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An American National Standard

Standard Specification for Design and Installation of Plastic Syphonic Roof Drainage Systems¹

This standard is issued under the fixed designation F 2021; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification² covers requirements for plastic syphonic roof drain systems for industrial, commercial, public, and residential buildings. Requirements for materials, pipe, and fittings are included.

1.2 The interchangeability of pipe and fittings made by different manufacturers is not addressed in this specification. Transition fittings for joining pipe and fittings of different manufacturers is provided for in the referenced pipe and fitting specification.

1.3 In referee decisions, the SI units shall be used for metric-sized pipe and inch-pound units for pipe sized in the IPS system (ANSI B36.10). In all cases, the values given in parentheses are for information only.

1.4 The following safety hazards caveat pertains only to the test methods, Section 7, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 1600 Terminology for Abbreviated Terms Relating to Plastics³

F 412 Terminology Relating to Plastic Piping Systems⁴

F 1901 Specification for Polyethylene (PE) Pipe and Fittings for Drain Systems⁴

2.2 ANSI/ASME Standards:

A112.21.2M Roof Drains⁵

B31.9-1996 Building Service Piping⁵

B36.10 Standard Dimensions of Steel Pipe (IPS)⁵

2.3 Federal Standard:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁶

2.4 Military Standard:

MIL-STD-129 Marking for Shipment and Storage⁶

3. Terminology

3.1 *Definitions*—Terms and abbreviations as described in Terminologies F 412 and D 1600, respectively, shall apply in this specification. General terminology pertaining to roof drains as described in ANSI/ASME A112.21.2M shall also apply in this specification.

3.2 Descriptions of Terms Specific to This Standard:

3.2.1 *closed flow, n*—a system of piping and piping components that isolate the internal fluid pressure (vacuum) from the surrounding or external atmosphere.

3.2.2 *collection area, n*—the horizontal projected roof area plus allowance for vertical walls.

3.2.3 *down spout*⁷, *n*—also referred to as *down pipe(s)*. Those pipes carrying runoff from the leaders or collecting pipes to the combined building drain or storm sewer located at or near the lowest elevation of the building.

3.2.4 *drain*⁷, *n*—any pipe which carries waste water or waterborne wastes in a building drainage system.

3.2.4.1 *drainage system*⁷, *n*—includes all the piping within public or private premises, which conveys sewage, rain water, or other liquid wastes to a legal point of disposal. It does not include the mains of public sewer treatment or disposal plants.

3.2.4.2 *leader*⁷, *n*—also called the *collector* or *collecting pipe(s)*. Any pipe(s) running laterally connecting each roof drain(s) with the down spout(s). These collecting pipes may or may not run horizontally below the plane of the roof being drained.

3.2.4.3 *roof drain*⁷, *n*—also referred to as an *outlet*. A conveyance device installed to receive water collected on the surface of a roof and to discharge it to the leader or to the down spout. Normally fitted with a strainer or screened to prevent influx of solids.

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² This specification was developed from the American Society of Plumbing Engineers Data Book, Vol I, Chapter 2, “Storm Drainage Systems” and *Engineering Manual* by R.H. Perry.

³ *Annual Book of ASTM Standards*, Vol 08.01.

⁴ *Annual Book of ASTM Standards*, Vol 08.04.

⁵ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

⁶ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Phila., PA 19111-5094, Attn: NPODS.

⁷ Reference American Society of Sanitary Engineers, *Plumbing Dictionary*, Third Edition.

3.2.4.4 *syphonic (siphonic) roof drain, n*—a roof drain with gravity-induced vacuum based on the vertical differential fluid head principle. (The height of a column of water expressed in pounds per square inch pressure or equivalent metric units.)

3.2.5 *roof cutter*⁷, *n*—any valley-shaped device to collect storm water from a roof, directing it to the roof drain.

4. System Components

4.1 Materials:

4.1.1 *General*—The pressure (vacuum) ratings established under this specification are based upon materials of high quality. The manufacturer shall be prepared to certify that his product has the mechanical and chemical properties at least equal to the requirements of the specifications governing the material selected.

4.1.2 *Piping*—Polyethylene piping systems shall meet the requirements of Specification F 1901 and shall be tested and rated for the maximum negative pressure.

4.1.3 *Other Piping Materials*—Materials other than those described in 4.1.2 that meet the requirements of this specification shall be permitted to be used.

4.2 Syphonic Roof Drains:

4.2.1 *General*—Any water collection device that provides a sump (trough) and is designed to produce a vacuum or closed flow in the drainage pipe. The closed flow is a necessary feature and differentiates the syphonic roof drain from the general purpose roof drain. Each manufacturer shall rate their syphonic roof drain for maximum flow at specified syphonic (negative) pressures.

4.2.2 *Roof Drain Features*—Features applicable to the syphonic roof drain that are common to most roof drain designs include:

- 4.2.2.1 Drain body sump (collection trough),
- 4.2.2.2 Overflow pipe,
- 4.2.2.3 Gravel barrier (optional), and
- 4.2.2.4 Leaf or foliage guard (dome).

4.3 *Drain Piping*—The piping of a roof drain system consists of collecting pipes and down pipes leading to the storm sewer. Drain piping for a syphonic roof drain system shall meet the requirements of closed flow from roof drain to storm sewer.

5. Requirements

5.1 At the design rainfall intensity, the system installation shall ensure that the roof drain(s) eliminate the intake of air into the system. This sets up the syphonic action and maximizes the capacity of the drain system.

5.1.1 System Design and Dimensioning:

5.1.1.1 The maximum negative pressure must not be less than 20 kPa (2.9 psi) absolute [80 kPa (11.6 psi) below atmospheric] for pipes rated at a pressure of 400 kPa (58 psi) and up to 160 mm (6.3 in.) in diameter. For pipes 200 mm (7.9 in.) or more in diameter, the limiting pressures are dependent on the nominal pressure rating of the pipe. For pipes with a pressure rating of 320 kPa (46.4 psi), the limiting pressure is 40

kPa (5.8 psi) absolute [60 kPa (8.7 psi) below atmospheric]. For pipes with a pressure rating of 400 kPa, the limiting pressure is 20 kPa absolute below atmospheric].

5.1.1.2 Minimum design water velocity under peak load condition shall be 1.0 m/s (3.3 ft/s).

5.1.1.3 Computed flow from an individual roof drain must be within 10 % of the normal required flow and must not exceed the manufacturer's specified maximum for each roof drain size.

NOTE 1—*Computed Flow*—For some manufacturers, this computation is based on two-phase modeling of the flow conditions, incorporating standard hydraulic principles and verified by testing. Consult with the manufacturer's technical data sheet for appropriate piping sizes and maximum permitted flow recommendations for each roof drain size.

NOTE 2—The system shall be designed to meet requirements of local building and plumbing jurisdictions for secondary or emergency roof drainage and for structural loading at maximum ponding of water that can occur with blockage of the primary syphonic drain system

5.1.2 Roof/Gutter Design:

5.1.2.1 The roof must be designed to allow rainwater to flow freely to the roof drain(s).

NOTE 3—Roof drains being utilized at their maximum flow capacity should have water retention at each roof drain or in the adjacent gutter no greater than 40 mm (1.57 in.).

5.1.2.2 When used in long valley gutters, only roof drains of 6-L/s (95-gal/min) capacity shall be used.

5.1.2.3 The roof or gutter design, or both, shall incorporate a built-in overflow facility and shall be designed to hold water up to this level should the design rainfall be exceeded or unexpected blockages occur.

5.1.3 Performance of Joints:

5.1.3.1 The pipe joints shall be watertight under conditions of pressure and thermal movement expected to occur in the installation.

5.1.3.2 The joint between each roof drain and the roof material shall be made watertight using conventional joining techniques specified for the materials selected.

5.1.4 Flow Characteristics:

5.1.4.1 When the system is operating syphonically, the high velocity of the water will ensure the system is self-cleansing. This effect can also occur at rainfall intensity of up to 50 % of the design intensity.

5.1.4.2 At rainfall intensities less than those in 5.1.4.1, the syphonic roof drain system will operate as a conventional system.

6. System Calculations

6.1 Roof Drainage Area:

6.1.1 The storm drainage system for a simple building is shown in Fig. 1 and Fig. 2. The collection area is the projected area of a horizontal (flat) roof as shown in Fig. 3.

6.1.2 The collection area, where there is an adjacent wall, is based on a horizontal collection area plus 50 % of the adjacent wall areas (see Fig. 4).

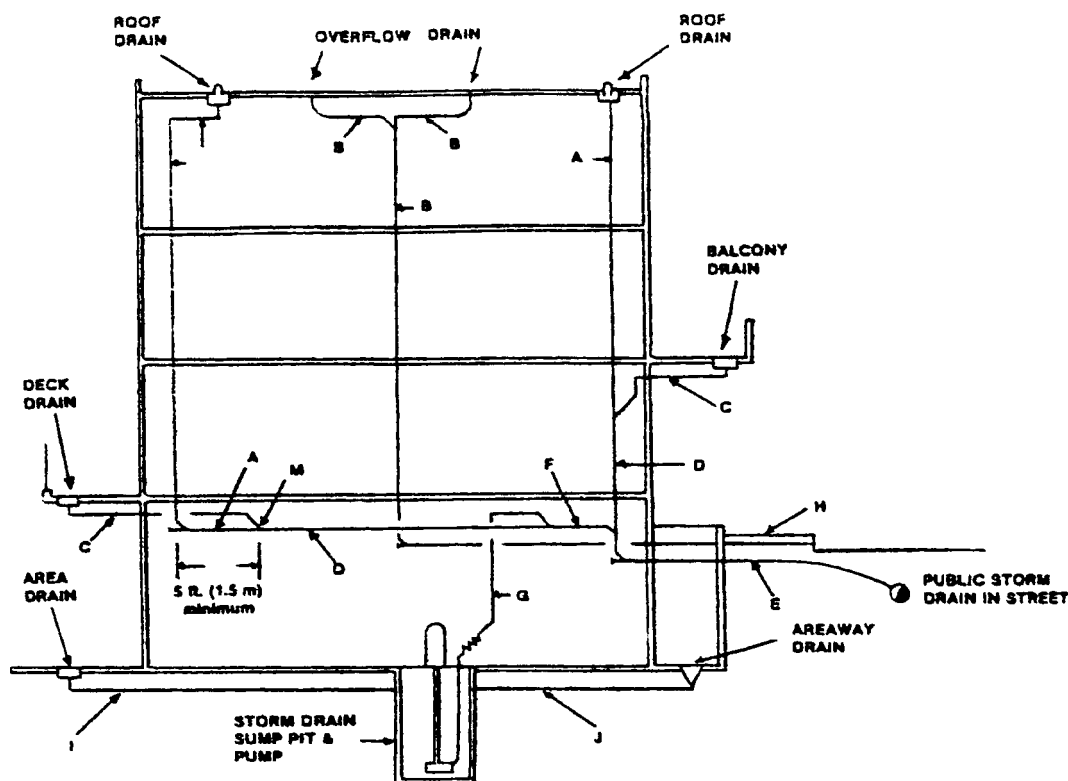


FIG. 1 Elevation Example

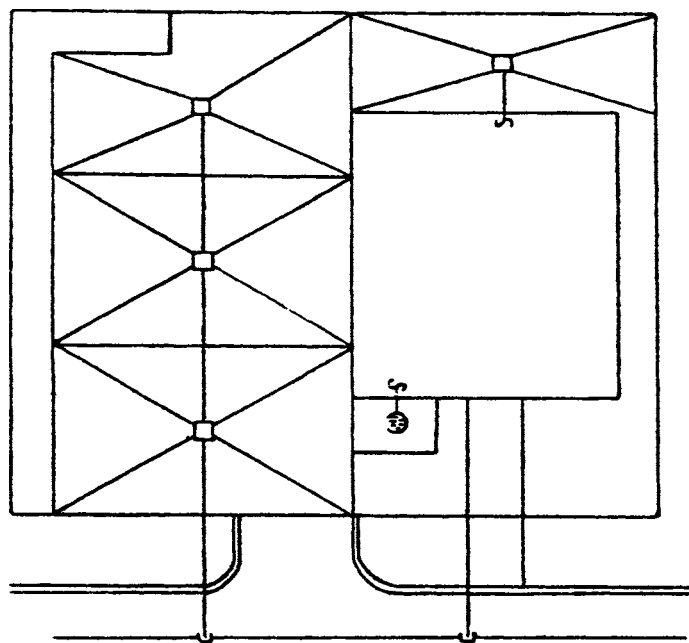


FIG. 2 Plan View Example

6.1.3 *Alternate*—Instead of sizing the storm drainage system on the basis of the actual maximum projected roof area, the roof drainage system (or part of it) shall be sized on the equivalent or adjusted projected roof areas which result from the controlled flow and the storage of storm water on the roof, provided that flow control devices, acceptable to the administrative authority, are used and appropriate roof design details are incorporated into the finished roof. Also, the water of a

25-year frequency storm shall not be stored on the roof for more than 17 h and the water depth on the roof shall not exceed 76.2 mm (3 in.) during the storm. The control device shall be installed so that the rate of discharge of the water shall not exceed the rate allowed, using the values for continued flow of 2.2 mm² (23 ft²) of roof area, based upon a rate of rainfall of 1.7 mm/min (4 in./h), as equivalent of 0.063 L/s (1 gal/min). The roof design for controlled flow roof drainage shall be