



**ASME A112.18.1-2012/  
CSA B125.1-12**

# Plumbing supply fittings



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# Preface

This is the third edition of ASME A112.18.1/CSA B125.1, *Plumbing supply fittings*. It supersedes the previous editions, published in 2011 and 2005.

Together with ASME A112.18.2/CSA B125.2, *Plumbing waste fittings*, CSA B125.3-10, *Plumbing fittings*, and ASME A112.18.6/CSA B125.6, *Flexible water connectors*, this Standard forms a series to cover plumbing fittings.

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

This Standard was prepared by the ASME/CSA Joint Harmonization Task Group on Plumbing Fittings, under the jurisdiction of the ASME Standards Committee on Plumbing Materials and Equipment and the CSA Technical Committee on Plumbing Fittings. The CSA Technical Committee operates under the jurisdiction of the CSA Strategic Steering Committee on Water Management Products, Materials, and Systems. This Standard has been formally approved by the ASME Standards Committee and the CSA Technical Committee. This Standard was approved as an American National Standard by the American National Standards Institute on November 30, 2012.

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# ASME A112.18.1-2012/CSA B125.1-12

## *Plumbing supply fittings*

### 1 Scope

#### 1.1

This Standard covers plumbing supply fittings and accessories located between the supply stop and the terminal fitting, inclusive, as follows:

- (a) automatic compensating valves for individual wall-mounted showering systems;
- (b) bath and shower supply fittings;
- (c) bidet supply fittings;
- (d) clothes washer supply fittings;
- (e) drinking fountain supply fittings;
- (f) humidifier supply stops;
- (g) kitchen, sink, and lavatory supply fittings;
- (h) laundry tub supply fittings;
- (i) lawn and sediment faucets;
- (j) metering and self-closing supply fittings;
- (k) shower heads, hand-held showers, and body sprays; and
- (l) supply stops.

#### 1.2

This Standard does not cover

- (a) plumbing waste fittings, which are covered by ASME A112.18.2/CSA B125.2;
- (b) other devices (e.g., temperature-actuated in-line mixing valves), which are covered by CSA B125.3 or other plumbing product Standards; and
- (c) flexible water connectors under continuous pressure, which are covered by ASME A112.18.6/CSA B125.6.

#### 1.3

Except for push-fit fittings, this Standard does not cover pipes and tubes or pipe and tube fittings.

#### 1.4

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

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

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

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

#### 1.5

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

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

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

For information on the conversion criteria used in this Standard, see [Annex A](#).

## 2 Reference publications

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

### **ASSE/ASME/CSA Group (American Society of Sanitary Engineering/The American Society of Mechanical Engineers)**

ASSE 1016-2011/ASME A112.1016-2011/CSA B125.16-11

*Performance requirements for automatic compensating valves for individual showers and tub/shower combinations*

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

ASME A112.18.2-2011/CSA B125.2-11

*Plumbing waste fittings*

ASME A112.18.6-2009/CSA B125.6-09

*Flexible water connectors*

### **ASME (The American Society of Mechanical Engineers)**

A112.1.2-2004

*Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)*

A112.18.3-2002 (R2008)

*Performance Requirements for Backflow Protection Devices and Systems in Plumbing Fixture Fittings*

B1.20.1-1983 (R2006)

*Pipe Threads, General Purpose, Inch*

B1.20.7-1991 (R2008)

*Hose Coupling Screw Threads, Inch*

B16.18-2001 (R2005)

*Cast Copper Alloy Solder Joint Pressure Fittings*

B16.22-2001 (R2005.)

*Wrought Copper and Copper Alloy Solder Joint Pressure Fittings*

B16.26-2006

*Cast Copper Alloy Fittings for Flared Copper Tubes*

PTC 19.2-1987 (R2004)

*Pressure Measurement*

PTC 19.5-2004

*Flow measurement*

### **CSA Group**

CAN/CSA-B64 Series-07

*Backflow preventers and vacuum breakers*

B125.3-11  
*Plumbing fittings*

**ASSE (American Society of Sanitary Engineering)**

1019-2004  
*Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type*

1061-2006  
*Removable & Non-Removable Push-Fit Fittings*

**ASTM International (American Society for Testing and Materials)**

B117-07a  
*Standard Practice for Operating Salt Spray (Fog) Apparatus*

B368-97(2003)e1  
*Standard Method for Copper-Accelerated Acetic Acid-Salt Spray (Fog) Testing (CASS Test)*

B380-97(2008)e1  
*Standard Test Method of Corrosion Testing of Decorative Electrodeposited Coatings by the Corrodokote Procedure*

B571-97(2008)e1  
*Standard Practice for Qualitative Adhesion Testing of Metallic Coatings*

D968-05e1  
*Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive*

D3359-09e2  
*Standard Test Methods for Measuring Adhesion by Tape Test*

E29-08  
*Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*

G85-02e1  
*Standard Practice for Modified Salt Spray (Fog) Testing*

**ISA (Instrumentation, Systems, and Automation Society)**

ANSI/ISA-75.02-2008  
*Control Valve Capacity Test Procedures*

MC96.1-1982  
*Temperature Measurement Thermocouples*

**ISO (International Organization for Standardization)**

228-1:2000  
*Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

**NSF International**

NSF/ANSI 61-2007a  
*Drinking Water System Components — Health Effects*

NSF/ANSI 372-2010  
*Drinking Water System Components — Lead content*

**SAE International (Society of Automotive Engineers)**

J512 (1997)

*Automotive Tube Fittings*

### 3 Definitions and abbreviations

#### 3.1 Definitions

The following definitions shall apply in this Standard:

**Accessible** — readily serviceable or readily replaceable.

**Accessible design** — a design approach for making devices accessible to persons with physical, sensory, or cognitive disabilities.

**Note:** *Accessible designs were formerly called barrier-free designs.*

**Accessory** — a component that can, at the discretion of the user, be readily added, removed, or replaced and that, when removed, will not prevent the fitting from fulfilling its primary function.

**Note:** *Examples include aerators, hand-held shower assemblies, shower heads, and in-line flow controls.*

**Air gap** — the unobstructed vertical distance, through air, between the lowest point of a water supply outlet and the mounting deck of the fitting.

**Automatic compensating valve** — a water-mixing valve that is supplied with hot and cold water and that provides a means of automatically maintaining the water temperature selected for an outlet.

**Note:** *Automatic compensating valves are used to reduce the risk of scalding and thermal shock.*

**Backflow** — a flowing back or reversal of the normal direction of flow.

**Note:** *Back siphonage and back pressure are types of backflow.*

**Backflow prevention device** — a mechanical device, whether used singly or in combination with other devices, that automatically prevents reversal of water flow in a water system due to back pressure or back siphonage.

**Back pressure** — pressure higher at the downstream or outlet end of a water system than at a point upstream.

**Back siphonage** — backflow caused by below-atmospheric pressure in the water system.

**Body spray** — a shower device for spraying water onto a bather other than from the overhead position.

**Note:** *An example is a device mounted on a wall below the bather's head that sprays water in an approximately horizontal direction and can be fixed or allowed to swivel on a ball joint.*

**Critical level (CL)** — the lowest water level in a fitting at which back siphonage will not occur.

**Cross-flow** — the exchange of water from one supply to the other without water flowing through the mixing valve outlet(s).

**Defect** —

**Blister** — a dome-shaped defect resulting from loss of adhesion between layers or between one or more layers and the substrate.

**Crack (as applied in coatings evaluation)** —

- (a) a separation in a coating layer that extends down to the next layer or to the substrate in a coating that has lost its adhesion; or



- (b) any indication of a crack (e.g., white deposits or corrosion) that results from performance tests, allows penetration through a plating layer, and did not appear on the surface or part before performance testing.

**Note:** Coating surface deformations that appear after performance testing (e.g., stretch marks, flow lines under the coating, or deformations caused by stress relieving of the substrate) and do not separate, peel, or come loose are not considered cracks.

**Pit** — a small depression or cavity.

**Surface defect** — a pit, blister, crack, peeling, wrinkling, corrosion, or exposure of the substrate visible to the unaided eye at normal reading distance.

**Note:** “Unaided eye” includes vision assisted by corrective lenses normally worn by the person inspecting a device for surface defects.

**Diverter** — a device that is integral to a fitting or that functions as an accessory and is used to direct the flow of water from a primary outlet to one or more secondary outlets.

**Faucet** — a terminal fitting.

**Lawn faucet** — a faucet designed to be installed horizontally on the outside wall of a building with male or female IPS threads or copper solder connections on the inlet and hose threads on the outlet.

**Notes:**

- (1) Lawn faucets can be frostproof.
- (2) The outlet is usually angled 45° from the horizontal. Lawn faucets include a flange that mounts flush with the wall.

**Sediment faucet** — a horizontal faucet with male or female IPS threads on the inlet side and male hose threads at the outlet spout.

**Notes:**

- (1) The outlet can be angled approximately perpendicularly to the inlet or angled outward.
- (2) Sediment faucets were formerly called boiler drains because they were originally designed to drain water from boilers and release any accumulated sediment. Today they are also used in laundry rooms as hook-ups for washing machines.

**Self-closing faucet** — a faucet that closes itself after the actuation or control mechanism is deactivated.

**Note:** The actuation or control mechanism can be mechanical or electronic.

**Fitting** — a device that controls and guides the flow of water.

**Note:** Fittings include faucets and valves.

**Combination fitting** — a fitting with more than one supply inlet delivering water through a single spout.

**Concealed fitting** — a fitting with its body mounted beneath or behind a fixture, wall, or surface.

**Deck-mounted fitting** — a fitting that is mounted on top of a horizontal surface.

**Exposed fitting** — a fitting whose body is mounted above or in front of a fixture’s deck or shelf.

**Line fitting** — a fitting that does not discharge to atmosphere.

**Public lavatory fitting** — a fitting intended to be installed in non-residential bathrooms that are exposed to walk-in traffic.

**Supply fitting** — a fitting that controls and guides the flow of water in a supply system.

**Terminal fitting** — a fitting with an open or atmospheric discharge.

**Fixture** — a device that receives water or waste matter, or both, and directs these substances into a drainage system.

**Grasp** — to firmly hold and seize an object by wrapping the fingers and thumb around it.

**Operating control** — a part of a supply fitting or accessory that manually controls the temperature, direction, or flow rate of water or that closes and opens the water supply.

**Outlet** —

**Primary outlet** — the outlet from a supply fitting on the discharge side of a valve through which water will discharge unless diverted to a secondary outlet.

**Secondary outlet** — an outlet from a supply fitting on the discharge side of a valve, other than the primary outlet, through which water can be discharged.

**Permanent mark or label** — a mark or label that is intended to remain in place for the lifetime of the fitting under conditions of normal use.

**Physical vapour deposition (PVD)** — a family of coating processes in which the surface layer is formed by the deposition of individual atoms or molecules.

**Note:** In PVD a material is vaporized from a solid or liquid source, transported through a low-pressure gaseous or plasma environment, and condensed on a substrate surface.

**Potable water** — water that is satisfactory for drinking and for culinary and domestic purposes.

**Note:** Potable water meets the requirements of the health authority having jurisdiction.

**Pressure** —

**Flowing pressure** — the pressure in the piping upstream of an open fitting or accessory.

**Supply pressure** — the static water pressure in the fitting supply piping.

**Pressure envelope** — the outside part of a supply fitting that withstands and contains the water pressure.

**Push-fit fitting** — a mechanical fitting that joins pipes or tubes and achieves a seal by pushing by hand the mating pipe or tube into the fitting.

**Note:** The fitting can be removable or non-removable.

**Rigid waterway** — a cross-section of a waterway that can transmit a bending load to the body of a fitting.

**Seal** — a component or other portion of a fitting that prevents water leakage.

**Seat disc** — a disc or washer that provides a watertight joint when compressed against the seat.

**Service conditions 1 (SC-1)** — the coated surfaces of concealed fittings and concealed parts of exposed fittings.

**Service conditions 2 (SC-2)** — the coated significant surfaces of exposed fittings and exposed parts of concealed fittings.

**Shank** — the rigid threaded portion of a supply fitting that extends below the mounting surface and has a means for connecting to the supply piping.

**Shower head** — an accessory to a supply fitting for spraying water onto a bather, typically from an overhead position.

**Significant surface** — an exposed surface that, if blemished, spoils the appearance or affects the performance of a fitting.

**Standard tools** — tools that are normally carried by plumbers for installing and maintaining plumbing.

**Note:** Examples include screwdrivers, key wrenches, flat-jawed wrenches, and pliers.

**Substrate** — the base material and all of the layers of coating under the final coating.

**Supply stop** — a valve that is placed immediately upstream of a terminal fitting to shut off the water supply to the terminal fitting so that it can be serviced or replaced.

**Valve** — a fitting with a movable part that regulates the flow of water through one or more passages.

**Cycling mixing valve** — a supply fitting with a single handle that can rotate from the closed position, through cold to hot, and in the reverse direction back to the closed position.

**Single-control mixing valve** — a supply fitting with a single handle that turns water on and off and changes water volume and temperature.

**Single-handle mixing valve** — a supply fitting with a single handle for changing the discharge water temperature when the fitting is supplied with both hot and cold water.

**Two-handle mixing valve** — a supply fitting with separate hot and cold water control valves.

## 3.2 Abbreviations

The following abbreviations apply in this Standard:

CL	— critical level
IPS	— Iron Pipe Size
NPS	— Nominal Pipe Size
NPSM	— National Pipe Straight Mechanical
NPT	— National Pipe Tapered
PTC	— Performance test code
PVD	— physical vapour deposition
SC-1	— service conditions 1
SC-2	— service conditions 2

# 4 Design requirements

## 4.1 Supply fittings

### 4.1.1 Rated pressure

#### 4.1.1.1

Supply fittings shall be designed for a rated supply pressure of 690 kPa (100 psi).

#### 4.1.1.2

Supply fittings shall be designed to function at a supply pressure between 140 and 860 kPa (20 and 125 psi).

### 4.1.2 Rated temperatures

Supply fittings shall be designed for rated supply temperatures from 5 to 71 °C (40 to 160°F).

### 4.1.3 Seating members

#### 4.1.3.1

The following fittings shall have replaceable seats:

- (a) supply valves for bath and shower fittings, except concealed stops;
- (b) combination lavatory fittings;
- (c) combination kitchen sink fittings;
- (d) bidet fittings;
- (e) single lavatory faucets; and
- (f) exposed valve-type bath and shower fittings.

#### 4.1.3.2

Seat disc arrangements shall be replaceable.

#### 4.1.3.3

Seat disc arrangements shall not vibrate in service. When a threaded device is used to secure the disc, it shall remain secure after the disc has been removed and replaced five times.

#### 4.1.3.4

In lieu of a replaceable seat, as required in [Clauses 4.1.3.1](#) and [4.1.3.2](#), a replaceable cartridge that includes both seat and seal may be used.

#### 4.1.3.5

The solenoid valve used to open and close the flow of water shall be replaceable.

### 4.2 Servicing

Supply fittings, excluding supply stops, shall be designed so that replacement of wearing parts can be accomplished

- (a) without removing the fitting from the supply system;
- (b) without removing the piping from the body;
- (c) without disturbing the finished wall; and
- (d) using standard tools or manufacturer-provided tools.

Swing spouts designed to use adjustable packing in the joint between the spout and the body shall be constructed so that the adjustments can be made without removing the spout.

### 4.3 Installation

A method of sealing between the fitting and the fixture to which it is fastened shall be provided.

### 4.4 Threaded connections

#### 4.4.1

Pipe threads shall comply with ASME B1.20.1.

#### 4.4.2

Hose threads shall comply with ASME B1.20.7.

#### 4.4.3

##### 4.4.3.1

Aerators and other end point devices with standard threads shall be compatible with one of the following thread designations:

- (a) 13/16-27 UNS-2A, 3/4-27 UNS-2B, 15/16-27 UNS-2A, or 55/64-27 UNS-2B; or
- (b) M18X1-6g, M16X1-6H, M24X1-6g, M22X1-6H, or M28X1-6g.

#### 4.4.3.2

Fittings with non-standard threads for aerators or other end point devices may be used.

#### 4.4.4

Hand-held shower connection threads shall be 1/2-14 NPSM or ISO 228-G 1/2 B (see ISO 228-1).

#### 4.4.5

The dimensions of supply flare connections shall be as specified in ASME B16.26.

#### 4.4.6

The dimensions of supply compression connections shall be compatible with SAE J512.

#### 4.4.7

The dimensions for the inlets and shank lengths of 1/2-14 NPSM rigid shanks of deck-mounted lavatory and sink supply fittings designed to mate with a standard 1/2 NPSM coupling nut and tailpiece or 1/2 nominal size copper water tube shall be as shown in [Figures 1](#) and [2](#).

Inlets and shanks may be designed to mate with other common connections.

**Note:** Longer shank lengths are sometimes necessary on account of fitting orientations and countertop thickness or materials.

#### 4.4.8

Alternative end-threaded connections for flexible hoses and flexible components shall comply with the performance requirements of this Standard.

#### 4.4.9

Shower heads for installation on standard shower arms shall be capable of being connected to a 1/2 NPT male thread.

### 4.5 Connections other than threaded connections

#### 4.5.1

The lengths and diameters of solder-joint sockets shall be as specified in ASME B16.18 or ASME B16.22 for connections to copper tubes. This requirement shall not apply to factory-assembled parts.

#### 4.5.2

Connections achieved by push-fit fittings, intended for use under continuous pressure, shall comply with ASSE 1061.

#### 4.5.3

Alternative end connections for flexible hoses and flexible components shall comply with the performance requirements of this Standard.

#### 4.5.4

Fittings with proprietary connections for aerators or other end point devices may be used.

### 4.6 Accessible designs

Operating controls intended for use in accessible designs shall

- (a) be automatically controlled; or
- (b) meet the following requirements:
  - (i) be operable with one hand;
  - (ii) not require tight grasping, pinching, or twisting of the wrist; and
  - (iii) require an operating force not greater than that specified in [Clause 5.5.2](#).

## 4.7 Backflow prevention

Fittings shall be designed to protect the potable water supply from contamination due to backflow by a means that meets the applicable requirements of [Clause 5.9](#).

Diverting and anti-siphoning devices incorporated into a fitting shall be removable for cleaning, repair, and replacement.

## 4.8 Cover plates and escutcheons

### 4.8.1

The cover plates of deck-mounted lavatory and sink supply fittings shall have the dimensions indicated in [Figure 1](#), except as specified in [Clause 4.8.2](#).

**Note:** Refer to the appropriate fixture standards for the minimum mounting surface dimensions.

### 4.8.2

Concealed and deck-mounted supply fitting bodies or their escutcheons shall be capable of concealing a circular area with a diameter of not less than 44 mm (1.73 in).

## 4.9 Toxicity and lead content

### 4.9.1

Fittings covered by this Standard shall comply with the applicable requirements of NSF/ANSI 61.

### 4.9.2

Solders and fluxes in contact with potable water shall not exceed, by mass, 0.2% lead content. Metal alloys in contact with potable water shall not exceed 8% lead content.

### 4.9.3

Fittings intended to convey or dispense water for human consumption through drinking or cooking shall not contain a weighted average lead content in excess of 0.25% when evaluated in accordance with the test method specified in NSF/ANSI 372.

## 4.10 Frost-proof faucets and hydrants

Frost-proof faucets and hydrants shall comply with the performance requirements of this Standard. Devices with integral backflow protection shall comply with CAN/CSA-B64 Series or ASSE 1019.

## 4.11 Shower heads, body sprays, and hand-held showers

### 4.11.1 General

When used as a component part of a shower head, body spray, or hand-held shower assembly, the flow-restricting inserts shall be mechanically retained at the point of manufacture. For the purpose of this requirement, the term “mechanically retained” shall mean that a force of 36 N (8.0 lbf) or more is required to remove the flow-restricting insert. This requirement shall not apply to shower heads that would cause water to leak significantly from areas other than the spray face if the flow-restricting insert were removed.

### 4.11.2 High-efficiency shower heads and hand-held showers

**Note:** Water conserving shower heads do not necessarily have to comply with the high-efficiency requirements specified in [Clause 5.12](#) if they are not designated as high-efficiency shower heads.

#### **4.11.2.1**

If the high-efficiency shower head or hand-held shower has more than one mode,

- (a) all modes shall comply with the maximum flow rate requirements specified in [Clause 5.12.2.1](#);
- (b) all modes shall comply with the minimum flow rate requirements specified in [Clause 5.12.2.2.1](#); and
- (c) at least one of the modes shall comply with the requirements specified in [Clauses 5.12.2.2.2, 5.12.3, and 5.12.4](#) for high-efficiency. The manufacturer shall indicate which mode is to be tested for high-efficiency.

#### **4.11.2.2**

See [Clause 6.4](#) for additional marking requirements for high-efficiency shower heads and hand-held showers.

### **4.12 Cross-flow**

#### **4.12.1**

Except as otherwise allowed by [Clause 4.12.2](#), a flow-control device shall not completely shut off the flow of water downstream of the primary shut-off valve when

- (a) fitted to a faucet or fitting; or
- (b) fitted to, or integral with, a shower head or hand-held shower.

#### **4.12.2**

Faucets or fittings that have integral flow-control devices downstream of the primary shut-off valves that completely shut off the flow of water or that have devices upstream of the primary shut-off valves that might allow cross-flow shall have check valves installed in the faucet or fitting to prevent cross-flow. These check valves shall comply with [Clause 5.3.3](#).

### **4.13 Fittings incorporating electrical features**

#### **4.13.1 General**

##### **4.13.1.1**

Electrical power to low-voltage circuits involving a peak open-circuit potential of not more than 42.2 V shall be supplied by a

- (a) primary battery supply;
- (b) suitable Class 2 low-voltage transformer complying with the applicable CSA or UL electrical Standards; or
- (c) combination of a transformer and fixed impedance that, as a unit, complies with the requirements for a Class 2 transformer specified in Item (b).

##### **4.13.1.2**

Fittings incorporating electrical features other than low-voltage circuits shall comply with the applicable CSA or UL electrical Standards.

#### **4.13.2 Testing**

When used with a plumbing fitting, electrical plumbing controls, including solenoid valves, shall

- (a) be considered components of the plumbing fitting;
- (b) be tested with the fitting; and
- (c) comply with [Clause 5.6](#).

Replacement of a battery during the life cycle testing specified in [Clause 5.6](#) shall not be considered a failure.

#### 4.14 Materials

Coupling nuts, locknuts, and spout-holding nuts shall be made from

- (a) copper alloys with a minimum copper content of 56%;
- (b) stainless steel alloys of the 300 or 400 Series;
- (c) plastics; or
- (d) materials that comply with [Clause 5.11](#).

#### 4.15 Automatic compensating valve temperature control

Automatic compensating valves shall comply with ASSE 1016/ASME A112.1016/CSA B125.16.

#### 4.16 Lawn faucets

Lawn faucets (other than frost-proof lawn faucets) shall comply with [Clause 5.10](#).

#### 4.17 Flexible water connectors

Flexible water connectors intended for use under continuous pressure shall comply with ASME A112.18.6/CSA B125.6.

### 5 Performance requirements and test procedures

#### 5.1 General

##### 5.1.1 Preconditioning

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

##### 5.1.2 Installation for testing

For test purposes, specimens shall be installed in accordance with the manufacturer's instructions.

##### 5.1.3 Test conditions

Unless otherwise specified in this Standard, tests shall be conducted at ambient laboratory conditions.

##### 5.1.4 Order of tests

It shall not be necessary to conduct the tests in a particular order, unless a sequence is specified in this Standard.

**Note:** A summary of the applicable tests, by fitting type, is provided in [Table B.1](#).

#### 5.2 Coatings

##### 5.2.1 General

The fittings selected for testing shall be as received from the manufacturer and shall not have been subjected to any other test. The significant surfaces of the coated components shall be free of surface defects and uncoated areas and shall not be stained.

##### 5.2.2 Corrosion (all substrates and coatings)

###### 5.2.2.1 Performance requirements

After undergoing the applicable test specified in [Clause 5.2.2.1](#), coatings shall not show more than one surface defect in any 650 mm<sup>2</sup> (1.0 in<sup>2</sup>) area of the significant surface or up to three surface defects on a 25 mm (1.0 in) length of parting line. The surface defects shall be not larger than 0.8 mm (0.03 in) in any dimension.



If widely scattered surface defects are observed after testing (as occasionally occurs), such defects shall not significantly deface or adversely affect the function of the coated part.

### 5.2.2.2 Test procedure

#### 5.2.2.2.1

The coated parts shall comply with the performance requirements of [Clause 5.2.2.1](#) after being subjected to one of the following corrosion tests:

- (a) ASTM G85 (Annex A1 — acetic acid): the test duration shall be 8 h for service conditions 1 (SC-1) and 24 h for service conditions 2 (SC-2).
- (b) ASTM B117 (neutral salt): this test shall be applicable to SC-2 devices and shall have a duration of 24 h.
- (c) ASTM B368 (CASS): this test shall be applicable to SC-2 devices and shall have a duration of 4 h.
- (d) ASTM B380 (Corrodokote): this test shall be applicable to SC-2 devices and shall have a duration of 4 h.

**Note:** If more than one test method is specified, the manufacturer may specify which method is to be used. SC-1 and SC-2 are defined in [Clause 3.1](#).

#### 5.2.2.2.2

An SC-1 specimen that passes the SC-2 test shall be considered to have met the requirements of [Clause 5.2.2.2.1](#).

### 5.2.3 Adhesion

#### 5.2.3.1 Performance requirements

The coating and the separate layers of multi-layer coatings shall be sufficiently adherent to each other and to the base material to comply with one of the adhesion tests specified in [Clause 5.2.3.2](#), [5.2.3.3](#), or [5.2.3.4](#), as applicable.

#### 5.2.3.2 Electrodeposited and PVD coatings on metals

Specimens shall be tested in accordance and comply with one of the following adhesion tests specified in ASTM B571:

- (a) Paragraph 4: burnish test;
- (b) Paragraph 7: file test;
- (c) Paragraph 8: grind-saw test; or
- (d) Paragraph 9: heat-quench test.

#### 5.2.3.3 Electrodeposited and PVD coatings on plastics

##### 5.2.3.3.1 Performance requirements

Fittings or component parts of fittings that have electrodeposited coatings on plastic bases, including those with additional organic coatings, shall comply with the following requirements when tested in accordance with [Clause 5.2.3.3.2](#):

- (a) No surface defects shall be present on significant surfaces.
- (b) Non-significant surfaces, gates, and parting lines may have minor cracks not longer than 6 mm (0.25 in), provided that there is no loss of adhesion between the base material and the coating.
- (c) Blisters not exceeding 6 mm<sup>2</sup> (0.01 in<sup>2</sup>) in area shall be acceptable within 6 mm (0.25 in) of an injection point. If an injection point is within 6 mm (0.25 in) of a significant surface, Item (a) shall apply.
- (d) Warpage shall be considered acceptable only where it does not affect the performance of the fitting or component.

The adhesion of organic coatings shall be evaluated following the procedure specified in [Clause 5.2.3.4](#) and shall not be evaluated during the test specified in [Clause 5.2.3.3.2](#).

### 5.2.3.3.2 Thermal cycling procedure

Before the thermal cycling test begins, the fittings or component parts of fittings shall be examined and surface imperfections (e.g., small mould imperfections) shall be noted. These surface imperfections shall not be considered failures after the thermal cycling test unless they develop into surface defects.

Under dry conditions, the specimens shall be subjected consecutively to four complete cycles of temperatures, with each complete cycle consisting of the following steps in the following order:

- (a)  $-40 \pm 2$  °C ( $-40 \pm 4$ °F) for 20 min to 1 h;
- (b)  $20 \pm 5$  °C ( $68 \pm 9$ °F) for a minimum of 20 min;
- (c)  $75 \pm 2$  °C ( $167 \pm 4$ °F) for 20 min to 1 h; and
- (d)  $20 \pm 5$  °C ( $68 \pm 9$ °F) for a minimum of 20 min.

The temperatures specified in Items (a) to (d) shall be measured within 50 mm (2 in) of the centre of the location of the specimens. Temperature ramping may be used for achieving the temperatures specified in Items (a) to (d). For the steps specified in Items (a) and (c), the temperature ramping time (if any) plus the time during which the specimen is at the specified temperature (a minimum of 20 min) shall not exceed 1 h.

During testing, there shall be free circulation of air around the specimens and most of their surface area shall not be in contact with other specimens or the holding container.

### 5.2.3.4 Organic coatings

The adhesion of organic coatings shall be tested in accordance with Method A of ASTM D3359. The organic coating shall have an adhesion rating of 3A or better.

## 5.2.4 Decorative organic coatings

### 5.2.4.1 Performance requirements

In addition to complying with the adhesion testing specified in [Clause 5.2.3.4](#), decorative organic coatings shall show no surface defects when they are tested in accordance with [Clauses 5.2.4.2](#) and [5.2.4.3](#), and their finish shall not erode in such a way that the surface directly beneath the organic coating is exposed when they are tested in accordance with [Clause 5.2.4.4](#).

### 5.2.4.2 Water degradation

Specimens shall be immersed in distilled water maintained at  $38 \pm 1$  °C ( $100 \pm 2$ °F) for  $24 \pm 0.5$  h in a corrosion-proof container and then removed and examined.

### 5.2.4.3 Soap and cleaner effects

Two drops (0.10 mL total) of each of the following solutions shall be applied to the organic coating (preferably on a flat surface) and allowed to remain there for 16 h:

- (a) ammonium hydroxide (6N);
- (b) sodium hydroxide (6N);
- (c) methanol (100%); and
- (d) surfactant (100% polyethylene oxyethanol).

At the end of the 16 h period, the excess liquid shall be removed by rinsing with water, and the coating shall be dried and examined.

**Note:** Non-ionic surfactants complying with Item (d) include GAF Igepal CO, GAF Igepal CA, and Shell Triton X-100.

### 5.2.4.4 Abrasion resistance

Specimens shall be tested in accordance with Method A of ASTM D968 using 12 L (3.2 gal) of silica sand on a relatively flat surface of the specimen.

## 5.3 Pressure and temperature

### 5.3.1 Static and dynamic seals

#### 5.3.1.1 Failure criteria

Seals of plumbing supply fittings and accessories, except those of automatic compensating valves (see [Clause 4.15](#)), shall not leak or otherwise fail when tested in accordance with [Clauses 5.3.1.2 to 5.3.1.4](#).

#### 5.3.1.2 Procedure with the valve closed

The specimen shall be tested in accordance with [Clause 5.3.1.4](#), after which it shall be subjected to the supply pressures specified in [Clause 5.3.1.4](#), for 5 min each, with the valve closed.

#### 5.3.1.3 Procedure with the outlet(s) blocked

The specimen shall be tested in accordance with [Clause 5.3.1.4](#), after which it shall be subjected to the supply pressures specified in [Clause 5.3.1.4](#), for 5 min each, with the outlet(s) blocked.

Where the outlet(s) is difficult to block, the flowing pressure shall be increased to the pressures specified in [Clause 5.3.1.4](#), for 5 min each. The joints of the fittings shall be checked for leakages.

### 5.3.1.4 Test temperatures and pressures

#### 5.3.1.4.1

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

#### 5.3.1.4.2

The test temperatures and pressures shall be as follows:

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

Devices intended only for cold water applications shall be tested in accordance with Items (a) and (b) only.

### 5.3.2 Burst pressure

#### 5.3.2.1 Failure criteria

Fittings shall withstand a hydrostatic burst pressure test at the pressures specified in [Clause 5.3.2.2](#) or [5.3.2.3](#), without permanent distortion or failure of the pressure envelope.

#### 5.3.2.2 Terminal fittings

Terminal fittings shall withstand a hydrostatic pressure of 3450 kPa (500 psi) for 1 min. The pressure shall be applied to the inlet with the valve(s) closed. Fittings may be of the pressure-relieving type, provided that the relief occurs at a pressure above 1030 kPa (150 psi) and the relief discharge is into the fixture.

#### 5.3.2.3 Line fittings

Line fittings shall withstand a hydrostatic pressure of 3450 kPa (500 psi) for 1 min. The pressure shall be applied to the inlet with the outlet blocked and the valve open.

### 5.3.3 Cross-flow check valves

**Note:** See [Clause 4.12](#) for additional cross-flow requirements.

### 5.3.3.1 Performance requirements

When tested in accordance with [Clauses 5.3.3.2](#) and [5.3.3.3](#), cross-flow check valves shall not leak more than 35 mL/min (0.01 gpm) out of one supply inlet when the opposite supply inlet is pressurized. This test shall be run before and after the life cycle test specified in [Clause 5.6](#).

### 5.3.3.2 Set-up

Faucets or fittings that have integral flow-control devices downstream of the primary shut-off valves that completely shut off the flow of water shall be tested with the primary shut-off valves open and all outlets blocked.

Faucets or fittings that have devices upstream of the primary shut-off valves that might allow cross-flow shall be tested with the primary shut-off valves closed.

### 5.3.3.3 Test procedure

The cross-flow check valve leak test shall be conducted as follows:

- (a) Pressurize one supply inlet to 35 kPa (5 psi) with water at  $10 \pm 6^\circ\text{C}$  ( $50 \pm 10^\circ\text{F}$ ) for 1 min with the primary shut-off valves open and all outlets blocked.
- (b) Observe the opposite supply inlet for leakage.
- (c) Repeat Items (a) and (b) for the opposite supply inlet.

## 5.3.4 Hose assemblies

### 5.3.4.1 Failure criteria

Hose assemblies shall not fail or leak when tested in accordance with [Clauses 5.3.4.2](#) and [5.3.4.3](#).

### 5.3.4.2 Torque

The threaded connections of hose assemblies shall be tested as specified in [Clause 5.3.1.3](#) with the threaded connections tightened to

- (a) the torque required to affect the seal; and
- (b) 150% of the torque required by Item (a).

### 5.3.4.3 Burst pressure

Hose assemblies shall be tested at a hydrostatic pressure of 690 kPa (100 psi) for 1 h, followed by a burst pressure test of 2000 kPa (290 psi) for 1 min using water at  $10 \pm 6^\circ\text{C}$  ( $50 \pm 10^\circ\text{F}$ ).

## 5.3.5 Ball joints

Shower head, body spray, and hand-held shower assembly ball joints shall not leak in any position more than 35 mL/min (0.01 gpm) measured over 5 min when tested at a flowing pressure of  $345 \pm 35$  kPa ( $50 \pm 5$  psi) and a temperature of  $38 \pm 6^\circ\text{C}$  ( $100 \pm 10^\circ\text{F}$ ).

## 5.3.6 Diverters

### 5.3.6.1 Bath and shower

#### 5.3.6.1.1

When tested in accordance with [Clause 5.3.6.1.2](#), the rate of the leakage from a primary outlet when flow is through the secondary outlet shall not exceed 400 mL/min (0.1 gpm).

#### 5.3.6.1.2

Bath and shower diverters shall be tested for rate of leakage at 69 kPa (10 psi) flowing pressure, measured between the diverter and the secondary outlet at 300 mm (12 in) from the diverter, with water at  $38 \pm 6^\circ\text{C}$  ( $100 \pm 10^\circ\text{F}$ ). Measurements shall be taken for 5 min, beginning 1 min after the diverter is activated.

### 5.3.6.2 Kitchen and lavatory

#### 5.3.6.2.1

When tested in accordance with [Clause 5.3.6.2.2](#), the rate of leakage out of the spout of kitchen and lavatory side spray diverters shall not exceed 400 mL/min (0.1 gpm).

#### 5.3.6.2.2

Kitchen and lavatory side spray diverters shall be tested for rate of leakage out of the spout at  $140 \pm 7$  kPa ( $20 \pm 1$  psi) and  $690 \pm 7$  kPa ( $100 \pm 1$  psi) flowing pressure with water diverted to the side spray using water at  $10 \pm 6$  °C ( $50 \pm 10$ °F) and  $38 \pm 6$  °C ( $100 \pm 10$ °F). Measurements shall be taken for 5 min, beginning 1 min after the diverter is activated.

### 5.3.7 Aerators and other end point devices

Aerators and other end point devices shall maintain their installed position without leakage, stripping of threads, or loosening when tested for 5 min with water flowing at the pressures and temperatures specified in Items (b) and (d) of [Clause 5.3.1.4.2](#).

**Note:** Other end point devices include stream straighteners, laminar flow devices, barb fittings, and point-of-use filters.

## 5.4 Flow rate

### 5.4.1 Supply fittings

Fittings and accessories shall meet the minimum and maximum flow rate requirements specified in [Table 1](#), at the temperatures and flowing pressures specified in [Clause 5.4.2.3](#). These requirements shall be met before and after the life cycle tests specified in [Clause 5.6](#).

### 5.4.2 Test procedure

#### 5.4.2.1 Specimen

The specimen shall

- (a) be thoroughly flushed before the flow rate is measured;
- (b) be connected to a smooth-interior pipe or tubing with a length equal to at least 20 times the inside diameter of the inlet(s) of the specimen;
- (c) have a pipe or tubing of the length specified in Item (b) connected to the outlet of the specimen if the specimen does not discharge to the atmosphere;
- (d) be connected to a pipe or tubing of the same nominal size as the specimen connections;
- (e) have its standard accessories installed, when tested for compliance with the maximum flow rates and the minimum flow rates for high-efficiency devices specified in [Table 1](#); and
- (f) have its standard accessories removed, when tested for compliance with the minimum flow rates specified in [Table 1](#).

If the accessories are supplied separately, they shall be tested as separate devices using commercially available pipe or tubing.

The test set-up shall be as shown in [Figure 3](#).

#### 5.4.2.2 Flow rate

Other flow rate test conditions shall be as follows:

- (a) the upstream pressure tap(s) and downstream pressure tap (if required) shall be located as shown in [Figure 3](#);
- (b) pressure tap size and configuration shall comply with ASME PTC 19.2 or ANSI/ISA-75.02;
- (c) if a fluid meter is used to measure flow rate, the installation shall be as specified in ASME PTC 19.5; and
- (d) if the time/volume method is used, the container shall be of sufficient size to hold the collected water for at least 1 min.

### 5.4.2.3 Procedure

#### 5.4.2.3.1

Fittings shall be tested at the maximum flow setting, if adjustable, with both hot and cold water valves fully open on combination fittings.

The flow rate test shall be conducted with water between 5 and 71 °C (40 and 160°F) in accordance with the intended end use of the fitting and under the following conditions:

- (a) for minimum flow: at  $140 \pm 7$  kPa ( $20 \pm 1$  psi) at the inlet when water is flowing; and
- (b) for maximum flow for faucets: at  $410 \pm 7$  kPa ( $60 \pm 1$  psi) at the inlet when water is flowing.

#### 5.4.2.3.2

Flow rate tests for shower heads, body sprays, and hand showers shall be conducted with water at  $38 \pm 6$  °C ( $100 \pm 10$ °F) and the flow maintained for at least 1 min. The flow rate test for

- (a) maximum flow for shower heads shall be conducted at  $550 \pm 14$  kPa ( $80 \pm 2$  psi);
- (b) minimum flow for shower heads and hand showers shall be conducted at  $310 \pm 14$  kPa ( $45 \pm 2$  psi).

If the shower head or hand-held shower has more than one mode, the minimum flow rate shall be determined at a flowing pressure of  $310 \pm 7$  kPa ( $45 \pm 1$  psi) in all modes. Pause or trickle modes designed to flow at less than 1.9 L/min (0.5 gpm) at 550 kPa (80 psi) shall be excluded from the minimum flow requirements; and

**Note:** The intent of Item (b) is to aid in the selection of an appropriate automatic compensating valve.

- (c) high-efficiency shower heads and hand-held showers shall be conducted in accordance with [Clause 5.12.2](#).

## 5.5 Operating requirements

### 5.5.1

Except for accessible designs and tub-to-shower and tub spout diverters, the torque or force required to open, operate, and close a manually activated valve or operating control shall not exceed the applicable operating torque or linear force specified in [Table 2](#) when the manually operated valve or operating control is tested at the temperatures and pressures specified in [Clause 5.3.1.4](#).

### 5.5.2

Accessible design devices shall be tested in accordance with [Clause 5.3.1.4.1](#). Before and after the life cycle test, the linear force required to open, operate, and close a manually activated valve or operating control shall not exceed

- (a) 22 N (5 lbf) when tested at
  - (i)  $140 \pm 14$  kPa and  $10 \pm 6$  °C ( $20 \pm 2$  psi and  $50 \pm 10$ °F);
  - (ii)  $550 \pm 14$  kPa and  $10 \pm 6$  °C ( $80 \pm 2$  psi and  $50 \pm 10$ °F);
  - (iii)  $140 \pm 14$  kPa and  $66 \pm 6$  °C ( $20 \pm 2$  psi and  $150 \pm 10$ °F); and
  - (iv)  $550 \pm 14$  kPa and  $66 \pm 6$  °C ( $80 \pm 2$  psi and  $150 \pm 10$ °F); and
- (b) 45 N (10 lbf) when tested in accordance with Items (b) and (d) of [Clause 5.3.1.4.2](#).

### 5.5.3

Swing spouts, including those with pullout spouts, shall be tested at a flowing pressure of  $860 \pm 14$  kPa ( $125 \pm 2$  psi), with water at  $10 \pm 6$  °C ( $50 \pm 10$ °F). The force required to turn the spouts shall not exceed 45 N (10 lbf) measured at the end of the spout.

### 5.5.4

At a flowing pressure of  $860 \pm 14$  kPa ( $125 \pm 2$  psi), with water at  $38 \pm 6$  °C ( $100 \pm 10$ °F), shower head, body spray, and hand-held shower assembly ball joints shall not require a moving force greater than 45 N (10 lbf) at the farthest point from the ball joint.

## 5.6 Life cycle

### 5.6.1 Performance requirements

#### 5.6.1.1 General

##### 5.6.1.1.1

Fittings incorporating moving parts or parts subject to wear shall be tested in accordance with [Clauses 5.6.2](#) and [5.6.3](#) for the number of cycles specified in [Table 3](#), except for automatic compensating valves (see [Clause 4.15](#)).

##### 5.6.1.1.2

The specimens shall be installed in accordance with the manufacturer's instructions.

During and after the test, the specimens shall continue to function as they did at the beginning of the test and shall not develop defects that could adversely affect their functionality or serviceability.

##### 5.6.1.1.3

In addition to the requirements specified in [Clauses 5.6.1.1.1](#) and [5.6.1.1.2](#), valves, swing spouts, shower heads, body sprays, hand-held shower assemblies, diverters, aerators, and other end point devices shall comply with the applicable requirements specified in [Clauses 5.6.1.2](#) to [5.6.1.6](#) after the life cycle test specified in [Clause 5.6.2](#).

#### 5.6.1.2 Valves or controls

Manually activated valves or controls

- (a) shall open, operate, and close with a torque or force that does not exceed 120% of that specified in [Table 2](#) when tested in accordance with [Clause 5.5](#) (except for accessible design valves, which shall not exceed the force specified in [Clause 5.5.2](#)); and
- (b) may have the packing nut tightened once during the test to stop leakage along the stem.

#### 5.6.1.3 Swing spouts

##### 5.6.1.3.1

Swing spouts, except those with pullout spouts,

- (a) shall not leak at the spout joint when tested in accordance with [Clause 5.3.1.3](#);
- (b) may have the spout nut tightened once during the test to stop leakage; and
- (c) shall not require a turning force greater than 45 N (10 lbf) at the end of the spout when the flowing pressure is 860 kPa (125 psi) and the water temperature is  $10 \pm 6^\circ\text{C}$  ( $50 \pm 10^\circ\text{F}$ ).

##### 5.6.1.3.2

Swing spouts with pullout spouts shall not require a turning force greater than 45 N (10 lbf) at the end of the spout.

#### 5.6.1.4 Shower heads, body sprays, and hand-held shower assemblies

Shower heads, body sprays, and hand-held shower assemblies

- (a) shall not leak more than 35 mL/min (0.01 gpm) at the ball joint in any position when tested in accordance with [Clause 5.3.5](#);
- (b) may have the ball joint packing nut tightened once during the test to reduce leakage; and
- (c) shall not require a moving force greater than 45 N (10 lbf) at the farthest point from the ball joint when the flowing pressure is  $860 \pm 14$  kPa ( $125 \pm 2$  psi) and the water temperature is  $38 \pm 6^\circ\text{C}$  ( $100 \pm 10^\circ\text{F}$ ).



### 5.6.1.5 Diverters

#### 5.6.1.5.1

Diverters shall

- (a) operate with a torque or force that does not exceed 120% of the torque or force specified in [Table 2](#) when tested in accordance with [Clause 5.5](#) (except for tub-to-shower and tub spout diverters);
- (b) (if they are bath or shower diverters) not leak more than 800 mL/min (0.2 gpm) from a primary outlet when flow is through the secondary outlet when tested in accordance with [Clause 5.3.6.1.2](#); and
- (c) (if they are kitchen or lavatory side spray diverters) not leak more than 800 mL/min (0.2 gpm) out of the spout when tested in accordance with [Clause 5.3.6.2.2](#).

#### 5.6.1.5.2

In addition to the requirements specified in [Clause 5.6.1.5.1](#), a bath and shower automatic reset diverter shall be considered to have failed this test if it does not remain functional and reset itself to the tub position.

### 5.6.1.6 Aerators and other end point devices

Aerators and other end point devices shall comply with the performance requirements specified in [Clause 5.3.7](#).

## 5.6.2 Test procedures

### 5.6.2.1 Set-up

The specimen shall be positioned so that the life cycle test apparatus can operate the specimen through its normal operating range without imposing forces inconsistent with its normal operation. The specimen shall be installed as it would be in its intended application.

### 5.6.2.2 General parameters

#### 5.6.2.2.1

The speed of the life cycle test apparatus shall be adjusted to  $1500 \pm 150$  cycles of operation per hour unless otherwise specified in this Standard or by the manufacturer.

#### 5.6.2.2.2

Water at a flowing pressure of  $345 \pm 35$  kPa ( $50 \pm 5$  psi) and a supply pressure of 550 kPa (80 psi) maximum (valve closed) shall be supplied to the specimen throughout the test.

Hot water shall be at  $66 \pm 6$  °C ( $150 \pm 10$ °F), and cold water shall be at  $10 \pm 6$  °C ( $50 \pm 10$ °F).

#### 5.6.2.2.3

For devices that flow in excess of 15 L/min (4.0 gpm) at  $345 \pm 35$  kPa ( $50 \pm 5$  psi) flowing pressure, the outlet may be restricted to a flow rate of not less than 15 L/min (4.0 gpm) during the test.

#### 5.6.2.2.4

Fittings or valves in fittings that are intended to be used only with cold water shall be tested only with cold water.

Fittings or valves in fittings that are intended to be used only with hot water shall be tested to the temperature cycles specified in [Clause 5.6.2.3](#).



### 5.6.2.3 Cycling

Unless otherwise specified in this Standard, fittings shall be temperature-cycled by supplying hot water to both supplies and then supplying cold water to both supplies every 1000 volume-control cycles (closed-open-closed).

**Note:** *The test specified in this Clause may be started with cold water and then switched to hot water as long as the specified sequences are maintained.*

### 5.6.2.4 Test loads

The test apparatus shall apply a torque or force sufficient to operate the specimen throughout the test but not exceeding 120% of the applicable torque or force specified in [Table 2](#).

## 5.6.3 Fittings and other control devices

### 5.6.3.1 Mixing valves

**Notes:**

- (1) *The tests specified in this Clause may be started in the cold position and then switched to the hot position as long as the specified sequences are maintained.*
- (2) *The temperature cycle from the hot open to the cold open and back to the hot open position is counted as one cycle.*

#### 5.6.3.1.1

For fittings with a rotary action valve, the apparatus shall be adjusted to turn the valve and any associated handle mechanism from the fully closed position to a position between 37° and 75° of the fully open position, but not exceeding 360°. This test shall simulate the intended operating motion of the fitting without making contact with the end stops, except as agreed to by the manufacturer.

#### 5.6.3.1.2

For single-control mixing valves or mixing valves with separate volume and temperature controls, the apparatus shall be adjusted to operate the valve as follows:

- (a) For the volume cycle, the volume control shall be moved from the fully closed position to 80% (minimum) of the fully open position, without making contact with the end stops and back to the fully closed position.
- (b) For the temperature cycle, the temperature control shall be moved a minimum of 80% of the range between the full hot position to the full cold position, and back to the full hot position, without making contact with the end stops, except as agreed to by the manufacturer.
- (c) The total number of cycles specified in [Table 3](#) shall be calculated by adding together the following:
  - (i) the total volume control cycles (open-closed-open) in the hot position;
  - (ii) the total volume control cycles (open-closed-open) in the cold position; and
  - (iii) the total number of temperature control cycles (full open hot position to full open cold position and back to full open hot position).

The sequence shall be seven open-closed-open cycles in the hot position, then a switch to the cold position, then seven open-closed-open cycles in the cold position, and then a switch back from the cold position to the hot position, for a total of 15 cycles.

For single-control mixing valves, hot and cold water shall be supplied alternately to both supplies and then switched every 1000 cycles.

#### 5.6.3.1.3

For single-handle cycling mixing valves of the cycling type, the apparatus shall be adjusted to operate the specimen from closed to 80% (minimum) of the range between the cold position and the hot position, and back to closed, without making contact with the end stops, except as agreed to by the manufacturer.

#### 5.6.3.1.4

For two-handle mixing valves, the hot and cold water valves shall be opened and closed simultaneously.

### 5.6.3.2 Metering and self-closing faucets

#### 5.6.3.2.1

Metering faucets shall close before reactivation of the next cycle. Adjustable metering faucets shall be set to run for approximately 5 s after actuation. Non-adjustable metering faucets shall be operated at their maximum run duration.

#### 5.6.3.2.2

Self-closing faucets, not including metering, shall be opened to the applicable extent specified in [Clause 5.6.3.1.2](#) and allowed to close at a rate specified by the manufacturer.

### 5.6.3.3 Other devices

#### 5.6.3.3.1

The following devices shall be tested at a flowing pressure of  $345 \pm 35$  kPa ( $50 \pm 5$  psi) flowing through the device outlet with the highest flow rate, with their standard accessories installed:

- (a) bidet diverters;
- (b) multi-function aerators;
- (c) shampoo diverters;
- (d) shower head adjustment mechanisms;
- (e) shower head flow or function controls; and
- (f) side spray flow or function controls.

#### 5.6.3.3.2

The following devices shall be tested at a flowing pressure of  $345 \pm 35$  kPa ( $50 \pm 5$  psi) at  $9.5 \pm 0.4$  L/min ( $2.5 \pm 0.1$  gpm) through a fixed outlet or with their standard accessories installed, when installed at a maximum distance of 2.0 m (78 in) from the outlet of the diverter:

- (a) in-line flow-control devices in showers;
- (b) shower-to-shower diverters;
- (c) tub spout diverters; and
- (d) tub-to-shower diverters.

#### 5.6.3.3.3

For tub-to-shower diverters and tub-spout diverters, the specimen shall be mechanically activated to deliver full flow through the outlet. The flow of water shall be shut off by a bath or shower supply fitting or control valve installed upstream of the specimen. Diverters shall be reset to the tub position mechanically except for automatic diverters, which are intended to reset themselves to the tub position. The test apparatus for automatic diverters may relieve the shower head flowing pressure while simultaneously shutting off the supply valve to accelerate the life cycle test.

#### 5.6.3.3.4

One complete cycle for a device shall consist of switching the device from one position to the other and back to the original position. In the case of devices with multiple adjustable positions, one complete cycle shall consist of switching from one extreme position, through all the intermediate positions, to the other extreme position and back to the original position.

#### 5.6.3.3.5

For shower head, body spray, and hand-held shower assembly ball joints, one complete cycle shall consist of moving the device horizontally from an initial full-side position to the opposite full-side position and back to the initial-side position without making contact with surfaces at the extreme ends of the path.

### 5.6.3.4 Swing spouts

The life cycle test for swing spouts shall be conducted as follows:

- (a) Mount the specimen on the life cycle test apparatus with the axis about which the spout turns mounted vertically and in line with the axis of the drive spindle.
- (b) Fit the forked end of the drive adapter loosely over the spout and allow the spout tip to freely move vertically.
- (c) Attach a weight with a mass of 0.18 kg (0.40 lb) to the spout outlet connection.
- (d) Adjust the apparatus to turn the spout through an equal arc on each side of the centre through 90% of the total path and not more than 90°.
- (e) Establish and maintain sufficient force to rotate the spout throughout the test, but do not exceed 45 N (10 lbf) applied at the end of the spout.
- (f) Alternate cold and hot water every 1000 cycles, starting with cold.

The hot and cold water temperatures and the water pressures shall be those specified in [Clause 5.6.2.2.2](#).

### 5.6.3.5 Shower hoses, pullout spout hoses, and side spray hoses

#### 5.6.3.5.1

Hoses shall be subjected to a 67 N (15 lbf) tension test for 10 000 cycles, with the force applied gradually at the end of the hose connector.

#### 5.6.3.5.2

The end connections of hoses shall not pull out when an axial force is applied and increased to 334 N (75 lbf) by extending the hose at a rate not faster than 127 cm/min (50 in/min) and then maintained for 15 s.

#### 5.6.3.5.3

Following completion of the test specified in [Clause 5.6.3.5.2](#), the hose shall be bent for one complete turn around a mandrel 50 mm (2.0 in) in diameter. The end connections of the hose shall then be pulled until a force of 67 N (15 lbf) is applied or until the hose comes fully into contact with the mandrel, whichever occurs first. The hose and the end connections shall not leak when tested in accordance with [Clause 5.3.1.3](#).

## 5.7 Resistance to installation loading

### 5.7.1 Bending strength

#### 5.7.1.1 Performance requirements

No cross-section of a rigid waterway on the pressure side of a terminal supply fitting or on both sides of a non-terminal supply fitting shall be damaged when tested in accordance with [Clause 5.7.1.2](#). This requirement shall not apply to waterways through a solder joint.

#### 5.7.1.2 Test procedure

The force shall be applied to the cross-section being tested between two and three times the major diameter of that section. The bending moment shall be as specified in [Figure 4](#).

### 5.7.2 Thread torque strength

#### 5.7.2.1

Metal tapered pipe size threaded connections shall withstand the torque load specified in [Table 4](#) without evidence of cracking or separation. The torque shall be applied with a torque wrench that has a maximum allowable inaccuracy of 3% of the full-scale reading. This test shall apply to NPT supply connections only.

### 5.7.2.2

Threaded connections intended to seal water shall not crack, strip, or leak when tested in accordance with [Clause 5.3.1.3](#) with the threaded connections tightened to

- (a) the torque required to affect the seal; and
- (b) 150% of the torque required by Item (a).

### 5.7.2.3

In addition to complying with the requirements specified in [Clause 5.7.2.2](#), threaded supply connections shall comply with [Clause 5.3.2](#).

### 5.7.2.4

[Clauses 5.7.2.1](#) to [5.7.2.3](#) shall not apply to factory-assembled connections.

## 5.8 Resistance to use loading

### 5.8.1 Operating controls

#### 5.8.1.1

Operating controls that close or open the water supply shall withstand a torque or force, applied in the manner required to close or open the valve, three times greater than that specified in [Table 2](#). Fracture of the handle or stem shall constitute failure.

#### 5.8.1.2

Wall-mounted bath or shower operating controls that can be grasped shall not pull off when subjected to an axial force of 445 N (100 lbf).

#### 5.8.1.3

Operating controls other than those specified in [Clause 5.8.1.2](#) shall not pull off when subjected to an axial force of 45 N (10 lbf).

### 5.8.2 Maintenance of installed position

Hand-held showers provided with a lug or other device to hang the hand-held shower shall be installed in their mounted position and shall have a force of 67 N (15 lbf) applied at the centre of the hand grip for 1 min. There shall be no damage that would prevent the hand-held shower from being re-hung in its intended position.

### 5.8.3 Swing spout strength

#### 5.8.3.1 Performance requirements

When tested in accordance with [Clause 5.8.3.2](#), swing spouts shall withstand a mass of 6.4 kg (14 lb) attached at the spout outlet and the angle at the spout outlet shall not change by more than 15°. This test shall not apply to pullout spouts.

#### 5.8.3.2 Test procedure

The swing spout strength test shall be conducted as follows:

- (a) Mount the faucet in accordance with the manufacturer's instructions.
- (b) Measure the spout outlet angle from the vertical.
- (c) Suspend the mass from the centreline of the spout outlet for 3 min and then remove it.
- (d) After 30 min, measure the spout outlet angle.

## 5.9 Backflow prevention

### 5.9.1 General

Fittings shall be tested in accordance with the applicable tests specified in [Clauses 5.9.2](#) and [5.9.3](#) and then retested within 48 to 96 h of completing all applicable life cycle tests specified in [Clause 5.6](#).

### 5.9.2 Fittings with plain outlets

#### 5.9.2.1 Air gaps

Fittings with plain outlets shall be protected by an air gap in accordance with ASME A112.1.2. For deck-mounted fittings, the air gap shall be measured as the vertical distance from the plane of the mounting surface of the fitting to the lowest point of the outlet. Where the fittings incorporate threads to accept an aerator or similar device, this measurement shall be taken with the aerator or similar device installed (see [Figure 1](#)).

A critical level mark on the fittings may be used as an alternative to the air gap. The critical level shall be confirmed by the test method specified in [Clause 5.9.2.2](#).

#### 5.9.2.2 Test procedure

##### 5.9.2.2.1

The specimen shall be set up as follows:

- (a) Remove all checking members or open them fully.
- (b) Install the specimen as recommended by the manufacturer by mounting it over a container measuring approximately 380 × 250 × 150 mm (15 × 10 × 6 in). Ensure that the mounting surface is plumb or level with the water surface in the container.
- (c) Allow the outlet of the specimen to have a free area at least four times the area of its effective opening between the container and the outlet.

##### 5.9.2.2.2

The critical air gap test for fittings with plain outlets shall be conducted as follows:

- (a) Connect the inlet(s) of the specimen to a vacuum source.
- (b) Measure the vacuum at the inlet(s) of the specimen.
- (c) Provide a means to change the water level in the container, relative to the outlet of the specimen.
- (d) Start the test with the water level at the mounting surface level.
- (e) With the specimen fully open from the inlet(s) to the place of discharge to the atmosphere, apply a vacuum of 85 kPa (12 psi) to the inlet(s).
- (f) Hold for 1 min. Back siphonage at this time shall be a cause for rejection.
- (g) Slowly bring the water level closer to the discharge outlet until the level at which back siphonage occurs is reached.
- (h) At the level specified in Item (g), measure and record the distance between the lowest point of the outlet of the specimen and the water surface.
- (i) Return the specimen to atmospheric pressure.
- (j) Starting with the water level higher than where back siphonage occurred, apply a vacuum of 85 kPa (12 psi) to the inlet(s).
- (k) Slowly lower the water level until back siphonage ceases.
- (l) Maintain the vacuum for 1 min to ensure that water is not being drawn into the discharge outlet.
- (m) At the level specified in Item (k), measure and record the distance between the lowest point of the outlet of the specimen and the water surface.

The greater of the distances determined in Items (h) and (m) shall be the critical air gap of the fitting.

The critical air gap test shall be repeated twice to confirm the critical air gap measurement.

The critical level mark on the fittings (see [Clause 5.9.2.1](#)) shall be at or below the critical air gap determined by this test.

**Note:** 85 kPa (12 psi) is equivalent to 638 mm (25 in) of mercury.

### 5.9.3 Fittings with submersible outlets

#### 5.9.3.1 General

Fittings where the outlets are submersible shall

- (a) have a backflow prevention device(s) that complies with the applicable requirements of the CAN/CSA-B64 Series or ASME A112.18.3; or
- (b) comply with the applicable requirements specified in [Clause 5.9.3.2](#) or [5.9.3.3](#).

#### 5.9.3.2 Single-outlet fittings with a submersible outlet

##### 5.9.3.2.1 General

Single-outlet fittings with a submersible outlet shall comply with [Clause 5.9.3.2.2](#) and shall have an atmospheric vent between two check valves. The atmospheric vent shall be located downstream of the last control valve and the critical level of the device shall be at least 25 mm (1 in) above the plane of the mounting surface of the fitting.

##### 5.9.3.2.2 Test to determine the presence of hidden check valves

###### 5.9.3.2.2.1 General

Fittings incorporating check valves shall be tested in accordance with [Clause 5.9.3.2.2.4](#).

When the test is performed as specified in [Clause 5.9.3.2.2.4](#), water shall be drawn into the sight tube, demonstrating that all check valves are fouled open and that there are no hidden check valves.

###### 5.9.3.2.2.2 Settings

The procedure for testing the settings shall be as follows:

- (a) Connect a sight tube in a leak-proof manner to the outlet of the specimen.
- (b) Seal all atmospheric vents.
- (c) Foul all check valves open.
- (d) Install the specimen in accordance with [Clause 5.9.3.2.2.3](#).
- (e) Conduct the test in accordance with [Clause 5.9.3.2.2.4](#).
- (f) Once water is drawn into the sight tube, terminate the test.

###### 5.9.3.2.2.3 Mounting

The specimen shall be mounted in its normal operating position in accordance with the manufacturer's instructions and using the test set-up shown in [Figure 5](#). The inlet pipe(s) shall be connected collectively to

- (a) a water supply that can deliver water through the specimen at normal flow;
- (b) a vacuum system that can maintain a 0 to 85 kPa (0 to 12 psi) vacuum; and
- (c) the atmosphere.

The coloured-water reservoir shown in [Figure 5](#) shall be located below the mounting surface level of the specimen. The coloured water in the reservoir shall be at the mounting surface level.

The terminal end of the sight tube shall be immersed 13 mm (0.5 in) below the mounting surface level of the coloured water in the reservoir. The sight tube shall be transparent and have an inside diameter of  $13 \pm 1.5$  mm ( $1/2 \pm 1/16$  in).

###### 5.9.3.2.2.4 Test procedure

The test to determine the presence of hidden check valves in single-outlet fittings with a submersible outlet shall be conducted as follows (see [Figure 5](#)):

- (a) Mount the specimen in accordance with [Clause 5.9.3.2.2.3](#).
- (b) Open Valve 3.
- (c) Apply and hold a vacuum of 85 kPa (12 psi) for 5 min.
- (d) Close Valve 3, gradually open Valve 2, and allow the pressure on the supply side of the specimen device to gradually return to atmospheric.

- (e) Close Valve 2 and gradually open Valve 3.
- (f) Gradually raise the vacuum test load from 0 to 85 kPa (0 to 12 psi) and then gradually reduce it to 0 kPa (0 psi).
- (g) Create a surge effect by quickly opening and closing Valves 2 and 3 at least five times. During the test, the applied vacuum load shall start at 0 kPa (0 psi), be increased to 85 kPa (12 psi), and then be decreased to 0 kPa (0 psi).

**Note:** 85 kPa (12 psi) is equivalent to 638 mm (25 in) of mercury.

### 5.9.3.2.3 Check valve leakage

#### 5.9.3.2.3.1 General

Fittings incorporating check valves shall be tested in accordance with [Clauses 5.9.3.2.3.3](#) and [5.9.3.2.3.4](#) to determine their resistance to leakage.

#### 5.9.3.2.3.2 Performance requirements

There shall be no drop in the pressure applied to the outlet within the 5 min period of the test specified in [Clause 5.9.3.2.3.6](#).

#### 5.9.3.2.3.3 Upstream check valves

The check valve leakage test for single-outlet fittings with a submersible outlet shall be conducted as follows:

- (a) Block open or remove all check valves except the upstream check valve.
- (b) Install the specimen in accordance with [Clause 5.9.3.2.3.5](#).
- (c) Conduct the test in accordance with [Clause 5.9.3.2.3.6](#).

#### 5.9.3.2.3.4 Downstream check valves

The check valve leakage test for single-outlet fittings with a submersible outlet shall be conducted as follows:

- (a) Block open or remove all check valves except the downstream check valve.
- (b) Install the specimen in accordance with [Clause 5.9.3.2.3.5](#).
- (c) Conduct the test in accordance with [Clause 5.9.3.2.3.6](#).

#### 5.9.3.2.3.5 Test set-up

The specimen shall be set up as follows:

- (a) Mount the specimen in its normal operating position, in accordance with the manufacturer's instructions and using the test set-up shown in [Figure 6](#).
- (b) Connect the inlet pipe(s) collectively to a water supply that can deliver water through the specimen at normal flow and to the atmosphere.
- (c) Connect a pressurized water supply, as shown in [Figure 6](#), to the specimen outlet in a leak-proof manner.

#### 5.9.3.2.3.6 Test procedure

The check valve leakage test shall be conducted as follows (see [Figure 6](#)):

- (a) Mount the specimen in accordance with [Clause 5.9.3.2.3.5](#).
- (b) Seal all atmospheric vents.
- (c) Open Valve 1 and purge the air from the system.
- (d) Close Valve 1.
- (e) Open Valve 2 to reduce the water pressure on the inlet side to 0.
- (f) Gradually raise the outlet pressure to 1.4 kPa (0.2 psi).
- (g) Isolate the pressure source for 5 min.
- (h) Increase the outlet pressure to 35 kPa (5 psi).
- (i) Isolate the pressure source for 5 min.



### 5.9.3.2.4 Adequacy of the atmospheric vent

#### 5.9.3.2.4.1 General

For fittings incorporating an atmospheric vent, the adequacy of the atmospheric vent shall be verified by performing the test specified in [Clause 5.9.3.2.4.3](#).

#### 5.9.3.2.4.2 Performance requirements

The maximum allowable rise in water level in the sight tube shall be to within  $\pm 25$  mm ( $\pm 1.0$  in) of the critical level of the device when the test is performed as specified in [Clause 5.9.3.2.4.3](#).

**Note:** The location of the critical level of the device may be determined in accordance with Clause 16 of ASME A112.18.3.

#### 5.9.3.2.4.3 Test procedure

The test for verifying the adequacy of the atmospheric vent shall be conducted as follows:

- (a) Connect a sight tube in a leak-proof manner to the outlet of the specimen.
- (b) Foul all check valves with a 0.81 mm (0.032 in) wire.
- (c) Leave the atmospheric vents open.
- (d) Install the specimen in accordance with [Clause 5.9.3.2.2.3](#).
- (e) Conduct the test in accordance with [Clause 5.9.3.2.2.4](#).

### 5.9.3.3 Back siphonage prevention in side spray diverters

#### 5.9.3.3.1 General

Fittings incorporating a side spray diverter shall comply with the performance requirements of [Clause 5.9.3.3.2](#) when tested in accordance with [Clause 5.9.3.3.3](#).

#### 5.9.3.3.2 Performance requirements

During testing in accordance with [Clause 5.9.3.3.3](#), water shall not rise in the sight tube except for an upward bowing of the meniscus of not more than 3 mm (0.12 in).

#### 5.9.3.3.3 Test procedure

The test shall be conducted as follows (see [Figure 5](#)):

- (a) Remove the spray head.
- (b) Connect a sight tube in a leak-proof manner to the spray hose outlet of the specimen.
- (c) Install the specimen in accordance with [Clause 5.9.3.2.2.3](#).
- (d) Open Valve 1.
- (e) Flush the specimen with water for 5 min.
- (f) Close Valve 1.
- (g) Open Valve 2 to the atmosphere and allow water to drain from the device and from the hose.
- (h) Conduct the test in accordance with [Clause 5.9.3.2.2.4](#).

### 5.10 Lawn faucets

#### 5.10.1 Performance requirements

When tested in accordance with [Clause 5.10.2](#), lawn faucets shall drain at least 50% of the volume of the inlet shank and pipe.

#### 5.10.2 Test procedure

Lawn faucets shall be tested as follows:

- (a) Connect the faucet to a 1.2 m (48 in) length of standard-weight pipe of the same nominal diameter as the inlet of the faucet.
- (b) Install the assembly (faucet and pipe) with a downward slope of 1% toward the faucet.



- (c) Close the faucet, fill the assembly with water, and measure the amount of water required to fill the assembly.
- (d) Open the faucet and allow the assembly to drain for 5 min, collecting the water that drains.
- (e) Measure the amount of water drained.

## 5.11 Alternative materials test

### 5.11.1 Performance requirements

Coupling nuts, locknuts, and spout-holding nuts shall not be adversely affected when tested in accordance with [Clause 5.11.2](#). Fittings shall be capable of being disassembled and reassembled and continue to comply with [Clause 5.3.1](#).

### 5.11.2 Test procedure

#### 5.11.2.1

The specimen shall

- (a) be a complete fitting;
- (b) be mounted in its intended operating position; and
- (c) have its parts tightened to the maximum torque as specified by the manufacturer.

#### 5.11.2.2

The specimen shall be tested in accordance with ASTM B117 (neutral salt) for 96 h. After exposure, it shall be left to dry for a minimum of 24 h at ambient laboratory conditions. The specimen shall then be disassembled and reassembled using standard tools.

## 5.12 High-efficiency shower heads and hand-held showers

### 5.12.1 General

High-efficiency shower heads and hand-held showers shall comply with [Clauses 5.12.2](#) to [5.12.4](#).

If the shower head or hand-held shower has more than one mode, the manufacturer shall specify the mode or modes that are intended to comply with the high-efficiency requirements.

The flow rate tests shall be conducted with water at  $38 \pm 6^\circ\text{C}$  ( $100 \pm 10^\circ\text{F}$ ) and the flow maintained for at least 1 min.

### 5.12.2 Flow rate

#### 5.12.2.1 Maximum

The maximum flow rate for high-efficiency shower heads and hand-held showers shall be

- (a) specified by the manufacturer but in no case shall be more than 7.6 L/min (2.0 gpm) at each test pressure;
- (b) verified through testing at flowing pressures of 140, 310, and  $550 \pm 7$  kPa (20, 45, and  $80 \pm 1$  psi); and
- (c) used for determining the minimum flow rates in accordance with [Clause 5.12.2.2](#).

#### 5.12.2.2 Minimum

##### 5.12.2.2.1

If the shower head or hand-held shower has more than one mode, the minimum flow rate shall be determined at a flowing pressure of  $310 \pm 7$  kPa ( $45 \pm 1$  psi) in all modes.

Pause or trickle modes designed to flow at less than 1.9 L/min (0.5 gpm) at 550 kPa (80 psi) shall be excluded from the minimum flow requirements.

**Note:** The intent of this Clause is to aid in the selection of an appropriate automatic compensating valve.

### 5.12.2.2.2

The minimum flow rate for the manufacturer's specified mode or modes shall be determined through testing and shall be not less than

- (a) 60% of the maximum flow rate specified in [Clause 5.12.2.1](#) when tested at a flowing pressure of  $140 \pm 7$  kPa ( $20 \pm 1$  psi); and
- (b) 75% of the maximum flow rate specified in [Clause 5.12.2.1](#) when tested at flowing pressures of  $310 \pm 7$  kPa ( $45 \pm 1$  psi) and  $550 \pm 7$  kPa ( $80 \pm 1$  psi).

## 5.12.3 Spray force

### 5.12.3.1 Performance requirement

When tested in accordance with [Clause 5.12.3.2](#), the minimum spray force for high-efficiency shower heads and hand-held showers shall be not less than 0.56 N (2.0 ozf) at a flowing pressure of  $140 \pm 7$  kPa ( $20 \pm 1$  psi) at the inlet.

The specimen shall be deemed to exceed the minimum spray force requirement when the force-balance fixture rotates past  $0.0 \pm 0.1^\circ$ .

### 5.12.3.2 Set-up

The specimen shall

- (a) be thoroughly flushed before measuring the spray force;
- (b) be connected to a smooth-interior pipe or tube with a length equal to at least 20 times the inside diameter of the inlet(s) of the specimen;
- (c) be connected to a pipe or tubing of the same nominal size as the specimen connections;
- (d) have its standard components installed; and
- (e) be tested with an apparatus that utilizes a force balance fixture, as illustrated in [Figure 7](#), in accordance with [Clauses 5.12.3.3](#) to [5.12.3.5](#).

See [Figure 10](#).

### 5.12.3.3 Spray force-balance test fixture

The force-balance test fixture shall have a means for measuring the rotation from the horizontal or for determining the point of balance, or both, and shall be calibrated as follows:

- (a) establish the zero angle position when the target is at  $45 \pm 1^\circ$  to the horizontal and the force-balance fixture is balanced;
- (b) position a force gauge to be in contact perpendicularly with the centre of the target, as illustrated in [Figure 8\(a\)](#);
- (c) zero the force gauge;
- (d) place counterweights on the force-balance fixture so that it balances the force specified in [Clause 5.12.3.1](#) applied at the centre and perpendicular to the target, while maintaining the  $0.0 \pm 0.1^\circ$  position, as shown in [Figure 8\(b\)](#); and
- (e) remove the force gauge from the force-balance fixture.

The final angle position shall be a non-zero value, calibrated to the force specified in [Clause 5.12.3.1](#).

### 5.12.3.4 Additional test conditions

Additional test conditions shall be as follows:

- (a) the upstream pressure gauge shall be located  $200 \pm 50$  mm ( $8 \pm 2$  in) upstream of the specimen inlet;
- (b) the pressure gauge size and configuration shall comply with ASME PTC 19.2 or ANSI/ISA-75.02;
- (c) if a fluid meter is used to measure the flow rate, the installation shall be in accordance with ASME PTC 19.5;
- (d) the water temperature shall be  $38 \pm 6^\circ\text{C}$  ( $100 \pm 10^\circ\text{F}$ ) and shall be maintained for at least 1 min; and
- (e) the flowing pressure shall be  $140 \pm 7$  kPa ( $20 \pm 1$  psi) at the inlet.

### 5.12.3.5 Test procedure

The test procedure shall be as follows:

- (a) mount the specimen so the force target surface and shower head faceplate are parallel, and the centre of the force target and the centre of the shower head are aligned and  $455 \pm 6$  mm ( $18 \pm 0.25$  in) apart, measured before the water flow is initiated;
- (b) once the water flow has been initiated, adjust the specimen using only the standard components so that the centre of the spray pattern aligns with the centre of the target;
- (c) maintain water flow for at least 1 min; and
- (d) verify that the spray force meets the performance requirement specified in [Clause 5.12.3.1](#).

If the centre of the spray pattern cannot hit the centre of the target, the specimen shall be deemed to have not met the spray force performance requirement.

## 5.12.4 Spray coverage

### 5.12.4.1 Performance criteria

The maximum volume of water collected in the 50 and 100 mm (2 and 4 in) rings shall not exceed 75% of the total volume of water collected and the total combined minimum volume of water collected in the 50, 100, and 150 mm (2, 4, and 6 in) rings shall be not less than 25% of the total volume of water collected.

### 5.12.4.2 Set-up

The specimen shall

- (a) be thoroughly flushed before measuring the spray coverage;
- (b) be connected to a smooth-interior pipe or tube with a length equal to at least 20 times the inside diameter of the inlet(s) of the specimen;
- (c) be connected to a pipe or tubing of the same nominal size as the specimen connections;
- (d) have its standard components installed; and
- (e) be tested with an annular ring test apparatus as illustrated in [Figures 9 to 11](#).

### 5.12.4.3 Test fixture

The test fixture annular rings shall have a dimensional tolerance of  $\pm 1.5$  mm ( $\pm 0.06$  in). Material for the test fixture should be 0.75 mm (0.03 in) thick Type 304 stainless steel.

### 5.12.4.4 Other test conditions

Other test conditions shall be as follows:

- (a) the upstream pressure tap shall be located  $200 \pm 50$  mm ( $8 \pm 2$  in) upstream of the specimen inlet;
- (b) the pressure tap size and configuration shall comply with ASME PTC 19.2 or ANSI/ISA-75.02;
- (c) if a fluid meter is used to measure the flow rate, the installation shall be in accordance with ASME PTC 19.5;
- (d) if the volume/time method is used for the flow rate measurement, the container shall be of sufficient size to hold water collected for at least 1 min;
- (e) the water temperature shall be  $38 \pm 6$  °C ( $100 \pm 10$  °F) and shall be maintained for at least 1 min; and
- (f) the flowing pressure shall be  $310 \pm 7$  kPa ( $45 \pm 1$  psi) at the inlet.

### 5.12.4.5 Test procedure

The test procedure shall be as follows:

- (a) mount the specimen so that its faceplate is horizontal and parallel with the top surface of the annular rings;
- (b) position the annular rings underneath the specimen so the centre line of the faceplate and the centre ring are in vertical alignment and the top of the annular gauge is  $450 \pm 6$  mm ( $18 \pm 0.25$  in) from the faceplate (see [Figure 11](#));
- (c) cover the top of the annular rings and adjust the flowing pressure until stabilized;
- (d) remove the cover and allow the water to flow through the specimen and into the annular rings for at least 1 min;

- (e) record the measured flow rate and, using a stopwatch, the time to the nearest second;
- (f) collect, measure, and record the volume of water in each annular ring and determine the total volume collected in all of the rings;
- (g) calculate and record the percentage collected in each ring relative to the total recorded volume collected; and
- (h) if the total volume collected varies by more than  $\pm 5\%$  of the total volume calculated from the recorded flow rate and time, repeat the procedure.

## 6 Markings, packaging, and installation instructions

### 6.1 General

#### 6.1.1

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

- (a) the manufacturer's recognized name, trademark, or other mark; or
- (b) in the case of private labelling, the name, trademark, or other mark of the customer for whom the fitting was manufactured.

Markings shall be accomplished by use of a permanent mark or by placing a permanent label on the product.

Markings shall be located in such a way that they are visible after installation.

#### 6.1.2

Shower heads and hand-held showers shall be marked with the manufacturer's specified maximum flow rate, in L/min and gpm, in accordance with [Clause 5.4.2.3.2\(a\)](#).

### 6.2 Temperature identification

The following bath and shower mixing valves shall have their temperature control settings identified alphabetically, numerically, or graphically:

- (a) single-handle valves; and
- (b) single-control valves.

**Note:** *Graphically includes colour.*

### 6.3 Packaging

#### 6.3.1

Packaging shall be marked with

- (a) the manufacturer's recognized name, trademark, or other mark as well as the model number; or
- (b) in the case of private labelling, the name, trademark, or other mark of the customer for whom the fitting was manufactured as well as the model number.

#### 6.3.2

Packaging or other included literature for shower heads and hand-held showers shall be marked with

- (a) the manufacturer's specified maximum flow rate determined in accordance with [Clause 5.4.2.3.2\(a\)](#); and
- (b) the statement "For use with automatic compensating valves rated at xxx L/min (yyy gpm) or less", where xxx L/min (yyy gpm) is the lowest minimum flow rate recorded in accordance with [Clause 5.4.2.3.2\(b\)](#).

## 6.4 High-efficiency shower heads and hand-held showers

### 6.4.1

High-efficiency shower heads and hand-held showers shall be marked with the manufacturer's specified maximum flow rate determined in accordance with [Clause 5.12.2.1](#) and expressed in L/min (gpm).

### 6.4.2

Packaging or other included literature for high-efficiency shower heads and hand-held showers shall be marked with the

- (a) manufacturer's specified maximum flow rate in accordance with [Clause 5.12.2.1](#);
- (b) minimum flow rate at  $310 \pm 7$  kPa ( $45 \pm 1$  psi) determined in accordance with [Clause 5.12.2.2](#); and
- (c) following statement "For use with automatic compensating valves rated at xxx L/min (xxx gpm) or less", where xxx L/min (xxx gpm) is the lowest minimum flow rate determined in accordance with [Clause 5.12.2.1](#).

### 6.4.3

High-efficiency shower heads, body sprays, and hand-held showers shall not be packaged, marked, or provided with instructions directing the user to an alternative water-use setting that would override the maximum flow rate specified in [Clause 5.12.2.1](#). Instructions related to the maintenance of the devices, including changing or cleaning shower head components, shall direct the user on how to return the device to its intended maximum flow rate.

**Table 1**  
**Minimum and maximum flow rates**  
 (See [Clauses 3](#), [5.4.1](#), and [5.4.2.1](#).)

Fitting or accessory	Minimum, L/min (gpm)	Maximum, L/min (gpm)
Bathtub	9.0 (2.4)	—
Bidet	5.7 (1.5)	—
Commercial pre-rinse spray valve	—	6.0 (1.6)
Low-flow commercial pre-rinse spray valve	—	4.7 (1.25)
Laundry tray	15 (4.0)	—
Lavatory (other than public lavatory or metering)	—	8.3 (2.2)
High-efficiency lavatory faucet	3.0 (0.8)	5.7 (1.5)
Lawn or sediment faucet	15 (4.0)	—
Metering	—	1.0 L/cycle (0.25 gal/cycle)
Public lavatory (other than metering)	—	1.9 (0.5)
Service sink	15 (4.0)	—
Shower head*	See <a href="#">Clause 4.11.1</a>	9.5 (2.5)
High-efficiency shower head and hand-held shower	See <a href="#">Clause 5.12.2.2</a>	See <a href="#">Clause 5.12.2.1</a>
Sink	—	8.3 (2.2)
Supply stop†		
3/8 in (pipe)	21 (5.5)	—
3/8 in (compression)	15 (4.0)	—
1/2 in (pipe)	36 (9.5)	—
1/2 in (compression)	21 (5.5)	—

\*Includes hand-held shower heads and body sprays. Safety shower heads shall be exempt from the maximum flow rate requirements specified in this Table.

†Supply stop sizing shall be based on the nominal size for the outlet indicated in the manufacturer's literature.

**Note:** For purposes of determining compliance with these specifications, an observed or calculated value should be rounded "to the nearest unit" in the last right-hand digit used in expressing the specification limit in accordance with the Rounding Method of ASTM E29.

**Table 2**  
**Operating requirements**  
(See [Clauses 5.5.1, 5.6.1.2, 5.6.1.5.1, 5.6.2.4, and 5.8.1.1.](#))

Operating control	Linear force, N (lbf)	Operating torque, N•m (lbf•in)
Accessible design	See <a href="#">Clause 5.5.2</a>	—
All other operating controls*	45 (10)	1.7 (15)
Supply stop		
NPS-1/2 and smaller	67 (15)	1.7 (15)
Larger than NPS-1/2	110 (25)	2.8 (25)

\*For self-closing valves, the specified torques and forces shall apply only to the opening operation of the valves.

**Table 3**  
**Life cycle test**  
(See [Clauses 5.6.1.1.1 and 5.6.3.1.2.](#))

Fitting	Cycles
Bath or shower fitting*	250 000
Bidet fitting	50 000
Body spray, hand shower, or shower head adjusting mechanism (flow or function control)	10 000
Body spray or shower head ball joint	10 000
Diverter (tub-to-shower, shower-to-shower, tub spout, bidet, shampoo, shower-to-body spray, or in-line flow control device)	15 000
Laundry tub fitting	250 000
Lavatory or sink fitting*	500 000
Lawn or sediment faucet or hydrant	150 000
Metering faucet*	150 000
Self-closing faucet*	150 000
Side spray assembly, including the diverter (pullout spout handpiece function control or multi-function aerator)	10 000
Supply stop†	2 000
Swing spout	50 000

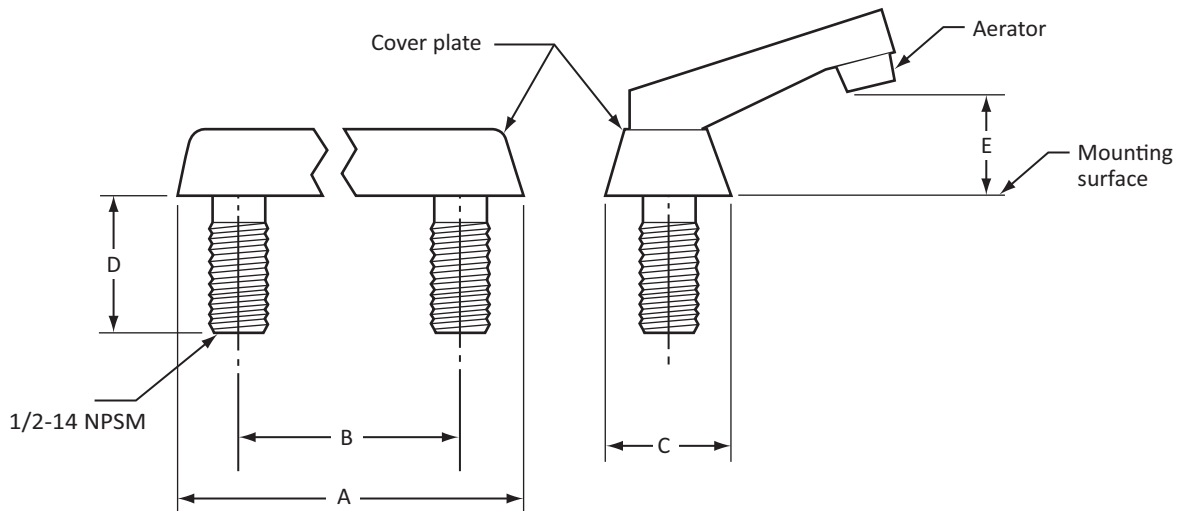
\*Includes electronic fittings.

†Supply stops integral with automatic compensating valves are not subject to the life cycle test.

**Table 4**  
**Thread torque strength**  
(See [Clause 5.7.2.1](#).)

Thread size	Torque, N•m (lbf•ft)
3/8 NPT	43 (32)
1/2 NPT	61 (45)
3/4 NPT	88 (65)
1 NPT	129 (95)

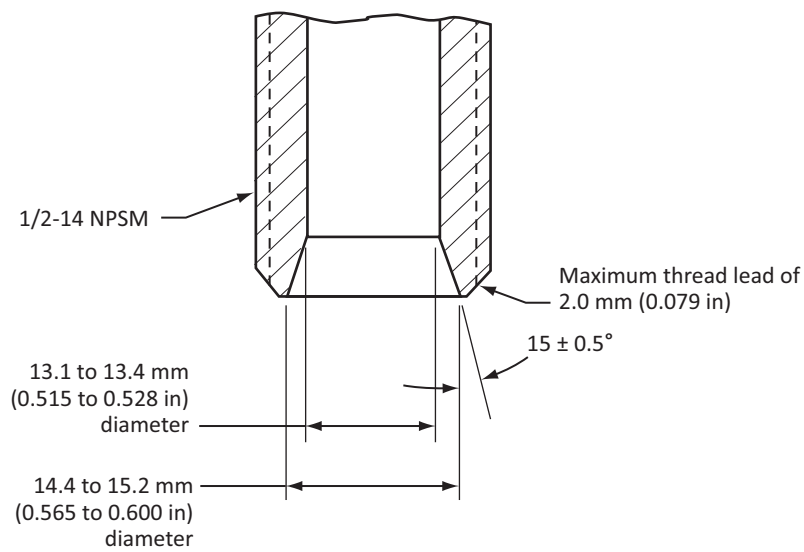
**Note:** The thread-assembling torque requirements apply only to NPT supply connections.



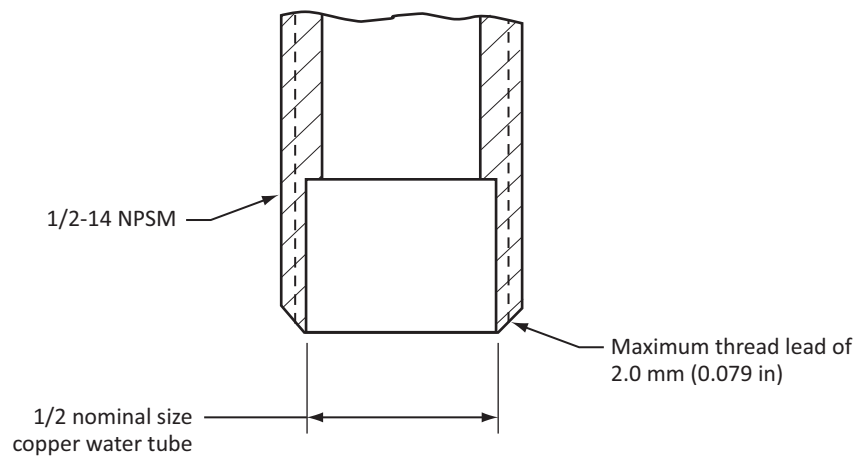
Type of fitting	A maximum	B	C minimum	D minimum	E Air gap
100 (4) centre set	170 (6.75)	102 ± 2 (4.00 ± 0.08)	44 (1.73)	44.5 (1.75)	See <a href="#">Clause 5.9.2.1</a>
200 (8) deck fitting	285 (11.25)	204 ± 2 (8.00 ± 0.08)	44 (1.73)	44.5 (1.75)	See <a href="#">Clause 5.9.2.1</a>
Single lavatory faucet	—	—	44 (1.73)	44.5 (1.75)	See <a href="#">Clause 5.9.2.1</a>

**Figure 1**  
**Deck-mounted lavatory and sink supply fittings**  
(See [Clauses 4.4.7](#), [4.8.1](#), and [5.9.2.1](#).)



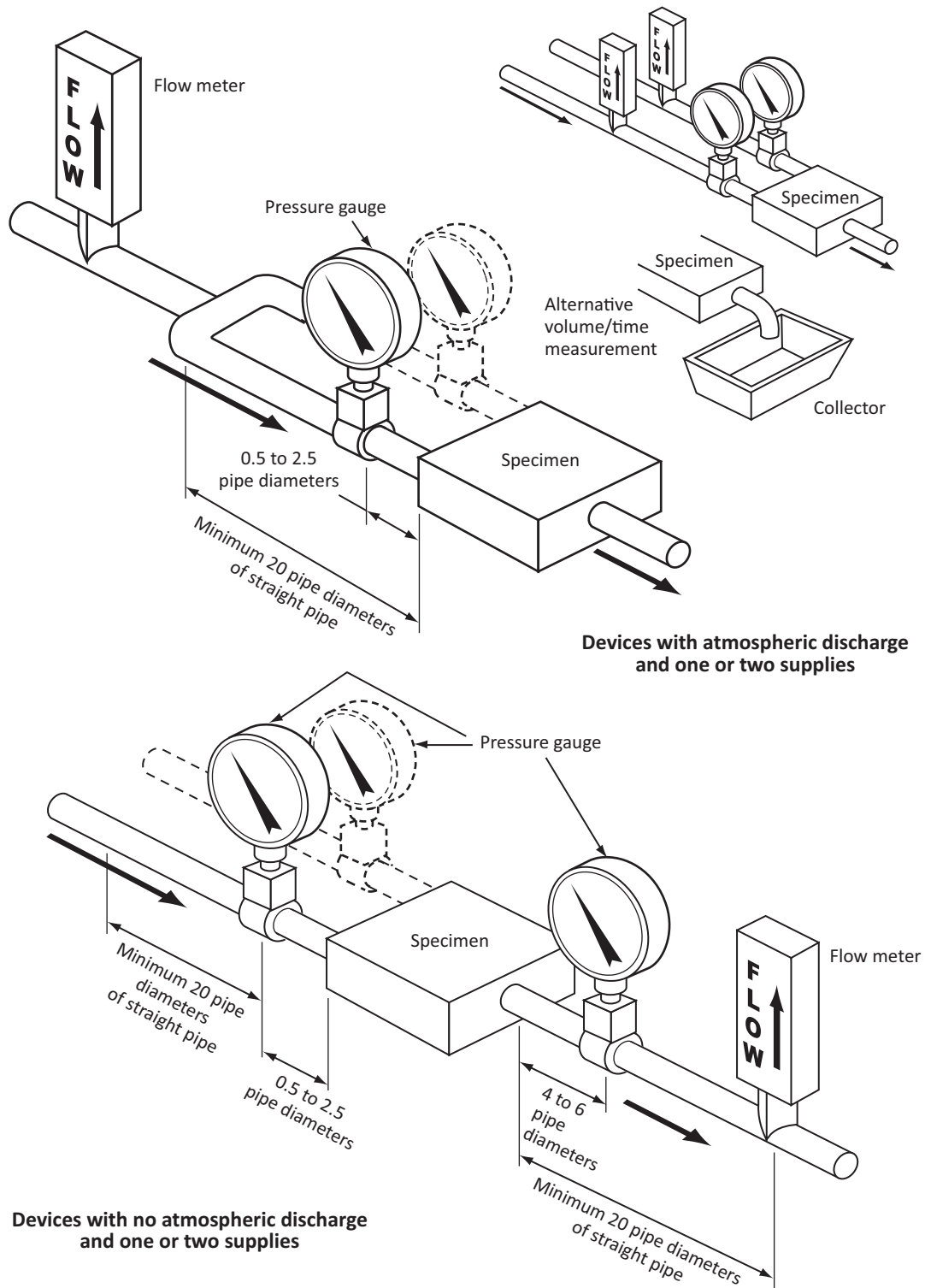


(a) Shank with coupling nut and tailpiece connection

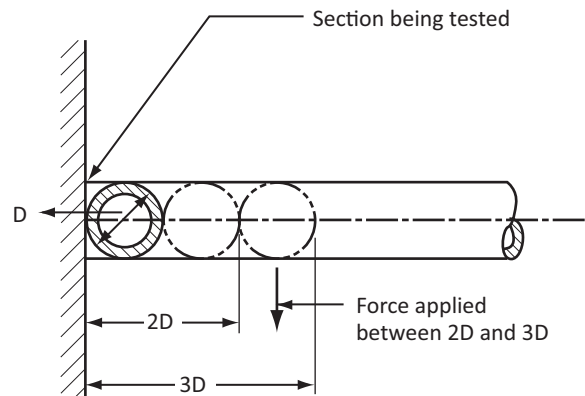


(b) Shank with 1/2 nominal size copper water tube connection

**Figure 2**  
**Dimensions for 1/2-14 NPSM shanks**  
(See [Clause 4.4.7.](#))

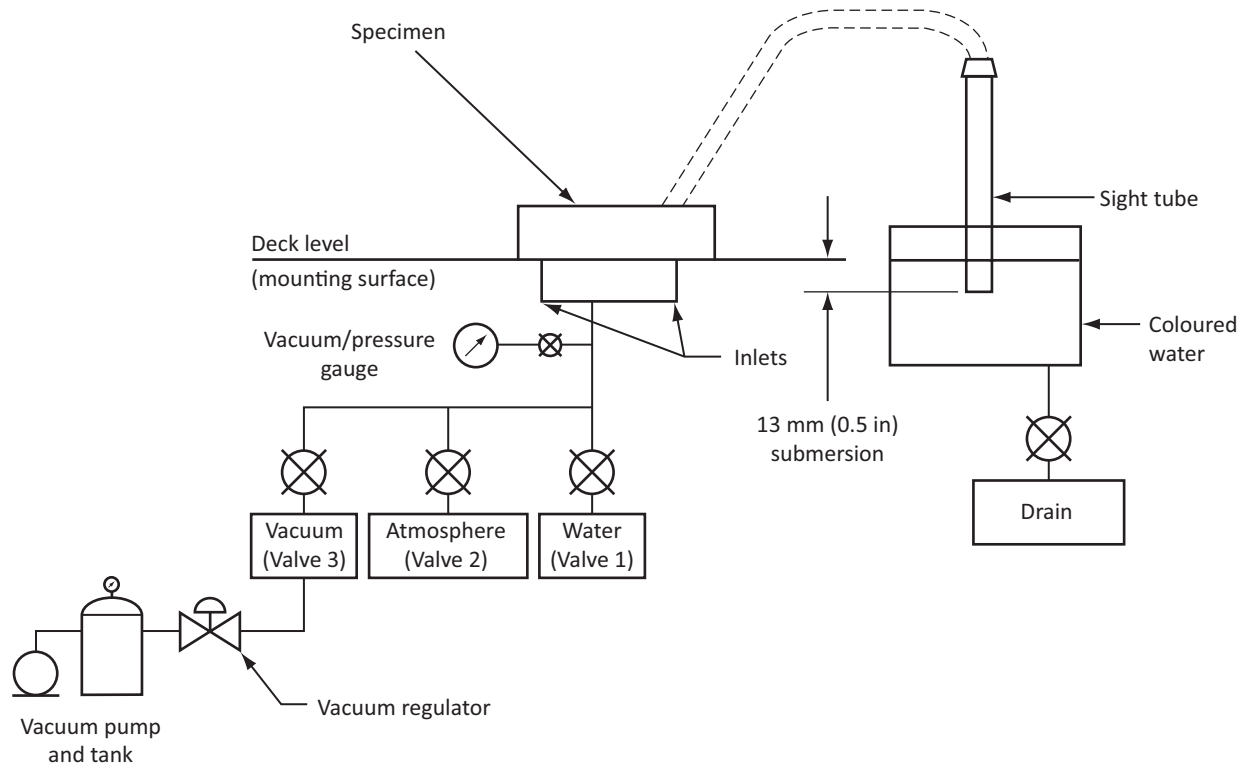


**Figure 3**  
**Discharge capacity test schematics**  
(See [Clauses 5.4.2.1](#) and [5.4.2.2.](#))

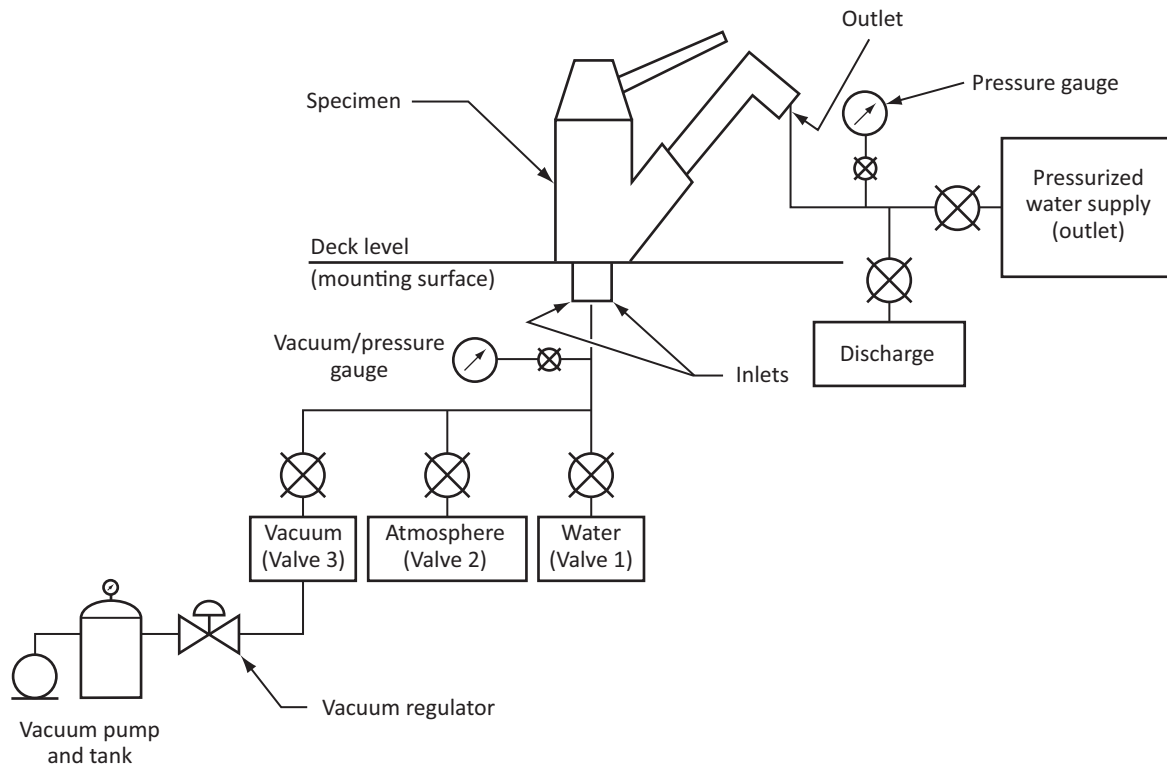


Fitting size	Metal bending moment, N•m (ft•lbf)	Plastic bending moment, N•m (ft•lbf)
NPS-3/8	40 (30)	40 (30)
NPS-1/2	60 (44)	40 (30)
NPS-3/4	80 (60)	40 (30)
NPS-1	100 (74)	40 (30)

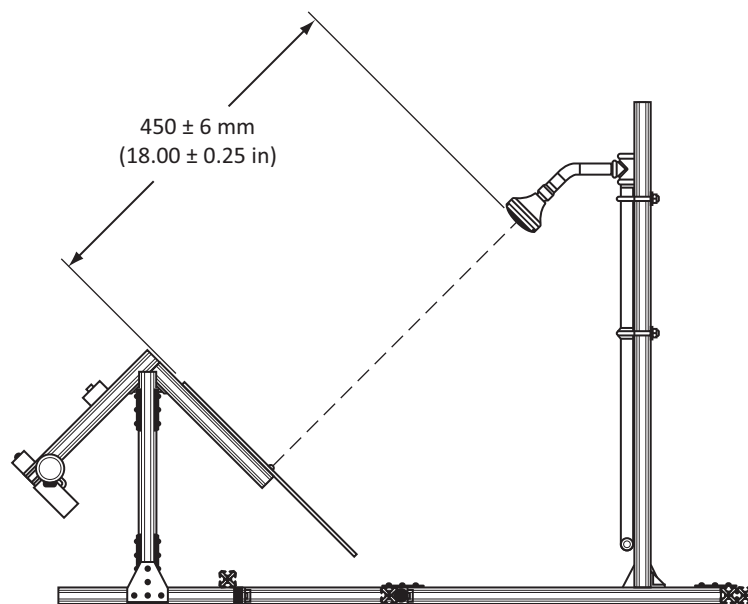
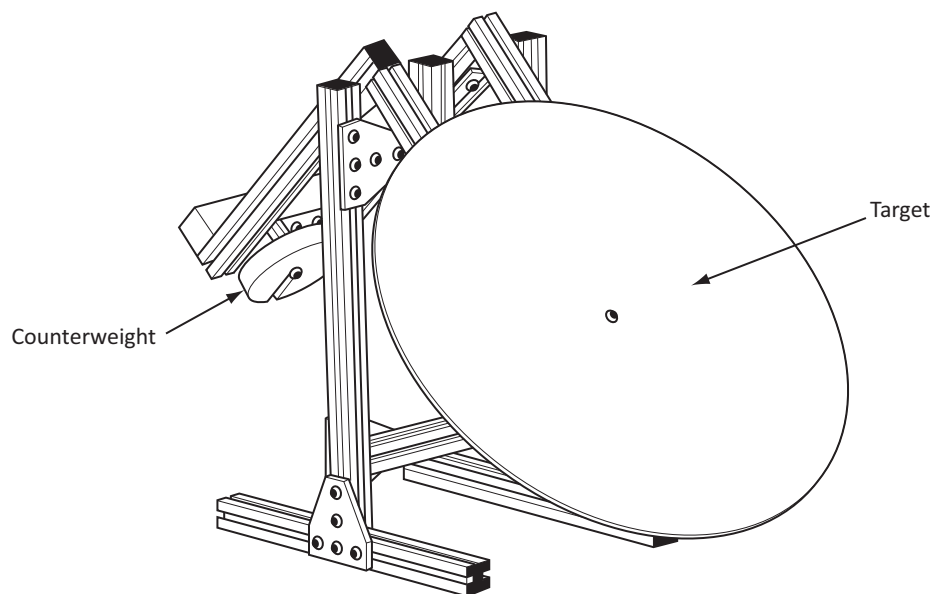
**Figure 4**  
**Bending loads on supply fittings**  
 (See [Clause 5.7.1.2.](#))



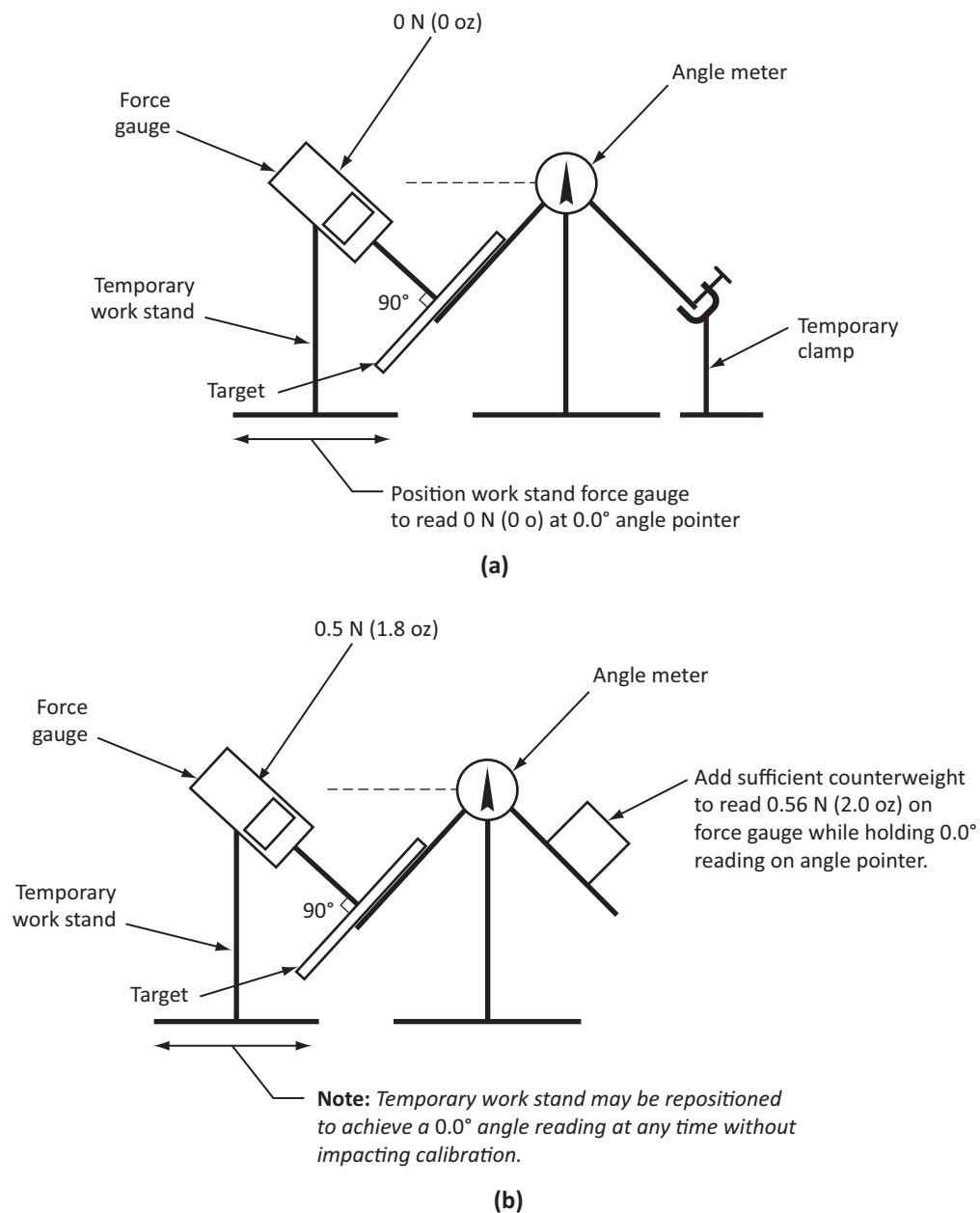
**Figure 5**  
**Set-up for back siphonage and hidden check valve test**  
(See [Clauses 5.9.3.2.2.3](#), [5.9.3.2.2.4](#), and [5.9.3.3.3](#).)



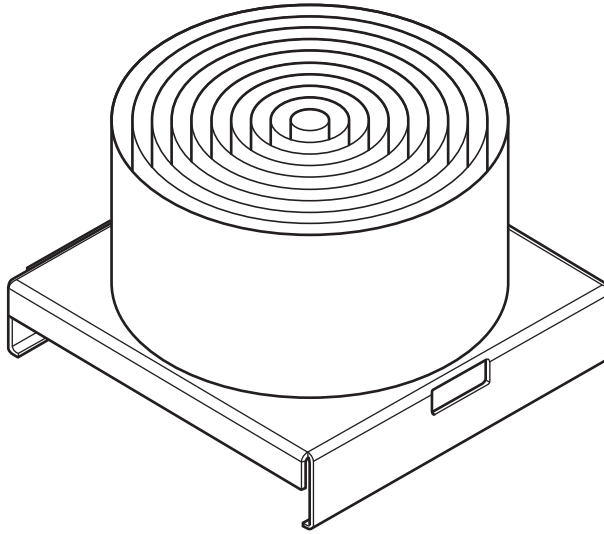
**Figure 6**  
**Set-up for check valve leakage test**  
(See [Clauses 5.9.3.2.3.5](#) and [5.9.3.2.3.6](#).)



**Figure 7**  
**Spray force-balance test fixture**  
(See [Clause 5.12.3.2.](#))

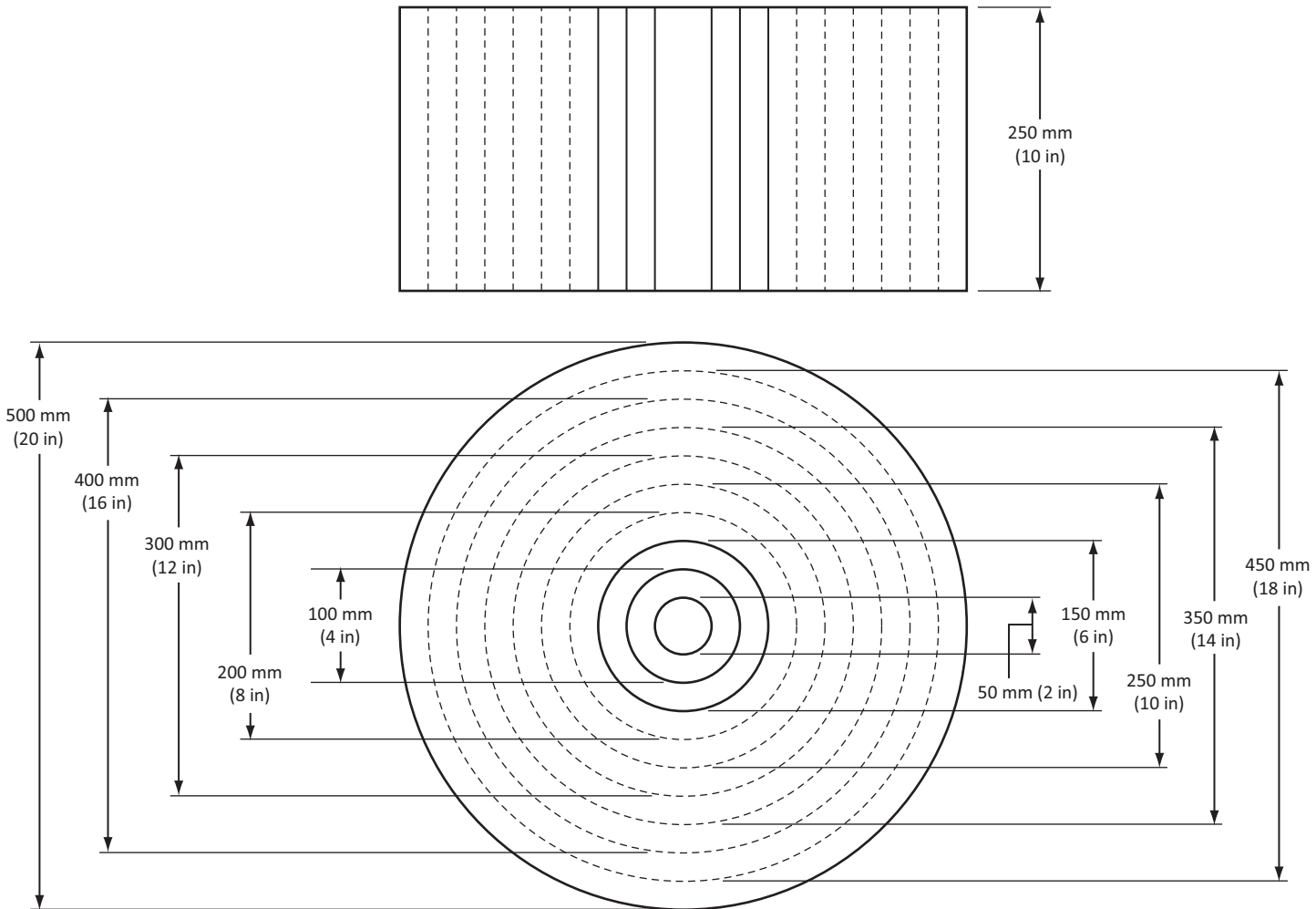


**Figure 8**  
**Spray force test fixture set-up**  
(See [Clause 5.12.3.3.](#))

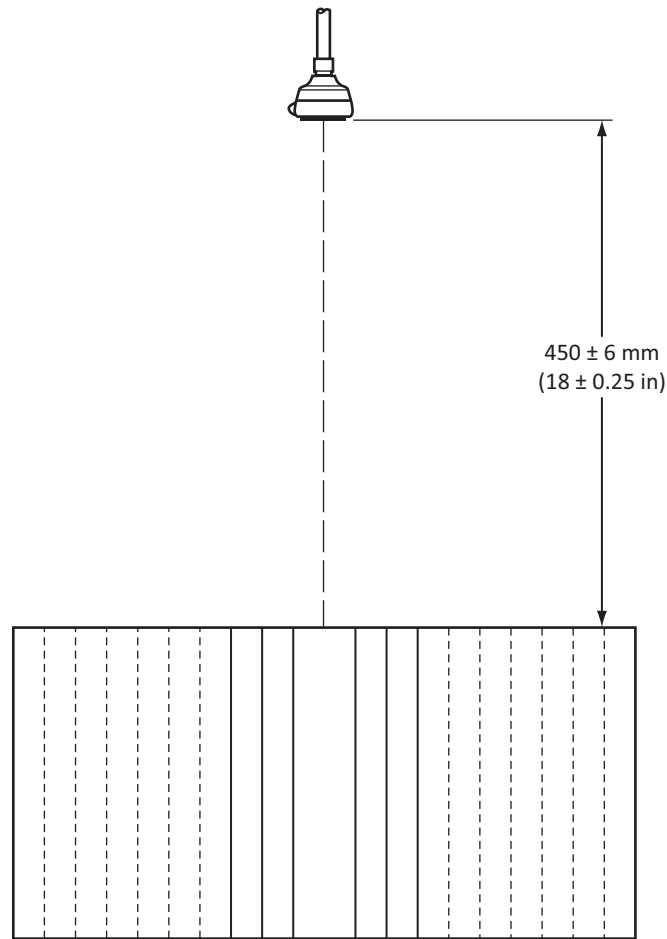


**Figure 9**  
**Spray coverage test fixture**  
(See [Clause 5.12.4.2.](#))





**Figure 10**  
**Spray coverage test fixture set-up ring**  
(See [Clauses 5.12.3.2](#) and [5.12.4.2.](#))



**Figure 11**  
**Spray coverage test fixture set-up**  
(See [Clauses 5.12.4.2](#) and [5.12.4.5](#).)

## *Annex A (informative)*

# ***Unit conversion and rounding criteria***

**Note:** *This Annex is an informative (non-mandatory) part of this Standard.*

### **A.1 Conversion**

The following conversion rules are used in this Standard:

- (a) Zeros to the left of the first non-zero digit are not significant.
- (b) If the number is greater than 1, all zeros to the right of the decimal point are significant.
- (c) In multiplication and division, the original number with the smallest number of significant digits determines the number of significant digits in the product or quotient.
- (d) If an exact constant is used (e.g., 3 ft = 1 yd), it does not affect the number of significant digits in the calculated value.
- (e) If inexact constants are used (e.g.,  $\pi = 3.1416$ ), the constant with at least one more significant digit than the smallest number of significant digits in the original data is used.

### **A.2 Rounding**

The following rounding rules are used in this Standard:

- (a) The digits that follow the last significant digit are dropped if the first digit is less than 5.
- (b) If the first digit dropped is greater than 5, the preceding digit is increased by 1.
- (c) If the first digit dropped is 5 and there are non-zero digits following the 5, the preceding digit is increased by 1.
- (d) If the first digit dropped is 5 and there are only zeros following the 5, the digit is rounded to the even number (e.g., for three significant digits, 1.655000 becomes 1.66, 1.625000 becomes 1.62).
- (e) For maximums and minimums, rounding is performed within the range of the maximum and minimum values in a way that does not violate the original limits.

## Annex B (normative)

### Tests by fitting type

**Note:** This Annex is a mandatory part of this Standard.

**Table B.1**  
**Tests by fitting type**  
(See [Clause 5.1.4.](#))

Test	Clause(s)	Fitting type																
		Automatic compensating valve	Bath or shower	Bath or shower with diverter	Bidet	Bidet with diverter	Kitchen	Kitchen and lavatory side spray diverter	Kitchen and lavatory side spray function control	Laundry	Lavatory and bar	Lawn and sediment	Metering or self-closing	Shower head or body spray	Hand shower	Shower head, hand shower, or body spray adjusting mechanisms or function control	Pullout spout faucet	Supply stop
Backflow prevention	5.9		X	X	X	X	X	X		X	X	X	X		X		X	
Ball joint leakage	5.3.5													X	X			
Burst pressure	5.3.2		X	X	X	X	X	X		X	X	X	X				X	X
Burst pressure — hose assembly	5.3.4.3		X	X	X	X	X	X			X		X		X		X	
Coatings	5.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Diverter leakage — bath/shower	5.3.6.1			X														
Diverter leakage — kitchen/lavatory	5.3.6.2							X			X						X	
Drainage test	5.10											X						
Flow rate	5.4		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Life cycle	5.6		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Life cycle — swing spouts	5.6.3.4						X	X		X	X						X	
Life cycle — hoses	5.6.3.5.1							X			X				X		X	

(Continued)

**Table B.1 (Concluded)**

Test	Clause(s)	Fitting type																
		Automatic compensating valve	Bath or shower	Bath or shower with diverter	Bidet	Bidet with diverter	Kitchen	Kitchen and lavatory side spray diverter	Kitchen and lavatory side spray function control	Laundry	Lavatory and bar	Lawn and sediment	Metering or self-closing	Shower head or body spray	Hand shower	Shower head, hand shower, or body spray adjusting mechanisms or function control	Pullout spout faucet	Supply stop
Mandrel strength	5.6.3.5.3							X			X				X		X	
Operating requirements	5.5		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Preconditioning and installation	5.1.1 and 5.1.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pressure and temperature — outlet blocked	5.3.1.3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pressure and temperature — valve closed	5.3.1.2		X	X	X	X	X	X		X	X	X	X				X	X
Pullout strength	5.6.3.5.2							X			X				X		X	
Resistance to installation loading — bending strength	5.7.1	X	X	X	X	X	X	X		X	X	X	X				X	X
Resistance to installation loading — thread torque strength	5.7.2	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X
Resistance to use loading	5.8	X	X	X	X	X	X	X		X	X	X	X		X		X	X
Threaded connections	4.4	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X
Torque	5.3.4.2		X	X	X	X	X	X			X		X		X		X	

**Note:** The tests specified in this Table are the applicable tests by fitting type. They need not be conducted in a particular order unless an order is specified in this Standard.





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