve. This Standard provides for valves suitable for water inlet temperatures of up to 100 °C.

2 DEFINITIONS

2.1
For the purposes of this Standard the following definitions shall apply:

SET TEMPERATURE. The outlet temperature of the water at which a valve is to operate; also referred to as MIXED WATER TEMPERATURE.

TEMPERING VALVE. A temperature-actuated valve which is connected to the outlet of a water heater (or other hot water supply) and to a cold water supply and which automatically controls the water at the outlet of the valve to a set temperature within specified limits. A tempering valve may be either a separate valve or be combined with another valve at the outlet of a water heater.

2.2
For the purposes of this Standard, the word "shall" refers to practices which are mandatory for compliance with this Standard. The word "should" refers to practices which are advised or recommended.

3 MATERIALS

3.1
Materials used in the construction of valves shall be compatible such that corrosion of components is prevented under the conditions of use.

3.2
Valve materials shall not impart to water any taste or odour, any cloudiness or discolouration or any toxic or undesirable substances that could be injurious to health.

3.3
All materials used shall be such that when a valve is subjected to a leakage test (Appendix A) and a continuous operation test (Appendix D) it shows no sign of deformation, cracking or any other weakness that might impair the operation of any component.

3.4
All materials used for components that are normally in contact with water shall be corrosion resistant. Valve seats and components that have valve seats integral within them which are made from copper alloy shall be tested in accordance with AS 2345 and the average depth of dezincification shall not exceed:

(a) For extruded bar

Longitudinally	300 µm
Transversely	100 µm

(b) For forgings and castings 100 µm

NOTE - Stringers which do not exceed 400 µm at any one point are acceptable.

3.5
As a tempering valve is a safety device any material used in its construction shall be capable of withstanding water at a temperature of 100 °C at the manufacturer's stated maximum working pressure. (See 5.11).

3.6
The serviceable life of a tempering valve should be compatible with other components in a water heating system.

NOTE - The tests specified in this Standard are designed to establish the operational limitations and performance of the valve and *not* to validate any material.

4 DESIGN AND CONSTRUCTION

4.1 General

4.1.1
Valves and their components shall be designed and constructed so that in the course of normal operation, handling or installation, they will not become damaged to an extent that would prevent their continued compliance with this Standard.

4.1.2
Valves shall operate without undue noise under all conditions of inlet and delivery.

4.2
Connections

4.2.1
End connections shall be designed so that when a pipe or fitting is screwed onto the connection it shall not reduce the area of flow passage through the valve body or adversely affect the operation of the valve.

4.2.2
End connections shall be of the same nominal size as the valve or, in the case of outlet connections only, one size larger than the nominal size of valve. All screwed connection ends shall be threaded with external parallel pipe threads complying with BS 2779 Class B.

4.2.3
Connecting threads shall be capable of forming leak proof joints when the connections are subject to a torque of not more than 8 Nm in the case of plastics components, and 16 Nm for other materials. The threads shall be capable of withstanding without any sign of stripping, a torque of 2.5 times the above values.

4.2.4
Where connections require wrenches to be used, wrench-flats shall be provided.

4.3
Reverse flow prevention
The valve shall include a means to prevent reverse flow. (See 5.10).

4.4
Design pressure
Tempering valves shall be designed for operation up to the maximum design inlet water pressure specified by the manufacturer in accordance with 8.3(a).

4.5
Resistance to heat
Tempering valves shall be capable of operating on water at a temperature of 100 °C without any adverse effect on the safe operation of the valves. (See 5.11).

4.6
Joints in valve construction
The fit of mechanically-made joints shall be free from warp and other distortions. Soldered, brazed or welded joints shall be clean, smooth and free from porosity, slag, spatter and undercuts.

4.7
Jumper washers
Where used, jumper washers (other than in the temperature sensoring element) shall be replaceable without damage to the components.

4.8
Finish
Components that are cast or hot-pressed shall have an acceptably smooth surface finish and shall be free from blowholes, sand, burns, and other deleterious defects. Components formed from a sheet metal or a plastics material, shall have clean-cut edges and shall be free from burrs, cracks, warps, dents, buckles and other deleterious defects.

4.9
Flow marking
Valves shall be permanently marked (i.e. stamped, engraved or cast on the valve body) to suitably identify connections. This may be done by identifying the inlets and outlet, or by an arrow indicating directions of flow provided that one of the inlets is identified.

5
SPECIFIC REQUIREMENTS

5.1
Construction strength
When tested in accordance with Appendix A there shall be no sign of leakage or distortion.

5.2
Set temperature
The maximum set temperature shall be 55 °C. Lower set temperatures are acceptable if the valve is intended for low temperature applications.

5.3
Initial water temperature range
In the initial stages of operation and when tested in accordance with Appendix B and Appendix C, the temperature of the mixed water discharged from the valve shall not vary from the set temperature by more than +5 or -3 °C after 4 s when installed in accordance with the manufacturer's instructions and the maximum allowable temperature of 60 °C shall at no time be exceeded.

5.4
Continuous operation
After testing in accordance with Appendix D, the temperature of the mixed water discharged from the valve shall not vary from the set temperature by more than +5 or -3 °C after 4 s operation.

5.5
Temperature hazard
With the temperature-actuating element in the normal position and rendered inoperative by appropriate means, the test procedure in Appendix C shall be repeated. Under these conditions, the outlet temperature shall not exceed 60 °C.

5.6
Adjustment
Means for field adjustment of the temperature sensoring element may be provided, in which case

an indication of the direction to increase and decrease the set temperature shall be given.

5.7
Air locking
Where a valve can cause air-locking, provision for air bleeding of the hot water system at the valve shall be incorporated into the valve.

5.8
Flow rates
When tested in accordance with Appendix B the mixed water flow rate of the valve shall not be less than 20 L/min when supplied with water at the valve's declared minimum operating supply pressure.

5.9
Valve seats and jumper washers
When the valve is tested in accordance with Appendix D there shall be no sign of excessive wear of the valve seat or of the jumper washer.

5.10
Reverse flow (thermosyphoning)
With the outlet port sealed and a pressure not greater than 0.35 mH_20 (3.5 kPa) applied to the cold water inlet there shall be no evidence of reverse flow through the hot inlet port.

5.11
Resistance to boiling water
After testing in accordance with Appendix E the valve shall be capable of complying with all of the performance requirements of this Standard.

6 PRODUCTION TESTS

6.1
Every valve shall satisfy the test criteria for every function for which the valve is designed. There shall be production tests to ensure that the maximum allowable temperature of 60 °C is not exceeded and a hydrostatic pressure test at 2000 kPa.

7 TYPE TESTS

7.1
Each valve shall be capable of satisfying the test criteria for every function for which the valve is designed. These tests shall be carried out to prove the design of each type and size of valve; they shall be repeated if there is any change in design, material or manufacturing method, and in any case at intervals not exceeding 2 years.

7.2
Tests shall be carried out on 3 valves of each type and size.

7.3
Details of the type tests for the different functions are given in table 1.

Table 1
TYPE TEST REQUIREMENTS

Clause	*Test*	*Purpose*	*Appendix*
4.2.3	Threads	Torque and leakage	–
5.1	Construction strength	Low and high pressure leakage and construction strength	A
5.3	Mixed water temperature	To check compliance with outlet water temperature requirements	C
5.4	Continuous operation	To check compliance with performance requirements after 50 000 cycles of operation	D
5.8	Flow rate	To check compliance with minimum flow requirements	B
5.10	Reverse flow	Back circulation leakage	–
5.11	Boiling water	Suitability for dual systems incorporating wetbacks	E

8
PACKAGING AND MARKING

8.1
Packaging
Each tempering valve shall be packed so that it is protected from damage during normal handling, transportation and storage. All openings in the body of the valve shall be covered to prevent the entry of foreign material.

8.2
Marking
Each tempering valve shall be provided with the following information stamped or embossed on the body of the valve or given on a durable label, closely and securely attached to the valve.

(a) Month and year of manufacture, e.g. 09-87

(b) The set temperature, or if adjustable, the set temperature range

(c) The maximum supply temperature to the valve

(d) The flow at minimum operating pressure

(e) The manufacturer's name, trade-name, or trademark.

8.3
Additional information
The following information shall be given in a leaflet or booklet that is attached to, or packed with the valve.

(a) Operating conditions, e.g., maximum operating temperature, maximum design water pressure, minimum water pressures to achieve specific flow rates

(b) Any other information required for correct, safe, and satisfactory installation.

APPENDIX A
CONSTRUCTION STRENGTH AND LEAKAGE TEST

A1
Scope
This Appendix sets out the method of assessing leakage at low and high pressure and the construction strength.

A2
Apparatus
The following apparatus is required:

a) Hydrostatic test rig

b) Certified test pressure gauges reading to 20 kPa, and 3000 kPa with an air bleed attachment

c) Instrumentation complying with the requirements of Appendix F.

A3
Procedure
The procedure shall be as follows:

a) Ensure that any connecting threads on the valve under test have withstood without stripping the requirements of 4.2.3, and adjust the torque to the maximum value specified by 4.2.3 for the formation of leakproof joints.

b) Bleed air from the test equipment and the valve

c) With the cold inlet and the outlet closed apply hydrostatic test pressures of 7 kPa and 2000 kPa to the hot inlet for a period of not less than 3 min or more than 5 min and check for any leakage

d) With the hot inlet and the outlet closed apply hydrostatic test pressures of 7 kPa and 2000 kPa to the cold inlet for a period of not less than 3 min or more than 5 min and check for any leakage.

A4
Report
Any leakage or distortion shall be reported.

APPENDIX B
FLOW TEST

B1
Scope
This Appendix sets out the test method for determining the ability of the valve to deliver a mixed water discharge of not less than 20 L/min when operated at the manufacturer's stated minimum design operating pressure and hot water inlet temperatures of 65 °C, 90 °C and at either 10 °C below the specified set temperature for fixed temperature valves, or at 10 °C below the specified maximum temperature for variable temperature (adjustable) valves.

B2
Apparatus
The following apparatus is required:

a) Test rig as shown in fig. B1

b) A supply of water at 15 ±5 °C

c) Instrumentation complying with the requirements of Appendix F.

B3
Procedure
The procedure shall be as follows:

a) Install the tempering valve under test in accordance with the manufacturer's instructions

b) Between the test valve outlet and the temperature indicating device fit 1 ±0.01 m of copper tube complying with NZS 3501 and of the same nominal size as the valve outlet

c) Set the cold water inlet pressure to the manufacturer's stated minimum design operating pressure within +5 -0 kPa using either a supply tank or an adjustable pressure reducing valve

d) Fully open the inlet and outlet ball valves

e) Fill the water heater and the outlet pipe with cold water and ensure all air is exhausted from the system by operating the relief valve lever during the filling process. Close the outlet ball valve

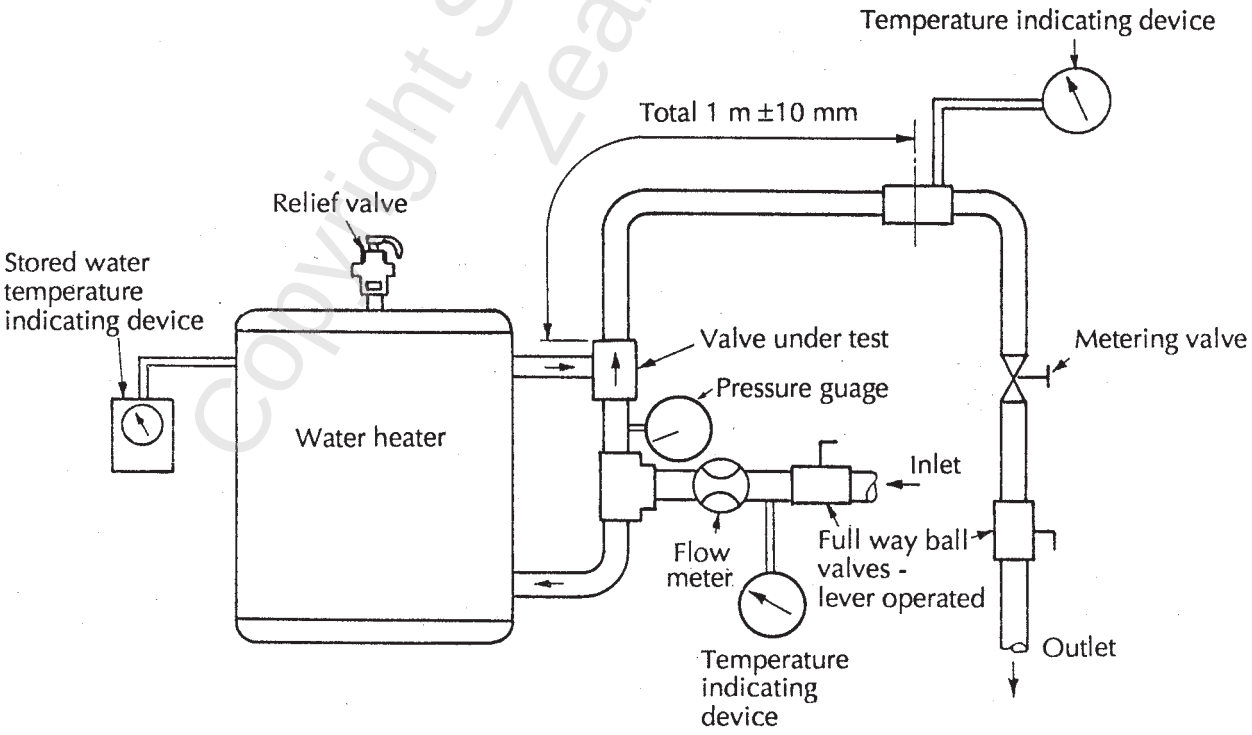


Fig. B1
TYPICAL TEST RIG FOR FLOW TEST

f) Where a pressure reducing valve is used adjust the valve to maintain, under conditions of flow, the manufacturer's stated minimum pressure within +5 -0 kPa

g) Switch on the water heater elements

h) Allow heating to continue at a rate not exceeding 3 °C/min until a temperature of 10 ±2 °C below the set temperature specified by the manufacturer is reached as indicated on the stored water temperature indicating device

j) Switch off the water heater elements

k) Fully open the outlet ball valve

m) Observe and record the mixed outlet water flow and temperature

n) Allow the flow to continue until the mixed outlet water temperature stabilizes to within 2 °C for 15 s or until 65 % of the test water heater capacity has been used

p) Close the outlet ball valve, switch on the water heater elements and raise the water temperature at a rate not exceeding 3 °C/min to 65 ±2 °C

q) Repeat steps (j) to (n)

r) Close the outlet ball valve, switch on the water heater elements and raise the water temperature at a rate not exceeding 1.5 °C/min to 90 +5 – 0 °C

s) Repeat steps (j) to (n).

B4
Report

Report the set temperature and cold water supply pressure at which the test was conducted. For each test temperature report the mixed water temperature and flow.

APPENDIX C
MIXED WATER TEMPERATURE TEST

C1
Scope
This Appendix sets out the method of test for determining the temperature of the mixed water discharge.

C2
Apparatus
The following apparatus is required:

a) Test rig as shown in fig. C1

b) A supply of water at 15 ±5 °C

c) A stopwatch

d) Instrumentation complying with the requirements of Appendix F.

C3
Procedure
The procedure shall be as follows:

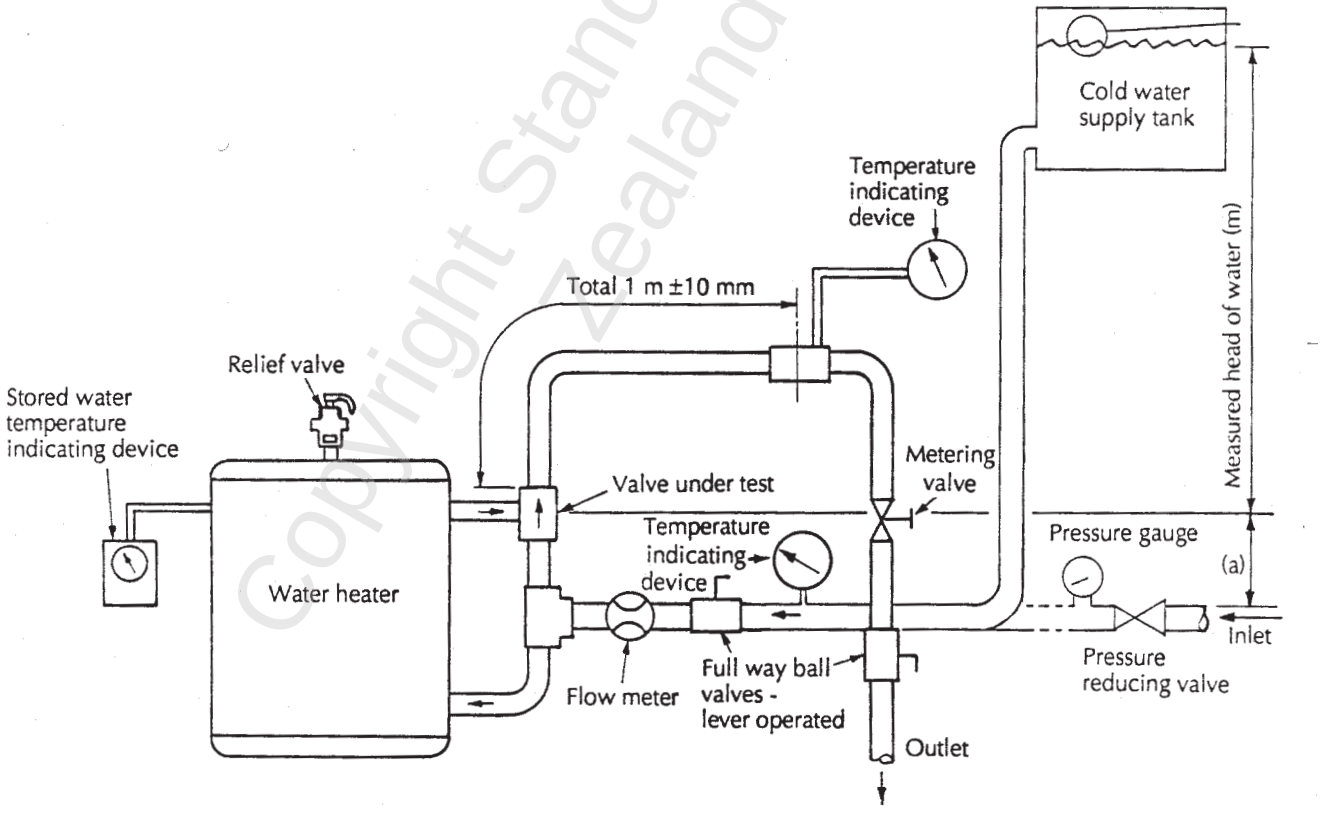
a) Install the tempering valve under test in accordance with the manufacturer's instructions

NOTE - Fig. C1 is an example only.

b) Between the valve outlet and the mixed water temperature indicating device fit 1 ±0.01m of copper tube complying with NZS 3501 and of the same nominal size as the valve outlet

c) Fully open the inlet ball valve, metering valve and outlet ball valve

d) Fill the water heater and the outlet pipe with



NOTE - Record dimension (a) so that the pressure at the test valve can be calculated when using a pressure reducing valve.

Fig. C1
TYPICAL TEST RIG FOR MIXED WATER TEMPERATURE TEST

cold water, and ensure all air is exhausted from the system, by operating the relief valve lever during the filling process

e) Adjust the metering valve until a flow rate of 4 ±0.5 L/min is obtained as registered on the flow meter

f) Close the outlet ball valve

g) Switch on the water heater elements

h) Allow heating to continue at a rate not exceeding 3 °C/min until a temperature of 65 ±2 °C is obtained as registered on the stored water temperature indicating device

j) Switch off the water heater elements

k) Fully open the outlet ball valve

m) Observe and record the mixed outlet water temperature. Record specifically any period when the temperature exceeds 60 °C

n) Allow the flow to continue until the mixed outlet water temperature stabilizes or until 65 % of the test water heater capacity has been used. Record this temperature and record the time taken for the temperature to stabilize

p) Adjust metering valve until a flow rate of 12 ±0.5 L/min is obtained as registered on the flow meter and repeat steps (f) to (n)

q) Adjust metering valve until a flow rate of 30 ±0.5 L/min or that obtained at the manufacturer's stated maximum operating pressure, whichever is the lesser, is registered on the flow meter, and repeat steps (f) to (n)

r) Adjust metering valve until a flow rate of 4 ±0.5 L/min is obtained as registered on the flow meter and close the outlet ball valve

s) Switch on the water heater elements and raise the water temperature at a rate not exceeding 1.5 °C/min to 90 +5 -0 °C

t) Switch off the water heater elements and repeat steps (k), (m) and (n)

u) Adjust metering valve until a flow rate of 12 ±0.5 L/min is obtained as registered on the flow meter and close the outlet valve

v) Repeat steps (s), (t), (k), (m) and (n)

w) Adjust metering valve until a flow rate of 30 ±0.5 L/min, or that obtained at the manufacturer's stated maximum operating pressure, whichever is the lesser, is registered on the flow meter, and close the outlet valve

x) Repeat steps (s), (t), (k), (m) and (n).

C4
Report
Report for each discharge:

a) The temperature in degrees Celsius at which the mixed outlet water stabilized

b) The time in seconds for the temperature of the mixed outlet water to stabilize and the duration of any instance where the temperature exceeded 60 °C.

APPENDIX D
CONTINUOUS OPERATION TEST

D1
Scope
This Appendix sets out the method of test for determining the temperature variation of the mixed water discharge after subjecting the temperature actuating element to 50 000 cycles in water alternating between specified minimum and maximum temperatures.

D2
Apparatus
The following apparatus is required:

a) Test rig as shown in fig. D1

b) A supply of hot water at 80-85 °C

c) A supply of cold water at 15 ±5 °C

d) Instrumentation complying with the requirements of Appendix F.

D3
Procedure
The procedure is as follows:

a) Install the test valve with the temperature sensing element fully immersed in water

b) Connect the supply of cold water

c) Connect the supply of hot water

d) Start the timing device

e) Activate the cold water supply for 30 ±5 s followed by the hot water supply for 30 ±5 s

f) Repeat step (e) for 50 000 cycles

g) Test the valve in accordance with Appendix C

h) Dismantle the valve and check for evidence of excessive wear of valve seats or jumper washers.

D4
Report
Report for each mixed water discharge the maximum temperature (in degrees Celsius) excluding the first 4 s of operation.

Report any evidence of excessible wear of valve seats or jumper washers.

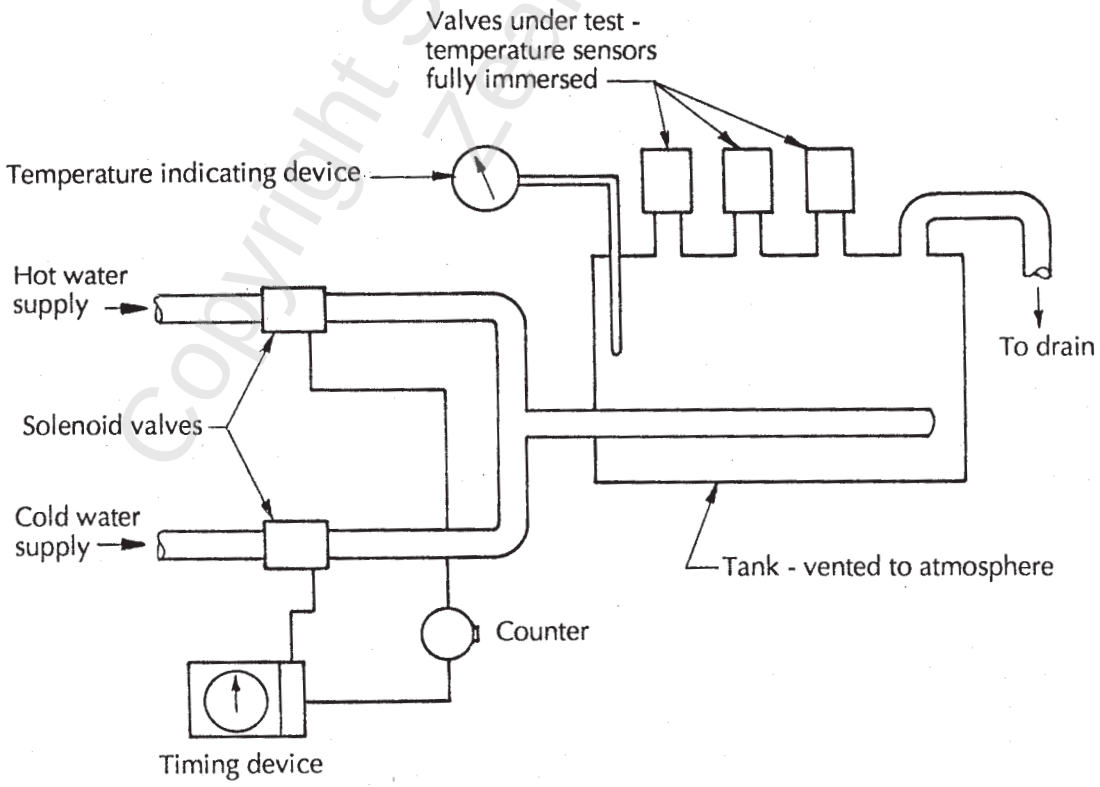


Fig. D1
TYPICAL TEST ARRANGEMENT FOR CONTINUOUS OPERATION TEST

APPENDIX E
BOILING WATER TEST

E1
Scope
This Appendix sets out the method of assessing the valves' resistance to boiling water as could occur in dual systems incorporating a wetback.

E2
Apparatus
The following apparatus is required:

a) A supply of hot water at a temperature of 100 +0 -2 °C and at a pressure equal to the manufacturer's nominated maximum operating pressure

b) A supply of cold water at ambient temperature and at a pressure equal to the manufacturer's nominated maximum operating pressure

c) A temperature indicating device complying with Appendix F.

E3
Procedure
a) Mount the test valve in accordance with the manufacturer's installation procedure

b) Install the thermocouple of the temperature indicating device in the hot water line immediately upstream of the hot water inlet to the valve

c) Thermally insulate the hot water line up to the hot water inlet of the valve

d) Open a mixed water outlet. After 10 ±1 s close the mixed water outlet

e) Observe and record the temperature reading

f) Monitor the temperature reading. If the temperature falls below 98 °C repeat step (d)

g) Continue the test for a period of 24 h.

APPENDIX F
INSTRUMENTATION

F1
General
Where applicable, the accuracy of the instrumentation used in the tests required by this Standard shall be not less than specified below.

F2
Flowmeter (for use with water)

Flow rate range: 0 to 50 L/min

Accuracy: ±1 % of full scale

Response time: 1 s maximum

F3
Pressure gauges (for use with water)
All gauges shall be test gauges complying with BS1780.

F4
Temperature-indicating device

Temperature range: 0 - 150 °C

Accuracy: ±0.5 %

Response time: 1 s maximum

F5
Stopwatch

Accuracy: ±0.01 s

THE NEW ZEALAND STANDARD CERTIFICATION MARK SCHEME

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