ASME A112.1.2-2004
(Revision of ASME A112.1.2-1991)

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

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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A N   A M E R I C A N   N A T I O N A L   S T A N D A R D

AIR GAPS IN PLUMBING SYSTEMS (FOR PLUMBING FIXTURES AND WATER-CONNECTED RECEPTORS)

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The next edition of this Standard is scheduled for publication in 2009. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME Web site under the Committee Pages at http://www.asme.org/codes/ as they are issued.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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FOREWORD

The Sectional Committee on Minimum Requirements for Plumbing and Standardization of Plumbing Equipment, A40, realizing the need for regulations and devices to protect the purity of water supplies in buildings, organized a technical subcommittee on air gaps and backflow preventers in 1938. This subgroup completed a tentative draft of a proposed standard for air gaps for a meeting of Subcommittee 12 on January 20, 1939.

The draft proposal was considered and revised. Copies of this revised report were distributed to interested firms and individuals in industry for further criticism and comment. At the October meeting of the subcommittee, the comments received were carefully considered. The April 1940 draft was distributed to the members of Sectional Committee A40 for discussion. Certain changes were recommended and two sections covering water inlets to tanks having overflows and drinking fountain bubblers were added. These were incorporated into the revised draft dated May 1940. Copies of this draft were distributed to the members of the sectional committee and to a group of more than 100 health supervisory officials, plumbing inspectors, state plumbing associations, and others. The received recommendations prompted another revision, which was reviewed by the members of Subcommittee 12. The changes and refinements made were incorporated, and a final revision dated July 1941 was approved by letter ballot vote of the sectional committee.

Following approval by the sectional committee and the sponsor organizations, the draft was transmitted to the American Standards Association (now known as the American National Standards Institute) for approval and designation as an American Standard. This designation was given in January 1942.

In 1958, the functions of Sectional Committee A40 pertaining to Standards for Plumbing Equipment were transferred to Standards Committee A112, and this Standard on Air Gaps in Plumbing Systems was assigned to Panel I. Panel I recommended the Standard's reaffirmation on April 18, 1972, and the Standards Committee A112 concurred in this recommendation on June 28, 1972. The American National Standards Institute approved this reaffirmation on January 23, 1973. The document was reaffirmed in 1989 and revised in 1990 to comply with technology.

This Standard is based on the application of certain physical principles to the design of plumbing fixtures and other water-connected devices and their installation in plumbing systems. It has been prepared to avoid complicated measurements and tests, to determine proper air gaps by taking simple measurements in the field, to provide an adequate margin of safety over laboratory tests, and to simplify inspections and the preparation of definite regulations. It also was prepared to prevent all types of backflow conditions where or when the insertion of a suitable air gap is appropriate.

This revision includes alternate performance requirements in addition to the prescriptive requirements that already existed. It has been prepared to prevent backflow due to back siphonage where or when the insertion of a suitable air gap is appropriate.

It is recognized that, in some cases, the air gap is not practical and other types of backflow preventers would give adequate protection. For more information on these devices, see Nonmandatory Appendix A.

This Standard was developed with the intent that due consideration be given to the adoption of these provisions by model, state, and local codes.

Suggestions for improvement of this Standard are welcome. They should be sent to The American Society of Mechanical Engineers, Attn: Secretary, A112 Main Committee, Three Park Avenue, New York, NY 10016-5990.

This revision was approved as an American National Standard on January 14, 2004.

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to:

Secretary, A112 Standards Committee
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Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the edition, the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation. When appropriate, proposals should be submitted using the A112 Project Initiation Request Form.

Interpretations. Upon request, the A112 Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the A112 Standards Committee.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The A112 Standards Committee schedules meetings as needed, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the A112 Standards Committee. The A112 home page contains information on future meeting dates and locations.

AIR GAPS IN PLUMBING SYSTEMS (FOR PLUMBING FIXTURES AND WATER-CONNECTED RECEPTORS)

1 GENERAL

1.1 Scope

This Standard identifies methods of providing protection against back siphonage through means of an air gap and establishes physical requirements and methods of testing air gaps for plumbing fixtures and water receptors.

1.2 Units of Measurement

Values are stated in U.S. Customary Units and in the International System of Units (SI); the U.S. Customary Units shall be considered as the standard.

1.3 Air Gap for Tanks or Vats With Water Inlets Below the Flood-Level Rim

For those cases where it is not practicable to provide a minimum required air gap above the flood-level rim (top edge) of a tank or vat, a suggested substitute procedure is given in Nonmandatory Appendix A.

1.4 References

The following documents form a part of this Standard to the extent specified herein. Unless otherwise specified, the latest edition shall apply.

ASME A112.19.5, Trim for Water-Closet Bowls, Tanks, and Urinals[1]

Publisher: The American Society of Mechanical Engineers (ASME International), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300

ASSE/ANSI 1011, Water-Closet Flush Tank Ball Cocks[1]

Publisher: The American Society of Sanitary Engineering (ASSE), 901 Canterbury Road, Suite A, Westlake, OH 44145

CSA B125, Plumbing Fittings

Publisher: Canadian Standards Association (CSA), 5060 Spectrum Way, Suite 100, Mississauga, Ontario L4W 5N6, Canada

[1] May also be obtained from American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036.

1.5 Definitions

air gap: a vertical distance through the atmosphere between the lowest potable water outlet and the highest level of the source of fluid contamination.

air gap, critical: the air gap that will prevent back siphonage when tested under laboratory conditions, with still water, wide-open control valve, and a vacuum of at least 25 in. Hg (635 mm Hg).

air gap, minimum required: an air gap greater than the critical air gap by a factor of safety to cover service conditions. The air gap required to prevent back siphonage through a water supply opening (faucet or valve), under the action of atmospheric pressure and a vacuum in the water supply system, depends principally on the size of the effective opening and the distance between the end of the supply fitting outlet (spout) pipe and a nearby wall. The minimum required air gap shall be measured vertically from the lowest part of the outlet of the faucet, spout, or supply pipe to the flood-level rim of the fixture or receptor (see Figs. 1, 2, and A-1).

backflow: the flow of water or other liquids into the distributing pipes of a potable supply of water from any source or sources other than the intended source. Back siphonage and back pressure are types of backflow.

backflow connection or condition: any arrangement whereby backflow can occur.

backflow prevention device: a device or assembly (combination of devices) designed to prevent backflow.

critical level mark: the level at which back siphonage will not occur, including any required factor of safety; a permanent mark on the external surface of the faucet or device that is visible after installation of the faucet or device. When the faucet or device is installed with the critical level mark at or above the flood-level rim of a fixture or receptor, this creates the minimum required air gap and will prevent back siphonage.

effective opening: the smallest cross-sectional area in a faucet, device, or a supply pipe through which water flows to an outlet. If two or more lines supply one outlet, the effective opening shall be the sum of the cross-sectional areas of the individual lines or the area of the outlet, whichever is smaller.

NOTE: See Fig. 1 for *effective opening*. With ordinary plumbing fixtures, the minimum cross-sectional area usually occurs at the

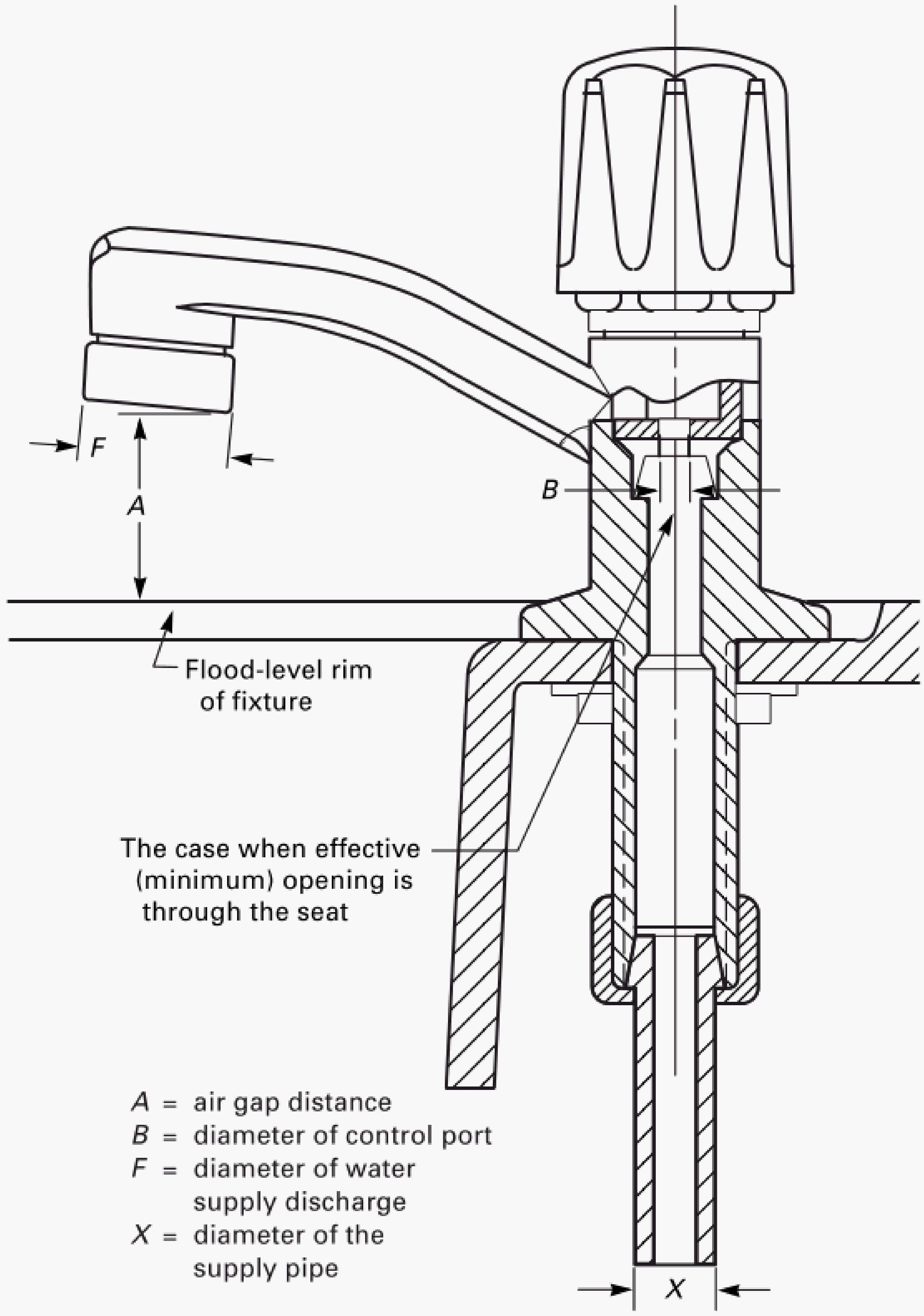

Fig. 1 Example of Air Gap and Effective Opening

seat of the control valve, *B*; but, in other cases, it may be at the point of discharge (spout) or at the inlet to the control valve, *X*.

elevation: the air gap–related term applied to drinking fountain nozzles.

flood-level rim: the top edge of the receptor from which water will flow out of the receptor (an overflow opening is not considered a flood-level rim).

NOTE: The definition of *flood-level rim* is based on a fixture or receptor with reasonably level edges. It is recognized that certain fixtures or receptors may be provided with uneven edges. In such cases, the equivalent of flood-level rim shall be considered as the maximum water elevation possible with full flow of water from all water-supplied pipes discharging into the fixture or receptor. Obviously, in such cases, the flood-level rim or its equivalent is not capable of simple measurement in the field. For connections below the rim, which are called *overflows*, see *spill level*.

free area: the area created between a near wall and the faucet or fitting when the distance between the wall and the outlet of the faucet or device is four times the effective opening of the faucet or device.

spill level: the horizontal plane to which water will rise to overflow through channels or connections that are not directly connected to any drainage system, when water is flowing into the fixture at any maximum rate.

NOTE: Overflow channels in water closet tanks shall not be considered as being directly connected to the drainage system because, in case of drain line stoppage, the water will spill over the water closet rim (see para. 2.2).

2 REQUIREMENTS

2.1 Minimum Required Air Gap

The following requirements of minimum required air gaps shall apply to plumbing fixtures in general use. It is recognized that the actual water level in a receptor may rise higher than the flood-level rim and a factor of

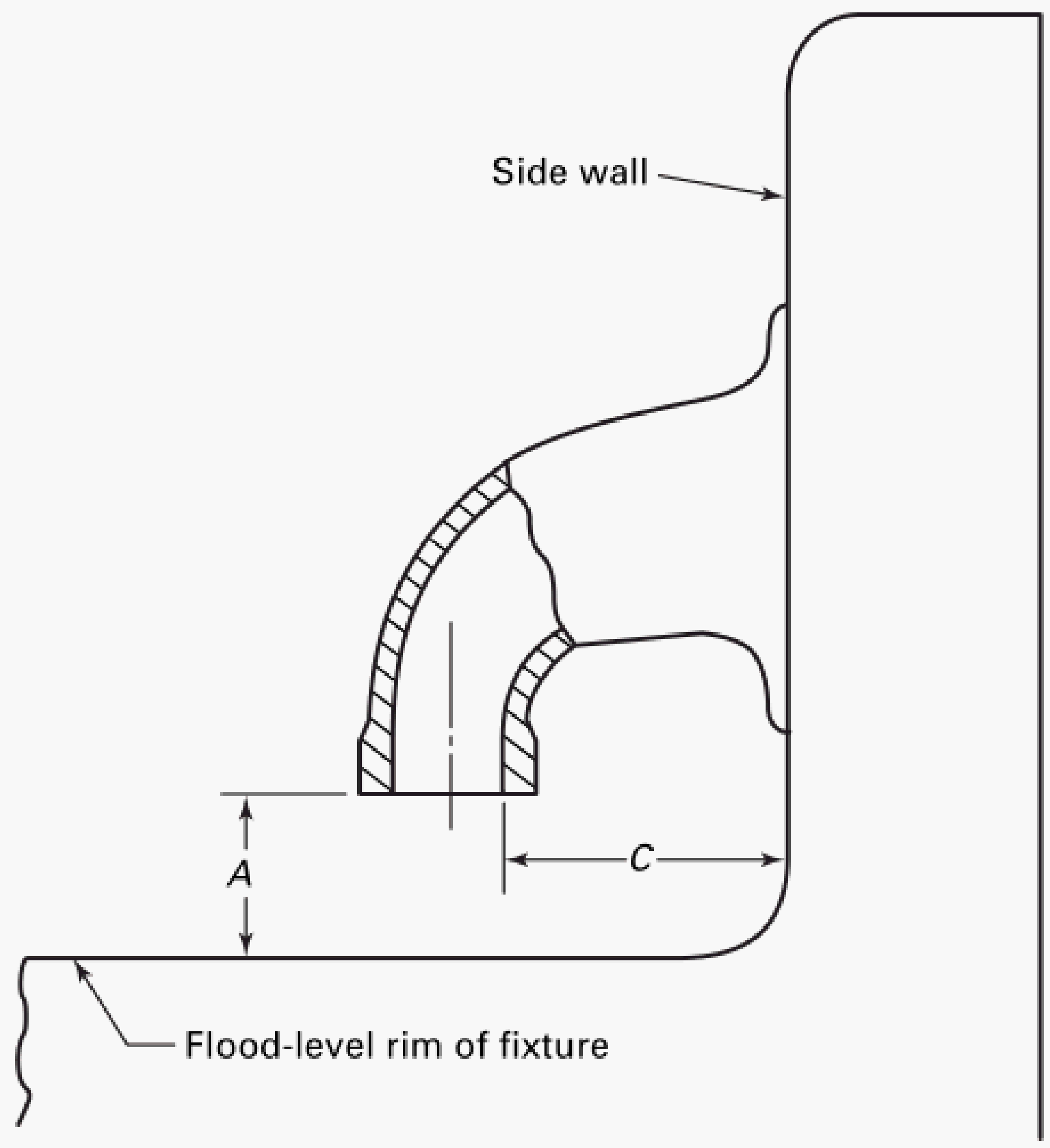

Fig. 2 Example of Near-Wall Influence on Air Gap

safety has been applied to compensate for this higher level.

(a) The minimum required air gap shall be twice the diameter of the effective opening, but in no case less than the minimum air gaps specified in Table 1.

(b) When a receptor receives water from two or more outlets of different sizes, air gaps for all water supply openings shall be at least equal to that required for the largest opening.

(c) As an alternative to (a), the minimum required air gap shall be in conformance with the performance requirements of paras. 2.4 and 2.5.

(d) For additional standards relating to backflow and backflow prevention, which are not specifically mentioned in this Standard, see Nonmandatory Appendix B.

2.2 Water Closet Tanks

Fill valves in gravity water closet tanks shall conform to ASSE/ANSI 1011 or CSA B125.

2.3 Minimum Elevation of Drinking Fountain Nozzles[2]

Drinking fountain nozzles, including those that extend through a water surface and with orifice diameter not greater than $^7\!/_{16}$ (0.440) in. (11 mm) or 0.150 in.^{2} (97 mm^2) area shall be placed so that the lower edge of the nozzle orifice is at an elevation not less than ¾ in. (19 mm) above the flood-level rim of the fixture or receptor.

The ¾-in. (19-mm) elevation shall also apply to nozzles with more than one orifice, providing that the sum of the areas of all orifices shall not exceed the area of a circle $^7\!/_{16}$ in. (11 mm) in diameter.

Where the cross-sectional area of a single-nozzle orifice or the sum of the cross sections of the orifices, in case there is more than one, is greater than that of a circle $^7\!/_{16}$ in. (11 mm) in diameter, the elevation shall not be less than H in the following formula:

$$H = \frac{d}{0.440} \times 0.75 \text{ in.}$$

$$H = \frac{d}{11} \times 19 \text{ mm}$$

where

d = the diameter of a circle equal in cross-sectional area to that of the nozzle orifice or orifices[3]

2.4 Determination of Minimum Air Gaps for Plumbing Systems

The following is the procedure for the determination of minimum air gaps for plumbing systems:

(a) Install the faucet or device, with all checking members upstream of the air gap removed or held fully open, in its normally installed position in a container [approximately 15 in. (380 mm) × 10 in. (250 mm) × 6 in. (150 mm) deep]. The outlet of the faucet or device shall have at least a free area of four times its effective opening between the container and the outlet. The mounting surface of the faucet or device shall be level or plumb with the water surface in the container.

(b) Connect the inlet(s) of the faucet or device to a vacuum source. The vacuum shall be measured at the inlet of the faucet or device.

(c) A means to change the water level in the container relative to the outlet of the faucet or device shall be provided.

(d) Start the test with the water level at the mounting surface of the faucet or device.

(e) With the faucet or device fully open from its inlet(s) to the point of discharge to the atmosphere, apply a vacuum of 25 in. Hg (635 mm Hg) to the inlet(s). Back siphonage under these conditions is cause for rejection of the faucet or device.

(f) The water level shall slowly be brought closer to the discharge outlet of the faucet or device until back siphonage occurs. At this point, record the water level. The vertical distance between the water level and the lowest point on the discharge outlet of the faucet or device shall be measured and recorded.

[2] The term *elevation* is used instead of air gap for nozzles because some nozzles may be assembled without an air gap, as defined in this Standard.

[3] Other provisions relating to drinking fountains are contained in ANSI/ARI 1010, Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking-Water Coolers [available from the Air-Conditioning & Refrigeration Institute (ARI), 4100 North Fairfax Drive, Arlington, VA 22203].

Table 1 Minimum Air Gaps for Generally Used Plumbing Fixtures

Fixtures	Minimum Air Gaps	
	When Not Affected by Near Wall [Note (1)]	When Affected by Near Wall [Note (2)]
Lavatories with effective openings not greater than $^1/_2$ in. (12 mm) in diameter	1.0 in. (25 mm)	1.5 in. (38 mm)
Sinks, laundry trays, and bath faucets with effective openings not greater than $^3/_4$ in. (19 mm) in diameter	1.5 in. (38 mm)	2.25 in. (57 mm)
Over-rim bath fillers with effective openings not greater than 1 in. (25 mm) in diameter	2.0 in. (50 mm)	3.00 in. (76 mm)
Effective openings greater than 1 in. (26 mm)	2× effective opening	3× effective opening

NOTES:

(1) Side walls, ribs, or similar obstructions do not affect the air gaps when spaced from the inside edge of the spout opening (*C* of Fig. 2) a distance greater than three times the diameter of the effective opening for a single wall or a distance greater than four times the diameter of the effective opening for two intersecting walls (see Fig. 2).

(2) Vertical walls, ribs, or similar obstructions extending from the water surface to or above the horizontal plane of the spout opening require greater air gaps when spaced closer to the nearest inside edge of the spout opening than specified in Note (1). The effect of three or more such vertical walls or ribs has not been determined. In such cases, the air gap shall be measured from the top of the walls.

(g) Return the faucet or device to atmospheric conditions.

(h) Starting with the water level higher than where back siphonage occurred, apply a vacuum to the inlet(s) of 25 in. Hg (635 mm Hg). Slowly lower the water level until the back siphonage stops. Maintain the vacuum for another 1 min to be sure no more water is being drawn into the discharge outlet of the faucet or device. At this point, record the water level. The vertical distance from the water level and the lowest point on the discharge outlet of the faucet or device shall be measured and recorded.

(i) The larger of the two distances measured and recorded shall be considered the critical air gap of the faucet or fitting device. Faucets or devices that are marked with a critical level mark shall be marked at or below the lowest water level, from para. 2.4(h), where back siphonage stopped.

(j) Repeat this test for two sequences to confirm the measured and recorded critical air gap.

(k) For faucets and devices with a critical level mark, confirm that the mark is at a level that is at or below the highest water level recorded in determining the critical air gap.

NOTE: Faucets or devices that can be installed and have a near-wall effect [see Table 1, Notes (1) and (2)] shall be tested with the discharge outlet of the faucet or device against one wall of the test container.

2.5 Back Siphonage

With the water level at the critical level mark on the faucet or device or at the mandatory levels of Table 1 when the faucet or device has no mark, apply a vacuum of 25 in. Hg (635 mm Hg) to the inlet(s) of the faucet or device. Indication of water at the inlet(s) shall be cause for rejection.

NONMANDATORY APPENDIX A
METHOD OF PROVIDING AN AIR GAP FOR TANKS OR VATS WITH WATER INLETS BELOW THE FLOOD-LEVEL RIM

For those cases where it is not practicable to provide a minimum required air gap above the flood-level rim (top edge) of a tank or vat, the following is suggested as a substitute procedure, although not comparable in safety with the positive separation of a proper air gap above the flood-level rim (top edge; see Fig. A-1).

The overflow pipe or channel shall be so arranged as to allow overflow water a free discharge to atmosphere under all conditions; the overflow piping shall be provided with an adequate break in the piping as close to the tank as possible; and an area of the free opening shall be at least equal to that of the overflow pipe (see Fig. A-1). The tank and overflow piping shall be protected against freezing.

When water is entering the tank at the maximum rate with all inlets open and all outlets closed, the size and capacity of overflow pipe or channel shall be sufficient to keep the water level from rising to more than half of the minimum required air gap as shown in Table 1. This distance shall be measured above the top of the overflow.

The minimum air gap, as measured from the lowest point of any supply outlet to the top of the overflow opening, shall be one and a half times the minimum air gap specified in Table 1 (see Fig. A-1).

If, however, a tank or vat cannot be provided with an adequate air gap as specified above, a backflow preventer shall be installed in accordance with local codes.

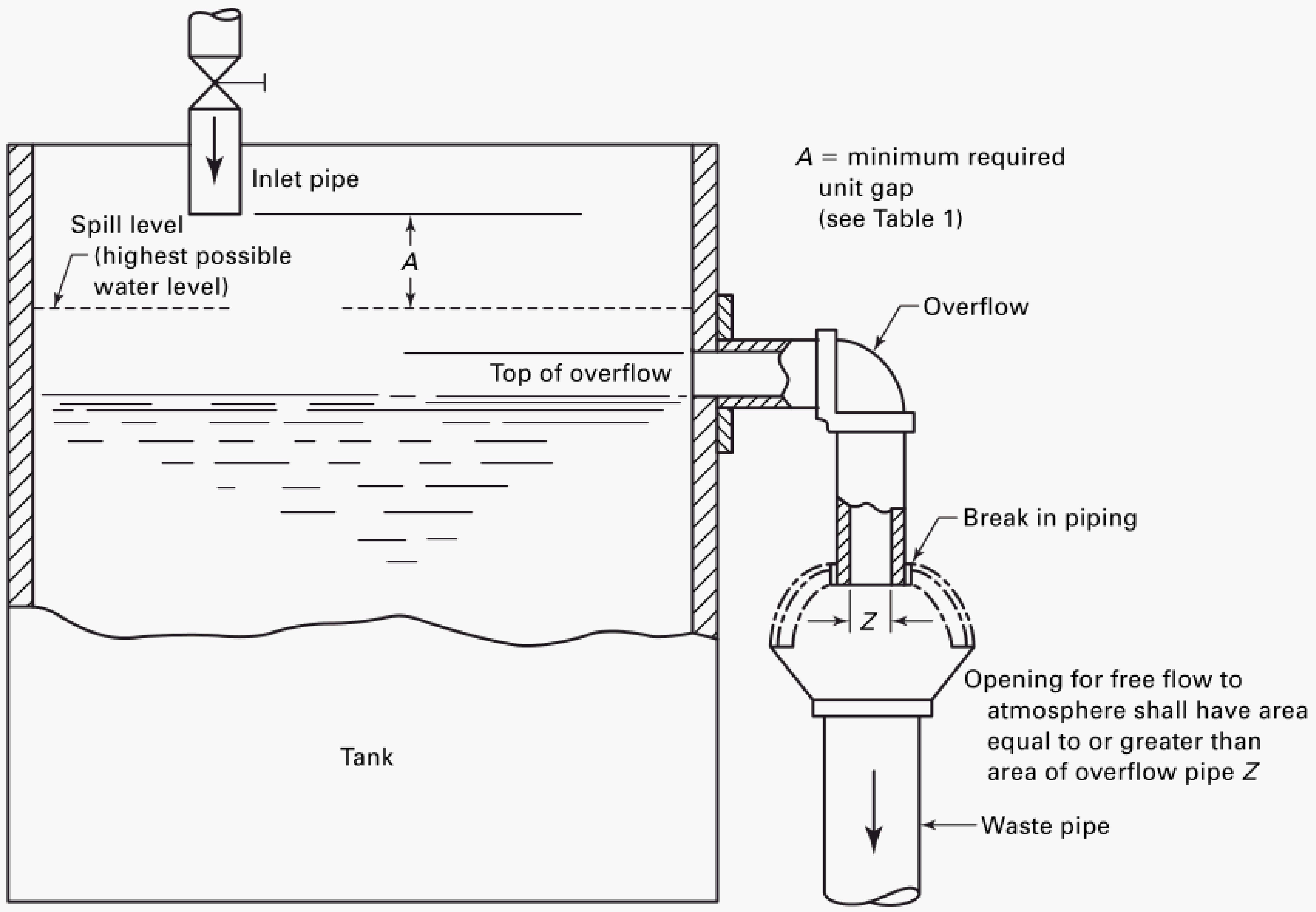

Fig. A-1 Example of Air Gap in Open Tank With Overflow

NONMANDATORY APPENDIX B
OTHER STANDARDS APPLICABLE TO BACKFLOW PREVENTION

For other references to standards for backflow prevention, contact the American Society of Sanitary Engineering (ASSE), 901 Canterbury Road, Suite A, Westlake, OH 44145. ASSE Standards applicable to backflow are the following:

ASSE/ANSI 1001-2002, Pipe Applied Atmospheric Type Vacuum Breakers
ASSE/ANSI 1002-1994, Hose Connection Vacuum Breakers
ASSE/ANSI 1011-1995, Water-Closet Flush Tank Ball Cocks
ASSE/ANSI 1012-2002, Backflow Preventer/Intermediate Atmospheric Vent
ASSE/ANSI 1013-1999, Reduced Pressure Principle Backflow Preventer
ASSE/ANSI 1014-1989, Handheld Shower
ASSE/ANSI 1015-1998, Double Check Valve Type Back Pressure Backflow Preventers
ASSE/ANSI 1020-1998, Vacuum Breakers — Anti-Siphon, Pressure Type
ASSE/ANSI 1022-1996, 1998, Backflow Preventer for Carbonated Beverage Machines
ASSE/ANSI 1024-1994, Dual Check Valve Type Backflow Preventer
ASSE/ANSI 1025-1978, Diverters for Plumbing Faucets With Hose Spray Anti-Siphon Type Residential Application
ASSE/ANSI 1032-1980, Dual Check Valve Type Backflow Preventer for Carbonated Beverage Dispensers
ASSE/ANSI 1035-1990, Laboratory Faucet Vacuum Breakers
ASSE/ANSI 1037-1986, 1990, Pressurized Flushing Devices for Plumbing Fixture
ASSE/ANSI 1047-1999, Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies
ASSE/ANSI 1048-1999, Double Check Detector Fire Protection Backflow Prevention Assemblies
ASSE/ANSI 1052-1993, 1994, Hose Connection Backflow Preventers
ASSE/ANSI 1056-2001, 2002, Spill Resistant Vacuum Breaker

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