ASME A112.6.9-2005

Siphonic Roof Drains

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The next edition of this Standard is scheduled for publication in 2010. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. The interpretations are not part of the Standard.

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

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FOREWORD

The American Society of Mechanical Engineers has prepared this Standard for the purpose of establishing standardization and uniformity in the manufacture and testing of siphonic roof drains as well as the practice of siphonic roof drainage design in the United States. This Standard is not intended to be static or immutable but shall be subject to periodic review and revision.

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

This Standard was approved as an American National Standard on July 8, 2005.

ASME A112 COMMITTEE
Standardization of Plumbing Materials and Equipment

(The following is the roster of the Committee at the time of approval of this Standard.)

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PROJECT TEAM 6.9 — SIPHONIC ROOF DRAINS

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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 by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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SIPHONIC ROOF DRAINS

1 GENERAL

1.1 Scope

This Standard establishes minimum requirements and provides guidelines for the proper design, installation, examination, and testing of siphonic roof drains. It includes definitions of terms and parameters involved in the proper design of siphonic drainage systems.

This Standard applies to roof drains designed, manufactured, and installed in piping systems that are intended to operate under depressurized siphonic conditions created by the connected piping system.

Unless noted otherwise in this Standard, the requirements and standards for roof drains specified in ASME A112.6.4 do not apply to siphonic roof drains.

This Standard does not apply to conventional roof drains covered under ASME A112.6.4.

It is not the intent of this Standard to specify that a drain of a given diameter must drain a minimum or maximum amount of water. It is the intent of this Standard to provide standardized test procedures to ensure that drain products are evaluated equally.

This Standard does not dictate minimum flow or depth performance criteria for siphonic roof drains. Instead, it specifies standard test procedures to be performed on siphonic roof drain products to document their actual performance and physical limits. These data are to be made available in manufacturer literature for use by designers for selecting the drain product and entering performance characteristics into design calculations.

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 Reference

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

ASME A112.6.4, Roof, Deck, and Balcony Drains

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

1.6 Definitions and Nomenclature

1.6.1 Definitions

air baffle: a device that limits the flow of air into a drain, causing the connected drainage piping to run at full-bore flow at dimensional rainfall intensity with a limited water depth on the roof surface.

depressurized: the condition or state of being below atmospheric or ambient pressure.

designer: the specifier of a siphonic roof drain product.

drain outlet: the drain "neck" of a siphonic roof drain configured to connect to the tailpiece with a standard coupling device.

full-bore flow: the flow of water in a pipe where theoretically 100% of the cross-section of the pipe bore is filled. In practical terms, full-bore flow is regarded as achieved at water content greater than 95% by volume.

single resistance value, K_i: a coefficient that is characteristic of a pipe fitting's or drain's contribution to energy losses.

1.6.2 Nomenclature

cfs = cubic feet per second
d_i = pipe inner diameter, ft
f = friction factor (dimensionless)
g = gravitational constant, 32.2 ft/sec^2
gpm = gallons per minute
h_t = height, ft
K_i = single resistance value (dimensionless)
k_0 = resistance coefficient (dimensionless)
L = pipe length, ft
L/s = liters (metric liquid) per second
P = static pressure, lb$_f$/ft^2 or ft H_20
Q = volumetric flow, cfs
Re = Reynold's Number (dimensionless)
ρ = fluid density, slug/ft^3
V = fluid velocity, ft/sec
ν = fluid kinematic viscosity, ft^2/sec
w.c. = water column

2 ACCEPTABLE MATERIALS AND COMPONENTS

2.1 Siphonic Roof Drains

The materials of construction, finishes, and hardware components used to manufacture siphonic roof drains shall comply with the requirements of ASME A112.6.4, para. 5.

3 TESTING

3.1 General

3.1.1 Manufacturers of siphonic roof drains may utilize existing conventional drain body designs with an air baffle adaptor to achieve siphonic capability when connected to a properly engineered siphonic drainage piping system. This adaptation, however, requires hydraulic analysis in order to ensure the baffle design is stable, will be capable of priming, and will minimize the depth of water on the roof as much as possible.

3.1.2 Siphonic roof drain products shall be verified experimentally and have documented results.

3.1.3 The design of any air baffle and drain shall follow three main principles:

(a) It shall be able to prime the test standpipe quickly. Thus, the height of the baffle above the sump bowl should be minimized. This will help achieve a high Reynolds Number beneath the baffle and the necessary turbulence for proper air to water mixing during priming.

(b) The baffle shall not introduce a limiting effect with respect to maximum flow. In other words, the drain shall be limited in maximum flow capacity by the fixed spigot drain diameter and not by the introduction of a baffle.

(c) The first two goals must be balanced with the desire to have a minimum of water depth on the roof above the baffle, which means that the resistance of the baffle/drain/strainer combination should be minimized.

3.2 Design of Siphonic Drains

3.2.1 The design of any siphonic roof drain shall follow the basic principles described in para. 3.1.3.

3.2.2 The materials, spigot connections, components, and leaf guard designs of siphonic roof drains shall meet with the minimum requirements of ASME A112.6.4, with the exception of the air baffle design.

3.2.3 This Standard is not intended to restrict or prohibit the development or application of new and innovative siphonic roof drainage products provided that such products conform to the spigot connection requirements of ASME A112.6.4.

3.2.3.1 A spigot connection type shall not reduce or increase the flow path in a manner that will alter the drain's tested single resistance value.

3.3 Testing of Siphonic Roof Drains

3.3.1 The following test procedures shall be applied to siphonic roof drain products.

3.3.2 These tests have three purposes

(a) to determine the relationship between the flow rate entering the drain and the depth of water at the approach to the drain (i.e., the flow rating curve for the product)

(b) to determine the head loss coefficient (i.e., single resistance value) for the drain for use by the designer for designing the piping system in which the drain will be installed

(c) to check the effectiveness of the drain at preventing entry of air and for the speed of response to sudden changes in flow rate

3.3.3 The performance characteristics of a siphonic roof drain product are vital in the attainment of full-bore flow in the connected piping system.

3.3.4 The relationship between flow rate and upstream depth of rain water depends on where the drain is to be installed. For a given flow rate, the depth will be less on a flat roof than in a gutter. The narrower the gutter, the greater the upstream depth. Siphonic roof drains shall be tested for the most critical condition in which the drain is intended to be installed.

3.3.5 These test procedures do not include the performance and flow capacity of the connected siphonic piping system.

3.4 Test Apparatus, Single Resistance Value (Loss Coefficient)

3.4.1 The test apparatus (Fig. 1) for quantifying a siphonic roof drain single resistance value shall consist of a minimum 39.4 in. (1 m) radius test tank (A) of sufficient height or freeboard [12 in. (305 mm) minimum] with an open top and a level test section (B) not less than a 35.4 in. (0.9 m) radius. The level floor section shall not deviate more than ± $^3/_{32}$ in. (± 4 mm) from the horizontal. The tank (A) shall have a maximum overall surface area of 53.8 ft^2 (5 m^2).

3.4.2 The test tank (A) shall be supplied with water at four points (C) equally spaced near the tank center.

3.4.3 Water shall be pumped from a suitable reservoir using a pump or array of pumps capable of providing a range of flow from the minimum test flow condition to the maximum anticipated flow for the product(s) being tested. Maximum flows of up to 2,000 gpm (126 L/s) or more may be required.

3.4.4 Flow rate shall be measured by a suitable flow element in the supply pump discharge with a turndown ratio of 100:1. Flow shall be measured to an accuracy of ±1%. Calibrate the flow output to read in units of cubic feet per second (cfs).

3.4.5 Water depths in the level test section (B) shall be measured to an accuracy of ± 0.04 in. (± 1 mm) at a location 20 in. ± 1 in. (500 mm ± 25 mm) from the center of the drain product. For gutter flow simulations, water depth shall be measured along the centerline of the simulated gutter.

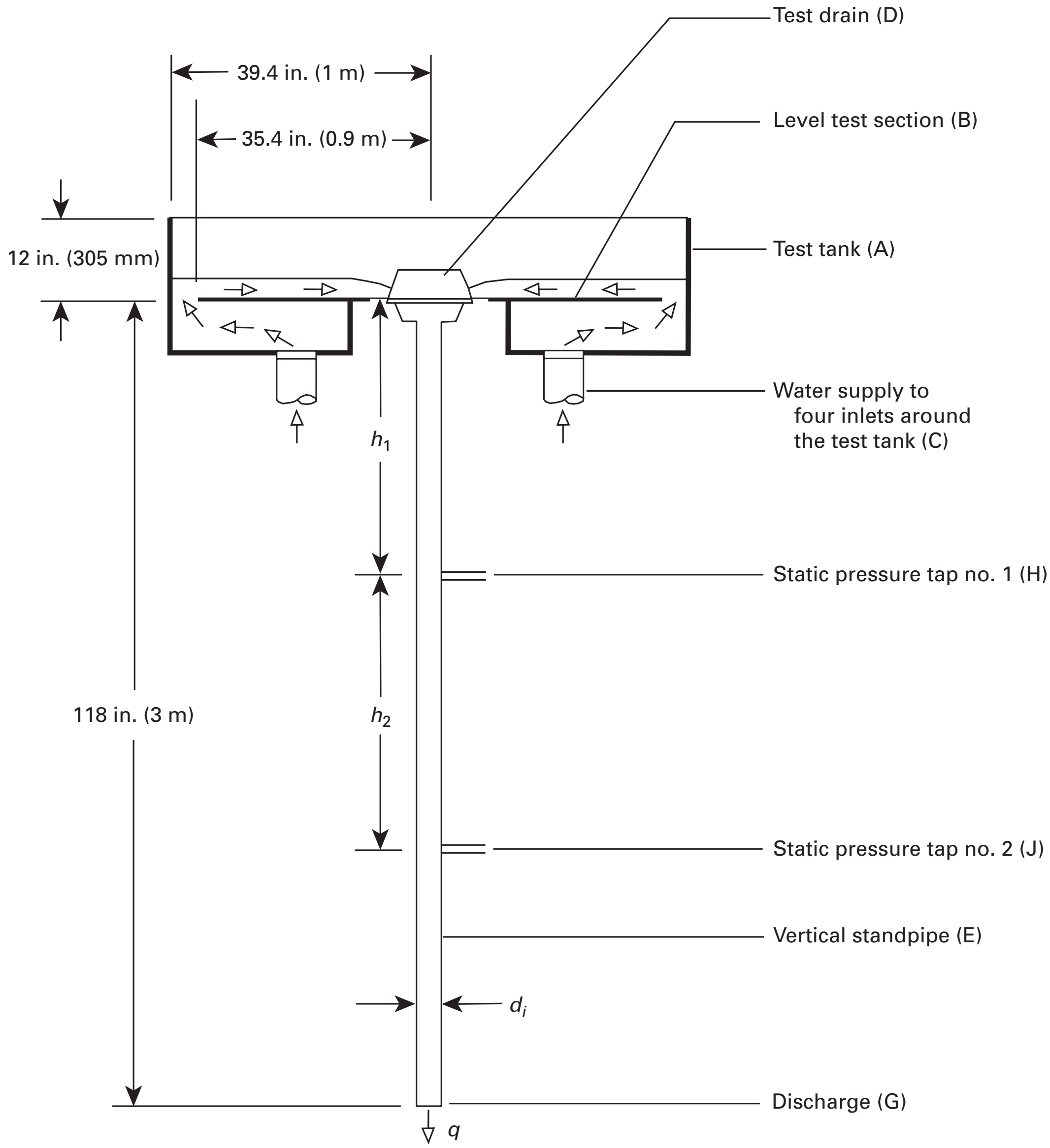

Fig. 1 Resistance Value Apparatus

3.4.6 The center of the level test section (B) shall be capable of accepting the roof drain product to be tested (D), normally by fastening the drain's flashing clamp and body to a fixed circular opening or sump receiver installed in accordance with the manufacturer's installation instructions.

3.4.7 The single resistance value, *K*, of the drain shall be obtained by connection of a vertical standpipe (E), not less than 118 in. ± 4 in. (3 m ± 100 mm) long, with a diameter differing from that of the drain outlet by not more than ± 0.08 in. (± 2 mm). The standpipe shall discharge (G) to a suitable water reservoir for recirculation.

3.4.8 Two static pressure taps [(H) and (J)] shall be installed, a minimum of ten pipe diameters from the drain outlet and ten pipe diameters apart. There shall be no pipe joints or couplings between the pressure taps. Pressure taps shall not be located within 20 in. (0.5 m) of the discharge (G). Pressure shall be measured at full-bore conditions using calibrated pressure transducers, capable of reading to an accuracy of ± 0.1 in. w.c. (± 2.5 mm w.c.).

3.4.9 The test shall be performed by filling the vessel by means of a pump or array of pumps, flow meter, and regulating valve. Slowly increase flow rate until the drain reaches maximum capacity. Reduce the flow rate until water depth stabilizes. This will be the fully primed flow rate for the drain with the connected standpipe diameter. If the drain product fails to prevent air entrainment into the test standpipe, the test shall be terminated.

3.4.10 At fully primed flow, log pressure readings at a sample rate of 100 Hertz, and calculate the average of not fewer than 1,000 readings. The purpose is to account for the characteristically "noisy" static pressure condition in the standpipe due to turbulent flow.

3.4.11 The collected data shall be the measured flow, q, and the static pressures in the standpipe, P_H and P_J. The velocity in the standpipe, V, shall be evaluated using the measured quantities of flow, q, and standpipe inner diameter, d_i, in accordance with Eq. (1)

$$V = 183.3\left(\frac{q}{d_i^2}\right) \tag{1}$$

3.4.12 The static pressure readings at taps (H) and (J) are used to establish the friction loss factor for the vertical standpipe. This value is used for further analysis of the tested drain resistance value. The friction factor, f, is evaluated with Eq. (2)

$$f = \left(\frac{d_i}{h_2}\right)\left(\frac{2g}{V^2}\right)\left(\frac{(P_H - P_J)}{\rho g} + h_2\right) \tag{2}$$

3.4.13 The single resistance value, K, shall be evaluated using the pressure readings from both pressure taps at (H) and (J). For pressure tap (H), use Eq. (3)

$$K_H = \frac{\left(h_1 - \frac{P_H}{\rho g} - \frac{V^2}{2g} - f\left(\frac{h_1}{d_i}\right)\frac{V^2}{2g}\right)}{\frac{V_{\text{out}}^2}{2g}} \tag{3}$$

3.4.14 For pressure tap (J), use Eq. (4)

$$K_J = \frac{\left((h_1 + h_2) - \frac{P_J}{\rho g} - \frac{V^2}{2g} - f\left(\frac{h_1 + h_2}{d_i}\right)\frac{V^2}{2g}\right)}{\frac{V_{\text{out}}^2}{2g}} \tag{4}$$

3.4.15 In Eqs. (3) and (4), V_{out} is referenced to the actual inner diameter of the roof drain spigot outlet, not the inner diameter of the test standpipe.

3.4.16 The values of K calculated at pressure taps (H) and (J) shall not vary by more than 0.05. The published value of K shall be the arithmetic mean of the (H) and (J) values.

3.4.17 Test the drain product with all accessories intended for normal installation, including leaf guards, overflow dams (if applicable), etc.

3.5 Test Apparatus, Depth Versus Flow, Stability, and Speed of Prime

3.5.1 To achieve a steady-state siphonic condition, a certain layer of water around and above the drain air baffle is required in order to prevent the ingestion of air into the piping system and create a closed system.

3.5.2 The testing apparatus for depth versus flow, stability, and speed of prime shall be similar to the test apparatus for single resistance value represented in Fig. 2. However, the standpipe shall have a minimum 40 in. (1 m) clear section (F) for visual observation and an adjustable throttle valve (K) at the standpipe discharge. This valve shall not offer significant resistance when fully open and shall be capable maintaining position without movement during testing. In lieu of a 40 in. section, the entire standpipe may be clear pipe. Refer to Fig. 2.

3.5.3 The standpipe diameter, d_1, shall be the largest diameter intended for installation, i.e., the diameter shall be the largest practicable and capable of developing a fully primed state for the connected drain product while achieving maximum flow capacity of the drain product.

3.5.4 To test stability and speed of prime, the throttle valve (K) shall be fully open. Increase the flow rate slowly until the drain reaches maximum capacity. This will be seen when no air passes through the clear section of tube and water depth begins to rise quickly. The depth where air is excluded will be the water depth at prime. Reduce the flow rate until the water depth stabilizes. This will be the fully primed flow rate for the drain with that particular standpipe diameter.

3.5.5 After establishing the fully primed flow rate, increase the flow rate from zero to maximum flow over a period of 15 sec. Water depth in the tank shall not exceed $\frac{3}{4}$ in. (20 mm) above the steady primed level established in para. 3.5.4 and shall have returned to a steady operating level within a further 5 sec.

3.5.6 The depth versus flow test is conducted by adjusting the throttle valve to achieve a stable water depth on the catchment surface at a given flow. Slowly increase the flow rate until the drain reaches maximum capacity. This will be seen when no air passes through the clear section of tube and water depth begins to rise quickly. The depth where air is excluded will be the water depth at prime. Reduce the flow rate until the water depth stabilizes. This will be the maximum flow rate for the drain. This depth shall be recorded within an accuracy of ± 0.12 in. (± 3 mm) for flow rates ranging from minimum flow to achieve full-bore conditions up to the maximum intended flow capacity. Repeat the flow

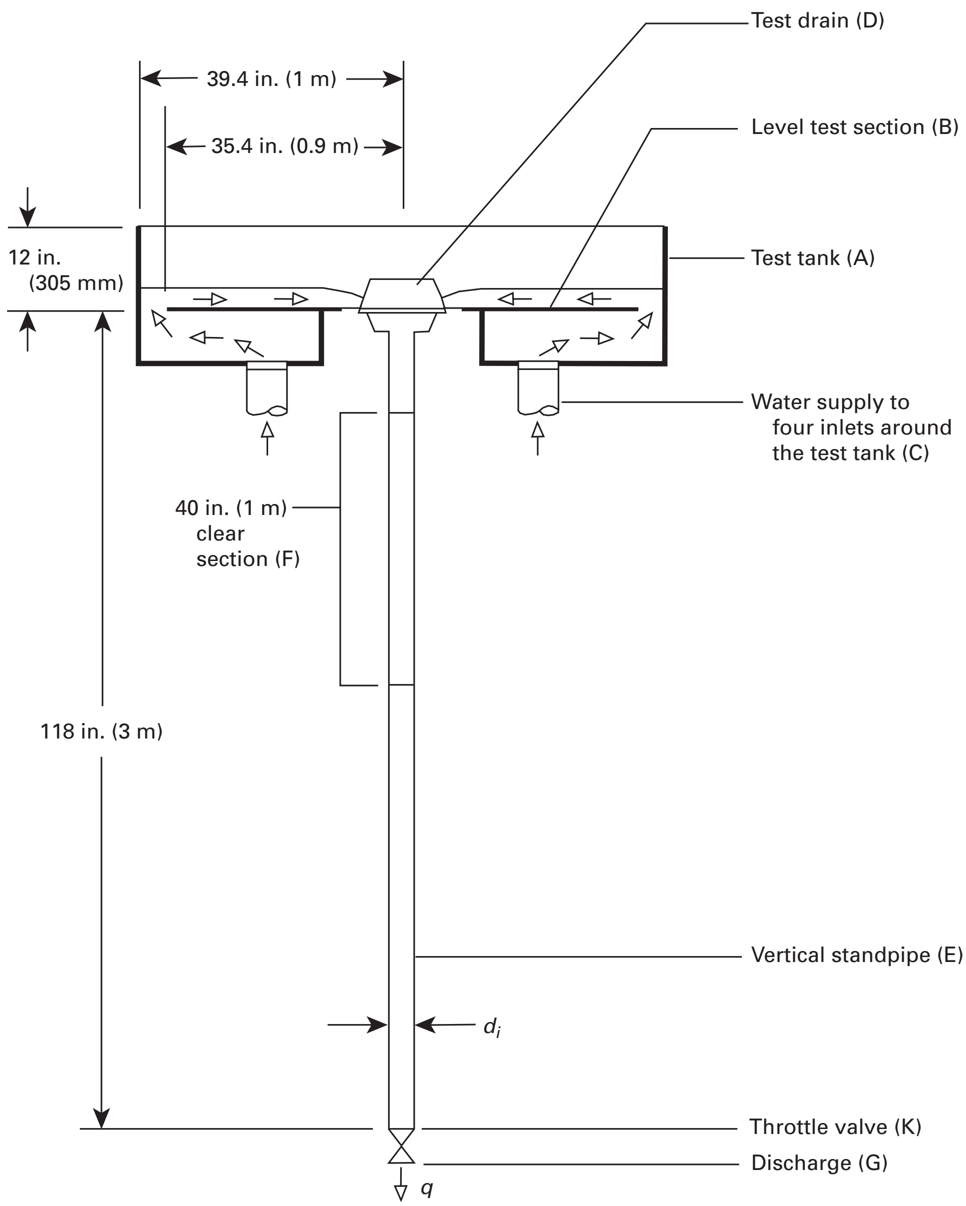

Fig. 2 Depth Versus Flow Apparatus

test several times at varying valve positions to document depth versus flow for the drain over this range.

4 ACCESSORIES

Drain accessories offered by the manufacturer shall comply with para. 6 of ASME A112.6.4

5 MARKINGS

(a) The dome, bodies, and baffle plates shall be marked with the manufacturer's name or trademark.

(b) The baffle plate and drain body shall be marked with the baffle plate model number, resistance value, *K*, and words, "REPLACE MISSING BAFFLE WITH MODEL_____."

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