

# CHAPTER 11

## STORM DRAINAGE

### 1101.0 General.

**1101.1 Where Required.** Roofs, paved areas, yards, courts, courtyards, vent shafts, light wells, or similar areas having rainwater, shall be drained into a separate storm sewer system, or into a combined sewer system where a separate storm sewer system is not available, or to some other place of disposal satisfactory to the Authority Having Jurisdiction. In no case shall water from roofs or any building roof drainage flow onto the public sidewalk. In the case of one- and two-family dwellings, storm water shall be permitted to be discharged on flat areas, such as streets or lawns, so long as the storm water shall flow away from the building and away from adjoining property, and shall not create a nuisance.

**1101.2 Storm Water Drainage to Sanitary Sewer Prohibited.** Storm water shall not be drained into sewers intended for sanitary drainage unless approved by the municipal sewer authority or stated elsewhere in this code.

**1101.3 Material Uses.** Rainwater piping placed within the interior of a building or run within a vent or shaft shall be of cast-iron, galvanized steel, wrought iron, brass, copper, lead, Schedule 40 ABS DWV, Schedule 40 PVC DWV, stainless steel 304 or 316L [stainless steel 304 pipe and fittings shall not be installed underground and shall be kept not less than 6 inches (152 mm) aboveground], or other approved materials. Changes in direction shall be in accordance with Section 706.0. ABS and PVC DWV piping installations shall be installed in accordance with IS 5 and IS 9.

**1101.4 Expansion Joints Required.** Expansion joints or sleeves shall be provided where warranted by temperature variations or physical conditions.

**1101.5 Subsoil Drains.** Subsoil drains shall be provided around the perimeter of buildings having basements, cellars, crawl spaces, or floors below grade. Such subsoil drains shall be permitted to be positioned inside or outside of the footing, shall be of perforated or open-jointed approved drain tile or pipe, not less than 3 inches (80 mm) in diameter, and shall be laid in gravel, slag, crushed rock, approved  $\frac{3}{4}$  of an inch (19.1 mm) crushed, recycled glass aggregate, or other approved porous material with not less than 4 inches (102 mm) surrounding the pipe. Filter media shall be provided for exterior subsoil piping.

**1101.5.1 Discharge.** Subsoil drains shall be piped to a storm drain, to an approved water course, to the front street curb or gutter, to an alley, or the discharge from the subsoil drains shall be conveyed to the alley by a concrete gutter. Where a continuously flowing spring or groundwater is encountered, subsoil drains shall be piped to a storm drain or an approved water course.

**1101.5.2 Sump.** Where it is not possible to convey

the drainage by gravity, subsoil drains shall discharge to an accessible sump provided with an approved automatic electric pump. The sump shall be not less than 15 inches (381 mm) in diameter, 18 inches (457 mm) in depth, and provided with a fitted cover. The sump pump shall have an adequate capacity to discharge water coming into the sump as it accumulates to the required discharge point, and the capacity of the pump shall be not less than 15 gallons per minute (gpm) (0.95 L/s). The discharge piping from the sump pump shall be not less than 1½ inches (40 mm) in diameter and have a union or other approved quick-disconnect assembly to make the pump accessible for servicing.

**1101.5.3 Splash Blocks.** For separate dwellings not serving continuously flowing springs or groundwater, the sump discharge pipe shall be permitted to discharge onto a concrete splash block with a minimum length of 24 inches (610 mm). This pipe shall be within 4 inches (102 mm) of the splash block and positioned to direct the flow parallel to the recessed line of the splash block.

**1101.5.4 Backflow Protection.** Subsoil drains subject to backflow where discharging into a storm drain shall be provided with a backwater valve in the drain line so located as to be accessible for inspection and maintenance.

**1101.5.5 Open Area.** Nothing in Section 1101.5 shall prevent drains that serve either subsoil drains or areaways of a detached building from discharging to a properly graded open area, provided that:

- (1) They do not serve continuously flowing springs or groundwater.
- (2) The point of discharge is not less than 10 feet (3048 mm) from a property line.
- (3) It is impracticable to discharge such drains to a storm drain, to an approved water course, to the front street curb or gutter, or to an alley.

**1101.6 Building Subdrains.** Building subdrains located below the public sewer level shall discharge into a sump or receiving tank, the contents of which shall be automatically lifted and discharged into the drainage system as required for building sumps.

**1101.7 Areaway Drains.** Open subsurface space adjacent to a building, serving as an entrance to the basement or cellar of a building, shall be provided with a drain or drains. Such areaway drains shall be not less than 2 inches (50 mm) in diameter for areaways at a maximum of 100 square feet (9.29 m<sup>2</sup>) in area, and shall be discharged in the manner provided for subsoil drains not serving continuously flowing springs or groundwater (see Section 1101.5.1). Areaways in excess of 100 square feet (9.29 m<sup>2</sup>) shall not drain into subsoil drains. Areaway drains for

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areaways exceeding 100 square feet (9.29 m<sup>2</sup>) shall be sized in accordance with Table 1101.7.

**1101.8 Window Areaway Drains.** Window areaways at a maximum of 10 square feet (0.93 m<sup>2</sup>) in area shall be permitted to discharge to the subsoil drains through a 2 inch (50 mm) pipe. However, window areaways exceeding 10 square feet (0.93 m<sup>2</sup>) in area shall be handled in the manner provided for entrance areaways (see Section 1101.7).

**1101.9 Filling Stations and Motor Vehicle Washing Establishments.** Public filling stations and motor vehicle washing establishments shall have the paved area sloped toward sumps or gratings within the property lines. Curbs not less than 6 inches (152 mm) high shall be placed where required to direct water to gratings or sumps.

**1101.10 Paved Areas.** Where the occupant creates surface water drainage, the sumps, gratings, or floor drains shall be piped to a storm drain or an approved water course.

### 1101.11 Roof Drainage.

**1101.11.1 Primary Roof Drainage.** When roof areas of a building are drained by roof drains, the location and sizing of the drains shall be coordinated with the structural design and pitch of the roof in accordance with Section 1106 or as permitted elsewhere in this code. The roof drainage system shall be sized on a basis of a rate of rainfall of at a minimum 4 inches per hour.

**1101.11.2 Secondary Drainage.** Secondary (emergency) roof drainage shall be provided in accordance with Minnesota Rules, chapter 1305.

**1101.12 Cleanouts.** Cleanouts for building storm drains shall comply with the requirements of Section 719.0 of this code.

**1101.12.1 Rain Leaders and Conductors.** Rain leaders and conductors connected to a building storm sewer shall have a cleanout installed at the base of the outside leader or outside conductor before it connects to the horizontal drain.

**1101.13 Rainwater Sumps.** Rainwater sumps serving "public use" occupancy buildings shall be provided with dual pumps arranged to function alternately in case of overload or mechanical failure.

### 1102.0 Materials.

**1102.1 Conductors.** Conductors installed aboveground in buildings shall be in accordance with the applicable standards referenced in Table 701.1 for aboveground drain, waste, and vent pipe.

**1102.1.1 Inside of Conductors.** The inside of conductors installed aboveground level shall be of seamless copper water tube, Type K, L, or M; Schedule 40 copper pipe or Schedule 40 copper alloy pipe; Type DWV copper drainage tube; service weight cast-iron soil pipe or hubless cast-iron soil pipe; standard weight galvanized steel pipe; stainless steel 304 or 316L [stainless steel 304 pipe and fittings shall not be

installed underground and shall be kept not less than 6 inches (152 mm) aboveground]; or Schedule 40 ABS or Schedule 40 PVC plastic pipe.

**1102.2 Leaders.** Leaders installed outside shall be in accordance with the applicable standards referenced in Table 701.1 for aboveground drain, waste, and vent pipe; aluminum sheet metal; galvanized steel sheet metal; or copper sheet metal.

**1102.3 Underground Building Storm Drains.** Underground building storm drains shall comply with the applicable standards referenced in Table 701.1 for underground drain, waste, and vent pipe.

**1102.4 Building Storm Sewers.** Building storm sewers shall comply with the applicable standards referenced in Table 701.1 for building sewer pipe.

**1102.5 Subsoil Drains.** Subsoil drains shall be open jointed, perforated, or both and constructed of materials in accordance with Table 1102.5.

TABLE 1102.5  
MATERIALS FOR SUBSOIL DRAIN PIPE AND FITTINGS

MATERIAL	REFERENCED STANDARD(S)
Asbestos Cement	ASTM C 444, ASTM C 508 ASTM C 966
PE	ASTM F 405
PVC	ASTM D 2729
Vitrified Clay (Extra strength)	ASTM C 4, ASTM C 700

### 1103.0 Traps on Storm Drains and Leaders.

**1103.1 Where Required.** Leaders and storm drains, where connected to a combined sewer, shall be trapped. Floor and area drains connected to a storm drain shall be trapped.

**Exception:** Traps shall not be required where roof drains, rain leaders, and other inlets are at locations allowed under Section 906.0, Vent Termination.

**1103.2 Where Not Required.** No trap shall be required for leaders or conductors that are connected to a sewer carrying storm water exclusively.

**1103.3 Trap Size.** Traps, where installed for individual conductors, shall be the same size as the horizontal drain to which they are connected.

**1103.4 Method of Installation of Combined Sewer.** Individual storm-water traps shall be installed on the storm-water drain branch serving each storm-water inlet, or a single trap shall be installed in the main storm drain just before its connection with the combined building sewer. Such traps shall be provided with an accessible cleanout on the outlet side of the trap.

### 1104.0 Leaders, Conductors, and Connections.

**1104.1 Improper Use.** Leaders or conductors shall not be used as soil, waste, or vent pipes nor shall soil, waste, or vent pipes be used as leaders or conductors.

**1104.2 Protection of Leaders.** Leaders installed along alleyways, driveways, or other locations where exposed to damage shall be protected by metal guards, recessed into the wall, or constructed from ferrous pipe.

**1104.3 Combining Storm with Sanitary Drainage.** The sanitary and storm drainage system of a building shall be entirely separate, except where a combined sewer is used, in which case the building storm drain shall be connected in the same horizontal plane through a single wye fitting to the combined building sewer not less than 10 feet (3048 mm) downstream from a soil stack.

#### 1105.0 Roof Drains.

**1105.1 Materials.** Requirements for roof drain materials shall comply with Section 1105.1.1 and Section 1105.1.2.

**1105.1.1 Lead.** Roof drains shall be constructed of materials in accordance with Table 1401.1.

**1105.1.2 Copper.** Roof drains shall be of cast-iron, copper or copper alloy, lead, or plastic.

**1105.2 Dome or Strainer for General Use.** Roof drains and overflow drains, except those draining to hanging gutters, shall be equipped with strainers extending not less than 4 inches (102 mm) above the surface of the roof immediately adjacent to the drain. Strainers shall have a minimum inlet area above the roof level not less than one and one-half times the area of the conductor or leader to which the drain is connected.

**1105.3 Strainers for Flat Decks.** Roof drain strainers for use on sun decks, parking decks, and similar areas that are normally serviced and maintained, shall be permitted to be of the flat surface type. Such roof drain strainers shall be level with the deck and shall have an available inlet area of not less than two times the area of the conductor or leader to which the drain is connected.

**1105.4 Roof Drain Flashings.** Connection between the roof and roof drains that pass through the roof and into the interior of the building shall be made watertight by the use of proper flashing material.

**1105.4.1 Lead Flashing.** Where lead flashing material is used, it shall be not less than 4 pounds per square foot (lb/ft<sup>2</sup>) (19 kg/m<sup>2</sup>).

**1105.4.2 Copper Flashing.** Where copper flashing material is used, it shall be not less than 12 ounces per square foot (oz/ft<sup>2</sup>) (3.7 kg/m<sup>2</sup>).

#### 1106.0 Size of Leaders, Conductors, and Storm Drains.

**1106.1 Vertical Conductors and Leaders.** Vertical conductors and leaders shall be sized on the basis of the maximum projected roof area and Table 1101.11.

**1106.2 Size of Horizontal Storm Drains and Sewers.** The size of building storm drains or building storm sewers or their horizontal branches shall be based upon the maximum projected roof or paved area to be handled and Table 1101.7.

**1106.3 Reduction in Size Prohibited.** Except for siphonic roof drainage systems, storm drain piping shall not reduce in size in the direction of flow, including changes in direction from horizontal to vertical.

**1106.4 Side Walls Draining onto a Roof.** Where vertical walls project above a roof so as to permit storm water to drain to the roof area below, the adjacent roof area shall be permitted to be computed from Table 1101.11 as follows:

- (1) For one wall – add 50 percent of the wall area to the roof area figures.
- (2) For two adjacent walls of equal height – add 35 percent of the total wall areas.
- (3) For two adjacent walls of unequal height – add 35 percent of the total common height and add 50 percent of the remaining height of the highest wall.
- (4) Two opposite walls of same height – add no additional area.
- (5) Two opposite walls of differing heights – add 50 percent of the wall area above the top of lower wall.
- (6) Walls on three sides – add 50 percent of the area of the inner wall below the top of the lowest wall, plus allowance for the area of the wall above the top of the lowest wall, in accordance with Section 1106.4(3) and Section 1106.4(5) above.
- (7) Walls on four sides – no allowance for wall areas below the top of the lowest wall – add for areas above the top of the lowest wall in accordance with Section 1106.4(1), Section 1106.4(3), Section 1106.4(5), and Section 1106.4(6) above.

#### 1107.0 Values for Continuous Flow.

**1107.1 General.** Where there is a continuous or semi-continuous discharge into the building storm drain or building storm sewer, as from a pump, ejector, air-conditioning plant, or similar device, 1 gpm (0.06 L/s) of such discharge shall be computed as being equivalent to 24 square feet (2.2 m<sup>2</sup>) of roof area, based upon a rate of rainfall of 4 inches per hour (in/h) (102 mm/h).

#### 1108.0 Controlled-Flow Roof Drainage.

**1108.1 Application.** The controlled-flow roof drainage system shall be sized on the basis of controlled flow and storage of the storm water on the roof, provided the design is based on a minimum of 4 inches per hour and the following conditions are met:

- (1) The water from a 25 year-frequency storm shall not be stored on the roof for more than 24 hours.
- (2) During the storm, the water depth on the roof shall not exceed the depths specified in Table 1108.1(2).
- (3) Not less than two drains shall be installed in roof areas of 10 000 square feet (929 m<sup>2</sup>) or less, and not less than one additional drain shall be installed for each additional 10 000 square feet (929 m<sup>2</sup>) or less of roof area.

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- (4) Each roof drain shall have a precalibrated, fixed (nonadjustable), and proportional weir (notched) in a standing water collar inside the strainer. No mechanical devices or valves shall be allowed.
- (5) Pipe sizing shall be based on the pre-calibrated rate of flow (gpm) (L/s) of the precalibrated weir for the maximum allowable water depth, and Table 1101.7 and Table 1101.11.
- (6) The height of stones or other granular material above the waterproofed surface shall not be considered in water depth measurement, and the roof surface in the vicinity of the drain shall not be recessed to create a reservoir.
- (7) Roof design, where controlled-flow roof drainage is used, shall be such that the design roof live load is not less than 40 lb/ft<sup>2</sup> (195 kg/m<sup>2</sup>).
- (8) Scuppers shall be provided in parapet walls. The distance of scupper bottoms above the roof level at the drains shall not exceed the maximum distances specified in Table 1108.1(8).
- (9) Scupper openings shall be not less than 4 inches (102 mm) high and have a width equal to the circumference of the roof drain required for the area served, sized in accordance with Table 1101.11.
- (10) Flashings shall extend above the top of the scuppers.
- (11) At a wall or parapet, 45 degree (0.79 rad) cants shall be installed.
- (12) Separate storm and sanitary drainage systems shall be provided within the building.
- (13) Calculations for the roof drainage system shall be submitted, along with the plans, to the Authority Having Jurisdiction for approval.

**1108.2 Setback Roofs.** Drains on setback roofs shall be permitted to be connected to the controlled-flow drainage systems provided:

- (1) The setback is designed for storing water, or
- (2) The square footage of the setback drainage area is converted as outlined in Section 1108.0 to gpm, and the storm-water pipe sizes in the controlled-flow system are based on the sum of the loads.
- (3) The branch from each of the roof drains that are not provided with controlled flow shall be sized in accordance with Table 1101.11.

**1109.0 Testing.**

**1109.1 Testing Required.** Building storm drainage systems that are new and parts of existing systems that have been altered, extended, or repaired shall be tested in accordance with section 712 to disclose leaks and defects except as provided in Section 1109.2. Any section of the building storm sewer that passes through contaminated soils or contaminated water must be air tested in accordance with Section 712.3.

**1109.2 Exceptions.**

**1109.2.1** Testing is not required for:

**TABLE 1108.1(2)  
CONTROLLED-FLOW MAXIMUM ROOF WATER DEPTH**

ROOF RISE* (inches)	MAXIMUM WATER DEPTH AT DRAIN (inches)
Flat	3
2	4
4	5
6	6

For SI units: 1 inch = 25.4 mm

\* Vertical measurement from the roof surface at the drain to the highest point of the roof surface served by the drain, ignoring a local depression immediately adjacent to the drain.

**TABLE 1108.1(8)  
DISTANCE OF SCUPPER BOTTOMS ABOVE ROOF**

ROOF RISE* (inches)	ABOVE ROOF LEVEL AT DRAIN (inches)
Flat	3
2	4
4	5
6	6

For SI units: 1 inch = 25.4 mm

\* Vertical measurement from the roof surface at the drain to the highest point of the roof surface served by the drain, ignoring a local depression immediately adjacent to the drain.

- (1) outside leaders;
- (2) perforated or open drain tile; or
- (3) portions of the storm drainage system and sewers that are located more than ten feet from buildings, more than ten feet from buried water lines, and more than 50 feet from water wells, and that do not pass through soil or water identified as being contaminated.

**1109.2.2** Building storm sewers shall be tested in accordance with Section 712 or the Hydrostatic Test Method from the City Engineers Association of Minnesota. The Hydrostatic Test Method, provisions E2 and E3, as specified in Standard Utilities Specifications for Watermain and Service Line Installation and Sanitary Sewer and Storm Sewer Installation, written and published by the City Engineers Association of Minnesota, 2013 edition, is incorporated by reference, is not subject to frequent change, and is available in the office of the commissioner of labor and industry.

**1110.0 Siphonic Roof Drainage System.**

**1110.1 General Requirements.** Siphonic roof drainage systems shall be designed as an engineered siphonic roof drainage system when allowed by the administrative authority. The engineered siphonic roof drainage system must meet the requirements of Sections 1110.2 and 1110.3.

**1110.2 Design Criteria.** The siphonic roof drainage system shall be designed and certified by a registered professional engineer.

**1110.2.1 Sizing.** The system shall be sized on the basis of a minimum rate of rainfall of 4 inches per hour.

**1110.2.2 Design.** The drainage system shall be designed according to ASPE Standard 45, Siphonic Roof Drainage, and according to the manufacturer's recommendations and requirements. Manufacturer design software shall be in accordance with ASPE Standard 45.

**1110.2.3 Roof Drain Bodies.** Roof drains shall meet ASME A112.6.9, Siphonic Roof Drains.

**1110.2.4 Water Accumulation.** When designed for water accumulation, the roof shall be designed for the maximum possible water accumulation according to Section 1108.1(7), as amended in this code, and Minnesota Rules, chapter 1305.

**1110.2.5 Pipe Size and Cleanouts.** Minimum pipe size shall be 1-1/2 inches. All pipe sizes and cleanouts in the drainage system shall be designed and installed according to ASPE Standard 45.

**1110.2.6 Horizontal Pipes.** Horizontal pipe size shall not reduce in the direction of flow.

**1110.2.7 Plans and Specifications.** The plans and specifications for the drainage system shall indicate the siphonic roof drainage system as an engineered method used for the design.

**1110.2.8 Markings.** The installed drainage system shall be permanently and continuously marked as a siphonic roof drainage system at approved intervals and clearly at points where piping passes through walls and floors. Roof drains shall be marked in accordance with ASME A112.6.9.

**1110.2.9 Transition Locations.** The transition locations from the siphonic roof drainage system to a gravity system shall be determined by the registered professional engineer at a location approved by the administrative authority. The design, sizing, and venting of the transition location shall be in accordance with ASPE Standard 45. The gravity portion of the building storm sewer system receiving the siphonic roof drainage system shall be sized for the design rate but not less than a rainfall rate of 4 inches per hour and in accordance with Section 1106.0.

**1110.2.10 Required Submissions.** All plans, specifications, and calculations shall be signed and sealed by the registered professional engineer and submitted to the administrative authority. The submitted calculations shall include performance data for the drainage system for the required rainfall rate, including the minimum and maximum calculated operating pressures and velocities verifying that the design solution is within the operating parameters required by

the design standard. All performance data shall be reported as the extreme maximum and minimum calculations and shall not be presented as averaged data.

**1110.3 Proof of Suitability.** Upon completion of the project: proper tests, inspections, and certification of the siphonic roof drainage system shall be performed according to items 1110.3.1 and 1110.3.2:

**1110.3.1 Testing.** Testing shall be performed according to ASPE Standard 45.

**1110.3.2 Written Certification.** Prior to the final plumbing inspection, the registered professional engineer shall provide written certification to the administrative authority that the system has been visually inspected by the registered professional engineer or the registered professional engineer's designee and the installation has been properly implemented according to the certified design, plans, calculations, and specifications. The submitted written certification shall include any field modification from the initial design involving dimensions, location, or routing of the siphonic drainage system that shall be reapproved and recertified by the registered professional engineer and be accompanied by a final as-built design of the alerted system and supported by calculated data to show that the overall system remains in accordance with ASPE Standard 45.

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**TABLE 1101.7  
SIZING OF HORIZONTAL RAINWATER PIPING<sup>1, 2</sup>**

SIZE OF PIPE	FLOW (1/8 inch per foot slope)	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)					
		1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
inches	gpm						
3	34	3288	1644	1096	822	657	548
4	78	7520	3760	2506	1880	1504	1253
5	139	13 360	6680	4453	3340	2672	2227
6	222	21 400	10 700	7133	5350	4280	3566
8	478	46 000	23 000	15 330	11 500	9200	7670
10	860	82 800	41 400	27 600	20 700	16 580	13 800
12	1384	133 200	66 600	44 400	33 300	26 650	22 200
15	2473	238 000	119 000	79 333	59 500	47 600	39 650

SIZE OF PIPE	FLOW (1/4 inch per foot slope)	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)					
		1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
inches	gpm						
3	48	4640	2320	1546	1160	928	773
4	110	10 600	5300	3533	2650	2120	1766
5	196	18 880	9440	6293	4720	3776	3146
6	314	30 200	15 100	10 066	7550	6040	5033
8	677	65 200	32 600	21 733	16 300	13 040	10 866
10	1214	116 800	58 400	38 950	29 200	23 350	19 450
12	1953	188 000	94 000	62 600	47 000	37 600	31 350
15	3491	336 000	168 000	112 000	84 000	67 250	56 000

SIZE OF PIPE	FLOW (1/2 inch per foot slope)	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)					
		1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
inches	gpm						
3	68	6576	3288	2192	1644	1310	1096
4	156	15 040	7520	5010	3760	3010	2500
5	278	26 720	13 360	8900	6680	5320	4450
6	445	42 800	21 400	14 267	10 700	8580	7140
8	956	92 000	46 000	30 650	23 000	18 400	15 320
10	1721	165 600	82 800	55 200	41 400	33 150	27 600
12	2768	266 400	133 200	88 800	66 600	53 200	44 400
15	4946	476 000	238 000	158 700	119 000	95 200	79 300

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1/8 inch per foot = 10.4 mm/m, 1 inch per hour = 25.4 mm/h, 1 square foot = 0.0929 m<sup>2</sup>

Notes:

<sup>1</sup> The sizing data for horizontal piping are based on the pipes flowing full.

<sup>2</sup> For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4 mm/h) column by the desired rainfall rate.

**TABLE 1101.11  
SIZING ROOF DRAINS, LEADERS, AND VERTICAL RAINWATER PIPING<sup>2, 3</sup>**

SIZE OF DRAIN, LEADER, OR PIPE	FLOW	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)												
		inches	gpm <sup>1</sup>	1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)	7 (in/h)	8 (in/h)	9 (in/h)	10 (in/h)	11 (in/h)
2	30		2880	1440	960	720	575	480	410	360	320	290	260	240
3	92		8800	4400	2930	2200	1760	1470	1260	1100	980	880	800	730
4	192		18 400	9200	6130	4600	3680	3070	2630	2300	2045	1840	1675	1530
5	360		34 600	17 300	11 530	8650	6920	5765	4945	4325	3845	3460	3145	2880
6	563		54 000	27 000	17 995	13 500	10 800	9000	7715	6750	6000	5400	4910	4500
8	1208		116 000	58 000	38 660	29 000	23 200	19 315	16 570	14 500	12 890	11 600	10 545	9600

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 inch per hour = 25.4 mm/h, 1 square foot = 0.0929 m<sup>2</sup>

Notes:

- <sup>1</sup> Maximum discharge capacity, gpm (L/s) with approximately 1¾ inch (44 mm) head of water at the drain.
- <sup>2</sup> For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4 mm/h) column by the desired rainfall rate.
- <sup>3</sup> Vertical piping shall be round, square, or rectangular. Square pipe shall be sized to enclose its equivalent roundpipe. Rectangular pipe shall have not less than the same cross-sectional area as its equivalent round pipe, except that the ratio of its side dimensions shall not exceed 3 to 1.



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**TABLE 1106.3  
SIZE OF GUTTERS**

DIAMETER OF GUTTER (1/16 inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
	inches	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)
3	340	226	170	136	113
4	720	480	360	288	240
5	1250	834	625	500	416
6	1920	1280	960	768	640
7	2760	1840	1380	1100	918
8	3980	2655	1990	1590	1325
10	7200	4800	3600	2880	2400

DIAMETER OF GUTTER (1/8 inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
	inches	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)
3	480	320	240	192	160
4	1020	681	510	408	340
5	1760	1172	880	704	587
6	2720	1815	1360	1085	905
7	3900	2600	1950	1560	1300
8	5600	3740	2800	2240	1870
10	10 200	6800	5100	4080	3400

DIAMETER OF GUTTER (1/4 inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
	inches	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)
3	680	454	340	272	226
4	1440	960	720	576	480
5	2500	1668	1250	1000	834
6	3840	2560	1920	1536	1280
7	5520	3680	2760	2205	1840
8	7960	5310	3980	3180	2655
10	14 400	9600	7200	5750	4800

DIAMETER OF GUTTER (1/2 inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
	inches	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)
3	960	640	480	384	320
4	2040	1360	1020	816	680
5	3540	2360	1770	1415	1180
6	5540	3695	2770	2220	1850
7	7800	5200	3900	3120	2600
8	11 200	7460	5600	4480	3730
10	20 000	13 330	10 000	8000	6660

For SI units: 1 inch = 25 mm, 1/16 inch per foot = 5.2 mm/m, 1 inch per hour = 25.4 mm/h, 1 square foot = 0.0929 m<sup>2</sup>