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PEAK™ PERFORMANCE

ATTIC PROTECTION SPRINKLER SYSTEM

Application:

The Use of Specific Application Sprinklers for Protecting Attics

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CONTENTS

INTRODUCTION 2

APPLICATION EXAMPLES 4

EXAMPLE 1, GABLE UP TO 60 FT. WIDE 6

EXAMPLE 2, GABLE GREATER THAN 60 FT. UP TO 80 FT. WIDE 10

EXAMPLE 3, HIP ROOF FRAMED WITH JOIST AND RAFTERS 14

EXAMPLE 4, HIP ROOF FRAMED WITH TRUSSES 18

EXAMPLE 5, GABLE ROOF WITH DOUBLE SHEAR WALLS 22

EXAMPLE 6, GABLE ROOF WITH A SINGLE SHEAR WALL 26

EXAMPLE 7, MAIN ROOF AREA CONNECTED TO GABLE ENDS 30

EXAMPLE 8, MAIN ROOF AREA WITH BUILT-ON DORMERS 34

EXAMPLE 9, REDUCED SIZE ATTIC OVER OCCUPIED ATTIC SPACE 38

WET PIPE VERSUS DRY PIPE SPRINKLER SYSTEMS 42

WHEN CAN CPVC PIPE AND FITTINGS BE USED 44

BETTER FIRE PROTECTION 47

WHAT ARE SPECIFIC APPLICATION SPRINKLERS 51

CONCLUSION 52

ABOUT THE AUTHOR 53

APPENDIX A (TFP610) 55

APPENDIX B (INSTALLATION OF STANDARD SPRAY SPRINKLERS UNDER A ROOF OR CEILING IN COMBUSTIBLE CONCEALED SPACES PER NFPA 13) 83

INTRODUCTION

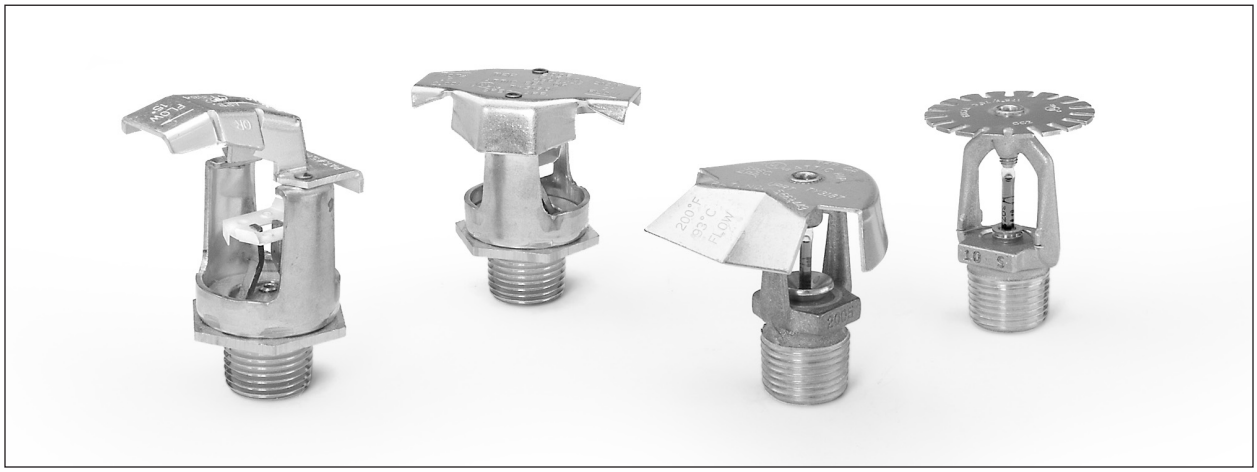
Fire sprinkler protection for attic spaces represents a unique challenge – both in sprinkler placement and fire control. Quite often unique challenges are best addressed by the use of specific application sprinklers. Tyco Fire & Building Products (TFBP) offers the Tyco® Peak™ Performance Model BB™ (Back to Back), SD™ (Single Directional), HIP™, and AP™ (Attic Plus) "Specific Application Sprinklers for Protecting Attics". These sprinklers are specifically intended for use in combustible and non-combustible sloped attic spaces and have been developed to produce unique water spray patterns to enhance sprinkler placement while improving fire control.

When compared to Standard Spray Sprinklers which have restricted NFPA 13 installation criteria within attic spaces, the Models BB, SD, HIP, and AP Sprinklers (Fig. 1) provide:

- installation with fewer sprinklers
- installation with fewer branch lines
- a hydraulic advantage
- reduction in system volume to help quicken water delivery time for dry pipe systems
- the ability to use of CPVC pipe and fittings within the attic spaces, as well as for the sprinklers protecting the spaces below the attic
- better fire protection

Technical Data Sheet TFP610 provides complete system design criteria for the Models BB, SD, HIP, and AP Sprinklers. TFP610 is provided as Appendix A to this document. (The latest version may also be downloaded from www.Tyco-Fire.com.) The information provided in this document is presented as an extended application guideline for use with TFP610.

NOTE: THE EXAMPLES PROVIDED ON PAGES 6 THROUGH 38 ARE FOR ILLUSTRATIVE PURPOSES ONLY TO AID IN THE UNDERSTANDING OF THE CONSIDERATIONS THAT A DESIGNER MAY BE CONFRONTED WITH WHEN DETERMINING WHETHER THERE IS AN ADVANTAGE TO USING "SPECIFIC APPLICATION SPRINKLERS FOR PROTECTING ATTICS". THE DESIGNATED HYDRAULIC DESIGN AREAS COULD VARY FROM THOSE SHOWN BASED ON THE WATER SUPPLY RISER LOCATION, WATER SUPPLY AVAILABILITY, AND ACTUAL BRANCH LINE LAYOUT.



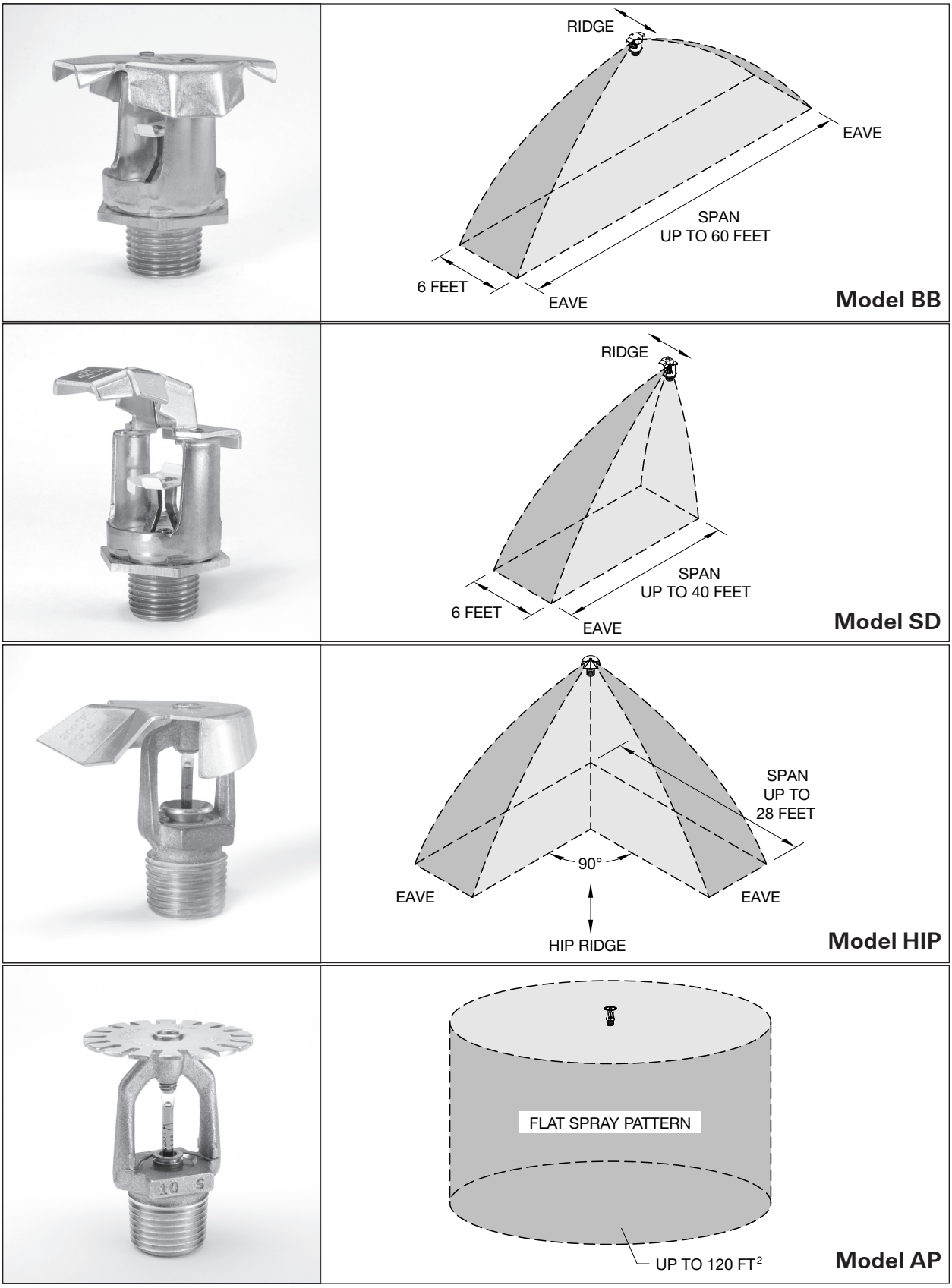

RIDGE
EAVE
SPAN
UP TO 60 FEET
6 FEET
EAVE
Model BB
RIDGE
SPAN
UP TO 40 FEET
6 FEET
EAVE
Model SD
SPAN
UP TO
28 FEET
90°
EAVE
EAVE
HIP RIDGE
Model HIP
FLAT SPRAY PATTERN
UP TO 120 FT²
Model AP

Figure 1

APPLICATION EXAMPLES

First and foremost, we are looking at the fire sprinkler protection of roof structures that are most commonly of wood joist and rafter construction (Fig. 2) or wood trusses (Fig. 3), and where there is a ceiling separating an unoccupied, combustible concealed attic space from the space below. There is also likely to be the presence of insulation above the ceiling. The ceiling slope of the attic can be from a 3:12 to 12:12 pitch. The attic space may be at temperatures at or above 40F at all times, for which a wet pipe sprinkler system may be used, or the attic space may be periodically or at all times be at temperatures below 40F, for which a dry pipe sprinkler system must be used. The temperature in the attic spaces at all times must not exceed 150F.

NOTE: The design criteria with respect to piping materials and hydraulic demand will vary greatly between the uses of a wet pipe system versus a dry pipe system. A wet pipe system will provide in most cases the option for using CPVC pipe and fittings within the attic space, as well as provide hydraulic advantages through smaller hydraulic design areas. Temperatures in the attic space will govern the need for when a wet pipe system may be used or when a dry pipe system must be used.

There are generally four steps to applying the "Specific Application Sprinklers for Protecting Attics".

1. Determine if Model BB (Back to Back), SD (Single Directional), HIP, or AP (Attic Plus) Sprinklers are needed. If more than one type of roof construction is present, select the correct sprinkler for each area.
2. Check the roof pitch for the areas to be protected and then refer to TFP610, Table A to confirm applicability of the selected sprinkler. A roof pitch of between 4:12 to 12:12 can be protected by the 5.6K & 8.0K Model BB, Model SD, and Model HIP Sprinklers. A roof pitch of 3:12 to 12:12 can be protected by the 4.2K Model BB and Model AP Sprinklers. If more than one slope is being used on a project, select the correct sprinkler for each area.
3. Follow the design criteria provided in TFP610 for each type sprinkler, for example, sprinkler positioning, coverage area, distance below roof deck, and distance from obstructions to water distribution. The use of Specific Application Sprinklers will differ from installation criteria found in NFPA. **Therefore, it is extremely important to refer to TFP610.**
4. Hydraulically calculate the sprinkler system in accordance with TFP610 making certain that the correct criteria is used for either a wet pipe or dry pipe system.

Other considerations will include where CPVC piping materials may be used instead of steel piping materials. In some cases, consideration will also need to be given for adding insulation for CPVC pipe materials.

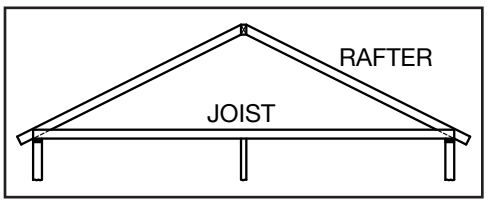


Figure 2

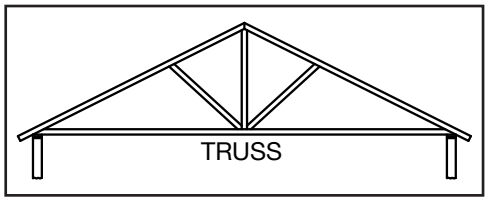


Figure 3

To determine whether to use the Model BB, SD, HIP, or AP, the designer must study the roof shapes and determine which of the following roof types apply:

- gable up to 60 feet wide (Example 1)
- gable greater than 60 feet up to 80 feet wide (Example 2)
- hip roof framed with joist and rafters (Example 3)
- hip roof framed with trusses (Example 4)
- gable roof with double shear walls (Example 5)
- gable roof with a single shear wall (Example 6)
- main roof area connected (i.e., non-compartmented) to gable ends (Example 7)
- main roof area with built-on (i.e., compartmented) dormers (Example 8)
- reduced size attic over occupied attic space (Example 9)

NOTE: Some applications will use a combination of the examples presented. Shear walls shown in Examples 5 and 6 may be under a hip roof instead of a gable roof, or the built-on dormers in Example 8 may be of a variety of shapes other than shown.

Some applications may have roof lines that are "cut up" to the point of being too complex for applying "Specific Application Sprinklers for Protecting Attics", or be outside the scope of application for the Model BB, SD, HIP, and AP Sprinklers. In these cases, the designer will have to use Standard Spray Sprinklers.

Examples 1 through 9 provide comparisons for locating Standard Spray Sprinklers and "Specific Application Sprinklers for Protecting Attics". Appendix B provides information for the spacing of Standard Spray Sprinklers. In general the maximum 8 foot on center spacing was used in the examples on the assumption that most designers would prefer the minimum design pressure of 7 psi as compared to 20 psi as referenced in the 2007 edition of NFPA 13, Table 8.2.2.1(a) so as to avoid larger system water flow demands and larger pipe sizes.

Each example is presented in four pages:

- **An overview**.
- **Comparative sprinkler layouts.** For the purposes of the examples and with regard to laying out Standard Spray Sprinklers, an assumption has been made that the maximum spacing perpendicular to the slope will be 8 feet so as to minimize the design pressure to 7 psi. Whereas, if the designer wanted to increase the spacing over 8 feet, the minimum design pressure would be 20 psi.
- **Wet pipe system hydraulic design comparisons.** For the purposes of the examples and with regard to wet system hydraulic demand, an assumption has been made that either the Model AP Sprinklers or Standard Spray Sprinklers will have a K-factor of 4.2 so as to minimize the design flow.
- **Dry pipe system hydraulic design comparisons.** For the purposes of the examples and with regard to dry system hydraulic demand, an assumption has been made that either the Model AP Sprinklers or Standard Spray Sprinklers will have a K-factor of 5.6 so as to avoid the use of galvanized pipe. The designer could also use 4.2 K-factor sprinklers and gain a hydraulic advantage if galvanized pipe were to be utilized.

Examples 4 and 7 specifically provide comparisons to illustrate the hydraulic advantage for those areas utilizing more than four Model AP (Attic Plus) Sprinklers. Please note and with reference to Appendix A, TFP610, Figure 20: "For individual areas requiring more than four AP Sprinklers, the maximum area of attic protected by AP Sprinklers is limited to 3000 ft^2 (279 m^2) in any single area. Areas must be separated by a minimum of 15 feet (4,6 m) by an area protected by BB, SD, or HIP Sprinklers, in order to be considered separate areas."

EXAMPLE 1
(Figures 4A thru 4F):

For Example 1, we determine that the roof type is a gable with a roof span of 60 feet and a ceiling slope of 8:12. Figure 4A illustrates the Standard Spray Sprinkler layout. In terms of "Specific Application Sprinklers for Protecting Attics" shown in Figure 4B, this roof type is best protected with Model BB Sprinklers. The Model BB Specific Application Attic Sprinkler throws a narrow but long pattern. The narrow spacing along the ridge serves two purposes. The response time is reduced by placing the sprinklers no farther than 6 feet apart, and the spray can be concentrated in the throw direction to obtain a pattern that will cover up to 30 feet in each direction when measured horizontally. There are three different models (i.e., BB1, BB2 & BB3) that account for different roof slopes, and each model is available in three different orifice sizes (K=4.2, 5.6, or 8.0). With reference to Appendix A, TFP610, Table A, we would select the Model BB2 based on ceiling pitch of 8:12, and for a roof span of 60 feet, we could use either the K=5.6 or 8.0.

Figures 4A and 4B clearly demonstrate the reduction from 5 branch lines (Fig. 4A) to 1 branch line (Fig. 4B) when using Model BB Sprinklers instead of Standard Spray Sprinklers. In addition to the reduction in branch lines, we also clearly see a reduction of 115 sprinklers to 30 sprinklers. Obviously buildings of varying widths and pitched ceilings would have an overall affect on branch line and sprinkler reduction. Nonetheless, we would expect a significant reduction in branch lines, sprinklers, material costs, and labor costs through the use of the Model BB Back to Back Sprinklers.

Wet Pipe System Calculations:

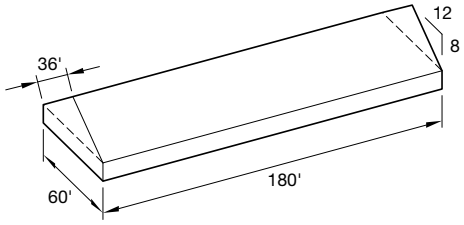
Fig. 4C – Standard Sprinklers: 177.6 GPM

Fig. 4D – Attic Sprinklers: 190.0 GPM

Dry Pipe System Calculations:

Fig. 4E – Standard Sprinklers: 414.4 GPM

Fig. 4F – Attic Sprinklers: 266.0 GPM



EXAMPLE 1:
SPRINKLER LAYOUTS

FIG. 4A

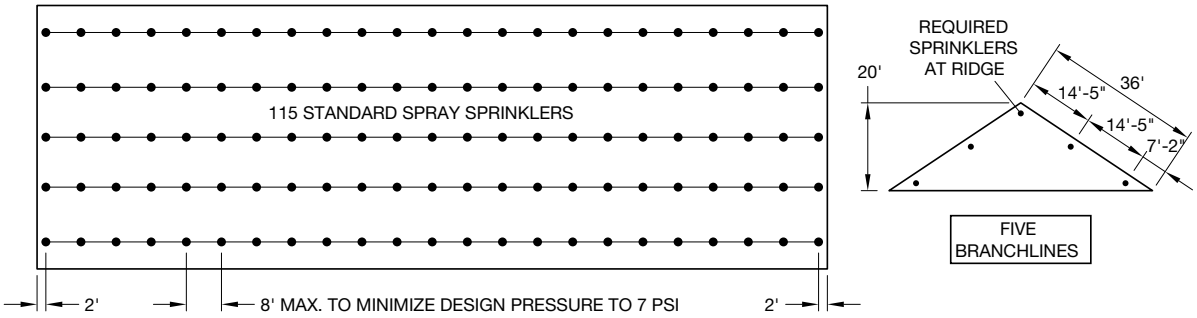
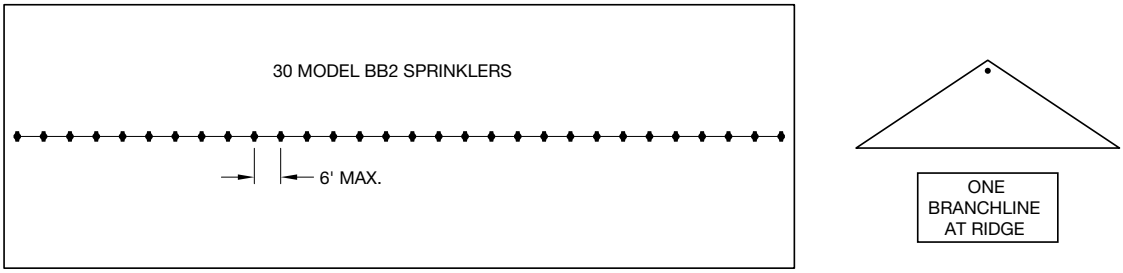
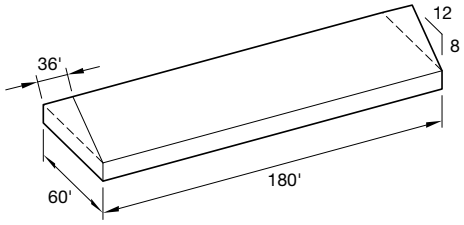


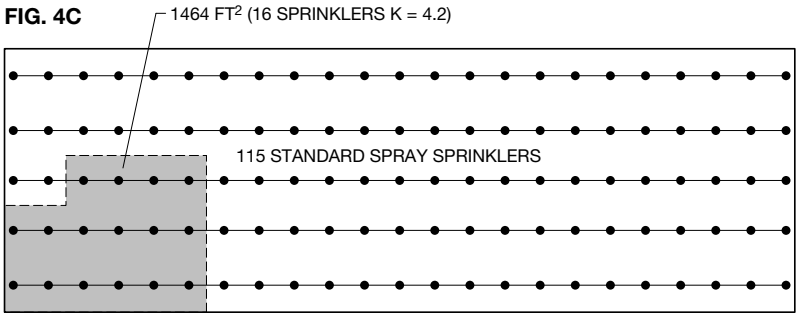
FIG. 4B





EXAMPLE 1:
WET PIPE SYSTEM CALCULATIONS

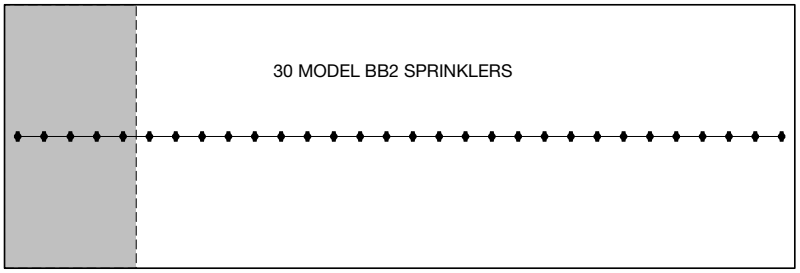
FIG. 4C



MIN. DESIGN AREA:
1500 FT^2 x 0.75[a] x 1.3[b]
= 1463 FT^2

16 SPRINKLERS x 11.1 GPM[c]
= 177.6 GPM[d]

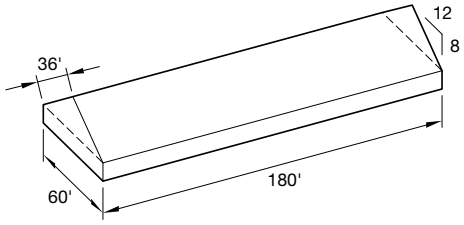
FIG. 4D



REF. TFP610, FIG. 20-A-1

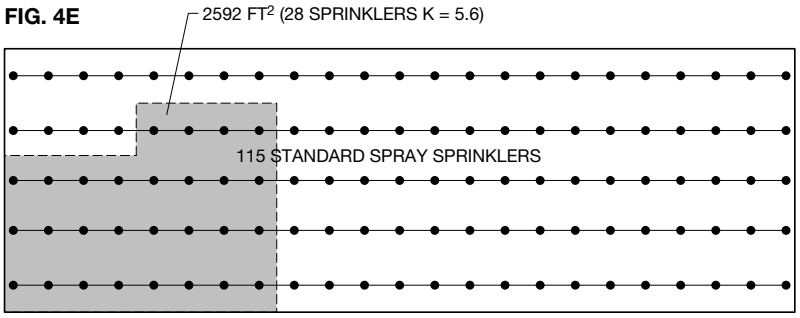
5 MODEL BB2 SPRINKLERS
AT 38 GPM = 190.0 GPM[d]

NOTES:
(a) 25% REDUCTION FOR QR SPRINKLERS AND 20 FOOT CEILING.
(b) 30% INCREASE FOR SLOPED CEILING.
(c) 8' x 12' x 0.1 GPM/FT^2 = 9.6 GPM; HOWEVER, 11.1 GPM IS MINIMUM FLOW AT 7 PSI.
(d) ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.



EXAMPLE 1:
DRY PIPE SYSTEM CALCULATIONS

FIG. 4E

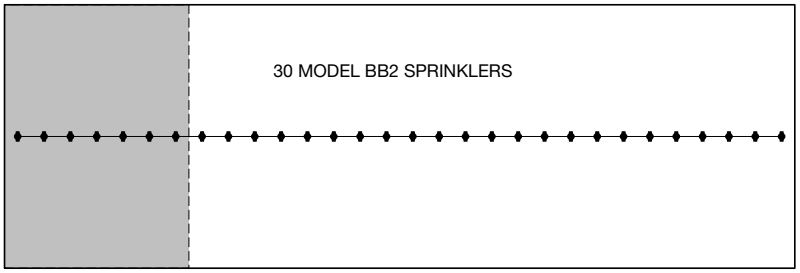


MIN. DESIGN AREA:
1500 FT^2 x 1.3[a] x 1.3[b]
= 2535 FT^2

28 SPRINKLERS x 14.8 GPM[c]
= 414.4 GPM[d]

(NO QR REDUCTION FOR
DRY PIPE SYSTEMS)

FIG. 4F



REF. TFP610, FIG. 20-A-1

7 MODEL BB2 SPRINKLERS
AT 38 GPM = 266.0 GPM[d]

NOTES:
(a) 30% INCREASE FOR DRY SYSTEM.
(b) 30% INCREASE FOR SLOPED CEILING.
(c) 8' x 12' x 0.1 GPM/FT^2 = 9.6 GPM; HOWEVER, 14.8 GPM IS MINIMUM FLOW AT 7 PSI.
(d) ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

EXAMPLE 2
(Figures 5A thru 5F):

For Example 2, we determine that the roof type is a gable with a roof span of 80 feet and a ceiling slope of 8:12. Figure 5A illustrates the Standard Spray Sprinkler layout. In terms of "Specific Application Sprinklers for Protecting Attics" shown in Figures 5B, this roof type is best protected with Model BB Sprinklers, plus two rows of Model AP Sprinklers to cover the 10 foot roof span areas at the eaves. With reference to Appendix A, TFP610, Table A, we would select the Model BB2 based on ceiling pitch of 8:12, and we could use either the K=5.6 or 8.0. based on allowable roof span.

With reference to Appendix A, TFP610, Figure 14A, "For single ridge construction, AP Sprinklers can be used to protect up to 10 feet of width at the eaves beyond the maximum allowable 60 foot, 40 foot, or 20 foot spans of the BB Sprinklers".

NOTES:

- *Where SD Sprinklers are used (ref. Appendix A, TFP610, Figure 14B), AP Sprinklers can be used to protect up to 10 feet of width at the eaves beyond the maximum allowable 40 foot, 30 foot, or 10 foot spans of the SD Sprinklers.*
- *Where HIP Sprinklers are used for hip roof construction (ref. Appendix A, TFP610, Figure 15), BB Sprinklers can be used in the center portion and HIP Sprinklers down the entire hip. AP Sprinklers can then be used to protect the eaves beyond the BB Sprinklers as described above, and AP Sprinklers can be used to protect up to 10 feet of width beyond the maximum allowable 28 foot or 20 foot horizontal coverage of the HIP Sprinklers.*
- *The use of Attic Sprinklers CANNOT be considered for attics over 80 feet wide.*

Figure 5B illustrates how the Model BB Sprinklers can be used in combination with the 2 additional rows of Model AP Sprinklers to protect attic spans up to 80 feet. There is the obvious advantage of using the Model BB Sprinklers as compared to the use of only Standard Spray Sprinklers. There will also be increased benefits for the use of Model AP Sprinklers, as explained later under the sub-section "When Can CPVC Pipe and Fittings Be Used".

Wet Pipe System Calculations:

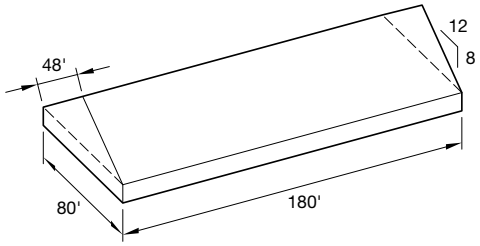
Fig. 5C – Standard Sprinklers: 255.3 GPM

Fig. 5D - Attic Sprinklers with AP Sprinklers at Eaves: 212.2 GPM

Dry Pipe System Calculations:

Fig. 5E – Standard Sprinklers: 429.2 GPM

Fig. 5F - Attic Sprinklers with AP Sprinklers at Eaves: 295.6 GPM



EXAMPLE 2:
SPRINKLER LAYOUTS

FIG. 5A

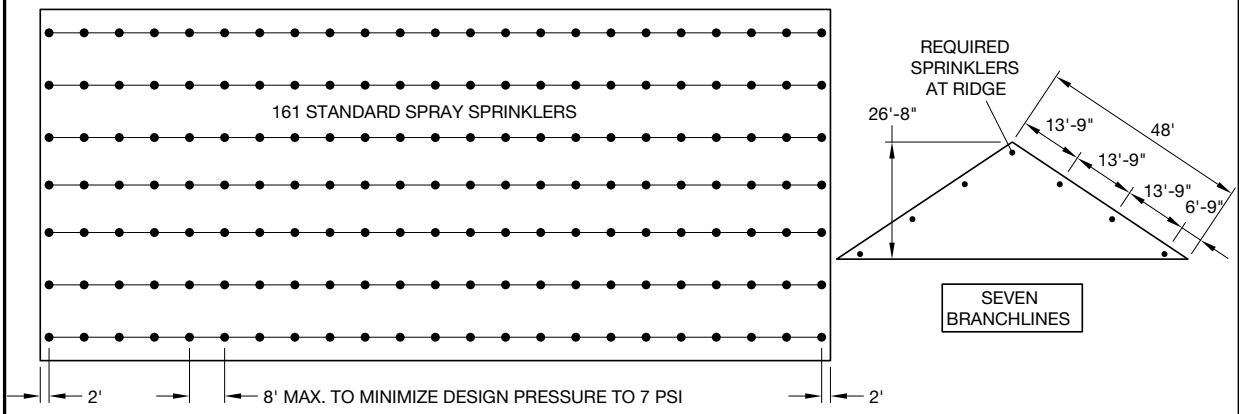
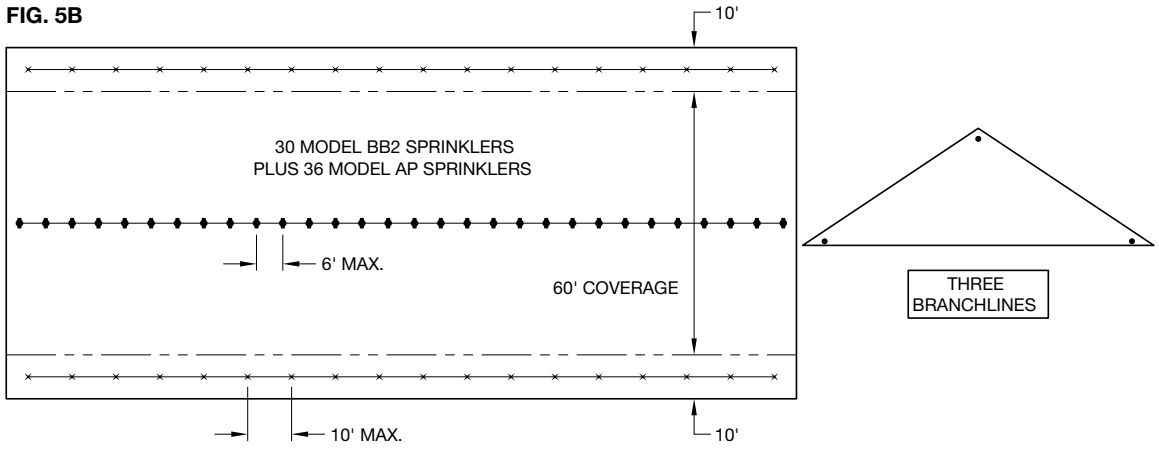
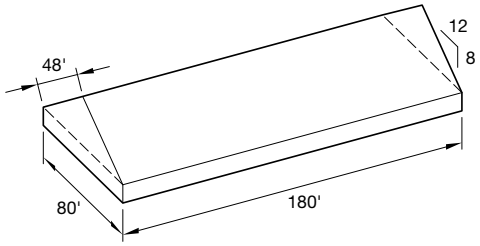


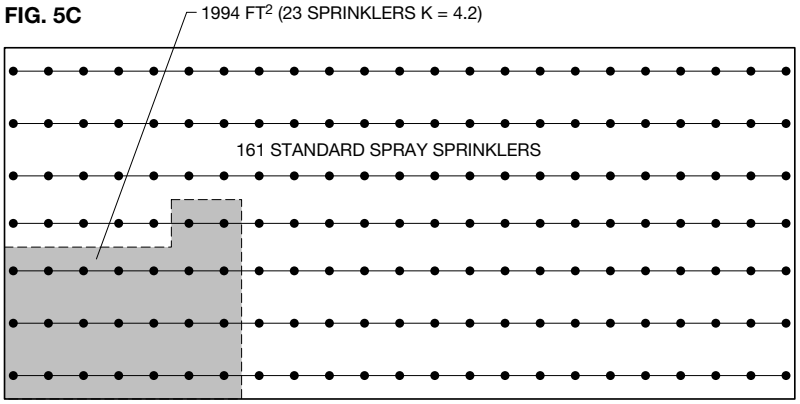
FIG. 5B





EXAMPLE 2:
WET PIPE SYSTEM CALCULATIONS

FIG. 5C

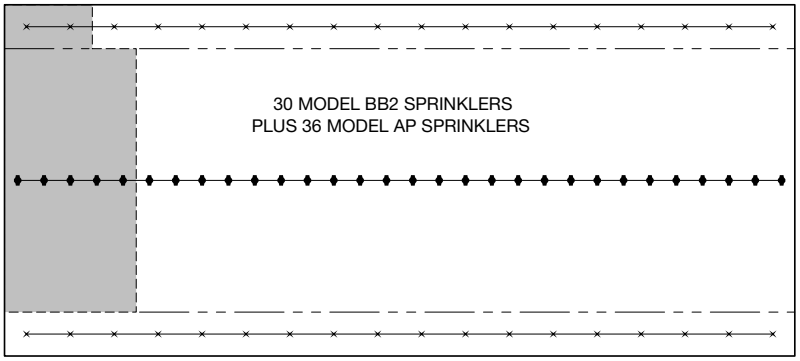


MIN. DESIGN AREA:
1500 FT^2 x 1.3[a] = 1950 FT^2

23 SPRINKLERS x 11.1 GPM[b]
= 255.3 GPM[c]

(NO QR REDUCTION FOR
26'-8" CEILING HEIGHT)

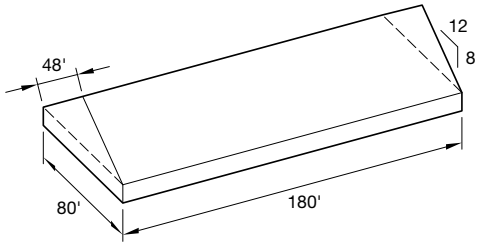
FIG. 5D



REF. TFP610, FIG. 20-B-2

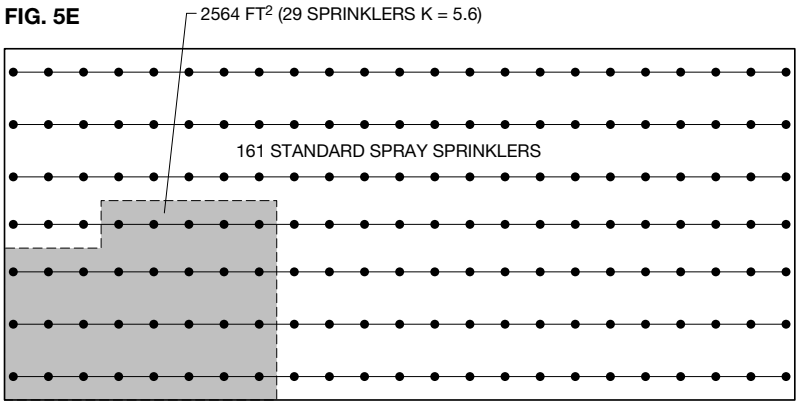
5 MODEL BB2 SPRINKLERS
AT 38 GPM PLUS 2 MODEL AP
SPRINKLERS AT 11.1 GPM
= 212.2 GPM[c]

NOTES:
(a) 30% INCREASE FOR SLOPED CEILING.
(b) 8' x 11.5' x 0.1 GPM/FT^2 = 9.2 GPM; HOWEVER, 11.1 GPM IS MINIMUM FLOW AT 7 PSI.
(c) ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.



EXAMPLE 2:
DRY PIPE SYSTEM CALCULATIONS

FIG. 5E

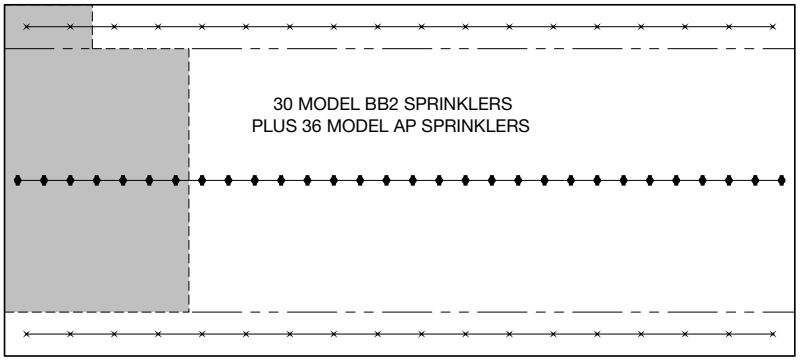


MIN. DESIGN AREA:
1500 FT^2 x 1.3[a] x 1.3[b]
= 2535 FT^2

29 SPRINKLERS x 14.8 GPM[c]
= 429.2 GPM[d]

(NO QR REDUCTION FOR
DRY PIPE SYSTEMS)

FIG. 5F



REF. TFP610, FIG. 20-B-2

7 MODEL BB2 SPRINKLERS
AT 38 GPM PLUS 2 MODEL AP
SPRINKLERS AT 14.8 GPM
= 295.6 GPM[d]

NOTES:
[a] 30% INCREASE FOR DRY SYSTEM.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 11.5' x 0.1 GPM/FT^2 = 9.2 GPM; HOWEVER, 14.8 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

EXAMPLE 3
(Figures 6A thru 6F):

For Example 3, we determine that the roof type is a hip with a roof span of 40 feet. We also determine that the framing for the roof structure is rafters framed perpendicular to the outside walls with a ceiling pitch of 12:12. Figure 6A illustrates the Standard Spray Sprinkler layout. In terms of "Specific Application Sprinklers for Protecting Attics" shown in Figure 6B, this roof type is best protected with a combination of Model BB and HIP Sprinklers.

The hip roof framed with rafters and joists presents a unique challenge for which the previously described Model BB Sprinklers cannot exclusively be used. The Model HIP Specific Application Attic Sprinkler covers the area of the hip in the attic. This is a slightly different concept than the BB (Back to Back). The HIP Sprinkler is located along the slope running down the hip, and throws a 90° pattern toward the outside eaves. This pattern allows the water to "corner" and control the fire. The HIP does not discharge much water directly up or down the hip, but rather it discharges most of the pattern out to each side (90°) down the slope of the roof. This sprinkler is spaced 6 feet to 3 feet on center down the slope. To use the HIP Sprinkler, the framing must be perpendicular to the outside wall and the maximum throw cannot exceed 28 feet measured horizontally.

Layout of the HIP takes special consideration. From the intersection of the top of the hip and the ridge, the maximum distance down the slope of the hip is 3 feet. Start the layout with the first sprinkler as close to that point as possible, but no further, while staying 6 inches away from the face of the trusses. Remember the slope of the hip is not equal to the slope of the roof from the ridge to the outside wall. In the case of the example, the hip length is 34'-6". Continue to space sprinklers down the hip at a maximum of 6 feet on center as measured along the slope of the hip. From the intersection of the bottom of the hip and the wall, the maximum distance up the slope of the hip is based on the sprinkler being within 7'-6" from the outside wall as measured flat (plan view). The distance between the top and bottom locations based on 6 foot maximum on center spacing determines that four additional HIP's will be necessary for a total of 6 HIP's per hip ridge.

Once again, we see evidence of the significant reduction in branch lines and sprinklers.

Wet Pipe System Calculations:

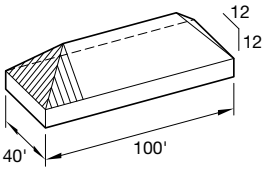
Fig. 6C – Standard Sprinklers: 299.7 GPM

Fig. 6D – Attic Sprinklers: 125.0 GPM

Dry Pipe System Calculations:

Fig. 6E – Standard Sprinklers: 651.2 GPM

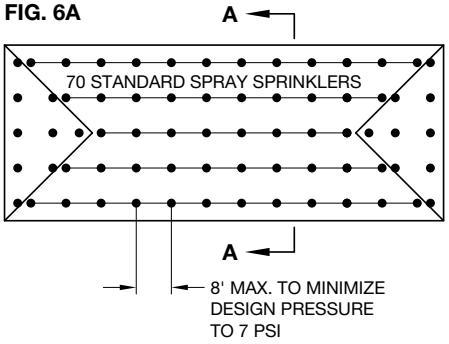
Fig. 6F – Attic Sprinklers: 225.0 GPM

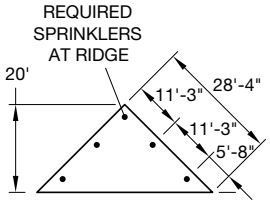


RAFTERS FRAMED PERPENDICULAR
TO OUTSIDE WALL

EXAMPLE 3:
SPRINKLER LAYOUTS

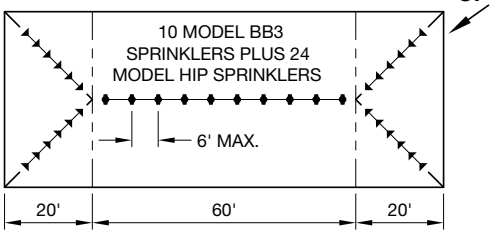
FIG. 6A



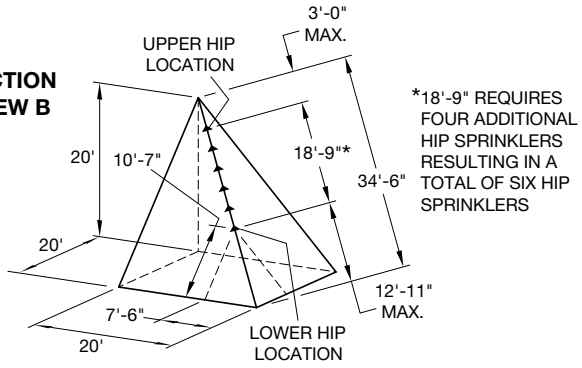


SECTION A-A

FIG. 6B

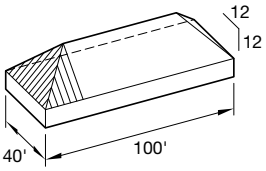


DIRECTION OF VIEW B



*18'-9" REQUIRES FOUR ADDITIONAL HIP SPRINKLERS RESULTING IN A TOTAL OF SIX HIP SPRINKLERS

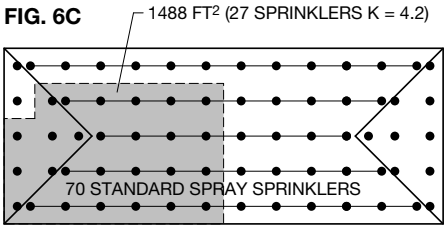
VIEW B



RAFTERS FRAMED PERPENDICULAR
TO OUTSIDE WALL

EXAMPLE 3:
WET PIPE SYSTEM CALCULATIONS

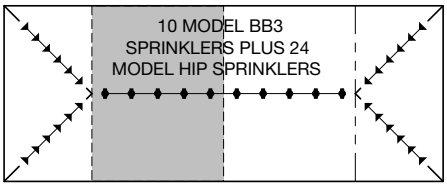
FIG. 6C



MIN. DESIGN AREA:
1500 FT^2 x 0.75[a] x 1.3[b]
= 1463 FT^2

27 SPRINKLERS x 11.1 GPM[c]
= 299.7 GPM[d]

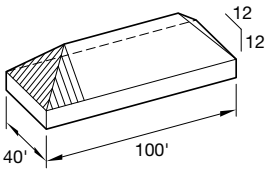
FIG. 6D



REF. TFP610, FIG. 20-A-2

5 MODEL BB3 SPRINKLERS AT
25 GPM = 125.0 GPM[d]

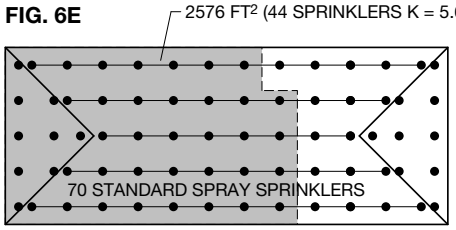
NOTES:
[a] 25% REDUCTION FOR QR SPRINKLERS AND 20 FOOT CEILING.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 8' x 0.1 GPM/FT^2 = 6.4 GPM; HOWEVER, 11.1 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.



RAFTERS FRAMED PERPENDICULAR
TO OUTSIDE WALL

EXAMPLE 3:
DRY PIPE SYSTEM CALCULATIONS

FIG. 6E

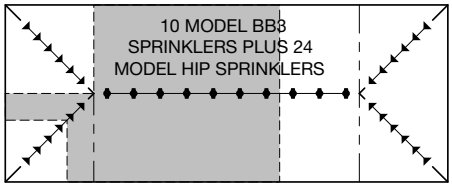


MIN. DESIGN AREA:
1500 FT^2 x 1.3[a] x 1.3[b]
= 2535 FT^2

44 SPRINKLERS x 14.8 GPM[c]
= 651.2 GPM[d]

(NO QR REDUCTION FOR
DRY PIPE SYSTEMS)

FIG. 6F



REF. TFP610, FIG. 20-A-2

7 MODEL BB3 SPRINKLERS AT
25 GPM PLUS 2 MODEL HIP
SPRINKLERS AT 25 GPM
= 225.0 GPM[d]

NOTE: PER TFP610, FIG. 20-A-2
THERE IS ALSO A SECOND
CALCULATION FOR THE MOST
DEMANDING SEVEN SPRINKLERS
THAT HAS NOT BEEN SHOWN.

NOTES:
[a] 30% INCREASE FOR DRY SYSTEM.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 8' x 0.1 GPM/FT^2 = 6.4 GPM; HOWEVER, 14.8 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

EXAMPLE 4
(Figures 7A thru 7J):

For Example 4, we determine that the roof type is a hip with a roof span of 40 feet. We also determine that the framing for the roof structure is trusses framed parallel to the outside walls with a ceiling pitch of 12:12. Figure 7A illustrates the Standard Spray Sprinkler layout. In terms of "Specific Application Sprinklers for Protecting Attics" shown in Figures 7B and 7C, this roof type is best protected with a combination of either Model BB Sprinklers and Standard Spray Sprinklers (Fig. 7B) or Model BB Sprinklers and Model AP Sprinklers (Fig. 7C).

The use of trusses in the hip area and where the trusses are parallel to the outside wall precludes the use of the Model HIP Sprinklers shown in Example 3. Therefore, the use of either Standard Spray Sprinklers or Model AP Sprinklers must be considered within the hip areas. There is not a significant reduction in sprinklers with installing AP Sprinklers instead of Standard Spray Sprinklers in combination with the Model BB Sprinklers; however, there will be increased benefits for the use of Model AP Sprinklers, as explained later under the sub-section "When Can CPVC Pipe and Fittings Be Used", as well as hydraulic advantages.

Wet Pipe System Calculations:

Fig. 7D – Standard Sprinklers: 299.7 GPM

Fig. 7E – Attic Sprinklers with Standard Sprinklers at Hips:
the more demanding* of 147.2 GPM or 285.9 GPM (see footnote below)

Fig. 7F – Attic Sprinklers with Model AP Sprinklers at Hips:
the more demanding* of 147.2 GPM or 199.8 GPM (see footnote below)

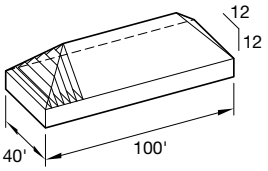
Dry Pipe System Calculations:

Fig. 7G – Standard Sprinklers: 651.2 GPM

Fig. 7H – Attic Sprinklers with Standard Sprinklers at Hips:
the more demanding* of 204.6 GPM or 481.2 GPM (see footnote below)

Fig. 7J – Attic Sprinklers with Model AP Sprinklers at Hips:
the more demanding* of 204.6 GPM or 266.4 GPM (see footnote below)

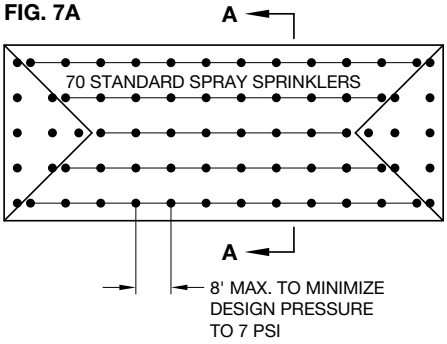
* Flow is not always indicative of the most demanding.
Required system pressure must also be taken into consideration.

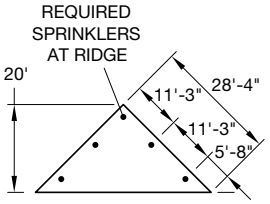


TRUSSES FRAMED PARALLEL
TO OUTSIDE WALL

EXAMPLE 4:
SPRINKLER LAYOUTS

FIG. 7A





SECTION A-A

FIG. 7B

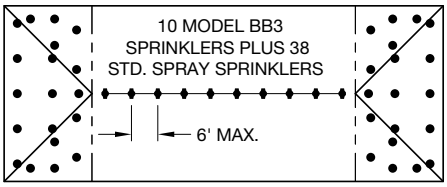
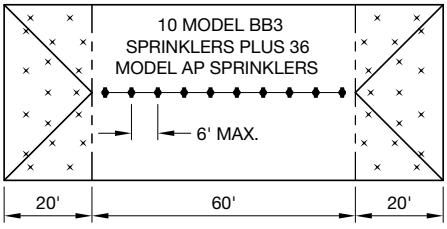
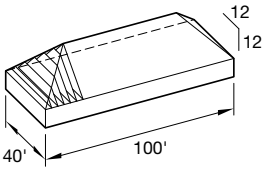


FIG. 7C

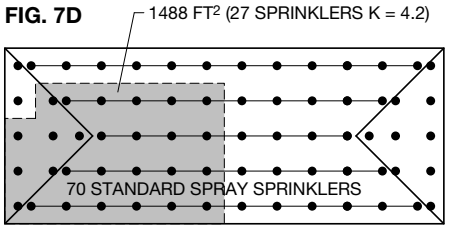




TRUSSES FRAMED PARALLEL
TO OUTSIDE WALL

EXAMPLE 4:
WET PIPE SYSTEM CALCULATIONS

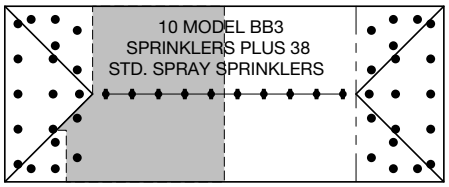
FIG. 7D



MIN. DESIGN AREA:
1500 FT^2 x 0.75[a] x 1.3[b]
= 1463 FT^2

27 SPRINKLERS x 11.1 GPM[c]
= 299.7 GPM[d]

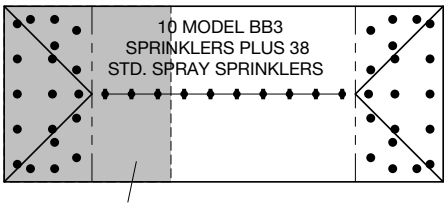
FIG. 7E - CALCULATION 1



REF. TFP610, FIG. 20-C-3

5 MODEL BB3 SPRINKLERS AT 25 GPM PLUS 2 STD. SPRAY SPRINKLERS AT 11.1 GPM = 147.2 GPM[d]

FIG. 7E - CALCULATION 2



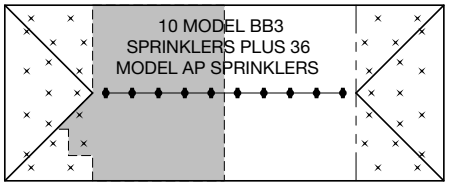
1520 FT^2 TO INCLUDE ENTIRE COVERAGE AREA OF LAST MODEL BB3 SPRINKLER

REF. TFP610, FIG. 20-C-3

MIN. DESIGN AREA:
1500 FT^2 x 0.75[a] x 1.3[b] = 1463 FT^2

3 MODEL BB3 SPRINKLERS AT 25 GPM PLUS 19 STD. SPRAY SPRINKLERS AT 11.1 GPM = 285.9 GPM(d)

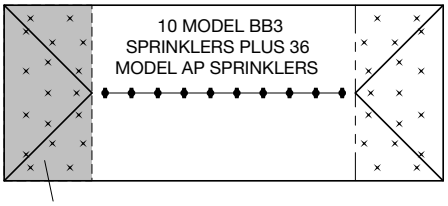
FIG. 7F - CALCULATION 1



REF. TFP610, FIG. 20-B-3

5 MODEL BB3 SPRINKLERS AT 25 GPM PLUS 2 MODEL AP SPRINKLERS AT 11.1 GPM = 147.2 GPM[d]

FIG. 7F - CALCULATION 2

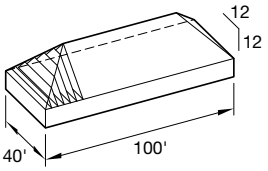


800 FT^2 (CALCULATE ALL AP SPRINKLERS UP TO A MAXIMUM OF 1500 FT^2)

REF. TFP610, FIG. 20-B-3

18 MODEL AP SPRINKLERS AT 11.1 GPM
= 199.8 GPM[d]

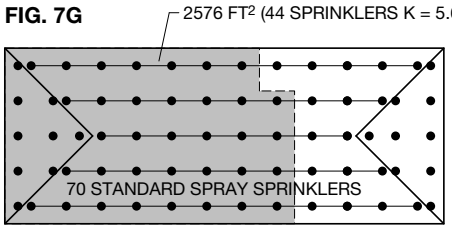
NOTES:
- [a] 25% REDUCTION FOR QR SPRINKLERS AND 20 FOOT CEILING.
- [b] 30% INCREASE FOR SLOPED CEILING.
- [c] 8' x 8' x 0.1 GPM/FT^2 = 6.4 GPM; HOWEVER, 11.1 GPM IS MINIMUM FLOW AT 7 PSI.
- [d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.



TRUSSES FRAMED PARALLEL
TO OUTSIDE WALL

EXAMPLE 4:
DRY PIPE SYSTEM CALCULATIONS

FIG. 7G

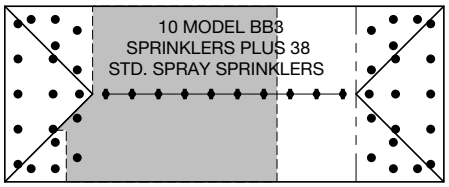


MIN. DESIGN AREA:
1500 FT^2 x 1.3[a] x 1.3[b]
= 2535 FT^2

44 SPRINKLERS x 14.8 GPM[c]
= 651.2 GPM[d]

(NO QR REDUCTION FOR
DRY PIPE SYSTEMS)

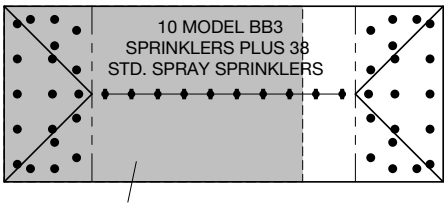
FIG. 7H - CALCULATION 1



REF. TFP610, FIG. 20-C-3

7 MODEL BB3 SPRINKLERS AT 25 GPM PLUS 2 STD.
SPRAY SPRINKLERS AT 14.8 GPM = 204.6 GPM[d]

FIG. 7H - CALCULATION 2



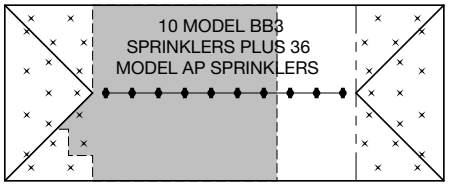
2720 FT^2 TO INCLUDE ENTIRE COVERAGE AREA
OF LAST MODEL BB3 SPRINKLER

REF. TFP610, FIG. 20-C-3

MIN. DESIGN AREA:
1500 FT^2 x 1.3[a] x 1.3[b] = 2535 FT^2

8 MODEL BB3 SPRINKLERS AT 25 GPM PLUS 19 STD.
SPRAY SPRINKLERS AT 14.8 GPM = 481.2 GPM[d]

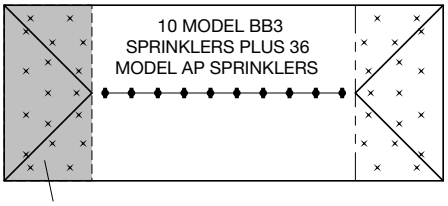
FIG. 7J - CALCULATION 1



REF. TFP610, FIG. 20-B-3

7 MODEL BB3 SPRINKLERS AT 25 GPM PLUS 2
MODEL AP SPRINKLERS AT 14.8 GPM = 204.6 GPM[d]

FIG. 7J - CALCULATION 2



800 FT^2 (CALCULATE ALL AP SPRINKLERS UP TO
A MAXIMUM OF 1950 FT^2)

REF. TFP610, FIG. 20-B-3

18 MODEL AP SPRINKLERS AT 14.8 GPM
= 266.4 GPM[d]

NOTES:
[a] 30% INCREASE FOR DRY SYSTEM.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 8' x 0.1 GPM/FT^2 = 6.4 GPM; HOWEVER, 14.8 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

EXAMPLE 5
(Figures 8A thru 8F):

For Example 5, we determine that the roof is a gable having a span of 60 feet and a ceiling pitch of 8:12. Figure 8A illustrates the Standard Spray Sprinkler layout. Compounding the complexity of the sprinkler design is the presence of double shear walls, where the walls are located 4 feet from the ridge on both sides of the ridge. In terms of "Specific Application Sprinklers for Protecting Attics" shown in Figure 8B, this roof type is best protected with a combination of Model SD and Standard Spray Sprinklers.

In the case of applying Standard Spray Sprinklers (Ref. Fig. 8A), this attic space arrangement presents the need for two additional rows of Standard Spray Sprinklers due to the need for locating sprinklers at the high points adjacent to the shear walls. For this type of situation, the Model SD Sprinklers should be considered. The Model SD (Single Directional) Specific Application Attic Sprinkler, like the Model BB, throws a narrow but long pattern. However, unlike the Model BB, the Model SD only discharges in one direction. These sprinklers are primarily used where shear walls or draft curtains have been installed within an attic space. Three different models (i.e., SD1, SD2 & SD3) are available for different roof slopes. With reference to Appendix A, TFP610, Table A, we would select the Model SD2 based on ceiling pitch of 8:12, and we could ultimately use the minimum flow rate of 25 GPM for the 26 foot span of coverage.

The corridor created by the shear walls may be protected by Standard Spray Sprinklers, as shown in Figure 8B, or Model AP Sprinklers. There would not be a significant reduction in quantity of AP Sprinklers as compared to Standard Spray Sprinklers, and the system demand would be identical. However there will be increased benefits for the use of Model AP Sprinklers, as explained later under the sub-section "When Can CPVC Pipe and Fittings Be Used".

Wet Pipe System Calculations:

Fig. 8C – Standard Sprinklers: 255.3 GPM

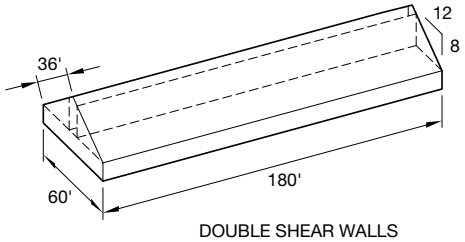
Fig. 8D – Attic Sprinklers with Standard Sprinklers
(or Model AP Sprinklers) between Shear Walls:
the more demanding* of 125.0 GPM or 55.5 GPM (see footnote below)

Dry Pipe System Calculations:

Fig. 8E – Standard Sprinklers: 621.6 GPM

Fig. 8F – Attic Sprinklers with Standard Sprinklers
(or Model AP Sprinklers) between Shear Walls:
the more demanding* of 225.0 GPM or 103.6 GPM (see footnote below)

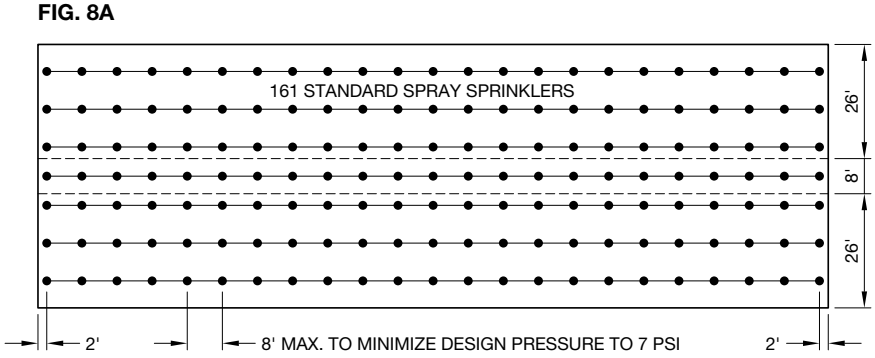
* Flow is not always indicative of the most demanding.
Required system pressure must also be taken into consideration.

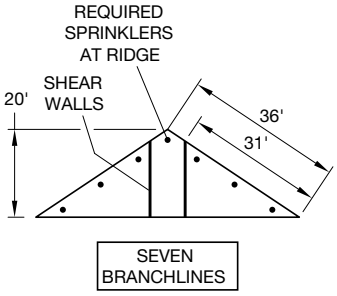


DOUBLE SHEAR WALLS
(COMPARTMENTED)

EXAMPLE 5:
SPRINKLER LAYOUTS

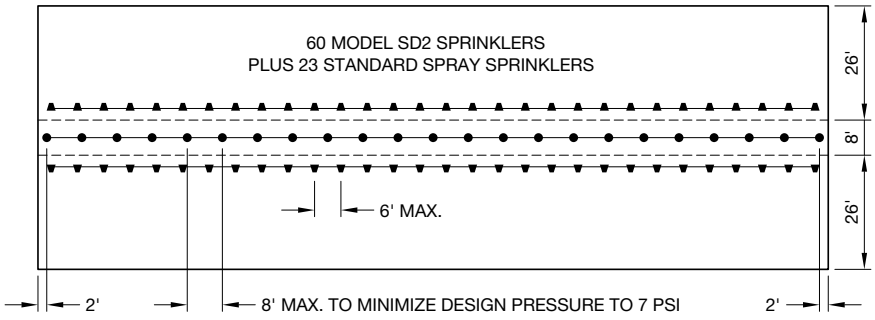
FIG. 8A

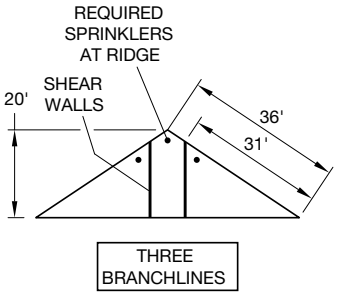




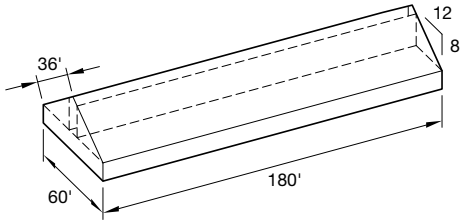
SEVEN
BRANCHLINES

FIG. 8B





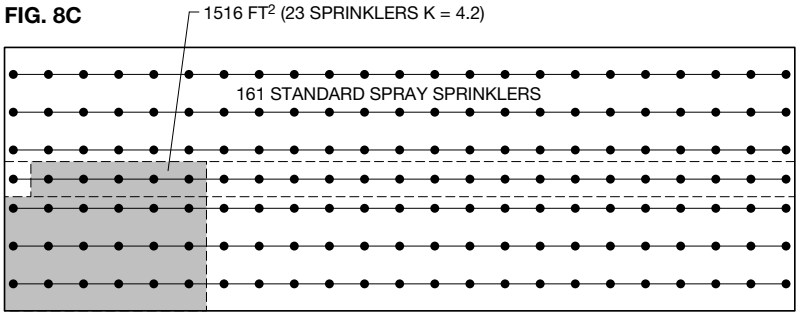
THREE
BRANCHLINES



DOUBLE SHEAR WALLS
(COMPARTMENTED)

EXAMPLE 5:
WET PIPE SYSTEM CALCULATIONS

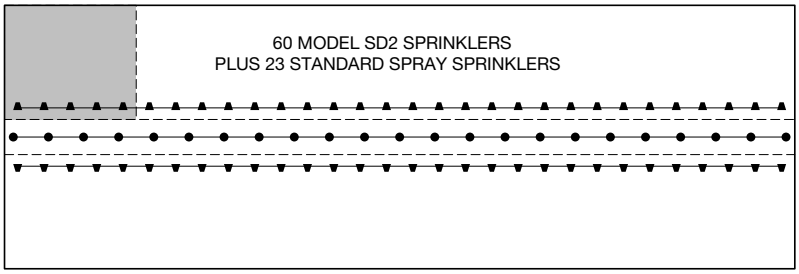
FIG. 8C



MIN. DESIGN AREA:
1500 FT^2 x 0.75[a] x 1.3[b]
= 1463 FT^2

23 SPRINKLERS x 11.1 GPM[c]
= 255.3 GPM[d]

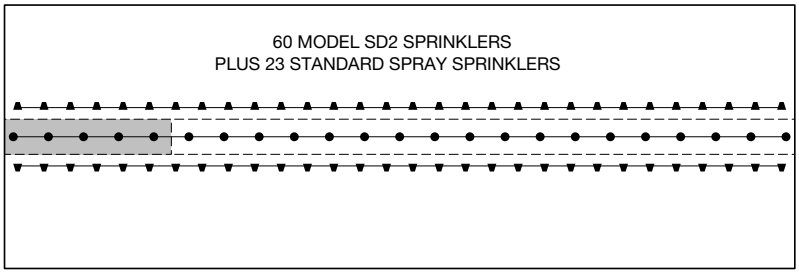
FIG. 8D - CALCULATION 1



REF. TFP610, FIG. 20-C-1

5 MODEL SD2 SPRINKLERS AT
25 GPM = 125.0 GPM[d]

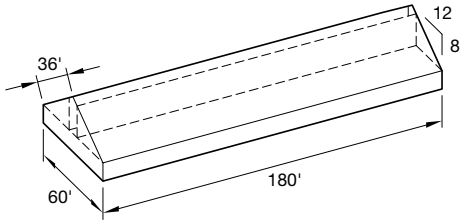
FIG. 8D - CALCULATION 2



REF. TFP610, FIG. 20-C-1

5 STD. SPRAY SPRINKLERS AT
11.1 GPM = 55.5 GPM[d]

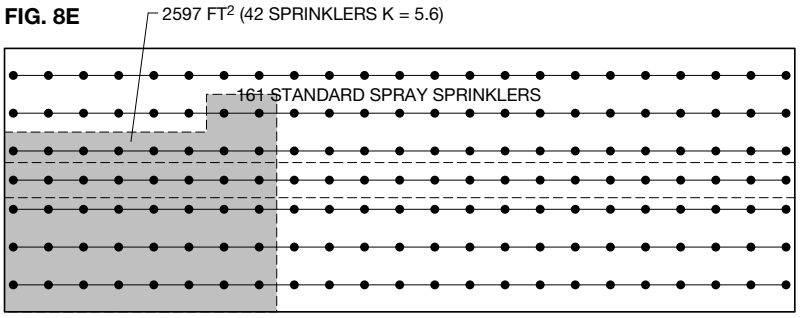
NOTES:
[a] 25% REDUCTION FOR QR SPRINKLERS AND 20 FOOT CEILING.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 10.25' x 0.1 GPM/FT^2 = 8.2 GPM; HOWEVER, 11.1 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.



DOUBLE SHEAR WALLS
(COMPARTMENTED)

EXAMPLE 5:
DRY PIPE SYSTEM CALCULATIONS

FIG. 8E

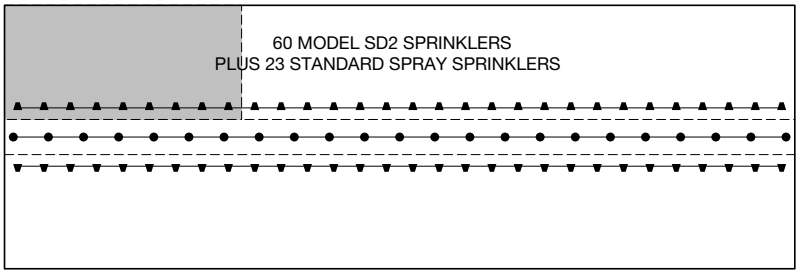


MIN. DESIGN AREA:
1500 FT^2 x 1.3[a] x 1.3[b]
= 2535 FT^2

42 SPRINKLERS x 14.8 GPM[c]
= 621.6 GPM[d]

(NO QR REDUCTION FOR
DRY PIPE SYSTEMS)

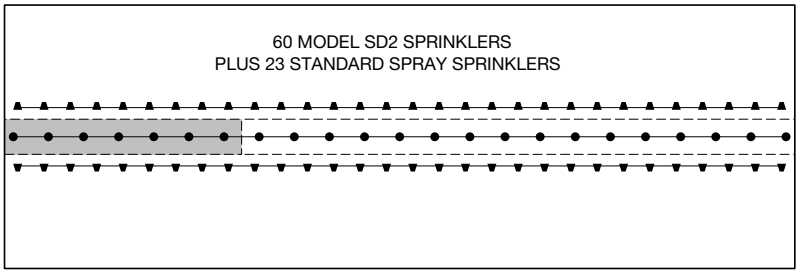
FIG. 8F - CALCULATION 1



REF. TFP610, FIG. 20-C-1

9 MODEL SD2 SPRINKLERS AT
25 GPM = 225.0 GPM[d]

FIG. 8F - CALCULATION 2



REF. TFP610, FIG. 20-C-1

7 STD. SPRAY SPRINKLERS AT
14.8 GPM = 103.6 GPM[d]

NOTES:
[a] 30% INCREASE FOR DRY SYSTEM.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 10.25' x 0.1 GPM/FT^2 = 8.2 GPM; HOWEVER, 14.8 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

EXAMPLE 6
(Figures 9A thru 9F):

For Example 6, we determine that the roof is a gable having a span of 60 feet and a ceiling pitch of 8:12. Compounding the complexity of the sprinkler design is the presence of a single shear wall, where the wall is located 4 feet from the ridge. Figure 9A illustrates the Standard Spray Sprinkler layout. In terms of "Specific Application Sprinklers for Protecting Attics" shown in Figure 9B, this roof type is best protected with a combination of Model SD and Model BB Sprinklers.

In the case of applying Standard Spray Sprinklers, this attic space arrangement presents the need for one additional row of Standard Spray Sprinklers due to the need for locating sprinklers at the high-point adjacent to the shear wall.

In this example with one shear wall, a corridor as shown in Example 5 is not present, and a combination of Model SD and Model BB Sprinklers can provide a reduction in branch lines and sprinklers.

Consideration can also be given to using SD's instead of BB's when the ceiling pitch to maximum distance from ridge to shear wall combination permits the SD to be located 16 to 22 inches below the theoretical intersection of the shear wall and ceiling. In cases where SD's can be used instead of BB's, an increased hydraulic advantage can be gained. And, in the case of the wet pipe system calculations (Figs. 9C and 9D) where the Attic Sprinklers have a greater system demand than the Standard Spray Sprinklers, the use of SD's instead of BB's may provide the desired hydraulic advantage in addition to decreasing branch lines and sprinklers.

Wet Pipe System Calculations:

Fig. 9C – Standard Sprinklers: 242.2 GPM

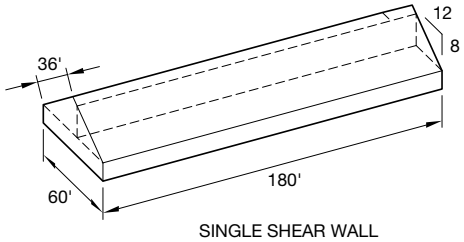
Fig. 9D – Attic Sprinklers:
the greater demand* of 175.0 GPM or 190.0 GPM (see footnote below)

Dry Pipe System Calculations:

Fig. 9E – Standard Sprinklers: 488.4 GPM

Fig. 9F – Attic Sprinklers:
the greater demand* of 315.0 GPM or 266.0 GPM (see footnote below)

* Flow is not always indicative of the most demanding.
Required system pressure must also be taken into consideration.



SINGLE SHEAR WALL
(COMPARTMENTED)

EXAMPLE 6:
SPRINKLER LAYOUTS

FIG. 9A

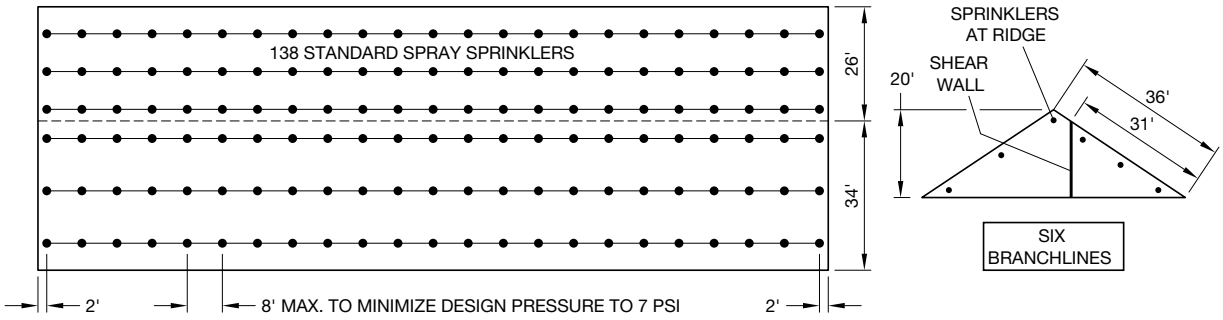
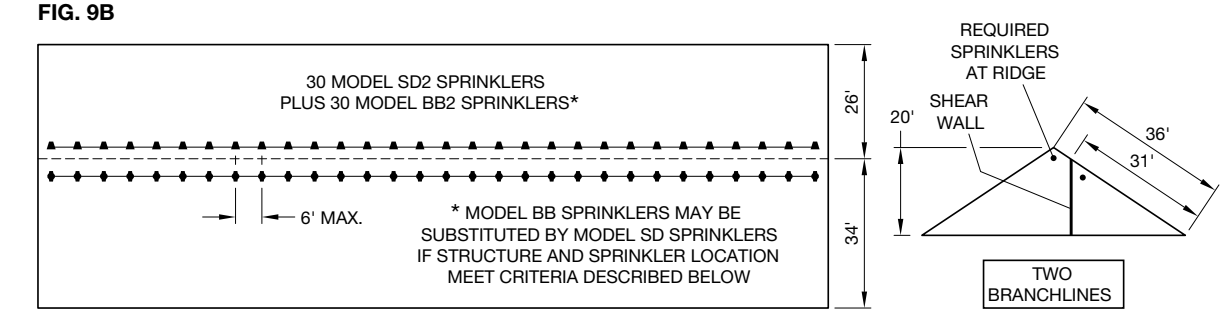
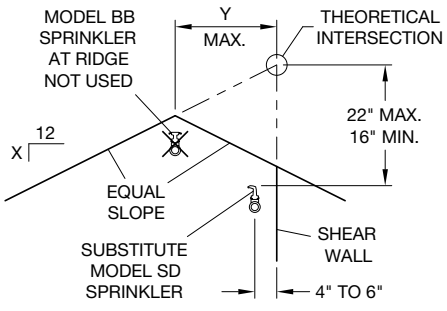
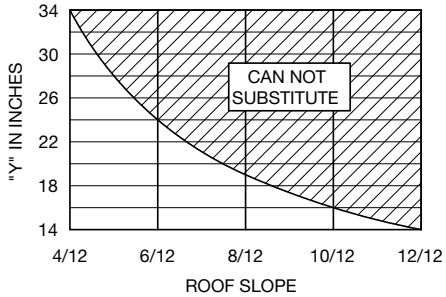
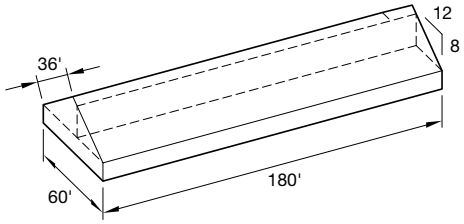


FIG. 9B





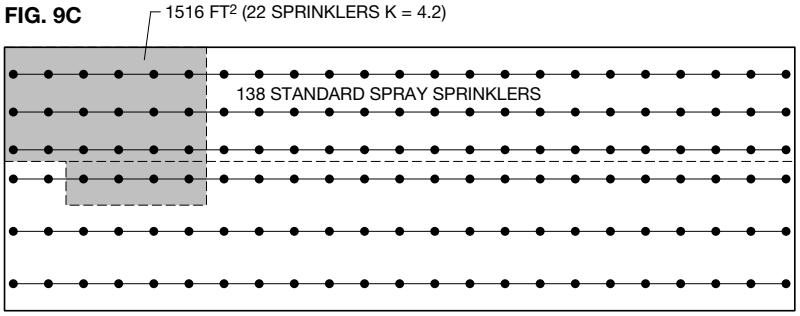




SINGLE SHEAR WALL
(COMPARTMENTED)

EXAMPLE 6:
WET PIPE SYSTEM CALCULATIONS

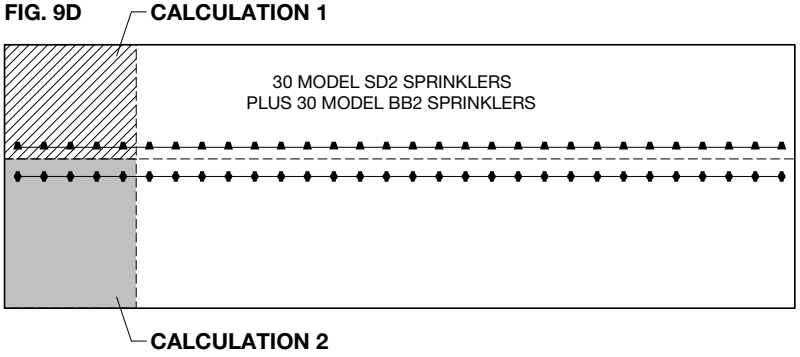
FIG. 9C



MIN. DESIGN AREA:
1500 FT^2 x 0.75[a] x 1.3[b]
= 1463 FT^2

22 SPRINKLERS x 11.1 GPM[c]
= 244.2 GPM[d]

FIG. 9D



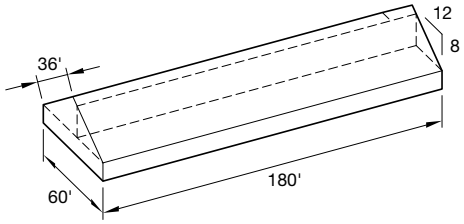
REF. TFP610, FIG. 20-A-1 & 20-A-4

5 MODEL SD2 SPRINKLERS
AT 35 GPM = 175.0 GPM[d]

- AND PROVE -

5 MODEL BB2 SPRINKLERS
AT 38 GPM = 190.0 GPM[d]

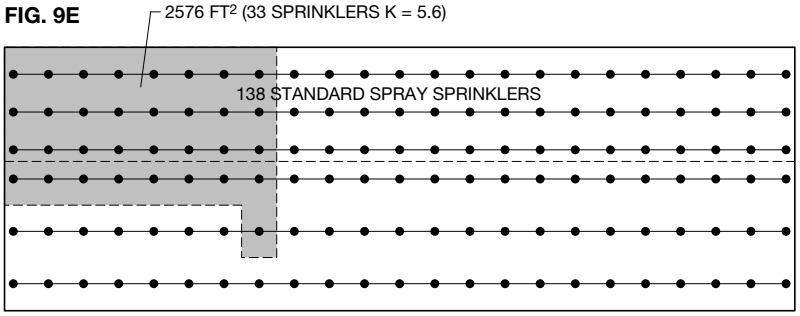
NOTES:
[a] 25% REDUCTION FOR QR SPRINKLERS AND 20 FOOT CEILING.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 12' x 0.1 GPM/FT^2 = 9.6 GPM; HOWEVER, 11.1 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.



SINGLE SHEAR WALL
(COMPARTMENTED)

EXAMPLE 6:
DRY PIPE SYSTEM CALCULATIONS

FIG. 9E

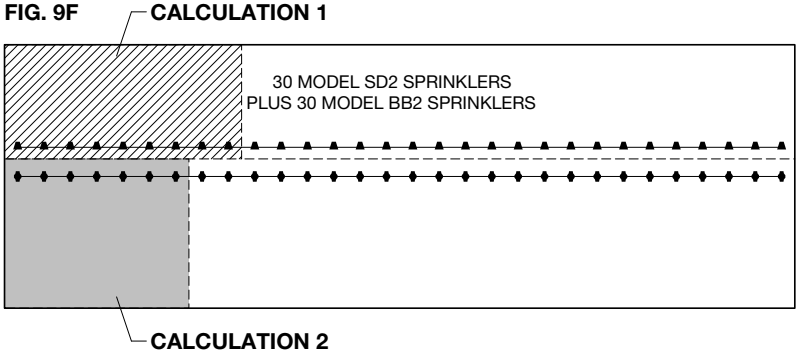


MIN. DESIGN AREA:
1500 FT^2 x 1.3[a] x 1.3[b]
= 2535 FT^2

33 SPRINKLERS x 14.8 GPM[c]
= 488.4 GPM[d]

(NO QR REDUCTION FOR
DRY PIPE SYSTEMS)

FIG. 9F



REF. TFP610, FIG. 20-A-1 & 20-A-4

9 MODEL SD2 SPRINKLERS
AT 35 GPM = 315.0 GPM[d]

- AND PROVE -

7 MODEL BB2 SPRINKLERS
AT 38 GPM = 266.0 GPM[d]

NOTES:
[a] 30% INCREASE FOR DRY SYSTEM.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 12' x 0.1 GPM/FT^2 = 9.6 GPM; HOWEVER, 14.8 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

EXAMPLE 7
(Figures 10A thru 10J):

For Example 7, we determine that there are two different roof structure configurations – a main hip roof and two smaller gable ended attic spaces. The ceiling pitch is noted to be 12:12 throughout and the gable ended attic spaces are open to the main hip roof area. Figure 10A illustrates the Standard Spray Sprinkler layout. In terms of "Specific Application Sprinklers for Protecting Attics" shown in Figures 10B and 10C, this roof type is best protected with a combination of Model BB and Standard Spray Sprinklers (Fig. 10B) or Model BB Sprinklers and Model AP Sprinklers (Fig. 10C). With reference to Appendix A, TFP610, Table A, we would select the Model BB3 with a K-factor of 5.6 or 8.0 for the main hip roof due to the 40 foot span, and we would select the BB3 with a K-factor of 4.2 for the gable ended attic spaces having the 20 foot span.

The reduction in branch lines and sprinklers is once again observed with the use of Specific Application Attic Sprinklers. Further advantages of the use of AP Sprinklers as compare to Standard Spray Sprinklers are explained later under the sub-section "When Can CPVC Pipe and Fittings Be Used".

Two important elements are included in Example 7. First -- the use of the 4.2 K-factor Model BB Sprinklers with their maximum span coverage of 20 feet in the gable ended attic spaces. The smaller span rating of the 4.2 K-factor BB Sprinkler has a lower design flow than the 5.6 or 8.0 K-factor BB Sprinklers. Second– the use of Model AP Sprinklers instead of Standard Spray Sprinklers in the adjoining areas between the BB3 Sprinklers. Where areas protected by AP Sprinklers are separated by a minimum of 15 feet by areas protected by BB, SD, or HIP Sprinklers, the area protected by the AP Sprinklers can be considered a separate hydraulic design area. The potential hydraulic advantage is illustrated in Figures 10F and 10J.

Wet Pipe System Calculations:

Fig. 10D – Standard Sprinklers: 321.9 GPM

Fig. 10E – Attic Sprinklers with Standard Sprinklers in Adjoining Areas:
the more demanding* of 147.2 GPM or 304,7 GPM (see footnote below)

Fig. 10F - Attic Sprinklers with Model AP Sprinklers in Adjoining Areas :
the more demanding* of 147.2 GPM or 188.7 GPM (see footnote below)

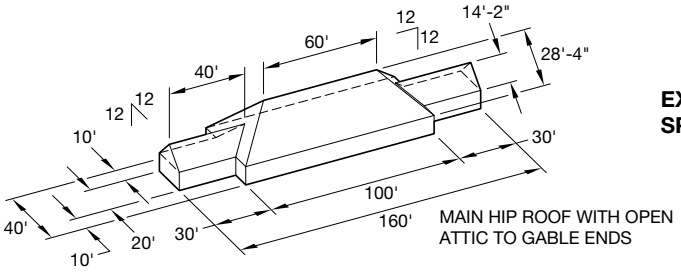
Dry Pipe System Calculations:

Fig. 10G – Standard Sprinklers: 666.0 GPM

Fig. 10H – Attic Sprinklers with Standard Sprinklers in Adjoining Areas:
the more demanding* of 204.6 GPM or 467.6 GPM (see footnote below)

Fig. 10J - Attic Sprinklers with Model AP Sprinklers in Adjoining Areas:
the more demanding* of 204.6 GPM or 251.6 GPM (see footnote below)

* Flow is not always indicative of the most demanding.
Required system pressure must also be taken into consideration.



EXAMPLE 7:
SPRINKLER LAYOUTS

FIG. 10A

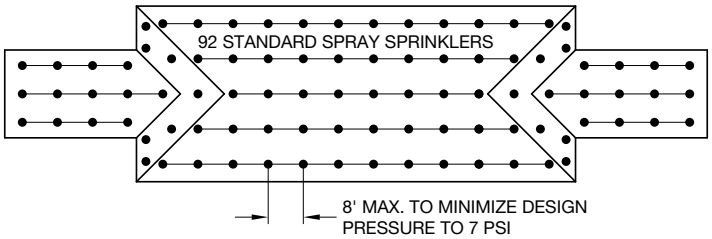


FIG. 10B

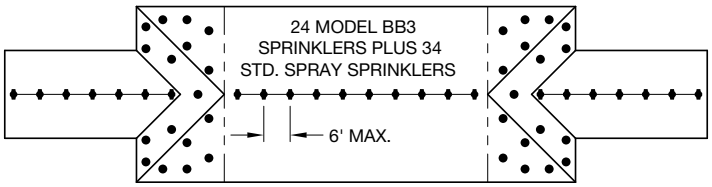
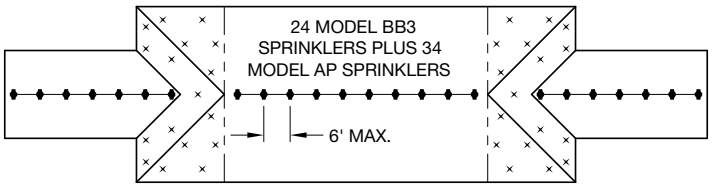
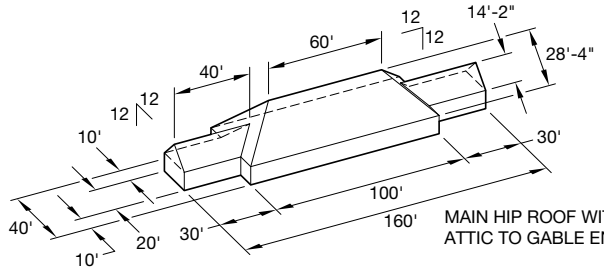


FIG. 10C

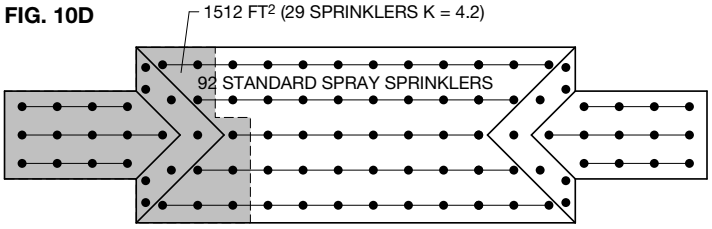


EXAMPLE 7:
WET PIPE SYSTEM CALCULATIONS



MAIN HIP ROOF WITH OPEN ATTIC TO GABLE ENDS

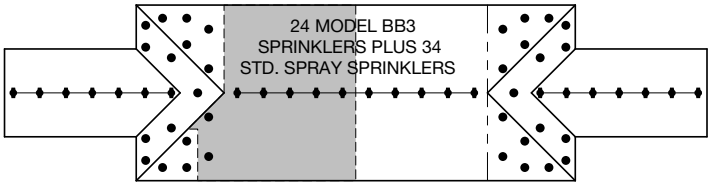
FIG. 10D



MIN. DESIGN AREA:
1500 FT^2 x 0.75[a] x 1.3[b] = 1463 FT^2

29 SPRINKLERS x 11.1 GPM[c]
= 321.9 GPM[d]

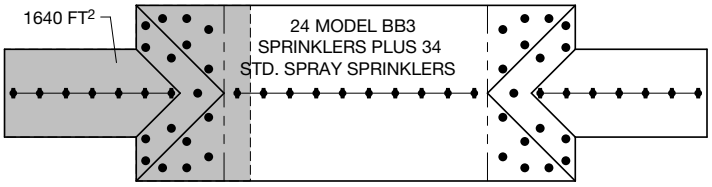
FIG. 10E - CALCULATION 1



REF. TFP610, FIG. 20-C-5 & FIG. 20-C-3

5 MODEL BB3 SPRINKLERS AT 25 GPM
PLUS 2 STD. SPRAY SPRINKLERS AT
11.1 GPM = 147.2 GPM[d]

FIG. 10E - CALCULATION 2

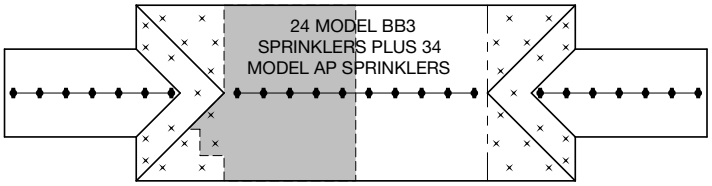


REF. TFP610, FIG. 20-C-5 & FIG. 20-C-3

MIN. DESIGN AREA:
1500 FT^2 x 0.75[a] x 1.3[b] = 1463 FT^2

1 MODEL BB3 SPRINKLERS AT 25 GPM
PLUS 7 MODEL BB3 SPRINKLERS AT
13 GPM PLUS 17 STD. SPRAY SPRINKLERS
AT 11.1 GPM = 304.7 GPM[d]

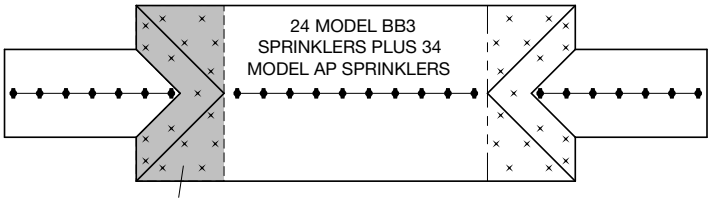
FIG. 10F - CALCULATION 1



REF. TFP610, FIG. 20-B-5 & FIG. 20-B-3

5 MODEL BB3 SPRINKLERS AT 25 GPM
PLUS 2 MODEL AP SPRINKLERS AT
11.1 GPM = 147.2 GPM[d]

FIG. 10F - CALCULATION 2



REF. TFP610, FIG. 20-B-5 & FIG. 20-B-3

17 MODEL AP SPRINKLERS AT 11.1 GPM
= 188.7 GPM[d]

700 FT^2 (CALCULATE ALL AP SPRINKLERS UP TO A MAXIMUM OF 1500 FT^2)

NOTES:

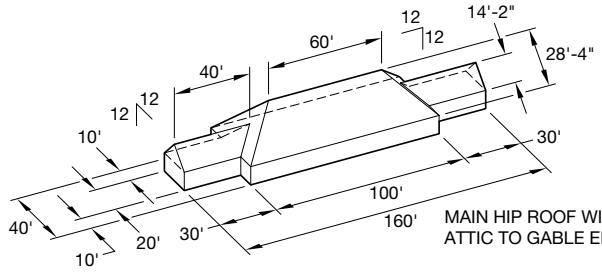
[a] 25% REDUCTION FOR QR SPRINKLERS AND 20 FOOT CEILING.

[b] 30% INCREASE FOR SLOPED CEILING.

[c] 8' x 8' x 0.1 GPM/FT^2 = 6.4 GPM; HOWEVER, 11.1 GPM IS MINIMUM FLOW AT 7 PSI.

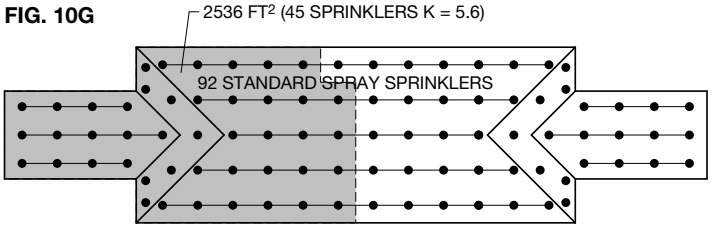
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

EXAMPLE 7:
DRY PIPE SYSTEM CALCULATIONS



MAIN HIP ROOF WITH OPEN ATTIC TO GABLE ENDS

FIG. 10G

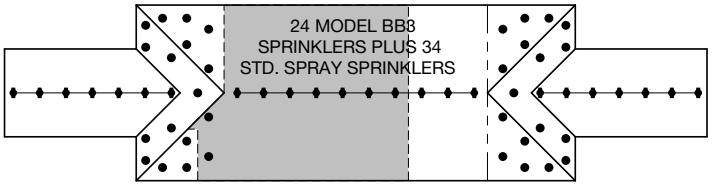


MIN. DESIGN AREA:
1500 FT² x 1.3[a] x 1.3[b] = 2535 FT²

45 SPRINKLERS x 14.8 GPM[c]
= 666.0 GPM[d]

(NO QR REDUCTION FOR
DRY PIPE SYSTEMS)

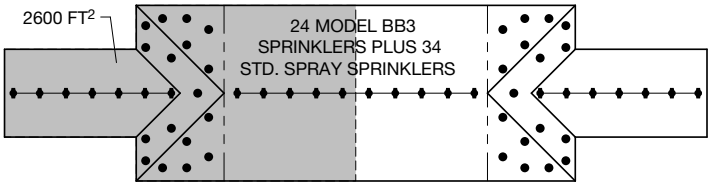
FIG. 10H - CALCULATION 1



REF. TFP610, FIG. 20-C-5 & FIG. 20-C-3

7 MODEL BB3 SPRINKLERS AT 25 GPM
PLUS 2 STD. SPRAY SPRINKLERS AT
14.8 GPM = 204.6 GPM[d]

FIG. 10H - CALCULATION 2

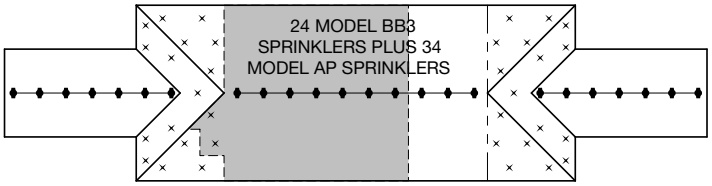


REF. TFP610, FIG. 20-C-5 & FIG. 20-C-3

MIN. DESIGN AREA:
1500 FT² x 1.3[a] x 1.3[b] = 2535 FT²

5 MODEL BB3 SPRINKLERS AT 25 GPM
PLUS 7 MODEL BB3 SPRINKLERS AT
13 GPM PLUS 17 STD. SPRAY SPRINKLERS
AT 14.8 GPM = 467.6 GPM[d]

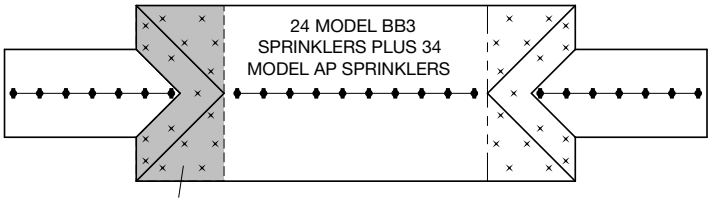
FIG. 10J - CALCULATION 1



REF. TFP610, FIG. 20-B-5 & FIG. 20-B-3

7 MODEL BB3 SPRINKLERS AT 25 GPM
PLUS 2 MODEL AP SPRINKLERS AT
14.8 GPM = 204.6 GPM[d]

FIG. 10J - CALCULATION 2



REF. TFP610, FIG. 20-B-5 & FIG. 20-B-3

17 MODEL AP SPRINKLERS AT 14.8 GPM
= 251.6 GPM[d]

700 FT² (CALCULATE ALL
AP SPRINKLERS UP TO A
MAXIMUM OF 1950 FT²)

NOTES:

[a] 30% INCREASE FOR DRY SYSTEM.

[b] 30% INCREASE FOR SLOPED CEILING.

[c] 8' x 8' x 0.1 GPM/FT² = 6.4 GPM; HOWEVER, 14.8 GPM IS MINIMUM FLOW AT 7 PSI.

[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

EXAMPLE 8:
(Figures 11A thru 11F):

For Example 8, we determine that the roof type is a gable with a roof span of 60 feet and a ceiling slope of 12:12. In addition, there are three built-on dormers (i.e., the dormers are built on top of the main roof sheathing creating a compartmentalization between the main roof area and the dormers). Figure 11A illustrates the Standard Spray Sprinkler layout. In terms of "Specific Application Sprinklers for Protecting Attics" shown in Figure 11B, this roof type is best protected using Model BB Sprinklers under the main roof and Standard Spray Sprinklers within the dormers. Some dormer shapes, for example a gable roof instead of a shed roof, may lend themselves to using Attic Sprinklers within the dormers.

Example 8 illustrates that for Figures 11D and 11F there is no need to add any of the Standard Spray Sprinklers into the Attic Sprinkler calculation; however, per TFP610, Figure 20-C-6, each dormer area (or compartmented area having Standard Spray Sprinklers) needs to be separately calculated per NFPA 13. The largest demand would then be used for the system water supply. In this case, due to the limited number of sprinklers in each dormer, it is assumed that the Attic Sprinkler demand would automatically be the largest demand. The dormers, however, must still be individually calculated to assure proper size piping to supply the Standard Spray Sprinklers.

Wet Pipe System Calculations:

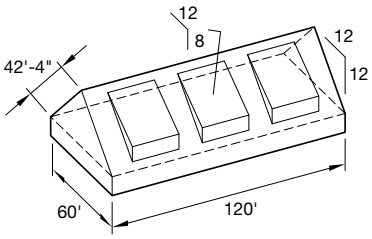
Fig. 11C – Standard Sprinklers: 321.9 GPM

Fig. 11D – Attic Sprinklers: 190.0 GPM

Dry Pipe System Calculations:

Fig. 11E – Standard Sprinklers: 547.6 GPM

Fig. 11F – Attic Sprinklers: 266.0 GPM

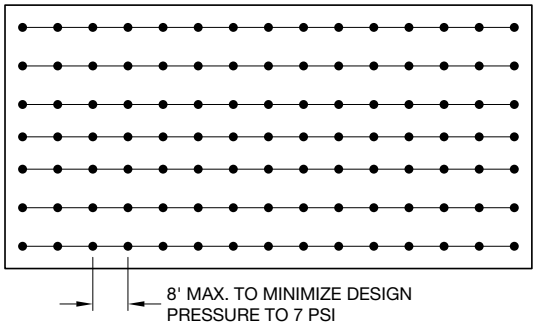


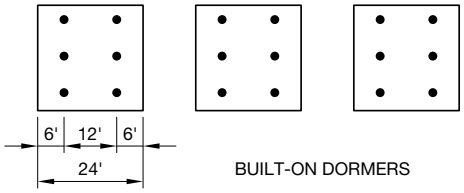
MAIN ROOF AREA WITH
BUILT-ON DORMERS

EXAMPLE 8:
SPRINKLER LAYOUTS

FIG. 11A

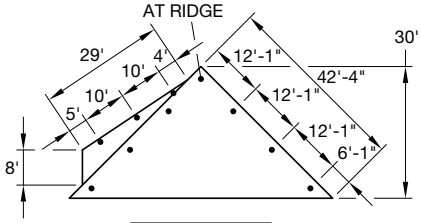
123 STANDARD SPRAY SPRINKLERS
(105 UNDER MAIN ROOF PLUS
18 IN BUILT-ON DORMERS)





BUILT-ON DORMERS

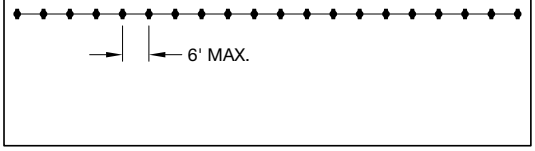
REQUIRED
SPRINKLERS
AT RIDGE

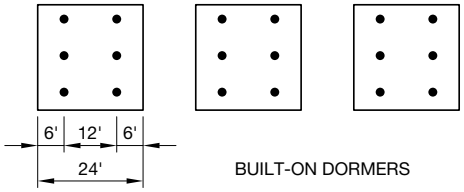


SEVEN
BRANCHLINES
PLUS DORMER
PROTECTION

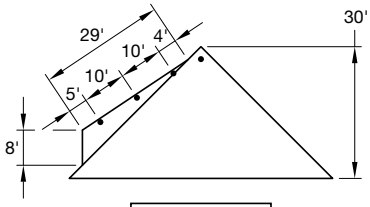
FIG. 11B

20 MODEL BB3 SPRINKLERS
UNDER MAIN ROOF PLUS
18 STANDARD SPRAY SPRINKLERS
IN BUILT-ON DORMERS

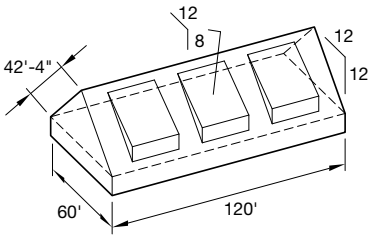




BUILT-ON DORMERS



ONE
BRANCHLINE
AT RIDGE
PLUS DORMER
PROTECTION

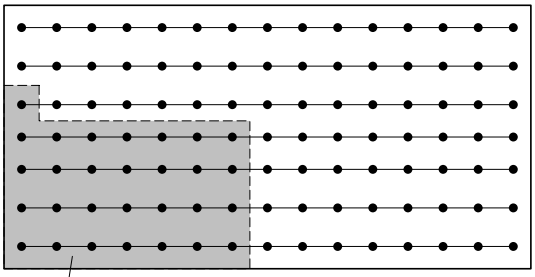


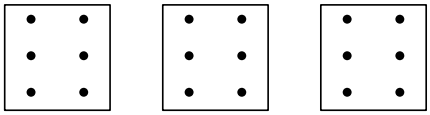
MAIN ROOF AREA WITH
BUILT-ON DORMERS

EXAMPLE 8:
WET PIPE SYSTEM CALCULATIONS

FIG. 11C

123 STANDARD SPRAY SPRINKLERS
(105 UNDER MAIN ROOF PLUS
18 IN BUILT-ON DORMERS)





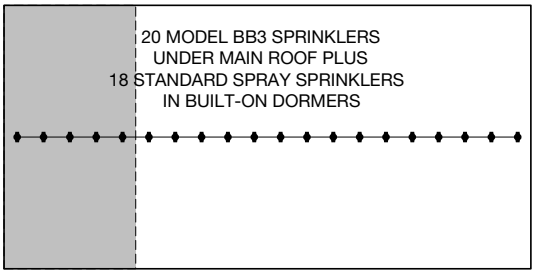
BUILT-ON DORMERS

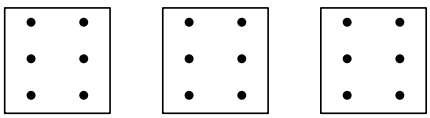
MIN. DESIGN AREA:
1500 FT^2 x 1.3[a] = 1950 FT^2

29 SPRINKLERS x 11.1 GPM[b]
= 321.9 GPM[c]

(NO QR REDUCTION FOR
30'-0" CEILING HEIGHT)

FIG. 11D



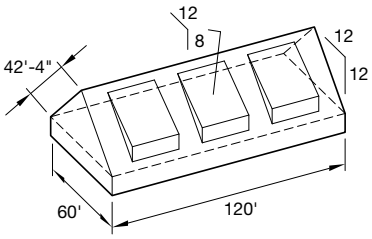


BUILT-ON DORMERS

REF. TFP610, FIG. 20-A-1

5 MODEL BB3 SPRINKLERS
AT 38 GPM = 190.0 GPM[c]

NOTES:
[a] 30% INCREASE FOR SLOPED CEILING.
[b] 8' x 8.6' x 0.1 GPM/FT^2 = 6.9 GPM; HOWEVER, 11.1 GPM IS MINIMUM FLOW AT 7 PSI.
[c] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

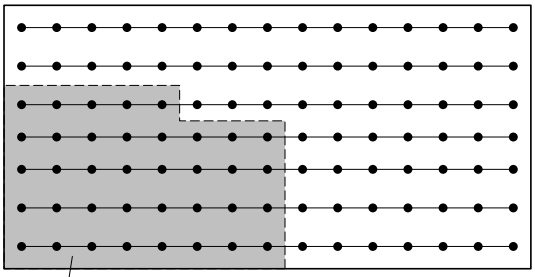


MAIN ROOF AREA WITH
BUILT-ON DORMERS

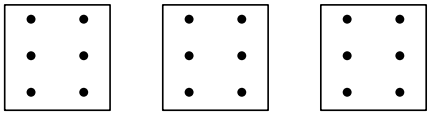
EXAMPLE 8:
DRY PIPE SYSTEM CALCULATIONS

FIG. 11E

123 STANDARD SPRAY SPRINKLERS
(105 UNDER MAIN ROOF PLUS
18 IN BUILT-ON DORMERS)



2546 FT^2 (37 SPRINKLERS K = 5.6)



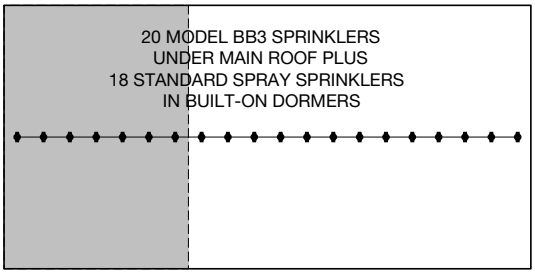
BUILT-ON DORMERS

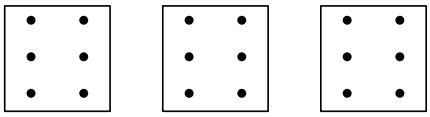
MIN. DESIGN AREA:
1500 FT^2 x 1.3[a] x 1.3[b] = 2535 FT^2

37 SPRINKLERS x 14.8 GPM[c]
= 547.6 GPM[d]

(NO QR REDUCTION FOR
DRY PIPE SYSTEMS)

FIG. 11F





BUILT-ON DORMERS

REF. TFP610, FIG. 20-A-1

7 MODEL BB3 SPRINKLERS
AT 38 GPM = 266.0 GPM[d]

NOTES:
[a] 30% INCREASE FOR DRY SYSTEM.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 8.6' x 0.1 GPM/FT^2 = 6.9 GPM; HOWEVER, 14.8 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

EXAMPLE 9:
(Figures 12A thru 12F):

For Example 9, we determine that the roof type is a gable with a roof span of 20 feet and a ceiling slope of 12:12. The attic space is over occupied space within the pitched roof creating a smaller attic space than the 40 foot width the building might otherwise have. Figure 12A illustrates the Standard Spray Sprinkler layout. In terms of "Specific Application Sprinklers for Protecting Attics" shown in Figure 12B, this roof type is best protected using Model BB Sprinklers.

With reference to Appendix A, TFP610, Table A, we would select the Model BB3 based on ceiling pitch of 12:12, and for a roof span of 20 feet, we would use the K=4.2. The smaller span rating (up to 20 feet) for the 4.2 K-factor BB Sprinkler provides a much lower design flow than the 5.6 or 8.0 K-factor BB Sprinklers, and certainly a much lower design flow than Standard Spray Sprinklers.

Wet Pipe System Calculations:

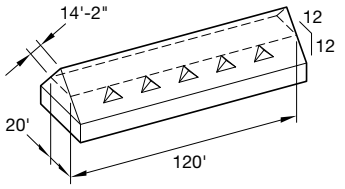
Fig. 11C – Standard Sprinklers: 255.3 GPM

Fig. 11D – Attic Sprinklers: 65.0 GPM

Dry Pipe System Calculations:

Fig. 11E – Standard Sprinklers: 666.0 GPM

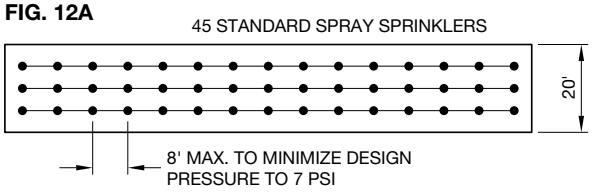
Fig. 11F – Attic Sprinklers: 91.0 GPM



ATTIC SPACE OVER
OCCUPIED SPACE WITHIN
PITCHED ROOF

EXAMPLE 9:
SPRINKLER LAYOUTS

FIG. 12A



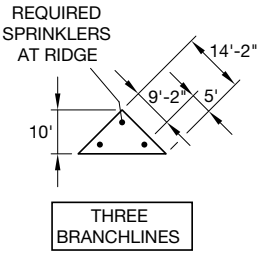
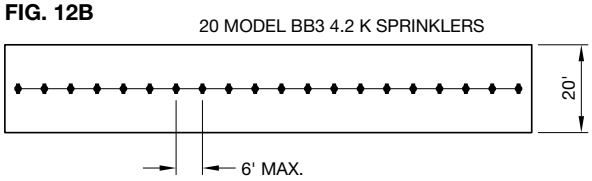
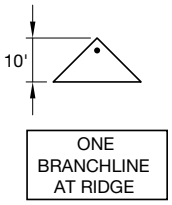
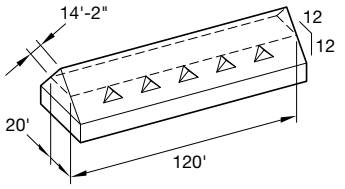


FIG. 12B



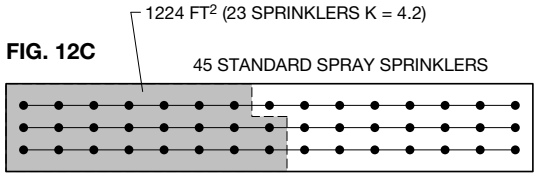




ATTIC SPACE OVER
OCCUPIED SPACE WITHIN
PITCHED ROOF

EXAMPLE 9:
WET PIPE SYSTEM CALCULATIONS

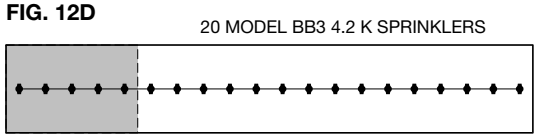
FIG. 12C



MIN. DESIGN AREA:
1500 FT^2 x 0.6[a] x 1.3[b] = 1170 FT^2

23 SPRINKLERS x 11.1 GPM[c]
= 255.3 GPM[d]

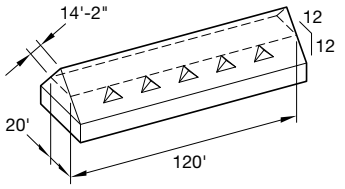
FIG. 12D



REF. TFP610, FIG. 20-A-1

5 MODEL BB3 SPRINKLERS
AT 13 GPM = 65.0 GPM[d]

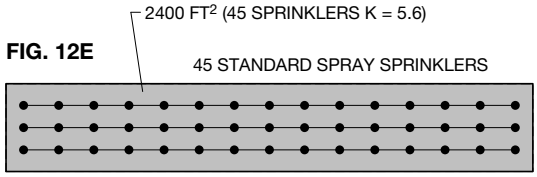
NOTES:
[a] 40% REDUCTION FOR QR SPRINKLERS AND 10 FOOT CEILING.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 6.8' x 0.1 GPM/FT^2 = 5.4 GPM; HOWEVER, 11.1 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.



ATTIC SPACE OVER
OCCUPIED SPACE WITHIN
PITCHED ROOF

EXAMPLE 9:
DRY PIPE SYSTEM CALCULATIONS

FIG. 12E

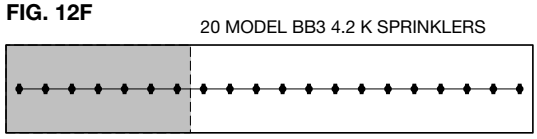


MIN. DESIGN AREA:
1500 FT_2 x 1.3[a] x 1.3[b]
= 2535 FT^2

45 SPRINKLERS x 14.8 GPM[c]
= 666.0 GPM[d]

(NO QR REDUCTION FOR
DRY PIPE SYSTEMS)

FIG. 12F



REF. TFP610, FIG. 20-A-1

7 MODEL BB3 SPRINKLERS
AT 13 GPM = 91.0 GPM[d]

NOTES:
[a] 30% INCREASE FOR DRY SYSTEM.
[b] 30% INCREASE FOR SLOPED CEILING.
[c] 8' x 6.8' x 0.1 GPM/FT^2 = 5.4 GPM; HOWEVER, 14.8 GPM IS MINIMUM FLOW AT 7 PSI.
[d] ACTUAL DEMAND WILL BE HIGHER DUE TO BALANCING.

WET PIPE VERSUS DRY PIPE SPRINKLER SYSTEMS

When considering the use of either a wet pipe sprinkler system or a dry pipe sprinkler system there are four basic criteria to consider:

- ambient temperature
- piping materials
- hydraulic design
- water delivery times (dry pipe sprinkler systems)

Ambient Temperature

Where attic spaces are at temperatures at or above 40F at all times, a wet pipe sprinkler system may be used. Where attic spaces may be periodically or at all times at temperatures below 40F, a dry pipe sprinkler system must be used.

NOTE: Instead of a dry pipe sprinkler system, consideration could be given to the use of an anti-freeze solution filled wet pipe sprinkler system. For the purposes of this application guideline, references to wet pipe sprinkler systems is only for water filled systems.

Piping Materials

The following piping materials may be used as a function of system type.

Piping Material	Wet Pipe	Dry Pipe
Black Steel	A	A
Galvanized Steel	A	A
CPVC	A*	N/A

A: Applicable NA: Not Applicable
* refer to "When Can CPVC Pipe and Fittings Be Used" sub-section

Hydraulic Design

As can be seen in the Application Examples there will be increased areas of hydraulic design or increased number of sprinklers to be hydraulically designed for a dry pipe sprinkler system. The use of a dry pipe system may present a challenge to meeting water supply demands. The use of "Specific Application Sprinkler for Protecting Attics" can significantly reduce the water supply demand – especially for dry pipe sprinkler systems.

Water Delivery Times (Dry Pipe Sprinkler Systems)

Due to the reduction of branch lines and corresponding system volume attributed to the use of "Specific Application Sprinklers for Protecting Attics", the need for a dry pipe valve quick opening device or the need to prove water delivery time may be eliminated.

There is an inherent delay in getting water to the sprinklers in a dry pipe sprinkler system. Although there are many variables that affect water delivery times (James Golinveaux, "Variables That Affect the Performance of Dry Pipe Systems" September 2002), NFPA 13 only makes reference to system volume as the controlling factor.

When using Standard Spray Sprinklers for light hazard occupancies, and installing per the requirements of NFPA 13, system volumes up to 500 gallons are assumed to deliver water in sufficient time. System volumes greater of 500 gallons and up to 750 gallons are assumed to deliver water in sufficient time when a dry pipe valve quick opening device is installed, or as an alternative, the quick opening device may be omitted if a water delivery time of 60 seconds is proven. For system volumes of 750 gallons or greater, a water delivery of up to 60 seconds must be proven. If a system designer can limit the volume to less than 500 gallons, a quick opening device need not be installed and water delivery time need not be proven. If the system designer can limit volume to less than 750 gallons and the system designer specifies the use of a dry pipe valve quick opening device, the water delivery time need not be proven.

For 5.6K & 8.0K Model BB Sprinklers, Model HIP Sprinklers, and Model SD Sprinklers, the requirements provided in NFPA 13 for Standard Spray Sprinklers in light hazard applications apply. When using "Specific Application Attic Sprinklers for Protecting Attics" in dry pipe sprinkler systems, there is an additional consideration for the use of 4.2K, Model BB Sprinklers or Model AP Sprinklers. For any system volume (Ref. Appendix A, TFP610 Table A), the water delivery time for the 4.2K Model BB Sprinklers must not exceed 45 seconds and for the Model AP Sprinklers water delivery time must not exceed 60 seconds.

In all cases, however, limiting system volume for dry pipe sprinkler systems through the use of "Specific Application Sprinklers for Protecting Attics" should be beneficial with respect to the potential for eliminating dry pipe valve quick opening devices and/or the potential for eliminating the need for proving water delivery times.

WHEN CAN CPVC PIPE AND FITTINGS BE USED

The use of CPVC Pipe and Fittings to supply sprinklers at the ceiling below combustible concealed attic space, where the attic space required sprinklers, had been prohibited. The use of CPVC Pipe and Fittings within an attic space to supply sprinklers in the attic space, had also been prohibited.

Ironically, installing CPVC within attic spaces is considered extremely desirable from an installer's standpoint. Pre-fabrication of steel pipe for sloped ceiling applications is difficult. When combined with small, barely accessible areas, the installation of steel pipe using pipe wrenches is further complicated. CPVC that is light weight, field cut in place, and solvent cemented provides the ideal piping material.

The use of "Specific Application Sprinklers For Attic Spaces" provides an alternative for the use of CPVC, assuming that the systems are wet pipe. With reference to Appendix A, TFP610, TFPB BlazeMaster® CPVC piping may be used in a combustible concealed attic spaces requiring sprinklers when installed in accordance with Installation Handbook IH1900 and the following guidelines.

NOTE: Where the use of non-combustible insulation is specified, verify with the insulation manufacturer as to the non-combustibility of the insulation. The non-combustible insulation (e.g., fiberglass) may be faced or unfaced. Where faced, the facing need not be non-combustible. The insulation is to have a flame spread index of not more than 25. Verify chemical compatibility of the insulation with BlazeMaster CPVC by consulting www.lubrizol.com.

TFBP BlazeMaster CPVC may be used to supply the wet system ceiling sprinklers on the floor below. There must be 6 inches of non-combustible insulation covering the pipe extending 12 inches on each side away from the centerline of the pipe, and the area above the CPVC must be protected by Model BB, SD, HIP, or AP Sprinklers (Ref. Fig. 13A). If the pipe is located inside the ceiling joist, the joist channel must be covered or filled with 6 inches of non-combustible insulation on top of the pipe and the area above must be protected by BB, SD, HIP, or AP Sprinklers (Ref. Fig. 13B). Insulation is for fire protection purposes. It is not freeze protection. BlazeMaster CPVC must be installed in accordance with the BlazeMaster installation guide instructions.

NOTE: Where Standard Spray Sprinklers are used in attic spaces (Figs. 4A, 5A, 5B, 6A, 7A, 7B, 8A, 8B, 9A, 10A, 10B, 11A, and 12A), CPVC in accordance with it's UL Listing cannot be used to supply the wet system ceiling sprinklers on the floor below. Where Model BB, SD, or HIP Sprinklers cannot be exclusively used, consideration should be given to using Model AP Sprinklers instead of Standard Spray Sprinklers so that the advantages of CPVC may be recognized throughout the building.

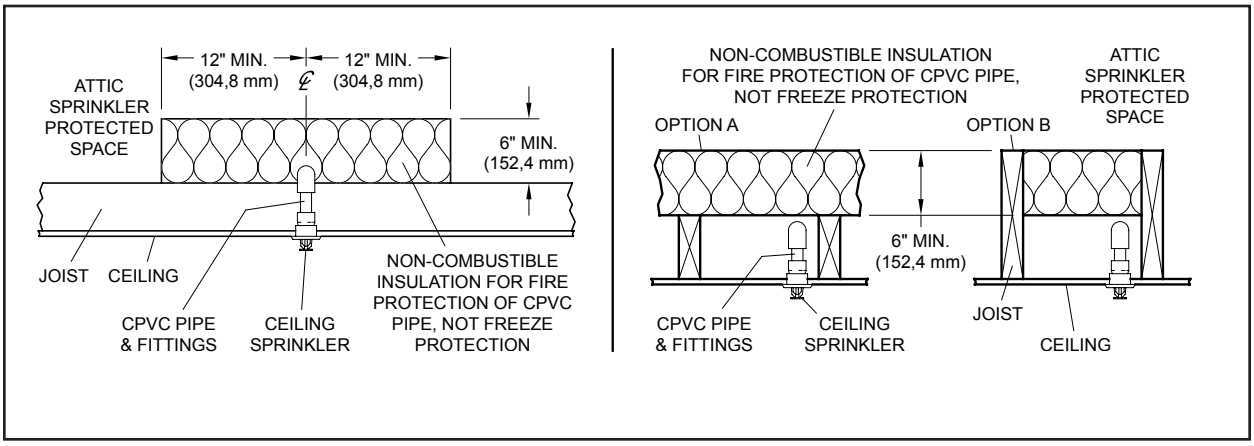
With reference to Figure 14, TFBP BlazeMaster CPVC may be used exposed to supply wet system BB, SD, or HIP Sprinklers where:

- Risers are vertical and protected by a BB, SD, or HIP Sprinkler located at a maximum lateral distance of 12 inches from the riser center line.
- BB, SD, or HIP Sprinklers are directly mounted on the branch line.
- BB, SD, or HIP Sprinklers are on armovers and located at a maximum lateral distance of 6 inches from the branch line center line.
- BB, SD, or HIP Sprinklers are on vertical sprigs attached to the branch line.

- BB, SD, or HIP Sprinklers are on armover or angled sprigs, and located at a maximum lateral distance of 6 inches from the branch line centerline.
- A minimum lateral distance of 18 inches is maintained between the CPVC pipe and a heat producing device such as heat pumps, fan motors, and heat lamps.

TFBP BlazeMaster CPVC may be used exposed to provide wet system, vertical or angled, sprigs to AP Sprinklers (Ref. Figs. 15A and 15B) where:

- The exposed portion of an angled sprig is a maximum length of 3 feet, the sprig is supported within 12 inches of the AP Sprinkler, and pipe hangers are provided using the CPVC hanger support for horizontal pipe runs.
- Vertical sprigs have a maximum exposed length of 10 feet, the AP Sprinkler is located at a maximum lateral distance of 12 inches from the sprig centerline, and the sprig is supported at the swing joint to the AP Sprinkler.
- A minimum 6 inches deep of non-combustible insulation extends 12 inches on each side away from the centerline of the CPVC branch line feeding the AP sprigs (Ref. Fig. 15A). If the CPVC branch line is located inside the ceiling joist, the joist channel must be covered or filled with a minimum of 6 inches deep of non-combustible insulation on top of the branch line supplying the AP sprigs (Ref. Fig. 15B). Insulation is for fire protection purposes. It is not freeze protection. Additional depth of non-combustible insulation may be added to reduce the exposed length of the AP sprigs.
- A minimum lateral distance of 18 inches is maintained between the CPVC pipe and a heat producing device such as heat pumps, fan motors, and heat lamps.



Figures 13A & 13B

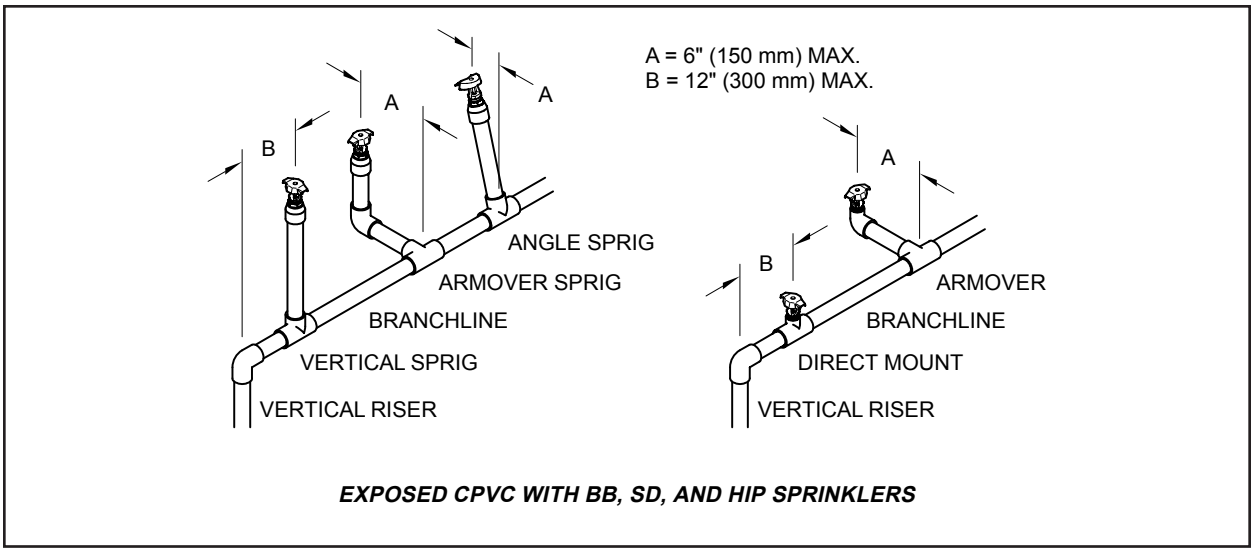
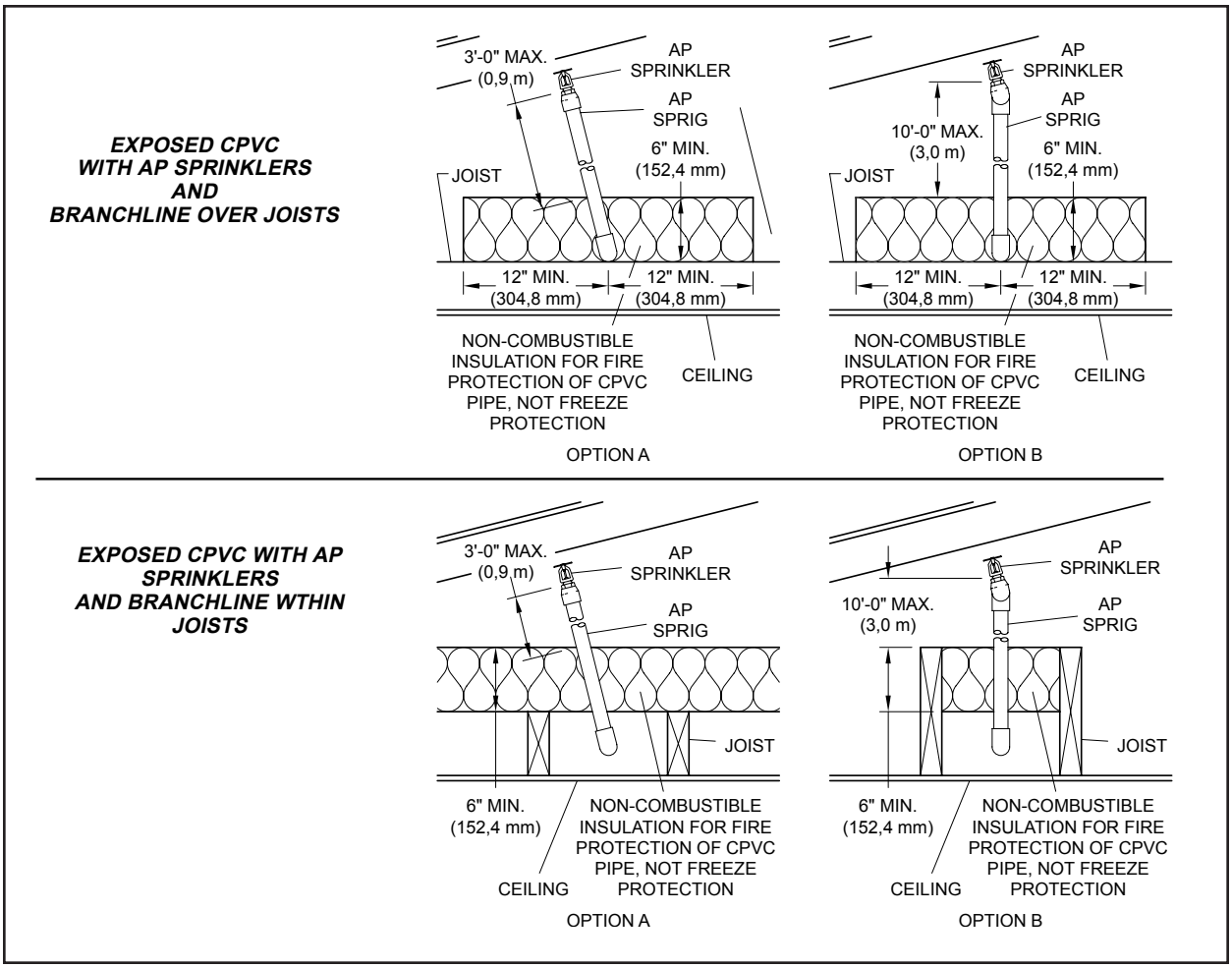


Figure 14



Figures 15A & 15B

BETTER FIRE PROTECTION

Originally, a research program was established to expand the UL Listing of CPVC. In particular, the research program was intended to investigate the use of CPVC to supply sprinklers at the ceiling below a combustible concealed attic space, where the attic space required sprinklers. The initial plan was to have standard response Standard Spray Sprinklers (which were located in accordance with NFPA 13 installation requirements) operate and control the fire, and then evaluate the damage to the CPVC. In the test program, the fire (started between the sprinklers) burned up the slope, setting the entire underside of the roof on fire. It burned through the roof in several different locations.

The results of the test are reported in "Investigation of Specific Application Sprinklers Installed in Sloped Combustible Attic Spaces" Underwriters Laboratories Inc. Project 94NK9620, EX683, for Central Sprinkler Co., Issued: August 23, 1994. The test was a failure, not because the CPVC failed, but because the sprinklers failed to provide sufficient protection as evidenced by the "Roof Deck Fire Penetration Area" and "Fire Involvement Area" (Tables 1 and 2).

The development of the Specific Application Attic Sprinklers (Model BB, HIP, and SD), at that time, was the result of the failure of Standard Spray Sprinklers to provide sufficient protection in a situation that was well within the allowable protection schemes described in NFPA 13.

In full scale testing, the Specific Application Attic Sprinklers demonstrated that they could effectively protect an attic configuration as evidenced by the minimized "Roof Deck Fire Penetration Area" and "Fire Involvement Area" (Tables 3 and 4). They demonstrated this by comparative fire testing proving their superiority to Standard Spray Sprinklers in these applications by having a spray pattern that could effectively wet the floors and walls of these attic spaces even with the challenging construction features and obstructions frequently found within these areas. Also they are positioned in such a manner that the thermal sensitivity of the sprinkler is optimized. In addition they effectively meet the challenges presented by the slope of these ceiling configurations by having a design requirement that is significantly better than traditionally required by NFPA.

Since this testing in the early 1990's, there have been significant changes to the installation requirements provided in NFPA 13 for sloped ceiling combustible concealed attic spaces. While increasing the effectiveness of Standard Spray Sprinklers, the 2002 and 2007 editions of NFPA 13 have severely restricted the use of Standard Spray Sprinklers, making the use of "Specific Application Sprinklers for Protecting Attics" even more advantageous. However, better fire protection can still be expected from the Attic Sprinklers due to sprinkler location and development of spray pattern.

Sprinkler Location

The Model BB, SD, and HIP Sprinklers are located at the high points of the attic spaces where their positioning for heat response is optimized. This heat responsive optimization combined with the long throw water distribution (Ref. Fig. 1) are expected to outperform rows of Standard Spray Sprinklers that will tend to have sprinkler operations at high points even when the fire is under sprinklers at low points.

Development Of Spray Pattern

The unique spray patterns of the Model BB, SD, and HIP Sprinklers (Ref. Fig. 1) are better shaped for the roof slope of attic spaces and can be expected to "fill-in" spaces that cannot be assumed to be "filled-in" with the semi-hemispherical spray patterns of Standard Spray Sprinklers. The flat spray pattern of the Model AP Sprinklers (Ref. Fig. 1) can be expected to be advantageous when compared to Standard Spray Sprinklers when it becomes necessary to supplement the coverage areas of the Models BB, SD, and HIP Sprinklers.

Table 1

Fire Test Results, Model A SSU, 4/12 (in. / in.) Roof Pitch				Damage Assessment (Approximate Area)	
Test Number	Illustration Number	Number of Sprinklers operated	Sprinkler Operation, ID # - Time Mins:secs.	Roof Deck Fire Penetration area/sq. ft. †	Fire Involvement area/sq. ft. ‡
8	B15, B16	2	9-1:34 10-1:49	0	16
9	B17, B18	2	9-2:46 10- 2:26	64	122
10	B19, B20, B21	13	11-6:09 17-6:14 *	68	480

* 11 Sprinklers operated between 6:14 and 7:10
† Portion of roof totally consumed by fire resulting in the specified opening area
‡ Portion of roof exhibiting any signs of charring

Table 2

Fire Test Results, Model A SSU, 8/12 (in. / in.) Roof Pitch				Damage Assessment (Approximate Area)	
Test Number	Illustration Number	Number of Sprinklers operated	Sprinkler Operation, ID # - Time Mins:secs.	Roof Deck Fire Penetration area/sq. ft. †	Fire Involvement area/sq. ft. ‡
17	B35, B36, B37, B38	10	6- 20:43 7- 20:43 9- 5:28 10- 4:19 11- 5:32 12- 21:43 13- 20:53 14- 22:28 15- 20:48 17- 21:08	31	400
18	B39, B40	2	9-1:43 11- 1:59	0	6
19	B41, B42	3	10-31:39 14-0:56 20- 1:51	8	52

† Portion of roof totally consumed by fire resulting in the specified opening area
‡ Portion of roof exhibiting any signs of charring

Table 3

Fire Test Results, Model BB1 – 17/32, 4/12 (in. / in.) Roof Pitch				Damage Assessment (Approximate Area)	
Test Number	**Illustration Number**	**Number of Sprinklers operated**	**Sprinkler Operation, ID # - Time Mins:secs.**	**Roof Deck Fire Penetration area/sq. ft. †**	**Fire Involvement area/sq. ft. ‡**
1	B1, B2	5	9 - 5:28 10 - 4:19 11 - 5:32 12 - 21:43 13 - 20:53	0	16
2	B3, B4	2	13 - 8:27 14 - 11:39	0	45
3	B5, B6	4	8 - 0:42 9 - 0:28 10 - 0:45 11 - 1:36	0	0
4	B7, B6	1	13 - 7:18	0	40
5	B9, B10	5	8 - 1:22 9 - 1:05 10 - 1:18 11 - 1:33 12 - 1:49	0	32
6	B11, B12	2	10 - 1:34 11 - 1:29	1	16
7	B13, B14	1	8 - 6:33	4	33

† Portion of roof totally consumed by fire resulting in the specified opening area

‡ Portion of roof exhibiting any signs of charring

Table 4

Fire Test Results, Model BB2 – 17/32, 8/12 (in. / in.) Roof Pitch				Damage Assessment (Approximate Area)	
Test Number	**Illustration Number**	**Number of Sprinklers operated**	**Sprinkler Operation, ID # - Time Mins:secs.**	**Roof Deck Fire Penetration area/sq. ft. †**	**Fire Involvement area/sq. ft. ‡**
11*	B22, B23	2	10- 1:03 11- 1:00	0	0
12*	B25, B25, B26	1	10- 8:06	0	40
13*	B27, B28	2	8- 1:46 9- 1:36	0	48
14*	B29, B30	1	12- 1:09	0	0
15	B31, B32,	5	6- 5:59 7- 5:54 8 - 5:26 9- 5:54 10- 5:49	0	40
16	B33, B34	7	7- 2:09 8 - 1:49 9- 0:55 10- 1:21 11- 1:27 12- 2:01 13- 2:03	0	4

† Portion of roof totally consumed by fire resulting in the specified opening area

‡ Portion of roof exhibiting any signs of charring

* Wet Sprinkler System was used

WHAT ARE SPECIFIC APPLICATION SPRINKLERS

The 2007 edition of NFPA 13, Section 1.6.1, under New Technology states "Nothing in this standard shall be intended to restrict new technologies or alternate arrangements, provided the level of safety prescribed by this standard is not lowered."

This simple statement has allowed individuals and manufacturers to recognize the limitations of existing technology and develop truly unique products and ideas to meet the ever-changing needs of the fire protection community.

Recognizing that traditional automatic sprinklers have their limitations, NFPA 13 created a special classification of sprinkler the – "Special Sprinkler" (NPFA 13, Section 3.6.2.11). Special sprinklers are intended for the protection of specific hazards or construction features and are evaluated and listed for performance under the following conditions:

(1) Fire tests related to the intended hazard

(2) Distribution of the spray pattern with respect to wetting of floors and walls

(3) Distribution of the spray pattern with respect to obstructions

(4) Evaluation of the thermal sensitivity of the sprinkler

(5) Performance under horizontal or sloped ceilings

(6) Area of design

(7) Allowable clearance to ceilings

CONCLUSION

Tyco® Peak™ Performance Model BB™, SD™, HIP™, and AP™ "Specific Application Sprinklers for Protecting Attics" are expected to provide a higher level of protection then Standard Spray Sprinklers in combustible sloped ceiling attic spaces. These sprinklers control costs by eliminating the need for additional sprinklers and branch line piping when compared to Standard Spray Sprinklers. In many cases, an attic can be entirely protected with just one line of piping located below the peak of the roof using Model BB Sprinklers. The Models SD, HIP or AP Sprinklers can often complement the BB Sprinklers and serve to protect those areas that are particularly challenging.

In many cases the "Specific Application Sprinklers for Protecting Attics" can provide a hydraulic design advantage by lowering the system water flow demand. `Where more than four Model AP Sprinklers are utilized within an individual area, a further hydraulic design advantage (Ref. Figs. 4 & 7) can be achieved as compared to the use of Standard Spray Sprinklers.

The 2002 and 2007 editions of NFPA 13 have severely restricted the use of Standard Spray Sprinklers making the "Specific Application Sprinklers for Protecting Attics" even more advantageous. For example, assuming the use of Standard Spray Sprinklers, a system in a 60 foot wide attic, with up to a 12:12 roof pitch, designed to the 2007 edition of NFPA 13, would require seven branch lines to cover the main portion of the attic and several additional branch lines to cover the hip areas. With the Model BB Sprinklers combined with the Model HIP Sprinklers, the required coverage can be obtained with just one branch line running below the peak and one down each slope of the hip ridge. This piping arrangement would result in approximately 90% less pipe needed for installation. This reduction in the number of branch lines saves the cost of the pipe, fittings, hangers, and associated labor by eliminating up to five branch lines.

Another important cost reduction is the use of BlazeMaster CPVC in attic spaces to feed both the Specific Application Sprinklers in a wet system, as well as the wet system sprinklers below the ceiling. Traditionally, BlazeMaster CPVC has been used on the lower floors in the joist space above a ceiling that does not require sprinklers. The cost of using CPVC on those floors can now be translated to the upper floor even if sprinklers are required in the attic.

Ultimately, a design contemplated in accordance with either the 2002 or 2007 editions of NFPA 13 will be much more demanding than those of previous editions. It is critical that an estimator and/or designer understand the criteria required within their jurisdiction. It is also critical to know what options exist, such as the use of "Specific Application Sprinklers for Protecting Attics" that can gain the estimator and/or designer a competitive advantage.

ABOUT THE AUTHOR

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Director of Engineering Services

Roger Wilkins is Director of Engineering Services, Research and Development for Tyco Fire & Building Products located at the Global Technology Center in Cranston, Rhode Island. During his thirty plus years of service in Tyco's fire protection research and development department, Roger has principally been involved in product development through the preparation of technical literature – working with Engineering, Manufacturing, and Marketing. In addition, Roger has been extensively involved in offering technical support and providing product training.

While employed at Tyco, he received his Associates Degree in Mechanical Engineering Technology from Roger Williams College.

tyco / Fire & Building Products

Technical Services: Tel: (800) 381-9312 / Fax: (800) 791-5500

PEAK™ PERFORMANCE
ATTIC PROTECTION SPRINKLER SYSTEM

Models BB, SD, HIP, and AP "Specific Application Sprinklers for Protecting Attics"

General Description

The Tyco® Peak™ Performance Models BB™ (Back to Back), SD™ (Single Directional), HIP™, and AP™ (Attic Plus) "Specific Application Sprinklers for Protecting Attics" are fire sprinklers for combustible and non-combustible sloped attic spaces. The Model BB, SD, and HIP are Specific Application Attic Sprinklers, whereas the Model AP is a Specific Application Combustible Concealed Space Sprinkler having specific application criteria for its use with the Model BB, SD, and HIP in attic spaces. Specific Application Attic Sprinklers provide superior fire protection in attic spaces and, when compared to Standard Spray Sprinklers, cost savings are achieved by eliminating branchline materials and the associated installation labor. "The Specific Application Sprinklers for Protecting Attics" have undergone the most extensive fire testing ever performed for sloped attic spaces. They are UL Listed with their specific application guidelines for use as special sprinklers as defined by the NFPA.

The Specific Application Attic Sprinklers provide an extended coverage spacing alternative to the restricted spacing of Standard Spray Sprinklers. The restricted spacings of Standard Spray Sprinklers used within attics is described in the 2007 edition of NFPA 13, Table 8.6.2.2.1(a) and Section 8.6.4.1.4.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

The Specific Application Attic Sprinklers are the first sprinklers to be:

- Listed for extended coverage in combustible construction.
- Full-scale fire tested in both wet and dry system scenarios.
- Full-scale fire tested, for use in wood truss construction.
- Listed for specific roof slopes (Refer to Table A).

The Specific Application Attic Sprinklers provide the best level of protection and control cost by eliminating the need for additional sprinklers and branchline piping. In many cases, an attic can be entirely protected with just one line of piping located below the peak of the roof using Model BB (Back to Back) Sprinklers. If there is a need for Model SD (Single Directional) or Model HIP Sprinklers, one line of either of these sprinkler types is usually sufficient at each area being covered. For example and assuming the use of Standard Spray Sprinklers, a system in a 60 foot (18,3 m) wide attic, with up to a 12:12 roof pitch, designed to the 2007 edition of NFPA 13, would require seven branchlines to cover the main portion of the attic and several additional branchlines to cover the hip areas. With the Specific Application Attic Sprinklers, the required coverage can be obtained with just one branchline below the peak and one down each slope of the hip beam. This would result in approximately 90% less pipe needed for installation. This reduction in the number of branchlines saves the cost of the pipe, fittings, hangers, and associated labor by eliminating up to five branchlines.

Another important aspect of the Specific Application Attic Sprinkler technology is the reduction in system volume. This volume reduction may result in reducing the size of a dry pipe valve (and air compressor) and possibly al-

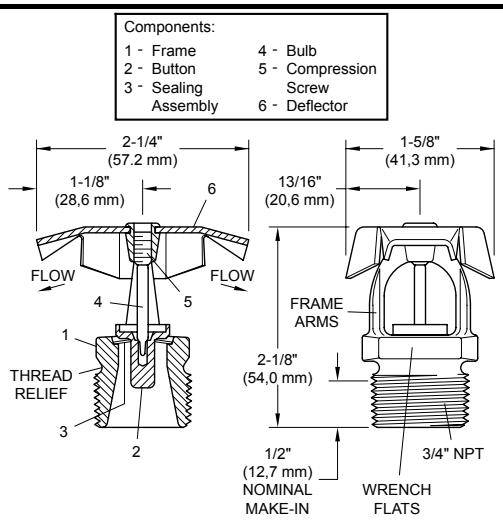


FIGURE A
MODEL BB1, BB2 & BB3
WITH 8.0 K-FACTOR
SPECIFIC APPLICATION ATTIC
SPRINKLERS

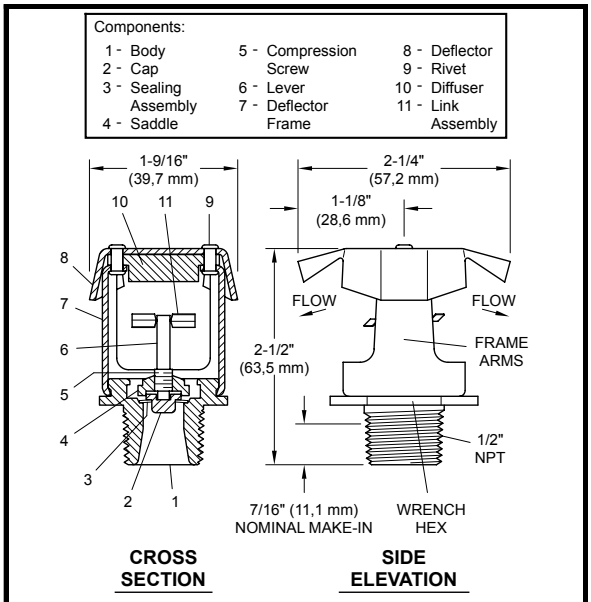


FIGURE B
MODEL BB1, BB2 & BB3
WITH 5.6 K-FACTOR
SPECIFIC APPLICATION ATTIC
SPRINKLERS

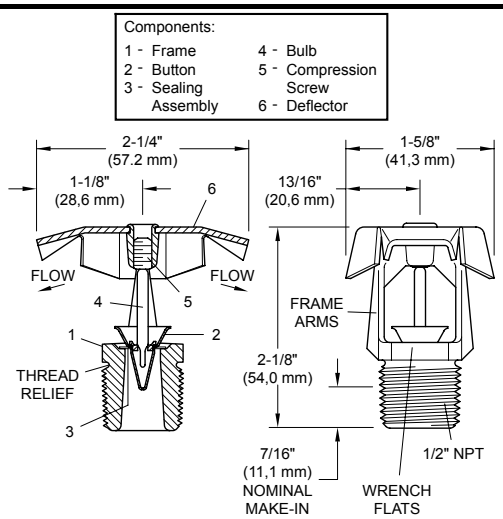


FIGURE C
MODEL BB1, BB2 & BB3
WITH 4.2 K-FACTOR
SPECIFIC APPLICATION ATTIC
SPRINKLERS

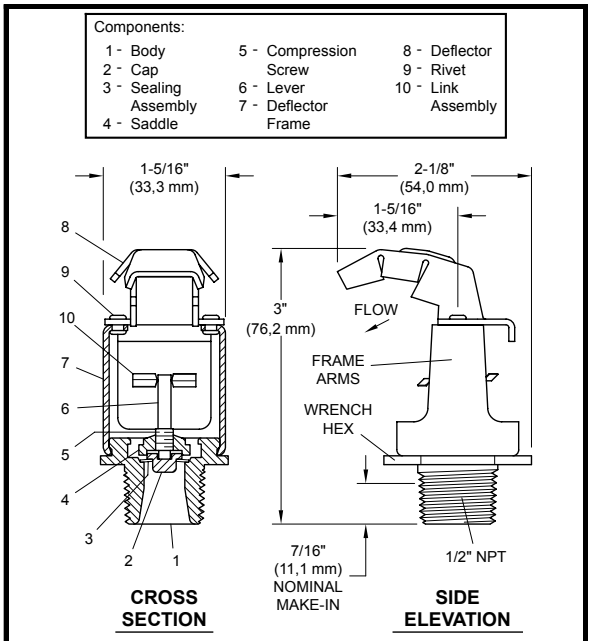


FIGURE D
MODEL SD1, SD2 & SD3
WITH 5.6 K-FACTOR
SPECIFIC APPLICATION ATTIC
SPRINKLERS

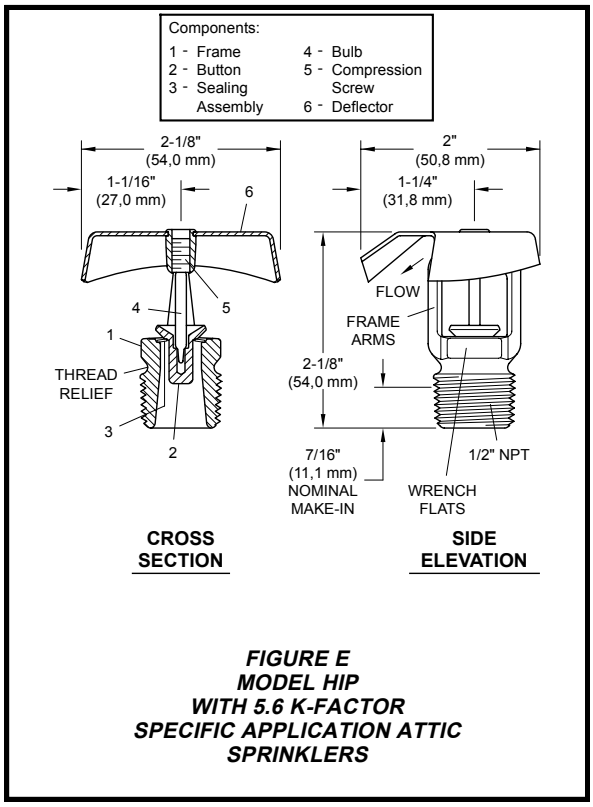


FIGURE E
MODEL HIP
WITH 5.6 K-FACTOR
SPECIFIC APPLICATION ATTIC SPRINKLERS

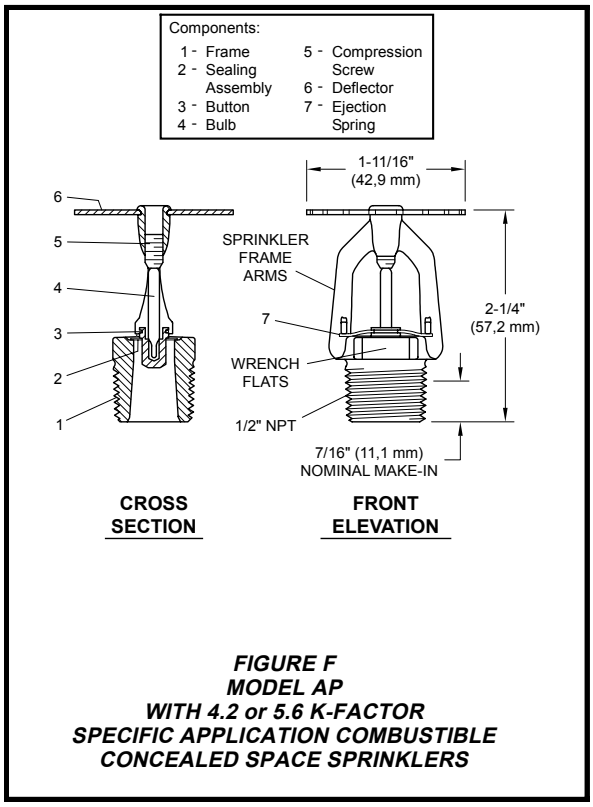


FIGURE F
MODEL AP
WITH 4.2 or 5.6 K-FACTOR
SPECIFIC APPLICATION COMBUSTIBLE CONCEALED SPACE SPRINKLERS

low for quicker water delivery times, eliminating the need for an accelerator.

The other cost reduction is the Listing of BlazeMaster* CPVC for use in attic spaces to supply the wet system "Specific Application Sprinklers for Protecting Attics", as well as the wet system sprinklers below the ceiling. Traditionally BlazeMaster CPVC has been used on the lower floors in the joist space above a ceiling that does not require sprinklers. The savings of using CPVC on those floors can now be translated to the upper floor even if sprinklers are required in the attic.

There are four (4) models of the "Specific Application Sprinklers for Protecting Attics" — BB™ (Back to Back Dual Directional), SD™ (Single Directional), HIP™, and AP™ (Attic Plus). The BB and SD Sprinklers have three separate versions that are used for different roof pitches. The pitches, as applicable, can vary from a minimum of 3:12 to a maximum of 12:12 (Ref. Table A).

BB Sprinkler (Back to Back Dual Directional)
The Tyco® Model BB™ Specific Application Attic Sprinkler (Figure A, B & C) throws a narrow but long pattern. The narrow spacing along the ridge serves two purposes. The response time is reduced by placing the sprinklers no farther than 6 feet (1,8 m) apart, and the spray can be concentrated in the throw direction to obtain a pattern that will cover up to 30 feet (9,1m) in each direction when measured horizontally. There are three different models (i.e., BB1, BB2 & BB3) that account for different roof slopes, and each model is available in one of three different orifice sizes (K=4.2, 5.6, or 8.0).

SD Sprinkler (Single Directional)
The Tyco® Model SD™ Specific Application Attic Sprinkler (Figure D), like the Model BB, throws a narrow but long pattern. However, unlike the Model BB the Model SD only discharges in one direction. These sprinklers are primarily used where shear walls or draft curtains have been installed within an attic space. Another use is when the framing direction is parallel with the outside wall in the hip area (Ref. Figure 13). In this case, the SD would be used on one side of the slope, and AP Sprinklers or Standard Spray Sprinklers would be used to protect the other side. The Model SD Sprinklers must be installed in a vertical upright orientation and not angled with the slope. (Achieving the vertical upright orientation may require the use of a swing joint if the SD Sprinklers are being supplied from a line running along and parallel to the roof hip.) Three different models (i.e., SD1, SD2 & SD3) are available for different roof slopes.

HIP Sprinkler
The Tyco® Model HIP™ Specific Application Attic Sprinkler (Figure E) covers the area of the hip in the attic. This is a slightly different concept than the BB (Back to Back) or SD (Single Directional). The HIP Sprinkler is located along the slope running down the hip, and throws a 90° pattern toward the outside eaves. This pattern allows the water to "corner" and control the fire. The HIP Sprinkler does not discharge much water directly up or down the hip, but rather it discharges most of the pattern out to each side (90°) down the slope of the roof. This sprinkler is typically spaced 6 feet (1,8 m) to 3 feet (0,9 m) on center down the slope. To use the HIP Sprinkler, the framing must be perpendicular to the outside wall (Ref. Figure 12) and the maximum throw cannot exceed 28 feet (8,5 m) measured horizontally. The HIP, unlike the BB and SD, is installed with the deflector parallel with the slope. A single model is available with flow and

*registered trademark of Lubrizol Advanced Materials, Inc.

pressure requirements for two different spacings.

AP Sprinkler (Attic Plus)
Installed in the upright orientation with their deflector parallel to the roof, the Tyco® Model AP™ Sprinklers (Figure F) are intended to be used to provide protection of attic areas outside the scope of application for the BB, SD, or HIP Sprinklers. When used, the AP Sprinklers in most cases will provide a hydraulic advantage over Standard Spray Sprinklers for the protection of attic areas outside the scope of application for the BB, SD, or HIP Sprinklers (Ref. Figures 21 and 22 for examples).

WARNING

The "Specific Application Sprinklers for Protecting Attics" described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of any other authorities having jurisdiction. ***Failure to do so may impair the performance of these devices.***

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or manufacturer should be contacted with any questions.

Sprinkler Identification Number

TY4180* - BB1, K=8.0
TY4181* - BB2, K=8.0
TY4182* - BB3, K=8.0
TY3180* - BB1, K=5.6
TY3181* - BB2, K=5.6
TY3182* - BB3, K=5.6
TY2180 - BB1, K=4.2
TY2181 - BB2, K=4.2
TY2182 - BB3, K=4.2
TY3183* - SD1, K=5.6
TY3184* - SD2, K=5.6
TY3185* - SD3, K=5.6
TY3187* - HIP, K=5.6
TY3190 - AP, K=5.6
TY2190 - AP, K=4.2

*The "TY" prefix is a redesignation of the previous "C" prefix (e.g., TY4180 is a redesignation for C4180).

Technical Data

Approvals
UL & C-UL Listed.
(The approvals only apply to the service conditions indicated in the Design Criteria section on Page 6 and the Design Guidelines section on Page 8.)

Pipe Thread Connection
1/2 inch NPT for K=4.2 & 5.6
3/4 inch NPT for K=8.0

Discharge Coefficient
K = 4.2 GPM/psi$^{1/2}$ (60,5 LPM/bar$^{1/2}$)
K = 5.6 GPM/psi$^{1/2}$ (80,6 LPM/bar$^{1/2}$)
K = 8.0 GPM/psi$^{1/2}$ (115,5 LPM/bar$^{1/2}$)

Temperature Rating
Intermediate Temperature as follows:
- 200°F/93°C for BB (K4.2 & K8.0), HIP, AP
- 212°F/100°C for BB (K5.6), SD

Finish
Natural Brass

Physical Characteristics (Figures A, C & E)

Frame	Bronze
Button	Bronze/Copper
Sealing Assembly	Beryllium Nickel w/Teflon†
Bulb	Glass (3 mm dia.)
Link	Monel
Compression Screw	Brass
Deflector	Brass/Bronze

† DuPont Registered Trademark

Physical Characteristics (Figures B & D)

Body	Brass
Cap	Bronze
Sealing Assembly	Beryllium Nickel w/Teflon†
Saddle	Brass
Link Assembly	Nickel
Compression Screw	Brass
Deflector	Brass/Bronze
Lever	Bronze
Deflector Frame	Bronze
Diffuser	Brass
Rivet	Brass

† DuPont Registered Trademark

Physical Characteristics (Figure F)

Frame	Brass
Button	Bronze
Sealing Assembly	Stainless Steel w/Teflon†
Bulb	Glass (3 mm dia.)
Compression Screw	Brass
Deflector	Bronze

† DuPont Registered Trademark

Patents
U.S.A. 5,669,449; patent pending

Operation

BB (K=8.0 & 4.2), HIP (K=5.6) & AP (5.6 & 4.2)
The glass bulb contains a fluid that expands when exposed to heat. When the rated temperature is reached, the fluid expands sufficiently to shatter the glass bulb, allowing the sprinkler to activate and water to flow.

BB (K=5.6) & SD (K=5.6)
The fusible link assembly is comprised of two link halves which are joined by a thin layer of solder. When the rated temperature is reached, the solder melts and the two link halves separate, allowing the sprinkler to activate and water to flow.

Installation

The Tyco® Peak™ Performance Models BB™, SD™, HIP™, and AP™ "Specific Application Attic Sprinklers for Protecting Attics" must be installed in accordance with the following instructions:

NOTES

Do not install any bulb type sprinkler if the bulb is cracked or there is a loss of liquid from the bulb. With the sprinkler held horizontally, a small air bubble should be present. The diameter of the air bubble is approximately 1/16 inch (1,6 mm).

A 1/2 inch NPT sprinkler joint should be obtained with a minimum to maximum torque range of 7 to 14 ft.lbs. (9,5 to 19,0 Nm). A 3/4 inch NPT sprinkler joint should be obtained with a minimum to maximum torque range of 10 to 20 ft.lbs. (13,4 to 26,8 Nm). Higher levels of torque may distort the sprinkler inlet with consequent leakage or impairment of the sprinkler.

Step 1. Sprinklers must be oriented correctly:

- Model BB Sprinklers are to be installed in the upright vertical position with the flow arrows on the deflector pointing down the two opposing slopes.
- Model SD Sprinklers are to be installed in the upright vertical position with the flow direction arrow on the deflector pointing down the slope.
- The Model HIP Sprinklers are to be installed with the deflector at the top and with the sprinkler centerline perpendicular to the ridge of the hip roof and with the flow direction arrows on the deflector pointing down the two opposing slopes. (Unlike the Model BB and Model SD, the Model HIP is installed at an angle so that its deflector is parallel with the slope of hip ridge line.)
- The Model AP Sprinklers are to be installed in the upright position with the deflector parallel to the roof slope.

Step 2. With pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting. ***With reference to Figure G, do not grasp the sprinkler by the deflector.***

Step 3. Wrench tighten the sprinkler using only the wrenches shown in Figures H thru M. Wrenches are only to be applied to the sprinkler wrench flats or wrench hex, as applicable.

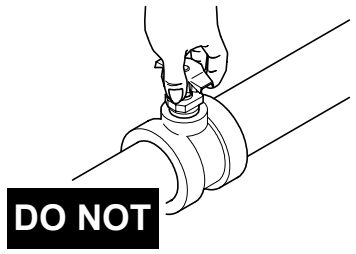


FIGURE G
DO NOT GRASP DEFLECTOR

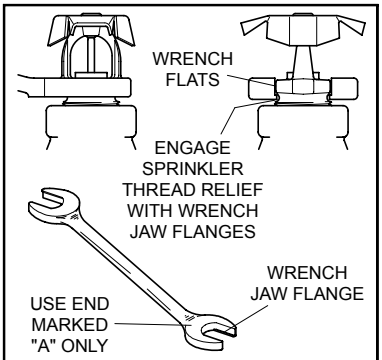


FIGURE H
W-TYPE 3 SPRINKLER WRENCH
For use with BB (K=8.0) Sprinklers

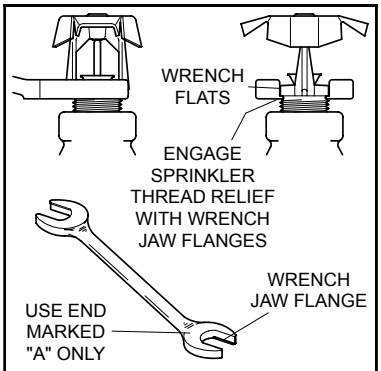


FIGURE J
W-TYPE 6 SPRINKLER WRENCH
For use with BB (K=4.2) Sprinklers

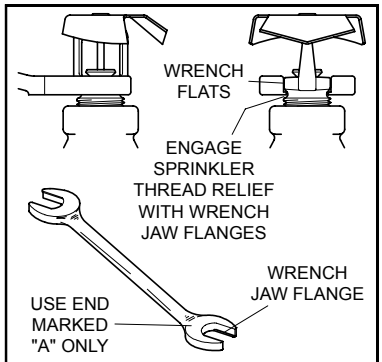


FIGURE K
W-TYPE 20 SPRINKLER WRENCH
For use with HIP (K=5.6) Sprinklers

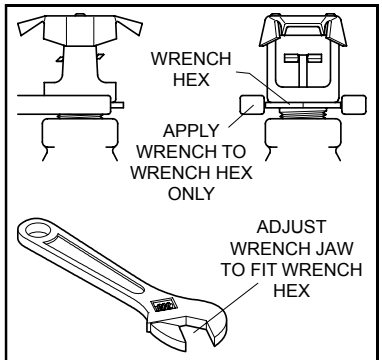


FIGURE L
ADJUSTABLE WRENCH
For use with BB (K=5.6) & SD (K=5.6) Sprinklers

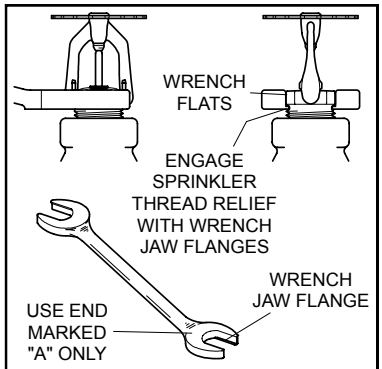


FIGURE M
W-TYPE 6 SPRINKLER WRENCH
For use with AP (K=4.2 & 5.6) Sprinklers

Design Criteria

Area Of Use:
Roof structures, combustible and non-combustible, including wood joist/rafters and wood trussed attics, with a ceiling below.

System Type for BB, SD, HIP, or AP:
Wet using CPVC pipe.
Wet or dry using steel pipe.

NOTE

Use of the 4.2 K sprinklers in dry pipe systems is permitted by section 8.3.4.3 of NFPA 13 (2007 edition) where piping is corrosion resistant or internally galvanized.

Hazard:
Light hazard.

BB, SD, or HIP Allowable Roof Span (Coverage) and Roof Pitch:
Refer to Table A for allowable roof spans and roof pitches, as well as for the associated minimum sprinkler flows and pressures. Figures 1, 2, 11, and 12 illustrate where the roof span is to be measured.

Coverage Beyond BB, SD or HIP Allowable Roof Spans:
Up to 10 feet (3,1 m) of coverage at the eave(s) beyond the allowable roof spans for BB, SD, or HIP Sprinklers may be obtained by using a single row of AP Sprinklers (Ref. Figures 14A, 14B, and 15).

BB, SD, HIP, or AP Minimum Distance Between Sprinklers:
4 feet (1,2 m) as measured along branchline for BB and SD (Ref. Figure 3).

3 feet (0,9 m) as measured along branch line for HIP (Ref. Figure 12).

7 feet (2,1 m) between AP Sprinklers.

BB, SD, HIP, or AP Maximum Distance Between Sprinklers:
6 feet (1,8 m) on center along the branch line (Ref. Figure 3 and 12) for BB, SD, and HIP.

For AP, the maximum spacing is 10 feet (3,1 m) perpendicular to slope and 12 feet (3,6 m) parallel to slope. When there is more than one row of AP Sprinklers, the sprinklers must be staggered per Figure 20-B-3.

BB, SD, HIP, or AP Minimum Distance To AP Sprinklers or Standard Spray Sprinklers:
As measured along the peak/ridge direction (Ref. Figure 4), 6 feet (1,8 m) from BB, SD, and HIP to Standard Spray Sprinklers.

As measured along the peak/ridge direction (Ref. Figure 4), 7 feet (2,1 m) from AP to Standard Spray Sprinklers.

In the slope direction (Ref. Figure 6), 26 feet (7,9 m) from BB, SD, or HIP Sprinklers to AP Sprinklers or Standard Spray Sprinklers.

BB, SD, or HIP Deflector Installation Position Below Peak/Ridge or Deck:
For roof pitches of 4:12 (33%) to 12:12 (100%), 22 inches (558,8 mm) maximum, 16 inches (406,4 mm) minimum (Ref. Figures 2 and 5).

For roof pitches of 3:12 (25%) up to 4:12 (33%) [only 4.2K Model BB], 12 inches (304,8 mm) maximum below the peak and a minimum of 1 inch (25,4 mm) below the bottom of top chord or solid wood rafter.

AP Deflector Position and Roof Pitch:
1 to 3 inches (25,4 to 75,6 mm) below the bottom of the top chord or bottom of solid wood rafter, where the roof pitch is 3:12 to 12:12 and the top chord or solid wood rafter is nominal 12 inch (600 mm) or less.

BB or SD Deflector Installation Position Above Scissor Truss
18 inches (457,2 mm) minimum (Ref. Figure 5).

BB, SD, or HIP Minimum Distance Away From Trusses:
Attic Sprinklers must be installed 6 inches (152,4 mm) from the face of trusses (Ref. Figure 7).

SD Distance From Shear Wall Or Draft Curtain:
4 to 6 inches (101,6 to 152,4 mm) from face, and minimum 8 inches (203,2 mm) above bottom of draft curtain (Ref. Figure 2).

Draft Curtains:
Draft curtains installed to permit the installation of Attic Sprinklers shall be constructed so as to not allow heat to escape through or above the draft curtain. The draft curtain may be constructed of 1/2 inch (12,7 mm) plywood.

BB Or HIP Maximum Distance From The Center Line Of The Ridge:
6 inches (152,4 mm) (Ref. Figure 8) with the deflector located 16 inches (406,4 mm) to 22 inches (558,8 mm) from the peak.

Use Of UL Listed BlazeMaster CPVC Piping With "Specific Application Sprinklers For Protecting Attics" (Wet Systems Only):
TFPB BlazeMaster CPVC piping may be used in a combustible concealed attic space requiring sprinklers when installed in accordance with the following guidelines:

NOTES

Where the use of non-combustible insulation is specified, verify with the insulation manufacturer as to the non-combustibility of the insulation. The non-combustible insulation (e.g., fiberglass) may be faced or unfaced. Where faced, the facing need not be non-combustible. The insulation is to have a flame spread index of not more than 25.

Verify chemical compatibility of the insulation with BlazeMaster CPVC by consulting www.lubrizol.com.

- TFBP BlazeMaster CPVC may be used to supply the wet system ceiling sprinklers on the floor below. There must be 6 inches (152,4 mm) of non-combustible insulation covering the pipe extending 12 inches (304,8 mm) on each side away from the centerline of the pipe, and the area above the CPVC must be protected by Model BB, SD, HIP, or AP Sprinklers (Ref. Figure 9A). If the pipe is located inside the ceiling joist, the joist channel must be covered or filled with 6 inches (152,4 mm) of non-combustible insulation on top of the pipe and the area above must be protected by BB, SD, HIP, or AP Sprinklers (Ref. Figure 9B). **Insulation is for fire protection purposes. It is not freeze protection.** BlazeMaster CPVC must be installed in accordance with the BlazeMaster installation guide instructions.
- With reference to Figure 19, TFBP BlazeMaster CPVC may be used exposed to supply wet system BB, SD, or HIP Sprinklers where
  - Risers are vertical and protected by a BB, SD, or HIP Sprinkler located at a maximum lateral distance of 12 inches (300 mm) from the riser centerline.
  - BB, SD, or HIP Sprinklers are directly mounted on the branchline.
  - BB, SD, or HIP Sprinklers are on armovers and located at a maximum lateral distance of 6 inches (150 mm) from the branchline centerline.
  - BB, SD, or HIP Sprinklers are on vertical sprigs attached to the branchline.
  - BB, SD, or HIP Sprinklers are on armover or angled sprigs, and located at a maximum lateral distance of 6 inches (150 mm) from the branchline centerline.
  - A minimum lateral distance of 18 inches (450 mm) is maintained between the CPVC pipe and a

MODEL	K	SIN	ALLOWABLE ROOF SPAN, (a) (b) (e) Feet (m)	MINIMUM FLOW, GPM (lpm)	MINIMUM PRESSURE, PSI (bar)	PITCH, Rise Over Run (%)	DRY PIPE SYSTEM MAXIMUM WATER DELIVERY TIME, Seconds
BB1	8.0	TY4180	≤60 (18,3)	38 (144)	22.6 (1,5)	4:12 (33) to less than 7:12 (58)	(c)
BB2	8.0	TY4181	≤60 (18,3)	38 (144)	22.6 (1,5)	7:12 (58) to less than 10:12 (83)	(c)
BB3	8.0	TY4182	≤60 (18,3)	40 (152)	25.0 (1,7)	10:12 (83) to 12:12 (100)	(c)
BB1	5.6	TY3180	>40 (12,2) to ≤60 (18,3)	38 (144)	46.0 (3,2)	4:12 (33) to less than 7:12 (58)	(c)
BB2	5.6	TY3181	>40 (12,2) to ≤60 (18,3)	38 (144)	46.0 (3,2)	7:12 (58) to less than 10:12 (83)	(c)
BB3	5.6	TY3182	>40 (12,2) to ≤60 (18,3)	38 (144)	46.0 (3,2)	10:12 (83) to 12:12 (100)	(c)
BB1	5.6	TY3180	≤40 (12,2)	25 (95)	20.0 (1,4)	4:12 (33) to less than 7:12 (58)	(c)
BB2	5.6	TY3181	≤40 (12,2)	25 (95)	20.0 (1,4)	7:12 (58) to less than 10:12 (83)	(c)
BB3	5.6	TY3182	≤40 (12,2)	25 (95)	20.0 (1,4)	10:12 (83) to 12:12 (100)	(c)
BB1	4.2	TY2180	≤20 (6,1)	13 (49)	9.6 (0,7)	3:12 (25) to less than 7:12 (58)	45 (d)
BB2	4.2	TY2181	≤20 (6,1)	13 (49)	9.6 (0,7)	7:12 (58) to less than 10:12 (83)	45 (d)
BB3	4.2	TY2182	≤20 (6,1)	13 (49)	9.6 (0,7)	10:12 (83) to 12:12 (100)	45 (d)
SD1	5.6	TY3183	>30 (9,1) to ≤40 (12,2)	35 (132)	39.0 (2,7)	4:12 (33) to less than 7:12 (58)	(c)
SD2	5.6	TY3184	>30 (9,1) to ≤40 (12,2)	35 (132)	39.0 (2,7)	7:12 (58) to less than 10:12 (83)	(c)
SD3	5.6	TY3185	>30 (9,1) to ≤40 (12,2)	35 (132)	39.0 (2,7)	10:12 (83) to 12:12 (100)	(c)
SD1	5.6	TY3183	>10 (3,0) to ≤30 (9,1)	25 (95)	20.0 (1,4)	4:12 (33) to less than 7:12 (58)	(c)
SD2	5.6	TY3184	>10 (3,0) to ≤30 (9,1)	25 (95)	20.0 (1,4)	7:12 (58) to less than 10:12 (83)	(c)
SD3	5.6	TY3185	>10 (3,0) to ≤30 (9,1)	25 (95)	20.0 (1,4)	10:12 (83) to 12:12 (100)	(c)
SD1	5.6	TY3183	≤10 (3,0)	19 (72)	11.5 (0,8)	4:12 (33) to less than 7:12 (58)	(c)
SD2	5.6	TY3184	≤10 (3,0)	19 (72)	11.5 (0,8)	7:12 (58) to less than 10:12 (83)	(c)
SD3	5.6	TY3185	≤10 (3,0)	19 (72)	11.5 (0,8)	10:12 (83) to 12:12 (100)	(c)
HIP	5.6	TY3187	>20 (6,1) to ≤28 (8,5)	34 (129)	36.9 (2,5)	4:12 (33) to 12:12 (100)	(c)
HIP	5.6	TY3187	≤20 (6,1)	25 (95)	20.0 (1,4)	4:12 (33) to 12:12 (100)	(c)
AP	5.6	TY3190	10 (3,1) x 12 (3,6) - See note (e) -	Minimum 7 psi (0,48 bar) Minimum 0.10 gpm/sq. ft. (4,1 mm/min.) Design Density		3:12 (25) to 12:12 (100)	60 (d)
AP	4.2	TY2190				3:12 (25) to 12:12 (100)	60 (d)

NOTES:
(a) The BB and SD roof span is measured horizontally (not along the slope) as shown in Figure 1 and 2.
(b) The HIP roof span is measured horizontally as shown in Figure 12.
(c) Refer to 2007 edition of NFPA 13, Section 7.2.3.
(d) Maximum water delivery time for all size of systems.
(e) The AP roof span is measured along the slope. Maximum 10 feet (3,1 m) perpendicular to slope by maximum 12 feet (3,6 m) parallel to slope.

TABLE A
ALLOWABLE ROOF SPAN, FLOW, PRESSURE, AND PITCH FOR
"SPECIFIC APPLICATION SPRINKLERS FOR PROTECTING ATTICS"

heat producing device such as heat pumps, fan motors, lights, and heat lamps.

- TFBP BlazeMaster CPVC may be used exposed to provide wet system, vertical or angled, sprigs to AP Sprinklers (Ref. Figures 17A and 17B) where

  * The exposed portion of an angled sprig is a maximum length of 3 feet (0,9 m), the sprig is supported within 12 inches (0,3 m) of the AP Sprinkler, and pipe hangers are provided using the CPVC hanger support for horizontal pipe runs.

  * Vertical sprigs have a maximum exposed length of 10 feet (3,05 m), the AP Sprinkler is located at a maximum lateral distance of 12 inches (300 mm) from the sprig centerline, and the sprig is supported at the swing joint to the AP Sprinkler.

  * A minimum 6 inches (152,4 mm) deep of non-combustible insulation extending 12 inches (304,8 mm) on each side away from the centerline of the CPVC branchline feeding the AP sprigs (Ref. Figures 17A). If the CPVC branchline is located inside the ceiling joist, the joist channel must be covered or filled with a minimum of 6 inches (152,4 mm) deep of non-combustible insulation on top of

the branchline supplying the AP sprigs (Ref. Figure 17B). **Insulation is for fire protection purposes. It is not freeze protection.** *Additional depth of non-combustible insulation may be added to reduce the exposed length of the AP sprigs.*

* A minimum lateral distance of 18 inches (450 mm) is maintained between the CPVC pipe and a heat producing device such as heat pumps, fan motors, lights and heat lamps.

Mismatched Slopes:
For mismatched slopes refer to Figure 10.

Obstructions:
For BB, SD, and HIP, refer to Figure 16. For AP Sprinklers, refer to Figure 18. BB, SD, HIP, and AP Sprinklers may be installed directly on maximum 2-1/2 inch NPS (DN65) branchlines without the need for sprigs. See the 2007 edition of NFPA 13, 8.8.5.2 for requirements when installed on pipe greater than 2-1/2 inch NPS (DN65).

Hydraulic Requirements:
For hydraulic requirements refer to Figure 20.

To Determine The Correct Flow And Pressure:
For BB, SD, or HIP Sprinklers, determine the roof span (measured horizontally) and the slope of the roof, and refer to Table A. There is no interpolation of the flow and pressure shown. Round all cases to the next higher spacing. For example, a 45 feet (13,7 m) span with the BB1 (K=8.0) would be calculated at the 60 feet (18,3 m) span.

For the AP Sprinklers, the minimum design pressure is 7 psi, and the minimum design density is 0.10 gpm/ft^2 (4,1 mm/min). *The NFPA 13, 20 psi (1,4 bar) minimum operating pressure for Standard Spray Sprinkler spacings parallel to the ridge that are above 8 feet (2,4 m) does not apply to the AP.*

Coverage Area:

- Coverage area for **BB (Back to Back) Sprinklers** is determined by twice the distance of the furthest throw measured along the slope, multiplied by the distance along the branchline (maximum distance along branchline is 6 feet (1,8 m) regardless of the length of the throw).

NOTE
The distance along the branchline may have to be reduced to less than the maximum of 6 feet (1,8 m) to remain under 400 ft^2 (37,2 m^2) maximum depending on the slope and the span. In no case can the span exceed 60 feet (18,3 m) without the use of additional Model AP Sprinklers or Standard Spray Sprinklers.

- Coverage area for the **SD (Single Directional) Sprinklers** is the distance along the branchline multiplied by the distance of the throw down the slope. Regardless of the throw, the maximum distance along the branchline is 6 feet (1,8 m), the maximum throw, measured horizontally is 40 feet (12,2 m), and the maximum coverage per sprinkler is 400 ft^2 (37,2 m^2).
- Coverage area for the **HIP Sprinklers** is the distance down the larger slope multiplied by two, then multiplied by the distance between the sprinklers as measured along the slope of the hip.
- Coverage area for the **AP (Attic Plus) Sprinklers** is the distance along the branchline multiplied by the distance between the branchlines. The maximum spacing is 10 feet (3,1 m) perpendicular to the slope and 12 feet (3,6 m) parallel to slope, and as measured on the slope. When there is more than one row of AP Sprinklers, the sprinklers must be staggered per Figure 20-B-3. The maximum spacing per sprinkler is 120 ft^2 (11,1 m^2).

Design Guidelines

To design a project with attic sprinklers use these steps as a guideline:

- Determine if Model BB, SD, or HIP Sprinkler is needed.
- Determine if the roof slope is between 3:12 to 12:12. If more than one slope is being used on a project, select the correct sprinkler for each area.
- Follow the guidelines for each type of sprinkler.
- Calculate the sprinkler system in accordance with the appropriate flow and pressure information provided in Table A, as well as Figure 20. There is no interpolation of the flows and pressures shown on the chart.

For BB Sprinklers
(Back to Back Dual Directional)

- Determine the throw needed (see spacing requirements in Table A). If over 20 feet (6,1 m) and up to 60 feet (18,3 m) is required, use the 8.0 K-factor, BB Sprinklers to reduce the pressure required. If pressure is not a concern, use the 5.6 K-factor, BB Sprinklers to minimize over discharge.
- If less than 20 feet (6,1 m) is required, use the 4.2 K-factor, Back to Back Dual Directional to minimize pressure and flow requirements
- Determine the distance along the slope. If the distance is not equal, use the longer side. Multiply the longer side by two to determine the spacing down the slope. Four hundred divided by this value will determine the maximum spacing along the ridge. The maximum distance is 6 feet (1,8 m). For example, a 12:12 slope at the maximum span of 60 feet (18,3 m) will produce a slope length of approximately 42.5 feet (13,0 m). That number multiplied by two produces an 85 feet (25,9 m) throw. Four hundred square feet maximum divided by an 85 feet (25,9 m) throw only allows a 4 feet - 8 inches (1,4 m) spacing along the ridge. Using the maximum spacing, space the sprinklers along the ridge.
- Avoid obstructions as shown in Figure 16. If necessary, add Model AP Sprinklers or Standard Spray Sprinklers to maintain coverage around obstructions.

For SD Sprinklers
(Single Directional)

- Determine the throw needed.
- As the 400 ft^2 (37,2 m^2) is not a factor with the SD Sprinklers, the maximum spacing is 6 feet (1,8 m) and the minimum is 4 feet (1,2 m) (Ref. Figures 2 &11). (400 ft^2 is not an issue with the single directional because at its maximum spacing of 6 foot (1,8 m) on center/covering 40 feet (12,2 m) flat / a 12:12 slope / and the discharge being 56.5 feet (17,2 m), the 400 ft^2 (37,2 m2) maximum would not be exceeded.)
- Avoid obstructions as shown in Figure 16. If necessary, add Model AP Sprinklers or Standard Spray Sprinklers to maintain coverage around obstructions.

For HIP Sprinklers

- Verify framing direction is perpendicular to outside wall (Ref. Figure 12). If not, protect that area with AP Sprinklers or Standard Spray Sprinklers (Ref. Figure 13)
- From the intersection of the top of the hip and the ridge, the maximum

distance down the slope of the hip is 3 feet (0,9 m). Start the layout with the first sprinkler as close to that point as possible, but no further, while staying 6 inches (152,4 mm) away from the face of the trusses. Remember the slope of the hip is not equal to the slope of the roof from the ridge to the outside wall. Continue to space sprinklers down the hip at a maximum of 6 feet (1,8 m) on center as measured along the slope of the hip. When the bottom of the hip is reached, the last sprinkler must be within 7-1/2 feet (2,3 m) of the outside wall as measured flat (plan view). If this pipe is "cut to fit", the different slopes of the hip and the roof, as well as distances measured along the slope verses horizontal in plan view, must be accounted for.

- Avoid obstructions as shown in Figure 16. If necessary, add Model AP Sprinklers or Standard Spray Sprinklers to maintain coverage around obstructions.

Care and Maintenance

The Tyco® Peak™ Performance Models BB™, SD™, HIP™, and AP™ "Specific Application Sprinklers for Protecting Attics" must be maintained and serviced in accordance with the following instructions:

NOTE

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, permission to shut down the affected fire protection systems must be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

Sprinklers that are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated, or otherwise altered after leaving the factory. Modified sprinklers must be replaced.

Over-heated solder type sprinklers must be replaced. Bulb-type sprinklers that have been exposed to corrosive products of combustion, but have not operated, should be replaced if they cannot be completely cleaned by wiping the sprinkler with a cloth or by brushing it with a soft bristle brush.

Care must be exercised to avoid damage to the sprinklers - before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb. (Ref. Installation Section).

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. The installing contractor or sprinkler manufacturer should be contacted relative to any questions.

Automatic sprinkler systems should be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Limited Warranty

Products manufactured by Tyco Fire & Building Products (TFBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFBP to be defective shall be either repaired or replaced, at TFBP's sole option. TFBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFBP was informed about the possibility of such damages, and in no event shall TFBP's liability exceed an amount equal to the sales price.

The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

Ordering Procedure

Contact your local distributor for availability.

Sprinkler Assemblies with NPT Thread Connections:
Specify: Model (specify), K-factor (specify), SIN (specify), Specific Application Attic Sprinkler, P/N (specify).

BB1 (K=8.0),
TY4180 . . . . . P/N 51-623-1-200
BB2 (K=8.0),
TY4181 . . . . . P/N 51-621-1-200
BB3 (K=8.0),
TY4182 . . . . . P/N 51-622-1-200

BB1 (K=5.6),
TY3180 . . . . . P/N 50-601-1-212
BB2 (K=5.6),
TY3181 . . . . . P/N 50-602-1-212
BB3 (K=5.6),
TY3182 . . . . . P/N 50-603-1-212

BB1 (K=4.2),
TY4180 . . . . . P/N 50-620-1-200
BB2 (K=4.2),
TY4181 . . . . . P/N 50-621-1-200
BB3 (K=4.2),
TY4182 . . . . . P/N 50-622-1-200

SD1 (K=5.6),
TY3183 . . . . . P/N 50-611-1-212
SD2 (K=5.6),
TY3184 . . . . . P/N 50-612-1-212
SD3 (K=5.6),
TY3185 . . . . . P/N 50-613-1-212

HIP (K=5.6),
TY3187 . . . . . P/N 51-620-1-200

AP (K=5.6),
TY3190 . . . . . P/N 50-625-1-200
AP (K=4.2),
TY2190 . . . . . P/N 50-624-1-200

Sprinkler Wrench:
Specify: W-Type 3 Sprinkler Wrench, P/N 56-895-1-001.

Specify: W-Type 20 Sprinkler Wrench, P/N 56-000-1-106.

Specify: W-Type 6 Sprinkler Wrench, P/N 56-000-6-387.

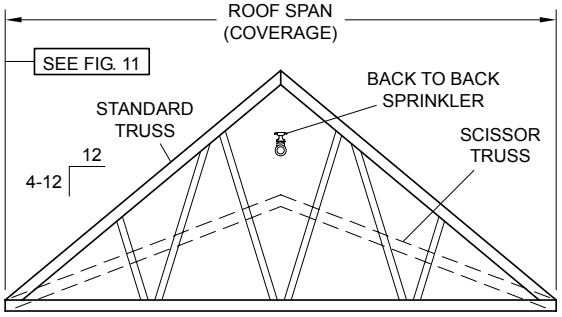


FIGURE 1

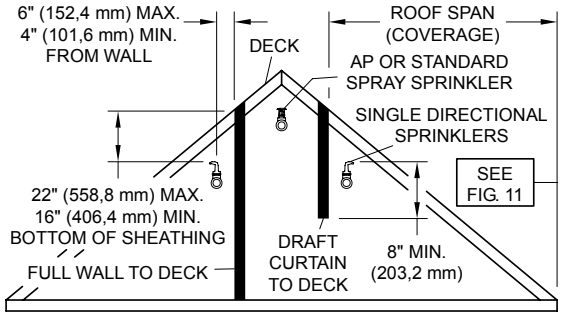


FIGURE 2

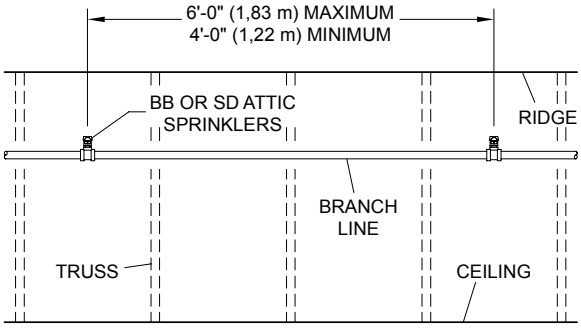


FIGURE 3

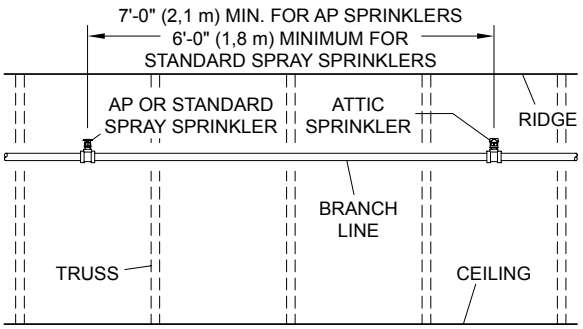


FIGURE 4

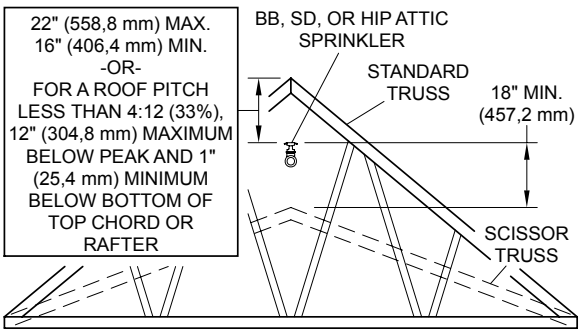


FIGURE 5

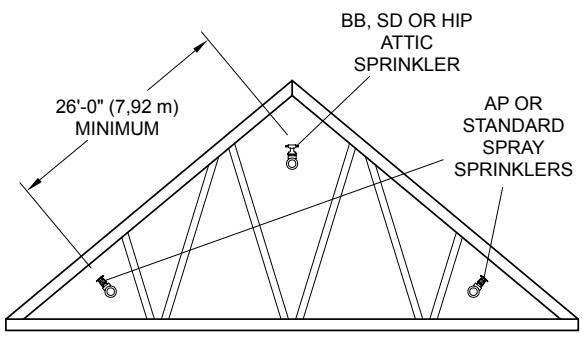


FIGURE 6

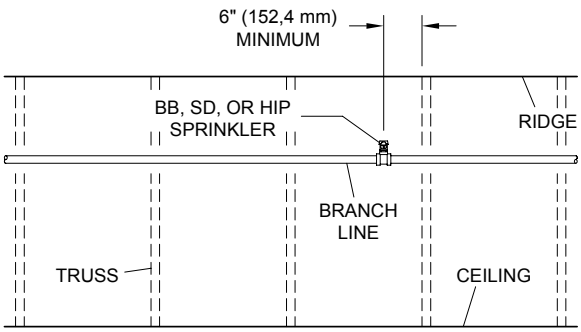


FIGURE 7

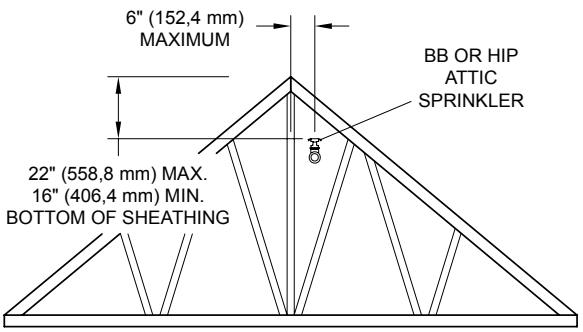


FIGURE 8

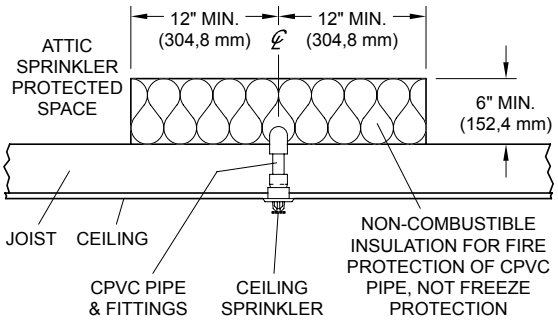


FIGURE 9A

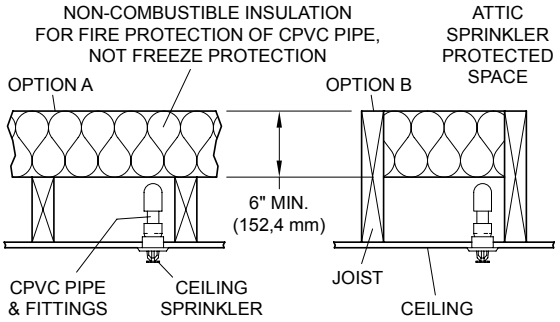
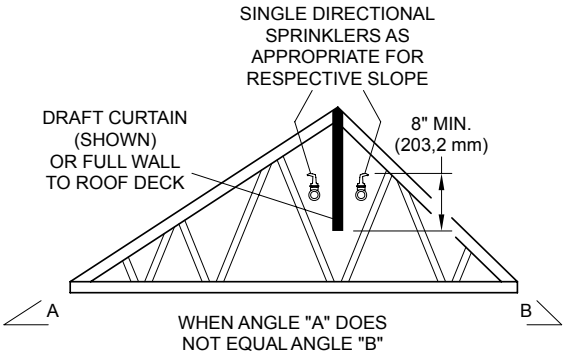


FIGURE 9B

FIGURE 10
Permitted Use Of Attic Sprinklers
For Mismatched Slopes



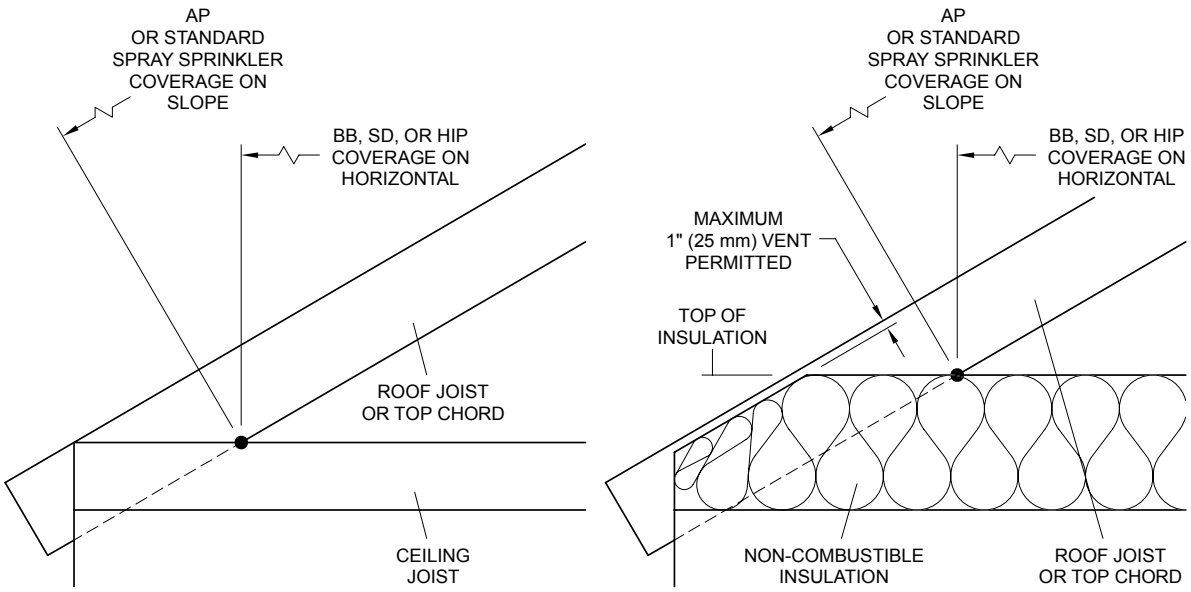


FIGURE 11
Coverage Starting Point At Eave

FIGURE 12
Hip Roof Installation With Rafters Framed Perpendicular To Outside Wall (Shown With HIP Sprinklers Protecting Hip Slope & Adjacent Areas To Hip Slope)

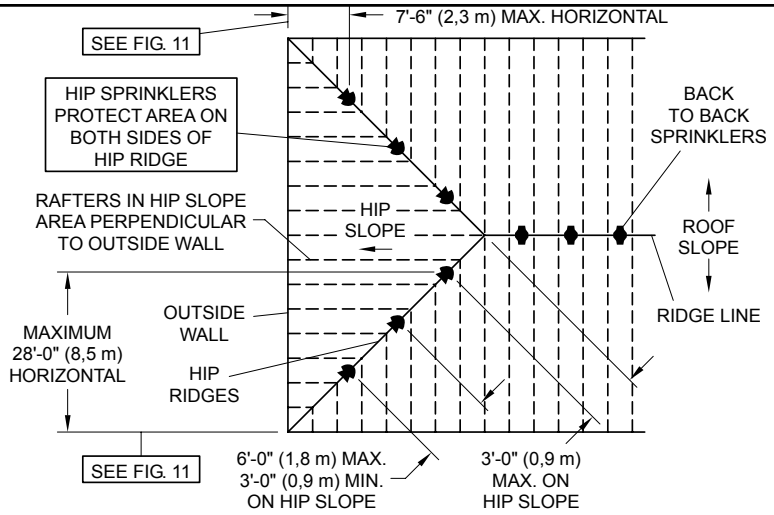


FIGURE 13A
Hip Roof Installation With Trusses Framed Parallel To Outside Wall (Shown With Standard Spray Or AP Sprinklers In Hip Slope)

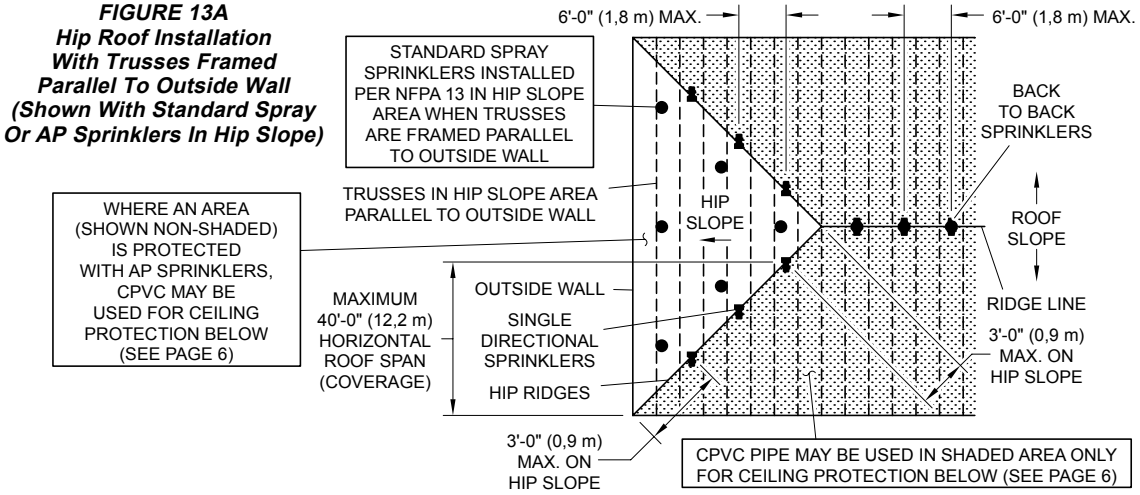
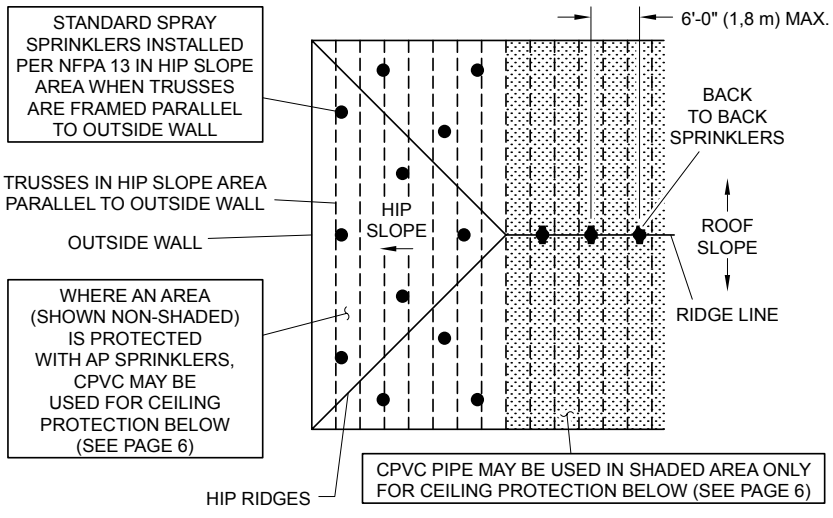


FIGURE 13B
Hip Roof Installation With Trusses Framed Parallel To Outside Wall (Shown With Standard Spray Or AP Sprinklers In Hip Slope & Adjacent Areas To Hip Slope)



Coverage Beyond BB, SD, or HIP Allowable Roof Spans

A. For single ridge construction (Ref. Figure 14A), AP Sprinklers can be used to protect up to 10 feet (3,1 m) of width at the eaves beyond the maximum allowable 60 foot (18,3 m), 40 foot (12,2 m), or 20 foot (6,1 m) spans of the BB Sprinklers (Ref. Table A).

B. Where SD Sprinklers are used (Ref. Figure 14B), AP Sprinklers can be used to protect up to 10 feet (3,1 m) of width at the eaves beyond the maximum allowable 40 foot (12,2 m), 30 foot (9,1 m), or 10 foot (3,0 m) spans of the SD Sprinklers (Ref. Table A).

C. Where HIP Sprinklers are used for hip roof construction (Ref. Figure 15), use BB Sprinklers in the center portion and HIP Sprinklers down the entire hip. AP Sprinklers can then used to protect the eaves beyond the BB Sprinklers as described in Paragraph A. Also, AP Sprinklers can be used to protect up to 10 feet (3,1 m) of width beyond the maximum allowable 28 foot (8,5 m) or 20 foot (6,1 m) horizontal coverage of the HIP Sprinklers (Ref. Table A). Spacing of the AP Sprinklers is to be as detailed for their use with the BB Sprinklers in Figure 14A.

NOTE: *The use of Attic Sprinklers CANNOT be considered for attics over 80 feet (24,4 m) wide.*

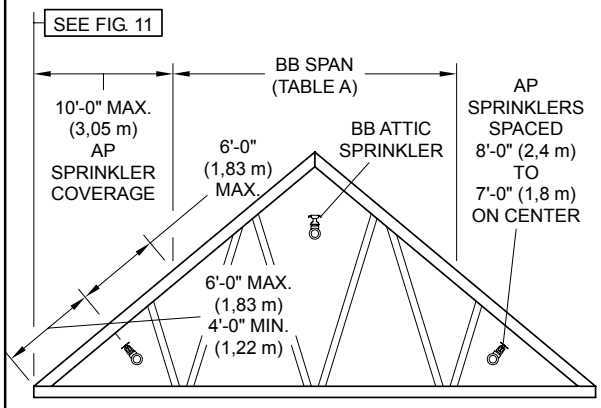


FIGURE 14A — BB w/ AP SPRINKLERS

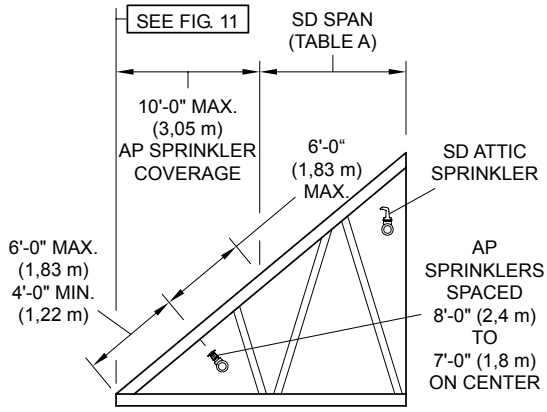


FIGURE 14B — SD w/ AP SPRINKLERS

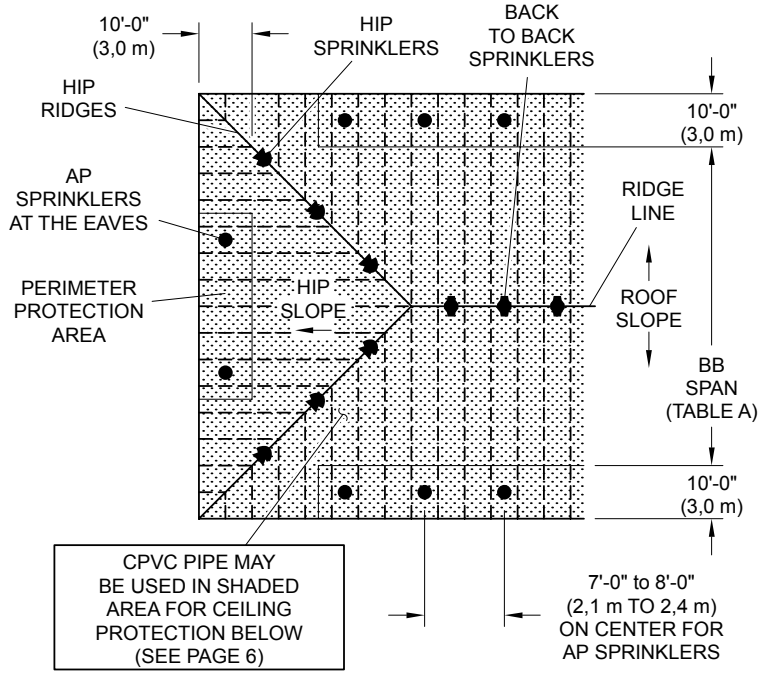


FIGURE 15 — HIP w/ AP SPRINKLERS

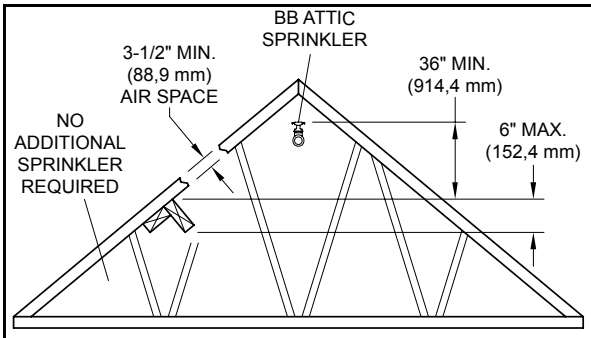


FIGURE 16A

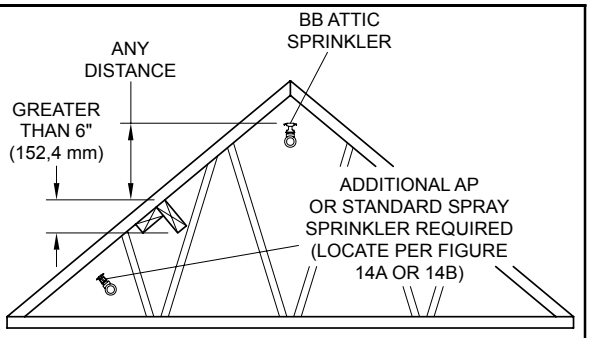


FIGURE 16B

There can be a maximum 6 inch (152,4 mm) high Horizontal Obstruction as long as it is 36 inches (914,4 mm), measured vertically, below the Attic Sprinkler. If the obstruction is closer or larger, there must be a sprinkler on the other side of the obstruction. Reference Figures 16A and 16B. This criteria does not limit the top chord of the trusses or the depth of the rafter, but does limit the obstructions that run across the trusses or rafters.

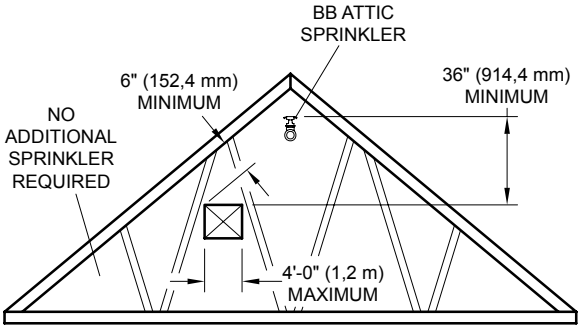


FIGURE 16C

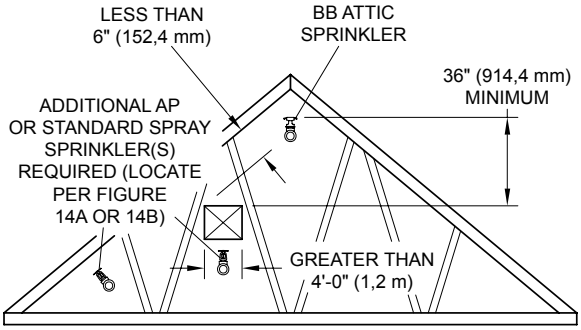


FIGURE 16D

If the Horizontal Obstruction is below the sprinkler, there must be 6 inches (152,4 mm) clearance over the top of the obstruction, and the obstruction must be 4 feet (1,2 m) or less in width to allow water to pass both over and under the obstruction. The clearance is measured perpendicular to and from the bottom of the rafter. If there is not 6 inches (152,4 mm) of clearance above the obstruction, a sprinkler must be located on the other side of the obstruction. If the obstruction is greater than 4 feet (1,2 m) in width, a sprinkler must be added below the obstruction. Reference Figures 16C and 16D, where the maximum spacing for AP Sprinklers is 12 feet (3,7 m) and Standard Spray Sprinklers is 15 feet (4,6 m).

Dimension A	Distance B	Additional Sprinkler Required Beyond Obstruction
Maximum Horizontal Dimension of Obstruction	Minimum Horizontal Distance to Obstruction	
All Vertical Obstructions	< 6" (152,4 mm)	YES
1/2"-1" (12,7 mm-25,4 mm)	6" (152,4 mm)	NO
1"-4" (25,4 mm-101,6 mm)	12" (304,8 mm)	NO
4"-8" (101,4 mm-203,2 mm)	24" (609,6 mm)	NO
8"-10" (203,2 mm-254,0 mm)	5'-0" (1,52 m)	NO
10"-20" (254,0 mm-508,0 mm)	10'-0" (3,05 m)	NO
20"-30" (508,0 mm-762,0 mm)	15'-0" (4,57 m)	NO
30"-40" (762,0 mm-1016,0 mm)	20'-0" (6,10 m)	NO
40"-48" (1016,0 mm-1219,2 mm)	25'-0" (7,62 m)	NO
> 48" (1219,2 mm)	Any Distance	YES

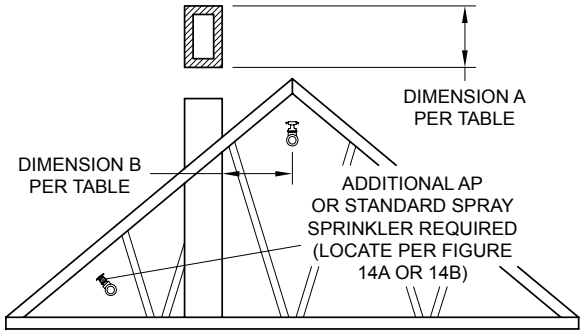


FIGURE 16E

For Vertical Obstructions, the maximum dimension of the obstruction is its width and the horizontal distance away from the obstruction is measured horizontally.

FIGURE 16 — PART 1 of 2 — OBSTRUCTIONS TO WATER DISTRIBUTION — BB, SD & HIP
(Obstructions to water distribution for Attic Sprinklers differ from standard sprinklers as shown)

FIGURE 16F
Area Outside Of Mechanical Space Or Similar Compartmented Space

When a BB Sprinkler is 36 inches (914,4 mm) or greater above the space, and 36 inches (914,4 mm) or greater clearance above the space is present, additional sprinklers are not needed.

When a BB Sprinkler is a 36 inches (914,4 mm) or greater above the space, and a 12 to 36 inches (304,8 mm to 914,4 mm) clearance above the space is present, Intermediate Level Standard Sprinklers are to be installed to protect the obstructed area.

Otherwise, the area beyond the mechanical space is to be protected as shown by installing Standard Spray Sprinklers as necessary — OR — by constructing a shear wall and installing SD Sprinklers.

NOTE: In all cases, the mechanical space or similar compartmented space is to be sprinklered per its respective hazard rating and separated from the light hazard attic space by construction that has a fire resistance rating based on the water supply duration required for the hazard rating within the mechanical space or similar compartmented space.

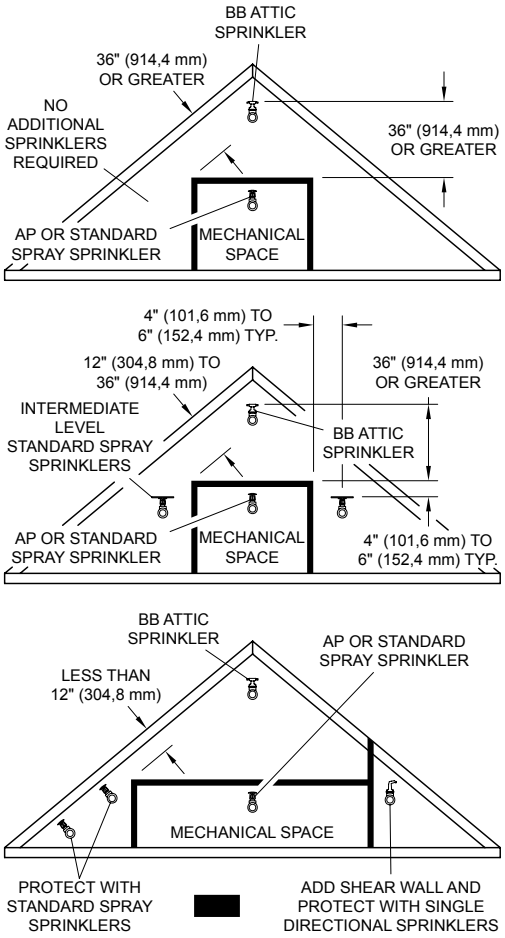
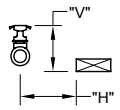


FIGURE 16G
Piggyback Trusses

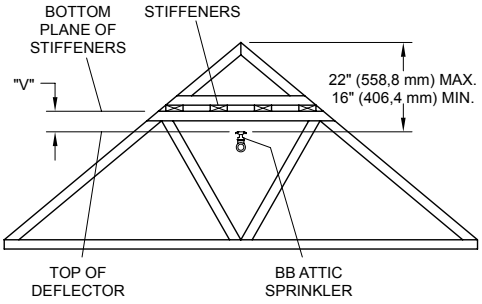
When a BB Sprinkler can be installed below or between stiffeners and maintain the 16 to 22 inch (404,4 to 558,8 mm) distance to the peak, as well as the “V” and “H” clearance to the stiffeners, additional sprinklers are not required.

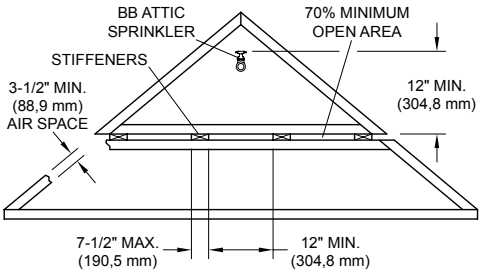
When the stiffeners are located a minimum of 12 inches (304,8 mm) below the BB Sprinkler, the stiffeners are 7-1/2 inches (190,5 mm) maximum in width, the openings are 12 inches (304,8 mm) minimum, and there is 70% minimum open area, additional sprinklers are not required.

Otherwise, additional sprinklers are required as shown.



V	H		
	BB1	BB2	BB3
0"	0"	0"	0"
V > 0"	V + 15"	V + 10"	V + 8"





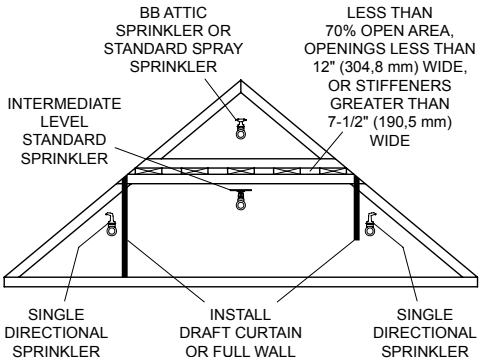


FIGURE 16 — PART 2 of 2 — OBSTRUCTIONS TO WATER DISTRIBUTION — BB, SD & HIP
(Obstructions to water distribution for Attic Sprinklers differ from standard sprinklers as shown)

FIGURE 17A
EXPOSED CPVC
WITH AP SPRINKLERS
AND
BRANCHLINE OVER JOISTS

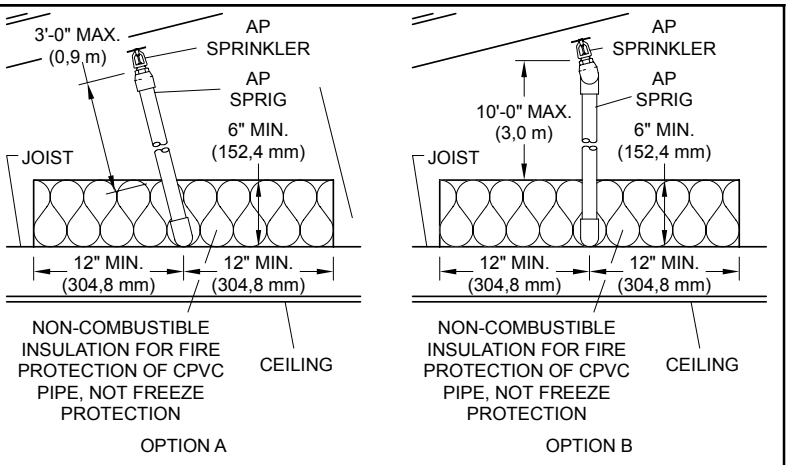


FIGURE 17B
EXPOSED CPVC WITH AP
SPRINKLERS
AND BRANCHLINE WTHIN
JOISTS

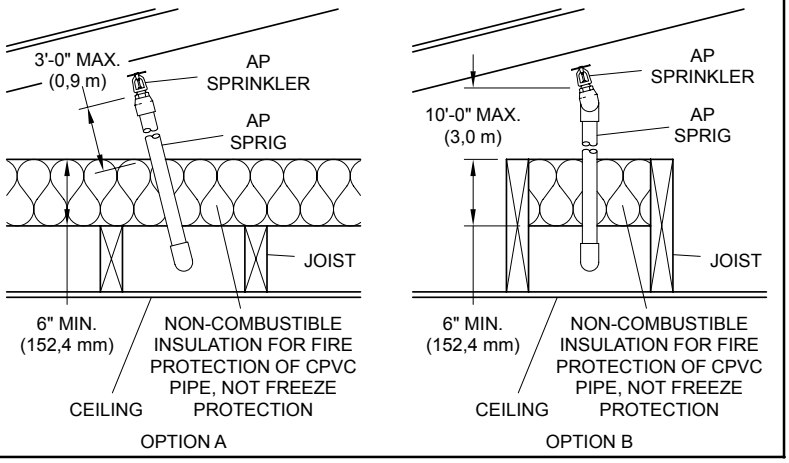
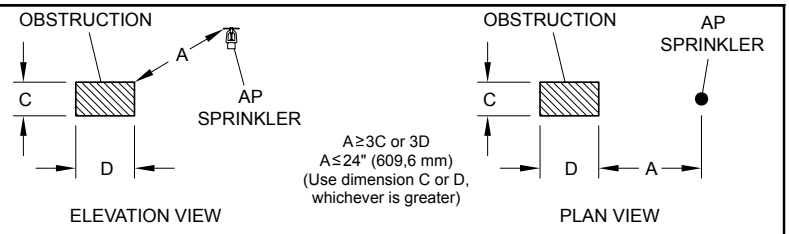
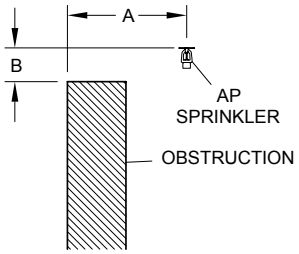


FIGURE 18
OBSTRUCTIONS TO WATER
DISTRIBUTION FOR
MODEL AP SPRINKLERS





Horizontal Distance (A)	Minimum Vertical Distance Below Deflector (B)
≤6" (≤152,4 mm)	3" (76,2 mm)
>6" to 9" (>152,4 to 228,6 mm)	4" (101,6 mm)
>9" to 12" (>228,6 mm to 304,8 mm)	6" (88,9 mm)
>12" to 15" (>304,8 mm to 381,0 mm)	8" (203,2 mm)
>15" to 18" (>381,0 to 457,2 mm)	9-1/2" (241,3 mm)
>18" to 24" (457,2 mm to 609,6 mm)	12-1/2" (317,5 mm)
>24" to 30" (>609,6 mm to 762,0 mm)	15-1/2" (393,7 mm)
>30" (>762,0 mm)	18" (457,2 mm)

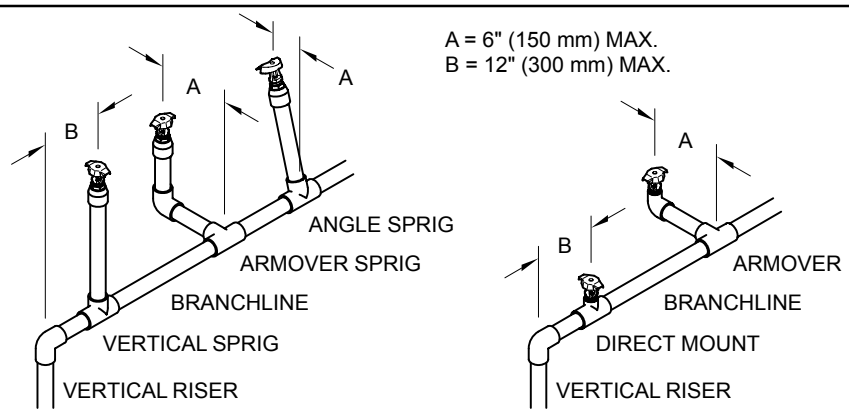


FIGURE 19
EXPOSED CPVC WITH BB, SD, AND HIP SPRINKLERS

HYDRAULIC CALCULATIONS

Attic sprinklers must be calculated in conformance with these guidelines. In all cases, the design area shall include the most hydraulically demanding sprinklers. More than one set of calculations may be required to prove different situations.

For individual areas requiring more than four AP Sprinklers, the maximum area of attic protected by AP Sprinklers is limited to 3000 ft^2 (279 m^2) in any single area. Areas must be separated by a minimum of 15 feet (4,6 m) by an area protected by BB, SD,or HIP Sprinklers, in order to be considered separate areas.

The hydraulic calculations have been divided into three parts as follows:

- **FIGURE 20-A: "Attics Protected Entirely By BB, SD, and HIP Attic Sprinklers".**

  20-A-1 (Page 18) BB Sprinklers
  20-A-2 (Page 18) BB and HIP Sprinklers
  20-A-3 (Page 19) BB and SD Sprinklers
  20-A-4 (Page 19) SD Sprinklers
  20-A-5 (Page 19) SD and HIP Sprinklers
  20-A-6 (Page 19) HIP Sprinklers

- **FIGURE 20-B: "Attics Protected With A Mixture Of BB. SD, and HIP Attic Sprinklers And AP Sprinklers".**

  20-B-1 (Page 20) SD Sprinklers & AP Sprinklers At The Ridge
  20-B-2 (Page 20) BB Sprinklers & AP Sprinklers At The Eaves or Beyond An Obstruction
  20-B-3 (Page 21) BB Sprinklers & AP Sprinklers At The Hip
  20-B-4 (Page 21) BB Sprinklers, SD Sprinklers, HIP Sprinklers, & AP Sprinklers At The Hip
  20-B-5 (Page 22) BB, SD, or HIP Sprinklers & AP Sprinklers in a Dormer, at a Cross, or at an Ell
  20-B-6 (Page 22) BB,SD, or HIP Sprinklers & AP Sprinklers Separated By Compartmentalization

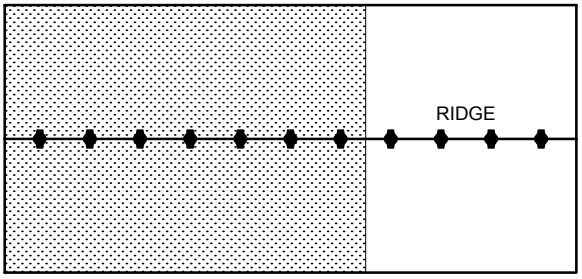
- **FIGURE 20-C: "Attics Protected With A Mixture Of BB. SD, and HIP Attic Sprinklers And Standard Spray Sprinklers".**

  20-C-1 (Page 23) SD Sprinklers & Standard Spray Sprinklers At The Ridge
  20-C-2 (Page 23) BB Sprinklers & Standard Spray Sprinklers At The Eaves or Beyond An Obstruction
  20-C-3 (Page 24) BB Sprinklers & Standard Spray Sprinklers At The Hip
  20-C-4 (Page 25) BB Sprinklers, SD Sprinklers, HIP Sprinklers, & Standard Spray Sprinklers At The Hip
  20-C-5 (Page 26) BB, SD, or HIP Sprinklers & Standard Spray Sprinklers in a Dormer, at a Cross, or at an Ell
  20-C-6 (Page 26) BB, SD, or HIP Sprinklers & Standard Sprinklers Separated By Compartmentalization

FIGURE 20 — HYDRAULIC CALCULATIONS

Figure 20-A-1. BB Sprinklers

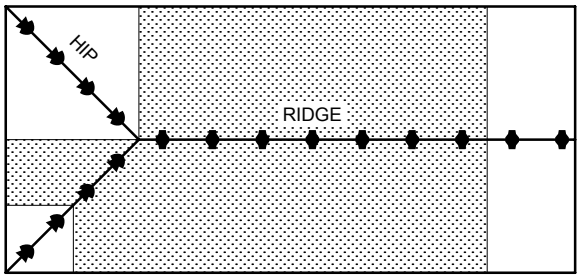
- Wet Systems — Calculate the most demanding five sprinklers.
- Dry Systems — Calculate the most demanding seven sprinklers (see adjacent figure).



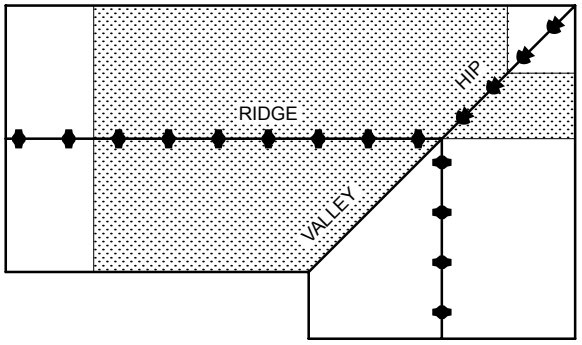
DRY SYSTEM SHOWN

Figure 20-A-2. BB and HIP Sprinklers

- Wet Systems — Calculate the most demanding five sprinklers.
- Dry Systems — Calculate the most demanding seven sprinklers, and then calculate the most demanding contiguous nine sprinklers with a maximum of seven to be BB Sprinklers (see adjacent figures). Use the most demanding calculation.



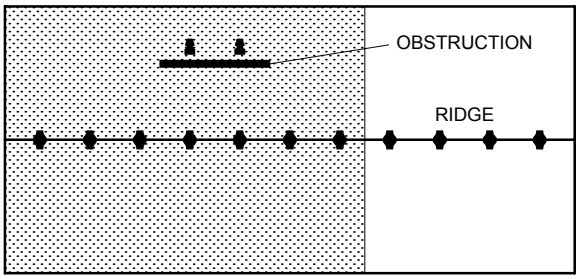
DRY SYSTEM SHOWN



DRY SYSTEM SHOWN

Figure 20-A-3. BB and SD Sprinklers

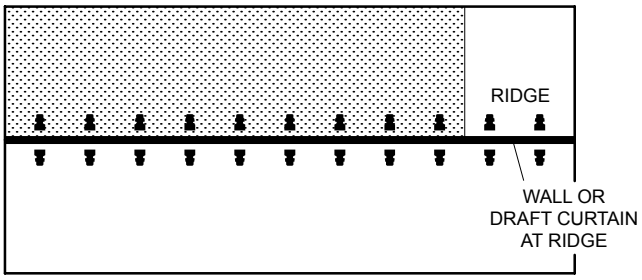
- Wet Systems — Calculate the most demanding five BB Sprinklers plus two SD Sprinklers.
- Dry Systems — Calculate the most demanding seven BB Sprinklers plus up to two SD Sprinklers (see adjacent figure).



DRY SYSTEM SHOWN

Figure 20-A-4. SD Sprinklers

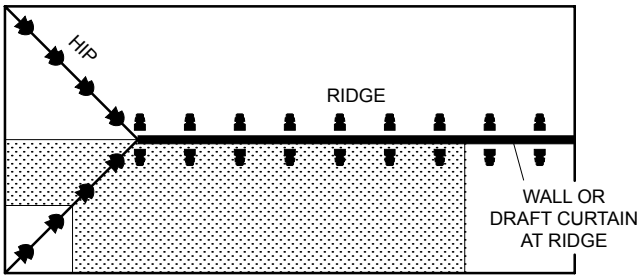
- Wet Systems — Calculate the most demanding five SD Sprinklers.
- Dry Systems — Calculate the most demanding nine SD Sprinklers (see adjacent figure).



DRY SYSTEM SHOWN

Figure 20-A-5. SD and HIP Sprinklers

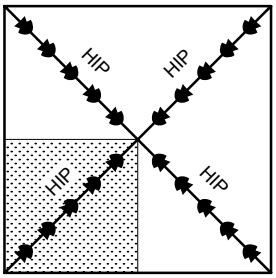
- Wet Systems — Calculate the most demanding five sprinklers.
- Dry Systems — Calculate the most demanding nine sprinklers with a maximum of seven to be SD Sprinklers (see adjacent figure).



DRY SYSTEM SHOWN

Figure 20-A-6. HIP Sprinklers

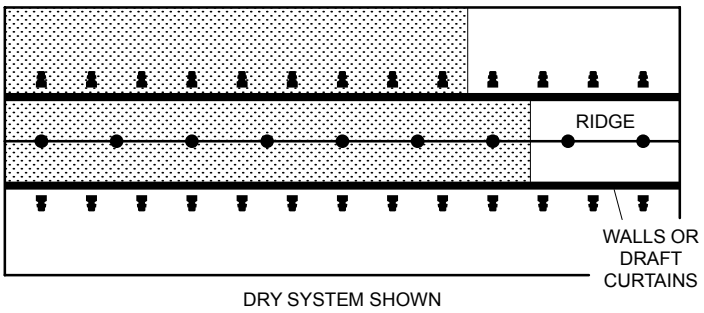
- Wet Systems — Calculate the most demanding five sprinklers (see adjacent figure).
- Dry Systems — Calculate the most demanding nine sprinklers.



WET SYSTEM SHOWN

Figure 20-B-1. SD Sprinklers & AP Sprinklers At The Ridge

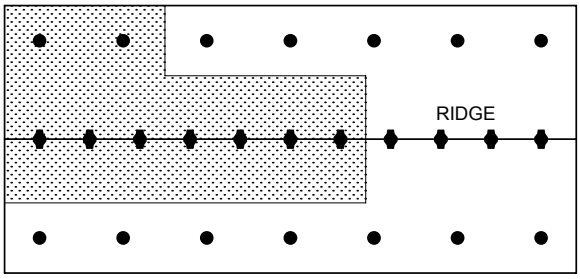
- Wet Systems — Calculate the most demanding five sprinklers of one type. Use the most demanding calculation.
- Dry Systems — Calculate the most demanding nine SD Sprinklers, and then calculate the most demanding seven AP Sprinklers. Use the most demanding calculation (see adjacent figure).



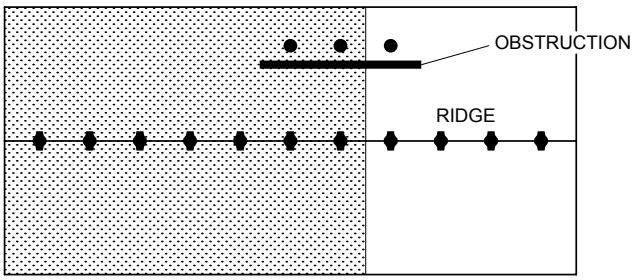
DRY SYSTEM SHOWN

Figure 20-B-2. BB or SD Sprinklers & AP Sprinklers At The Eaves or Beyond An Obstruction

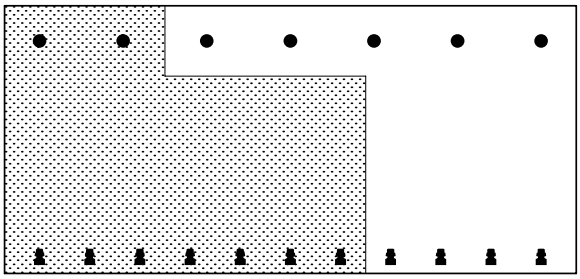
- Wet Systems — Calculate the most demanding five BB or SD Sprinklers plus up to two most demanding AP Sprinklers.
- Dry Systems — Calculate the most demanding seven BB or SD Sprinklers plus up to two most demanding AP Sprinklers (see adjacent figures).



DRY SYSTEM SHOWN



DRY SYSTEM SHOWN

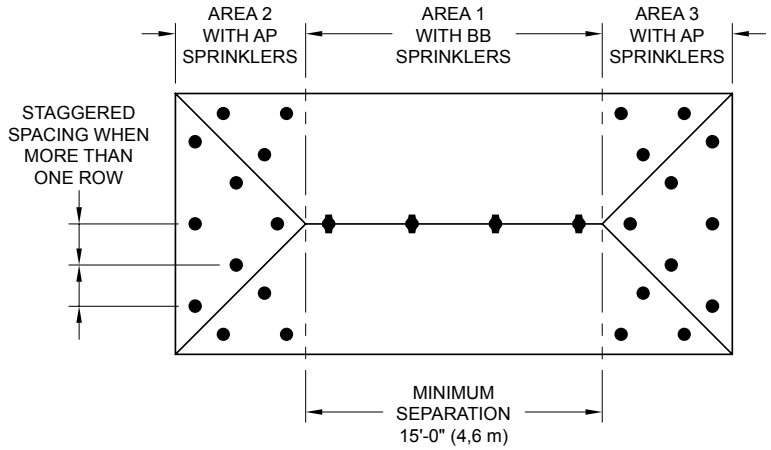


DRY SYSTEM SHOWN

Figure 20-B-3. BB Sprinklers & AP Sprinklers At The Hip

Where the total number of AP Sprinklers at the hip is greater than four:

- Wet Systems — Calculate the most demanding five BB Sprinklers plus the two most demanding AP Sprinklers, and then calculate the most demanding area up to 1500 ft^2 (137 m^2) having AP Sprinklers (e.g., Area 2 in adjacent upper figure). Use the most demanding calculation.
- Dry Systems — Calculate the most demanding seven BB Sprinklers plus the two most demanding AP Sprinklers, and then calculate the most demanding area up to 1950 ft^2 (181 m^2) having AP Sprinklers(e.g., Area 2 in adjacent upper figure). Use the most demanding calculation.



SEE ALSO FIGURES 21 AND 22

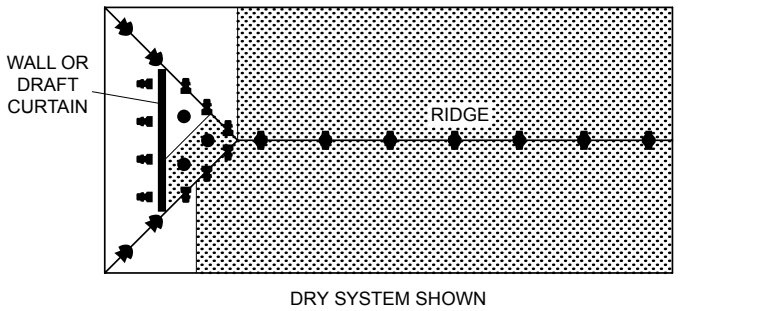
Figure 20-B-4. BB Sprinklers, SD Sprinklers, HIP Sprinklers, & AP Sprinklers At The Hip

Where the total number of AP Sprinklers at the hip is four or less:

- Wet Systems — Calculate the most demanding five BB, SD, or HIP Sprinklers plus up to two most demanding AP Sprinklers.
- Dry Systems — Calculate the most demanding nine BB, SD, or HIP Sprinklers plus up to two most demanding AP Sprinklers (Of the nine BB, SD, or HIP Sprinklers, calculate up to a maximum of seven BB Sprinklers, see adjacent upper figure).

Where the total number of AP Sprinklers at the hip is greater than four:

- Wet Systems — Calculate up to the most demanding five BB, SD, or HIP Sprinklers plus the two most demanding AP Sprinklers, and then calculate the most demanding area up to 1500 ft^2 (137 m^2) having AP Sprinklers(e.g., Area 2). Use the most demanding calculation.
- Dry Systems — Calculate up to the most demanding nine BB, SD, or HIP Sprinklers plus the two most demanding AP Sprinklers, and then calculate the most demanding area up to 1950 ft^2 (181 m^2) having AP Sprinklers (e.g., Area 2). Use the most demanding calculation.



DRY SYSTEM SHOWN

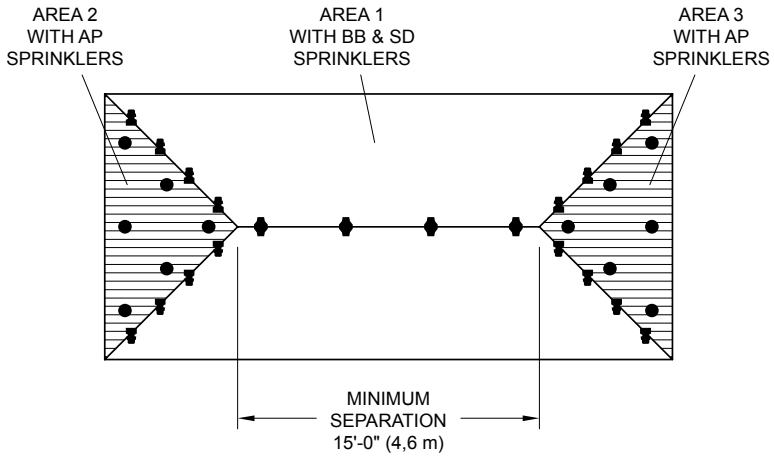


Figure 20-B-5. BB, SD, or HIP Sprinklers & AP Sprinklers in a Dormer, at a Cross, at a Hip, or at an Ell

Where the quantity of AP Sprinklers in each dormer, cross, or ell is four or less (see adjacent figure) and all of the dormers, crosses and ells meet the maximum four AP Sprinkler criteria, calculate the BB, SD, or HIP Sprinkler demand as described in Part A-1 thru A-6 or Part B-1 thru B-4, plus up to two of the most demanding AP Sprinklers in the dormer, cross, or ell that is adjacent to the BB, SD, or HIP Sprinklers that are being included in the demand calculation.

Where the quantity of AP Sprinklers in any dormer, cross, or ell is greater than four, refer to Figure B-3.

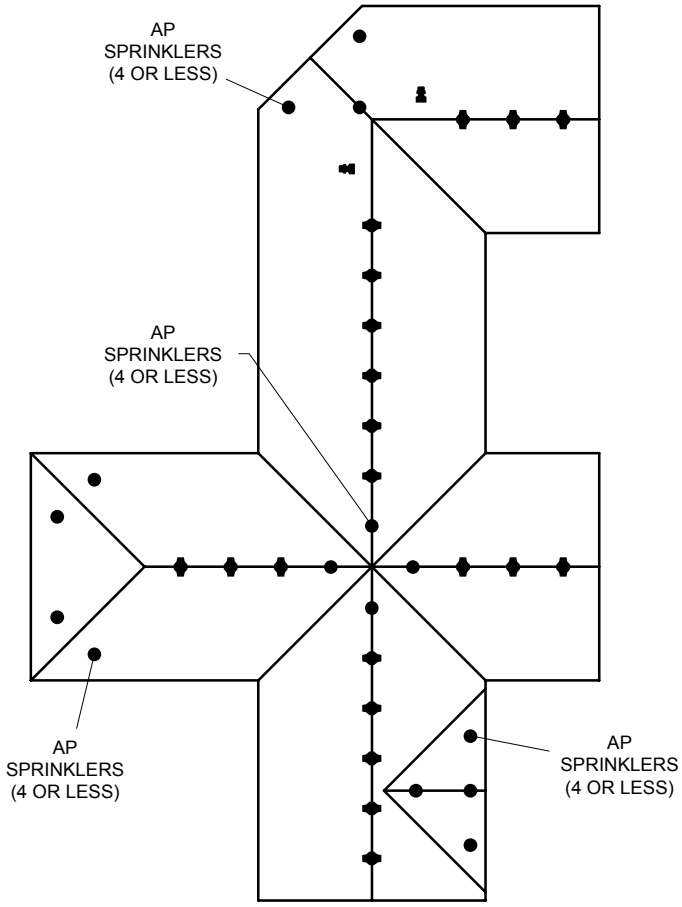


Figure 20-B-6. BB,SD, or HIP Sprinklers & AP Sprinklers Separated By Compartmentalization

- Wet Systems— Calculate the BB, SD, or HIP Sprinkler demand as described in Part A-1 thru A-6 or Part B-1 thru B-4, and then calculate the most demanding area up to 1500 ft^2 (137 m^2) having AP Sprinklers. Use the most demanding calculation (see adjacent figure).
- Dry Systems— Calculate the BB, SD, or HIP Sprinkler demand as described in Part A-1 thru A-6 or Part B-1 thru B-4, and then calculate the most demanding area up to 1950 ft^2 (181 m^2) having AP Sprinklers. Use the most demanding calculation (see adjacent figure).

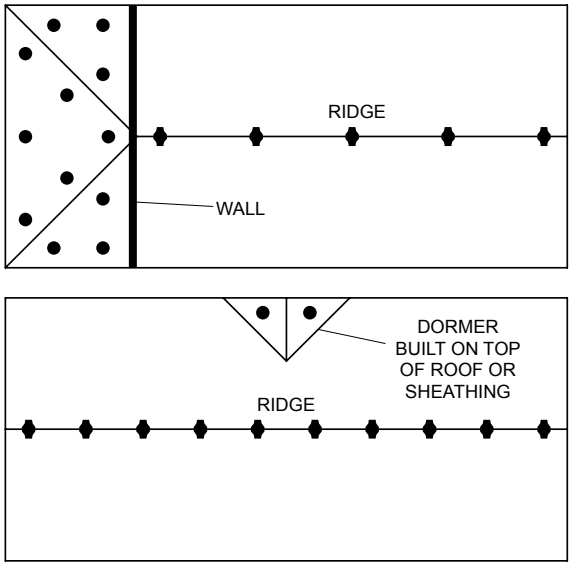
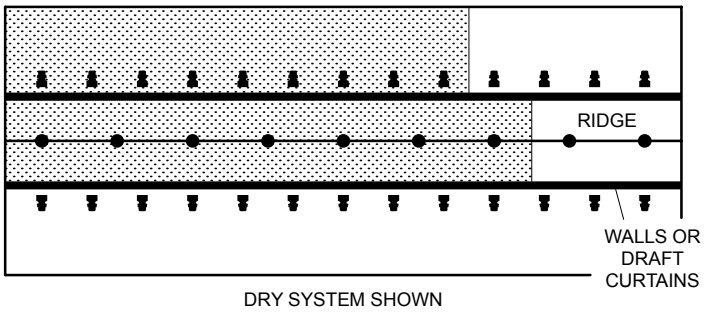


Figure 20-C-1. SD Sprinklers & Standard Spray Sprinklers At The Ridge

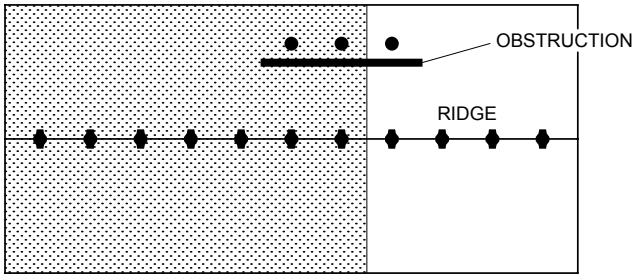
- Wet Systems — Calculate the most demanding five sprinklers of one type. Use the most demanding calculation.
- Dry Systems — Calculate the most demanding nine SD Sprinklers, and then calculate the most demanding seven Standard Spray Sprinklers. Use the most demanding calculation (see adjacent fig-



DRY SYSTEM SHOWN

Figure 20-C-2. BB Sprinklers & Standard Spray Sprinklers Beyond An Obstruction

- Wet Systems — Calculate the most demanding five BB Sprinklers plus up to two most demanding Standard Spray Sprinklers.
- Dry Systems — Calculate the most demanding seven BB Sprinklers plus up to two most demanding Standard Spray Sprinklers (see adjacent figures).

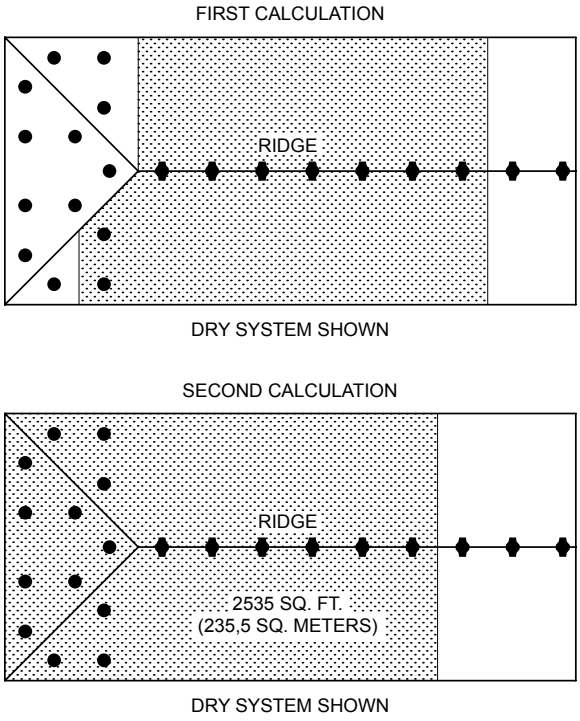


DRY SYSTEM SHOWN

Figure 20-C-3. BB Sprinklers & Standard Spray Sprinklers At The Hip

Where the total number of standard spray sprinklers at the hip is greater than four:

- Wet Systems — Calculate the most demanding five BB Sprinklers plus up to two most demanding Standard Spray Sprinklers, and then calculate the most demanding remote design area (Including all sprinklers types) per NFPA 13 (i.e., area reduction for quick response & 30% increase for sloped ceilings). Use the most demanding calculation.
- Dry Systems — Calculate the most demanding seven BB Sprinklers plus up to two most demanding Standard Spray Sprinklers, and then calculate the most demanding design area (including all sprinkler types) per NFPA 13 (i.e., 30% increase for sloped ceilings & 30% increase for dry systems). Include all sprinklers types within this area (see adjacent figure). Use the most demanding calculation.



NOTE:
Dry Pipe = 1500 SQ. FT. (NFPA Light Hazard) x 1.3 x 1.3 = 2535 SQ. FT.

SEE ALSO FIGURES 21 AND 22

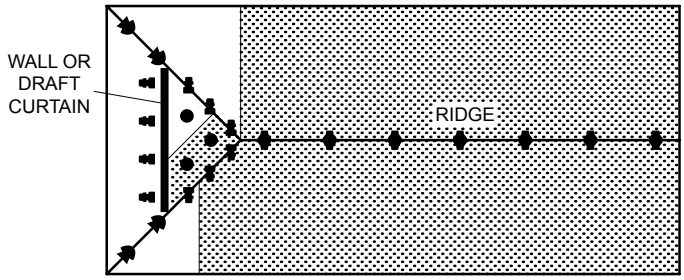
Figure 20-C-4. BB Sprinklers, SD Sprinklers, HIP Sprinklers, & Standard Spray Sprinklers At The Hip

Where the total number of Standard Spray Sprinklers at the hip is four or less:

- Wet Systems — Calculate the most demanding five BB, SD, or HIP Sprinklers plus up to two most demanding Standard Spray Sprinklers.
- Dry Systems — Calculate the most demanding nine BB, SD, or HIP Sprinklers plus up to two most demanding Standard Spray Sprinklers (Of the nine BB,SD, or HIP Sprinklers, calculate up to a maximum of seven BB Sprinklers, see adjacent upper figure).

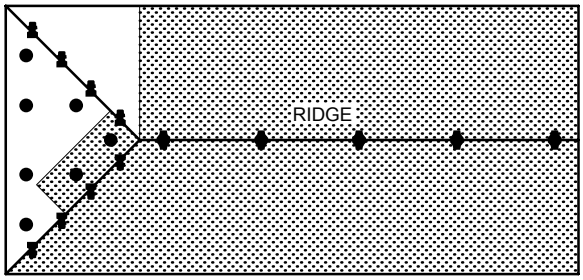
Where the total number of standard spray sprinklers at the hip is greater than four:

- Wet Systems — Calculate the most demanding five BB, SD, or HIP Sprinklers plus up to two most demanding Standard Spray Sprinklers, and then calculate the most demanding remote design area (Including all sprinklers types) per NFPA 13 (i.e., area reduction for quick response & 30% increase for sloped ceilings). Use the most demanding calculation.
- Dry Systems — Calculate the most demanding nine BB, SD, or HIP Sprinklers plus up to two most demanding Standard Spray Sprinklers (Of the nine BB,SD, or HIP Sprinklers, calculate up to a maximum of seven BB Sprinklers, see adjacent upper figure), and then calculate the most demanding design area (including all sprinkler types) per NFPA 13 (i.e., 30% increase for sloped ceilings & 30% increase for dry systems). Include all sprinklers types within this area (see adjacent figure).



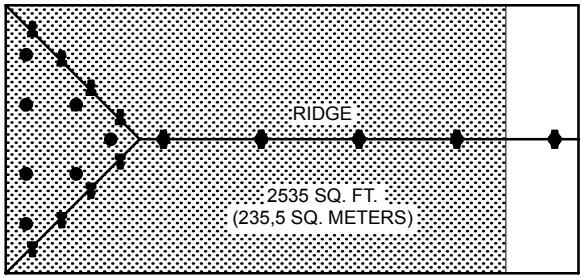
DRY SYSTEM SHOWN

FIRST CALCULATION



DRY SYSTEM SHOWN

SECOND CALCULATION



DRY SYSTEM SHOWN

NOTE:
Dry Pipe = 1500 SQ. FT. (NFPA Light Hazard) x 1.3 x 1.3 = 2535 SQ. FT.

Figure 20-C-5. BB, SD, or HIP Sprinklers & Standard Spray Sprinklers in a Dormer, at a Cross, at a Hip, or at an Ell

Where the quantity of standard spray sprinklers in each dormer, cross, or ell is four or less (see adjacent figure) and all of the dormers, crosses and ells meet the maximum four standard sprinkler criteria, calculate the Attic Sprinkler demand as described in Part A-1 thru A-6 or Part B-1 thru B-4, plus up to two of the most demanding standard spray sprinklers in the dormer, cross, or ell that is adjacent to the Attic Sprinklers that are being included in the demand calculation.

Where the quantity of standard spray sprinklers in any dormer, cross, or ell is greater than four, refer to Figure C-3.

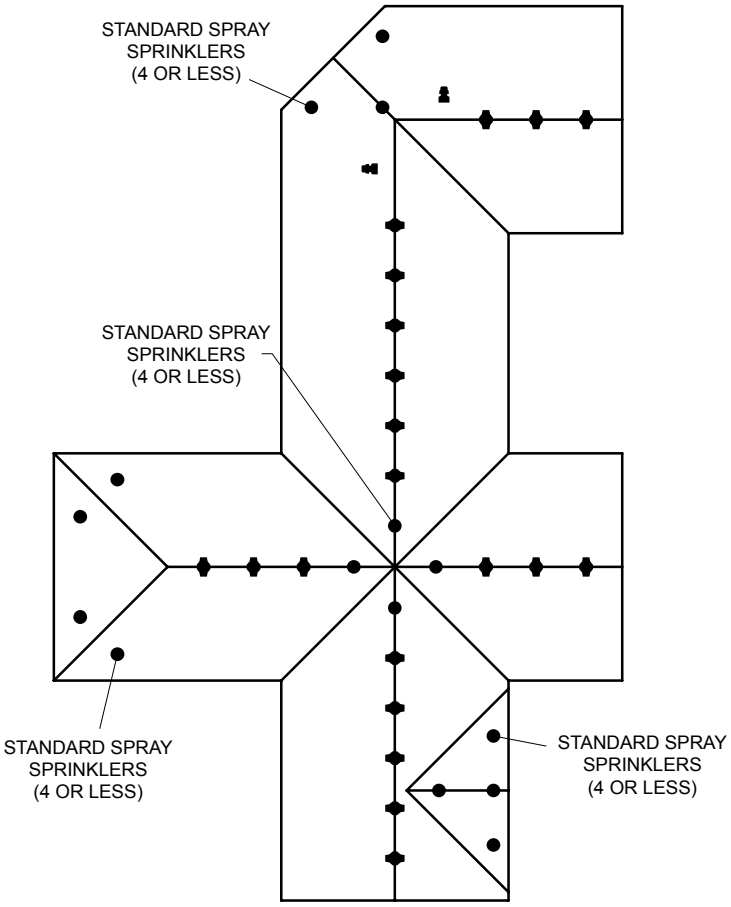
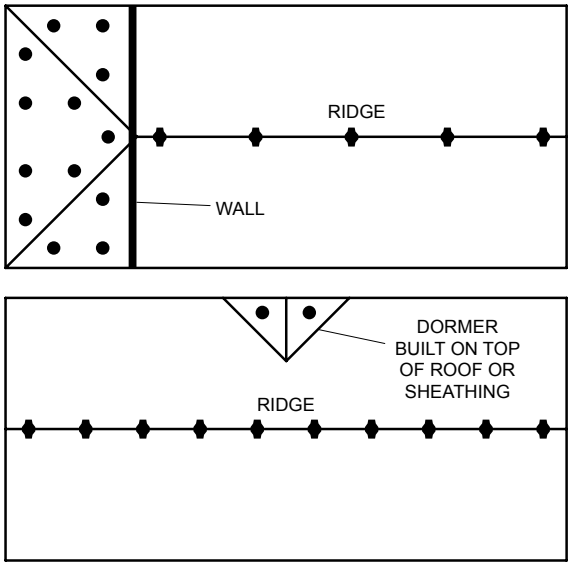
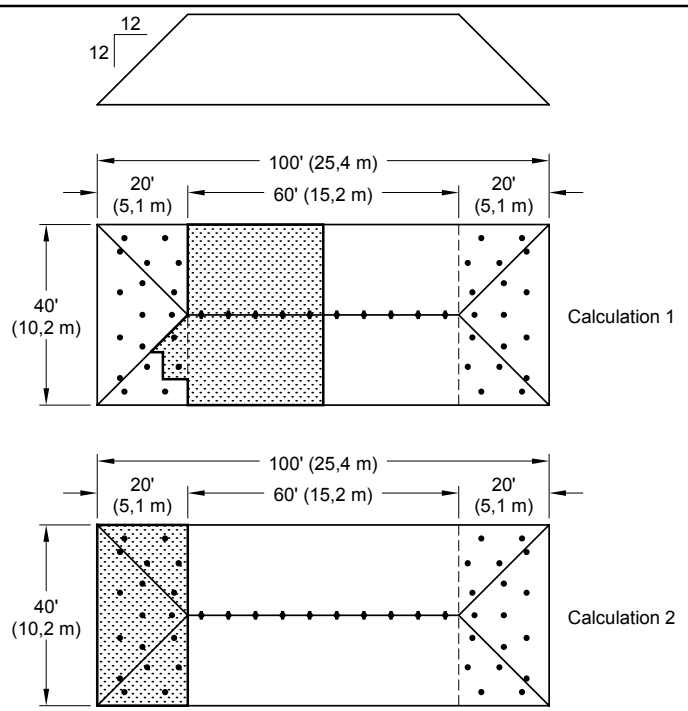


Figure 20-C-6. BB, SD, or HIP Sprinklers & Standard Sprinklers Separated By Compartmentalization

Calculate the Attic Sprinkler demand as described in Part A-1 thru A-6 or Part C-1 thru C-4, and then calculate the Standard Spray Sprinklers per NFPA 13. Use the most demanding calculation (see adjacent figure).





MODEL AP SPRINKLERS

WET PIPE SYSTEM

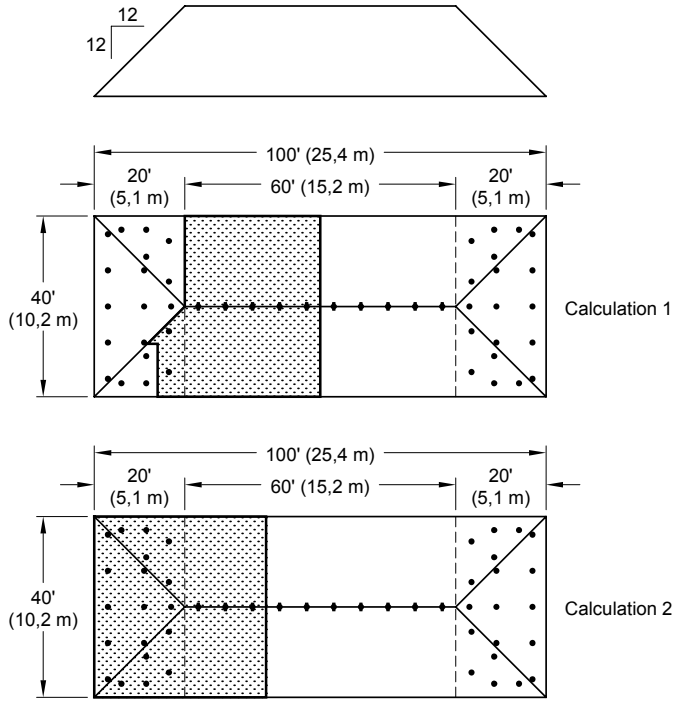
(Ref. Figure 20-B-3)

Calculation 1:
Calculate the most demanding five BB Sprinklers plus the two most demanding AP Sprinklers.

Calculation 2:
Calculate the most demanding area up to 1500 ft^2 having AP Sprinklers. In this case the design area will be 800 ft^2 (40 ft. x 20 ft.)

Use the most demanding calculation (i.e., for proving the adequacy of the water supply).

Where AP Sprinklers are utilized, CPVC pipe may be used to supply the AP Sprinklers, as well as the ceiling sprinklers below the AP Sprinklers (See Page 6).



STANDARD SPRAY SPRINKLERS

WET PIPE SYSTEM

(Ref. Figure 20-C-3)

Calculation 1:
Calculate the most demanding five BB Sprinklers plus the two most demanding Standard Spray Sprinklers.

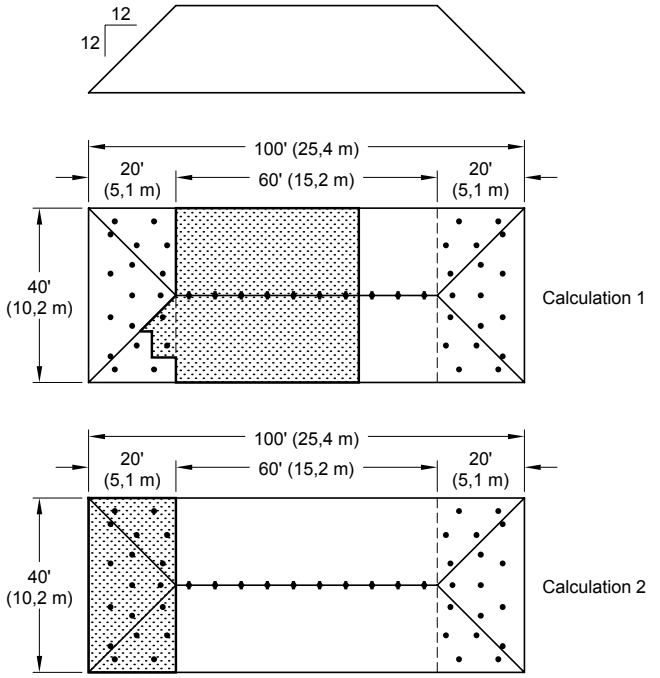
Calculation 2:
Calculate the most demanding remote design area (Including all sprinklers types) per NFPA 13 (i.e., area reduction for quick response & 30% increase for sloped ceilings). In this case the theoretical design area is 1463 ft^2 (1500 ft^2 x 0.75* x 1.3). The actual design area, however, will need to be 1520 ft^2 to pick up the entire coverage area of the last BB Sprinkler.

Use the most demanding calculation (i.e., for proving the adequacy of the water supply).

Where Standard Sprinklers are utilized, CPVC pipe CANNOT be used to supply the Standard Spray Sprinklers or the ceiling sprinklers below the Standard Spray Sprinklers.

** A 25% reduction for 20 ft. ceiling.*

FIGURE 21
EXAMPLE FOR A WET PIPE SYSTEM HYDRAULIC DESIGN AREA COMPARISON OF MODEL AP SPRINKLERS VERSES STANDARD SPRAY SPRINKLERS WHERE MODEL AP OR STANDARD SPRAY SPRINKLERS ARE USED IN HIP AREAS OUTSIDE THE SCOPE OF APPLICATION FOR MODEL BB BACK-TO-BACK SPRINKLERS



MODEL AP SPRINKLERS

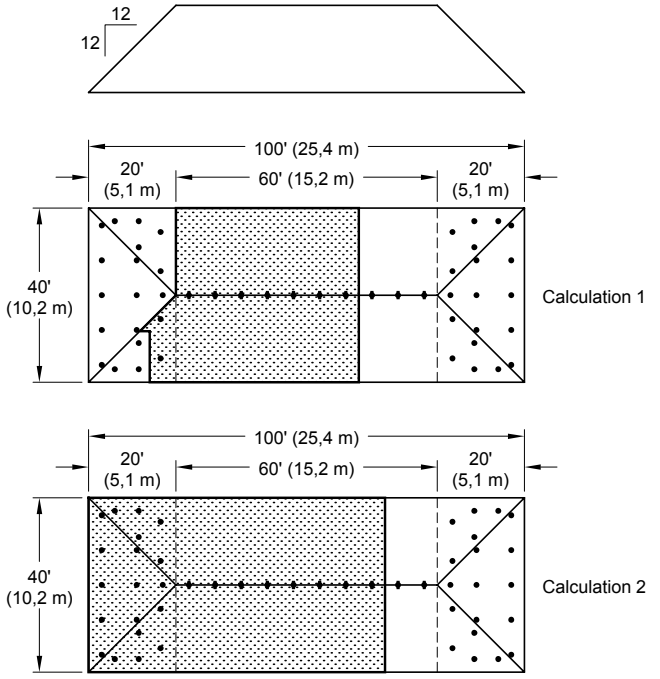
DRY PIPE SYSTEM

(Ref. Figure 20-B-3)

Calculation 1:
Calculate the most demanding seven BB Sprinklers plus the two most demanding AP Sprinklers.

Calculation 2:
Calculate the most demanding area up to 1950 ft^2 having AP Sprinklers. In this case the design area will be 800 ft^2 (40 ft. x 20 ft.)

Use the most demanding calculation (i.e., for proving the adequacy of the water supply).



STANDARD SPRAY SPRINKLERS

DRY PIPE SYSTEM

(Ref. Figure 20-C-3)

Calculation 1:
Calculate the most demanding seven BB Sprinklers plus the two most demanding Standard Spray Sprinklers.

Calculation 2:
Calculate the most demanding remote design area (Including all sprinklers types) per NFPA 13 (i.e., 30% increase for sloped ceilings & 30% increase for dry systems). In this case the theoretical design area will be 2535 ft^2 (1500 ft^2 x 1.3 x 1.3). The actual design area, however, will need to be 2720 ft^2 to pick up the entire coverage area of the last BB Sprinkler.

Use the most demanding calculation (i.e., for proving the adequacy of the water supply).

FIGURE 22
EXAMPLE FOR A DRY PIPE SYSTEM HYDRAULIC DESIGN AREA COMPARISON OF MODEL AP SPRINKLERS VERSES STANDARD SPRAY SPRINKLERS WHERE MODEL AP OR STANDARD SPRAY SPRINKLERS ARE USED IN HIP AREAS OUTSIDE THE SCOPE OF APPLICATION FOR MODEL BB BACK-TO-BACK SPRINKLERS

Appendix B

Installation of Standard Spray Sprinklers Under a Roof or Ceiling in Combustible Concealed Spaces

The information shown on Pages 84, 85, and 86 have been extracted from the 2007 edition of NFPA 13. The information extracted relates to sprinkler type, sprinkler spacing, protection area, and the area used for hydraulic calculation. The extracted information is not intended to provide a complete set of installation rules. In attic spaces we would expect to see a minimum of three rows of sprinklers perpendicular to the roof slope. One row at the ridge (8.6.4.1.4.2), and one row each at the eaves (8.6.4.1.4.4). In larger attic spaces, there may be five or even seven rows of sprinklers.

Although not specifically addressed by NFPA 13, permitted spacing as measured on slope is assumed to be per Figure 16. The sprinkler located at the ridge will have some obstruction to sprinkler discharge pattern development– especially as the pitch of the roof is increased. This obstruction at the ridge is assumed to be disregarded in most cases. However, when locating sprinklers under hip roofs having converging slopes with compounding angles (slope of the roof and slope of hip ridge), the conservative approach is to treat each facet of the roof as a separate layout area. This approach tends to increase the number of standard sprinklers, but eliminates the need to prove that there is no obstruction to sprinkler pattern development if the pattern were to wrap around the hip.

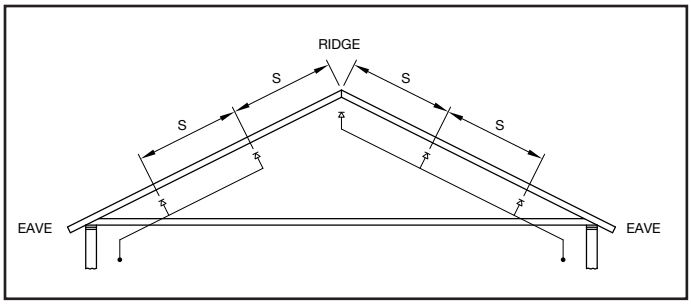


Figure 16

For a light hazard application such as an unoccupied attic space, the hydraulic design area starts at 0.1 GPM/ft^2 over 1500 ft^2. However there will be a 30% increase for sloped ceilings resulting in a design area of 0.1 GPM/ft^2 over 1950 ft^2.

For a wet pipe system, we may see an area reduction (25% to 40%) for the use of required quick response sprinklers (8.6.4.1.4.1 & 11.2.3.2.3). Or we may see a 30% increase for dry pipe systems resulting in 0.1 GPM/ft^2 over 2535 ft^2.

Whatever the design area might be (22.4.4.5.3), the complication that arises is the resulting over discharge when applying the area sprinkler application based on horizontal projection. Assuming we could space the sprinklers for a maximum coverage area of 120 ft^2, the projected horizontal area would be 84.8 ft^2 for a 12:12 pitch or 113.8 ft^2 for a 4:12 pitch. The resulting minimum flow per sprinkler would be 8.5 GPM or 11.4 GPM, respectively. The minimum flow at 7 psi for a 4.2 K-factor sprinkler is 11.1 GPM and for a 5.6 K-factor sprinkler is 14.8 GPM. The prospect for over-discharging is increased with slope pitch and with increased K-factor. Consequently, as shown in Application Example 1 (Fig. 4E), even though the theoretical minimum system demand would be 2535 ft^2 x 0.1 GPM/ft^2 = 253.5 GPM; the actual system demand was calculated at a minimum 414.4 GPM.

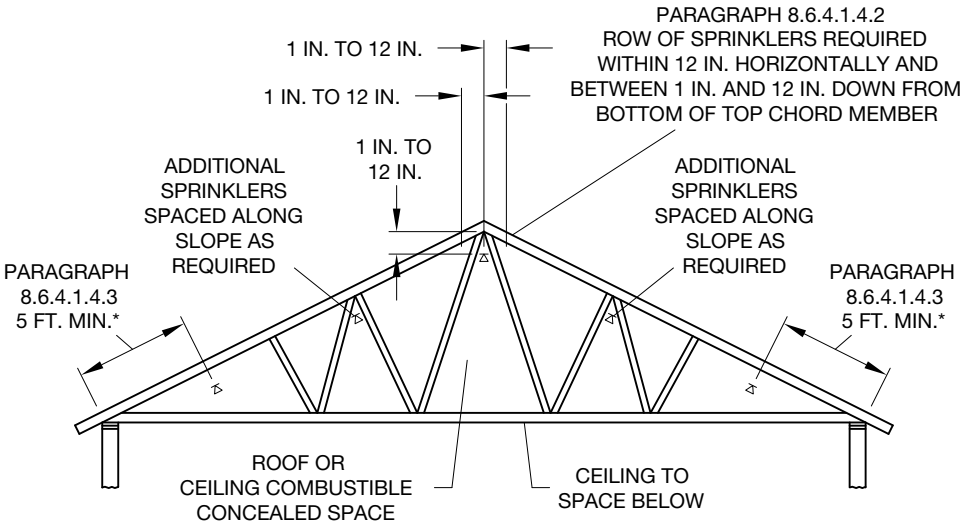
8.6.4.1.4 Sprinklers Under a Roof or Ceiling in Combustible Concealed Spaces of Wood Joist or Wood Truss Construction with Members 3 ft (0.91 m) or Less on Center and a Slope Having a Pitch of 4 to 12 in Greater. *(See Figure 8.6.4.1.4.)*

8.6.4.1.4.1 Sprinklers under a roof or ceiling in combustible concealed spaces of wood joist or wood truss construction with members 3 ft (0.91 m) or less on center and a slope having a pitch of 4 in 12 or greater shall be quick response.

8.6.4.1.4.2 Sprinklers under a roof or ceiling in combustible concealed spaces of wood joist or wood truss construction with members 3 ft (0.91 m) or less on center and a slope having a pitch of 4 in 12 or greater shall be installed so that a row of sprinklers is installed within 12 in (305 mm) horizontally of the peak and between 1 in and 12 in (25.4 mm and 305 mm) down from the bottom of the top chord member.

8.6.4.1.4.3 Sprinklers under a roof or ceiling in combustible concealed spaces of wood joist or wood truss construction with members 3 ft (0.91 m) or less on center and a slope having a pitch of 4 in 12 or greater shall be installed so that the sprinklers installed along the eave are located not less than 5 ft (1.52 m) from the intersection of the truss chords, or the wood rafters and ceiling joists.

8.6.4.1.4.4 Sprinklers under a roof or ceiling in combustible concealed spaces, consisting of combustible wood joist or wood truss construction with members spaced less than 3 ft (0.91 m) on center, used with slopes with a pitch at or exceeding 4 in 12, and using standard spray sprinklers, shall be quick response having pressures in accordance with the requirements of Table 8.6.2.2.1(a).



FOR SI UNITS, 1 IN = 25.4 mm: 1 FT = 0.3048 m.

*NOTE: THE 5 FT MINIMUM DIMENSION IS MEASURED FROM THE INTERSECTION OF THE UPPER AND LOWER TRUSS CHORDS, OR THE WOOD RAFTERS AND CEILING JOISTS.

Figure 8.6.4.1.4 Sprinklers Under a Roof or Ceiling in Combustible Concealed Spaces of Wood Joist or Wood Truss Construction with Members 3 ft (0.91 m) or Less on Center and a Slope Having a Pitch of 4 to 12 in Greater.

		Protection Area		Spacing (maximum)	
Construction Type	System Type	ft^2	m^2	ft	m
Combustible concealed space under a pitched roof having combustible wood joist or wood truss construction with members less than 3 ft (0.91 m) on center with slopes having a pitch of 4 in 12 or greater	All	120	11.1	15 parallel to the slope, 10 perpendicular to the slope*	4.6 parallel to the slope, 3.05 perpendicular to the slope*

*Where the dimension perpendicular to the slope exceeds 8 ft (2.4 m), the minimum pressure shall be 20 psi (1.4 bar).

Table 8.6.2.2.1 (a)

11.2.3.2.3 Quick-Response Sprinklers.

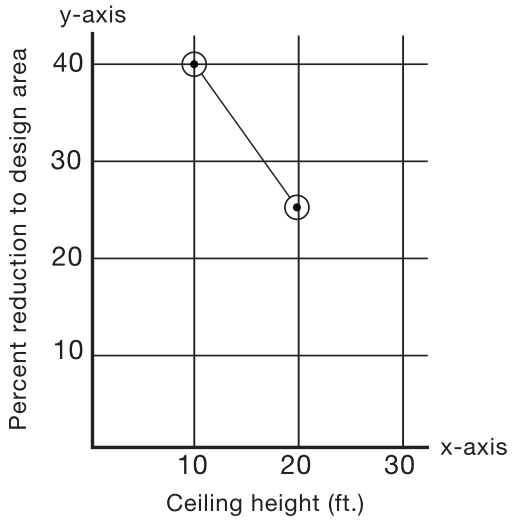
11.2.3.2.3.1 Where listed quick-response sprinklers, including extended coverage quick-response sprinklers, are used throughout a system or portion of a system having the same hydraulic design basis, the system area of operation shall be permitted to be reduced without revising the density as indicated in Figure 11.2.3.2.3.1 when all of the following, conditions are satisfied:

(1) Wet pipe system

(2) Light hazard or ordinary hazard occupancy

(3) 20 ft (6.1 m) maximum ceiling height

(4) There are no unprotected ceiling pockets as allowed by 8.6.7 and 8.8.7 exceeding 32 ft (3 m)



Note: $\frac{-3x}{2} + 55$

For ceiling height $\geq$ 10 ft. and $\leq$ 20 ft., $y = \frac{-3x}{2} + 55$

For ceiling height < 10 ft., $y = 40$

For ceiling height > 20, $y = 0$

For SI units, 1ft. = 0.31 m

FIGURE 11.2.3.2.3.1 Design Area Reduction for Quick Response Sprinklers

22.4.4.5.3* The density shall he calculated on the basis of floor area of sprinkler operation. Where sprinklers are installed under a sloped ceiling, the area used for this calculation shall be the horizontal plane below the sprinklers.

22.4.4.5.6* For sloped ceiling applications, the area of sprinkler application for density calculations shall be based upon the projected horizontal area.

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