ROOF DRAIN
TECHNICAL DATA SECTION

DEFINITION - ORIGIN - USAGE

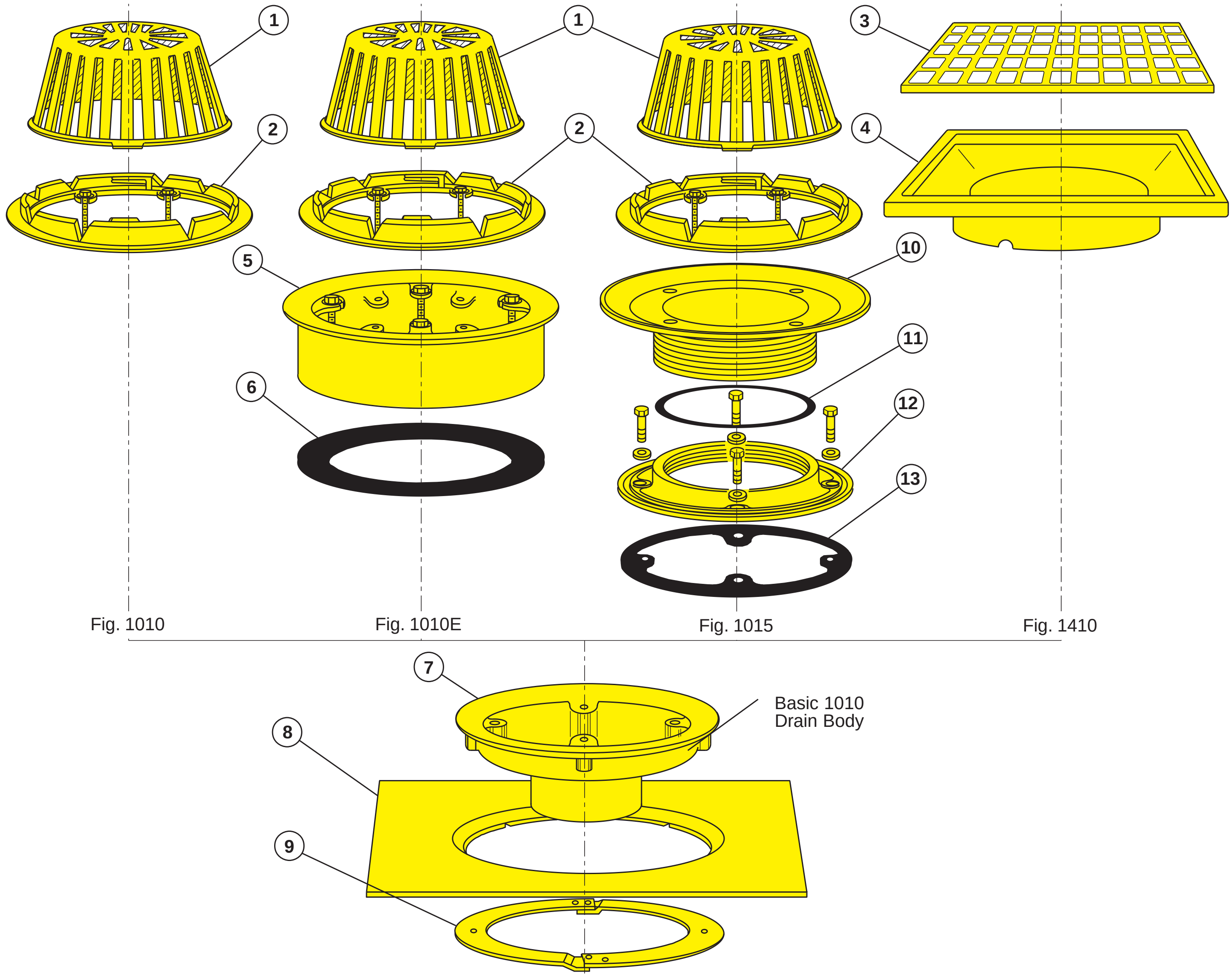
The modern roof drain is designed to drain off rainwater in the most effective manner possible while maintaining an aesthetic appeal because in many instances it is placed in full view of the public.

Through the years, Smith has attempted to satisfy both the artistic eye of the architect and the calculating mind of the engineer, concluding the properly designed roof drain must have the following features:

- Pleasing dome shape with a low profile and adequate free drainage area
- Corrosion-resisting dome material
- Effective debris protection
- Overflow drainage to allow drainage during debris build-up
- Gravel stop
- Positive Flashing Clamp
- Seepage control channels
- Sump designed to minimize air entrapment
- Flexibility to meet all construction requirements

Smith roof drains include all of these features.

TYPICAL SMITH ROOF DRAINS



ROOF DRAIN PARTS LIST

NO.	DESCRIPTION	NO.	DESCRIPTION
1	High Density Polyethylene Dome	7	Drain Body
2	Combined Cast Iron Flashing Clamp and Gravel Stop	8	Sump Receiver
3	Secured Square Hole Grate	9	Underdeck Clamp
4	Flashing Clamp for Square Grate	10	Adjustable Extension Sleeve
5	Fixed Extension	11	O-Ring Gasket
6	Fixed Extension Gasket	12	Reversible Collar
		13	Neoprene Gasket

SELECTING A ROOF DRAIN

To select the proper roof drain, the following information must be determined by the designer/specifier.

- Type of roof construction
- Roof pitch
- Maximum volume of expected rainfall and storm design criteria (This information must be obtained from your local weather bureau and/or local code authority)
- Desired rate of drainage
- Safety overflow requirements (Emergency/secondary overflow roof drains are recommended. Local codes vary but it is recommended to provide a 1 to 1 ratio)
- Roof load (The maximum possible rainwater [build-up] load should be determined and provided to the structural engineer for inclusion in the roof structure design)
- Location of drains (Consult your local code requirements)
- Size
- Vandal-proofing
- **NOTE: ALWAYS CONSULT YOUR LOCAL CODE FOR SIZING AND DESIGN CRITERIA WHEN DESIGNING THE ROOF DRAIN SYSTEM. LOCAL CODE REQUIREMENTS TAKE PRECEDENCE OVER CATALOG INFORMATION.**
- **DATA SHOWN IN TABLES 1 AND 2 BELOW ARE TAKEN FROM THE UNIFORM PLUMBING CODE (UPC) - 2006 EDITION.**

SUGGESTED STEPS FOR SELECTING PROPER ROOF DRAIN LEADER SIZES AND NUMBER REQUIRED FOR A GIVEN ROOF

	Example: Using a 4" Vertical Leader	**Example: Using a 6" Vertical Leader**
1. Calculate the total roof area.	1. Total roof area - 500' by 200' = 100,000 sq. ft.	1. Total roof area - 500' by 200' = 100,000 sq. ft.
2. Determine the maximum hourly rainfall in inches. (The figure can be acquired from your local weather bureau and/or local code authority.)	2. Determine rate of rainfall - for this example use 4".	2. Determine rate of rainfall - for this example use 4".
3. Select leader size.	3. After studying building plan and physical arrangement, assume that 4" leaders are required for this project.	3. After studying building plan and physical arrangement, assume that 6" leaders are required for this project.
4. From Table 1, determine the number of square feet that can be drained by one roof leader at the local maximum rainfall rate.	4. From Table 1 - one 4" leader at 4" rate of rainfall will take care of 3,460 sq. ft. of roof area.	4. From Table 1 - one 6" leader at 4" rate of rainfall will take care of 10,200 sq. ft. of roof area.
5. Divide the total roof area by the area that one leader will handle. The above result is the number of roof drains required for the building. If the result is a fraction less, use the next higher number.	5. Number of roof leaders required is 29 (100,000 sq. ft. divided by 3,460 sq. ft.), Therefore 29 roof drains would be required.	5. Number of roof leaders required is 10 (100,000 sq. ft. divided by 10,200 sq. ft.), Therefore 10 roof drains would be required.

TABLE 1

ROOF DRAIN VERTICAL LEADER REQUIREMENTS FOR HORIZONTAL ROOF AREAS AT VARIOUS RAINFALL RATES

Leaders [2] [4] Pipe Size Inches	Size Open Area SQ. In.	Maximum Allowable Horizontal Projected Roof Area Square Feet at Various Rainfall Rates [1]					
		1 IN./HR.	2 IN./HR.	3 IN./HR.	4 IN./HR.	5 IN./HR.	6 IN./HR.
02	3.14	2,176	1,088	725	544	435	363
03	7.06	6,440	3,220	2,147	1,610	1,288	1,073
04	12.56	13,840	6,920	4,613	3,460	2,768	2,307
05	19.60	25,120	12,560	8,373	6,280	5,024	4,187
06	28.30	40,800	20,400	13,600	10,200	8,160	6,800
08	50.25	88,000	44,000	29,333	22,000	17,600	14,667

TABLE 1 IS BASED ON TABLE 11-1 FROM THE UNIFORM PLUMBING CODE (UPC) - 2006 EDITION

[1] For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 in./hr. column by the desired rainfall rate.

TABLE 2
ALLOWABLE FLOW FOR VERTICAL LEADERS AND HORIZONTAL STORM DRAINS
ALLOWABLE FLOW IN G.P.M. [2] [3]

PIPE SIZE	[2] [4] VERTICAL LEADER	HORIZONTAL STORM DRAIN SLOPE PER FOOT		
		1/8"[3]	1/4"[3]	1/2"[3]
02	23	10	15	20
03	67	34	48	68
04	144	78	110	156
05	261	139	196	278
06	424	222	314	445
08	913	478	677	956
10	—	860	1214	1721
12	—	1384	1953	2768
15	—	2473	3491	4946

TABLE 2 IS BASED ON TABLE 11-2 FROM THE UNIFORM PLUMBING CODE (UPC) - 2006 EDITION.

[2] The sizing data for vertical conductors, leaders, and drains are based on the pipes flowing 7/24 full. Head of water over drain will determine exact flow rates.

[3] The sizing for the horizontal piping is based on the pipes flowing full.

[4] To avoid severe hydraulic jump and/or backpressure, good engineering practice requires the vertical leader transition into a larger size horizontal storm drain per the GPM flow indicated in Table 2 for 1/8" and 1/4" sloped storm drains.

STEPS FOR CALCULATING DRAINAGE REQUIREMENTS FOR ABOVE EXAMPLE USING G.P.M.

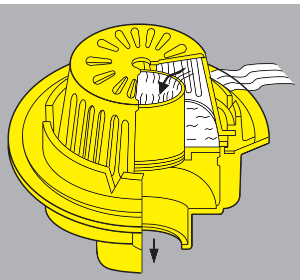
1. Use the following formula to determine G.P.M.:
   G.P.M. = .0104 x R x A
   G.P.M. = Gallons per minute
   R = Rainfall intensity - inches/hour
   A = Roof area - square feet
   .0104 = Conversion factor - G.P.M./sq. ft. for 1" (one) inch/hr. rainfall

2. **Example:**
   A. 4" rainfall inches/hr.
   B. 100,000 sq. ft. roof area
   C. G.P.M. = .0104 x 4" x 100,000 sq. ft. = 4,160 G.P.M.

3. Refer to table 2: a 4" leader [2] will handle 144 G.P.M.
   4,160 G.P.M/ ÷ 144 = (28.8) 29 - 4" vertical leaders required.

   Refer to Table 2: a 6" leader [2] will handle 424 G.P.M.
   4, 160 G.P.M. ÷ 424 = (9.8) 10 - 6" vertical leaders required.

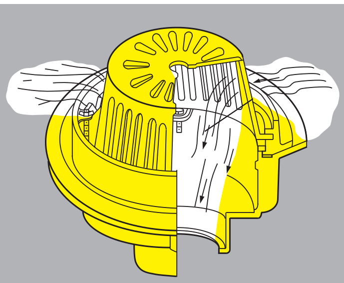
OVERFLOW DRAINS



See Pg. 1-11

Fig. 1070-Standpipe Type Overflow Drain

Overflow drains should be specified to prevent the overloading of roofs where the building code calls for a specific maximum water build-up depth. This is where parapet scuppers are not used. Parapet scuppers have fallen into some disfavor because they create unsightly streaks on the building face. Certain codes call for the overflow system to remain independent of the primary leader system to the exterior of the building. In those systems the overflow drains remain inactive until the water level reaches the overflow level.



See Pg. 1-11

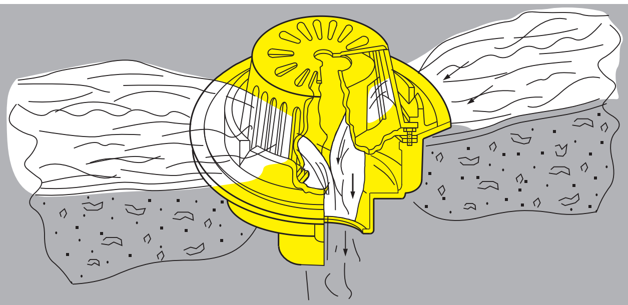
Fig. 1080-Water Dam Type Overflow Drain

The exterior water dam type overflow drain, Fig. 1080, is usually preferred to the interior standpipe overflow drain, Fig. 1070, because the dam keeps debris away from the dome and accommodates more overflow drainage with less head build-up than the standpipe.

NOTE: Fig. No. 1070 and 1080 drains are special purpose drains used in conjunction with the conventional roof drainage system. These drains should never be used unless special structural and architectural considerations have been provided.

RAINTROL® ROOF DRAIN

Metered flow rate roof drains should be specified to control rainwater run-off from roofs where uncontrolled run-off would overburden storm drainage systems. Such control, with temporary retention of rainwater on the roof until the storm abates, provides relief for the drainage system. Roofs for which metered flow drainage is planned must be structurally designed to support and retain the rainwater load during the prolonged drainage period.

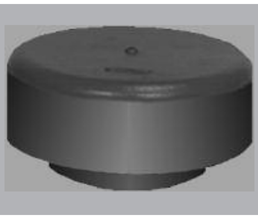


Series 1083-1089-Raintrol Roof Drain

Smith RAINTROL® metered flow rate roof drains are designed to provide this control. Sizing, quantity and location of RAINTROL® roof drains are separate and distinct procedures from those for regular roof drains.

VANDAL PROOFING

Fig. 1748
Vent Cap



See Pg. 1-18

All roof openings, whether they are at the roof drain or at the vent stack, should be protected from vandalism. It is recommended that all vent stacks be furnished with vandal proof vent caps. Vandal proof roof drain domes and vent caps protect the roof leaders and vent stacks from vandalism prohibiting foreign objects being either carelessly or maliciously placed in the pipes.

VANDAL PROOF VENT CAPS add to the finished look of any roof and are designed with a vent open area to pipe area ratio of 3 to 1.

ROOF DECK INDIRECT WASTE RECEPTORS

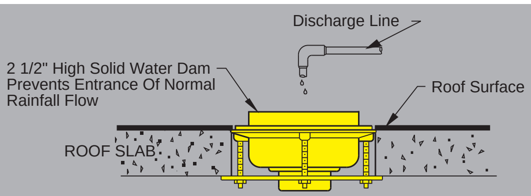


Fig. 3960 Pg. 3-22

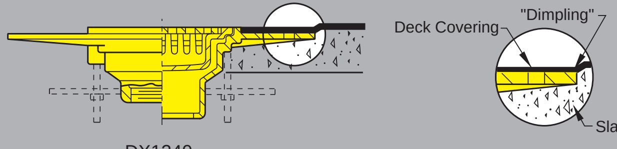
ROOF-CEPTORS® are indirect waste receptors designed specifically for roofs. These units are recommended for use in roof areas to receive wastewater from air conditioning units, cooling towers and other mechanical equipment installed on the roof. The 2 1/2" high solid water dam prevents normal rainwater from entering the waste line. The large vandal proof dome bottom strainer provides ample drainage and prevents entry of debris. All accessories necessary to install roof drains are available with these receptors.

PREFIX DX

Designates a wide flange that can be added to certain Smith roof drains. This flange receives and serves as a bonding base for the membranes and coatings of waterproof roof deck covering systems. These coverings consist of thin elastomeric coatings which are applied in a series of trowel coats. The covering forms its own membrane, flashing and durable traffic surface. The DX flange is regularly furnished 4" in width. The usual covering is approximately 3/16" thick and may be applied over many subsurfaces such as concrete, gypsum or wood decks. Such coverings are particularly adaptable to flat roofs, used for recreational purposes, balconies, area ways, plazas, sun decks, floors and corridors.

When the DX flange is required on drains other than those shown in this section, the prefix DX must be used with the figure number. The regular flange will have a minimum 4" width with a 3/16" lip at drain body. If waterproof deck covering thickness is greater (or less) than 3/16", lip dimension must be specified. Roughing dimensions of the body must be adjusted accordingly. Drain body should be set low enough to permit "dimpling" of area surrounding drain.

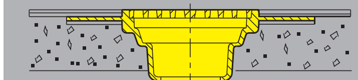
Illustrated is a typical waterproof traffic bearing deck covering installation and an example of the "dimpling" effect.



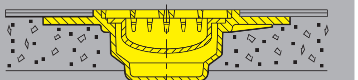
DX1240

CONCRETE DECK INSTALLATIONS

Typical Deck Drain with Nickel Bronze Flat Grate



Typical Deck Drain with Bucket and Nickel Bronze Flat Grate



NOTE: For Wood Deck Installations, See pg. 1-05.

SIPHONIC ROOF DRAIN

SMITH®
CUSTOMER DRIVEN

COMPONENTS OF A SIPHONIC ROOF DRAIN

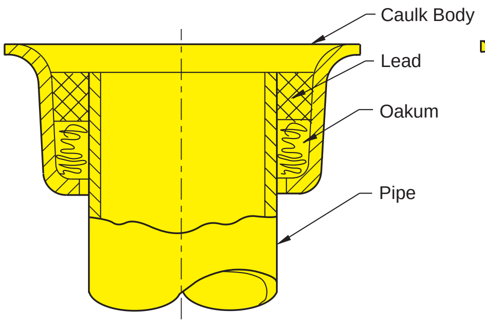
A siphonic roof drain looks much like a traditional roof drain. The distinguishing feature of a siphonic roof drain is the air baffle. This air baffle is engineered and tested to prevent air from entering the piping system at peak flows.

Other than the baffle, a siphonic roof drain has the same features as a traditional roof drain including a drain body, flashing ring, dome strainer, and fastening hardware.

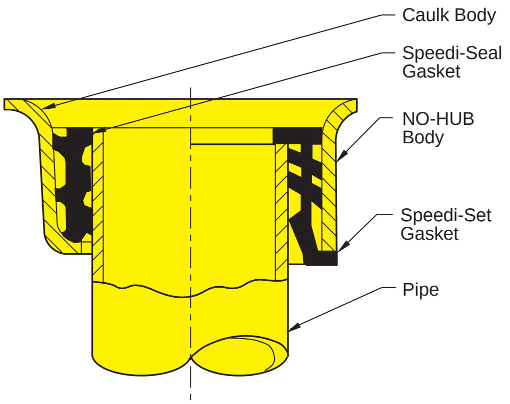
In contrast to traditional roof drains, siphonic roof drains are not designed with a large diameter or deep sump bowl because their operation is by means of sub-atmospheric pressure generated at the under side of the baffle and outlet. The depth of water maintained on the roof is dependent only on the resistance value of the drain assembly while operating under siphonic conditions. Any viscous weir effect of the drain body becomes minor and the flow is determined by simple inertial hydraulic effect of flow from a high pressure (atmospheric pressure at the roof surface) to low pressure (within the piping system).

Unlike a traditional roof drain system, a siphonic system is designed to operate with the piping completely filled with water during a rainstorm. Several drains tie into a horizontal collector that is routed to a convenient point where it transitions into a vertical stack, once it reaches the ground, is piped to a vented manhole or inspection-chamber where the water is discharged at atmospheric pressure and low velocity into the storm system.

PIPE CONNECTIONS

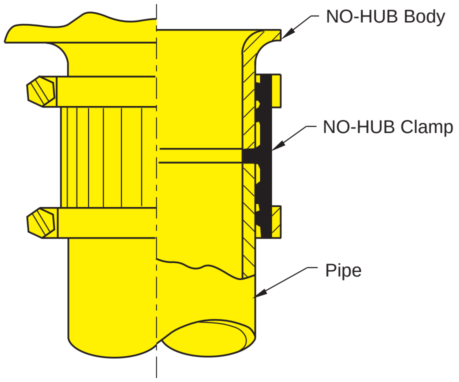


INSIDE CAULK OUTLET -C



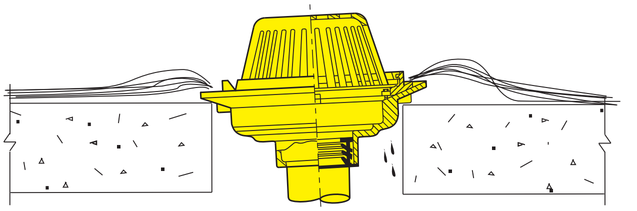
Speedi-Seal Speedi-Set -L

GASKET OUTLET

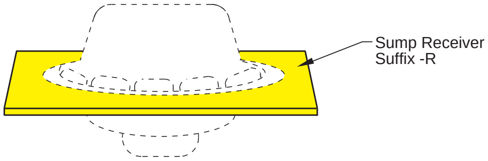


NO-HUB CONNECTION -Y

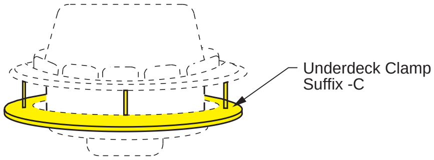
OPTIONAL VARIATIONS



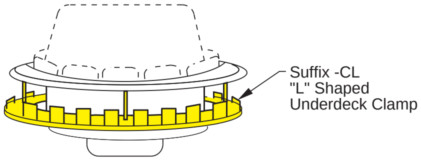
A poor installation occurs when a circular hole has been cut in the roof that ends up off center of the leader pipe. The result is usually a crooked or off-set leader. The Smith square sump receiver allows the hole to be cut oversize and square permitting the drain to be shifted and centered over the pipe. The illustration shows the probable result of not using a sump receiver. The drain body is improperly seated on the deck, causing roofing felts and other roofing materials to create a dam-like effect around the drain, resulting in a puddle in the vicinity of the drain. This problem can always be eliminated with a sump receiver.



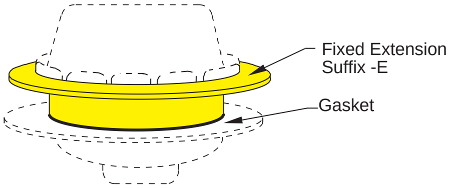
SUFFIX -R **SUMP RECEIVER** should be specified on all but poured-in-place roof drain installations. The sump receiver is a square metal plate with recessed center opening to accept the drain body flange. This eliminates the puddle of water surrounding many roof drain installations due to the flange resting on top of a circular hole cut in the roof.



SUFFIX -C **UNDERDECK CLAMP** should be specified on all but poured-in-place installations. Roof drains must be firmly secured to the roof with an underdeck clamp, otherwise, due to snow loads, rain loads and regular expansion and contraction, the drain will work in and out of the roofing, causing roofing membranes to flex and fail. Brittle tar will crack and leaks will occur.

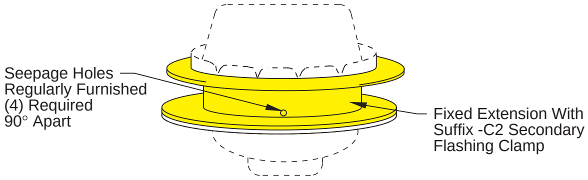


An "L" shaped underdeck clamp Suffix -CL is available for use when the regular underdeck clamp is not acceptable. Specify the "L" shaped underdeck clamp when the deck thickness is less than the minimum dimension shown for the regular underdeck clamp. This is particularly applicable for roof drain installations in metal roof decks.



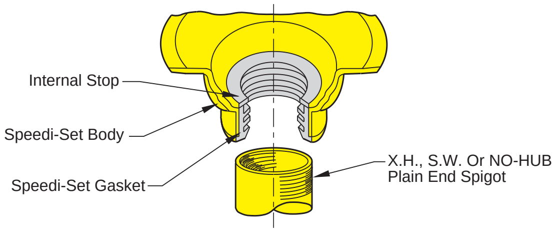
EXTENSION HEIGHT SHOULD BE SPECIFIED 1/2" LESS THAN INSULATION THICKNESS

SUFFIX -E **FIXED EXTENSION** is specified when insulation is used, it is available in any height from 3/4" (minimum). During construction, prior to installation of insulation, the extension can be removed to eliminate water build-up. The extension is sealed by gasketing. Adjustable type extensions are available. (See Fig. 1015)



SUFFIX -C2 **SECONDARY FLASHING CLAMP** is specified when an extension is required with a flashing clamp at the bottom of the extension to clamp the flashing at that location in lieu of the upper flashing clamp or it may be used to clamp a secondary flashing.

SPEEDI-SET



OUTLET TYPE L **SPEEDI-SET** connection consists of a push on outlet with a factory inserted neoprene gasket. This connection can be used with all piping materials, including service weight, extra heavy, "NO-HUB", steel and plastic. **NOTE:** Piping material must be specified.

EXPANSION JOINTS

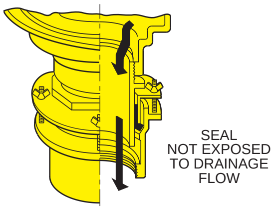
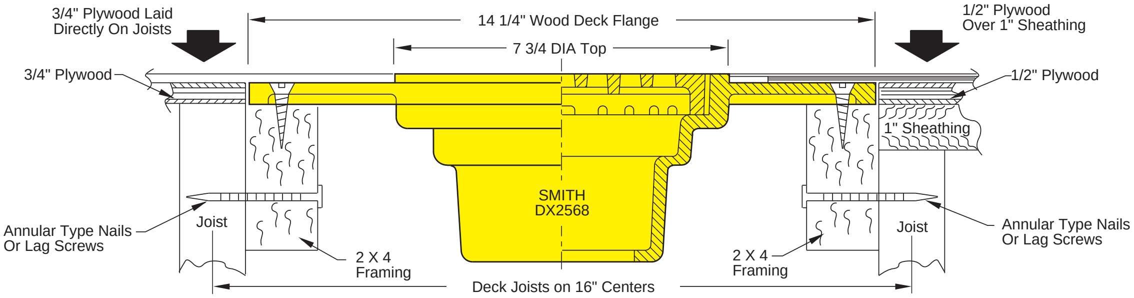


FIG. 1710 **SEPARATE EXPANSION JOINT** with internal seal not exposed to the flow drainage passing; however, provisions must be made in installation for access to the outside packing gland adjustment nuts. These units should only be used in a vertical position and with a roof drain.

NOTE: Do not use with speedi-seal and plastic leaders.

DX DRAIN IN WOOD DECK INSTALLATION



NOTE: For concrete deck installation see pg. 1-04.

CONSTRUCTION VARIATIONS

APPLICATIONS AND ACCESSORIES

Fig. 1010

Drain set in poured roof deck slab. Flashing is secured by a non-puncturing flashing clamp.

POURED CONCRETE **PRECAST DECK**

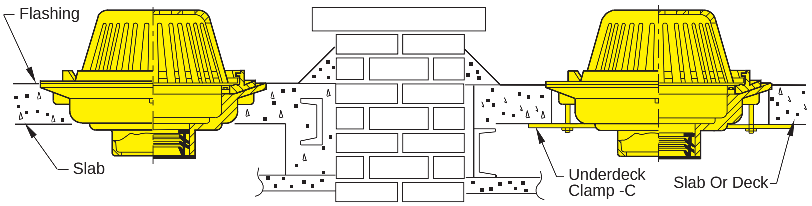


Fig. 1010 (-C**)**

Drain with underdeck clamp -C used where roof drain openings are presleeved in the slab. Underdeck clamp provides positive anchoring of the drain body. May be used in any slab or deck. **NOTE:** Drain flange rests in a recessed portion of the deck, eliminating sump receiver.

Fig. 1015 (-R-C)

Drain with adjustable extension sleeve, sump receiver -R and underdeck clamp -C. Extension sleeve adjusts for any specified thickness of insulation required above the roof slab or deck. Removal of the extension sleeve permits roof drainage during construction.

ANY INSULATED DECK **PROMENADE FINISHED DECK**

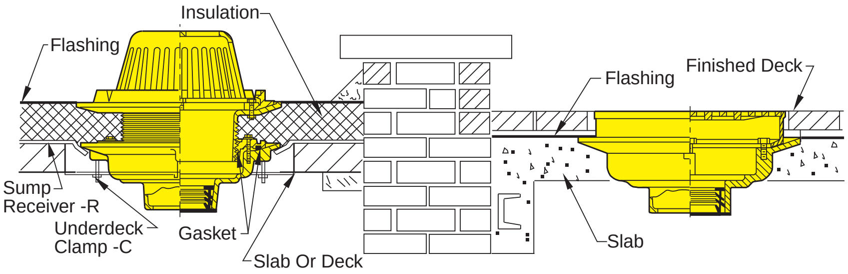
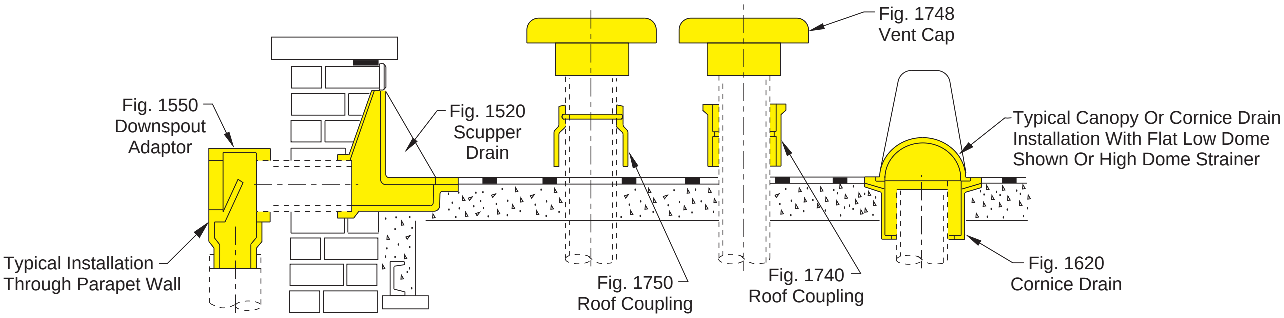


Fig. 1410

Promenade deck drain set in finished roof deck. The construction provides for waterproof flashing at the roof slab and topping of tile or any finished roof deck material.



TYPICAL ROOF COUPLING INSTALLATION WITH VANDAL PROOF VENT CAPS

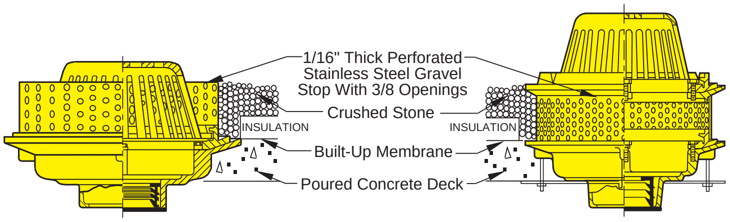


Fig. 1011 POURED CONCRETE OR GYPSUM DECK Fig. 1017

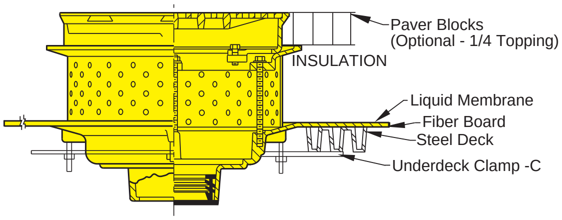


Fig. 1419

IRMA SYSTEMS (INSULATED ROOF MEMBRANE ASSEMBLY)

The "Insulated Roof Membrane Assembly" design turns conventional roofing upside down.

Conventional Roofing has the waterproof membrane (built-up felts and asphalt) as the top layer, exposed to all outside weather conditions. Insulation, when used, is installed under the membrane (directly on deck or structural slab). Thus, the membrane is continuously exposed to extremes of weather which severely test its performance and durability.

"Insulated Roof Membrane Assembly" (sometimes called "Inverted Membrane") places the waterproofing membrane directly on the structural deck. Rigid foam type insulation from 1" to 3" thick is placed over the membrane layer. A layer of crushed stone or a finished traffic deck is then installed over the insulation. The insulation, placed in this manner, insulates the building roof and also protects the membrane layer from weather and temperature extremes. Proponents state that the insulated roof membrane assembly prolongs roof life, practically eliminating membrane failures.

Some insulated membrane systems use a liquid membrane instead of the built-up felt and asphalt type membrane. Since either of these two membrane materials may be specified, Smith offers a separate body design for each type.

Drain Figure Numbers and Application--For insulated membrane systems:

Built-Up Membrane Type

Uses conventional hot asphalt and felt layers which are clamped to the drain body with our conventional roof drain flashing clamp.

Smith figure numbers are:

Roof Drain - Fig. 1011 - This is similar to the regular Fig. 1010 drain and is regularly furnished with a 4" high perforated stainless steel gravel stop. (see also Fig. 1017)

Deck Drain - Fig. 1409 - This is similar to Fig. 1410 (-E) except a secondary clamping device and extension perforated with seepage holes, are regularly furnished.

Liquid Membrane Type

A liquid membrane is a self-adhering liquid polymer which cures to a flexible rubber-like seamless blanket. This material is not clamped to the drain body, but is bonded to a wide flange drain body.

Smith figure numbers are:

Roof Drain - Fig. 1019 - Body has a 20" diameter integral bonding flange to bond the liquid membrane. Drain is regularly furnished with a 4" perforated stainless steel gravel stop. (see also Fig. 1018)

Deck Drain - Fig. 1419 - Body has a 20" diameter integral bonding flange and is regularly furnished with a perforated extension with rows of seepage holes.

RAINTROL®
ROOF DRAINS

SMITH®
CUSTOMER DRIVEN

control flow to sewers
reduce material and labor cost

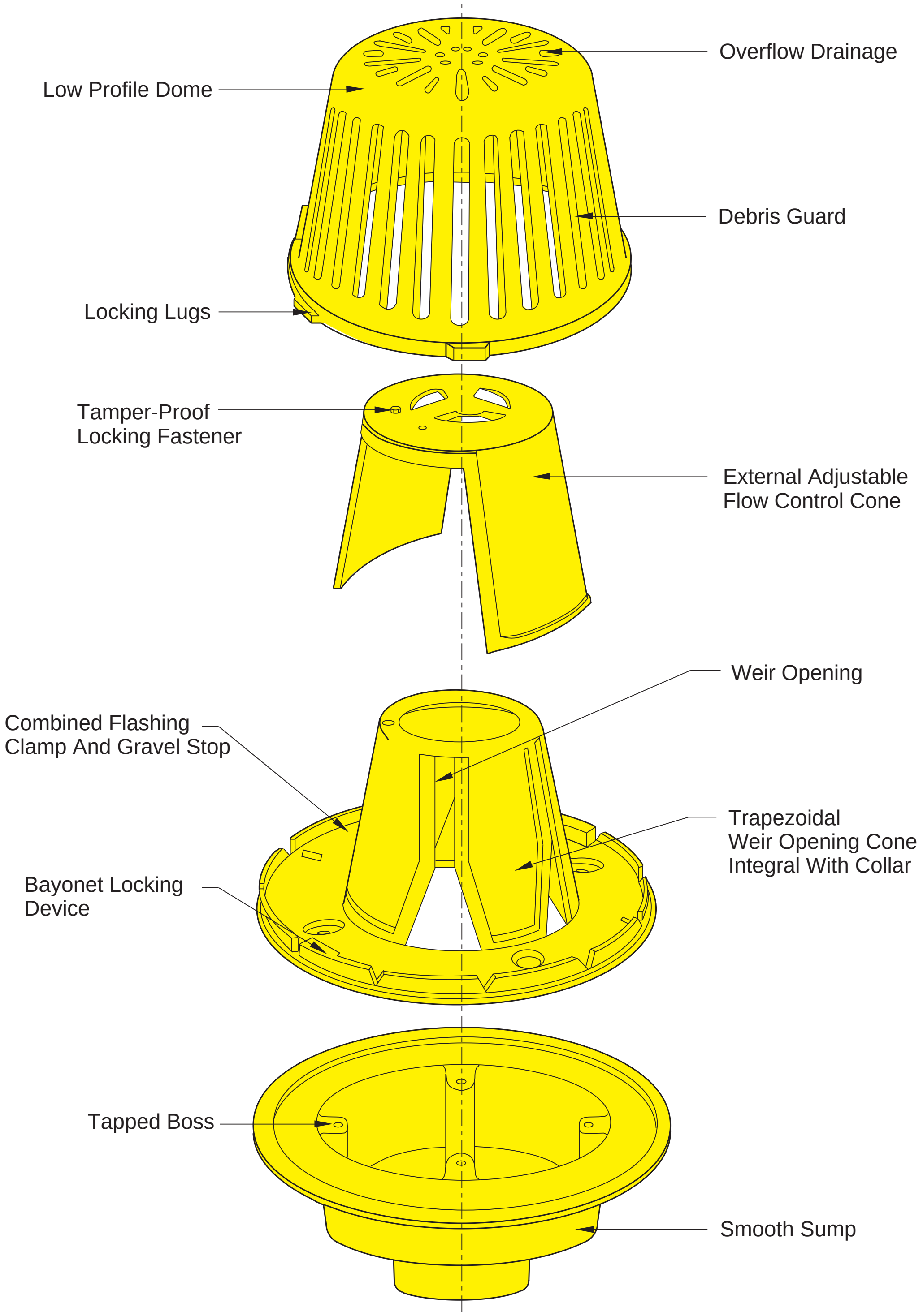


Fig. 1085

RAINTROL®
FLOW CONTROL DRAIN

The RAINTROL® roof drain was developed to offer certain advantageous features. Drains, leaders, storm sewers, etc., can be economically sized by controlling the flow of water. This will reflect in significant cost savings, both in material and labor. In addition, by controlling the drain rate, existing facilities can be utilized without overloading, thus, new construction can be undertaken and tied into the present storm drains.

To accomplish the above, the RAINTROL® drain retains water on the roof. The water is allowed to build up to a predetermined height while the excess is drained off at a known maximum rate. The amount of net build-up is a function of rainfall intensity, time, roof area and drain flow rate. Also note that the flow rate is a function of the build-up or head of water, and not the height of the weir. As an example, water at a 2" depth will flow through either the three inch high or six inch high weir at the same rate.

The area rating, flow rate and drain down time are given for various locations, consistent with the rainfall data for the localities. The data has been established for over 200 localities. Use of this data and tables will allow the engineer to lay out an efficient roof drainage system which will result in significant economies. Local codes must be observed to avoid conflict and approval problems.

THE AREA RATING IS THE MAXIMUM AREA WHICH CAN BE HANDLED BY ONE WEIR OPENING. The corresponding flow rate and drain down time are also given. Data is presented for four conditions of roof slope and four return periods. This provides data for sixteen conditions for each locality. In cases where the area rating would exceed 25,000 sq. ft., the rating is limited to 25,000 sq. ft. with a resulting lower flow rate and drain down time. Depth or build-up, the other limit upon which the table data is based, is as follows: 3" depth for flat roof, 4" for 2" rise, 5" for 4" rise and 6" for 6" rise.

DATA DERIVATIONS

The data presented is the result of extensive computer processing. Rainfall information obtained from isopluvial maps was computer matched with the flow characteristics of the weir. The results were computer plotted and tabulated in the final pages of tables.

The Weather Bureau Technical Bulletin No. 40, contains the isopluvials which provide the information for the Weiss Equations of Rainfall Intensity. This is more representative than other data available for design purposes. It also covers all areas, not just point locations. The weir equations were developed from test data. When the two equations are solved simultaneously, the area ratings in the tables are produced. Because of the methods employed, extreme accuracy was realized. Fig. 1 is an example of an isopluvial map. Cities along the same isopluvial will have similar rainfall. This allows use of the data for locations which are not listed.

100-YEAR 1-HOUR RAINFALL (INCHES)

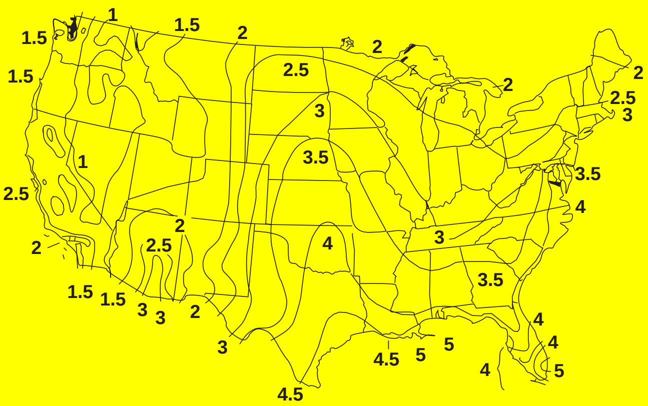
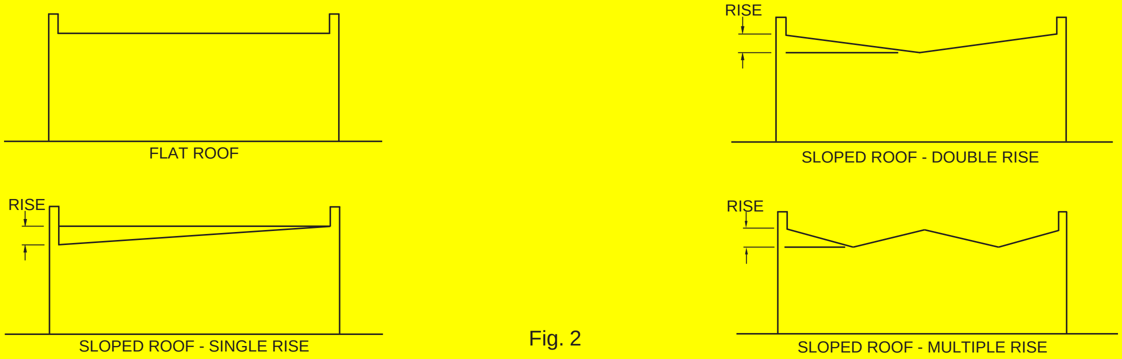


Fig. 1

ROOF TYPES

The roof to be drained may vary from flat to a slope of 6" rise. Rise is measured, vertically from the low point or valley to the high point or ridge. (Refer to Fig. 2 below.)



FLAT ROOF

SLOPED ROOF - DOUBLE RISE

SLOPED ROOF - SINGLE RISE

SLOPED ROOF - MULTIPLE RISE

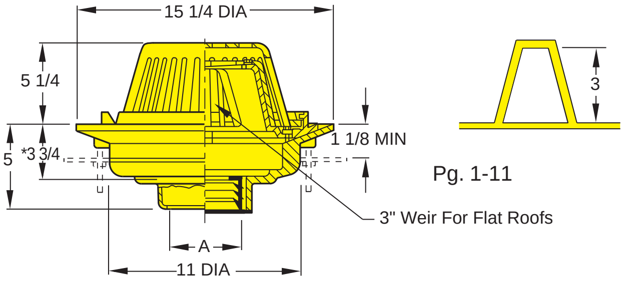
Fig. 2

RAINTROL®
SPECIFICATIONS

The RAINTROL® drain is offered in two basic designs. The three inch high weir is principally for flat roofs. Though this may be used on sloped roofs, the limited factor is the build up which can not exceed 3". The second design is the six inch weir which can be used on all roofs up to and including a sloped roof with a 6" rise.

NOTE: The roof drains are supplied in increments of weir openings. They are shipped from the factory with the correct weir openings in accordance with the specifications. However, should some requirements or conditions change, the drain can be adjusted. Vandal proof fasteners prevent unauthorized tampering with the setting.

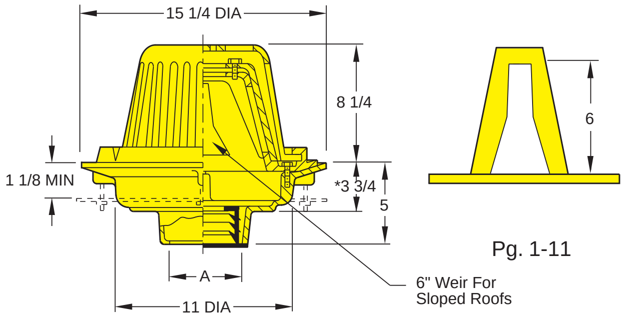
Included in this section are tables of data for a number of localities. For locations not listed, use values for similar or nearby locations. For specific conditions which require more information, contact Jay R. Smith Mfg. Co.®, Montgomery, Alabama.



FLAT ROOF TYPE

Fig. 1083 ....BOTTOM OUTLET
Fig. 1088 ....SIDE OUTLET

*This Dimension to Internal Stop of Speedi-Set Gasket.



SLOPED ROOF TYPE

Fig. 1085 ....BOTTOM OUTLET
Fig. 1089 ....SIDE OUTLET

DRAIN SYSTEMS

The engineer should lay out the roof drain system consistent with the structural design strength of the roof. Normally for a flat roof with a 30 lb. sq. ft. design load, the water depth or build-up would be limited to 3". This will keep the load down to approximately 15 lbs. per square foot. For sloped roofs, the allowed water depth can be greater, but only to the point where the stresses will be within the design limitations. This will be up to the discretion of the engineer.

The roof drainage design can be based on a number of factors. The prime consideration could be economy, using minimum leaders and storm sewers. The allowable roof load or build-up could limit the design. Or possibly, drain down time could be the limiting design criteria. In any case, knowing the maximum flow rates, which are controlled, the engineer can properly size leaders and storm sewers economically consistent with his selected design criteria.

DESIGN CONSIDERATIONS

When designing the roof drain system, the engineer must remember that the roof is being utilized as a temporary reservoir to retain some water. Flashing and waterproofing should be high enough to prevent any leakage. The engineer must also provide adequate strength for structural safety. In addition, the following considerations should be observed:

a. On all roofs, use minimum of two drains, if possible.

b. On larger roofs, use a greater number of drains as dictated by design layout.

c. Limit roof area to 25,000 sq. ft. per weir opening.

d. Recommended maximum distance from roof edge to drain is 50 ft. (flat roofs).

e. Recommended maximum distance from end of valley to drain is 50 ft. (sloped roofs).

f. Recommended maximum distance between drains is 200 ft.

g. Provide adequate flashing at parapets, openings, walls, joints, etc.

h. Limit parapet walls or provide overflow scuppers. These should be located at the anticipated maximum water depth (build-up). If located in a higher position which could result in a greater flow rate, piping must be sized accordingly.

i. Consider wind effect in locating the drains, and the number of drains.

j. Possible roof deflection due to load. This could create low spots and adversely affect drainage and/or structural safety.

These are not absolute requirements, but are suggestions to be considered. The final design is at the discretion of the design engineer and should be consistent with the roof requirements.

SPECIFYING AND SIZING

A convenient worksheet (Form No. 2052) is available for sizing and determining RAINTROL® requirements. Refer to page 19 for sample.

Specifying can be done quickly and easily.

1. Determine roof area to be drained. Each area that is bounded by expansion joints, ridges and any enclosure is considered a separate roof area.

2. Divide the roof area by the area rating from the Table of Area Ratings (Table 1) to obtain the total number of weir openings.

3. Determine the number of roof drains. This is determined by the engineer and/or roof layout, using the above design consideration as a guide.

4. Divide the number of drains into the number of weir openings to obtain the number of weir openings per drain. It is not necessary that all drains have the same number of weir openings. As an example, a roof may require eight weir openings, but only six drains. In this case, four drains could have one weir opening and two drains would have two weir openings.

NOTE: There is a minimum of one weir opening per drain.

Table 1, from which the area rating is selected, also lists the corresponding flow rate and drain down time. With this data, the engineer can select the proper leader and storm sewer to accommodate the flow (Table 3). Scupper or overflow protection must be set at the depth corresponding to the flow rate (Tables 1 and 2). This would limit the potential build-up, flow rate and roof loading. The weir height is the maximum potential build-up. If the scuppers are set at a higher level, the potential build-up would be greater. Leaders and storm sewers would have to be sized for the higher flow rates which correspond to the greater build-up. Also, a greater load might be placed on the roof. Refer to Table 3 on page 1-30 for allowable flow rates. Select leaders and storm sewers, which will accommodate the maximum potential flow.

Local codes may be the determining criteria and deviation must be approved.

TABLES

Table 1 on pages 11 thru 15 is the area rating table for one weir and contains the principal data. It is arranged in alphabetical order by states and cities. The data is divided according to roof type. Example: Flat, 2" 4" or 6" rise. Then four return periods are listed under each roof type. Each block shows three values. The top figure is the area rating, the lower left is the maximum flow rate for the particular area, and the lower right figure gives the corresponding drain down time. The drain down time is based on draining from the maximum depth to a depth of one half inch, which is the practical minimum. (Refer to Fig. 3 below).

For values not shown in Table 1, straight line interpolation will give acceptable figures. Using this table will provide practical solutions. For necessary data not listed, the factory should be contacted. The limits on which Table 1 is based are allowable build-up and maximum area. The build-up limit is 3" for flat roofs, 4" for 2" rise, 5" for 4" rise and 6" for 6" rise. The area ratings are the square foot areas that will produce the above build-ups. However, if the area rating would exceed 25,000 sq. ft., the area rating was limited to 25,000 and the corresponding maximum flow rate and drain down time recorded. The corresponding build-up can be obtained from Table 2 on page 1-30. Interpolate between values shown when intermediate values are desired.

Table 2 lists flow rates for various heads in 1 inch increments.

Table 3 lists the allowable flow rates for various pipe sizes. Rates are given for vertical leaders, and horizontal storm drains installed at three different slopes. These values are consistent with the National Plumbing Code, and values obtained using Mannings formula.

EXPLANATION OF AREA RATING TABLE 1

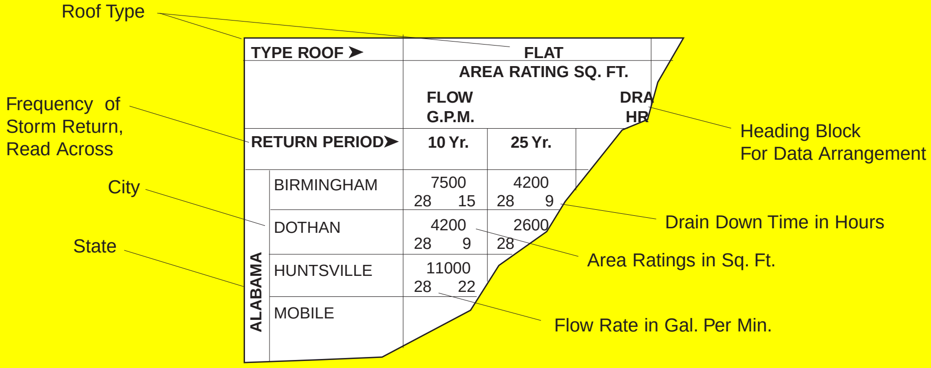


Fig. 3

AREA RATING TABLE 1

	TYPE ROOF ➤	FLAT				2" RISE				4" RISE				6" RISE			
		AREA RATING SQ. FT. FLOW G.P.M. DRAIN DOWN HRS.				AREA RATING SQ. FT. FLOW G.P.M. DRAIN DOWN HRS.				AREA RATING SQ. FT. FLOW G.P.M. DRAIN DOWN HRS.				AREA RATING SQ. FT. FLOW G.P.M. DRAIN DOWN HRS.			
	RETURN PERIOD➤	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.
ALABAMA	BIRMINGHAM	7500 28 15	4200 28 9	3000 28 6	2200 28 5	11600 39 19	6600 39 11	4600 39 7	3500 39 6	14900 49 18	8400 49 10	6000 49 7	4500 49 6	18500 60 19	10300 60 10	7300 60 7	5400 60 5
	DOTHAN	4200 28 9	2600 28 5	1900 28 4	1500 28 3	6500 39 10	4000 39 6	3000 39 5	2300 39 4	8200 49 10	5200 49 6	3900 49 5	3100 49 4	9900 60 10	6200 60 6	4700 60 5	3700 60 4
	HUNTSVILLE	11000 28 22	6000 28 12	4100 28 8	3000 28 6	17200 39 28	9400 39 15	6500 39 10	4600 39 7	22700 49 28	12100 49 15	8400 49 10	6000 49 7	25000 59 25	15300 60 15	10300 60 10	7300 60 7
	MOBILE	2500 28 5	1700 28 3	1400 28 3	1100 28 2	3800 39 6	2600 39 4	2100 39 3	1700 39 3	5000 49 6	3500 49 4	2800 49 3	2300 49 3	6000 60 6	4100 60 4	3300 60 3	2800 60 3
	MONTGOMERY	5300 28 11	3200 28 6	2400 28 5	1800 28 4	8300 39 13	4900 39 8	3600 39 6	2800 39 4	10700 49 13	6400 49 8	4700 49 6	3700 49 5	13600 60 14	7900 60 8	5700 60 6	4400 60 4
ALASKA	ANCHORAGE	25000 14 32	25000 18 38	25000 21 42	25000 23 45	25000 20 23	25000 23 27	25000 26 30	25000 29 33	25000 26 16	25000 30 19	25000 33 20	25000 35 22	25000 30 13	25000 35 15	25000 38 16	25000 42 18
	FAIRBANKS	25000 13 30	25000 16 36	25000 19 39	25000 21 43	25000 20 23	25000 23 26	25000 25 29	25000 27 31	25000 26 16	25000 30 18	25000 32 20	25000 35 22	25000 31 13	25000 35 15	25000 38 16	25000 41 17
	JUNEAU	25000 24 46	25000 28 50	19000 28 38	14500 28 29	25000 29 33	25000 34 37	25000 37 39	22100 39 36	25000 35 22	25000 40 25	25000 43 27	25000 46 29	25000 41 17	25000 46 19	25000 50 21	25000 53 22
	KETCHIKAN	10000 28 20	7700 28 16	6600 28 13	5600 28 11	15400 39 25	11700 39 19	10000 39 16	8500 39 14	21100 49 26	16000 49 19	13300 49 16	11300 49 14	25000 59 25	20900 60 21	17600 60 18	15000 60 15
ARIZ.	PHOENIX	25000 21 42	25000 26 48	20900 28 42	12300 28 25	25000 28 32	25000 33 36	25000 37 39	19500 39 31	25000 36 23	25000 41 26	25000 45 28	25000 49 30	25000 44 18	25000 50 21	25000 54 23	25000 58 24
	TUCSON	25000 22 44	25000 28 50	12400 28 25	5400 28 11	25000 30 34	25000 36 38	20400 39 33	9000 39 15	25000 39 25	25000 45 28	25000 49 30	12200 49 15	25000 48 20	25000 54 23	25000 59 25	14400 60 14
ARKANSAS	ELDORADO	5300 28 11	3100 28 6	2200 28 5	1700 28 3	8300 39 13	4700 39 8	3400 39 6	2600 39 4	10800 49 13	6200 49 8	4500 49 5	3400 49 4	13700 60 14	7500 60 8	5400 60 5	4100 60 4
	FAYETTEVILLE	6500 28 13	3500 28 7	2400 28 5	1700 28 3	10400 39 17	5500 39 9	3700 39 6	2600 39 4	13400 49 16	7300 49 9	5000 49 6	3500 49 4	17000 60 17	8800 60 9	6000 60 6	4300 60 4
	FORT SMITH	6000 28 12	3200 28 7	2200 28 5	1600 28 3	9400 39 15	5100 39 8	3500 39 6	2500 39 4	12100 49 15	6700 49 8	4600 49 6	3300 49 4	15200 60 15	8000 60 8	5600 60 6	4000 60 4
	LITTLE ROCK	7000 28 14	3900 28 8	2700 28 5	1900 28 4	11200 39 18	6000 39 10	4200 39 7	3000 39 5	14300 49 17	8000 49 10	5600 49 7	4000 49 5	18100 60 18	9600 60 10	6700 60 7	4800 60 5
CALIFORNIA	ALTURAS	25000 12 26	25000 14 31	25000 16 35	25000 18 38	25000 18 20	25000 20 24	25000 22 26	25000 24 28	25000 24 14	25000 27 17	25000 29 18	25000 31 19	25000 29 12	25000 32 13	25000 35 15	25000 37 16
	BAKERSFIELD	25000 13 29	25000 17 36	25000 20 41	25000 23 44	25000 20 23	25000 23 27	25000 26 30	25000 29 33	25000 26 16	25000 31 19	25000 34 21	25000 37 23	25000 31 13	25000 36 15	25000 40 17	25000 44 18
	EUREKA	15200 28 31	10600 28 21	8500 28 17	6900 28 14	22900 39 37	16100 39 26	12600 39 20	10200 39 16	25000 46 29	21700 49 26	17000 49 21	13600 49 16	25000 53 22	25000 58 24	22100 60 22	17900 60 18
	FRESNO	25000 12 28	25000 15 33	25000 17 37	25000 19 40	25000 19 22	25000 21 25	25000 23 27	25000 26 30	25000 25 15	25000 29 18	25000 31 19	25000 33 21	25000 30 12	25000 34 14	25000 37 15	25000 39 18
	LOS ANGELES	13700 28 28	7500 28 15	5300 28 11	4000 28 8	20600 39 33	11200 39 18	8100 39 13	6100 39 10	25000 48 30	14700 49 18	10300 49 13	7700 49 9	25000 55 23	19600 60 20	13700 60 14	10100 60 10
	NEEDLES	25000 12 28	25000 15 34	25000 18 38	25000 20 41	25000 20 23	25000 23 27	25000 25 29	25000 27 31	25000 27 16	25000 31 19	25000 33 21	25000 36 23	25000 32 14	25000 37 16	25000 40 17	25000 43 18
	RED BLUFF	25000 27 49	18300 28 37	13400 28 27	10200 28 21	25000 33 36	25000 37 39	20200 39 33	15200 39 25	25000 40 25	25000 45 28	25000 48 30	20400 49 25	25000 47 20	25000 52 22	25000 55 23	25000 59 25
	SACRAMENTO	25000 21 43	25000 26 48	23700 28 48	17100 28 35	25000 27 31	25000 32 35	25000 35 38	25000 38 40	25000 34 22	25000 39 24	25000 42 26	25000 45 28	25000 41 17	25000 46 19	25000 49 21	25000 52 22
	SAN DIEGO	25000 19 40	25000 25 47	25000 28 50	16400 28 33	25000 26 30	25000 31 34	25000 34 37	25000 38 40	25000 33 21	25000 38 24	25000 42 26	25000 46 29	25000 39 17	25000 45 19	25000 49 21	25000 54 23
	SAN FRANCISCO	25000 27 49	18200 28 37	13400 28 27	10200 28 21	25000 33 36	25000 37 39	20200 39 33	15200 39 25	25000 40 25	25000 45 28	25000 48 30	20400 49 25	25000 47 20	25000 52 22	25000 56 23	25000 59 25
	SAN JOSE	17400 28 35	9600 28 19	6900 28 14	5200 28 11	25000 38 40	14300 39 23	10300 39 17	7800 39 13	25000 45 28	19300 49 23	13600 49 17	10000 49 12	25000 52 22	25000 60 25	17800 60 18	13100 60 13
	SUSANVILLE	25000 19 39	25000 23 45	25000 26 48	23900 28 48	25000 25 29	25000 29 33	25000 32 35	25000 35 38	25000 32 20	25000 36 23	25000 39 25	25000 42 26	25000 37 16	25000 42 18	25000 46 19	25000 49 21
COLORADO	DENVER	25000 18 38	25000 22 44	25000 25 47	25000 28 50	25000 25 29	25000 29 33	25000 32 36	25000 36 38	25000 34 21	25000 38 24	25000 41 26	25000 44 28	25000 41 17	25000 46 19	25000 50 21	25000 53 22
	DURANGO	25000 17 37	25000 21 42	25000 24 46	25000 27 49	25000 24 28	25000 28 32	25000 30 34	25000 33 37	25000 31 20	25000 36 22	25000 38 24	25000 42 26	25000 38 16	25000 43 18	25000 46 20	25000 50 21
	GRAND JCT.	25000 13 29	25000 16 35	25000 18 38	25000 20 41	25000 20 23	25000 23 27	25000 25 29	25000 28 32	25000 28 17	25000 31 19	25000 34 21	25000 36 23	25000 33 14	25000 38 16	25000 41 17	25000 44 18
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CONN.	HARTFORD	19000 28 38	9800 28 20	6600 28 13	4700 28 9	25000 37 39	15600 39 25	10300 39 17	7200 39 12	25000 45 28	20500 49 25	13100 49 16	9300 49 11	25000 54 23	25000 60 25	16700 60 17	11600 60 12
	NEW HAVEN	16500 28 33	8500 28 17	5700 28 12	4100 28 8	25000 38 40	13400 39 22	9000 39 15	6300 39 10	25000 46 29	17600 49 21	11500 49 14	8100 49 10	25000 55 23	22100 60 22	14500 60 15	10000 60 1
DEL.	WILMINGTON	14400 28 29	6900 28 14	4500 28 9	3100 28 6	22700 39 37	10900 39 18	7200 39 12	4900 39 8	25000 48 30	14200 49 17	9300 49 11	6400 49 8	25000 56 24	18100 60 18	11500 60 12	7800 60 8
D.C.	WASHINGTON	9700 28 20	4100 28 8	2400 28 5	1500 28 3	16100 39 26	6400 39 10	3800 39 6	2300 39 4	21100 49 26	8500 49 10	5000 49 6	3100 49 4	25000 60 25	10600 60 11	6000 60 6	3700 60 4
FLORIDA	FT. MYERS	3500 28 7	2200 28 5	1700 28 4	1400 28 3	5400 39 9	3400 39 5	2600 39 4	2100 39 3	7000 49 8	4400 49 5	3500 49 4	2800 49 3	8600 60 9	5400 60 5	4200 60 4	3300 60 3
	GAINESVILLE	4900 28 10	2900 28 6	2100 28 4	1600 28 3	7800 39 13	4400 39 7	3200 39 5	2400 39 4	10200 49 12	5900 49 7	4300 49 5	3300 49 4	12500 60 13	7100 60 7	5200 60 5	4000 60 4
	JACKSONVILLE	3600 28 7	2200 28 4	1700 28 3	1300 28 3	5500 39 9	3400 39 6	2600 39 4	2000 39 3	7200 49 9	4500 49 5	3400 49 4	2700 49 3	8900 60 9	5500 60 6	4100 60 4	3300 60 3
	MIAMI	2000 28 4	1300 28 3	1000 28 2	800 28 2	3000 39 5	2000 39 3	1500 39 3	1200 39 2	3900 49 5	2700 49 3	2100 49 3	1700 49 2	4800 60 5	3200 60 3	2600 60 3	2100 60 2
	PENSACOLA	2200 28 5	1600 28 3	1300 28 3	1000 28 2	3400 39 6	2400 39 4	1900 39 3	1600 39 3	4500 49 5	3100 49 4	2500 49 3	2100 49 3	5300 60 5	3800 60 4	3100 60 3	2600 60 3
	TALLAHASSEE	3800 28 8	2400 28 5	1800 28 4	1400 28 3	6000 39 10	3700 39 6	2800 39 5	2200 39 4	7700 49 9	4800 49 6	3700 49 4	2900 49 4	9700 60 10	5800 60 6	4400 60 4	3600 60 4
	TAMPA	2700 28 6	1700 28 4	1300 28 3	1100 28 2	4200 39 7	2600 39 4	2000 39 3	1600 39 3	5500 49 7	3500 49 4	2700 49 3	2200 49 3	6700 60 7	4200 60 4	3300 60 3	2700 60 3
GA.	ATLANTA	9000 28 18	4800 28 10	3300 28 7	2300 28 5	14600 39 24	7600 39 12	5200 39 8	3700 39 6	18800 49 23	9900 49 12	6800 49 8	4900 49 6	23900 60 24	12300 60 12	8300 60 8	5800 60 6

AREA RATING TABLE 1 (Continued)

TYPE ROOF ➤		FLAT				2" RISE				4" RISE				6" RISE			
		AREA RATING SQ. FT. FLOW G.P.M. DRAIN DOWN HRS.				AREA RATING SQ. FT. FLOW G.P.M. DRAIN DOWN HRS.				AREA RATING SQ. FT. FLOW G.P.M. DRAIN DOWN HRS.				AREA RATING SQ. FT. FLOW G.P.M. DRAIN DOWN HRS.			
RETURN PERIOD➤		10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.
GEORGIA	AUGUSTA	8800 28 18	4700 28 10	3300 28 7	2400 28 5	14300 39 23	7500 39 12	5100 39 8	3700 39 6	18400 49 22	9800 49 12	6700 49 8	4900 49 6	23500 60 24	12100 60 12	8200 60 8	5900 60 6
	COLUMBUS	6500 28 13	3600 28 7	2500 28 5	1900 28 4	10200 39 16	5700 39 9	4000 39 6	2900 39 5	13200 49 16	7500 49 9	5300 49 6	3900 49 5	16800 60 17	9000 60 9	6400 60 6	4700 60 5
	MACON	7700 28 16	4100 28 8	2800 28 6	2000 28 4	12400 39 20	6500 39 10	4400 39 7	3200 39 5	15900 49 19	8500 49 10	5900 49 7	4300 49 5	20300 60 20	10400 60 10	7200 60 7	5100 60 5
	SAVANNAH	4000 28 8	2400 28 5	1800 28 4	1400 28 3	6200 39 10	3700 39 6	2700 39 4	2100 39 3	8100 49 10	4900 49 6	3600 49 4	2800 49 3	9900 60 10	5900 60 6	4400 60 4	3400 60 3
	VALDOSTA	5200 28 11	3000 28 6	2100 28 4	1600 28 3	8300 39 13	4700 39 8	3300 39 5	2500 39 4	10800 49 13	6100 49 7	4400 49 5	3300 49 4	13400 60 14	7500 60 8	5300 60 5	4000 60 4
HAWAII	HILO	900 28 2	600 28 1	500 28 1	500 28 1	1300 39 2	1000 39 2	800 39 1	700 39 1	1700 49 2	1300 49 2	1100 49 1	900 49 1	2200 60 2	1600 60 2	1400 60 1	1200 60 1
	HONOLULU	4600 28 9	2900 28 6	2200 28 5	1800 28 4	7000 39 11	4400 39 7	3400 39 6	2700 39 4	8800 49 11	5700 49 7	4400 49 5	3600 49 4	11300 60 11	7000 60 7	5400 60 5	4300 60 4
	KAPAA	1700 28 3	1100 28 2	900 28 2	800 28 2	2500 39 4	1700 39 3	1400 39 2	1200 39 2	3400 49 4	2300 49 3	1900 49 2	1600 49 2	4000 60 4	2900 60 3	2400 60 2	2000 60 2
IDAHO	BOISE	25000 12 28	25000 14 32	25000 15 34	25000 17 36	25000 19 21	25000 20 24	25000 22 25	25000 23 27	25000 25 15	25000 27 17	25000 29 18	25000 31 19	25000 30 12	25000 33 14	25000 35 15	25000 37 16
	IDAHO FALLS	25000 11 25	25000 13 30	25000 15 33	25000 17 36	25000 18 21	25000 20 24	25000 22 26	25000 24 28	25000 25 15	25000 28 17	25000 30 19	25000 32 20	25000 30 12	25000 33 14	25000 36 15	25000 38 16
	TWIN FALLS	25000 11 25	25000 13 30	25000 15 33	25000 17 36	25000 18 20	25000 20 23	25000 22 25	25000 23 27	25000 24 14	25000 27 16	25000 29 18	25000 31 19	25000 29 12	25000 32 13	25000 35 14	25000 37 15
ILLINOIS	CAIRO	13300 28 27	7200 28 15	4700 28 10	3400 28 7	21000 39 34	11100 39 18	7400 39 12	5200 39 8	25000 48 30	14500 49 18	9800 49 12	6900 49 8	25000 57 24	18400 60 18	12100 60 12	8300 60 8
	CHICAGO	25000 27 49	16100 28 32	10100 28 20	6700 28 13	25000 34 37	25000 38 40	15800 39 25	10500 39 17	25000 42 26	25000 47 29	21200 49 26	13900 49 17	25000 51 21	25000 56 23	25000 59 25	17600 60 18
	PEORIA	21200 28 43	10400 28 21	6900 28 14	4600 28 9	25000 37 39	16500 39 27	10700 39 17	7200 39 12	25000 45 28	21900 49 27	13800 49 17	9500 49 12	25000 54 22	25000 59 25	17700 60 18	11900 60 12
	SPRINGFIELD	18100 28 36	9300 28 19	6000 28 12	4300 28 9	25000 38 40	14500 39 23	9600 39 15	6600 39 11	25000 46 29	19000 49 23	12300 49 15	8700 49 11	25000 55 23	24200 60 24	15600 60 16	10700 60 11
INDIANA	EVANSVILLE	18500 28 37	9600 28 19	6500 28 13	4500 28 9	25000 37 40	15300 39 25	10100 39 16	7000 39 11	25000 46 28	20000 49 24	13000 49 16	9200 49 11	25000 55 23	25000 60 25	16600 60 17	11400 60 11
	INDIANAPOLIS	25000 28 50	14300 28 29	9200 28 19	6200 28 13	25000 35 37	22700 39 37	14300 39 23	9700 39 16	25000 43 27	25000 48 30	19300 49 23	12900 49 16	25000 51 22	25000 57 24	24400 60 25	16200 60 16
	SOUTH BEND	25000 25 48	19800 28 40	12300 28 25	8000 28 16	25000 33 36	25000 37 39	19300 39 31	12700 39 21	25000 41 26	25000 46 28	25000 49 30	16700 49 20	25000 50 21	25000 54 23	25000 58 24	21300 60 21
	TERRE HAUTE	23200 28 47	11600 28 23	7500 28 15	5100 28 10	25000 36 38	18300 39 30	11900 39 19	8000 39 13	25000 44 28	23600 49 29	15500 49 19	10600 49 13	25000 53 22	25000 58 24	19800 60 20	13200 60 13
IOWA	BURLINGTON	17300 28 35	8500 28 17	5500 28 11	3700 28 8	25000 38 40	13500 39 22	8700 39 14	5900 39 10	25000 46 29	17500 49 21	11100 49 14	7800 49 9	25000 55 23	22300 60 22	14200 60 14	9500 60 10
	DAVENPORT	20100 28 41	9900 28 20	6400 28 13	4500 28 9	25000 37 39	15600 39 25	10100 39 16	6900 39 11	25000 45 28	20600 49 25	13100 49 16	9100 49 11	25000 54 23	25000 60 25	16700 60 17	11200 60 11
	DES MOINES	16000 28 32	7400 28 15	4600 28 9	3000 28 6	25000 38 40	11600 39 19	7300 39 12	4700 39 8	25000 47 29	15300 49 19	9400 49 11	6300 49 8	25000 56 23	19400 60 19	11900 60 12	7600 60 8
	DUBUQUE	22400 28 45	10900 28 22	7200 28 15	4800 28 10	25000 36 39	17400 39 28	11200 39 18	7500 39 12	25000 44 28	23100 49 28	14500 49 18	9900 49 12	25000 53 22	25000 59 25	18500 60 19	12300 60 12
	SIOUX CITY	23600 28 48	8900 28 18	4900 28 10	2700 28 6	25000 36 39	14400 39 23	7600 39 12	4300 39 7	25000 45 28	19200 49 23	10100 49 12	5800 49 7	25000 54 23	24300 60 24	12600 60 13	7200 60 7
	WATERLOU	19400 28 39	9400 28 19	5900 28 12	4000 28 8	25000 37 39	14700 39 24	9300 39 15	6200 39 10	25000 45 28	19300 49 23	12000 49 15	8200 49 10	25000 54 23	24500 60 25	15300 60 15	10100 60 10
KANSAS	CONCORDIA	14500 28 29	5500 28 11	3000 28 6	1800 28 4	23800 39 38	8600 39 14	5000 39 8	3000 39 5	25000 48 30	11500 49 14	6400 49 8	4000 49 5	25000 57 24	14400 60 14	7800 60 8	4700 60 5
	DODGE CITY	25000 28 50	8500 28 17	4200 28 9	2100 28 4	25000 36 38	13900 39 22	6600 39 11	3400 39 6	25000 45 28	18600 49 23	8800 49 11	4600 49 6	25000 54 23	23100 60 23	10800 60 11	5600 60 6
	KANSAS CITY	9800 28 20	4700 28 10	3000 28 6	2000 28 4	15800 39 25	7500 39 12	4700 39 8	3200 39 5	20800 49 25	9800 49 12	6300 49 8	4200 49 5	25000 60 25	12200 60 12	7700 60 8	5100 60 5
	WICHITA	9100 28 18	4100 28 8	2500 28 5	1600 28 3	14700 39 24	6500 39 10	3900 39 6	2500 39 4	19100 49 23	8500 49 10	5300 49 6	3400 49 4	25000 60 25	10500 60 11	6600 60 7	4100 60 4
KY.	LOUISVILLE	23200 28 47	12000 28 24	7800 28 16	5300 28 11	25000 36 38	18700 39 30	12300 39 20	8300 39 13	25000 44 28	24300 49 29	15900 49 19	11000 49 13	25000 53 22	25000 58 24	20300 60 20	13700 60 14
	PADUCAH	14600 28 29	7700 28 15	5200 28 11	3600 28 7	23100 39 37	12100 39 20	8100 39 13	5600 39 9	25000 48 29	15700 49 19	10300 49 13	7400 49 9	25000 56 24	19900 60 20	13200 60 13	9100 60 9
LOUISIANA	ALEXANDRIA	3700 28 8	2300 28 5	1800 28 4	1400 28 3	5800 39 9	3600 39 6	2700 39 4	2100 39 3	7400 49 9	4700 49 6	3600 49 4	2900 49 4	9200 60 9	5700 60 6	4400 60 4	3400 60 3
	LAKE CHARLES	2500 28 5	1700 28 3	1300 28 3	1100 28 2	3900 39 6	2600 39 4	2000 39 3	1600 39 3	5100 49 6	3400 49 4	2700 49 3	2200 49 3	6200 60 6	4100 60 4	3200 60 3	2700 60 3
	NEW ORLEANS	2200 28 5	1500 28 3	1200 28 2	1000 28 2	3400 39 6	2300 39 4	1800 39 3	1500 39 2	4500 49 5	3100 49 4	2500 49 3	2000 49 2	5400 60 5	3800 60 4	3000 60 3	2500 60 3
	SHREVEPORT	4500 28 9	2600 28 5	1900 28 4	1400 28 3	6900 39 11	4000 39 7	2900 39 5	2200 39 4	8800 49 11	5200 49 6	3900 49 5	3000 49 4	11100 60 11	6400 60 6	4700 60 5	3600 60 4
MAINE	BANGOR	25000 26 48	19300 28 39	13200 28 27	9400 28 19	25000 32 35	25000 37 39	20500 39 33	14500 39 23	25000 40 25	25000 45 28	25000 48 30	18900 49 23	25000 47 20	25000 53 22	25000 56 24	24500 60 25
	PORTLAND	23300 28 47	12600 28 25	8700 28 18	6300 28 13	25000 35 38	19900 39 32	13400 39 22	9700 39 16	25000 43 27	25000 49 30	17400 49 21	12200 49 15	25000 51 21	25000 57 24	22300 60 22	15900 60 16
MARYLAND	BALTIMORE	13300 28 27	6100 28 12	3900 28 8	2500 28 5	21100 39 34	9600 39 16	6000 39 10	4000 39 6	25000 48 30	12600 49 15	7900 49 10	5300 49 6	25000 57 24	15700 60 16	9800 60 10	6300 60 6
	HAGERSTOWN	20000 28 40	9500 28 19	6000 28 12	4200 28 8	25000 37 39	14900 39 24	9500 39 15	6400 39 10	25000 45 28	19600 49 24	12100 49 15	8400 49 10	25000 54 23	24600 60 25	15500 60 16	10200 60 10
	SALISBURY	9500 28 19	4500 28 9	2900 28 6	1900 28 4	15400 39 25	7100 39 12	4500 39 7	3000 39 5	20000 49 24	9400 49 11	6000 49 7	4000 49 5	25000 60 25	11700 60 12	7300 60 7	4900 60 5
MASS.	BOSTON	19900 28 40	11000 28 22	7500 28 15	5300 28 11	25000 36 39	17300 39 28	11800 39 19	8300 39 13	25000 44 28	22800 49 28	14800 49 18	10400 49 13	25000 53 22	25000 59 25	19500 60 20	13500 60 14
	SPRINGFIELD	22300 28 45	11500 28 23	7600 28 15	5400 28 11	25000 36 38	18000 39 29	12000 39 19	8400 39 14	25000 44 28	24400 49 30	15500 49 19	10500 49 13	25000 52 22	25000 58 24	19700 60 20	13400 60 13
MICH.	DETROIT	25000 22 44	25000 26 49	21600 28 44	13400 28 27	25000 30 34	25000 34 37	25000 36 39	21800 39 35	25000 38 24	25000 42 27	25000 45 28	25000 48 30	25000 46 20	25000 51 21	25000 54 23	25000 57 24
	GRAND RAPIDS	25000 23 45	25000 28 50	17200 28 35	11000 28 22	25000 31 34	25000 35 38	25000 38 40	17800 39 29	25000 39 25	25000 43 27	25000 46 29	23600 49 29	25000 47 20	25000 52 22	25000 55 23	25000 59 24

AREA RATING TABLE 1 (Continued)

TYPE ROOF ➤		FLAT				2" RISE				4" RISE				6" RISE			
		AREA RATING SQ. FT.				AREA RATING SQ. FT.				AREA RATING SQ. FT.				AREA RATING SQ. FT.			
		FLOW G.P.M.		DRAIN DOWN HRS.		FLOW G.P.M.		DRAIN DOWN HRS.		FLOW G.P.M.		DRAIN DOWN HRS.		FLOW G.P.M.		DRAIN DOWN HRS.	
RETURN PERIOD➤		10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.
MICHIGAN	KALAMAZOO	25000 24 46	24900 28 50	15100 28 31	9500 28 19	25000 31 35	25000 36 38	24000 39 39	15100 39 24	25000 40 25	25000 44 28	25000 47 29	20400 49 25	25000 48 20	25000 53 22	25000 56 24	25000 60 25
	MARQUETTE	25000 21 42	25000 25 47	25000 27 49	19800 28 40	25000 28 32	25000 31 35	25000 34 37	25000 37 39	25000 36 23	25000 40 25	25000 42 27	25000 45 28	25000 43 18	25000 47 20	25000 51 21	25000 54 23
	SAGINAW	25000 22 43	25000 25 47	25000 28 50	16300 28 33	25000 29 33	25000 32 36	25000 35 38	25000 38 40	25000 37 23	25000 41 26	25000 44 28	25000 47 29	25000 45 19	25000 50 21	25000 53 22	25000 56 23
	SAULT STE. MARIE	25000 18 39	25000 21 43	25000 24 46	25000 26 48	25000 25 29	25000 28 32	25000 31 34	25000 33 36	25000 33 21	25000 37 23	25000 39 25	25000 42 26	25000 40 17	25000 44 19	25000 47 20	25000 50 21
	TRAVERSE CITY	25000 21 42	25000 25 47	25000 27 49	19300 28 39	25000 28 32	25000 32 35	25000 34 37	25000 37 39	25000 37 23	25000 40 25	25000 43 27	25000 46 29	25000 44 19	25000 48 20	25000 51 22	25000 55 23
MINNESOTA	AUSTIN	23300 28 47	10700 28 22	6600 28 13	4400 28 9	25000 36 39	17100 39 28	10600 39 17	6900 39 11	25000 44 28	22600 49 27	13700 49 17	9200 49 11	25000 53 22	25000 59 25	17500 60 18	11300 60 11
	DULUTH	25000 24 47	22800 28 46	13800 28 28	8900 28 18	25000 32 35	25000 36 39	21800 39 35	14100 39 23	25000 40 25	25000 45 28	25000 48 30	18600 49 23	25000 48 20	25000 53 22	25000 57 24	23800 60 24
	MINNEAPOLIS	25000 27 49	13400 28 27	8100 28 16	5200 28 11	25000 34 37	21400 39 34	12700 39 21	8100 39 13	25000 43 27	25000 48 30	17000 49 21	11000 49 13	25000 52 22	25000 57 24	21700 60 22	13600 60 14
MISS.	JACKSON	5700 28 12	3400 28 7	2500 28 5	1900 28 4	8900 39 14	5300 39 9	3900 39 6	2900 39 5	11700 49 14	6900 49 8	5000 49 6	3800 49 5	14500 60 15	8500 60 9	6100 60 6	4600 60 5
	GREENVILLE	6200 28 13	3600 28 7	2600 28 5	1900 28 4	9800 39 16	5600 39 9	4000 39 6	2900 39 5	12700 49 15	7300 49 9	5200 49 6	3900 49 5	15900 60 16	9000 60 9	6400 60 6	4700 60 5
	GULFPORT	2400 28 5	1600 28 3	1300 28 3	1000 28 2	3600 39 6	2500 39 4	1900 39 3	1600 39 3	4800 49 6	3300 49 4	2600 49 3	2100 49 3	5800 60 6	3900 60 4	3100 60 3	2600 60 3
MISSOURI	COLUMBIA	12300 28 25	6100 28 12	4000 28 8	2700 28 5	19500 39 31	9500 39 15	6200 39 10	4200 39 7	25000 49 30	12500 49 15	8200 49 10	5600 49 7	25000 58 24	15700 60 16	10100 60 10	6900 60 7
	KIRKSVILLE	14200 28 29	6900 28 14	4400 28 9	3000 28 6	22600 39 36	10900 39 18	7000 39 11	4600 39 8	25000 48 30	14300 49 17	9200 49 11	6200 49 8	25000 57 24	17900 60 18	11400 60 11	7500 60 8
	SPRINGFIELD	8700 28 18	4600 28 9	3000 28 6	2100 28 4	13700 39 22	7100 39 11	4700 39 8	3300 39 5	17800 49 22	9300 49 11	6300 49 8	4400 49 5	22600 60 23	11500 60 12	7600 60 8	5300 60 5
	ST. LOUIS	13600 28 28	7200 28 15	4700 28 10	3300 28 7	21500 39 35	11200 39 18	7400 39 12	5100 39 8	25000 48 30	14600 49 18	9800 49 12	6800 49 8	25000 57 24	18600 60 19	12100 60 12	8200 60 8
MONTANA	BILLINGS	25000 15 34	25000 19 39	25000 21 43	25000 24 46	25000 23 26	25000 26 30	25000 28 32	25000 31 34	25000 30 19	25000 34 21	25000 37 23	25000 39 25	25000 36 15	25000 41 17	25000 44 19	25000 47 20
	BUTTE	25000 12 28	25000 15 33	25000 17 37	25000 19 40	25000 20 23	25000 22 26	25000 24 28	25000 26 30	25000 27 16	25000 30 19	25000 32 20	25000 34 22	25000 32 13	25000 36 15	25000 39 16	25000 41 17
	GLENDIVE	25000 19 40	25000 23 45	25000 26 49	25000 28 40	25000 26 30	25000 31 34	25000 34 37	25000 37 39	25000 35 22	25000 39 25	25000 43 27	25000 46 29	25000 43 18	25000 48 20	25000 52 22	25000 55 23
	GREAT FALLS	25000 15 34	25000 18 39	25000 21 42	25000 23 45	25000 22 26	25000 25 29	25000 27 32	25000 30 34	25000 30 18	25000 33 21	25000 36 22	25000 38 24	25000 35 15	25000 40 17	25000 43 18	25000 46 19
	WAVRE	25000 17 36	25000 20 42	25000 23 45	25000 26 48	25000 24 27	25000 27 31	25000 30 34	25000 33 36	25000 31 19	25000 35 22	25000 38 24	25000 41 26	25000 37 16	25000 42 18	25000 46 19	25000 49 21
	MISSOULA	25000 13 30	25000 16 35	25000 18 38	25000 20 41	25000 20 23	25000 23 26	25000 25 29	25000 26 31	25000 27 17	25000 30 19	25000 32 20	25000 35 22	25000 32 14	25000 36 15	25000 39 16	25000 42 18
NEBRASKA	CHADRON	25000 21 43	25000 26 48	23100 28 47	12000 28 24	25000 28 32	25000 33 36	25000 36 39	19700 39 32	25000 37 24	25000 42 26	25000 45 28	25000 49 30	25000 45 19	25000 51 21	25000 55 23	25000 59 25
	GRAND ISLAND	25000 28 50	9000 28 18	4100 28 8	2000 28 4	25000 38 36	13900 39 22	6500 39 10	3300 39 5	25000 44 28	18800 49 23	8800 49 11	4400 49 5	25000 54 23	23800 60 24	10700 60 11	5300 60 5
	LINCOLN	16700 28 34	6400 28 13	3500 28 7	2100 28 4	25000 38 40	10400 39 17	5600 39 9	3400 39 5	25000 47 29	13600 49 17	7500 49 9	4400 49 5	25000 56 24	17200 60 17	9200 60 9	5600 60 6
	NORTH PLATTE	25000 25 47	15100 28 31	6200 28 13	2700 28 5	25000 33 36	23700 39 38	9900 39 16	4300 39 7	25000 42 27	25000 48 30	13000 49 16	5600 49 7	25000 51 22	25000 58 24	16400 60 16	6800 60 7
	OMAHA	16500 28 33	6700 28 14	3900 28 8	2400 28 5	25000 38 40	11000 39 18	6300 39 10	3800 39 6	25000 47 29	14200 49 17	8000 49 10	5100 49 6	25000 56 24	18300 60 18	10100 60 10	6300 60 6
NEVADA	LAS VEGAS	25000 13 28	25000 15 34	25000 17 37	25000 20 41	25000 20 23	25000 22 26	25000 24 28	25000 27 31	25000 27 16	25000 30 19	25000 33 20	25000 35 22	25000 32 13	25000 36 15	25000 39 16	25000 42 18
	RENO WIN-	25000 17 37	25000 20 42	25000 23 45	25000 26 48	25000 23 27	25000 26 31	25000 29 33	25000 32 35	25000 30 19	25000 34 21	25000 36 23	25000 39 25	25000 35 15	25000 40 17	25000 43 18	25000 46 20
	NEMUCCA	25000 10 21	25000 12 26	25000 13 29	25000 14 32	25000 17 18	25000 18 21	25000 20 23	25000 21 25	25000 22 13	25000 25 15	25000 27 16	25000 28 18	25000 27 11	25000 30 12	25000 32 13	25000 34 14
N.H.	BERLIN	25000 27 50	16000 28 32	11100 28 22	8000 28 16	25000 34 37	25000 38 40	17300 39 28	12300 39 20	25000 41 26	25000 46 29	22900 49 28	15900 49 19	25000 49 21	25000 54 23	25000 58 24	20800 60 21
	PORTSMOUTH	22600 28 46	12400 28 25	8600 28 17	6100 28 12	25000 36 38	19900 39 32	13300 39 21	9500 39 15	25000 43 27	25000 49 30	18200 49 21	12100 49 15	25000 51 22	25000 57 24	22300 60 22	15600 60 16
NEW JERSEY	ATLANTIC CITY	11500 28 23	5800 28 12	3900 28 8	2700 28 6	18600 39 30	9300 39 15	6100 39 10	4200 39 7	24500 49 30	12100 49 15	8000 49 10	5600 49 7	25000 58 24	15100 60 15	9900 60 10	6800 60 7
	NEWARK	14900 28 30	7700 28 16	5200 28 11	3600 28 7	24000 39 39	12200 39 20	8100 39 13	5600 39 9	25000 47 29	15800 49 19	10400 49 13	7300 49 9	25000 56 23	19800 60 20	12900 60 13	9000 60 9
	TRENTON	14200 28 29	7200 28 15	4700 28 10	3200 28 7	22900 39 37	11200 39 18	7400 39 12	5000 39 8	25000 48 29	14700 49 18	9600 49 12	6600 49 8	25000 56 24	18600 60 19	11900 60 12	8000 60 8
NEW MEXICO	ALBUQUERQUE	25000 15 34	25000 19 39	25000 21 43	25000 24 46	25000 23 26	25000 26 30	25000 28 32	25000 31 35	25000 31 19	25000 34 21	25000 37 23	25000 40 25	25000 37 15	25000 41 17	25000 44 19	25000 48 20
	ALAMOGORDO	25000 17 36	25000 20 42	25000 23 45	25000 26 48	25000 24 28	25000 28 32	25000 31 34	25000 34 37	25000 32 20	25000 36 23	25000 39 25	25000 42 27	25000 39 16	25000 44 19	25000 48 20	25000 51 22
	FARMINGTON	25000 15 34	25000 19 40	25000 22 43	25000 24 46	25000 23 27	25000 26 30	25000 29 33	25000 31 35	25000 31 19	25000 35 22	25000 37 24	25000 40 25	25000 38 16	25000 42 18	25000 45 19	25000 48 20
	ROSWELL	25000 22 43	25000 27 49	18600 28 34	10500 28 21	25000 29 33	25000 34 37	25000 37 39	16900 39 27	25000 37 23	25000 42 27	25000 46 29	22500 49 27	25000 45 19	25000 51 21	25000 55 23	25000 59 25
NEW YORK	ALBANY	25000 26 48	17600 28 36	11200 28 23	7500 28 15	25000 33 36	25000 38 40	17400 39 28	11700 39 19	25000 41 26	25000 46 29	23700 49 29	15500 49 19	25000 49 21	25000 55 23	25000 59 25	19300 60 19
	BINGHAMTON	25000 26 48	18100 28 37	11800 28 24	8000 28 16	25000 33 36	25000 38 40	18100 39 29	12400 39 20	25000 41 26	25000 46 29	24400 49 30	16100 49 20	25000 49 21	25000 54 23	25000 58 24	20800 60 21
	BUFFALO	25000 22 43	25000 26 48	24700 28 50	15900 28 32	25000 29 33	25000 33 36	25000 36 38	25000 39 40	25000 37 23	25000 41 26	25000 44 28	25000 47 29	25000 45 19	25000 49 21	25000 53 22	25000 56 23
	ELMIRA	25000 25 47	21100 28 43	13600 28 28	9300 28 19	25000 32 35	25000 37 39	21200 39 34	14300 39 23	25000 40 25	25000 45 28	25000 48 30	19000 49 23	25000 48 20	25000 53 22	25000 57 24	24300 60 24
	HUNTINGTON	14300 28 29	7700 28 16	5200 28 11	3600 28 7	23000 39 37	12000 39 19	8000 39 13	5600 39 9	25000 47 29	15600 49 19	10400 49 13	7300 49 9	25000 56 24	19700 60 20	13100 60 13	9000 60 9
	JAMESTOWN	25000 23 44	25000 27 49	21700 28 44	14300 28 29	25000 30 34	25000 33 37	25000 36 39	22700 39 37	25000 38 24	25000 42 26	25000 45 28	25000 48 30	25000 46 19	25000 50 21	25000 53 22	25000 57 24

AREA RATING TABLE 1 (Continued)

TYPE ROOF ➤		FLAT				2" RISE				4" RISE				6" RISE			
		AREA RATING SQ. FT.				AREA RATING SQ. FT.				AREA RATING SQ. FT.				AREA RATING SQ. FT.			
		FLOW G.P.M.		DRAIN DOWN HRS.		FLOW G.P.M.		DRAIN DOWN HRS.		FLOW G.P.M.		DRAIN DOWN HRS.		FLOW G.P.M.		DRAIN DOWN HRS.	
RETURN PERIOD➤		10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.
NEW YORK	NEW YORK CITY	14300 28 29	7600 28 15	5100 28 10	3600 28 7	22900 39 37	11900 39 19	7900 39 13	5600 39 9	25000 47 29	15500 49 19	10300 49 13	7300 49 9	25000 56 24	19200 60 19	12900 60 13	9000 60 9
	ROCHESTER	25000 22 44	25000 26 48	23400 28 47	15300 28 31	25000 29 33	25000 33 36	25000 36 38	24000 39 39	25000 37 23	25000 41 26	25000 44 28	25000 47 29	25000 45 19	25000 50 21	25000 53 22	25000 56 24
	SYRACUSE	25000 23 45	25000 27 49	19000 28 38	12500 28 25	25000 30 34	25000 34 37	25000 37 39	20000 39 32	25000 38 24	25000 42 27	25000 45 28	25000 49 30	25000 46 19	25000 51 21	25000 54 23	25000 58 24
	WATERTOWN	25000 21 43	25000 25 47	25000 28 50	17600 28 36	25000 29 32	25000 32 36	25000 35 38	25000 38 40	25000 37 23	25000 40 26	25000 43 27	25000 46 29	25000 44 19	25000 49 21	25000 52 22	25000 55 23
NORTH CAROLINA	ASHEVILLE	11500 28 23	6000 28 12	4100 28 8	3000 28 6	18300 39 29	9500 39 15	6500 39 10	4600 39 7	24200 49 29	12300 49 15	8300 49 10	6000 49 7	25000 58 24	15600 60 16	10400 60 10	4800 60 5
	CHARLOTTE	13100 28 26	6500 28 13	4200 28 8	2800 28 6	20700 39 33	10300 39 17	6600 39 11	4400 39 7	25000 48 30	13400 49 16	8800 49 11	5900 49 7	25000 57 24	16800 60 17	10800 60 11	7200 60 7
	ELIZABETH CITY	5400 28 11	2700 28 6	1800 28 4	1300 28 3	8500 39 14	4300 39 7	2800 39 5	2000 39 3	11100 49 14	5700 49 7	3800 49 5	2700 49 3	14000 60 14	6900 60 7	4600 60 5	3300 60 3
	GREENSBORO	11900 28 24	5900 28 12	3900 28 8	2600 28 5	18800 39 30	9300 39 15	6000 39 10	4100 39 7	24900 49 30	12100 49 15	8100 49 10	5500 49 7	25000 58 24	15400 60 15	9800 60 10	6700 60 7
	WILMINGTON	4100 28 8	2400 28 5	1700 28 4	1300 28 3	6400 39 10	3600 39 6	2700 39 4	2000 39 3	8400 49 10	4800 49 6	3500 49 4	2600 49 3	10400 60 10	5900 60 6	4200 60 4	3200 60 3
NO. DAKOTA	BISMARK	25000 21 43	25000 26 48	20600 28 42	11000 28 22	25000 29 33	25000 33 37	25000 37 39	18700 39 30	25000 38 24	25000 42 26	25000 46 29	23900 49 29	25000 46 19	25000 51 22	25000 55 23	25000 59 25
	FARGO	25000 24 45	25000 28 50	14000 28 28	8200 28 17	25000 31 34	25000 36 38	22300 39 36	13000 39 21	25000 39 25	25000 44 28	25000 48 30	17300 49 21	25000 48 20	25000 53 22	25000 57 24	22500 60 23
	WILLISTON	25000 19 40	25000 24 46	25000 27 49	17800 28 36	25000 27 31	25000 31 35	25000 34 37	25000 38 40	25000 35 22	25000 40 25	25000 43 27	25000 46 29	25000 43 18	25000 48 20	25000 52 22	25000 56 23
OHIO	CINCINNATI	25000 27 49	15400 28 31	9900 28 20	6600 28 13	25000 34 37	24400 39 39	15500 39 25	10400 39 17	25000 42 27	25000 47 29	20900 49 25	13800 49 17	25000 51 21	25000 56 23	25000 60 25	17400 60 17
	CLEVELAND	25000 22 44	25000 26 48	22600 28 46	13900 28 28	25000 29 33	25000 33 36	25000 36 39	22500 39 36	25000 38 24	25000 42 26	25000 45 28	25000 48 30	25000 46 19	25000 50 21	25000 54 23	25000 57 24
	COLUMBUS	25000 24 46	25000 28 50	16200 28 33	10100 28 20	25000 31 35	25000 35 38	25000 38 40	16600 39 27	25000 39 25	25000 44 27	25000 47 29	21800 49 26	25000 48 20	25000 53 22	25000 56 23	25000 59 25
	DAYTON	25000 26 48	18800 28 38	11800 28 24	7700 28 16	25000 33 36	25000 38 40	18400 39 30	12200 39 20	25000 41 26	25000 46 29	24700 49 30	16000 49 19	25000 50 21	25000 55 23	25000 58 24	20300 60 20
	TOLEDO	25000 23 45	25000 27 49	18200 28 37	11500 28 23	25000 30 34	25000 35 37	25000 37 39	18800 39 30	25000 39 25	25000 43 27	25000 46 29	24700 49 30	25000 47 20	25000 52 22	25000 55 23	25000 58 24
	YOUNGSTOWN	25000 23 44	25000 27 49	21300 28 43	13500 28 27	25000 30 34	25000 34 37	25000 37 39	21700 39 35	25000 38 24	25000 42 26	25000 45 28	25000 48 30	25000 46 19	25000 51 21	25000 54 23	25000 57 24
OKLA.	OKLAHOMA CITY	6600 28 13	3200 28 6	2100 28 4	1400 28 3	10700 39 17	5000 39 8	3200 39 5	2200 39 4	13800 49 17	6700 49 8	4300 49 5	2900 49 4	17500 60 18	8200 60 8	5200 60 5	3700 60 4
	TULSA	6200 28 13	3200 28 6	2100 28 4	1500 28 3	10000 39 16	5000 39 8	3200 39 5	2200 39 4	12900 49 16	6600 49 8	4300 49 5	3100 49 4	16400 60 16	8000 60 5	5200 60 5	3700 60 4
OREGON	EUGENE	25000 25 47	23200 28 47	17500 28 35	13200 28 27	25000 31 34	25000 35 38	25000 38 40	20200 39 32	25000 38 24	25000 42 26	25000 45 28	25000 48 30	25000 44 19	25000 49 21	25000 52 22	25000 56 23
	MEDFORD	25000 21 42	25000 25 47	24400 28 49	16900 28 34	25000 27 31	25000 31 35	25000 35 37	25000 38 40	25000 34 21	25000 38 24	25000 42 26	25000 45 28	25000 40 17	25000 45 19	25000 49 21	25000 53 22
	ONTARIO	25000 9 21	25000 11 26	25000 13 29	25000 14 32	25000 16 18	25000 18 21	25000 20 23	25000 21 24	25000 22 13	25000 25 15	25000 26 16	25000 28 17	25000 26 11	25000 29 12	25000 32 13	25000 34 14
	PENDLETON	25000 13 29	25000 15 34	25000 17 37	25000 19 40	25000 19 22	25000 22 25	25000 24 28	25000 26 30	25000 26 16	25000 29 18	25000 31 19	25000 33 21	25000 30 13	25000 34 14	25000 37 15	25000 39 17
	PORTLAND	25000 26 48	19000 28 38	14000 28 28	10600 28 22	25000 32 35	25000 37 39	21300 39 34	16100 39 26	25000 39 24	25000 43 27	25000 47 29	22200 49 27	25000 45 19	25000 51 21	25000 54 23	25000 58 24
PENNSYLVANIA	ALLENTOWN	18100 28 37	9000 28 18	6000 28 12	4100 28 8	25000 37 40	14200 39 23	9200 39 15	6300 39 10	25000 45 28	18600 49 23	12100 49 15	8300 49 10	25000 54 23	23300 60 23	15000 60 15	10300 60 10
	ERIE	25000 22 44	25000 26 48	23300 28 47	15000 28 30	25000 29 33	25000 33 36	25000 36 38	23700 39 38	25000 37 24	25000 41 26	25000 44 28	25000 48 30	25000 45 19	25000 50 21	25000 53 22	25000 56 24
	HARRISBURG	23400 28 47	11300 28 23	7400 28 15	5000 28 10	25000 36 38	17800 39 29	11600 39 19	7900 39 13	25000 44 27	23900 49 29	15000 49 18	10200 49 12	25000 53 22	25000 59 24	18800 60 19	12900 60 13
	PHILADELPHIA	14200 28 29	7000 28 14	4500 28 9	3100 28 6	22500 39 36	10900 39 18	7100 39 11	4800 39 8	25000 48 30	14200 49 17	9300 49 11	6400 49 8	25000 57 24	18000 60 18	11400 60 11	7600 60 8
	PITTSBURGH	25000 24 46	25000 28 50	16100 28 33	10600 28 21	25000 31 35	25000 38 40	25000 38 40	17100 39 28	25000 39 25	25000 43 27	25000 47 29	22700 49 27	25000 47 20	25000 52 22	25000 56 23	25000 59 25
	SCRANTON	24600 28 50	12400 28 25	8100 28 16	5500 28 11	25000 35 38	19200 39 31	12500 39 20	8500 39 14	25000 43 27	25000 49 30	16200 49 20	10800 49 13	25000 52 22	25000 58 24	20800 60 21	13900 60 14
	WILLIAMSPORT	25000 27 49	16900 28 34	11100 28 22	7500 28 15	25000 33 36	25000 38 40	16800 39 27	11600 39 19	25000 41 26	25000 46 29	23000 49 28	15300 49 19	25000 50 21	25000 55 23	25000 59 24	19300 60 19
P.R.	SAN JUAN	3300 28 7	2000 28 4	1500 28 3	1100 28 2	5100 39 8	3000 39 5	2200 39 4	1700 39 3	6500 49 8	4000 49 5	3000 49 4	2300 49 3	8000 60 8	4800 60 5	3600 60 4	2800 60 3
R.I.	PROVIDENCE	15900 28 32	8600 28 17	5800 28 12	4000 28 8	25000 39 40	13400 39 22	9000 39 15	6300 39 10	25000 47 29	17600 49 21	11500 49 14	8100 49 10	25000 55 23	22400 60 22	14600 60 15	10100 60 10
SO. CAR.	CHARLESTON	4200 28 8	2400 28 5	1800 28 4	1400 28 3	6400 39 10	3800 39 6	2800 39 4	2100 39 3	8400 49 10	5000 49 6	3700 49 4	2900 49 4	10300 60 10	6100 60 6	4400 60 4	3400 60 4
	COLUMBIA	9500 28 19	5000 28 10	3400 28 7	2400 28 5	15400 39 25	8000 39 13	5400 39 9	3800 39 6	20000 49 24	10400 49 13	7100 49 9	5100 49 6	25000 60 25	13000 60 13	8700 60 9	6100 60 6
	GREENVILLE	8200 28 17	5000 28 10	3700 28 7	2700 28 5	12700 39 20	7700 39 12	5600 39 9	4200 39 7	16900 49 20	10000 49 12	7200 49 9	5500 49 7	21500 60 22	12600 60 13	9100 60 9	6500 60 7
SO. DAKOTA	ABERDEEN	25000 24 46	23000 28 47	12000 28 24	6700 28 13	25000 31 35	25000 36 39	19200 39 31	10600 39 17	25000 40 25	25000 45 28	25000 49 30	14200 49 17	25000 49 20	25000 54 23	25000 58 24	17900 60 18
	RAPID CITY	25000 21 42	25000 25 47	25000 28 50	14100 28 28	25000 28 32	25000 32 36	25000 36 38	22900 39 37	25000 37 23	25000 41 26	25000 45 28	25000 48 30	25000 45 19	25000 50 21	25000 54 23	25000 58 24
	SIOUX FALLS	25000 27 49	11600 28 24	6200 28 12	3500 28 7	25000 35 38	18900 39 30	9900 39 16	5400 39 9	25000 43 27	24400 49 30	13300 49 16	7300 49 9	25000 53 22	25000 59 24	16500 60 17	9000 60 9
TENNESSEE	CHATTANOOGA	11600 28 23	6400 28 13	4500 28 9	3100 28 6	18700 39 30	10100 39 16	6900 39 11	4900 39 8	24700 49 30	13200 49 16	9100 49 11	6500 49 8	25000 58 24	16600 60 17	11100 60 11	7800 60 8
	KNOXVILLE	18300 28 37	9300 28 19	6100 28 12	4200 28 9	25000 38 40	14600 39 23	9500 39 15	6500 39 10	25000 46 29	19100 49 23	12200 49 15	8500 49 10	25000 55 23	24300 60 24	15500 60 16	10500 60 11
	MEMPHIS	8600 28 17	4900 28 10	3300 28 7	2400 28 5	13600 39 22	7500 39 12	5200 39 8	3800 39 6	17700 49 21	9800 49 12	6900 49 8	5000 49 6	22200 60 22	12000 60 12	8400 60 8	6000 60 6
	NASHVILLE	15600 28 32	8700 28 18	5900 28 12	4300 28 9	25000 39 40	13700 39 22	9300 39 15	6600 39 11	25000 47 29	17900 49 22	11900 49 14	8600 49 10	25000 56 23	22600 60 23	15300 60 15	10600 60 11

AREA RATING TABLE 1 (Continued)

TYPE ROOF ➤		FLAT				2" RISE				4" RISE				6" RISE			
		AREA RATING SQ. FT.				AREA RATING SQ. FT.				AREA RATING SQ. FT.				AREA RATING SQ. FT.			
		FLOW G.P.M.		DRAIN DOWN HRS.		FLOW G.P.M.		DRAIN DOWN HRS.		FLOW G.P.M.		DRAIN DOWN HRS.		FLOW G.P.M.		DRAIN DOWN HRS.	
RETURN PERIOD➤		10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.
TEXAS	ABILENE	10100 28 20	5000 28 10	3300 28 7	2300 28 5	16300 39 26	7800 39 13	5100 39 8	3500 39 6	21200 49 26	10100 49 12	6700 49 8	4700 49 6	25000 60 25	12500 60 13	8200 60 8	5700 60 6
	AMARILLO	24000 28 49	9100 28 18	5100 28 10	3000 28 6	25000 36 38	14600 39 23	8200 39 13	4800 39 8	25000 44 28	19400 49 23	10700 49 13	6400 49 8	25000 54 23	25000 60 25	13600 60 14	7900 60 8
	BROWNSVILLE	3100 28 6	1700 28 4	1300 28 3	1000 28 2	4800 39 8	2700 39 4	1900 39 3	1500 39 2	6300 49 8	3700 49 4	2600 49 3	2000 49 2	7800 60 8	4400 60 4	3200 60 3	2500 60 3
	CORPUS CHRISTI	3300 28 7	1800 28 4	1400 28 3	1000 28 2	5200 39 8	2900 39 5	2100 39 3	1600 39 3	6800 49 8	3800 49 5	2800 49 3	2100 49 3	8300 60 8	4600 60 5	3400 60 3	2600 60 3
	DALLAS	5000 28 10	2500 28 5	1700 28 3	1200 28 2	7800 39 13	3900 39 6	2600 39 4	1800 39 3	10200 49 12	5200 49 6	3500 49 4	2500 49 3	12700 60 13	6400 60 6	4200 60 4	3100 60 3
	EL PASO	25000 15 34	25000 19 39	25000 21 42	25000 23 45	25000 23 26	25000 26 30	25000 28 32	25000 31 34	25000 31 19	25000 34 21	25000 37 23	25000 39 25	25000 37 16	25000 42 17	25000 44 19	25000 47 20
	HOUSTON	2600 28 5	1600 28 3	1200 28 2	1000 28 2	4000 39 7	2400 39 4	1900 39 3	1500 39 2	5200 49 6	3300 49 4	2500 49 3	2000 49 2	6300 60 6	3900 60 4	3100 60 3	2500 60 3
	LUBBOCK	21700 28 44	9000 28 18	5300 28 11	3300 28 7	25000 36 39	14200 39 23	8400 39 14	5200 39 8	25000 45 28	18600 49 23	10800 49 13	7000 49 9	25000 54 23	23600 60 24	13900 60 14	8500 60 9
	ODESSA	25000 28 50	10500 28 21	6300 28 13	4000 28 8	25000 35 38	16700 39 27	9900 39 16	6300 39 10	25000 44 27	22200 49 27	12700 49 15	8300 49 10	25000 52 22	25000 59 25	16300 60 16	10200 60 10
	SAN ANTONIO	5000 28 10	2600 28 5	1700 28 4	1300 28 3	7800 39 13	4000 39 6	2700 39 4	1900 39 3	10200 49 12	5300 49 6	3600 49 4	2700 49 3	12700 60 13	6500 60 7	4400 60 4	3200 60 3
	TEXARKANA	5100 28 10	2900 28 6	2000 28 4	1500 28 3	7900 39 13	4400 39 7	3200 39 5	2400 39 4	10200 49 12	5800 49 7	4200 49 5	3200 49 4	12900 60 13	7600 60 8	5100 60 5	3800 60 4
	VICTORIA	3200 28 7	1900 28 4	1300 28 3	1000 28 2	5000 39 8	2800 39 5	2000 39 3	1500 39 3	6600 49 8	3800 49 5	2700 49 3	2100 49 3	7900 60 8	4500 60 5	3300 60 3	2600 60 3
	WICHITA FALLS	7100 28 14	3500 28 7	2200 28 5	1500 28 3	11500 39 18	5400 39 9	3400 39 6	2300 39 4	14800 49 18	7100 49 9	4500 49 6	3100 49 4	18700 60 19	8600 60 9	5500 60 6	3800 60 4
UTAH	CEDAR CITY	25000 12 28	25000 15 33	25000 17 37	25000 19 40	25000 20 23	25000 22 26	25000 24 28	25000 26 31	25000 27 17	25000 31 19	25000 33 21	25000 35 22	25000 33 14	25000 37 16	25000 40 17	25000 43 18
	SALT LAKE CITY	25000 15 33	25000 18 38	25000 20 41	25000 22 44	25000 21 25	25000 24 28	25000 27 31	25000 29 33	25000 28 17	25000 32 20	25000 34 21	25000 37 23	25000 33 14	25000 38 16	25000 41 17	25000 44 18
VERMONT	BRATTLEBORO	25000 27 49	14700 28 30	9500 28 19	6600 28 13	25000 34 37	23500 39 38	15300 39 25	10200 39 17	25000 42 26	25000 47 29	20200 49 24	13100 49 16	25000 50 21	25000 56 23	25000 60 25	17000 60 17
	BURLINGTON	25000 22 44	25000 26 49	21300 28 43	13800 28 28	25000 29 33	25000 33 36	25000 36 39	21700 39 35	25000 37 23	25000 41 26	25000 45 28	25000 48 30	25000 45 19	25000 50 21	25000 53 22	25000 57 24
	RUTLAND	25000 24 46	24100 28 49	14900 28 30	9800 28 20	25000 31 35	25000 36 38	23300 39 38	15300 39 25	25000 39 25	25000 44 27	25000 47 29	20300 49 25	25000 47 20	25000 52 22	25000 56 23	25000 60 25
VIRGINIA	BRISTOL	25000 28 50	12600 28 25	7700 28 16	4900 28 10	25000 35 38	20100 39 32	12300 39 20	7700 39 12	25000 43 27	25000 49 30	16100 49 19	10300 49 13	25000 52 22	25000 58 24	21100 60 21	12600 60 13
	CHARLOTTESVILLE	9000 28 18	5000 28 10	3400 28 7	2500 28 5	13800 39 22	7600 39 12	5300 39 9	3800 39 6	18200 49 22	9600 49 12	6700 49 8	5000 49 6	23200 60 23	12200 60 12	8300 60 8	6000 60 6
	NORFOLK	6800 28 14	3300 28 7	2200 28 5	1500 28 3	10800 39 18	5300 39 9	3400 39 6	2300 39 4	14000 49 17	7000 49 9	4600 49 6	3100 49 4	17600 60 18	8500 60 9	5500 60 6	3900 60 4
	RICHMOND	10000 28 20	4300 28 9	2600 28 5	1600 28 3	16000 39 26	6800 39 11	4100 39 7	2600 39 4	21200 49 26	9000 49 11	5500 49 7	3500 49 4	25000 59 25	11000 60 11	6600 60 7	4300 60 4
	ROANOKE	12700 28 26	6600 28 13	4500 28 9	3200 28 6	20300 39 33	10500 39 17	6900 39 11	4800 39 8	25000 48 30	13600 49 16	9100 49 11	6300 49 8	25000 57 24	16900 60 17	11200 60 11	7700 60 8
WASHINGTON	BELLINGHAM	25000 22 44	25000 26 49	22400 28 45	16800 28 34	25000 28 32	25000 32 35	25000 35 38	25000 38 40	25000 34 21	25000 38 24	25000 41 26	25000 45 28	25000 40 17	25000 45 19	25000 48 20	25000 52 22
	HOQUIAM	13800 28 28	9100 28 18	7000 28 14	5600 28 11	21000 39 34	13700 39 22	10500 39 17	8400 39 13	25000 47 29	18200 49 22	14100 49 17	10900 49 13	25000 54 23	23800 60 24	18400 60 19	14500 60 15
	PORT ANGELES	18100 28 36	11400 28 23	8700 28 18	6800 28 14	25000 37 40	17000 39 27	12900 39 21	10300 39 17	25000 43 27	23800 49 29	17800 49 22	13800 49 17	25000 51 21	25000 57 24	22900 60 23	18100 60 18
	RICHLAND	25000 9 19	25000 11 24	25000 12 27	25000 13 30	25000 16 18	25000 18 21	25000 20 22	25000 21 24	25000 22 13	25000 25 15	25000 27 16	25000 29 18	25000 27 11	25000 30 12	25000 32 14	25000 35 15
	SEATTLE	25000 21 42	25000 25 47	24600 28 50	17700 28 36	25000 26 30	25000 31 34	25000 34 37	25000 37 39	25000 33 21	25000 37 23	25000 41 26	25000 44 28	25000 38 16	25000 44 18	25000 48 20	25000 51 22
	SPOKANE	25000 13 28	25000 15 33	25000 17 36	25000 19 39	25000 19 22	25000 21 25	25000 23 27	25000 25 29	25000 25 15	25000 28 18	25000 30 19	25000 32 20	25000 30 13	25000 34 14	25000 36 15	25000 39 16
	WENATCHEE	25000 11 25	25000 14 31	25000 16 35	25000 18 38	25000 18 20	25000 20 24	25000 22 26	25000 24 28	25000 24 14	25000 27 17	25000 30 18	25000 32 20	25000 28 12	25000 33 14	25000 35 15	25000 38 16
	YAKIMA	25000 11 24	25000 13 30	25000 15 34	25000 17 37	25000 17 19	25000 20 23	25000 22 25	25000 24 28	25000 23 14	25000 27 16	25000 29 18	25000 31 19	25000 28 11	25000 32 13	25000 34 14	25000 37 15
W. VA.	CLARKSBURG	25000 25 47	19700 28 40	11900 28 24	7500 28 15	25000 32 36	25000 37 39	18800 39 30	11900 39 19	25000 41 26	25000 46 28	24600 49 30	15700 49 19	25000 49 21	25000 54 23	25000 58 24	20000 60 20
	HUNTINGTON	25000 25 47	21800 28 44	13000 28 26	8000 28 16	25000 32 36	25000 37 39	20600 39 33	12900 39 21	25000 41 26	25000 45 28	25000 48 30	17000 49 21	25000 49 21	25000 54 23	25000 58 24	21700 60 22
WISCONSIN	EAU CLAIRE	25000 27 49	14700 28 30	9200 28 19	6100 28 12	25000 34 37	23400 39 38	14300 39 23	9600 39 15	25000 42 27	25000 48 30	19200 49 23	12700 49 15	25000 51 21	25000 56 24	24500 60 25	16100 60 16
	GREEN BAY	25000 23 45	25000 27 49	17700 28 36	11200 28 23	25000 30 34	25000 35 37	25000 38 40	18200 39 29	25000 39 24	25000 43 27	25000 46 29	24100 49 29	25000 47 20	25000 52 22	25000 55 23	25000 58 24
	LA CROSSE	25000 28 50	12700 28 26	8000 28 16	5300 28 11	25000 35 38	12600 39 32	8300 39 20	25000 39 13	25000 43 27	16500 49 30	11100 49 20	25000 49 13	25000 52 22	21000 58 24	21000 60 21	13800 60 14
	MADISON	25000 27 49	14600 28 30	9200 28 19	6100 28 12	25000 34 37	23300 39 37	14400 39 23	9600 39 16	25000 42 27	25000 48 30	19300 49 23	12800 49 16	25000 51 22	25000 56 24	24500 60 25	16200 60 16
	MILWAUKEE	25000 25 47	19900 28 40	12200 28 25	7900 28 16	25000 32 36	25000 37 39	19100 39 31	12500 39 20	25000 41 26	25000 46 28	25000 49 30	16500 49 20	25000 49 21	25000 54 23	25000 58 24	20900 60 21
	WAUSAU	25000 25 47	20500 28 41	12700 28 26	8300 28 17	25000 32 36	25000 37 39	20000 39 32	13200 39 21	25000 41 26	25000 45 28	25000 49 30	17400 49 21	25000 49 21	25000 54 23	25000 58 24	22100 60 22
WYOMING	CASPER	25000 15 34	25000 19 40	25000 22 43	25000 25 47	25000 23 26	25000 26 30	25000 29 33	25000 32 35	25000 31 19	25000 35 22	25000 37 24	25000 40 25	25000 37 15	25000 42 18	25000 45 19	25000 48 20
	CHEYENNE	25000 18 38	25000 22 43	25000 25 47	25000 28 50	25000 25 29	25000 29 33	25000 32 36	25000 35 38	25000 34 21	25000 38 24	25000 41 26	25000 44 28	25000 41 17	25000 46 19	25000 50 21	25000 53 22
	CODY	25000 14 32	25000 17 37	25000 20 41	25000 22 44	25000 21 24	25000 24 28	25000 26 30	25000 29 33	25000 28 18	25000 32 20	25000 34 22	25000 37 23	25000 34 14	25000 38 16	25000 41 17	25000 44 19
	ROCK SPRINGS	25000 12 28	25000 15 33	25000 17 37	25000 19 40	25000 19 22	25000 22 26	25000 24 28	25000 26 30	25000 26 16	25000 30 18	25000 32 20	25000 35 22	25000 32 13	25000 36 15	25000 39 16	25000 42 18
	SHERIDAN	25000 16 35	25000 20 41	25000 22 44	25000 25 47	25000 23 27	25000 26 31	25000 29 33	25000 32 35	25000 31 19	25000 35 22	25000 38 24	25000 40 25	25000 37 15	25000 42 18	25000 45 19	25000 49 20

TABLE 2

FLOW RATE VS. BUILD-UP - ONE WEIR

Depth - Inches	1	2	3	4	5	6
Flow - G.P.M.	9.2	18.6	28.4	38.6	49.1	60.0

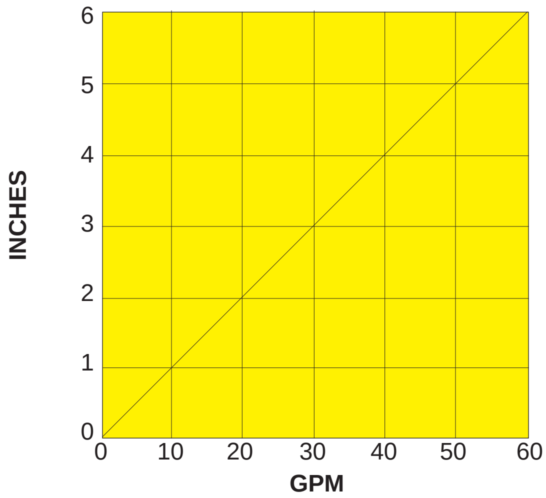


TABLE 3

ALLOWABLE FLOW FOR VERTICAL LEADERS AND HORIZONTAL STORM DRAIN

	ALLOWABLE FLOW IN G.P.M.			
		HORIZONTAL STORM DRAIN		
PIPE SIZE	VERTICAL LEADER	SLOPE PER FOOT		
		1/8"	1/4"	1/2"
2	30	12	17	24
3	90	36	51	72
4	192	78	111	157
5	348	142	201	284
6	-	231	327	462
8	-	498	705	996
10	-	902	1275	1804
12	-	1467	2076	2934
15	-	2666	3774	5332

EXAMPLES

These examples will indicate the potential savings by illustrating material differences, both in size and quantity. Labor savings will follow the same pattern. Because of the many variations throughout the country in labor, materials, organization, etc., it is too difficult to give dollar values that will be consistent. However, a quick comparison of the examples will show the possible savings available. Each individual can then relate this to their own situation and realize the money saved through the cost reduction.

The following examples illustrate the potential savings and advantages
that can be achieved with RAINTROL® roof drains.

CONDITIONS APPLY TO ALL EXAMPLES 1 THRU 7:

Location	Paducah, Kentucky
Rainfall	4" per hour
Flow Control	10 yr. storm return period
Leaders	Vertical- 20 ft. high
Storm Sewers	1/4" per ft. slope
Roof Size	210' x 580' or 121,800 sq. ft.
Type Roof	Flat Roof or 4" Rise (as indicated)

EXAMPLE 1 - CONVENTIONAL METHOD USING SMITH 4" FIG. 1010 ROOF DRAIN FOR FLAT ROOF

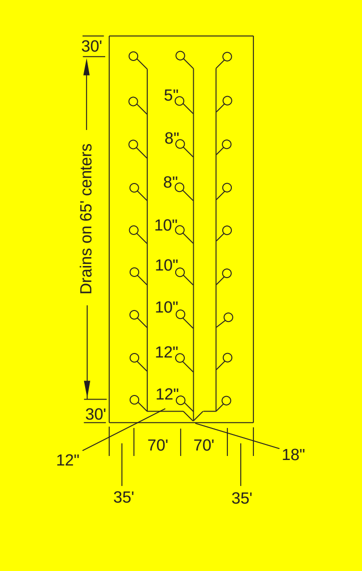
Roof Area/Drain..4,600 sq. ft. (From Table 1, pg. 1-03)

No. of drains ....121,800 ÷ 4,600 = 26.5 or 27 drains
Area/Drain ....121,800 ÷ 27 = 4,511 sq. ft.

Flow Rate = 4,511 (sq. ft.) x $\frac{4(in/hr)}{12(in/ft)}$ x$\frac{1}{60}$ (min. / hr) x 7.48 (gal/cu. ft.) = 187.5 gpm/drain

PIPE REQUIREMENTS
4" dia. pipe – 540'
5" dia. pipe – 195'
8" dia. pipe – 390'
10" dia. pipe – 585'
12" dia. pipe – 530'
18" dia. pipe – 30'

DRAIN REQUIREMENTS
(27) 04" Fig. 1010 roof drains



EXAMPLE 2 - CONVENTIONAL METHOD USING SMITH 5" FIG. 1010 ROOF DRAIN FOR FLAT ROOF

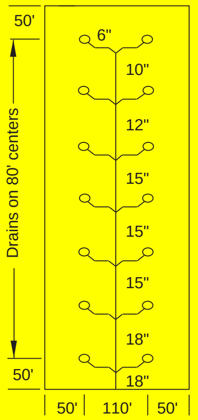
Roof Area/Drain..8,650 sq. ft. (From Table 1, Pg. 1-03)

No. of Drains...121,800 ÷ 8,650 = 14.1 or 14 drains
Area/Drain ....121,800 ÷ 14 = 8,700 sq. ft.

Flow Rate = 8,700 (sq. ft.) x $\frac{4}{12}$ x $\frac{1}{60}$ (min. / hr) x 7.48 (gal/cu. ft.) = 361.5 gpm/drain

PIPE REQUIREMENTS
5" dia. pipe – 280'
6" dia. pipe – 770'
10" dia. pipe – 80'
12" dia. pipe – 80'
15" dia. pipe – 240'
18" dia. pipe – 130'

DRAIN REQUIREMENTS
(14) 05" Fig. 1010 roof drains



EXAMPLE 3 – RAINTROL® METHOD - MAXIMUM ECONOMY FOR FLAT ROOF

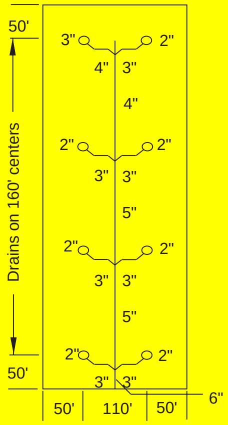
Roof Area/Drain..14,600 sq. ft./weir opening (From Table 1, Pg. 1-26)

Build up 3" (max)...Drain down time – 29 hours
Weir Openings...121,800 ÷ 14,600 = 8.3 or 9
Area/Weir Opening......................................121,800 ÷ 9 = 13,533 sq. ft.
No. of Drains...Use 8 to total 9 weir openings
7 drains with 1 weir opening -WR1
1 drain with 2 weir openings -WR2

Flow Rate = 28 gpm/weir opening @ 3" depth.
7 drains–28 gpm ea.
1 drain–56 gpm

PIPE REQUIREMENTS
2" dia. pipe – 140'
3" dia. pipe – 405'
4" dia. pipe – 215'
5" dia. pipe – 320'
6" dia. pipe – 50'

DRAIN REQUIREMENTS
(7) 02" Fig. 1083 roof drains with
1 weir opening -WR1
(1) 03" Fig. 1083 roof drain with
2 weir openings -WR2



EXAMPLE 4 - RAINTROL® METHOD - LIMIT DRAIN DOWN TIME TO 12 HOURS FOR FLAT ROOF

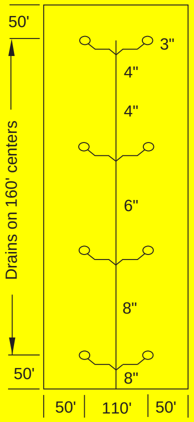
Roof Area/Drain.. $\frac{12 \text{ hrs.}}{29 \text{ hrs.}}$ x 14,600 sq. ft. = 6,041 sq. ft./weir opening

Build-up 3" (max)...Drain down time – 12 hours (approx.)
Weir Openings...121,800 ÷ 6,041 = 20.2 or 20
Area/Weir Opening......................................121,800 ÷ 20 = 6,090 sq. ft.
No. of Drains...Use 8 to total 20 weir openings
4 drains with 2 weir openings -WR2
4 drains with 3 weir openings -WR3

Flow Rate = 28 gpm/weir opening @ 3" depth
4 drains -- 56 gpm ea.
4 drains -- 84 gpm ea.

PIPE REQUIREMENTS
3" dia. pipe – 160'
4" dia. pipe – 600'
6" dia. pipe – 160'
8" dia. pipe – 210'

DRAIN REQUIREMENTS
(4) 03" Fig. 1083 roof drains with 2 weir openings -WR2
(4) 03" Fig. 1083 roof drains with 3 weir openings -WR3



EXAMPLE 5 – CONVENTIONAL METHOD USING SMITH 6" FIG. 1010 ROOF DRAIN FOR 4" RISE ROOF

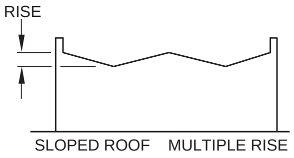
Roof Area/Drain ....13,500 sq. ft. (From Table 1, Pg. 1-03)

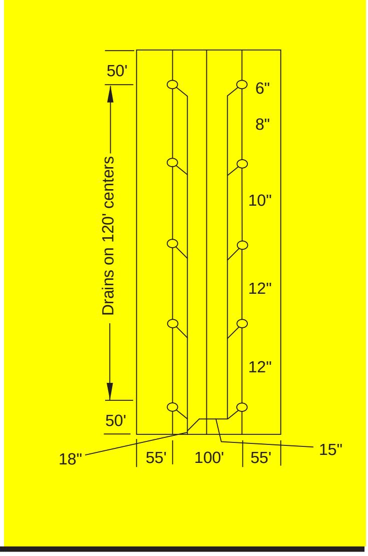
No. of drains..121,800 ÷ 13,500 = 9.02 or 10 drains
Area/Drain...121,800 ÷ 10 = 12,180 sq. ft.

Flow Rate = 12,180 x $\frac{4}{12}$ x $\frac{1}{60}$ x 7.48 = 506.1 gpm/drain

PIPE REQUIREMENTS
- 6" dia. pipe – 200'
- 8" dia. pipe – 240'
- 10" dia. pipe – 240'
- 12" dia. pipe – 480'
- 16" dia. pipe – 100'
- 18" dia. pipe – 50'

DRAIN REQUIREMENTS
(10) 06" Fig. 1010 roof drains

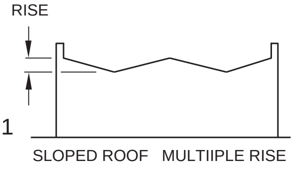




EXAMPLE 6– RAINTROL® METHOD – MAXIMUM - ECONOMY FOR 4" RISE ROOF

Roof Area/Drain..................................25,000 sq. ft./weir opening (From Table 1, Pg. 1-26)

Build-up 5" (max for 4" rise) ....Drain down time –29 hours
Weir Openings....................................121,800 ÷25,000 = 4.9 (use 8)*
Area/Weir Opening.............................121,800 ÷ 8 = 15,225 sq. ft.
No. of Drains.......................................Use 8 with 1 weir opening each -WR1



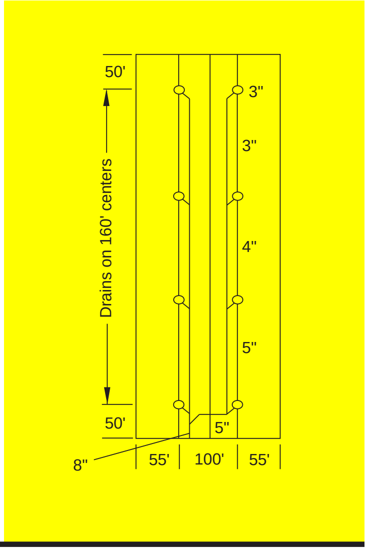
*Refer to Design Considerations – Page 1-23, paragraphs (e) and (f).

Flow Rate = 49 gpm/weir opening @ 5" depth

Drain Down time ....29 hrs. x $\frac{15,225 \text{ sq. ft.}}{25,000 \text{ sq. ft.}}$ = 17.7 hrs. (approx.)

PIPE REQUIREMENTS
- 3" dia. pipe – 480'
- 4" dia. pipe – 320'
- 6" dia. pipe – 420'
- 8" dia. pipe – 50'

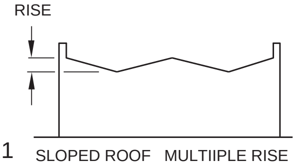
DRAIN REQUIREMENTS
(8) 03" Fig. 1085 roof drains with 1 weir opening -WR1



EXAMPLE 7– RAINTROL® METHOD – LIMIT DRAIN DOWN TIME TO 12 HOURS FOR 4" RISE ROOF

Roof Area/Drain.................................. $\frac{12 \text{ hrs.}}{29 \text{ hrs.}}$ x 25,000 sq. ft. = 10,344 sq. ft./weir opening

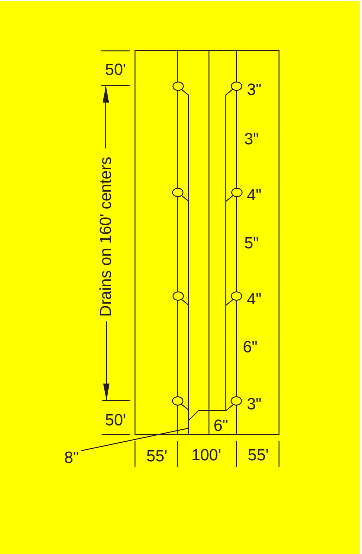
Build-up 5" (max for 4" rise) ....Drain down time -12 hrs.
Weir Openings....................................121,800 ÷10,344 = 11.8 or 12
Area/Weir Opening.............................121,800 ÷ 12 = 10,150 sq. ft.
No. of Drains.......................................Use 8 to total 12 weir openings
4 drains with 1 weir opening -WR1
4 drains with 2 weir openings -WR2



Flow Rate = 49 gpm/weir opening @ 5" depth
4 drains – 49 gpm ea.   4 drains – 98 gpm ea.

PIPE REQUIREMENTS
- 3" dia. pipe – 400'
- 4" dia. pipe – 80'
- 5" dia. pipe – 400'
- 6" dia. pipe – 400'
- 8" dia. pipe – 50'

DRAIN REQUIREMENTS
(4) 03" Fig. 1085 roof drains with 1 weir opening -WR1
(4) 04" Fig. 1085 roof drains with 2 weir openings -WR2



RAINTROL® FLOW CONTROL ROOF DRAIN SIZING WORKSHEET

(To be used in conjunction with Pages 7 thru 18)

Date ____________

By ____________

1. JOB DATA: PLANT/ENGINEER

a. Job Name Example No. 6

b. For roof area identified as Main Bldg.

c. Location: City: Paducah State: Ky

d. Type Roof: *(Circle one)* Flat (Use Fig. 1083) [✓ Sloped (Use Fig. 1085) (Indicate rise)] 2" Rise [✓ 4" Rise] 6" Rise

e. Return Period *(Circle one)* [✓ 10 yr.] 25 yr. 50 yr. 100 yr.

f. Overflow Provisions: Parapet Height 24" Scupper or Overflow Height 5"

2. SIZING

a. Area Length: 580 ft. X Width 210 ft. = 121,800 sq. ft.

b. Data from Table 1 for One Weir Opening

Area Rating 25,000 sq. ft. Flow Rate 49 G.P.M. Drain Down Time 29 hrs.

c. Build-up (Refer to Table 2) 5 inches

d. Area 121,800 sq. ft. ÷ Area Rating 25,000 sq. ft. = 4.9 5 No. of weir openings required

e. Number of Roof Drains 8 (refer to Pg. 1-23, (e and f)

(Determined by Roof Layout, Specifications and Design Considerations. Minimum of (2) up to 10,000 sq. ft. or (4) over 10,000 sq. ft.)

f. Number Weir Openings 5 ÷ Number of Drains 8 = 5/8 1 Weir Opening per Drain

No. of Drains 8 with (1) Weir Opening = 8 Weir Openings

No. of Drains ____ with (2) Weir Openings = ____ Weir Openings

No. of Drains ____ with (3) Weir Openings = ____ Weir Openings

No. of Drains ____ with (4) Weir Openings = ____ Weir Openings

g. Total No. of Drains 8 Total No. of Weir Openings 8 (Not less than 2-d)

h. Leader Sizing

Potential Build-up 5 inches (Indicate condition selected; [✓ Table 1,] Scupper Ht. or Weir Ht.)

Corresponding Flow Rate 49 G.P.M. per Weir (Table 2)

i. Flow per Drain:

No. Weir Openings per Drain	X	Flow Rate per Weir	=	Flow per Drain		Leader Size (Table 3)
1	X	49	=	49	G.P.M.	3"
	X		=		G.P.M.	
	X		=		G.P.M.	

3. DRAIN SPECIFICATION:

Fig. No.	No. Weir Openings	Quantity	Outlet	Size
1085	1	8	caulk	03"

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