RESIDENTIAL SPRINKLERS STUDY GROUP REPORT

June 9, 2022

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EXECUTIVE SUMMARY

During the 2018 Code Development Cycle, the Board of Housing and Community Development (BHCD) directed the Department of Housing and Community Development (DHCD) to convene a group of interested stakeholders with the scope of researching and discussing the potential impacts of mandating residential sprinkler systems in townhouses.

The study group convened virtually (through Adobe Connect) four times: December 15, 2021; January 11, 2022; March 25, 2022; and May 17, 2022.[1] At each of these meetings, the study group discussed the issues and shared pertinent information and concerns related to the requirements for residential sprinkler systems in townhouses.

Currently, the installation of residential sprinkler systems in townhouses is optional. When optional sprinkler systems are installed in townhouses, the Virginia Residential Code (VRC) allows for some relief from certain other code requirements, such as: reduced minimum distance to property lines, emergency escape and rescue openings are not required, the fire wall between units does not have to be structurally independent; and a reduction in the minimum required fire-resistance-rating of the fire wall between units.

Discussions included the review of fire and housing affordability data, sprinkler studies from other states, cost estimates, sample townhouse sprinkler plans, code change proposals and more.

Ultimately, the study group did not reach consensus on the feasibility of mandating sprinkler systems in townhouses. Below are some reasons cited by the supporters of mandating the installation of sprinkler systems, as well as reasons for opposing such a statewide mandate.

Reasons for support:

- Sprinklers save lives
- Sprinklers reduce injury to occupants and firefighters
- Sprinklers reduce building damage and repair costs associated with fires
- Today's building components and furnishings are much more flammable
- Incentives are available when sprinklers are installed, which could offset the cost
- Sprinklers have been required by the model codes for over a decade

Reasons for the opposition:

- Reduced housing affordability
- Lack of home fires data related to age of townhouses, presence of operational vs. non-operational smoke alarms vs. no smoke alarms, specific to Virginia
- Water availability issues, especially in rural areas without municipal water service
- Enhanced smoke detection, fire-resistant construction and other similar safety features could provide equivalent protection
- Virginia is in line with the majority of states that do not require townhouse sprinklers

[1] For a full list of Study Group members, please see Appendix B, "Study Group Members". For a full list of participants during each Study Group meeting, please see Appendix A, "Meeting Summaries, Agendas, Participants".

- There is no market demand for sprinklers in townhouses

The report that follows gives an overview of questions and concerns raised during the discussions. Supporting documents and the summaries from each of the four study group meetings are included as appendices following this report.

Note: the links referenced throughout the report were active as of the writing of this report.

BACKGROUND

The fire sprinkler requirements for townhouses first appeared in the 2006 edition of the International Residential Code (IRC), in the form of Appendix P.[2] The 2006 VRC did not incorporate said Appendix.

The 2009 edition of the IRC introduced fire sprinkler requirements in Section R313, “Automatic Fire Sprinkler Systems”.[3] The section mandated the installation of fire sprinkler systems in townhouses and in one- and two-family dwellings. Sprinkler systems for townhouses were required to be designed and installed in accordance with (IRC) Section P2904, and those for one- and two-family dwellings in accordance with Section P2904 or NFPA 13D[4]. During the 2009 Virginia Code Development Cycle, Virginia amended Section R313 to make the installation of sprinkler systems optional.[5] Section R329 “Fire Extinguishers” was also added, which mandates the installation of a fire extinguisher with a rating of 2-A:10-B:C in the kitchen area, if the dwelling is not equipped with an automatic fire sprinkler system.[6]

A minor change in the 2015 edition of the IRC allowed sprinkler systems for townhouses to comply with NFPA 13D (Section P2904 remained as one of the available options), as an option.[7]

The following code change proposals associated with the residential sprinkler system provisions were considered by the BHCD, during the 2018 Virginia Code Development Cycle.[8]

- **RB302.2.2-18 (Approved)** - allows water-filled fire sprinkler piping in the cavity of common walls shared by townhouses.
- **RB302.2.6-18 (Approved)** - exempts townhouses protected by a fire sprinkler system complying with Section P2904, NFPA 13D, NFPA 13R, or NFPA 13, from the structural independence requirement.
- **RB302.3(1)-18 (Approved)** - allows for a reduction in the required fire-resistance rating of assemblies separating two-family dwellings, from 1-hour to ½-hour, if the units are protected by a sprinkler system in accordance with NFPA 13R or Section P2904 (this reduction was already allowed where NFPA 13 systems were installed).
- **RB310.11-18 (Not approved)** – proposed the removal of all Virginia amendments related to the residential sprinkler provisions, and would have required the installation of fire sprinklers in townhouses, as well as one- and two-family dwellings.

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[2] 2006 IRC, Appendix P: https://codes.iccsafe.org/content/IRC2006/appendix-p-fire-sprinkler-system
[3] 2009 IRC, Section R313: https://codes.iccsafe.org/content/IRC2009/chapter-3-building-planning
[4] NFPA 13D: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=13D
[5] 2009 VRC, Section R313: http://ecodes.biz/ecodes_support/free_resources/Virginia2009/09Residential/PDFs/Chapter%203_Building%20Planning.pdf
[6] 2009, VRC Section R329: http://ecodes.biz/ecodes_support/free_resources/Virginia2009/09Residential/PDFs/Chapter%203_Building%20Planning.pdf
[7] 2015 IRC, Section R313.1: https://codes.iccsafe.org/content/IRC2015P3/chapter-3-building-planning
[8] 2018 VA Code Change Proposals: see Appendix C, “Supporting Documentation”

- **RB313.1-18 (Not approved)** – proposed the removal of all Virginia amendments related to the residential sprinkler provisions, and would have required the installation of fire sprinklers in townhouses, as well as one- and two-family dwellings.

At their October 19, 2020 meeting, the BHCD (Codes and Standards Committee) moved to approve RB313.1-18, as amended by the BHCD. As per the BHCD proposed amendment, the sprinkler requirements would have only applied to townhouses. Upon further deliberations at their December 14, 2020 meeting, the BHCD determined that additional discussions around mandating fire sprinkler systems in townhouses were needed and the BHCD disapproved the proposal. Given this, the motion for disapproval of RB313.1-18 included a directive for DHCD to convene a group of interested stakeholders to continue the discussions during the 2021 Code Development Cycle.

OTHER STATES AND JURISDICTIONS

Although the model code (beginning with the 2009 edition of the IRC), requires the installation of fire sprinkler systems in townhouses, research shows that the majority of states and jurisdictions across the United States eliminate or amend, in some fashion, these provisions during their code adoption processes.

As of the writing of this report, it appears that there are only four states that require sprinkler systems in townhouses statewide: California, Maryland, Pennsylvania and Tennessee. In addition, Washington D.C also requires townhouses to be protected with a sprinkler system in accordance with the IRC.[9]

The position of other states range from prohibiting local amendments imposing the installation of sprinkler systems, to requiring landlords to notify tenants of the existence or nonexistence of fire sprinklers in dwelling units, to mandating sprinklers when a building exceeds a certain height or number of townhouse units, etc.

The Virginia Fire Chiefs Association (VFCA) representative suggested that Virginia is at a bit of a disadvantage because individual localities are not able to make their own decision about this issue. Had they been able to make local amendments to the building codes, he believes that some Virginia localities would have already required sprinkler systems in townhouses.

SMOKE ALARMS VS. FIRE SPRINKLERS

Discussions helped draw a parallel between smoke alarms, which are currently required to be installed in all townhouses, and fire sprinkler systems.

Smoke alarms are notification devices, intended to warn the occupants and aid with timely evacuation during fire events. The VRC requires smoke alarms to be installed in townhouses in the following locations: in each sleeping room, outside each separate area in the immediate

[9] Townhouse Sprinklers by State (NFPA source): https://www.nfpa.org/Public-Education/Staying-safe/Safety-equipment/Home-fire-sprinklers/Fire-Sprinkler-Initiative/Legislation-and-adoptions/Sprinkler-requirements
Townhouse Sprinklers by State (NAHB source): https://www.nahb.org/-/media/NAHB/advocacy/docs/top-priorities/codes/fire-sprinklers/fire-sprinkler-state-adoption-2019.pdf

vicinity of bedrooms and on each additional story of the dwellings, including basements and habitable attics.

Smoke alarms do not have a direct impact on reducing or slowing the spread of smoke or fire; however, data shows that proper activation of smoke alarms has saved countless lives over the years. Smoke alarms do not require human intervention to activate, but do require periodic maintenance and testing to ensure reliability. Most smoke alarm manufacturers suggest testing the devices on a monthly basis. Some alarms are only intended to be used for ten years and must be replaced prior to the ten year mark. Research also reveals that in many cases where devices have not been properly maintained, they have failed to operate during a fire and provide the necessary warning to building occupants.

Sprinkler systems on the other hand, are intended to directly combat and slow the spread of fire and smoke. They reduce the likelihood of injury or death by providing additional time for occupants to escape safely, preventing flashover and controlling the fire until firefighting personnel arrive on scene. By slowing the fire spread, they can also reduce building damages from fire and firefighting operations. Sprinkler systems do not require human intervention to activate and require very little maintenance. Reports from localities where residential sprinkler systems are mandatory suggest that no lives have been lost, as a result of fires, in buildings protected by automatic sprinkler systems.

FIRE SPRINKLER SYSTEMS

Fire Sprinkler Types

At the infancy of the study group discussions, the sprinkler systems were referred to by the study group members in general terms, such as “residential” sprinklers. Given the different types of sprinkler systems covered by the code, it was suggested by study group members to clearly identify which type of sprinkler system should be mandated, if it comes to that point.

Although multiple sprinkler system types were mentioned during discussions, the study group members agreed that the focus should be on systems designed and installed in accordance with NFPA 13D and Section P2904 of the VRC.[10] NFPA 13R and NFPA 13 systems apply to buildings under the purview of the Virginia Construction Code and should not be considered by the study group.[11] [12] Additionally, while NFPA 13R and NFPA 13 systems are available options under the VRC, it is expected that they would not be installed due to the higher costs and complexity associated with them.

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[10] NFPA 13D: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=13D
VRC, Section P2904: https://codes.iccsafe.org/content/VRC2018P2/chapter-29-water-supply-and-distribution#VRC2018P2_Ch29_SecP2904
[11] NFPA 13R: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=13R
NFPA 13: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=13
[12] Virginia Construction Code: https://codes.iccsafe.org/content/VCC2018P3

Who Can Install Them?

Section P2904.1 of the 2018 VRC allows for the design and installation of residential fire sprinkler systems in accordance with "*NFPA 13D, 13, 13R* ***or Section P2904, which shall be considered to be equivalent to NFPA 13D"*** (emphasis added). Given the emphasized text, some study group members interpreted the Department of Professional and Occupational Regulation (DPOR) as allowing plumbing contractors (DPOR classification PLB) to install NFPA 13D sprinkler systems.[13]

Other study group members interpreted the DPOR Regulations as requiring a sprinkler contractor license (DPOR classification SPR) for the installation of all sprinkler systems, with the exception of those systems that are specifically designed in accordance with Section P2904 of the VRC. Or, otherwise stated: the PLB classification is only allowed to install sprinkler systems designed in accordance with Section P2904 of the VRC; and a SPR classification is required for the installation of all other fire sprinkler systems (i.e.: NFPA 13D, NFPA 13R and NFPA 13).

DHCD staff reached out to DPOR and requested clarification on the matter. DPOR staff confirmed that a contractor with a PLB classification is only allowed to install sprinkler systems designed in accordance with Section P2904 of the VRC and all NFPA sprinkler systems, including NFPA 13D, can only be installed by contractors with the SPR classification.

Plan Review and Inspections

Mandating the installation of sprinklers would mean additional steps in the permit review and approval process.

The VFCA representative suggested that the inspections would be the same as for other plumbing systems, and they would be performed at the same time as the plumbing inspections. Additionally, ongoing inspections are not required for 13D systems. Even NFPA 25 – the Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, does not require ongoing inspections for these systems.[14]

One of the Virginia Building and Code Officials Association (VBCOA) representatives emphasized that additional training, as well as additional review and inspection time would be needed for staff reviewing and approving these systems.

- If a sprinkler system requires two to four additional inspections per townhouse, that would be a significant increase in the workload for local building departments.
- The staff that would be required to perform the review and inspection of sprinkler systems has never performed those tasks before, so additional training would need to be developed and provided.
- Most jurisdictions are not currently performing plan review on building trades for townhouse projects. Requiring the installation of sprinklers would either mean that plan

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[13] Commonwealth of Virginia Board for Contractors Regulations: https://www.dpor.virginia.gov/sites/default/files/Boards/Contractors/A501-27REGS.pdf

[14] NFPA 25: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=25

review will have to be performed, or the inspectors would have to be knowledgeable enough to review for code compliance during field inspections.

FIRE SPRINKLERS COSTS

As it is the case with most code changes that propose the installation of additional building systems or features, requiring sprinkler systems in townhouses would also trigger certain new costs. Several costs associated with the installation of sprinkler systems were discussed.

Water Meter Size and Connection Fees

The study group debated whether the water service meter size would be required to be increased to accommodate a sprinkler system and if so, what are the potential cost impacts of upgrading to a larger water meter size. The VFCA representative shared with the group the costs charged by Loudoun County; they are as follows: the fee for a 1” meter is $285, the fee for a 3/4” meter is $240 and the connection fee for either is $7,395. He also provided information on the fees charged by Fairfax County: connection fees are $1,430 for 5/8” taps; $1,870 for 3/4" taps; and $1,960 for 1” taps. Meter costs are $4,400 for 5/8” meters; $8,800 for 3/4" meters; $14,000 for 1” meters. There is a special note for a 13D system, which is $4,400.

The Home Builders Association of Virginia (HBAV) representative, who also submitted cost estimates from builders in the Richmond area and the Town of Blacksburg, appreciated the costs shared by the VFCA representative and indicated that the water connection fees charged by some localities range between $2,300 and $18,000.[15] Also, if required to upgrade to a larger meter size, the connection fees can increase significantly. He gave the examples of Henrico County where upsizing to 1” meter costs up to $17,000 and Chesterfield up to $14,000.

The American Institute of Architects’ Virginia Chapter (AIA-VA) representative shared that currently there are active residential sprinkler installation projects in many localities across Virginia and the connection fees vary considerably between localities.

The VFCA representative maintained that the water connection is already there by default as it is needed to serve the dwelling’s plumbing fixtures. As such, a separate connection and fee would not apply. He did agree that there might be an increase in the connection fee if the meter must be increased from a 5/8” to a 3/4" meter. However, he disagreed that a 1” meter would be required for residential sprinklers as shown on the documentation submitted by the HBAV representative. He noted that he works with many Maryland contractors, who install residential sprinklers on a daily basis and recommends that the group should rely on their data.

The HBAV representative concurred that a separate connection is not needed, but maintained that a larger meter would be required in many cases. He also argued that these systems are being installed already in other parts of the Commonwealth, and reaffirmed that the estimates shared with the study group are for actual (and not assumed) projects. Different costs apply in different parts of the State and the study group should not base the decisions solely on information applicable to the Northern Virginia area.

[15] HBAV submitted cost estimates: see Appendix C, “Supporting Documentation”

Additional Water Supply Equipment

Private Water Supply

The Local Government/Rural Communities representative indicated that several townhouse complexes in his area, which is surrounded by other rural localities, are currently not connected to a public water system.

If sprinkler systems will be required in similar townhouses served by private water supplies, arrangements would have to be made to ensure adequate water supply for the systems. In most cases, additional water holding tanks or larger pumps would have to be provided to adequately supply the water flow rate for the minimum period of time required by the code (seven or ten minutes based upon the area and number of stories).[16] Also, while not required by the code, backup power may need to be provided for the pump, otherwise it could be out of commission during power outages or fire events when it is needed.

The estimate submitted by the HBAV representative from a Town of Blacksburg area builder shows a cost of $4,200 for the cistern storage tank (1200 gallons), pump, and installation; and a cost of $6,000 for backup power supply for the pump.

Public Water Supply

The Private Water Company representative indicated that the lack of adequate water supply is a valid point, as in some areas not even hydrants are installed because storage water is not available to supply the hydrants.

The VFCA representative opined that just because there is not adequate water supplies or hydrants, it does not mean that effective residential sprinklers cannot be installed. He also cited the Water Supplies for Home Fire Sprinkler Systems document he submitted, which shows that only 7psi is required to operate some systems, and a residential sprinkler system could use as little as 8 gallons per minute, which is in line with what is already required to serve a residential plumbing system.[17]

The representative from the Local Utility Department stated that from a utility engineering standpoint, ground storage tanks and pumps or potentially a hydromatic tank could provide water, but it would need to be engineered. The issue can be overcome, but it would impact cost.

The Virginia Fire Prevention Association (VFPA) representative shared that, based on tests of townhouse systems connected to a public water supply, that he has witnessed, most had more than adequate flow, even without adding a separate pump. The few systems that did use a pump had nothing more than a pool pump, which is simple and inexpensive to install. Labor is probably the most expensive part. He estimated the cost to be about $200.

System Design and Installation

The study group members concluded that it is difficult to estimate a specific cost for the design and installation of residential sprinkler systems in townhouses in Virginia. Some of the reasons cited were the limited number of sprinkler contractors currently installing these systems

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[16] VRC Section P2904.5.2: https://codes.iccsafe.org/content/VRC2018P2/chapter-29-water-supply-and-distribution#VRC2018P2_Ch29_SecP2904

[17] Water Supplies for Home Fire Sprinkler Systems: see Appendix C, "Supporting Documentation

throughout the Commonwealth, diverse geography and markets, and sprinkler contractors not always being forthcoming due to competition.

Cost estimates submitted by the study group members included the following:[18]

- Virginia Townhouse Sprinkler Price Survey – submitted by VFCA
- Sprinklers Pricing, Loudoun County – submitted by VFCA
- Richmond Region Townhome Builder Cost Estimates and Notes – submitted by HBAV
- Southwest Virginia Blacksburg Estimate – submitted by HBAV

The estimates submitted by study group members ranged from an average price of $1.13/square foot in Haymarket, VA, to (direct/tangible costs of) $2.75/square foot (plus infrastructure costs of $2,100/townhouse minimum plus other intangible costs) in Richmond, VA, and a total cost per townhouse unit of $22,000 (projects with private water supply) in the Southwest Virginia region.

Building Permit and Inspection Fees

Given the additional building department staff time required for ensuring compliance with the sprinkler requirements in the code, there is a reasonable expectation that the permit/inspection fees would also increase if sprinkler systems were required in townhouses. However, similar to the costs for system design and installation, it is not feasible to accurately estimate the increase in permit and inspection fees.

COST IMPACT ON HOUSING AFFORDABILITY

Documentation submitted by the HBAV representative highlights the housing affordability challenges in the Commonwealth.[19] The representative also underscored that many households are already considered housing cost burdened as they spend more than 30 percent of their income on housing expenses; and the percentage of cost burdened low-income households is growing. The Commonwealth is seeing a crisis where people cannot afford houses. The HBAV representative clarified that bringing these items up for discussion is unrelated to builder profit as the costs to build are passed on to the consumer. He also made the point that mandating the installation of fire sprinklers in townhouses across the Commonwealth would definitely add to the problem of housing affordability.

The VFCA representative acknowledged the affordability issues brought up, and agreed that the study group should keep housing affordability in mind and not price the homebuyer out of the market, but look to ensure affordable and safe housing, as that is the charge of the fire and building codes. He, as a fire chief, cannot put a price on a life or injury and if there is a way to prevent injuries and deaths to civilians and firefighters, his charge is to find the way. He submitted that the ultimate goal is for these systems to not increase the construction costs and he thinks that is possible through incentives and other insurance and tax credits for these systems.

[18] Cost estimates: see Appendix C, “Supporting Documentation

[19] Housing affordability documentation submitted by HBAV: see Appendix C, “Supporting Documentation

FIRE SPRINKLERS INCENTIVES

Discussion around costs associated with mandating the installation of sprinkler systems highlighted that such requirements could also provide for different types of potential financial incentives.

The VFCA representative argued that the increase in construction costs due to sprinkler systems could be offset by the benefits that come along with the installation of sprinklers, and in some scenarios, the financial incentives could even surpass the construction cost increase.

The UNLV Residential Sprinkler Study was cited for examples of potential incentives:[20]

- Fire separation between garages and residential portions of dwellings could be reduced
- Dwellings could be located closer to the property lines, allowing for larger homes, or additional lots/dwellings within the development
- Increased fire hydrant spacing
- Eliminating secondary emergency access points in residential developments
- Reduction of minimum required road and/or cul-de-sac widths

The HBAV representative opined that most of these incentives are site related and not building code driven. As such, it would be difficult to ensure that the incentives would be available consistently across the Commonwealth, or that savings would be passed along to the builder and homeowner. The VFCA representative suggested that most of them are actually already in the code and could not be dismissed by local jurisdictions, but would have to be applied accordingly throughout the Commonwealth. The VBCOA representative added that pursuant to Section 101.5 of the Statewide Fire Prevention Code (SFPC), which allows local governing bodies to adopt fire prevention regulations that are more restrictive or more extensive in scope than the SFPC, some of the potential incentives such as increased hydrant spacing or fire apparatus access road widths, could be overruled by local regulations.[21]

Some other existing code provisions, referred to as incentives during discussions, included:

- Emergency escape and rescue openings not required for dwellings equipped with sprinkler systems
- The ability to run a single water line to serve multiple units vs. individual lines to each unit

The AIA-VA representative noted that there is a difference between incentives and what is already accepted in the code. He gave the example in the current code of a multi-family dwelling building, which if protected by an NFPA 13 system instead of an NFPA 13R system, could have longer dead-end corridors and other benefits. He suggested that it would be good to explore the existing code provisions that would actually incentivize the installation of sprinklers. Any incentives offered by localities at the local level would be independent of that.

While not an incentive per se, the reduction in water damage sustained, as a result of less water being required to extinguish a fire in a building protected by a sprinkler system, was also

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[20] UNLV Residential Sprinkler Study: see Appendix C, "Supporting Documentation

[21] SFPC Section 101.5: https://codes.iccsafe.org/content/VFC2018P2/chapter-1-administration#VFC2018P2_Ch01_Sec101.5

identified as a benefit of sprinkler system installation. It was estimated that a residential sprinkler head may discharge an average of 200 gallons of water until turned off by emergency responders, while a fire hose can discharge anywhere from 100 gallons per minute up to 1,000 gallons per minute.

SAFETY IMPACT OF FIRE SPRINKLERS IN TOWNHOUSES

Given very limited fire and sprinkler data in Virginia, the study group members referred to data from other localities, outside of Virginia.

The VFCA representative indicated that in Maryland, where fire sprinklers are required, no lives have been lost, due to fire events, in residential homes with sprinklers installed. He emphasized the US Fire Experience with Sprinklers and US Fire Loss Data document shared with the group, which underscores the reduction of civilian and fire fighters injury and death in homes with sprinklers.[22] He added that an important factor to be considered is the positive effect sprinklers have on fire fighters. The installation of sprinklers limits injury and property loss, saves the lives of the occupants, but also protects the firefighters. Real life examples, where lives were lost were also shared with the group and he indicated that had there been sprinklers, the life of the residents might have been saved.

The HBAV representative stated that homes being built under current code requirements are safer than those built decades ago. He questioned the lack of home fires data on older homes, such as those built in the 40's to the 80's, vs. newer homes built over the last ten years. He suggested that perhaps the focus should be on promoting increased fire safety in older homes and noted that creating a statewide mandate that would add thousands of dollars to the construction cost of new homes, when there is no data to support the suggested benefits, would be haphazard.

The VFCA concurred that the fire data is limited as there's currently no mandatory requirement for fire departments to report the data to the federal system. He also agreed that homes now are being built safer, but stated that the issue is not with the buildings but with the people and the contents of buildings. Given the changes in materials used in construction and manufacturing from mostly wood and cotton, to liquid gas, plastics, synthetics and trusses, the escape time before flashover occurs has been reduced from 11-13 minutes to only 3-5 minutes.

The AIA-VA representative shared that he has over 30 projects under construction at the moment and has for some time. He does not believe those buildings are unsafe because they do not have sprinklers. He reiterated that every other states besides Maryland, California and the District of Columbia have opted out of the townhouse sprinkler requirements. He suggested that, in addition to sprinkler systems, there are other construction features that provide increased fire safety that could be considered. Things such as making everything a 1-hour fire-resistance-rated assembly could potentially result in buildings safer than if they were sprinklered but not fire-resistance-rated. He agrees that fire sprinklers are very effective and has designed many projects with sprinklers, but wishes to ensure that all options are considered before making a statewide mandate.

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[22] US Fire Experience with Sprinklers and US Fire Loss Data: see Appendix C, "Supporting Documentation

HOMEBUYERS' PERSPECTIVE

The VFCA representative suggested that there is significant homebuyer interest for homes protected with fire sprinklers. He cited a Fact Sheet by the International Residential Code Fire Sprinkler Coalition, which he shared with the study group.[23] The Fact Sheet indicates that 3/4 of respondents to a survey conducted in 2014 stated that they would more likely buy a home with sprinklers than one without. The same survey results show that a similar percentage agreed that a home with fire sprinklers has more value and provides "ultimate protection" for residents. He added that people do feel safer in houses equipped with sprinklers, but they do not know about the effectiveness of sprinklers, so even if the sprinklers would be an option offered by the builder, they do not ask for them.

The HBAV representative submitted that the builders build to what the market demands. Currently, there is no demand for sprinklers, although the builders are willing to provide sprinkler systems for those who want them. He also suggested that, given the differences between each locality, perhaps the best approach would be to continue to incentivize the installation of sprinklers at the local level, rather than mandating it across the Commonwealth.

SUPPORTING DOCUMENTATION AND REFERENCE MATERIALS

Documentation discussed by the study group included the following:

- DHCD staff power point presentation
- 2018 Code change proposals
  - RB302.2.2-18
  - RB302.2.6-18
  - RB302.3(1)-18
  - RB310.11-18
  - RB313.1-18
- Economic Cost Benefit Analysis of Residential Fire Sprinkler Systems Broward County, Florida; submitted by the VFCA
- Loudoun County Fire and Rescue - Fire Cause Determination; submitted by the VFCA
- UNLV Residential Fire Sprinkler Study; submitted by the VFCA
- Fact Sheet - Homebuyer Interest in Residential Sprinkler Systems; submitted by the VFCA
- Fact Sheet - Fire Sprinkler Systems for Townhouses; submitted by the VFCA
- Fact Sheet - Water Supplies for Home Fire Sprinkler Systems; submitted by the VFCA
- Additional IRCFSC resources associated with residential sprinkler systems; submitted by the VFCA
- Benefits of Residential Fire Sprinklers; submitted by the VFCA
- Virginia Townhouse Sprinkler Price Survey; submitted by the VFCA
- Townhouse fire sprinkler sample plans; submitted by the VFPA
- HBAV Comments on Virginia Specific Fire Data; submitted by the HBAV
- HBAV Compilation of Housing Affordability Reports; submitted by the HBAV

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[23] Fact Sheet by the IRC Fire Sprinkler Coalition: see Appendix C, "Supporting Documentation

- Richmond Region Townhome Builder Cost Estimates and Notes; submitted by the HBAV
- Southwest Virginia Blacksburg Estimate; submitted by the HBAV
- HFSC Fact Sheet; submitted by the VFCA
- NFPA US Fire Experience with Sprinklers 2021; submitted by the VFCA
- NFPA US Fire Experience with Sprinklers Supporting Tables 2021; submitted by the VFCA
- NFPA US Fire Loss Data 2020; submitted by the VFCA
- NFPA US Fire Loss Trend Tables 2020; submitted by the VFCA
- 2021 Code change proposals
    - RB313.1-21
    - RB313.1(2)-21
    - RB313.1(3)-21

CODE CHANGE PROPOSALS

Three code change proposals related to townhouse sprinklers were submitted in cdpVA by stakeholders during the 2021 Virginia Code Development Cycle.[24] [25] During the May 17, 2022, meeting, the proposals were discussed by the study group.

Proposals RB313.1-21 and RB313.1(3)-21 are similar in nature and require the installation of sprinkler systems in townhouses. Proposal RB313.1(2)-21 requires sprinklers systems in townhouses, as well as in one- and two-family dwellings.

Proposal RB313.1(2)-21 was not deliberated at length by the group given that its scope expands beyond requiring sprinklers in townhouses, which this study group was charged with discussing. Although a formal vote was not taken on whether to support the proposal, the HBAV and the VFCA representatives were in agreement that if a recommendation was to be given by this study group for this proposal, it should be recommended for disapproval.

The main difference between proposals RB313.1-21 and RB313.1(3)-21 is that the latter only requires sprinklers in buildings with more than three townhouse units. As per the proponent's statements, similar provisions have been approved in Washington State. He suggests that this would be a good compromise for Virginia and would assist with rural areas where water supply might be an issue. The VFCA representative shared that the VFCA is behind both of these proposals and he supports both of them.

The HBAV representative raised a concern with the proposals which allow the sprinkler systems to be designed and installed in accordance with Section P2904 or NFPA 13D, 13, or 13R. He cited statements made during earlier study group discussions made by others indicating that the study group should not and will not focus on NFPA 13, or 13R systems. The proponents clarified that the concern raised by the HBAV representative is related to existing code language and that the proposals do not modify those provisions. The HBAV representative asked for assurance from the code officials in the group that the permit applicant would not be forced, based on this existing language, to use a certain standard for the design and installation of the

[24] cdpVA (Virginia's Online Code Development Process): https://va.cdpaccess.com/login/

[25] 2021 VA Code change proposals: see Appendix C, "Supporting Documentation

sprinkler system, for instance NFPA 13R. The VBCOA representative confirmed that the townhouse designer has the ability to choose which type of system to install, and the code official does not have the authority to mandate which type of system to install.

Both proponents agreed to submit floor modifications during the General Stakeholder Workgroup meetings in June to remove the reference to NFPA 13 and 13R from VRC Section R313.1.1 and revert back to the IRC language for that code section.[26]

CONCLUSIONS AND ACKNOWLEDGEMENTS

Study group meetings yielded several fruitful discussions regarding the potential impacts of mandating residential sprinkler systems in townhouses.

The stakeholders did not reach consensus on what would constitute the best solution. This report documents the key issues discussed and it includes supplementary documents provided by stakeholders. Below are a summary of the key findings, based on the information provided and stakeholder process.

- Fire sprinklers are effective and save lives
- Enhanced smoke detection, fire-resistant construction and other similar safety features were suggested as potential alternatives to sprinklers
- Fire sprinklers have a direct impact on the cost of construction and housing affordability
- Fire sprinkler installation offers several financial incentives that could offset the cost
- Water supply limitations could present challenges for some systems, especially in rural areas
- Virginia is in line with the majority of states, which remove the IRC sprinkler requirements for townhouses

Finally, the staff of DHCD wish to thank the study group participants for the time and energy they committed to this process. The stakeholders presented arguments based on their backgrounds in fire services; fire and building codes; building design, building industry, affordable housing, public and private water providers, public administration, and more. This committed group lent many hours of their time submitting documents, conducting conversations, and reviewing their colleagues' arguments and positions. They shared their knowledge and experience in the form of anecdotes, documented case studies, and current practices. We deeply appreciate their expertise and willingness to engage in the study group discussions.

[26] 2021 IRC Section R313.1.1: https://codes.iccsafe.org/content/IRC2021P2/chapter-3-building-planning#IRC2021P2_Pt03_Ch03_SecR313.1.1

APPENDIX A: Agendas, Meeting Summaries, Participants

Residential Sprinklers
December 15, 2021
9:00 a.m.
Virtual Meeting: https://vadhcd.adobeconnect.com/va2021cdc/

AGENDA

1) Welcome

2) Introductions

3) Overview of VA Code Development Process

4) Background

5) Discussion

6) Assignments and Next Steps

7) Next Meeting

Residential Sprinklers Study Group Meeting Summary

December 15, 2021 9:00 a.m. – 10:05 a.m.

Virtual Meeting: https://vadhcd.adobeconnect.com/va2021cdc/

ATTENDEES:

VA Department of Housing and Community Development (DHCD) Staff:
Cindy Davis: Deputy Director, Division of Building and Fire Regulations (BFR)
Jeanette Campbell: Administrative Assistant, BFR
Jeff Brown: State Building Codes Director, State Building Codes Office (SBCO)
Richard Potts: Code Development and Technical Support Administrator, SBCO
Paul Messplay: Code and Regulation Specialist, SBCO
Florin Moldovan: Code and Regulation Specialist, SBCO

Study Group Members:
Mike Eutsey: First Vice President of Virginia Building and Code Officials Association (VBCOA) and Assistant Chief Building Official for Hanover County
Jimmy Csizmadia: Secretary of Virginia Fire Prevention Association (VFPA) and Inspector with the Prince William County Fire Marshal's Office
Garrett Dyer: Virginia Department of Fire Programs (VDFP)
Mike Poole: American Institute of Architects (AIA) Virginia and Principal of Poole & Poole Architecture
Overton McGehee: Habitat for Humanity
Reid Walters: Town Manager of the Town of Independence
Mike Nannery: Assistant Director of Engineering and Development for Chesterfield County Utilities
Meredith Raetz: Planning Engineer with Virginia American Water
Andrew Clark: Homebuilders Association of Virginia (HBAV)

Other Interested Parties:
Andrew Milliken: Virginia Fire Chiefs Association (VFCA), Virginia Fire Services Board (VFSB) - Chairman of Fire Codes and Standards Committee
Keith Johnson: VFCA, VFSB Vice Chair and on the Board of Housing and Community Development (BHCD)
Sean Farrell: VBCOA and BHCD
Jason Lewis: VBCOA
Timothy Loscomb: Vice President of American Fire Sprinkler Association (AFSA) – Virginia chapter
Todd Strang: Spotsylvania County Fire Official

Study Group Members not in attendance:
Ellis McKinney: Virginia Plumbing and Mechanical Inspectors Association (VPMIA)
Robbie McCraw - Carroll County Board of Supervisors and E&L Diamond Electric, Heating, Cooling and Plumbing

AGENDA AND DISCUSSION ITEMS:
Power Point presentation is available on the DHCD website, with a link on the cdpVA website

1) Welcome

Jeff Brown: Welcomed participants to the Adobe Connect meeting. He noted that these meetings will be recorded. There will be breaks after each hour, although today's introductory meeting probably will not be much longer than one hour. DHCD staff is available for technical assistance. Please keep microphones muted if not speaking, and introduce yourself if you are speaking. Please be professional, respectful and concise when speaking. Meetings are open for anyone to attend, but discussions should only include Study Group members.

2) Introductions

DHCD staff members introduced themselves. Study Group members introduced themselves.

3) Overview of VA Code Development Process

Jeff Brown: The Virginia code development cycle runs about every 3 years, starting with the latest international codes and considering state amendments proposed by stakeholders during the development process. The Board of Housing and Community Development makes decisions on each proposal and adopts the final Virginia building and fire regulations. The 2018 building and fire regulations became effective July 1, 2021.

Jeff gave an overview of the 2021 Virginia Code Development Cycle with approximate dates by month of when each of the steps happen, i.e.: cdpVA opened for proposals in October 2021; Notices of Intended Regulatory Action (NOIRAs) were published in November 2021; groups meet to discuss code change proposals between December 2021 and June 2022; BHCD considers code change proposals in September 2022 and proposed regulations in December 2022. The 2021 codes become effective in Virginia in the fall or winter of 2023.

The BHCD approved a new policy for 2021 to limit new code change proposals to the proposed phase and not after the proposed regulations have been published. New code change proposals will not be accepted in the final phase, which is limited to errors or minor corrections. Anything new that arrives in the final phase will be considered during the 2024 code development cycle.

va.cdpacess.com is the Virginia online code development system, which accepts code change proposals from anyone. In addition, all of the information provided and captured during the process is available for viewing.

Study Groups study specific topics, identify areas of consensus and disagreement, and determine if code change proposals or other solutions are appropriate. They may review proposals, provide analysis, make recommendations, and/or develop code change proposals. Proposals and recommendations of Study Groups are reviewed by the General Workgroups prior to BHCD consideration. Study Groups are disbanded after they complete discussions.

Sub-Workgroups Review all code change proposals within their subject topics. They make recommendations on each proposal, including negotiating compromises where appropriate, in an attempt to form a group consensus on each proposal. They may also develop new code change proposals, or support proposals submitted by others by joining the proposal as a proponent. Proposals and recommendations of Sub-Workgroups are reviewed by the General Workgroups prior to BHCD consideration.

General Workgroups are open to all public for discussion and comment. They will review all proposals received, and aim for a consensus to approve or disapprove each one. They will recommend the proposals to the BHCD in blocks, sorted by those receiving consensus to approve or disapprove, as well as non-consensus proposals. The consensus proposals are usually voted through as recommended. Non-consensus proposals go to the BHCD in their entirety, including summaries and all related documents. Recommendations from this Study Group, for example, will go to General Workgroups and then to the BHCD as outlined.

codes.iccsafe.org/codes/Virginia provides free online access to Virginia and ICC code books.

4) Background

IRC 2006: Was the first edition of the IRC that included provisions for sprinklers in residential structures or one- and two-family dwellings and townhouses. It was added as Appendix P “Fire Sprinkler System” and contained provisions for the installation of fire sprinkler systems in dwellings covered by the IRC. The Appendix is not mandatory unless specifically referenced in the adopting ordinance.

VRC 2006: No significant changes (IRC appendix not incorporated)

IRC 2009: New Section R313 “Automatic Fire Sprinkler Systems” mandates the installation of an automatic fire sprinkler system in townhouses and one- and two-family dwellings. The system is to be designed and installed in accordance with new Section P2904 “Dwelling unit Fire Sprinkler Systems” or NFPA 13D.

VRC 2009: Amends Section R313 of the 2009 IRC to make the installation of sprinkler systems optional. Section R329 “Fire Extinguishers” was added, which mandates the installation of a fire extinguisher with a rating of 2-A:10-B:C in the kitchen area, if the dwelling is not equipped with an automatic fire sprinkler system.

IRC 2012: No significant changes

VRC 2012: No significant changes

IRC 2015: Allows the NFPA 13D standard to be complied with for the design and installation of systems in townhouses (Section P2904 remains one of the options available). This change brings the townhouse requirements in line with those for one- and two-family dwellings.

VRC 2015: No significant changes

IRC 2018: No significant changes

VRC 2018: No significant changes

2018 Code Development Cycle: The Board of Housing and Community Development (BHCD) **approved** the following proposals, related to sprinkler systems, for inclusion in the 2018 VRC:

- **RB302.2.2-18** – allows water-filled fire sprinkler piping in cavity of common walls shared by townhouses.
- **RB302.2.6-18** – exempts townhouses protected by a fire sprinkler system complying with Section P2904, NFPA 13, NFPA 13R or NFPA 13D, from the structural independence requirement.
- **RB302.3(1)-18** –allows a fire-resistance rating reduction from 1 hour to 30 minutes for 2-family dwellings, if protected by an automatic sprinkler system complying with NFPA 13R or Section P2904 of the VRC

The BHCD **disapproved** proposals **RB310.11-18 and RB313.1-18**, requiring sprinkler system installation in both townhouses and one- and two-family dwellings.

<u>Jeff</u>: During the Board’s consideration of proposal RB313.1, a suggestion was made to amend the proposal to only require sprinklers in townhouses (and not one- and two-family dwellings). This generated a lot of discussion. Ultimately, the Board voted to not require sprinkler systems in townhouses. However, part of the Board’s motion and vote included a directive to DHCD staff to convene a group of interested stakeholders to continue the discussions regarding townhouse sprinklers during the 2021 Code Development Cycle.

2018 VRC: for townhouses and one- and two-family dwellings, automatic fire sprinkler systems are optional. Where installed, automatic fire sprinkler systems can be designed and installed in accordance with NFPA 13, NFPA 13R, NFPA 13D or VRC Section P2904.
2021 IRC: No significant changes

In other states: Sprinklers are required in all new townhouses and one- and two-family dwellings in California, Maryland and Washington DC. Sprinklers are required in some (based on size /height) townhouses and one- and two-family dwellings in New York and Massachusetts. Approximately 20 states allow local jurisdictions to mandate the installation of sprinklers in townhouses and one- and two-family dwellings.

<u>Jeff</u>: This is the latest information we were able to locate based on reports from NFPA and HBAV. He asked that if anyone has any updates or corrections, to please let DHCD know. These statistics are also not specific to

townhouses, so if anyone is able to provide information on states and localities that only require sprinklers in townhouses, it would be very helpful.

Study Group Objectives: Gather information and data for review and discussion. Identify areas of agreement and/or disagreement. Summarize findings or recommendations. Review any related proposals submitted during the 2021 cycle.

Jeff: There is a lot of information and data available from various sources, regarding the cost and effectiveness of residential sprinklers. This group will need to look at that data and identify or highlight the most helpful data to assist the Board in making decisions. Again, if anyone is able to provide data specific to townhouses, it would be helpful. Based on previous discussions around this topic, there will be areas of disagreement and those areas will need to be identified. If the group is able to resolve any of those disagreements during discussions, that would be even more helpful to the Board.

Jeff: Findings and/or recommendations will need to be summarized, keeping in mind that any recommendations developed by this group will be provided to all stakeholders for review and comment, prior to the Board making any final decisions on residential sprinkler related proposals.

Important discussion topics (future meetings): Safety impact of residential sprinklers. Cost(s) of residential sprinklers. Cost impact of residential sprinklers. Other?

Jeff: Has named a few topics that he believes are critical for the group to discuss and attempt to provide some clarity around. This is not intended to be an exhaustive list. These are topics where a lot of questions typically come up when discussing residential sprinklers, and he thinks it will be important for this group to discuss them, as he assumes that these will be some of the topics discussed by the Board when they consider any proposals in this cycle. If this group can help provide some clarity on any of these items, he thinks it will be very helpful to the Board. He doesn't expect anyone to be prepared to discuss them in depth today, but as data and information is gathered related to these topics, the group should be preparing for more in-depth discussion at future meetings.

5) Discussion

Mike Nannery: As a utility engineer, he's curious if there was any data compiled and discussed, during the 2018 cycle discussions on fire events that happened regionally (as a result of heating, kitchen fires, etc), which those in the Study Group can review.

Jeff: There was not a lot of discussion or review by stakeholders before proposals came before the BHCD and decisions were made. When the sprinkler proposals came to Workgroups, the proponents weren't available to discuss. They went forward as non-consensus. There was not much discussion about stats, which lead to board hesitancy on code changes. He suggested the group look at cdpVA to see what was submitted with the proposals last cycle. Jeff also asked the group to find and bring stats to the next meeting.

Mike: His concern is that he doesn't want to start from scratch if there were already statistics available from the original business case for these discussions.

Jeff: The initial proposals were for sprinklers in 1- and 2-family dwellings and townhouses. They were non consensus, but there was additional discussion around requiring sprinklers only in townhouses. This group's discussions will continue to focus on townhouses, so it would be good to search for data in other localities that is specific to townhouses.

Garrett Dyer: Is there a preferred way to organize or present the research and data collection at the next meeting?

Jeff: Asked everyone to think about what they want to discuss and submit it to DHCD before the next meeting (see assignments section). This will help DHCD to organize the data collected and prepare the agenda for the next discussion.

Andrew Clark: Thanked Jeff and Cindy for getting this group together. It is good to dig into some issues that were not addressed significantly in the last code cycle. He would like to know if this group will be able to schedule meetings around the General Assembly meetings, as it may result in a scheduling conflict for him and some others in the group.

Jeff: The tentative second meeting date for this group is January 11th, which is right before the General Assembly Session starts. Rather than wait until Session ends, he may send a poll to members of this group, and schedule the next meeting for the date that most members can attend.

Meredith Raetz: Wants to know if there is any intention to reach out to other states to see what they adopted and what happened with implementation. We may be able to leverage from their experiences, especially states physically close to us, which may have had similar challenges or demographics.

Jeff: We do hope to do some of that. For now, the general homework assignment is to gather readily available information. Perhaps after the next meeting, we'll be more prepared to reach out to other localities. DHCD will also do some research and bring to the group to fill in some blanks as we move forward. It would be great if we can find data from localities that mandated sprinklers for townhouses only. Most of the information he has now is general to one- and two-family dwellings and townhouses. He knows that some members of this group have studied this issue in the past, and can bring some data we can start with. We'll definitely be interested in the various costs and fees of systems and installation and also challenges for places without public water.

Keith Johnson: Stated that he is in a unique position because he sits on the BHCD and wanted to give some overview. He is grateful for this group because he doesn't think that big issues like this can be solved year after year in the final code development or code approval process. He said a group like this one is needed to gather all the facts and data. There are several new members on the board this year, who were not part of this discussion last cycle. It's about education; there are pros and cons, costs and accurate information and data to present to the Board, because they make the final decisions. He says that when they get to the final vote for the non-consensus items that there is so much to discuss with misconceptions and facts and figures being thrown about and it becomes mind-boggling, especially for people without a fire background. He is grateful if this group can get all the facts first, so that the board can be educated and discuss with correct information.

Jeff: It will be key for this group to gather all the information and sort through it so that it doesn't have to be done at the last minute, while trying to make decisions. The group won't decide anything for the board, but will clarify the data so that the board can make their decisions.

Mike Nannery: Please clarify the charge for this 2021 Study Group – is it to consider townhouses and 1- and 2-family dwellings, or only townhouses?

Jeff: Based on the last discussion and the BHCD directive, it's about townhouses. Some of the data available is from other states that address both dwelling types, so some data may or may not be relevant and helpful to us.

Mike: There's a new housing product called 2 over 2 condos. From a utility standpoint, we see that they have been sprinkled. Will they also be discussed?

Jeff: It sounds like they may be treated as multi-family dwellings.

Jimmy Csizmadia: _They are multi-family, which already require sprinklers because they are 4 stories.

Mike Poole: Confirmed that the 2 over 2 buildings fall under the IBC because they are 4 stories and do not necessarily have an independent fire wall between them. He works in multiple localities in the country and maintains a code spreadsheet based on projects in the various states. He can help provide information on other states. Some states that have adopted a state-wide building code, the smaller localities are not applying their own exceptions. In other states that have not adopted a state-wide building code, exceptions can range wildly in the interpretations. He is happy to share information, since they do track based on various building types. Single family rentals are a unique product coming into the marketplace now, which opens a lot of questions when dealing with the tenant instead of the owner. Will there be other discussion besides sprinklers? There are other safety measures that can be used and we should also mix them into our discussions.

Jeff: That information will be very helpful as we discuss the proposals. Please provide what is available for the next meeting.

Mike pool will be happy to share that information.

6) Assignments and Next Steps

Prior to the next meeting, please:

- Reach out to other members and/or DHCD staff with any questions related to information discussed today
- Identify areas of interest or concern that you would like to discuss at the next meeting (Provide to DHCD by December 27th)
- Identify and provide helpful/relevant information (reports, data, etc.) for the group to review (Provide to DHCD by December 27th)

Note: If any member wants to share information with the group between meetings, please send it to DHCD staff and we will distribute it to our email list to make sure we do not miss any interested parties that might be added to our list as we go along.

7) Next Meeting

January 11, 2021 9:00 am to 3:00 pm
(Lunch break from 12:00 pm to 1:00 pm)
Virtual Meeting Link: https://vadhcd.adobeconnect.com/va2021cdc/

AGENDA

Residential Sprinklers Study Group

January 11, 2022

9:00 a.m.

Virtual Meeting: https://vadhcd.adobeconnect.com/va2021cdc/

I) Welcome

II) Discussion

a) Study Group Members - Initial Thoughts

b) Townhouse Sprinklers:

i) Effectiveness

ii) Costs

iii) Cost Impact

iv) Other considerations

III) Other

IV) Assignments and Next Steps

V) Next Meeting

Residential Sprinklers Study Group

Meeting Summary: January 11, 2022 9:00 a.m. to 10:30 a.m.

Virtual Meeting: https://vadhcd.adobeconnect.com/va2021cdc/

ATTENDEES:

VA Department of Housing and Community Development (DHCD) Staff:

Cindy Davis: *Deputy Director, Division of Building and Fire Regulations (BFR)*
Jeanette Campbell: *Administrative Assistant, BFR*
Jeff Brown: *State Building Codes Director, State Building Codes Office (SBCO)*
Richard Potts: *Code Development and Technical Support Administrator, SBCO*
Paul Messplay: *Code and Regulation Specialist, SBCO*
Travis Luter: *Code and Regulation Specialist, SBCO*
Thomas King: *Code and Regulation Specialist, SBCO*
Kyle Flanders: *Senior Policy Analyst, Policy and Legislative Office*

Study Group Members:

Ron Clements: *Chesterfield Building Official, member of VBCOA*
Mike Nannery: *Assistant Director of Engineering and Development for Chesterfield County Utilities*
Mike Eutsey: *First Vice President of Virginia Building and Code Officials Association (VBCOA) and Assistant Chief Building Official for Hanover County*
Keith Johnson: *Virginia Fire Chiefs Association (VFCA), Virginia Fire Services Board (VFSB) Vice Chair, and member of the Board of Housing and Community Development (BHCD)*
Meredith Raetz: *Planning Engineer with Virginia American Water*
Overton McGehee: *Habitat for Humanity*
Ellis McKinney: *Virginia Plumbing and Mechanical Inspectors Association (VPMIA)*

Other Interested Parties:

Andrew Milliken: *VFCA, VFSB Chairman of Fire Codes and Standards Committee*
Timothy Loscomb: *Vice President of American Fire Sprinkler Association (AFSA) – Virginia chapter*
Jason Laws: *VBCOA*
Judy Hackler: *Executive Director, Virginia Assisted Living Association (VALA)*
Jeffrey Shapiro: *International Code Consultants*
Todd Strang: *Spotsylvania County Fire Official*
Sean Farrell: *Prince William County*
Robby Dawson: *National Fire Protection Association (NFPA)*
John Walser*: Fairfax County Fire & Rescue*
Glenn Dean
Terin Hopkins

Study Group Members not in attendance:

Jimmy Csizmadia: *Secretary of Virginia Fire Prevention Association (VFPA) and Inspector with the Prince William County Fire Marshal's Office*
Garrett Dyer: *Virginia Department of Fire Programs (VDFP)*
Mike Poole: *American Institute of Architects (AIA) Virginia and Principal of Poole & Poole Architecture*
Reid Walters: *Town Manager of the Town of Independence*
Robbie McCraw: *Carroll County Board of Supervisors and E&L Diamond Electric, Heating, Cooling and Plumbing*
Andrew Clark: *Homebuilders Association of Virginia (HBAV)*

AGENDA AND DISCUSSION ITEMS:

Welcome

Jeff Brown: Welcomed everyone to the second meeting of the Residential Sprinklers Study Group. The meeting is scheduled until 3pm, with 5 minute breaks every hour and a lunch break from 12pm-1pm. However, the meeting may end early. These meetings are recorded and written summaries are prepared. He asked members to use the raise hand function to speak, and to state their names as they speak. These meetings are open to the public, however discussion is only between the Study Group members, who are welcome to speak at any time. Other interested parties are asked to speak with group members outside of the meeting to express their views. Study Group members are listed in a pod on the side of the main screen.

Townhouse Sprinklers Discussion

Study Group Members - Initial Thoughts

Jeff: asked if anyone had initial thoughts to start the discussions.

Keith Johnson: thanked Jeff and DHCD for arranging the group. He asked Jeff what is the ultimate goal of the Study Group? Is it only to provide information? Obviously, the group is not the decision body, but the group will have a lot of influence. Ultimately, what does success look like, what are the parameters and how will information be transferred? There will be opinions on each side. For him, success would be having a proposal to put sprinklers in townhouses. He is wondering if there will be talk of incentives, offsets or compromises.

Jeff: The primary goal is to give clear information to the Board. There will be code change proposals submitted this cycle related to the townhouse sprinkler requirements. The group will want to think about questions and concerns about data have come up in past discussions when residential sprinkler proposals have been considered. He would like the group to gather and vet the data and information first and provide clarity around the issues. If there are areas of consensus, that would be great. In the areas where there are disagreements, providing a clear succinct report to clarify those issues and discussions will be very helpful.

Jeff: Asked if there were any other initial thoughts to share. He encouraged the group members to speak up. He noted that not every group member was available today, and it may be challenging to get everyone together while General Assembly is in session. He was hoping to wrap the meetings up before the General Assembly session ends, but it may not be possible.

Jeff: There are 4 items on the agenda today to start discussions. In addition, Keith sent over some documents after the agenda went out. He encouraged Keith to refer to any of the documents as applicable, when the topics come up in their discussions. He also said that if there was something else in the documents that he wanted to share with the group, he could do that when they get to the “other considerations” part of the meeting. (They were available to review in the ‘files’ pod to the left of the main meeting space.)

Jeff: Robbie McCraw was unable to attend the meeting today, but he sent along something for Jeff to share. He read Robbie’s statement and shared it in the chat box:

Jeff Brown - DHCD: from Robbie: I live in a rural area and am surrounded by other localities that are rural. The question that arises is available water for sprinkler systems, we have several townhouse complexes that are currently not connected to a public water system. If we have developers that continue to or desire to build townhouses in areas not served by public water systems what type of requirement would have to be made to maintain a water supply for a sprinkler system 09:16AM

Meredith Raetz: This is a valid point. In some areas, there aren’t even fire hydrants available because storage water isn’t available to supply the hydrants.

Keith: Just because there aren’t domestic water supplies or fire hydrants, it doesn’t mean that there can’t be effective residential sprinkler systems.

Jeff: He thinks this is one of the questions that this group will want to gather information on and continue discussing. If public water is not available at a site, what type of water supply is utilized to supply the sprinkler system? Maybe gathering information on examples of townhouse developments on private systems would be helpful to address questions around requirements for water storage tanks, pumps, etc... And what would be the associated costs? He asked group members to bring back ideas.

Mike Nannery: From a utility engineering standpoint, ground storage tanks and pumps or potentially a Hydromatic tank could provide water. It would need to be engineered. It can be overcome, but would impact cost.

Jeff: That's what he was wondering. It would be great if the group could obtain some examples. He will reach out to Robbie, as he has some rural townhouse developments without public water, and see what type of water systems they utilize.

Keith: If there's a domestic water supply with enough water to operate toilets and sinks in a development, you have enough water to supply a 13D system.

Jeff: He has heard that the supply can vary and he has heard arguments for both sides. Some have said that if it works for the plumbing system, there is adequate water. He asked for examples with townhouse size, plumbing fixture calculation for water supply and calculations for sprinklers, in order to see what the difference is, if any.

Keith: He supplied an IRC Fire Sprinkler Coalition fact sheet called "Water Supplies for Home Fire Sprinkler Systems", which lays out requirements for this. Essentially only 7psi is required to operate, and a residential sprinkler system could use about 8 gallons per minute (which is in line with residential plumbing). He also provided an IRC Fire Sprinkler Coalition fact sheet called "Fire Sprinkler Systems for Townhouses", which addresses costs.

Submitted in the Chat Box:

Paul Messplay - DHCD: For those who are interested, that fact sheet is item 6 in the files pod on the bottom left 09:23AM

Jeff: It would be helpful for this group to review and discuss the data that has been provided as well as some real-life examples of townhouse sprinkler designs, with calculations, so that those discussions can be included in the information submitted to the Board, rather than just providing informational documents submitted by members with no discussion or analysis.

Keith: Will work with other stakeholders to obtain examples. Since there are no requirements in Virginia currently, examples may have to come from other localities.

Effectiveness

Jeff: What will be the impact if sprinklers are added to newly-constructed townhouses? Is there data available that compares new construction with sprinklers vs. those with no sprinklers? What is the closest data that supports the topic?

Mike N: Pre-recession, he had a conversation with a builder about townhome construction. They needed to provide a 2-head system in a 4th floor loft per code. That was 14 years ago. Are there any such requirements now? What was being enforced back then for 4th story loft and taller townhouses? The small residential meter couldn't pass the flow, which they needed to reach the higher floors. Was that local?

Ron Clements: Doesn't know what exactly was discussed back then. However, buildings that are 4 stories or higher, are out of the Residential Code, and into the IBC and VCC, which do require sprinklers now.

Keith: The model fire codes limit townhouses to 3 stories. Buildings with 4 stories and above have to have sprinklers. There was a proposal put forward last time to deal with lofts. Regarding effectiveness, there's a need to look at other localities outside of VA. In MD, there has never been a death in residential buildings with sprinklers. The University of Nevada, Las Vegas (UNLV) study in 2017 was fair on both sides of the argument - not only looking at death and injury, but also looking at building damage, effectiveness, preventing a flashover, etc. The effect on fire fighters also needs to be considered in this discussion. The average sprinkler system may put out 200 gallons of water before the fire fighters get there. This helps the fire fighters, and isn't adding a lot to water damage, considering that a fire hose can put out 100 to 1,000 gallons of water. Smoke alarms are good, but they are notification tools, allowing residents to get out alive. They also need maintenance to work properly. A residential sprinkler can prevent flashover and control a fire, and also do not need human intervention to do so. They can be effective at limiting injury or death and property loss.

Jeff: These are also things that this group needs to discuss and can include in the information that is provided to the Board. Other benefits and improvements that come along with installation of sprinklers, and how the benefits differ from smoke alarms will all help to bring clarity to the final report.

Mike N: Asked if Keith provided all the handouts?

Keith: Yes. A lot of what he just discussed was in the UNLV study, which he thought was fair. It discussed trade-offs and incentives for builders and developers as well as costs.

Mike: He read the materials and noticed that most fires are caused by unintended cooking and a lot of them happen overnight.

Keith: Yes, they are. In one case, he had a call in 2019 with a fire caused by unattended cooking, and the door was not closed. There was no residential sprinkler system and there was a fatality. His opinion is that a sprinkler system may have saved the resident.

Jeff: This a good start to the effectiveness discussion, it will continue and be built upon as we continue our discussions.

Costs

Jeff: There are various costs associated with sprinkler systems. Keith provided some cost information to review. Based on past discussions, potential costs include:

- water service – system requirements, size, water meter
- water supply - public vs. private (tank and pump size)
- utility fees
- design fees
- permit and inspection fees
- system installation
- maintenance costs

Keith: Provided the UNLV study and the Economic Cost Study from Broward County FL, which discuss costs. Also provided is the VA Townhouse Sprinkler Price Survey by Jeff Shapiro with the IRC Sprinkler Coalition, which discuss costs in the Reston, Haymarket, Leesburg, Alexandria, and other areas of northern Virginia. The cost of the system and installation is not the only cost. There are also reductions and savings for construction, such as eliminating secondary access points, reduction of cul-de-sac widths, reduction of required fire flows, decreased required street widths, exterior and interior walls etc. that reduce the cost of building when a sprinkler system is installed.

Jeff: That is a good point and should be considered by this group as we look at the costs. Supporting data and discussion around the various costs and potential cost savings should be supplied. The final report can list not only potential costs, but also potential cost savings.

Ron: The numbers provided in the UNLV study and Economic Cost Study are helpful. He also wants to look at sample townhouse projects and the design of a P2904 system, in rural and suburban areas, in order to determine what the costs are in both areas. It will be helpful to have real world samples, which everyone can look at and agree on, including some actual costs. That will help identify what the actual and specific objections are, to this being a code requirement.

Submitted in the Chat Box:

Keith Johnson - SG: Good point Ron 09:53AM

Jeff: It would be helpful having real world examples. It will be given as an assignment later.

Ron: It would also be helpful to see if this group can agree on what the minimum system requirements would be to meet the code.

Mike N: He thinks the main goal is public safety and property protection. It would be helpful to define the scope: is it global, suburban, and/or rural; is it all sprinkler system types; which area of the buildings are covered. There doesn't seem to be a defined scope of what's in or out.

Jeff: That is a good point, it will help clarify things, especially to define the minimum system requirements. It might take a few examples, some in rural and some in municipal water areas.

Keith: He's personally talking about a system to cover the entire building, especially because it's not easy to predict what a hazard area would be that might start a fire. 13D systems can be used up to 3 stories, then a 13R system would be needed.

Ron: There is an IRC P2904 system that can be designed and installed by a plumber, as opposed to a 13D or 13R, which would come from a sprinkler contractor. Again, there needs to be agreement on what the minimum system requirements would be. Also, who will do field inspections?

Keith: Stated that an NFPA 13D system can be installed by a plumber contractor or sprinkler contractor unless there is some specific license requirement in the state.

Submitted in the Chat Box:

Ron Clements Chesterfield - SG: "Fire sprinkler contracting" (Abbr: SPR) means the service that provides for the installation, repair, alteration, addition, testing, maintenance, inspection, improvement, or removal of sprinkler systems using water as a means of fire suppression when annexed to real property. This specialty does not provide for the installation, repair, or maintenance of other types of fire suppression systems. The PLB classification allows for the installation of systems permitted to be designed in accordance with the plumbing provisions of the USBC. This specialty may engage in the installation of backflow prevention devices in the fire sprinkler supply main and incidental to the sprinkler system installation when the installer has received formal vocational training approved by the board that included instruction in the installation of backflow prevention devices. 10:07AM

{BREAK 10:02 to 10:07}

Jeff: He will give out homework assignments to get more detailed information on effectiveness and cost to discuss at the next meeting.

Cost Impact

Jeff: Asked what does the cost of the system do to the cost of the housing and affordable housing?

Keith: Inspections would be the same for a sprinkler system as other plumbing, and would be performed at the same time. He thinks they shouldn't make it more than it really is. Also wanted to point out that ongoing inspections are not required for a 13D system, and they are also not required by NFPA 25. Only the initial inspections are required.

Ron: Inspectors would need additional training and additional inspection time. So, there is an impact. He is not trying to make it more than what it is, but there is an impact that should be considered. He has a staff that is already running over 100,000 inspections per year. If this adds two to four additional inspections per townhouse, that would be a significant increase in the number of inspection a year and is something that he will have to consider. Also those plumbing inspectors have never inspected a sprinkler system before so they are going to have to be trained to do that, so there is going to have to be a training effort, hopefully at the state level. Most jurisdictions are also not doing plan review on trades. They will either have to start doing plan review on trades, in order to verify that the sprinkler system is in compliance with the code, or the inspector will have to know the code requirements and inspect for compliance. This is definitely something that should be considered and not lost in the conversations.

Other considerations

Jeff: Is there anything else to consider? He asked Keith if there was anything else in the documents he submitted that he wanted to discuss.

Keith: A lot has been covered in this discussion. He thinks there is a bit of a disadvantage in Virginia, because individual localities are not able to make their own decision about this issue. He thinks that if they were, there would have already been some localities in the Commonwealth to require sprinklers in townhouses. The Commonwealth of Virginia is large and vast, which makes this process difficult. He is a fire chief and official, and looks at things from that angle, but he's also sympathetic to affordable housing and the impact on inspections and other business partners. Just because he is passionate about life safety, doesn't mean that he disregards these other issues. There is a duty to ensure fire safety. There will be costs and challenges, but there are also incentives that offset some of the costs. In the UNLV study, there's a 97% increased chance of survival in residences with sprinkler systems. Townhomes are a higher hazard occupancy and it's important to start with them, because multiple dwellings are connected. They could discuss a minimum number of units, where required sprinklers would kick in. For example, it would not be applicable in a duplex, but would it be required if there are 3-4 units or more?

Mike N: There has been good discussion. The attachments are good to read. He finds that people like options. He would encourage the possibility of having options in the code, rather than all or nothing. He tries to provide safe infrastructure to support quality of life, and it's hard to put a price tag on a life.

Keith: Another consideration could be homebuyer interest. He submitted a fact sheet about homebuyer interest from the Residential Sprinkler Coalition. Beginning in 2009, the IRC required residential sprinklers in all new homes, but Virginia removed that requirement from single family and townhomes. The fact sheet indicates that in a 2014 survey, ¾ of the respondents were more likely to buy a home with sprinklers than without them. It also talks about the myth around the need for backflow preventers, which are not required, as well as the myth about inadequacy of rural water supply. People don't think about safety, but it's important. Things like smoke alarms, escape planning and sprinkler systems are important. People do feel safer having sprinklers if they are an option, but they don't know about the effectiveness of sprinklers, so they don't ask for it.

Mike N: He will give more consideration of the cost impact from a utilities standpoint. Everyone in the Richmond Metro area does something different about trying to accommodate the flow of a residential sprinkler system without a larger connection charge. Whatever recommendations the group has about system type, flows and pressure, he will be happy to add to that by determining the cost impact from a utilities standpoint. Also, he agrees that safety in townhouses is only as good as one's neighbors.

Other

Jeff: There will be some more discussion about the parameters, and more homework in that direction. There were a lot of good things that came up in this discussion that were not on the original agenda. Getting to agreement on the parameters, and finding samples of townhouses and systems will be key.

Assignments and Next Steps

Jeff: Will reach out to some group members after this meeting to bring back information for the next meeting. All group members are reminded to forward any additional information for consideration to DHCD as soon as possible for inclusion on the next agenda

Information needed:

- Types and cost of water supply systems in areas without public water. Examples of townhouse sprinkler designs with calculations and specifications.
  - Jeff to contact Robbie for information on rural townhouse developments without public water.

- What will be the impact if sprinklers are added to newly-constructed townhouses? Is there data available that compares new construction with sprinklers vs. those with no sprinklers? What is the closest data that supports the topic? What other benefits and improvements come along with installation of sprinklers?

Next Meeting

Jeff: A Doodle poll will be sent after we have some more solid things to bring back to the next meeting. He will try to give 2-3 weeks' notice, and will get discussion items and agenda out before the meeting.

AGENDA

Residential Sprinklers Study Group

March 25, 2022

9:00 a.m.

Virtual Meeting: https://vadhcd.adobeconnect.com/va2021cdc/

I) Welcome

II) Discussion

a) Contractor Licensing Requirements

b) Townhouse Sprinkler Plans

c) Cost estimates

d) Code Change Proposals

III) Other

IV) Next Steps

Residential Sprinklers Study Group

Meeting Summary: March 25, 2022 9:00 a.m. to 11:40 a.m.

Virtual Meeting: https://vadhcd.adobeconnect.com/va2021cdc/

ATTENDEES:

VA Department of Housing and Community Development (DHCD) Staff:

Jeff Brown: *State Building Codes Office Director, State Building Codes Office (SBCO)*
Richard Potts: *Code Development and Technical Support Administrator, SBCO*
Paul Messplay: *Code and Regulation Specialist, SBCO*
Florin Moldovan: *Code and Regulation Specialist, SBCO*
Jeanette Campbell: *Administrative Assistant, Building and Fire Regulations (BFR)*
Kyle Flanders: *Senior Policy Analyst, Policy and Legislative Office*

Study Group Members:

Andrew Clark: *Homebuilders Association of Virginia (HBAV)*
Keith Johnson: *Virginia Fire Chiefs Association (VFCA), Virginia Fire Services Board (VFSB) Vice Chair, and member of the Board of Housing and Community Development (BHCD)*
Jimmy Csizmadia: *Secretary of Virginia Fire Prevention Association (VFPA) and Inspector with the Prince William County Fire Marshal's Office*
Garrett Dyer: Director, *Virginia Department of Fire Programs (VDFP)*
Mike Poole: *American Institute of Architects (AIA) Virginia and Principal of Poole & Poole Architecture*

Other Interested Parties:

Andrew Milliken: *VFCA, VFSB Chairman of Fire Codes and Standards Committee*
Craig Toalson: *HBAV*
Judy Hackler: *Executive Director, Virginia Assisted Living Association (VALA)*
Jeffrey Shapiro: *International Code Consultants*
John Ainslie
Sean Farrell: *Prince William County*
Randy Grumbine: *Virginia Manufactured and Modular Housing Association (VAMMHA)*
Robby Dawson: *National Fire Protection Association (NFPA)*
John Walser*: Fairfax County Fire & Rescue*
Glenn Dean

Study Group Members not in attendance:

Ron Clements: *Chesterfield Building Official, member of VBCOA*
Mike Nannery: *Assistant Director of Engineering and Development for Chesterfield County Utilities*
Mike Eutsey: *First Vice President of Virginia Building and Code Officials Association (VBCOA) and Assistant Chief Building Official for Hanover County*
Reid Walters: *Town Manager of the Town of Independence*
Robbie McCraw: *Carroll County Board of Supervisors and E&L Diamond Electric, Heating, Cooling and Plumbing*
Meredith Raetz: *Planning Engineer with Virginia American Water*
Overton McGehee: *Habitat for Humanity*
Ellis McKinney: *Virginia Plumbing and Mechanical Inspectors Association (VPMIA)*

AGENDA AND DISCUSSION ITEMS:

Welcome

Jeff Brown: Agenda and documents were sent earlier to group members, and are also in the file pod. The meeting is being recorded. DHCD staff can help with any technical problems. There will be a break every hour, and an hour for lunch from 12-1 if the meeting runs that long. Only Study Group members will discuss topics in the meeting, but others are welcome to sit in and listen and contact Study Group members outside of the meeting.

Discussion

Jeff: The last meeting of this Study Group was January 11th and the meeting summary was sent out and posted shortly thereafter. One of the assignments from that meeting was to submit some samples of plans showing sprinkler system designs that the group could look at. It took some time to collect the plans, and in addition, the General Assembly was in session at the same time, making it more difficult for Study Group members to collect, submit and review documentation. There should be adequate time in this meeting to have open discussion about anything of interest that's the group would like to discuss. By the end of the meeting today, the group should have a good idea if another meeting will be needed or if everything has been covered sufficiently. Once the meetings have concluded, a report will be generated for the Board of Housing and Community Development.

Andrew Clark: Representing the Home Builders Association of Virginia (HBAV). He was not able to attend the first 2 meetings of this Study Group, however he submitted some comments to DHCD, which were sent to the group. He wants to ensure that the comments he submitted will be part of the record, even though he was not at the prior meetings in person. He does feel that there is some data lacking, which he is prepared to discuss today.

Jeff: The documents Andrew sent recently did come in a bit late, however they were forwarded to the entire group. The meeting agenda was not changed to accommodate the new materials Andrew submitted, however Andrew is welcome to address them if they are relevant to any of the topics that we are discussing, or towards the end of the meeting in the "Other" section of the agenda, if they were not already discussed during other parts of the meeting. If there is more time needed for other members to review the documents, another meeting can be scheduled to allow time to review them and continue the discussion. There have not been any official code change proposals submitted in cdpVA yet, so that is a discussion point on the agenda today. The group may want or need to meet again if there are any residential sprinkler proposals submitted, so that the group can discuss the proposals.

Keith Johnson: Andrew provided materials 18 hours prior to the meeting, which he didn't have time to review. He thinks the information that Andrew provided was already covered in the previous Study Group meetings. He thinks the materials Andrew provided are philosophical in nature, and the group has moved past that topic into actual fact finding and data. He also said that the effort of the group was not about affordable housing, but about looking at sprinklers, cost estimates and pros and cons of installing sprinklers. He said he will probably take the time to read what Andrew submitted and write something of his own in response. He's concerned that there are not enough Study Group members on the meeting with actual experience of installing sprinklers.

Jeff: The documents did come in late, so they are not on the agenda, but they have been provided to the group. Andrew is welcome to discuss any information related to the topics and present the documents he provided, as time permits. If there are any documents or information that the group needs more time to review before discussing, those topics can be continued at the next meeting.

Andrew: Speaking to Keith – his comments earlier were not made in order to be negative or to steer the discussion in any way. His group is small and trying to focus on a regulatory process at the same time as the General Assembly session has been difficult. The intent of the documents is to give the group information about the housing industry's philosophy and how they approach discussing code proposals in general and specifically about fire sprinklers. He has heard some in these types of meetings talk about the builder's profit motive. He wanted to get on the record to dispel some myths. The industry vets proposals based on data.

Jimmy Csizmadia: The documents came in late, and he hasn't read them yet. He wants to talk about the agenda items and the plans he submitted.

Jeff: The group will stick to the agenda, but any documents with merit that have been submitted should be discussed and if anyone needs additional time to review and wants to have additional discussions after their review, we can continue the discussions at the next meeting if needed. We have had other members submit documents well past the requested submittal deadline for a previous meeting and included those in the discussions.

Contractor Licensing Requirements

Jeff: This was discussed at a previous meeting and there was some question as to what licensing requirements were needed to install the different types of sprinkler systems. DHCD reached out to DPOR, and confirmed that provisions and exceptions in the DPOR licensing requirements around the plumbing contractor certification are specific to systems complying with Section P2904 of the IRC/VRC. That is the only system that can be installed by a plumbing contractor in Virginia. 13R or 13D systems cannot be installed under a plumbing contractor license.

Townhouse Sprinkler Plans

Jeff: Jimmy submitted a few sets of plans, which are included in the meeting documents. The group won't get into the details of sprinkler design, but the plans show the general layout and requirements. It should help to look at what is required for certain size rooms and what the plans would look like. Ron Clements brought this up at a previous meeting and thought it would be helpful to get an idea of what the plumbing inspector would look at, and if it would require any additional staff or other resources on his end. There are water flow calculations on the plans which should also tie into discussions about water needs. The first plan is titled "Lots 1-10 FP1".

Keith: It looks like a very large building. This should be required for sprinklers under the IBC. In Loudoun, it's hard to get answers from the sprinkler contractors; there's a lot of competition and they are not very forthcoming with plans. He spoke to an estimator from Nobel Fire Protection in MD about a local project with 30 sprinkler heads. The costs were about $3,000 for the system, $70 for the permit and $150 for the PE sealing the drawings. He noted their name and number in the documentation he supplied. He spoke with Andrew over the last few days about some of the water costs in Loudoun. A 1-inch meter is $285, a 3/4-inch meter is $240 and the connection fee for either is $7,395. These prices are on the Loudoun water website.

Andrew: Meter size was something we tried to look into. A good portion of the cost is probably the water connection fees. He appreciated the numbers provided by Keith from Loudoun. Water connection fees in some localities run from $2,300 to $18,000. Connection fees, to go up a meter size, can jump significantly. He is wondering if the plans they have for review are adaptable to a smaller meter size.

Keith: The group needs to be careful about which type of system they are referring to. A P2904 system doesn't require all the same things that a 13R requires. 13R is much more expensive. Systems built under the IRC are similar to adding other plumbing systems. 13R is not customary for residential housing, where domestic water is used. He noticed in one of the documents Andrew supplied, the estimates seemed very inflated. One estimate was using a 6-inch connection, which is way more than is needed in a residential building.

Garrett Dyer: He does think the systems should be identified in order to have a more constructive discussion.

Jeff: All of the systems discussed (13R, 13D and P2904) are options under the VRC, but most likely 13D and P2904 systems would be used. 13R is probably not going to be used as it will likely be more expensive. Most of the plans that were submitted are designed to 13D.

Andrew: Are the plans submitted for 1-inch meter size? The connection fees seem low in Loudoun, but could add significant costs in other places.

Jeff: Looking at flow rates in the sample plans could help answer questions about meter sizes required.

Jimmy: For the most part, the 13D and P2904 systems will be a 3/4-inch meter, some might be 1-inch. He sees 13D systems with 3/4-inch tie-ins from the ground to the backflow preventer then the sprinkler system branches off. If more pressure is needed, a 13D would require nothing more than a pool pump, which is about $200. The discussion is getting into the weeds. Townhouses do not require a 13R system. 13D and residential sprinklers are going to give occupants time to get out in the event of a fire. The systems are not designed to save the structure, but to prevent flash-over and give occupants time to get out of the building. These plans are not for what is put into townhouses in Prince William, they are usually installed in single-family residential occupancies. If the houses are closer than 25 ft. apart, there's a proffer that the houses get sprinklers.

Mike Poole: Understands what Jimmy and Andrew are saying. Every location isn't Loudoun County. There are active projects in many other localities and connection fees vary wildly between all of the counties. It costs about $4-5k for a connection fee in Henrico to start with. Empirical data would be good, if we can get it.

Jeff: The next set of plans is more for townhouse-style residential occupancies. There are more details on this plan which should help with the discussions.

Keith: He's confused about the direction of the conversation related to connection fees. If there's a domestic water connection for plumbing, it's already there for 13D or P2904 sprinkler systems. There is no separate connection fee. The only cost difference he thinks there might be is with a change from 5/8 to 3/4. One inch isn't required for residential occupancies. A typical 5/8-inch meter will flow 20 gallons per minute, which will operate an adequate sprinkler system in most homes. A 3/4-inch meter is not usually required, unless the flow is over 30 gallons per minute. Jeff Shapiro provided a fact sheet from the Fire Sprinkler Coalition, which was shared with the group in a previous meeting. That document had all of this information.

Andrew: Nobody is saying that there is a separate connection fee, but it would require a larger meter.

Mike: These numbers are from 2019 and can probably be double these days. Meters do have to be upgraded. This should be an empirical number that we can get our hands on.

Keith: Has any 2904 or 13D system ever needed a one inch meter?

Andrew: The numbers provided are what builders have put in. The Richmond region builders confirmed 13D. It is happening. It's not that a separate meter would be needed, but an up-sizing would be.

Keith: Wants to see the evidence. He disputes that 1-inch meter and 6-inch dedicated lines are needed. If there's a contractor who is upsizing to a 1-inch meter, evidence should be provided to the group, to discuss. Residential sprinklers are not required in Virginia. He works with a lot of Maryland contractors, who install systems every day, and do a lot of work in northern Virginia. He thinks they should rely on their data.

Andrew: That's not accurate, to say that we should base everything off of northern Virginia. People are doing it in other areas as well. The estimates given are for specific projects. Different parts of the state have different costs.

Keith: He still wants to see evidence.

Andrew: It's challenging for a builder to be part of this dialogue, because they would get beat up. Builders do go to other meetings, but they don't want to be involved in the meetings about sprinklers.

Keith: Tried to sit down with Andrew earlier, and couldn't get the time with him.

Andrew: There's a lot going on in his professional and personal life. Last time he engaged with Keith, he received a twitter barrage from all across the country. He's hesitant to engage in a conversation.

Jeff: It's been slow going because of the General Assembly session. If information is still needed, it needs to be submitted and discussed by this group. Sample sets of plans have been provided. The discussion should be around what is submitted. He doesn't want to prevent anything from being shared or discussed. It would be great if utility folks were on the call or if they could be consulted to bring back some information related to water supply and meter requirements and fees. Based on the sample plans that have been provided, they can be asked what would be required for the particular designs.

Keith: Connection fees from Fairfax are $1,430 for 5/8; $1,870 for 3/4; and $1,960 for 1 inch. Meter costs are $4,400 for 5/8; $8,800 for 3/4; $14,000 for 1 inch. There's a special note for a 13D system, which is $4,400.

Jimmy: Back to the plans. It was hard to find plans in Virginia because they're not required in Virginia. He got the plans from Maryland. He would like to see Richmond area plans. He thinks they should talk about what they have on the table now. He usually sees 3/4 meters in single family homes. Some are bringing in 1.5 inch water lines from the street. They may have a 3/4 inch meter, but they're putting in 1.5 inch into the house. The group should look at coverage area. It's a 13D system to help save occupants, not the structure. Why would anyone not want to do that?

Jeff: As far as this group looking at what is required in a P2904 sprinkler system design, he doesn't think it matters where the plans come from - Virginia or Maryland. P2904 systems would look the same. The plans will help identify what the average water supply requirements for these systems are and the group can discuss how that relates to utility requirements for meters and fees throughout the state.

Mike: There are other states besides Maryland. Most other jurisdictions don't require sprinklers. Maryland and California are early adopters. An NAHB document updated yearly shows that only a few localities require this.

Keith: Information submitted previously were from localities in other states such as Pennsylvania, Arizona and Nevada. He agrees that the group should look at other localities that have done this.

Mike: There's a difference between localities and state-wide mandates.

Jimmy: Almost everything they have been doing is 3/4-inch tie-in. The 3/4-inch meters are T110 or T10 from Prince William Water Authority. When the systems are installed, there's a 4 head flow test performed and 9 times out of 10, they get twice as much water than they need from a 3/4-inch meter.

{Break 10:10 to 10:15}

Jeff: Looking again at the plans. The second set of plans is titled "Lots 414-418". DHCD also provided specification documents for sprinkler heads that were specified in the design. The other plans provided for lots 226-232 and for lot 71 can be reviewed as well, if needed. The last set of plans submitted was for a 13R system. He asked the group which set of plans they wanted to review.

Jimmy: These plans were provided to get something on the table for the group to look at. They do a good job of laying out what would be required for a townhouse. He can answer any questions and go back to the contractor if needed. Although most of the plans do show a 1-inch meter, he has done thousands of these in Prince William County, and most are using 3/4-inch meters. There's no cost difference, besides extra piping.

Jeff: The group can continue this discussion with people from the utilities side. If information from across the state is gathered, they can assist with reviewing the meter options and determining at what point larger meters are needed. Looking at these plans, the 20-30 gallon per minute range seems average.

Jimmy: From 18-22 gallons per minute is normal. Again, most testing showed more than adequate flow, even without a separate pump. The few that did use a pump had nothing more than a pool pump, which is simple and inexpensive to install. Labor is probably the most expensive part.

Jeff: Ron Clements and VBCOA wanted to see some samples to give them an idea of what would be required for inspection and plan review. I.e. is a plan review required and can the plumbing inspectors review and inspect these systems? This discussion will be continued when other group members are available.

Jimmy: Sprinkler systems have static pressure, like a kitchen faucet turned off. There are RPZs that can be put on the systems, that would divert water to the sprinklers and shutoff all other water. It's not required, but it is another safety factor available. He doesn't see how anybody can argue to not put sprinklers in multi-family dwellings. The costs are minute, and in the big picture, it's pennies.

Keith: Residential systems only require a 2 head design, not 4. There's a difference between the water utility cost and what the contractor charges. The meter size is based on the design of the system.

Jimmy: Correct, there is a 2 head flow in 13D systems.

Jeff: There are a few more plans that can be reviewed. If there are no other questions or other discussion, this will be discussed again at the next meeting.

Andrew: If Keith or Jimmy or others want to review the materials he submitted and give their opinions or ask questions, it would be helpful. Builders will be happy to provide responses as to why something was done or clarify any confusion.

Jimmy: Would be happy to that. He hasn't had time to review the documents thoroughly yet.

Keith: Will also review the documents and send his thoughts to Andrew. He wanted to talk about incentives as part of the cost discussion. He has already provided documentation from the Home Sprinkler Coalition with examples. There are incentives in various localities, such as street width reductions, longer dead end streets, decreased turn around for fire apparatus, increased hydrant spacing, reduced access points to subdivisions, etc. These incentives should be a real cost savings to developers and should also be reflected in the final costs to home buyers.

Jeff: That would be a good discussion to have as well. It has already been touched on, and as was mentioned, there was some documentation provided prior to a previous meeting. It will be included in the final report as well.

Andrew: He is interested in the discussion about incentives, and thinks they are helpful. He does wonder how they can incorporate those incentives statewide or if they will remain one-off incentives in specific localities.

Keith: Many of the incentives are already in the statewide building code. There were several that were approved with consensus last year, although there were several others that didn't go forward. He asked if Jeff Shapiro could be a guest speaker in the Study Group to review the P2904 sprinkler system, since he has a lot of experience with the systems.

Mike: There's a difference between incentives and what's already accepted in the code. In a larger building, if he was moving from a 13R to a full 13 system, there would be an extra 25 feet of dead-end corridor length in a multi-family building, which is significant, and would result in a reduction in firewalls. It would be good to see what is actually in the code to incentivize these systems. Locality incentives would be independent of that. He would also be interested to hear what Mr. Shapiro has to say. On another note, flow issues have a lot to do with the height of the building.

Jeff: With no further discussion about plans, he moved the discussion to the cost estimate topic.

Cost estimates

Jeff: Keith submitted more recent pricing. The Virginia townhouse sprinkler survey he previously submitted is also in the file pod. He asked for discussion about costs, benefits and trade-offs, incentives, and any other specifics that are in the code. The topic can also be carried over to the next meeting if needed, in order to bring more information to the table. He put an email on the screen, showing the Nobel Fire Protection estimate which Keith referenced earlier in the meeting.

Keith: Tried to get an actual invoice, but he was not able to do so. The fire sprinkler system is not usually billed for separately.

Jeff: He agrees that it is not feasible for this group to attempt to identify or agree on what the costs will be since system designs and fees will vary greatly based on building design and location, and since the sprinklers are not required in Virginia. Anything around cost that is provided to the group will be noted in the final report, with the understanding that the data is limited at this time.

Andrew: The numbers can vary widely by region and locality. Ongoing discussion about invoices and cost estimates may not be fruitful at this point.

Keith Agrees with Andrew. He supplied a pricing sheet from Northern Virginia, updated in 2020 by Jeff Shapiro. He asked again if Jeff if Shapiro can come in for a 30 minute presentation about sprinkler systems to the group. He asked if they could have a poll of the members for support.

Andrew: Due to the differences in each locality, wouldn't the best approach be to continue adding incentives at the local level or in the code for builders or developers to install residential sprinkler systems instead of making it a requirement statewide? Builders are being pushed to add housing to the middle market, and a statewide mandate in the code would definitely add to the problem of affordability.

Keith: Local incentives can't be part of the building code. Builders can put in sprinklers now, but they probably won't if they are not required. Buyers look for esthetics in homes much more than they look for safety features such as residential sprinklers.

Mike: Agrees with Keith. International and statewide building codes attempt to make the standards less individualized, and this type of thing may be an unintended consequence of that mandate. Home buyers regularly chose the modern beautiful amenities over things like environmentally friendly or safety related items, and they always want them at no additional cost. The problem with statewide mandates is the vast differences in localities and what they can afford to do.

Andrew: Builders build to the market demand. If buyers want esthetics like hardwood floors and granite counter tops, they are not likely to want to spend additional money on sprinklers. There is not a demand for it, so why would the state then mandate it? Builders are willing to do it for those who want it.

Keith: If that was the argument, many minimum safety standards would not be in place. For example, when someone purchases a car, they don't have a choice about if they get seat belts or not; it's a minimum safety standard. Residential sprinklers have been in the IRC since 2009 and has been removed from the Virginia code. He doesn't see why, because the first thing they want to do is protect people.

Jimmy: Agrees with Keith. It's already in the international code. It all boils down to safety. There shouldn't be a cost on safety.

Mike: He has over 30 projects under construction now, and has for some time. He doesn't believe those buildings are unsafe. This discussion is about making buildings safer. It's not like talking about making a car without brakes. Every other state besides Maryland, D.C. and California have opted out of this. He wants to keep the discussion in perspective. There are probably some tradeoffs that can be discussed and agreed upon. I think you could make an argument that if you made everything a 1-hour fire-resistance-rated assembly it would actually be safer than sprinklers. As Jimmy pointed out, the sprinkler system is there to give the residents more time to get out. He is a fan of sprinklers and has built a lot of occupancies with them, but he wants to make sure that everything is considered before making a mandate across the state. There must be a reason that most states have opted out of this.

Garrett: Wants to speak about the fire services in the Commonwealth. These discussions always come to a crossroads when it comes to providing safety and the cost associated with that. Sometimes the discussions lean towards the enforcement aspects of the fire code. The approach is based on the concept of community risk reduction, which includes enforcement, design and economics. The systems are designed to get individuals out of the homes safely before flashover occurs, and they also provide safety and risk reduction for fire personnel.

Keith: There are 12 states that require residential sprinklers by statewide mandate. West Virginia also has it in their code, but they don't enforce it. He agrees with Mike that Virginia does build safe structures, and he is trying to make structures safer. When the code change was proposed last cycle, it was for sprinklers in townhomes and single family dwellings. He suggested they remove single family dwellings and just include townhomes. The proposal did not pass, by one vote. There does seem to be support for it. The higher risk for townhomes over individual units is that residents have to rely not only on their own safe practices, but also their attached neighbors. He thinks it would be good if code change passes for townhome, so that base costs can be evaluated and considered before possibly including single family homes.

Andrew: The homes being built now are safer than they were in previous decades. One question to ask is what are the characteristics of the structures where these townhome fires are occurring? The households that are cost burdened are predominantly in structures built in the 40s to the 80s. Homes built now don't have those cost burdens. Why isn't this data more on promoting fire safety in older existing structures? Is there a possibility of getting some fire safety information about older structures vs. structures built in the last 10 years? Creating a statewide mandate that would add a few thousand to maybe 15 thousand or so to the cost of housing seems haphazard.

Keith: He understands what Andrew is asking for, but the data is limited. There's currently no requirement for mandatory reporting of data to the federal system. There should be a national data fire system reporting requirement, and the new US Fire Administrator wants to do this. The buildings are being built safer, but it's not about the buildings, it's about the people and what is put into their homes. In the past, there were 11-13 minutes to escape a fire because things were made of cotton and wood. Now, with liquid gas, plastics, synthetics and trusses in the homes, there's only about 3-5 minutes to escape before flashover. Even with the best data in the world, what would be needed to say that there have been too many fires in townhomes and too many people have died?

Andrew: His point about looking at data is to prioritize efforts and see where the most impact on homeowner safety can be made. Prior to the General Assembly, he met with members of the fire services industry regarding the safety of having smoke alarms installed. Nobody is saying that action will be dependent on analyzing how many people have died.

{Break – 11:17 to 11:22}

Code Change Proposals

Jeff: The cutoff to submit proposals is May 1st. There are currently no proposals submitted in cdpVA around sprinklers in townhouses, although some have expressed an interest in putting one together. Group members are encouraged to make sure they submit any proposals by May 1st. Adjustments can still be made to submitted proposals during the June General Stakeholder Workgroup meetings, if needed. DHCD will prepare a summary report of the Study Group discussions, ahead of the June Workgroup meeting. Any proposals submitted can also be reviewed by this group and those discussions included in the report. Regarding Keith's request to provide training, it's a good idea for group members to get further training if there is an interest. He encouraged Keith to setup a meeting prior to the next Study Group meeting, if he wanted to bring in someone to provide some training, and send an invite to the group, so any interested members could participate.

Keith: Asked if Jeff Shapiro could do a presentation during a meeting of the Study Group.

Jeff: Doesn't think that would be helpful to the work of the group, however, Keith can set up a separate meeting outside of the group.

Andrew: Asked Keith what the intent of the presentation from Jeff Shapiro would be.

Keith: The design of the P2904 system and compared to a 13D system. It would be mostly about the technical design and operation aspect. It may lead to discussion of costs, including incentives that are in the code or may be added to the code.

Other

Jeff: Asked Andrew if he wanted to review the documents he submitted.

Andrew: Part of it is about home safety issues in existing vs. new homes. Another part is about cost perspective for the sake of affordability. He would be glad to address any questions offline.

Keith: Affordable housing is important and Virginia does a lot to provide incentives and grants in general. One thing he saw in a document Andrew provided, which hasn't been discussed much, is smoke alarms. He is a proponent of smoke alarms for safety, and Loudoun will install free smoke alarms for residents, which are provided by a FEMA grant. As much as he likes smoke alarms, they don't put out fires.

Andrew: He is in agreement with Keith about smoke alarms. He would like to see more dialogue between builders and fire officials to build awareness and get traction on some relatively easy things that can be done to keep fire personnel and homeowners safe.

Keith: Lastly, he wanted to remind everyone that there is a vulnerable population that needs extra consideration.

Next Steps

Jeff: Thanked everyone for their time and participation. There are still some items that could benefit form additional discussion, and there may be code change proposals related to sprinklers in townhouses submitted before May 1st, so we will plan on having another meeting. Watch for an email regarding the next meeting date in the next couple of weeks and an agenda to come out ahead of the selected meeting date.

AGENDA

Residential Sprinklers Study Group

May 17, 2022

9:00 a.m.

Virtual Meeting: https://vadhcd.adobeconnect.com/va2021cdc/

I) Welcome

II) Discussion

a) Townhouse Sprinkler Plans

b) Documents submitted by SG Member Andrew Clark:

- HBAV Comments on Virginia Specific Fire Data (1)
- HBAV Compilation of Housing Affordability Reports (final)
- Richmond Region Townhome Builder Cost Estimates and Notes
- Southwest Virginia Blacksburg Estimate

c) Documents submitted by SG Member Keith Johnson:

- HFSC Fact Sheet
- NFPA US Fire Experience with Sprinklers 2021
- NFPA US Fire Experience with Sprinklers Supporting Tables 2021
- NFPA US Fire Loss Data 2020
- NFPA US Fire Loss Trend Tables 2020

d) Other Documents and Considerations

e) Code Change Proposals:

- RB313.1-21
- RB313.1(2)-21
- RB313.1(3)-21

III) Other

IV) Next Steps

Residential Sprinklers Study Group
Meeting Summary: May 17, 2022 9:00 a.m.
Virtual Meeting: https://vadhcd.adobeconnect.com/va2021cdc/

ATTENDEES:

VA Department of Housing and Community Development (DHCD) Staff:

Jeff Brown: *State Building Codes Office Director, State Building Codes Office (SBCO)*
Richard Potts: *Code Development and Technical Support Administrator, SBCO*
Paul Messplay: *Code and Regulation Specialist, SBCO*
Florin Moldovan: *Code and Regulation Specialist, SBCO*

Study Group Members:

Andrew Clark: *Homebuilders Association of Virginia (HBAV)*
Keith Johnson: *Virginia Fire Chiefs Association (VFCA), Virginia Fire Services Board (VFSB) Vice Chair, and member of the Board of Housing and Community Development (BHCD)*
Mike Nannery: *Assistant Director of Engineering and Development for Chesterfield County Utilities*
Ron Clements: *Chesterfield County Building Official, Virginia Building and Code Officials Association (VBCOA)*
Jason Laws (Stand-In for Mike Eutsey): *Chesterfield County Deputy Building Official*; *VBCOA*
Jimmy Csizmadia: *Secretary of Virginia Fire Prevention Association (VFPA) and Inspector with the Prince William County Fire Marshal's Office*

Other Interested Parties:

Andrew Milliken: *VFCA, VFSB Chairman of Fire Codes and Standards Sub-Committee*
Jeffrey Shapiro: *International Code Consultants*
John Ainslie
Sean Farrell: *Prince William County*
Glenn Dean

Study Group Members not in attendance:
Mike Eutsey: *First Vice President of Virginia Building and Code Officials Association (VBCOA) and Assistant Chief Building Official for Hanover County*
Reid Walters: *Town Manager of the Town of Independence*
Robbie McCraw: *Carroll County Board of Supervisors and E&L Diamond Electric, Heating, Cooling and Plumbing*
Meredith Raetz: *Planning Engineer with Virginia American Water*
Overton McGehee: *Habitat for Humanity*
Ellis McKinney: *Virginia Plumbing and Mechanical Inspectors Association (VPMIA)*
Garrett Dyer: *Virginia Department of Fire Programs; State Fire Marshal's Office*
Mike Poole: *American Institute of Architect – Virginia Chapter*

AGENDA AND DISCUSSION ITEMS:

Welcome

Jeff Brown: Agenda and documents were sent earlier to Study Group members, and are also in the file pod. The meeting is being recorded. DHCD staff can help with any technical problems. There will be a break every hour, and an hour for lunch from 12-1 if the meeting runs that long. Only Study Group members will discuss topics in the meeting, but others are welcome to sit in and listen and contact Study Group members outside of the meeting.

Discussion

Townhouse Sprinkler Plans:

Staff shared a set of plans, previously submitted by Jimmy Csizmadia on the screen for the group.

Jeff: Explained the at the first couple of items on the agenda (townhouse sprinkler plans and documents submitted by Andrew Clark) were continued form the last meeting. Opens the floor for comments.

Keith Johnson: Sprinkler systems being allowed to use a single pipe in a row of townhouses is a huge benefit. Not having to install a window well is a huge cost savings. When you look at these plans, these aren't the only way to do business. There are lots of tradeoffs that can be done when looking at the installation of a sprinkler system. It's very hard to get plans from the sprinkler contractors since there's so much competition.

Andrew Clark: Asks Jeff Shapiro to send out his presentation that presented to interested group members prior to today's meeting. Some of these plans include 1" water meters and costs from localities for upsizing to a 1" meter is costly. These plans validate some of the concerns about the key driver of costs, which are water connection fees and meter fees. The incentives mentioned for developers are great, but they are outside the scope of the building code. Thanks, Jeff Shapiro, for the presentation.

Keith: The cost in Loudon County to upsize to a 1" meter is not expensive at all.

Andrew: I compiled costs from localities. We found places like Henrico got up to $17,000 when you move up to a 1" meter. Chesterfield went up to $14,000. This is one of those rare incidences where Loudon is on the low-end of the cost spectrum. To Keith's point, it does run the gamut, but it does jump up significantly in some localities.

Documents submitted by SG Member Andrew Clark:

Jeff: Turns the floor over to Andrew to provide any comments on the documents he submitted.

Andrew: What I attempted to do in these documents is show how the industry approaches not only sprinklers but building codes in general. The data here is fascinating, which has been done by the general assembly. On Page 6 you'll see a number of households where housing is a cost burden, which is the threshold where housing costs become unsustainable. Nearly 30% of households are facing those cost burdens. On page 8 you'll see a table that shows the median home sales prices increasing. We're seeing a crisis where people can't afford houses. When we're approaching codes, we try to find a balance of costs and try and fit it into a bigger picture. We pulled these documents together to show some insight. This isn't anything to do with profit. These are costs passed on to the consumer. I know we'll probably disagree on the code proposals but it's at least important to know where folks are coming from. The first document is related to fire data. It's important to support the department of fire programs to help pull together all of these essential data points from localities to find where the pain points are so we can evaluate that as a committee or as the Board of Housing every time we have a code cycle to really prioritize our initiatives and figure out what are the best ways to tackle the problems that we're seeing in VA. That's outside of this discussion but hopefully this information is helpful.

Keith Johnson: What Andrew is saying regarding affordable housing was forefront at the BHCD retreat and meeting last week, and I agree that we should look toward affordable housing to not price any homebuyer out of the market. I don't think you can blame the fire services for those costs. My ask was to look for affordable safe housing. It's the charge of fire and building codes. If I, as a fire chief, have a way to prevent injuries and deaths to civilians and firefighters, that's my charge. That's what I'm going to do. I can't put a price on a life or an injury. What I will offer is that the incentives offered by the building codes will help offset the cost of these systems. The ultimate goal is to not cost anything more for these systems and I think we can get there through the incentives and some of the insurance and tax credits for these systems.

Andrew: Would anyone from the fire services side agree that the development incentives are outside of the building code and are local-driven?

Keith: We mentioned the developer cost savings vs the building cost savings and many times those are the same entity. Those incentives are built into the building codes now, so there's nothing we need to do to put them in the code. I always get confused when we talk about costs because if we are saving money for the developer, certainly the builder is going to pay less because of the development process and ultimately the consumer will pay less.

Andrew: The land development side incentives are options provided by the locality, correct? I get that there are some references to them in the code, but there's nothing that requires, say, Halifax County to provide development incentives for a developer for residential sprinklers. Reduction in street widths, connectivity requirements, all of which would be beneficial, but none of that is required. That's purely at the discretion at the local gov't.

Documents submitted by SG Member Keith Johnson:

Jeff: Turns the floor over to Keith to provide comments on the documents he provided.

Keith: Just a couple of things. The HFSC Fact Sheet complements the NFPA documents I provided. I don't need to go through the benefits of sprinklers since everyone agrees on the benefits, so I'll focus on costs. Things have changed since the early 80's. Lumber is different, furnishings in the home are different. Residents have less than 2 minutes to get out of a house in the event of a fire. When sprinklers are present, 96% of fires are kept in the room of origin. Sprinklers aren't designed to totally put the fire out, but they are designed to get civilians out of homes. There's also data that shows that homebuyers, especially millennials who make up 80% of homebuyers, want sprinklers in their homes once they learn about them, but builders aren't offering them. There are two different documents I'd encourage the group to focus on: US Fire Experience with Sprinklers and US Fire Loss Data. From 2015-2019 sprinklers operating in home fires contained 96% of fires to the area of origin. The data that's all provided goes into great detail in the reduction of fires civilian injury and death, and firefighter injury and death.

Jimmy: Wants to go on the record stating that the presentation from Jeff Shapiro this morning was great and the documents provided by Keith are great.

Keith: To touch on Andrew's incentives question earlier. The incentives are built into the code so aren't the localities providing those incentives? How can a locality deny that?

Ron Clements: We need to separate the building code incentives from the site work incentives. The way the fire prevention code is set up, in section 503, that's the only provision I can find for building code incentives, which isn't' to say there aren't others, but section 503.1.1 does allow an exception to the maximum distance a building can be from the fire apparatus road when an NFPA 13d or 13r system is provided in a building. The problem is, if you look at 503.1, the first exception allows the locality to have their own access road requirements, which they may not allow those exceptions. And Ch. 1 of the fire prevention code allows localities to have more restrictive ordinances. It may be a worthy conversation to have to look into that. Is there more that could be done on the site side? Should there be some limitation put into Title 27 with regard to localities overriding the fire prevention code with more restrictive requirements.

Keith: Also references 507.5.1.2 for incentives.

Jimmy: The problem is with the developers – they want to put as many homes as possible in a given area.

Ron: Just to clarify what I meant by the exception. I do not see any such exception in 507 similar to 503 that allows a local written policy to override these sections. The broader point is in 101.5, which allows a locality to override the requirements of the fire prevention code via local amendment. It may be worth looking at this at the statutory level to prohibit removing sprinkler incentives in local regulations.

Jeff: The regs do say the localities can do something more restrictive. When dealing with things like fire roads and fire hydrants, which are outside the scope of construction, the localities could do something with those. If we want to guarantee these tradeoffs should be made available to everyone, that's something we should look at further.

Other Documents and Considerations

Code Change Proposals:

Jeff: The three proposals have been submitted in cdpVA and will be discussed at the June General Stakeholder Workgroup meetings. Since they are related to townhouse sprinkler systems, we wanted this group to have an opportunity to discuss them today, ahead of the June meetings, so we can capture any comments in the study group report. We will look at each of these and see if there's any thought or discussion surrounding them. If you see something you really like, we can look into the study group supporting it. We will allow code change proponents to provide an overview of their proposal and answer related questions from study group members.

RB313.1-21 – Andrew Milliken

Andrew M.: Provides an overview of the proposal, which requires automatic fire sprinkler systems in townhouses.

Andrew Clark: When we started this initial conversation, and Keith has mentioned it on several occasions, our focus was going to be only on townhouses. Now, we have proposals for townhomes and single-family homes - I thought the intent of this workgroup was to focus on townhomes.

Keith: All three proposals cover townhomes, but Glenn Dean's also covers single-family homes. When you look at the different types of systems, the code allows them to be installed in accordance with P2904, 13D, or 13R. So that's up to the builder.

Andrew Clark: Maybe we can pull up the meeting minutes from one of our prior discussions, but I thought the comment was made that there was no point in having a conversation about 13R.

Jeff: This is just intended to be an opportunity for this group to look at and discuss these residential sprinkler proposals that were submitted in cdpVA by individuals that are not part of this study group. If a member does not want to support a proposal because they feel it is outside of the scope, they are welcome to do that.

Keith: I would be fine recommending disapproval for proposals that deal with single-family homes and having the focus of the group being only townhomes.

Jeff: Asks the group how they want to proceed with proposals that reference single-family homes.

Keith: Fine with removing single-family dwelling discussions.

Andrew Clark: We can make it clear that the group did not discuss single-family and two-family system design. Or we move the single-family proposals as consensus for disapproval. This was a workgroup for townhomes and here we are covering the entire gamut of houses.

Jeff: We do not expect an official recommendation on these proposals from this group. Our thought is to collect comments on these proposals from this group to provide to the Board. If we feel like we do have complete consensus and we want to shift gears and make a recommendation we can do that, but the intent was never to make a recommendation. The intent is only to collect comments to provide to the Board.

Andrew Clark: I'm good with that. I'll respect the process. If the workgroup will not make a formal recommendation, then I'm good with that. I'll let the proponents figure out how they want to handle their individual proposals.

Andrew Milliken: Just to clarify. This proposal does not change or modify anything with regard to P2904, 13D or 13R. That's existing

language not being changed by this proposal. That's good feedback if there's a desire to limit it to P2904 and 13D systems.
Keith: In the spirit of collaboration, I agree with Andrew Clark 100%. This workgroup has not spoken about and will not be speaking about residential sprinkler systems in residential single-family homes. We are focusing on P2904 and 13D systems. 13R is existing language.
Jeff: Staff will capture everyone's thoughts on that and will be clear on that in the report. We will have the group review it and provide any feedback or needed corrections. We will get that report drafted and sent out to the group as soon as we can to give everyone 4 or 5 days to review it and provide comments.
Jimmy: I agree with excluding residential single-family homes. Andrew, I think the biggest thing here is that there are townhouses now that require a 13R system. That's why the NFPA standards are there. Once you get above 3 stories, it's got to be a 13R system.
Andrew Clark: If the 13R system language is in there, could a locality require the home be built to that standard?
Jimmy: We can't arbitrarily pick which system we want the builder to use. It's based on the design of the building. We can't force a builder to use a 13R system.
Ron Clements: The permit applicant or the designer would choose which system to use. The code official does not have the authority to pick the system.
Mike Nannery: My recollection for the task of the workgroup is to focus on townhouses, not single-family homes.

RB313.1(2)-21 – Glenn Dean

Jeff: Opens the floor to Glenn Dean

Glenn: Given the discussions so far, no further comments at this time.

RB313.1(3)-21 – Jeff Shapiro

Jeff Brown: Opens the floor to Jeff Shapiro.

Jeff Shapiro: Would like to bring up a couple of points. The terminology used in VA – I'm not sure why you vary from the model code. Model code language is "automatic sprinkler system" instead of "automatic residential fire sprinkler system." I would like to point out that the model codes do not include NFPA 13 or 13R. When I submitted my proposal last cycle, I was told that I had to include NFPA 13 and 13R. I think it would be better to remove 13 and 13R. My proposal here is a bit different than Andrew's. I looked at the approach taken in Washington State, which over the course of two cycles eventually passed a statewide requirement for townhouses to be fully sprinklered. My proposal provides an exception to only require townhouses to be sprinklered when they are over three townhouse units to accommodate smaller builders in rural areas. My desire was to provide an option to build townhouses without sprinklers up to three units.

Andrew Clark: Has the department of fire programs weighed in on these proposals? Do they support one over the other? Are they neutral?

Keith: No, the codes and standards committee is meeting today so they will be looking at them today.

Andrew Clark: So that is the Board, correct? But what about the department?

Keith: The department itself? No. The Fire Services Board is a part of the Department of Fire Programs and the Codes and Standards Committee is a part of the Fire Services Board. And I just wanted to comment on Jeff's proposal that the nuances of Virginia's code and the model codes are interesting and I appreciate those being brought up. The exception in the proposal for more than three townhomes is another example of trying to get consensus between all of the stakeholders. I don't know what else we can do to try and improve the civilian safety, firefighter safety, and building safety in our communities.

Andrew Clark: It would be nice to figure out what the position of the Fire Services Board is. I don't know what we do about the group expanding its scope beyond its original intent from focusing to townhomes to include single-family homes.

Keith Johnson: The VFCA is in support of both Andrew Milliken's proposal and Jeff Shapiro's proposal.

Andrew Clark: Asks staff to send him the audio and minutes from the previous meeting to review comments by Keith Johnson regarding 13R systems.

Jeff Brown: It seems like there is consensus from the group to remove 13 and 13R systems from the proposals. What does everyone think about that?

Keith: Can we ask the proponents of both code proposals if they are okay with that?

Jeff Brown: Yes. Andrew Clark, would that help with some of your concerns if the proponents did that?

Andrew Clark: Yes, it would certainly bring us consistent with the intent of the workgroup. I'd ask to strike the one and two-family language as well.

Jeff Brown: Andrew Milliken, would you be comfortable suggesting that floor amendment when we get to June on your proposal?

Andrew Milliken: Sure, I would have no objection to that.

Jeff Brown: Jeff Shapiro, are you in agreement with suggesting that floor amendment in June?

Jeff Shapiro: Actually, it would be best to just strike Virginia's amendment to get us back to the model code. It should be done in townhouses and one- and two-family dwellings.

Jeff Brown: Basically, what we are recommending is taking R313.1.1 and reverting it to the model language: "Automatic sprinkler systems for townhouses shall be designed and installed in accordance with Section P2904 or NFPA 13D." Andrew Milliken are you good with that for your proposal, as well?

Andrew Milliken: Yes.

Jeff Brown: We will get those floor amendments in a document based on discussions from the study group. I know Andrew Clark had concerns with one- and two-family dwellings in Glenn Dean's proposal, but he's not here right now so we can't ask him for a friendly amendment. Andrew Clark, we will capture your comments regarding the scope and intent of the study group.

Keith Johnson: I'm happy to meet with Andrew Clark and Glenn Dean to discuss removing that part from his proposal.

Other

Andrew Clark: I should know this, but are the June workgroup meetings in person, virtual, or hybrid?

Jeff Brown: They will be virtual

Andrew Clark: Alright, and there's opportunity from anyone from the public to speak on any of the proposals that are submitted or should folks submit public comment prior to that through cdp? How do you anticipate comments during that meeting?

Jeff Brown: Those will be open to anyone who wants to attend. We will always accept written comments via email. If there are comments in cdp VA before the agenda goes out, we will include those.

Andrew Clark: Thanks DHCD staff for all the work they do.

Jeff Shapiro: Wants to know the end time for the general workgroup meetings?

Jeff Brown: So far, we've just gone through the items on the agenda and some have been completed in a few hours. We typically try to wrap up around 3pm. It will not go past 5pm. If we have to end for the day without addressing everything on the agenda, we will take care of those at another date. I'd say mark your calendar to at least 3pm and 5pm at the latest.

APPENDIX B: Study Group Members

RESIDENTIAL SPRINKLERS

Study Group Members

Mike Eutsey - Virginia Building and Code Officials Association

Ron Clements - Virginia Building and Code Officials Association

Ellis McKinney - Virginia Plumbing and Mechanical Inspectors Association

Jimmy Csizmadia - Virginia Fire Prevention Association

Garrett Dyer - Virginia Department of Fire Programs/State Fire Marshal's Office

Keith Johnson – Virginia Fire Chiefs Association

Andrew Clark – Home Builders Association of Virginia

Mike Poole – American Institute of Architects - VA Chapter

Overton McGehee – Habitat for Humanity

Reid Walters - Local Government - General

Robbie McCraw - Local Government - Elected Official

Meredith Raetz - Private Water Provider

Mike Nannery - Local Utility Department

APPENDIX C: Supporting Documentation


VIRGINIA DHCD
VIRGINIA DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
Partners for Better Communities

Residential Sprinklers Study Group

December 15, 2021 Meeting

2021 Code Development Cycle

VIRGINIA DHCD

DHCD staff

Cindy Davis, Deputy Director of Building and Fire Regulations

Jeff Brown, State Building Codes Office Director

Richard Potts, Code Development and Technical Support Administrator

Florin Moldovan, Code & Regulation Specialist

Paul Messplay, Code & Regulation Specialist

Jeanette Campbell, Administrative Assistant

Study Group members

- Mike Eutsey - VBCOA
- Ellis McKinney - VPMIA
- Jimmy Csizmadia - VFPA
- Garrett Dyer - VDFP
- Mike Poole - AIA Virginia
- Overton McGehee - Habitat for Humanity
- Reid Walters - Town of Independence
- Robbie McCraw - Carroll County
- Mike Nannery - Chesterfield County
- Meredith Raetz - American Water
- Andrew Clark - HBAV

2021 code development cycle (tentative dates)

October 1st cdpVA was opened for submission on code change proposals for the 2021 Code Development Cycle

November 2021: Notices of Intended Regulatory Action (NOIRAs) Published

December 2021: Study Groups begin meeting

February 2022: Sub-Workgroups begin meeting

March-June 2022: Stakeholder Workgroup meetings

September 2022: BHCD meets to consider proposals

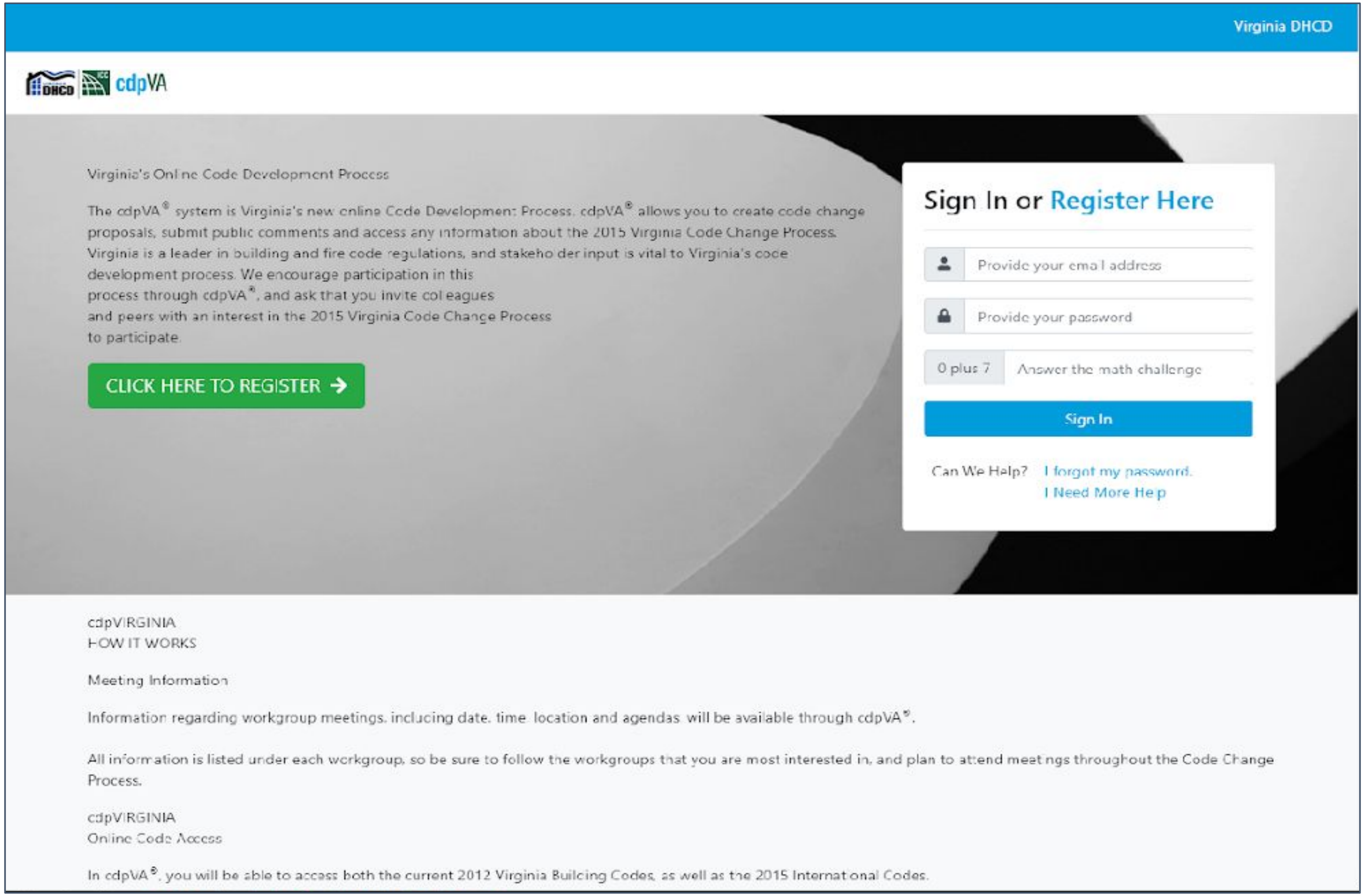
December 2022: BHCD considers proposed regulations

Fall/Winter 2023 = 2021 Virginia Codes Effective (Tentative)

cdpVA

va.cdpaccess.com

Virginia's online code development System (cdpVA)



Study Groups

- Study specific topics that require additional review and discussion
- Identify areas of consensus and disagreement
- Determine if code change proposals or other solutions are appropriate
- May review proposals, provide analysis, make recommendations, and/or develop code change proposals
- Proposals and recommendations of Study Groups are reviewed by the General Workgroups prior to BHCD consideration

Sub-workgroups

- Review all code change proposals within their subject topics, prior to the proposals being considered by the General Workgroups
- Make recommendations on each proposal, including negotiating compromises where appropriate
- May also develop new code change proposals, or support proposals submitted by others by joining the proposal as a proponent

General Stakeholder Workgroups

- All meetings are open to attendance and participation by anyone
- Review and discuss all submitted code change proposals, including all proposals and recommendations from Study Groups and Sub-Workgroups
- A workgroup recommendation is determined for each proposal and the recommendation is provided to the Board of Housing and Community Development
- Workgroup recommendations are classified as follows:

Consensus for Approval: No workgroup participant expressed opposition to the proposal

Consensus for Disapproval: Any workgroup participant expressed opposition to the proposal and no workgroup participant, other than the proponent, expressed support for the proposal.

Non-Consensus: Any workgroup participant expressed opposition to the proposal

Access to codes

codes.iccsafe.org/codes/virginia

Free Online Access to Virginia and ICC Code books!

History

International Residential Code	Virginia Residential Code
2006: Appendix P “Fire Sprinkler System” contains provisions for the installation of fire sprinkler systems in dwellings covered by the IRC. The Appendix is not mandatory unless specifically referenced in the adopting ordinance.	**2006:** No significant changes (IRC appendix not incorporated)
2009: Section 313 “Automatic Fire Sprinkler Systems” mandates the installation of an automatic fire sprinkler system in townhouses and one and two-family dwellings. The system is to be designed and installed in accordance with Section P2904 or NFPA 13D.	**2009:** Amends Section R313 of the 2009 IRC to make the installation of sprinkler systems optional. Section R329 “Fire Extinguishers” is added, which mandates the installation of a fire extinguisher with a rating of 2-A:10-B:C in the kitchen area, if the dwelling is not equipped with an automatic fire sprinkler system.

History

International Residential Code	Virginia Residential Code
2012: No significant changes	**2012:** No significant changes
2015: Allows NFPA 13D standard to be complied with for the design and installation of systems in townhouses (Section 2904 remains one of the options available). This change brings the townhouse requirements in line with those for one- and two-family dwellings.	**2015:** No significant changes
2018: No significant changes	**2018:** No significant changes

2018 code development cycle

During the 2018 Code Development Cycle, the Board of Housing and Community Development (BHCD) approved the following proposals, related to sprinkler systems, for inclusion in the 2018 VRC:

- **RB302.2.2-18** – allows water-filled fire sprinkler piping in cavity of common walls shared by townhouses.

- **RB302.2.6-18** – exempts townhouses protected by a fire sprinkler system complying with Section P2904, NFPA 13, NFPA 13R or NFPA 13D, from the structural independence requirement.

2018 code development cycle

The BHCD also considered the following proposals, to require sprinkler system installation in both townhouses and one- and two-family dwellings.

- **RB310.11-18** Disapproved

- **RB313.1-18** Disapproved

The BHCD also determined that additional discussions were needed and directed DHCD staff to convene a group of interested stakeholders to continue the discussions during the 2021 Code Development Cycle.

Townhouses and One- and Two-family Dwellings

Automatic fire sprinkler systems are optional

Where installed, automatic fire sprinkler systems can be designed and installed in accordance with:

- NFPA 13
- NFPA 13R
- NFPA 13D or
- VRC Section P2904

Other states

Sprinklers required in all new townhouses and one- and two-family dwellings:

- California
- Maryland
- Washington DC

Sprinklers required in some (based on size /height) townhouses and one- and two-family dwellings:

- New York
- Massachusetts

Approximately 20 states allow local jurisdictions to mandate the installation of sprinklers in townhouses and one- and two-family dwellings

Data Source: NFPA and HBAV

Study group objectives

- Gather information and data for review and discussion
- Identify areas of agreement and/or disagreement
- Summarize findings or recommendations
- Review any related proposals submitted during the 2021 cycle

Discussion topics

Important discussion topics (future meetings):

- Safety impact of residential sprinklers
- Cost(s) of residential sprinklers
- Cost impact of residential sprinklers
- Other?

Assignments/homework

Prior to the next meeting, please:

- **Reach out to other members and/or DHCD staff with any questions related to information discussed today**

- **Identify areas of interest or concern that you would like to discuss at the next meeting** (Provide to DHCD by December 27th)

- **Identify and provide helpful/relevant information (reports, data, etc.) for the group to review** (Provide to DHCD by December 27th)

Note: If any member wants to share information with the group between meetings, please send it to DHCD staff and we will distribute it to our email list to make sure we do not miss any interested parties that might be added to our list as we go along.

Next meeting

Next Meeting (Virtual)

January 11, 2021

9:00 am - 3:00 pm

(lunch break 12:00 pm -1:00 pm)

Link: https://vadhcd.adobeconnect.com/va2021cdc/

Division of Building and Fire Regulations

State Building Codes Office

sbco@dhcd.virginia.gov

804-371-7150

RB302.2.2-18

IRC®: R302.2.2, R302.4.1, R302.4.2

Proponents: Jeffrey Shapiro (jeff.shapiro@intlcodeconsultants.com)

2018 International Residential Code

Revise as follows:

R302.2.2 Common walls.. Common walls separating *townhouses* shall be assigned a fire-resistance rating in accordance with Item 1 or 2. The common wall shared by two *townhouses* shall be constructed without plumbing or mechanical equipment, ducts or vents ~~in~~ , other than water-filled fire sprinkler piping, in the cavity of the common wall. The wall shall be rated for fire exposure from both sides and shall extend to and be tight against exterior walls and the underside of the roof sheathing. Electrical installations shall be in accordance with Chapters 34 through 43. Penetrations of the membrane of common walls for electrical outlet boxes shall be in accordance with Section R302.4.

1. Where a fire sprinkler system in accordance with Section P2904 is provided, the common wall shall be not less than a 1-hour fire-resistance-rated wall assembly tested in accordance with ASTM E119, UL 263 or Section 703.3 of the International Building Code.
2. Where a fire sprinkler system in accordance with Section P2904 is not provided, the common wall shall be not less than a 2-hour fire-resistance-rated wall assembly tested in accordance with ASTM E119, UL 263 or Section 703.3 of the International Building Code.

R302.4.1 Through penetrations.. Through penetrations of fire-resistance-rated wall or floor assemblies shall comply with Section R302.4.1.1 or R302.4.1.2.
~~**Exception:**~~ **Exceptions:**

1. Where the penetrating items are steel, ferrous or copper pipes, tubes or conduits, the annular space shall be protected as follows:

~~1.~~ 1.1 In concrete or masonry wall or floor assemblies, concrete, grout or mortar shall be permitted where installed to the full thickness of the wall or floor assembly or the thickness required to maintain the fire-resistance rating, provided that both of the following are complied with:

~~1.1.~~

1.1.1. The nominal diameter of the penetrating item is not more than 6 inches (152 mm).

~~1.2.~~ 1.1.2. The area of the opening through the wall does not exceed 144 square inches (92 900 mm2).

~~2.~~ 1.2. The material used to fill the annular space shall prevent the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E119 or UL 263 time temperature fire conditions under a positive pressure differential of not less than 0.01 inch of water (3 Pa) at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated.

2. The annular space created by the penetration of water-filled fire sprinkler piping, provided the annular space is filled using a material complying with Exception 1.2 above.

R302.4.2 Membrane penetrations.. Membrane penetrations shall comply with Section R302.4.1. Where walls are required to have a fire-resistance rating, recessed fixtures shall be installed so that the required fire-resistance rating will not be reduced.
Exceptions:

1. Membrane penetrations of not more than 2-hour fire-resistance-rated walls and partitions by steel electrical boxes that do not exceed 16 square inches (0.0103 m2) in area provided that the aggregate area of the openings through the membrane does not exceed 100 square inches (0.0645 m2) in any 100 square feet (9.29 m2) of wall area. The annular space between the wall membrane and the box shall not exceed 1/8 inch (3.1 mm). Such boxes on opposite sides of the wall shall be separated by one of the following:

1.1. By a horizontal distance of not less than 24 inches (610 mm) where the wall or partition is constructed with individual noncommunicating stud cavities.
1.2. By a horizontal distance of not less than the depth of the wall cavity where the wall cavity is filled with cellulose loose-fill, rockwool or slag mineral wool insulation.
1.3. By solid fireblocking in accordance with Section R302.11.
1.4. By protecting both boxes with listed putty pads.
1.5. By other listed materials and methods.

2. Membrane penetrations by listed electrical boxes of any materials provided that the boxes have been tested for use in fire-resistance-rated

assemblies and are installed in accordance with the instructions included in the listing. The annular space between the wall membrane and the box shall not exceed 1/8 inch (3.1 mm) unless listed otherwise. Such boxes on opposite sides of the wall shall be separated by one of the following:

2.1. By the horizontal distance specified in the listing of the electrical boxes.
2.2. By solid fireblocking in accordance with Section R302.11.
2.3. By protecting both boxes with listed putty pads.
2.4. By other listed materials and methods.

3. The annular space created by the penetration of a fire sprinkler <u>or water-filled fire sprinkler piping,</u> provided that <u>the annular space is</u> covered by a metal escutcheon plate.
4. Ceiling membrane penetrations by listed luminaires or by luminaires protected with listed materials that have been tested for use in fire-resistance-rated assemblies and are installed in accordance with the instructions included in the listing.

Reason Statement: Allowing common fire sprinkler piping to protect multiple units in a townhouse can significantly reduce installation costs, and the IBC now allows penetration of townhouse separation walls in any townhouse that does not exceed the height and area limits. For reference, IBC Section 706.1.1, Exception 2 states: *Fire walls are not required on lot lines dividing a building for ownership purposes where the aggregate height and area of the portions of the building located on both sides of the lot line do not exceed the maximum height and area requirements of this code. For the code official's review and approval, he or she shall be provided with copies of dedicated access easements and contractual agreements that permit the owners of portions of the building located on either side of the lot line access to the other side for purposes of maintaining fire and life safety systems necessary for the operation of the building.* It makes no sense for the IRC to be more restrictive than the IBC with respect to allowing penetration of sprinkler piping through townhouse separation walls.
This proposal limits application of the proposed sprinkler penetration allowance to water-filled pipes. Although plastic pipe has been listed for dry residential sprinkler applications, use of those systems is not common enough to warrant arguing the point and missing this opportunity for progress with wet-pipe systems. Use of this allowance will require following the already recognized/tested method (in the current exception) for protecting annular spaces surrounding through penetrations. With that increased level of protection, a fire could only pass the membrane by melting the pipe and causing water to leak, which would inherently protect the opening. Flame would be stopped at the barrier.

Additionally, water-filled sprinkler pipes will be allowed in common walls. This option provides for improved sprinkler designs for townhouses by allowing sidewall sprinklers to be deployed from common walls, which unlike exterior walls, are not exposed to freezing exterior conditions. By using sidewall sprinklers to protect the top floor instead of pendent sprinklers in the ceiling, sprinkler piping can be kept out of attics, which are subject to freezing.

This change was processed as Item RB67-19 and has been approved by ICC for inclusion in the 2021 IRC. It was Approved as Modified by PC1 by the ICC membership.

Resiliency Impact Statement: This proposal will increase Resiliency
The reduced cost of installing fire sprinkler systems associated with this proposal and the allowance to run piping through and in interior walls separating townhouses will increase system reliability and performance.

Cost Impact: The code change proposal will decrease the cost of construction
The allowance for sprinkler piping to penetrate townhouse separation walls will reduce the infrastructure required to install a fire sprinkler system in some cases by allowing a shared feed for multiple units.

RB302.2.6-18

IRC®: R302.2.6

Proponents: Jeffrey Shapiro (jeff.shapiro@intlcodeconsultants.com)

2018 International Residential Code

Revise as follows:

R302.2.6 Structural independence.. Each individual *townhouse* shall be structurally independent.

Exceptions:

1. Foundations supporting *exterior walls* or common walls.
2. Structural roof and wall sheathing from each unit fastened to the common wall framing.
3. Nonstructural wall and roof coverings.
4. Flashing at termination of roof covering over common wall.
5. *Townhouses* separated by a common wall as provided in Section R302.2.2, Item 1 or 2.
6. Townhouses protected by a fire sprinkler system complying with Section P2904, NFPA 13, NFPA 13R or NFPA 13D.

Reason Statement: The IBC now allows townhouses to be built without structural independence provided that height and area limits for the overall townhouse building are not exceeded. This is true because the firewall requirement to separate units is no longer applicable in such cases. Therefore, only the 1-hour dwelling unit requirement applies, and that assembly is a fire barrier, which has no structural independence requirement. For reference IBC Section 706.1.1, Exception 2 states: Fire walls are not required on lot lines dividing a building for ownership purposes where the aggregate height and area of the portions of the building located on both sides of the lot line do not exceed the maximum height and area requirements of this code. For the code official's review and approval, he or she shall be provided with copies of dedicated access easements and contractual agreements that permit the owners of portions of the building located on either side of the lot line access to the other side for purposes of maintaining fire and life safety systems necessary for the operation of the building.
It makes no sense for the IRC to be more restrictive than the IBC with respect to requiring structural independence when townhouses are sprinklered.

This change was processed as Item RB60-19 and has been approved by ICC for inclusion in the 2021 IRC. It was Approved as Submitted by the code development committee and that action was sustained by the ICC membership.

Resiliency Impact Statement: This proposal will neither increase nor decrease Resiliency

Cost Impact: The code change proposal will decrease the cost of construction
Construction costs are reduced, consistent with the IBC, based on the allowance to not require structural independence of townhouse units.

RB302.3(1)-18

IRC®: R302.3, NFPA Chapter 44

Proponents: Jeffrey Shapiro (jeff.shapiro@intlcodeconsultants.com)

2018 International Residential Code

Revise as follows:

R302.3 Two-family dwellings.. *Dwelling units* in two-family dwellings shall be separated from each other by wall and floor assemblies having not less than a 1-hour fire-resistance rating where tested in accordance with ASTM E119, UL 263 or Section 703.3 of the International Building Code. Fire-resistance-rated floor/ceiling and wall assemblies shall extend to and be tight against the *exterior wall*, and wall assemblies shall extend from the foundation to the underside of the roof sheathing.

Exceptions:

1. 1. A fire-resistance rating of 1/2 hour shall be permitted in buildings equipped throughout with an automatic sprinkler system installed in accordance with NFPA 13, <u>NFPA 13R or Section P2904</u>.
2. Wall assemblies need not extend through attic spaces where the ceiling is protected by not less than 5/8-inch (15.9 mm) Type X gypsum board, an attic draft stop constructed as specified in Section R302.12.1 is provided aboveand along the wall assembly separating the dwellings and the structural framing supporting the ceiling is protected by not less than 1/2-inch (12.7 mm) gypsum board or equivalent.

NFPA

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471

~~13—16~~ ~~Standard for Installation of Sprinkler Systems~~

Reason Statement: The current exception will never be used because the cost of installing a full NFPA 13 system (typically associated with commercial structures) in a duplex will far outweigh savings associated with reducing the separation wall rating from one-hour to 30 minutes. From a parity perspective, it makes no sense to allow Section P2904 (equivalent of NFPA 13D) protection as a basis for reducing townhouse separations but require NFPA 13 for duplexes.
Perhaps the logic associated with the current provision was intending to gain sprinkler protection in the attic (which would typically be required by NFPA 13) as a basis of qualifying for the reduced fire rating. But, townhouse separations are allowed to be reduced in unsprinklered attics of sprinklered townhouses, recognizing that the vast majority of residential fires start in occupied spaces, where sprinklers are present to control a fire before extension into the attic. True, a reduced townhouse separation maintains a one-hour rating, versus 30 minutes in a duplex, but 30 minutes is still a sufficient separation rating to accommodate fire department response and setup at a duplex.

Note that IRC Section R313 only requires NFPA 13D for duplexes, so this change will align with Section R313. Also, the reference to NFPA 13 is proposed for deletion since this is the only place in the IRC where that standard is referenced.

This change was processed as Item RB64-19 and has been approved by ICC for inclusion in the 2021 IRC. It was Approved as Modified by the code development committee (as reflected in this proposal) and no public comments were submitted.

Resiliency Impact Statement: This proposal will neither increase nor decrease Resiliency

Cost Impact: The code change proposal will decrease the cost of construction
This change will allow a reduction from an NFPA 13 sprinkler system to an residential sprinkler system as a basis for reducing the fire rating of duplex separation walls.

RB310.11-18

VCC: 310.11

Proponents: Glenn Dean (gad.pompier@gmail.com)

2015 Virginia Construction Code

Revise as follows:

310.11 Amendments to the IRC.. The following changes shall be made to the IRC for its use as part of this code:
(DHCD Note: The changes to the IRC are available in the Virginia Residential Code published by ICC, or the pamphlet form of the VCC published by DHCD. They are not included in this printing of the VCC.)

Section R313

Automatic Fire Sprinkler Systems

R313.1 Townhouse automatic fire sprinkler systems. ~~Notwithstanding the requirements of Section 103.3, where installed, an automatic residential fire sprinkler system for townhouses shall be designed and installed in accordance with NFPA 13D or Section P2904.~~ An automatic residential fire sprinkler system shall be installed in townhouses.

Exception: An automatic residential fire sprinkler system shall not be required when additions or alterations are made to existing townhouses that do not have an automatic residential fire sprinkler system installed.

R313.1.1 Design and installation. Automatic residential fire sprinkler systems for townhouses shall be designed and installed in accordance with Section P2904 or NFPA 13D.

R313.2 One-family and two-family dwellings automatic fire sprinkler systems. ~~Notwithstanding the requirements of Section 103.3, where installed, an automatic residential fire sprinkler system shall be designed and installed in accordance with NFPA 13D or Section P2904.~~ An automatic residential fire sprinkler system shall be installed in one- and two-family dwellings.

Exception: An automatic residential fire sprinkler system shall not be required for additions or alterations to existing buildings that are not already provided with an automatic residential fire sprinkler system.

R313.2.1 Design and installation. Automatic residential fire sprinkler systems shall be designed and installed in accordance with Section P2904 or NFPA 13D.

Reason Statement: The facts supporting the requirement to install automatic fire sprinkler systems in townhouses and 1&2 family dwellings have not fundamentally changed over the past decade although they are stronger now than before. By the same token, the argument against requiring sprinklers is fundamentally the same, just somewhat weaker given the national expansion of them being required along with technical improvements, consumer, builder and local official's increased knowledge.

Attached is an article published online by Forbes dated August 3, 2019. It provides a concise overview of why fire sprinklers should be required in all newly constructed housing. (I've hi-lited a few important points.) In concert with the attachment, I urge watching a 10-minute video on YouTube (https://www.youtube.com/watch?v=OiHqRJVChlQ) that expands thearticle's cited example of Scottsdale, AZ, a locality with one of the oldest ordinances in the country requiring fire sprinklers. (There are other localities with similar requirements for fire sprinklers but their requirement is younger and thus don't have the more reliant record as Scottsdale, AZ does --- yet.) A fire sprinkler opponent in Virginia might say that Arizona is not Virginia and Arizona's fire experience is not the same as Virginia's. Really, about the only significant difference between Arizona and Virginia is the climate. People are people. Fire is fire. Construction is construction. They essentially use the same materials in Arizona as are used in Virginia. The only difference may be the appearance (architecture) once assembled.

One of the oldest arguments against fire sprinklers has been "cost". To require fire sprinklers will increase the cost of housing. Fire sprinklers will price people out housing. Fire sprinklers will hurt the economy. (Think *Chicken Little*.) These same tired arguments have been levied against other housing elements over the years. They've been used to argue against handrail geometry, stair geometry, GFIs, smoke detectors, window sizing, energy efficiencies, and the list goes on. The cost of installing fire sprinklers is LESS than the cost of most kitchen counter upgrades. They do not require a sprinkler contractor to install them. Under current DPOR licensing requirements, a plumber can install them. The plumbing loops in the house are lengthened in order to have a sprinkler head high on a wall in the middle of a ceiling. Maintenance is less than the amount of maintenance given to replacing worn washers in a faucet. (Other than someone physically damaging a fire sprinkler head, there's no maintenance.) The tap fee is a non-issue used for distraction. The same is true for the meter size because it does not need to be different from what is currently required or needed. The same is for houses on wells. Nor is there a need for a "stand by fee". In the event of a fire, the amount of water flow (GPM) needed to operate a sprinkler head is no more than what would be needed to take a shower or refill a toilet. If there is sufficient potable water to supply the house for domestic use, then by default there is enough water to supply the fire sprinkler system.

Probably the most ludicrous statement ever made against fire sprinklers was, in a public forum no less, “only OLD houses burn”. Really? If that were true, at what age does a newly construction house become “old”? (Please return to the attached article wherein it states that there have been NO fire deaths in any house constructed in Scottsdale, AZ since 1986.)

The technical merits and costs of requiring the installation of fire sprinklers in townhouses and 1&2 family dwellings are well known and have been for years. The argument against them hasn’t changed much either. So it simply comes down to politics and which argument, for or against, do you wish to subscribe to. As quoted in the attached article, it can be, “A puddle of water or a pile of ashes.” To that end, be mindful of the statutory charge that the USBC and its provisions *“…**shall** be such as to protect the health, safety and welfare of the residents of the Commonwealth, provided that buildings and structures **should** be permitted to be constructed, rehabilitated and maintained at the least possible cost consistent with recognized standards of health, safety, energy conservation and water conservation, including provisions necessary to prevent overcrowding, rodent or insect infestation, and garbage accumulation; and barrier-free provisions for the physically handicapped and aged.”* (§ 36-99 of the Code of Virginia) (Emphasis added to denote the order of placement and the hierarchy of the words “shall” and “should”.)

Resiliency Impact Statement: This proposal will increase Resiliency
COV Executive Order Twenty-four speaks to increasing Virginia's resilience to sea level rise and natural hazards. The Executive Order goes further in saying, "We must act now to protect lives and property from multiple threats and reduce taxpayer exposure through fiscally responsible planning." According to the **Resilient** Design Institute, **resilient** design is defined as “the intentional design of buildings, landscapes, communities, and regions in response to vulnerabilities to disaster and disruption of normal life”. Fire is a natural hazard to a community whether it is a single house or an entire neighborhood. I submit this proposal proposal provides resilience but it is targeted only to the hazards of fire on a scale smaller than what may be intended or described in Executive Order 24.

Cost Impact: The code change proposal will increase the cost of construction
Not including the cost of land, I estimate the cost of incorporating fire sprinkler systems into newly constructed townhouses and 1&2 family dwellings at 1% of the construction costs above the structure's foundation.

RB313.1-18

VRC: SECTION R313, R313.1, R313.2

Proponents: Glenn Dean (gad.pompier@gmail.com)

2015 Virginia Residential Code

SECTION R313
AUTOMATIC FIRE SPRINKLER SYSTEMS

R313.1 Townhouse automatic fire sprinkler systems.. ~~Notwithstanding the requirements of Section 103.3, where installed, an~~ An automatic residential fire sprinkler system ~~for townhouses~~ shall be ~~designed and installed in accordance with NFPA 13D or Section P2904.~~ installed in *townhouses* .

Exception: An automatic residential fire sprinkler system shall not be required when additions or alterations are made to existing townhouses that do not have an automatic residential fire sprinkler system installed.

R313.1.1 Design and installation.

Automatic residential fire sprinkler systems for *townhouses* shall be designed and installed in accordance with Section P2904 or NFPA 13D.

R313.2 One- and two-family dwellings automatic fire sprinkler systems.. ~~Notwithstanding the requirements of Section 103.3, where installed, an~~ An automatic residential fire sprinkler system shall be ~~designed and~~ installed in ~~accordance with NFPA 13D or Section P2904.~~ one- and two-family *dwellings* .

Exception: An automatic residential fire sprinkler system shall not be required for additions or alterations to existing buildings that are not already provided with an automatic residential fire sprinkler system.

R313.2.1 Design and installation.

Automatic residential fire sprinkler systems shall be designed and installed in accordance with Section P2904 or NFPA 13D.

Reason Statement: In part, the purpose of this proposal is to elevate Virginia's residential building code from one being sub-par to being equal to the national standard/model as it relates to fire safety and sustainability through preservation.T
he cost of residential sprinkler systems keeps dropping to where it may well be less than a typical kitchen counter upgrade. This statement is based on the attached 2017 study by the University of Nevada, Las Vegas. Beyond that, the facts supporting the requirement to install automatic fire sprinkler systems in townhouses and 1&2 family dwellings have not fundamentally changed over the past decade although they are stronger now than before. By the same token, the argument against requiring sprinklers is fundamentally the same, just somewhat weaker given the national expansion of them being required along with technical improvements, consumer, builder and local official's increased knowledge.

Attached is an article published online by Forbes dated August 3, 2019. It provides a concise overview of why fire sprinklers should be required in all newly constructed housing. (I've hi-lited a few important points.) In concert with the attachment, I urge watching a 10-minute video on YouTube (https://www.youtube.com/watch?v=OiHqRJVChlQ) that expands the article's cited example of Scottsdale, AZ, a locality with one of the oldest ordinances in the country requiring fire sprinklers. (There are other localities with similar requirements for fire sprinklers but their requirement is younger and thus don't have the more reliant record as Scottsdale, AZ does --- yet.) A fire sprinkler opponent in Virginia might say that Arizona is not Virginia and Arizona's fire experience is not the same as Virginia's. Really, about the only significant difference between Arizona and Virginia is the climate. People are people. Fire is fire. Construction is construction. They essentially use the same materials in Arizona as are used in Virginia with the only difference being the appearance (architecture) once assembled.

One of the oldest arguments against fire sprinklers has been "cost". It's been repeatedly stated that to require fire sprinklers will increase the cost of housing; fire sprinklers will price people out housing; fire sprinklers will hurt the economy. These same tired arguments have been levied against other housing elements over the years. They've been used to argue against handrail geometry, stair geometry, GFIs, smoke detectors, window sizing, energy efficiencies, and the list goes on. To repeat - the cost of installing fire sprinklers is LESS than the cost of most kitchen counter upgrades. They do not require a "sprinkler contractor" to install them. Under current DPOR licensing requirements, a plumber can install them. The plumbing loops in the house are lengthened in order to have a sprinkler head high on a wall in the middle of a ceiling. Maintenance is less than the amount of maintenance given to replacing worn washers in a faucet. (Other than someone physically damaging a fire sprinkler head, there's no maintenance.) The "tap fee" is a non-issue used for distraction. The same is true for the meter size because it does not need to be different from what is currently required or needed. The same is for houses on wells. Nor is there a need for a "stand by fee". In the event of a fire, the amount of water flow (GPM) needed to operate a sprinkler head is no more than what would be needed to take a shower or refill a toilet. If there is sufficient potable water to supply the house for domestic use, then by default there is enough water to supply the fire sprinkler system.

Probably the most ludicrous statement ever made against fire sprinklers was, in a public forum no less, "only OLD houses burn". If that were true, the question becomes at what age does a newly construction house become "old"? **(Please return to the attached article wherein it states that there have been NO - I repeat - NO fire deaths in any house constructed in Scottsdale, AZ since 1986 - 34 years ago.)**

The technical merits and costs of requiring the installation of fire sprinklers in townhouses and 1&2 family dwellings are well known and have been for years. The argument against them hasn't changed much either. So it simply comes down to politics and which argument, for or against, do you wish to subscribe to. As quoted in the attached article, it can be, "A puddle of water or a pile of ashes." To that end, be mindful of the statutory charge that the USBC and its provisions *"…**shall** be such as to protect the health, safety and welfare of the residents of the Commonwealth, provided that buildings and structures **should** be permitted to be constructed, rehabilitated and maintained at the least possible cost consistent with recognized standards of health, safety, energy conservation and water conservation, including provisions necessary to prevent overcrowding, rodent or insect infestation, and garbage accumulation; and barrier-free provisions for the physically handicapped and aged."* (§ 36-99 of the Code of Virginia) (Emphasis added to denote the order of placement and the importance of the words "shall" and "should".)

Resiliency Impact Statement:
COV Executive Order Twenty-four speaks to increasing Virginia's resilience to sea level rise and natural hazards. The Executive Order goes further in saying, "We must act now to protect lives and property from multiple threats and reduce taxpayer exposure through fiscally responsible planning." According to the Resilient Design Institute, resilient design is defined as "the intentional design of buildings, landscapes, communities, and regions in response to vulnerabilities to disaster and disruption of normal life". Fire is a natural hazard to a community whether it is a single house or an entire neighborhood. I submit this proposal proposal provides resilience but it is targeted only to the hazards of fire on a scale smaller than what may be intended or described in Executive Order 24.

Cost Impact:
Not including the cost of land, I estimate the cost of incorporating fire sprinkler systems into newly constructed townhouses and 1 &2 family dwellings at 1% or less of the construction costs above the structure's foundation.

Economic Cost Benefit Analysis of Residential Fire Sprinkler Systems Broward County, Florida

Prepared for:
Broward County

September 2021

Newport Partners L.L.C.

Prepared by:
Newport Partners, LLC
Davidsonville, MD

Table of Contents

Executive Summary

The cost of residential fire sprinkler systems varies across the country for a variety of reasons. Housing design, construction, and plumbing materials, and the availability of sprinkler contractors are a few variables that can factor into pricing. The purpose of this report is to present an estimate of the economic cost benefit pertaining to the installation of residential fire sprinkler systems in new, single-family homes in Broward County using the data from previously completed cost benefit studies from Coral Springs (2021) and Tamarac, Florida (2019), two jurisdictions located within Broward County.

To best estimate the costs associated with installing residential fire sprinkler systems Newport obtained estimates from sprinkler contractors in Broward County. Three estimates were provided by contractors in Coral Springs and three from Tamarac for a total of six estimates. The estimates were based on house plans identified by each jurisdiction that best represent the characteristics of new home construction in the area. Contractors were asked to only provide estimates for the design and installation of the system, and not include any outside fees or costs.

In addition to the design and installation costs, other costs that are typically associated with installing a residential fire sprinkler system include permit fees and water meter fees or upsizing charges. Often, these fees and costs are determined by the individual jurisdictions. For this report, Newport determined that both Coral Springs and Tamarac had permit fees as well as a hard cost for upsizing water meters. These costs were determined through conversations with city and fire officials and sprinkler contractors in both jurisdictions and are included in the final cost estimates.

The total cost for installing residential fire sprinklers in Broward County was estimated by using the six contractor estimates for design and installation and adding the estimated permit fees and meter upsizing costs to each to obtain a total cost estimate for each home. From these estimates, the average cost across Broward County is $2.78 per square foot of sprinklered space.[1] When compared to the most recent cost study from the National Fire Protection Association (NFPA) in 2013, this represents a higher-than-average cost. However, there are

[1] Sprinklered space refers to the area of the home required to covered by an automatic fire sprinkler system according to NFPA 13D.

many variables that factor into the price of installing a residential fire sprinkler system that will be discussed later in the report.

Benefit calculations took into consideration a variety of inputs including determining probability of a home fire, the average ratio of property loss to value for homes without sprinklers, expected deaths or injury that occur from fires, and the value of life. In addition, the home and property value in Tamarac and Coral Springs were considered. These measures were compared for homes with and without fire sprinkler systems. The differences resulted in significant benefits associated with fire sprinklers in homes, including monetary benefits of lives saved, injuries averted, and the uninsured direct and indirect costs from property loss. Additionally, reduced cost of homeowner’s insurance provides a direct economic benefit for homeowners.

In addition to the benefits associated with an individual homeowner or property, the jurisdiction may also benefit from the reduction of impact fees, as well as a reduction of infrastructure requirements. Examples of infrastructure requirement reductions include: reduced requirements for hydrant spacing, minimum road widths, fire flows, cul-de-sac widths, and dead-end street width. Applicable incentives associated with Florida’s adoption of NFPA 1, were considered in the net positive benefit calculations.

The costs and benefits associated with residential fire sprinkler systems are outlined in Table 1. This report discusses the methodology used in this study, the variables considered for both costs and benefits, and other factors that impact the costs of installing residential fire sprinklers. Overall, the study concludes residential fire sprinklers are estimated to provide a net positive benefit in Broward County.

Table 1. Net Benefit

	Broward County (Average)
Average Cost of Installation	$5,290.61
Infrastructure Reduction	$1,271
Benefit	$10,815.75
Net Positive Benefit	$6,796.14

Overview

Homeowners today are at significant risk for injury, property loss, and even death from home fires. A recent National Fire Protection Association (NFPA) study, reported annual fires in residential buildings to be over 270,500.[2] One-and-two family homes only represent about twenty percent of all structure fires reported yet these fires represent 66 percent of civilian deaths and 51 percent of civilian injuries according to the same report.[3]

Fire sprinkler installation in one- and two-family dwellings can be used as a tool to greatly reduce death and injury for home inhabitants. Across a 4-year period, there was an 81 percent reduction in civilian deaths in homes with fire sprinklers than those without.[4] Firefighters are also impacted by fire sprinklers when responding to home fires. Homes with fire sprinkler systems reported fire fighter injury rate being 79% lower than when responding to homes without sprinkler systems.[5]

Automatic residential fire sprinkler systems for one- and two-family dwellings have been required as part of the International Residential Code (IRC) since the 2009 version. This requirement has carried forward in each subsequent update (2012, 2015, 2018, and most recently in 2021). The 2020 Florida Building Code is based on the 2018 IRC with amendments that exclude provisions for residential fire sprinkler systems in one – and two-family dwellings.[6] The Florida Fire Prevention Code, based on NFPA 1 and NFPA 101, also removes the requirements for automatic fire sprinkler systems in one- and two-family dwellings at the state level.[7]

While not a statewide requirement, Florida allows local jurisdictions the ability to implement residential fire sprinkler requirement for one- and two-family dwellings. To do so, the jurisdiction must perform and submit an analysis of the economic impacts to inform local constituents prior to adopting the requirement. This analysis should not only include the cost to design and install the system, but also any additional fees as previously discussed, as well as the benefits that

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[2] *Trends and Patterns of Fire Losses in 2017*, National Fire Protection Association, January 2017
[3] Ibid
[4] Marty Ahrens*, U.S. Experience with Sprinklers*, National Fire Protection Association, July 2017
[5] Ibid
[6] Florida Building Code, 7th Edition, 2020, Section 903.2.11.3
[7] Florida Fire Prevention Code, 2020, Section 8(a)

may accrue to residents. Additionally, before imposing any requirement, the local government must provide the homeowner with a letter documenting any infrastructure, tax, or fee allowances and waivers as well as a cost analysis that determines these cost savings are approximate to the cost of installing a residential sprinkler system. [8] The purpose of this study is to show expected costs and benefits relevant to the proposed adoption of requirements for residential fire sprinkler systems in Broward County, Florida.

The main point of resistance to requiring automatic fire sprinklers in one- and two- family dwellings is cost. Because this is such a prevalent issue, there have been several economic studies conducted to analyze the cost impact associated with these sprinkler systems. In 2013, NFPA completed a comprehensive national study which found the national average to design and install a residential fire sprinkler system to be $1.35 per square foot. That report also compared the national data to data from states (California and Maryland) which have statewide requirements for all new construction, which dropped the average cost to $1.16 per square foot. The cost of sprinkler systems can vary widely depending on several variables (house size, house design, climate, type of pipe, water supply, labor costs, etc.). What was apparent however, was that widespread adoption helps to lower costs.[9]

In addition to the cost studies, NFPA conducted a 2016 market research study, "Home Fire Sprinklers- - Stakeholder Perceptions in Mandatory Requirement States." Various stakeholder groups (water purveyors, local government officials, and homeowners) in both California and Maryland were surveyed and interviewed to gauge how the statewide requirements were affecting stakeholders. The report highlights an overwhelmingly positive experience and perceived value from these groups. To summarize the key findings, homeowners noted that the sprinklers provided them with a sense of safety, added value to their home, and lowered their homeowners insurance rates. Local government officials believed that home fire sprinklers help reduce death and injury to both residents and firefighters and help in reducing the costs due to fire damage. Lastly, water purveyors indicated the impact on the water supply is a non-issue stating, "Our system can handle 2,000 gallons/min. Residential fire sprinklers are a drop in the bucket." That report can be read in its entirety here.[10]

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[8] Florida Fire Prevention Code, 2020, Section 8(a), Section 8(b) 2
[9] *Home Fire Sprinkler Cost Assessment*, Newport Partners, 2013
[10] *Stakeholder Perceptions of Home Fire Sprinklers*, Newport Partners, 2016

Based on the estimates used in his report, the average cost per square foot of sprinklered space is estimated to be $2.78 per square foot, as shown in Table 2. While at first this may seem significantly higher compared to the national average of $1.35 per square foot, there are several variables that factor into the higher estimated cost. The lack of a residential sprinkler requirement results in a low number of residential projects, which impacts the cost in several ways. First, it drives up the design costs as each home in this report needed an individual design. With more expertise and repetition of designs, the design cost decreases. Second, the labor costs for any different or innovative type of work are almost always higher. This is true even if the contractor has commercial experience as residential systems are designed and installed differently. Newport contacted over 40 fire sprinkler installers that included "residential installations" in their promotional material to secure bids used in this report, however the vast majority indicated they had little to no experience installing residential systems. If volume were to increase by instituting a sprinkler requirement, more contractors would gain experience designing and installing them, and competition for the jobs would drive prices down. Materials may then be purchased in bulk, and builders and developers would likely work directly with sprinkler contractors to reduce costs.

For Coral Springs, an additional factor and arguably the biggest factor in the high price estimates is due to the COVID-19 pandemic ongoing during the time of the study. During the pandemic, it has been widely documented that building material prices across the board have risen and labor has been in short supply. Businesses in the construction industry have now been forced to charge higher prices. As these prices normalize again, and with the adoption of a sprinkler requirement, the cost of designing and installing a residential fire sprinkler system will likely move closer to the national average of $1.35 per square foot.

Table 2. Cost per Square Foot

Location	Cost per square foot of sprinklered space
Tamarac	$2.40
Coral Springs	$3.16
Broward County (Average)	$2.78

Methodology

This report uses data collected from two previous economic studies, Coral Springs and Tamarac, to estimate the costs and benefits of residential sprinkler systems for Broward County. The benefit of using these two jurisdictions is the difference in demographics and housing characteristics. Coral Springs population has larger households, higher income, and higher property values than Tamarac. Single family units (both detached and attached) also represent a larger share of the housing stock. Taken together the costs and benefits are a better estimate for the costs and benefits in Broward County than either individual study.

Table 3. Household Size Trends shown in Median Persons per Housing Unit

Location	1990	2000	2010	2015
National	2.29	2.59	2.59	2.64
Florida	2.15	2.46	2.53	2.63
Broward	2.05	2.45	2.57	2.73
Coral Springs	2.85	2.96	2.95	3.12
Tamarac	1.85	2.00	2.13	2.31

Source: U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates

Table 4. Percent of Single-Family Housing both Detached and Attached

Location	1-Unit detached %	1-unit attached %
Broward	41.3	8.3
Coral Springs	49.4	6.9
Tamarac	38.5	15.3

Source: U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates

Table 5. Location Characteristics from US Census Bureau

	Tamarac	Coral Springs	Broward County
Property Value (Structure+Contents)	$340,000	$449,909	$265,000
Population	66,721	133,759	1,952,778
Median Income	$48,930	$77,360	$59,547

Several items contribute to the total cost of a residential fire sprinkler system. Much of the system's cost comes from the design and installation for the system, but other costs must also be included. Table 6 outlines different costs that are applicable to Broward County and describes sources of information for these costs. It is important to note that while Broward County does not impose any permit or meter upsizing fees, these may vary among jurisdictions.

Table 6. Residential Fire Sprinkler System Cost Categories

Cost Category	Information Source
System design, installation, and materials	Cost estimates for design, installation, and materials from fire sprinkler contractor.
Sprinkler system permit fees	Discussions with city officials and sprinkler contractors
Added hard cost for increased water meter size from 5/8 in. to 1 in. in diameter.	Discussions with city officials and published residential meter cost schedule.

The size of homes in terms of square footage, the number of stories, the foundation types, as well as the system type and material choices can all contribute to the overall cost of fire sprinklers. Actual building plans that had been submitted to Tamarac and Coral Springs that represent a typical single-family residence in that area were obtained to generate cost estimates. Four of the six homes were two-story structures, while two homes were single-story structures. The homes ranged from 1,612 square feet to 2,675 square feet in size.

Newport contacted sprinkler contractors in both areas to verify they had experience with installing residential fire sprinkler system and discuss the details of the study. Because residential fire sprinklers are not a requirement, it was important to ensure the contractors providing estimates had experience with residential systems to best estimate the cost of design and installation. Once the contractors were identified, Newport provided all three sets of building plans as well as project specifications and instructions for providing cost estimates. Each contractor was to provide an estimate for the design and installation of a NFPA 13D compliant fire sprinkler system, that was a standalone system using CPVC piping material, the most common system type and piping material found in residential systems. Contractors were asked to exclude any fees or additional costs, but were asked to identify what they were if they did exist.

Building Plans

Table 7 outlines the relevant characteristics for the homes with fire sprinkler specifications used in this report. All systems were to be designed to NFPA 13D standards, be a standalone sprinkler system type (as opposed to multi-purpose), use CPVC piping, and built on concrete slab on grade foundations.

Table 7. Sample Home Characteristics for Broward County

	Coral Springs			**Tamarac**		
Square Footage	1,721	1,915	2,076	1631 SF	1612 SF	2675 SF
Number of Stories	Two	One	Two	Two	One	Two

Estimated Costs

All estimates received from the fire sprinkler contractors were reviewed to ensure they included the correct system specifications and did not include any additional fees. In the case where detailed information was lacking, follow up contact was made with the fire sprinkler contractors to confirm the estimates were based on the correct details and specifications of the project. In some cases, minor adjustments were made to the original estimates. Contractors were asked to not include permit fees or any other additional fees beyond the design and installation of the fire sprinkler system as those were obtained from conversations with city officials in both Coral Springs and Tamarac and added to the estimates later.

To arrive at the average cost to design and install a residential fire sprinkler system in Broward County, permit fees and meter upsizing costs were added to the contractor estimates for each home. For Coral Springs these additional costs added $255 ($200 permit fees and $55 meter upsizing) to the contractor estimates, and $174 ($110 permit fees and $64 meter upsizing) was added to the contractor estimates in Tamarac. The average cost of each home in both studies was then added together and divided by the six estimates received. Based on this, the average system design and installation cost was calculated to be $5,290.61 in Broward County. Table 8 below shows the total cost estimates (design and install plus additional fees) used to derive the average cost for Broward County.

Table 8. Individual Sprinkler Contractor Estimates by Home

Coral Springs Estimates				
	Home A	Home B	Home C	Average
Home Size (ft^2)	1,721	1,915	2,076	1,904
Estimate ($)	$4,205.00	$4,505.00	$4,905.00	
Estimate ($)	$5,055.00	$5,055.00	$5,455.00	
Estimate ($)	$7,755.00	$8,805.00	$8,255.00	
Average ($)	$5,671.67	$6,121.67	$6,205.00	$5,999.45
Average $/ft2	$3.30	$3.20	$2.99	$3.16
Tamarac Estimates				
Home Size (ft^2)	1,631	1,612	2,675	1,973
Estimate ($)	$6,674.00	$5,374.00	$6,574.00	
Estimate ($)	$3,274.00	$3,374.00	$5,074.00	
Estimate ($)	$3,344.00	$3,499.00	$4,049.00	
Average ($)	$4,430.67	$4,082.33	$5,232.33	$4,581.78
Average $/ft2	$2.72	$2.53	$1.96	$2.40
Broward County Estimates				
Average Cost ($)	$5,290.61			
Average $/ft^2	$2.78			

Estimated Benefits

Benefit calculations of a sprinkler system for homeowners in Broward County, Florida generally follow the methodology used in the 2007 report *Benefit-Cost Analysis of Residential Fire Sprinkler Systems* prepared by the National Institute of Standards and Technology[11] as well as the 2012 *Economic Cost Benefit Analysis of Residential Fire Sprinkler Systems in Cape Coral.*[12] More recent data were used from updated sources in order to more accurately assess the benefits of a fire sprinkler system.

The estimates assume that the value of the structure and contents of a new home will be $449,090 in Coral Springs and $340,000 in Tamarac. That assumption influences the calculations for property damage and insurance, but not the values for lives saved and injuries averted. All monetary values in the calculations are in terms of 2021 prices. A real interest rate of 4.8 percent is used to discount future benefits (and costs) over 30 years to present values.

Table 10 shows the key assumptions and estimated future benefits of sprinklers in new homes in Coral Springs and Tamarac. The estimated benefit from Coral Springs and Tamarac were averaged together for an estimated benefit in Broward County of $10,815.75.

Table 9: Summary of Estimated Benefits

Jurisdiction	Estimated Benefits
Coral Springs	$13,527.15
Tamarac	$8,104.36
Broward County	$10,815.75

[11] David T. Butry, M. Hayden Brown, and Sieglinde K. Fuller, *Benefit-Cost Analysis of Residential Fire Sprinkler Systems* (U.S. Department of Commerce, National Institute of Standards and Technology, NISTIR7451, September 2007)
[12] Newport Partners LLC, *Economic Cost Benefit Analysis of Residential Fire Sprinkler Systems Cape Coral, FL,* July 2012

Table 10. Estimated Present Value of Benefits as Calculated for Tamarac and Coral Springs

	Tamarac		Coral Springs	
	Estimate 2019		Estimate 2021	
Inputs:				
Annual Fire Probability		0.0031		0.003067485
Pr: Death/Fire (No Sprinklers)		0.0075		0.0075
Pr: Injury/Fire (No Sprinklers)		0.0340		0.034
Property Value (Structure+Contents)	$	340,000.00		$449,909
Fire Loss-to value (No Sprinklers)		0.155		0.155
Uninsured Share of Direct Loss		0.20		0.2000
Indirect/Direct Loss		0.10		0.1000
Uninsured Share of Indirect Loss		0.40		0.4000
Reduction in Death (Sprinklers)		0.81		0.87
Reduction in Injury (Sprinklers)		0.31		0.27
Reduction in Fire Loss-to-value		0.63		0.63
Value of life (2019)	$	9,852,576.00		$11,600,000
Rate in real increase in life, injury value		0.0088		0.880%
Value of Injury (2019)	$	463,071.07	$	545,200.00
Annual Insurance Prem (No Sprinklers)	$	3,004.00		$6,143.00
Insur Discount for Sprinklers		9.00%		9.00%
Time horizon (years)		30		30
Real Discount Rate		4.80%		4.80%
Intermediate Calculations:				
Uniform PV of Constant T year benefit		15.7292203	$	15.73
Uniform PV with real growth g		17.46124368	$	17.46
Direct Prop Damage per Fire (No Sprinklers)	$	52,700.00	$	69,735.90
Uninsured direct loss/Fire (No Sprinklers)	$	10,540.00	$	13,947.18
Unins Indirect Costs/Fire (No Sprinklers)	$	2,108.00	$	2,789.44
Death/fire (Sprinklers)		0.001425	$	0.00
Injury/Fire (Sprinklers)		0.02346	$	0.02
Uninsured direct loss/Fire (Sprinklers)	$	3,899.80	$	5,160.46
Uninsured Indirect Costs/Fire (Sprinklers)	$	779.96	$	1,032.09
Value from Lower Deaths in 2019	$	183.60	$	232.18
Value from Lower Injury in 2019	$	14.97	$	15.35
Annual Value Lower Uninsured Direct	$	20.37	$	26.95
Annual Value Lower Uninsured Indirect	$	4.07	$	5.39
Annual Savings on Insurance	$	270.36	$	552.87
Present Value of Benefits:				
PV from Lower Deaths	$	3,205.93	$	4,054.12
PV from Lower Injury	$	261.42	$	268.07
PV from Lower Uninsured Direct Prop Loss	$	320.38	$	423.95
PV from Lower Uninsured Indirect	$	64.08	$	84.79
PV from Insurance Discount	$	4,252.55	$	8,696.21
	$	8,104.36	$	13,527.15

A large part of the estimated benefits of sprinklers consists of the value of lives saved. Although it is difficult to place a monetary value on a human life, people in fact implicitly do so regularly as they make choices about risks they face in choosing where to work or live, what products to buy, etc. Based on "revealed preferences" derived from those choices, particularly the wage premia demanded for riskier jobs, various studies have calculated the "value of a statistical life" (VSL), and such values have been widely employed in the evaluation of the costs and benefits of regulations and investments. VSL assumptions specified by the U.S. Department of Transportation in 2016 and used by a variety of government agencies are used as part of this analysis. Those VSL amounts were set at $9.6 million for 2016, with annual real increases of 0.877 percent for succeeding years.[13]

Another significant component of the estimated benefits of sprinklers looks at the annual savings on insurance. Homes in Coral Springs are significantly more expensive than the average home in Tamarac. Annual insurance premiums within Coral Springs are estimated to be nearly double that in Tamarac leading to greater annual savings on insurance for a home with a fire sprinkler system.

Findings

This study finds that, for Broward County, the average total cost to design and install a residential fire sprinkler to NFPA 13D standards is $5,290.61 or $2.78 per square foot of sprinklered space, based on six contractor bids and estimated fees.

Benefit calculations for this report follow the general methodology of the 2007 NIST report and use the 9 percent reduction in insurance rates referenced. Values were updated to reflect most recent local data. The Present Value of benefits for installing a fire sprinkler system in Broward County comes to $10,815.75 with most of the benefits attributable to savings on insurance and the value of fewer fatalities.

The net benefit expected is $6,796.14 as shown in Table 10.

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[13] Memorandum from Molly J. Morgan, Carlos Monje to Secretarial Officers Model Administrators, "Guidance on Treatment of the Economic Value of Statistical Life" August 8, 2016

Table 10. Net Positive Benefit

	Tamarac	Coral Springs	Broward County (Average)
Average Cost	$4,581.78	$5,999.44	$5,290.61
Infrastructure Reduction	$1,271.00	$1,271.00	$1,271
Benefit	$8,104.36	$13,527.15	$10,815.75
Net Positive Benefit	$4,793.58	$8,798.71	$6,796.14

Loudoun County Fire and Rescue

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For Additional Information:
Laura Rinehart, Public Information Officer
Laura.Rinehart@loudoun.gov or 571-233-1649
October 11, 2019

For Immediate Release:
Cause Determined in Fatal Sterling House Fire

Sterling, VA. – The Loudoun County Fire Marshal's Office has determined that unattended cooking was the cause of a fatal house fire in Sterling and have estimated damages to the home at $144,000. The investigation also revealed that there were no working smoke alarms in the residence.

A 9-1-1 call came into the Loudoun County Emergency Communications Center just before 3:00 a.m., Sunday, October 6, 2019 reporting a house fire in the 200 block of Giles Place in Sterling. Firefighters arrived to find smoke coming from a two-story townhouse and one adult outside suffering from burn injuries. The patient was transported to the Burn Center at MedStar Washington Hospital with non-life threatening injuries.

Once inside, firefighters located an adult male who was brought outside to waiting EMS crews. Paramedics immediately began advanced life support care and transported the victim to a local hospital where he was pronounced dead. One additional resident refused medical treatment on the scene.

Loudoun County Fire Officials remind residents of easy steps you can take to prevent these fires and protect your family if a fire does occur:

- **Stay in the kitchen** while cooking, especially on the stovetop. If you leave the kitchen, even briefly, turn off the stove. If baking, roasting, or broiling, set timers to remind you food is cooking.
- **Have working smoke alarms!** Smoke Alarms provide an early warning giving you more time to safely escape. Install smoke alarms on every level, outside the door of any sleeping area, and inside each bedroom. Test alarms monthly, change the battery, and replace after 10 years. Loudoun County Fire and Rescue has a free smoke alarm program, to learn more visit www.loudoun.gov/smokealarms for more information.
- **Close Before You Doze!** Closing your bedroom door before going to sleep can help slow the spread of smoke, heat, and fire. Homes have more open layouts, and lightweight construction materials which allow fires to spread much quicker affecting the time a family has to escape.
- **Have a home escape plan!** A family has as little as 2-3 minutes to escape should a fire occur. Discuss with your family a home escape plan that includes two ways out of each room and an outside meeting place.

For more fire prevention information for you and your family, please visit www.loudoun.gov/firemarshal or call Lisa Braun, Public Education Manager at 571-258-3222.

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UNLV GREENSPUN College of URBAN AFFAIRS
UNIVERSITY OF NEVADA, LAS VEGAS

Residential Fire Sprinkler Cost Benefit Analysis

For

City of Las Vegas (NV) Fire and Rescue

July 2017

Authors:

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UNLV GREENSPUN College of URBAN AFFAIRS
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Residential Fire Sprinkler Study - 2017

Executive Summary:

This is a study commissioned by the Las Vegas Fire and Rescue Department, which provides a dispassionate and objective cost benefit analysis of residential fire suppression (sprinkler) systems, which could be mandated in all new home construction up to 5,000 square feet of livable space*. This study is in direct response of Nevada Revised Statue (NRS) 278.586, which specifies that any governing body considering such a mandate must perform a cost benefit analysis and hold a public hearing on the results of that analysis prior to enacting legislation requiring residential fire suppression systems in all new home construction.

UNLV performed a detailed study over the course of 3 months and determined that there is a definite cost benefit to both homeowners and home builders by installing fire suppression systems in all new residential homes up to 5,000 square feet of livable space.

The following pages detail the UNLV study, which also compares and contrasts the study results with those provided by Applied Analysis (a local Las Vegas analytical company), which was contracted to perform a similar study by the Southern Nevada Homebuilders Association in March 2015.

The UNLV study clearly shows that survival is the primary reason for mandating installation of residential fire sprinkler systems, as well as detailing the source of all cost savings back to homeowners and homebuilders, if such a mandate were enacted.

***The scope of this report addresses new homes which are less than 5,000 square feet in total livable area to match the scope of the requirements of Section 278.586, added to Nevada Revised Statue as a result of the passage by of SB477. This statute requires that a cost cost-benefit analysis be performed whenever a residential sprinkler ordinance will be considered for residential dwelling structures which are less than 5000 sq. feet in livable area. Please see Attachment 1 of this report for the complete NRS 278.586.**

Residential Fire Sprinkler Study - 2017

Purpose:

The purpose of this study is to present an independent, objective analysis regarding the possible installation of residential fire suppression systems (sprinkler systems) in all new single-family home construction within the city limits of Las Vegas, Nevada. As a starting point, the University of Nevada Las Vegas (UNLV) was asked to study, analyze, and document the different perspectives presented in two studies prepared by reputable organizations:

- The National Institute of Standards and Technology (NIST): Benefit-Cost Analysis of Residential Fire Sprinkler Systems (NISTIR-7451), September 2007.
- Applied Analysis: Benefit-Cost Analysis of Residential Fire Suppression Systems – A Review and Analysis in Unincorporated Clark County, March 2015.

Background:

The City of Las Vegas, through the Las Vegas Fire and Rescue, commissioned a cost-benefit analysis to determine the affordability of residential fire sprinklers in single family dwellings with usable living space equaling 5,000 square feet or less. This analysis is to determine the costs associated with a local mandate, as well as the benefits the homeowner and the community gain from residential fire sprinklers. This cost-benefit analysis is also required to satisfy Nevada Revised Statute 278 enacted during the 2015 Nevada legislative session through Senate Bill 477 (attachment 1). Embedded in the Senate language is a mandate requiring that a cost-benefit analysis be performed to demonstrate that the installation of a residential fire suppression system in a new home would be:

> to the benefit of the owners of the residential dwelling units to which the requirement would be applicable and that such benefit exceeds the costs related to the installation of automatic fire sprinkler systems in such residential dwelling units. (Reference: Nevada Senate Bill 477)

Further, the City may elect to issue a mandate requiring fire suppression systems in new residential homes with livable area of 5,000 square feet or less, if:

> the unique characteristics or the location of the residential dwelling unit, when compared to residential dwelling units of comparable size or location within the jurisdiction of the governing body, would cause an unreasonable delay in firefighter response time. (Reference: Nevada Senate Bill 477)

The Senate bill also specifies that the City may mandate residential fire suppression systems in new homes with livable area greater than 5,000 square feet without requiring either of the two criteria mentioned above.

Following the City of Las Vegas' decision to consider adopting this fire suppression system mandate, the Southern Nevada Home Builders Association commissioned a local analytical company, Applied Analysis, to perform a cost-benefit analysis in order to determine the financial feasibility of such a mandate.

Applied Analysis used the 2007 NIST Study (referenced above) as a baseline document. Then, using only local Clark County (Nevada) data in the NIST-developed algorithms, Applied Analysis performed a study to determine if there was, indeed, a cost benefit to the homeowner derived from having a residential fire suppression system installed. Applied Analysis concluded:

> The National Study found that sprinkler systems are economical (i.e., the benefits outweigh the costs) based on national data; however, the utilization of local datasets leads to a different conclusion. Based on the cost-benefit analysis conducted and described herein, results indicate that in unincorporated Clark County, home fire sprinkler systems are not economical (i.e., the costs outweigh the benefits of installation) based on local fire probabilities and system installation costs. (Reference: Applied Analysis Study, page 3)

Observations:

It is important to note that the Applied Analysis study did not dispute the factual content of the NIST Study. Further, Applied Analysis did not suggest that the data used by NIST was flawed; the cost-benefit algorithms developed by NIST were incomplete; nor the conclusions reached by NIST were faulty. Rather, Applied Analysis simply stated that when local Clark County (Nevada) data is plugged into the NIST-developed algorithms, then the installation costs of a residential fire suppression system appear more expensive than any potential financial benefit for a homeowner.

Additionally, the Applied Analysis Study did not consider the potential economic benefits to the homebuilders nor the community, if residential fire suppression systems were mandated in all new residential home construction of 5,000 square feet or less. Without this information, any attempt to provide the City of Las Vegas with a comprehensive cost-benefit analysis is short-sighted and incomplete.

Following the action of the 2015 Legislative Session, the City of Las Vegas asked the University of Nevada Las Vegas (UNLV) to conduct an independent study in an attempt to, if possible, reconcile the differences between the two studies (NIST and Applied Analysis) and to determine if there was additional information, which could shed more light on the wisdom of adopting the legislation mandating the installation of fire suppression systems in all new residential home construction.

Armed with both studies, the UNLV researchers commenced their independent study.

Approach:

UNLV met with the Las Vegas Fire Rescue (LVFR) Fire Marshals with whom they conducted extensive interviews, took detailed notes, and obtained a wealth of background studies on residential fire suppression systems performed over the past 15 years. Further, UNLV met with several fire suppression installation contractors to determine the types of fire sprinkler systems available to home builders and the costs of installation based on current and projected residential home building trends with the Las Vegas city limits.

The researchers also contacted fire marshals, insurance companies, and analytical companies from across the nation. Specifically, they contacted Verisk Analytics:

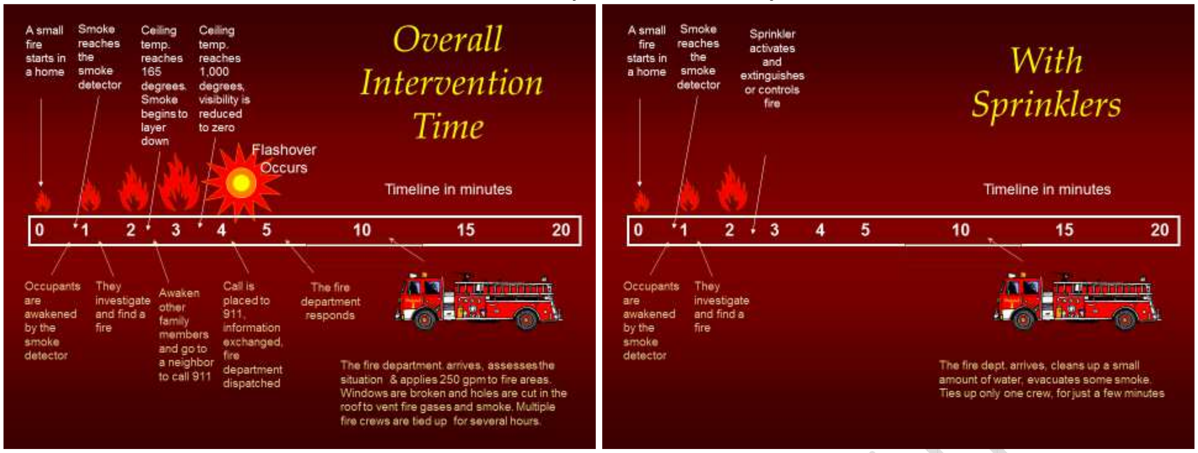
> Verisk Analytics, Inc. is an American data analytics and risk assessment firm based in Jersey City, New Jersey, United States, serving customers worldwide in insurance, natural resources, financial services, government, and risk management.

Each of the organizations and individuals provided the UNLV researchers with supplementary information. The information indicated that additional data (beyond simply just the cost of installation) needed to be factored into any thorough study on fire suppression systems. This new data coupled with realistic fire suppression system installation costs would provide Las Vegas City Council with comprehensive information upon which to make a final decision as to how to proceed with residential fire suppression system legislation.

Findings:

- **Cost:** UNLV performed an in-depth cost analysis, which refutes the cost figures generated by Applied Analysis and its subsequent conclusions (Attachment 2). As shown Attachment 3, UNLV discovered that a residential fire suppression system actually pays for itself in a matter of months after the new residential home is complete (For more detailed information, see Attachment 4). Further, the positive cost benefits to the homebuilder and community-in-general were studied and detailed in the following pages.

- **Smoke Alarms – A Case of Too Little, Too Late:** Smoke alarms without residential fire suppression systems do not appear to be enough to save lives and/or avert major home damage.
  - Smoke alarms do not provide sufficient warning to save all lives. In a typical residential house fire, they activate at about the 45 second point after a fire has started. Smoke becomes a visibility problem at 2 ½ minute point. Temperatures reach in excess of 1,000 degrees in about 4 minutes. Delays in notification (occupants waking up; assessing & identifying the problem; insuring humans and pets are alerted; then calling 911) means the Fire Department commences response at approximately the 5-minute point. It takes (on average) 10 minutes (total elapsed time) for the fire department to arrive. (Source: Power Point Presentation "Why Sprinklers?") By that time, the residence is fully involved in the fire.



Fire Suppression in Homes with and without Sprinkler Systems
(Source: "Residential 1-2 WHY SPRINKLERS" Presentation by Roy Marshall)

- **<u>Damage to Home:</u>** Beyond fire and smoke damage, there is a significant amount of water and structural damage to a house that has experienced a fire.
  - Residential sprinkler systems are set to activate at 150 degrees F.
    - The average residential sprinkler system outputs water at an average of 13 gallons per minute (GPM).
    - Given average fire department response times, a residential sprinkler head may output less than 200 gallons of water before being shut off by a fire fighter.
  - Unprotected residential dwellings will require between 1,500 and 100,000 gallons of water to extinguish the blaze. (This figure does not include damage to doors, windows, and the roof as the fire department works to gain entry into the home.)

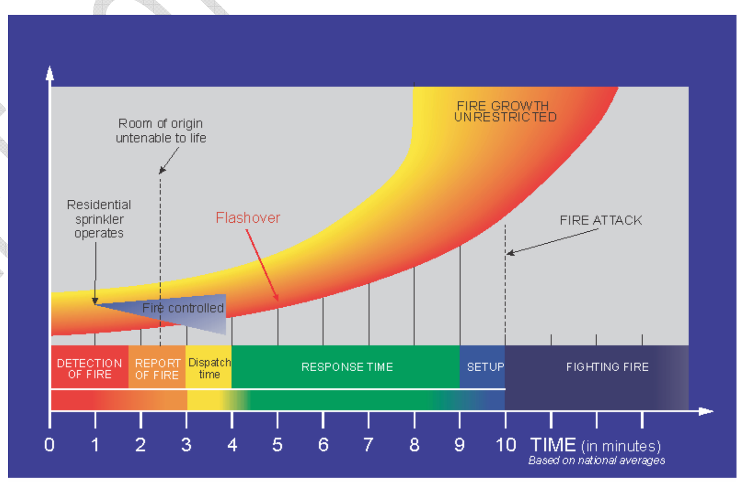


Figure 3: Positive Effects of Residential Sprinklers
(Source: "Why Sprinklers" Power Point Presentation by Pat Coughlin)

- **The Danger in Synthetics:**
  When a house is on fire, many times It is not the structural fire that causes fire deaths, it is the synthetic composition of the residential contents. (Synthetics burn twice as hot and twice as fast.) **(Source: Power Point Presentation "Why Sprinklers?")** Additionally, synthetic materials will typically outgas extremely hazardous and toxic smoke clouds.

  - During a fire, temperatures in a house (without fire suppression systems) can reach 1200 degrees F in less than 5 minutes.
  - "Thermal burns and smoke inhalation were the primary symptoms leading to death, accounting for 90 percent of all fatalities in residential fires." **[Source: Topical Fire Report Series, Volume 16, Issue 2 / July 2015, *"Civilian Fire Fatalities in Residential Buildings (2011-2013)*]**

- **Fatalities:**
  Residential Fire Suppression Systems save lives. According to an extensive study performed by the Medford (Oregon) Fire Department:

  - Home fire sprinklers are designed to ensure a tenable atmosphere for escape.
  - Fire sprinklers with smoke detectors increases chance of surviving a fire by over 97%.
  - Smoke detectors aren't enough.
    (Source: Power Point Presentation "The Case for Residential Sprinklers in Medford, Oregon.)

- **Modern Home Building Trends:**
  New trends in home building and modern furnishing are compressing the timelines between a fire starting, toxic smoke release, and flashover occurring. The Federal Emergency Management Agency (FEMA) and the US Fire Administration hosted a two-day workshop at the Maryland Fire & Rescue Institute (College Park, MD) on 11-12 Dec 2012. This workshop was attended by leading experts from the fire service and home fire research specialists, who gave compelling presentations on how the latest trends in homebuilding and residential furnishing are cause for concern. What they revealed is that there is not only increased concern for the residents, but substantially increased risks for the firefighters as they combat fires in newer residential homes. Their observations are summarized as follows:

  - Changes in the Design of New Homes
    - Larger home footprints.
    - Open concept floor plans.
    - More unventilated attics.
    - Increasingly airtight construction.
    - Increased concealed space.
    - Variety in plans and construction types.
    - Increased housing density.
    - Building at the wildland interface.

- **Modern Home Building Trends (continued):**

  - Changes in Home Construction Materials and Techniques
    - Engineered wood assemblies.
    - Combustible exterior finishes.
    - Green building features.

  - Changes in Home Furnishings
    - New information on effectiveness and hazards of fire retardant chemicals in upholstered furnishings.
    - Overall increased plastic contents.
    - Energy-saving technologies.
    - Photovoltaics.
    - Electric vehicles.
    - Energy storage and distributed power solutions.

  - Changing Fire Service-related Risks
    - Shorter time available for size up due to reduced times to flashover.
    - Fire flow/Wind-driven fires phenomena.
    - Current fire ground procedures and firefighter training inadequate to address those new risks.
    - Less experience in fighting fires due to fewer fires.
    - Staffing reductions in selected jurisdictions independent of increased risks.
    - New firefighter gear/tools with varying performance levels.
    - Firefighter gear improvements increasing other personnel risks.
    - Exposure to carcinogens from contents and construction materials.

    (Source: "Changing Severity of Home Fires Workshop Report," US Fire Administration/National Fire Data Center, December 2012)

- **IRC 2012:** Las Vegas adheres to 2012 International Residential Code (IRC), which mandates fire sprinkler systems. However, during the adoption process, the City placed a qualifier on when residential fire sprinklers will be required. Las Vegas City Ordinance 6351 stipulates:

The commencement date for residential sprinkler installation shall be the July 1st that follows the first calendar year, if any, during which the combined number of building permits issued by the Southern Nevada jurisdictions for single family dwellings reaches or exceeds 10,000.
(Note: Southern Nevada jurisdictions include all of Clark County to include the cities of Las Vegas, North Las Vegas, and Henderson.)

Although, special provisions are provided when fire sprinkler systems are installed (0-hour versus 1-hour fire resistance walls and decreased separation distances between homes), the lack of a mandate means that many new homes are built with the inherent issues identified in the bullet statement above.

It is important to note that Residential occupancies are required by the IRC and International Energy Conservation Code (IECC) to limit air leakage to prevent conditioned air escaping the dwelling. This approach to energy savings has created a condition to limit the escape of smoke and fire gases in the case of a fire condition within the dwelling. The combination of fire gases from synthetic materials with limited ability to vent causes fires to reach flashover potential within three minutes of ignition.

- **Incentives or Trade-ups for Homebuilders and Developers.**

  - **Garages:**
    The base IRC, 2012 Edition, Section 302.6 and Table 302.6 requires fire rated separation from habitable rooms and garages when the habitable rooms are located above the garage. The City of Las Vegas may consider the installation of fire sprinklers in the garage space as an equivalent alternative to 5/8" Type X gypsum board. This may be proposed as a local code amendment.
    - As a result, homes and garages with sprinklers can use less expensive and fewer gypsum panels in the construction of garage walls and ceilings. Assuming a 22' by 22' garage with 8' ceilings, two walls adjacent to living space, and living space above, the estimated cost savings per house from this incentive was estimated to be $226.
    - Without sprinklers in the house and garage, the design is assumed to include two layers of 5/8'' Type X gypsum board on the ceiling and have two garage walls with 5/8" Type X panels on both the inside and outside of the wall. These specifications are based on 1-hour rated assemblies found in the Gypsum Association's "Fire Resistance Design Manual." With sprinklers used in the garage and the home, there would be only one layer of ½'' drywall on the ceiling and ½" gypsum panels on the walls dividing the garage from the home.
    - Approximate prices for the 5/8'' Type X and ½'' standard gypsum panels were based on a review of the cost of a 4' by 12' panel from several national retailers who supply the products. The cost for 5/8'' Type X panel was roughly $15.23 per panel while the standard ½'' panel was about $11.98. (These prices are only estimates.)

  - **Exterior Wall Elements:**
    - The IRC requires separation between homes to reduce the likelihood of fire spreading from one home to the next. If they are placed closer than outlined in Section R302.1 (Table R302.1(1)) then a 1-hour minimum fire resistance rating, as tested by approved standards, is required.

- **Exterior Wall Elements (continued):**
    - Table R302.1(2) allows dwellings to be spaced two feet closer when fire sprinklers are installed versus Table R302.1(1) which is used for dwellings without fire sprinklers.
    - This provision allows a home builder to install fire sprinklers to decrease separation distance between houses without exterior walls being rated. The house can grow one foot wider on each side.

- **Increased Fire Hydrant Spacing:**
  The City of Las Vegas allows fire hydrants serving homes built under the IRC to be spaced every 500 feet, and if all homes served by the hydrant have fire sprinklers, then the spacing can be every 600 feet (CLV Fire Code - Section 507). The City of Las Vegas may consider larger spacing of fire hydrants, up to 900 foot intervals with master planned communities where all homes have fire sprinklers. This can be done as a code amendment, or as part of development agreement with a master developer. In considering the information gathered from jurisdictions for this incentive, it was determined that a 400 foot increase in hydrant spacing feet was representative, resulting in an "incentivized spacing" of roughly 900 feet. The more distance there is between hydrants, the lower the hydrant cost per building lot because one hydrant covers more lots. The value of the incentive is therefore presented as a reduced cost per building lot.
    - The value of this incentive was estimated to be $49 per building lot. In calculating this figure, the cost of a fire hydrant is estimated to be $4,000. This figure was obtained from a price sheet of a residential fire hydrant manufacturer (Kennedy). Also, it was necessary to assume that a standard sized lot would have 50 feet of frontage for tract home developments. This figure was sourced from a Tualatin Valley Fire and Rescue report on fire sprinkler incentives, and is a representative lot width in many residential developments nationwide. In considering both sides of the street, 20 building lots can be covered by a hydrant under standard spacing requirements. This results in a per-building lot hydrant cost of $110.
    - There can be 36 lots covered by a single hydrant under the incentivized spacing, reducing the per-building lot hydrant cost to about $122. This translates into an incentive value of $98 per building lot.
    - It is worth noting that the incentive's per-lot value may not hold under certain development scenarios. For example, a sub-division's layout might not allow for each hydrant to cover the maximum amount of building lots. Most hydrants may cover the full 36 lots, but others may cover fewer based on the layout of roads and buildable lots. (This would serve to increase the sub-division's hydrant cost per lot, and reduce the overall value of the incentive.)

- **Increased Fire Hydrant Spacing (continued):**

  - One additional benefit is reducing the need for water district easements for each hydrant location and, if applicable, additional space for on street parking.
    ("Study of Cost Implications Associated with a Voluntary Residential Sprinkler System for New Construction," hydrants. This report provides a comparison between the cost of a sprinkler system and the total value of a number on and off-site tradeoffs, or incentives.)

- **Reduction of Road Width:**
  The City of Las Vegas currently does not allow a reduction of road through a code amendment, but can as a condition of a development agreement. The City of Las Vegas has a fire apparatus access road minimum width requirement of 24 feet. Of the jurisdictions that offer this type of incentive, several different road width reductions are noted.
  - In light of this, a 4' reduction provides a reasonable estimate. In order to present this incentive on a per-lot basis, the reduction in width is divided by two to account for lots being present on each side of the street. The frontage length of a building lot (50') is multiplied by ½ of the road width reduction (2') to determine the area of road, per building lot, which no longer needs to be paved. This area, 100 square feet (SF), is then multiplied by an estimated road development cost ($3.50/SF) to determine the savings from avoided excavation and paving costs ($350/lot). The estimated road development cost per SF of $3.50 was calculated by obtaining the paving cost per single-family lot from Public Works Sources. This cost was divided by one-half the total area of road in front of a building lot, assuming road frontage of 50' and road width of 24', to obtain the cost per SF.

  - The value of the raw land that is able to remain unpaved as a result of this incentive also serves as a component of the value determination, because this land becomes available to the developer for some other use. It is assumed that the developer is able to make some sort of productive use of the non-paved land, such as additional building lots, open spaces, etc. In calculating an estimate for the value of raw land, a raw lot cost of $48,769 was obtained from the NAHB's 2004 Construction Cost Survey while a median lot size of 9,114 for new single-family detached homes was obtained from the U.S. Census Bureau's Characteristics of New Housing for 2009. Relevant data was combined to arrive at a raw land cost of $5.35 per SF, which was in turn multiplied by 100 SF (per lot) to arrive at value of $535/lot for the value of the additional available land.

  - Combining these two components of the reduced road width incentive, the estimated value of the 4' width reduction is roughly $1,172 per building lot.

- **Reduced Fire Flows:**
  Code required fire flow for one- and two-family dwelling currently is a minimum requirement of 1500 gallons per minute (GPM). The fire code as adopted will allow for a 50 percent reduction in fire flow as long as the 1500 gallons per minute is maintained. A reduced minimum fire flow requirement of 750 gallons per minute (GPM), down from a standard flow rate of 1,500 GPM could be implemented for dwellings less than 3000 square feet. The Las Vegas Valley Water District will maintain a minimum flow rate and pressure for residential tract areas, but a reduction in fire flow could reasonably result in the water main size being reduced from 8” to 6” in diameter.
  - The value of this incentive was found to be $50 per lot. For this calculation, it was assumed that the 2” reduction in water main diameter would result in a cost savings of $2 per linear foot of pipe.
  - To obtain the per-lot metric, a lot frontage of 50 feet was used. The water main was assumed to serve both sides of a street; therefore, lots across the street from each other “shared” the value of this incentive, essentially dividing the value by 2. Both the 50’ lot frontage and the $2 cost savings/lineal foot pipe figures were obtained from the Tualatin Valley Fire and Rescue report referenced above.

- **Reduced Cul-De-Sac Width:**
  Based on information gathered from jurisdictions offering this incentive, the most common reduction of a cul-de-sac radius was found to be 2 feet. For instance, to allow developers to decrease the radius of a cul-de-sac 2 feet in exchange for including sprinkler systems in the project’s homes.
  - Unlike some of the previous incentives which have been valued on a per-lot basis, this incentive is valued for a single cul-de-sac. With the three-foot reduction noted above, the estimated value was found to be $5,433 per cul-de-sac. This figure is based on the area of cul-de-sac which would not have to be paved in moving from a 52’ radius to 50’ radius, allowing for the fact that part of this area would still be paved where the road enters the cul-de-sac. Road paving cost per square foot was obtained using the same method as was applied in estimating the value of a reduced road width. (This will also require a code amendment if the City of Las Vegas and the homebuilding industry find value in using this approach.)
  - In addition to reduced excavation and paving costs, this figure is also based on the estimated value of raw land of $5.35 per SF that no longer needs to be paved and becomes available to the developer for some other use. Again, this component of the valuation assumes the developer can make some sort of productive use of the preserved land. The value for raw land was determined using the NAHB and U.S. Census Bureau sources noted above in the discussion on reduced road widths.

- **Increased Dead-End Street Length:**
  The typical amount of extended dead-end street length found in the study was 125 feet.
  - Similar to the incentive for reduced radii of cul-de-sacs, this incentive is not valued on per-lot basis. Instead, the benefit of the incentive is stated in terms of how many lots can be added as a result of the increased street length. Under a scenario where 125 feet of street length can be added to a dead-end, an additional four lots can be included.
  - **T**his determination assumes that a standard size lot includes 50 feet of street frontage, and that lots are situated on both sides of the extended dead-end. It should be noted that the value of these additional lots would be partially offset by added land development costs, and that the application of this incentive could be limited by some development layouts.

- **Secondary Access Point:**
  The International Fire Code as adopted and amended though Section 503.1.2 requires a secondary access point for emergency services when a planned community has more than 100 dwelling units. The code allows this secondary access point to be eliminated until a planned community reaches 200 dwelling units with equipped throughout with residential fire sprinklers. This secondary access point may represent a buildable lot for an additional dwelling unit. The return on investment for the homebuilder and master developer will vary based on the street and lot configuration of the community.

<u>Conclusions:</u>

- **<u>Cost is the wrong metric:</u>**
  The cost of installation is not a core issue. In our opinion, the issue of cost appears to be a "red herring" issue. Certainly, while important, cost cannot be used as the sole criterion for accepting or rejecting the provisions contained in Senate Bill 477, NRS 278.576.
  - First, it does not matter whether fire suppression systems increase value of a Las Vegas home by $3,500 - $5,049 (NIST Study) or provide negative value by as much as $2,230 (Applied Analysis Study). (See Attachments 2 & 3) The real issues are: "Do fire suppression systems work and do they save lives and property?" The answer to both questions is: "Yes."
  - Second, the UNLV Cost Analysis (Attachment 4) demonstrates that having a fire suppression system installed in a new home (during construction, not retrofitting) amortizes to zero within the first 12-18 months of home ownership. What is important about this analysis, is that it used current Las Vegas area costing data.

  - Third, on page 4 of the Applied Analysis study, the following statement is made:

    "It is also noteworthy that to retrofit older, existing houses in unincorporated Clark County with a fire sprinkler system, assuming similar pricing, it would cost nearly $ 1 billion."

Nowhere in Senate Bill 477, NRS 278.576, or any Las Vegas Fire Department proposal put in front of the City Council mention anything about retrofitting older homes. We view this statement as completely unnecessary and a distraction, which may be interpreted as an attempt to strengthen a very weak case against residential sprinkler systems.

- Finally, community developers and homebuilders can realize significant overall cost savings and increased profit margins by allowing residential fire suppression systems to be an integral part of new residential homes built in Las Vegas. These cost savings come in the form of reduced street widths; reduced cul-de-sac widths; less costly building materials in certain areas of the home; and more.

In the opinion of the UNLV researchers, cost is an ancillary issue. This study has essentially put the perception of increased cost of new home construction due to installation of fire suppression systems to rest. Fire suppression systems pay for themselves. So, if cost is not the main issue, what is? The core issue is Safety.

- **Survival is the Paramount Issue:** Abraham Maslow, noted American psychologist, developed a concept called the Hierarchy of Needs. The most fundamental human need is: Survival. While fire alarms provide some level of warning, they do not provide sufficient notification to the occupants of a burning home to allow the occupants to get to safety in a reliable manner. Residential sprinkler systems are designed to put water on the ignition source of a home fire, while allowing the resident to escape safely. Thus, residential fire sprinkler systems in new homes speaks to the most fundamental human need – Survival.

- **Mandated Residential Sprinklers do not "disincentize" home buyers:** The UNLV researchers took the extra step of reviewing new home permits for the Las Vegas area. What was discovered that the City of Henderson, NV (which mandates residential fire suppression systems in all new residential home construction) has surpassed the City of Las Vegas in new home permits. It would appear that mandating residential fire sprinkler systems will not adversely affect new home building in Las Vegas. (Attachment 5)

Recommendation:

In the opinion of the researchers from the University of Nevada Las Vegas, the Las Vegas City Council should immediately pass the ordinance mandating fire suppression systems for all new single family residential home construction.

Attachment 1

Adopted language as a result of Senate Bill 477

NRS 278.586 Adoption of building code or other action by local government requiring installation of automatic fire sprinkler system in new residential dwelling units and other structures.

1. A governing body may adopt a building code or take any other action that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of 5,000 square feet or more.

2. Except as otherwise provided in subsection 3, a governing body may, on or after July 1, 2015, adopt a building code or take any other action that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet only if, before adopting the building code or taking the action, the governing body:

(a) Conducts an independent cost-benefit analysis of the adoption of a building code or the taking of any other action by the governing body that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet; and

(b) Makes a finding at a public hearing that, based on the independent cost-benefit analysis conducted pursuant to paragraph (a), adoption of the building code or the taking of any other action by the governing body that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet is to the benefit of the owners of the residential dwelling units to which the requirement would be applicable and that such benefit exceeds the costs related to the installation of automatic fire sprinkler systems in such residential dwelling units.

3. A governing body may require the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet without conducting the analysis or making the findings required by subsection 2 if the governing body makes a determination at a public hearing that the unique characteristics or the location of the residential dwelling unit, when compared to residential dwelling units of comparable size or location within the jurisdiction of the governing body, would cause an unreasonable delay in firefighter response time. In making such a determination, the governing body may consider:

(a) The availability of water for use by firefighters in the area in which the residential dwelling unit is located;

(b) The availability to firefighters of access to the residential dwelling unit;

(c) The topography of the area in which the residential dwelling unit is located; and

(d) The availability of firefighting resources in the area in which the residential dwelling unit is located.

4. A governing body shall not adopt a building code or take any other action that requires the installation of an automatic fire sprinkler system in a structure other than a residential dwelling unit or any portion of such a structure, whether located on public or private property:

(a) That is covered but not completely enclosed;

(b) That is used primarily for agricultural, livestock or equestrian activities;

(c) That has spectator seating situated around the perimeter of the structure or portion thereof; and

(d) Which is otherwise in compliance with all relevant building codes concerning exits and fire alarm systems.

5. The provisions of this section do not prohibit:

(a) A local government from enforcing an agreement for the development of land which requires the installation of an automatic fire sprinkler system in any residential dwelling unit; or

(b) A person from installing an automatic fire sprinkler system in a structure described in subsection 4 or any residential dwelling unit.

6. As used in this section:

(a) "Automatic fire sprinkler system" has the meaning ascribed to it in NRS 202.580.

(b) "Residential dwelling unit" does not include a condominium unit, an apartment unit or a townhouse unit that shares a common wall with more than one other such unit.

(Added to NRS by 2015, 1989)

Attachment 2

Summary of Benefit-Cost Analysis per Housing Unit: National Study vs. Unincorporated Clark County

(Source: Applied Analysis Study: March 2015)

	National Study (2005 dollars)	National Study (2014 dollars)	Unincorporated Clark County (2014 dollars)
Benefits			
Fatalities Averted	$3,725.57	$4,516.01	$1,019.61
Injuries Averted	$224.74	$272.74	$145.18
Direct Uninsured Property Losses Averted	$79.64	$96.54	$36.95
Indirect Costs Averted	$15.93	$19.31	$7.39
Insurance Credit	$948.41	$1,149.63	$1,341.15
Benefits Subtotal	$4,994.29	$6,054.23	$2,550.29
Cost	$829-$2,075	$1,005-$2,515	$4,780.00

Attachment 3

Cost Benefit Comparison Analysis

	Cost of Sprinkler Installation		
Newly Constructed Tract Home	AA Study (2014 Dollars)	National Study (2014 Dollars)	UNLV Study (2016 Dollars)
Per Square Foot	$2.00	$1.02	$0.95
2,000 Square foot Home	($4,000)	($2,040)	($1,900)

	Benefit		
Newly Constructed Tract Home	AA Study (2014 Dollars)	National Study (2014 Dollars)	UNLV Study (2016 Dollars)
Insurance Premium Credit	12%	8%	15%
Annual Insurance savings	$71	$48	$89
Appreciation in First Year	2.80%	6.80%	2.80%
2,000 Square foot Home	$6,384	$15,504	$6,384
Total Benefit in first year	$6,455	$15,552	$6,473

Attachment 4

The provided Cost Benefit Analysis (CBA) will compare the cost of the installation with a residential fire suppression system versus the monetary benefits. For the ease of a mathematical baseline, the square footage of 2,000 was used to represent a single family new construction tract home in Las Vegas, NV. Please note that number for any square footage of a home does not affect the formula used in the Cost Benefit Analysis.

The following dataset inputs were used in the CBA:

1. The estimate proposal of $.95 per ft² for the cost of installation in a new tract home.[1]
2. The average cost of $114 per ft² to build was used for the square footage of a new constructed tract home. [2]
3. The average home appreciation of 2.8% was applied for a ten-year projection. [3]
4. The discount rate used was the same 4.6% discount rate found in the Applied Analysis study.
5. The average insurance premium discount of 15% for a credit of $89 annually. [4]

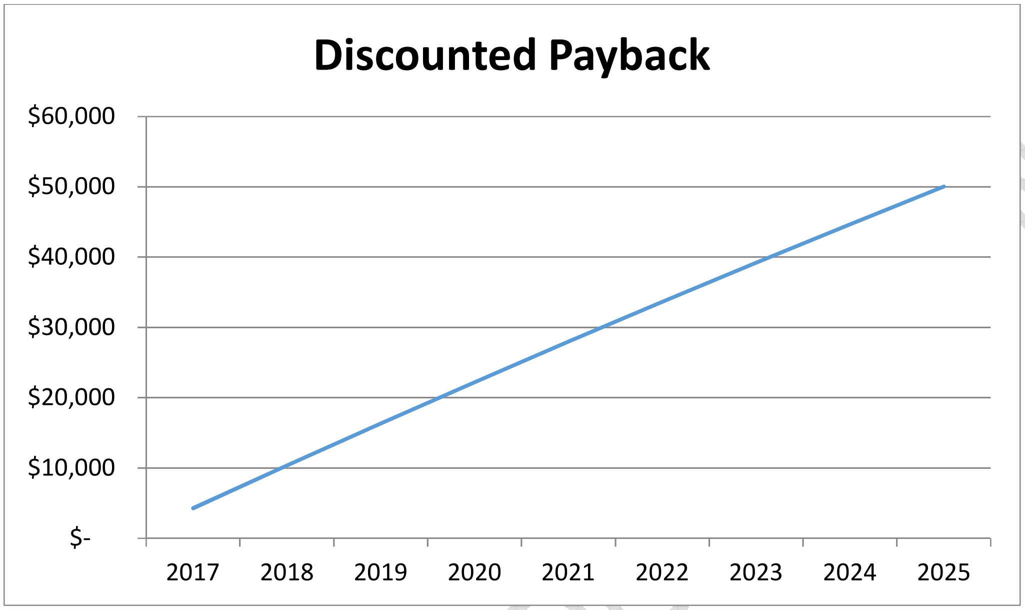
The cost of a new 2,000 ft² tract home is $228,000 in today's dollars net a projected 10-year benefit of $64,032 bringing the potential value of the home to $292,032 in 2025. The investment cost of a $1,900 residential fire suppression system has a payback period in the first year of home ownership. See table 1 below.

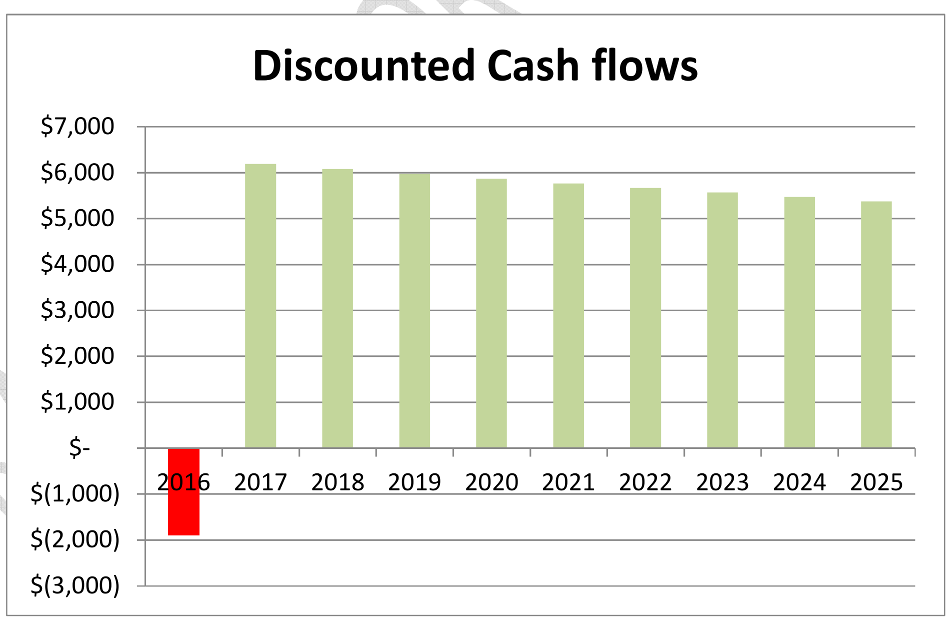
Table 1

2000 SF Single Family Home **$228,000**

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Fire Sprinkler Cost	$(1,900)									
Home Appreciation		$6,384	$6,563	$6,747	$6,935	$7,130	$7,329	$7,534	$7,745	$7,962
Insurance Premium Credit		$89	$89	$89	$89	$89	$89	$89	$89	$89
Total Benefits Per Year/FCF	$(1,900)	$6,473	$6,652	$6,836	$7,024	$7,219	$7,418	$7,623	$7,834	$8,051
Cumulative Benefits	$64,032									
Discount Factors										
Discount Rate	4.6%									
Base Year	2016									
Year Index	0	1	2	3	4	5	6	7	8	9
Discount Factor	1.0000	0.9560	0.9140	0.8738	0.8354	0.7986	0.7635	0.7299	0.6978	0.6671
Discounted FCF	$(1,900)	$6,188	$6,080	$5,973	$5,868	$5,765	$5,664	$5,565	$5,467	$5,371
Cumulative FCF	$(1,900)	$4,288	$10,368	$16,341	$22,209	$27,974	$33,637	$39,202	$44,669	$50,040
NPV	$50,048									
IRR	343%									

[1] The cost of the residential fire sprinkler system was based on an estimate from a local reputable installer.
[2] According to the Las Vegas Review-Journal, the average sale price of home in 2015 is $114 per square foot.
[3] Since 1990 the average appreciation rate for homes in Las Vegas is 2.8% (neighborhoodscout.com).
[4] The average insurance rate premium credit for an automatic sprinkler system to a home in Las Vegas is 15% annually (USAA underwriting, property and casualty).


Discounted Payback
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$-
2017
2018
2019
2020
2021
2022
2023
2024
2025


Discounted Cash flows
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$-
$(1,000)
$(2,000)
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2016
2017
2018
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2020
2021
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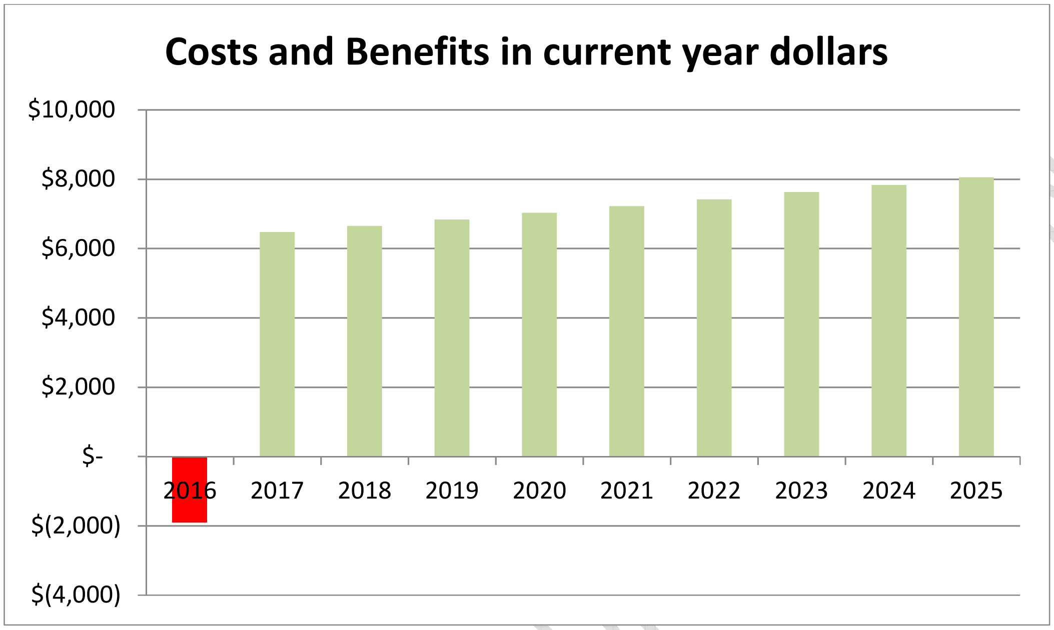
2023
2024
2025

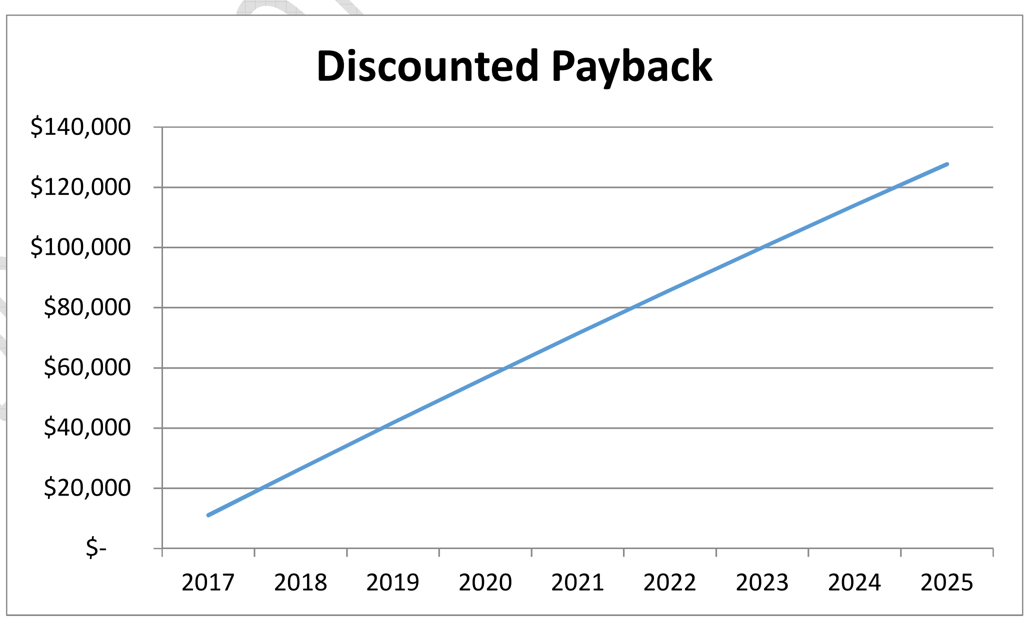

Costs and Benefits in current year dollars
$10,000
$8,000
$6,000
$4,000
$2,000
$-
$(2,000)
$(4,000)
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

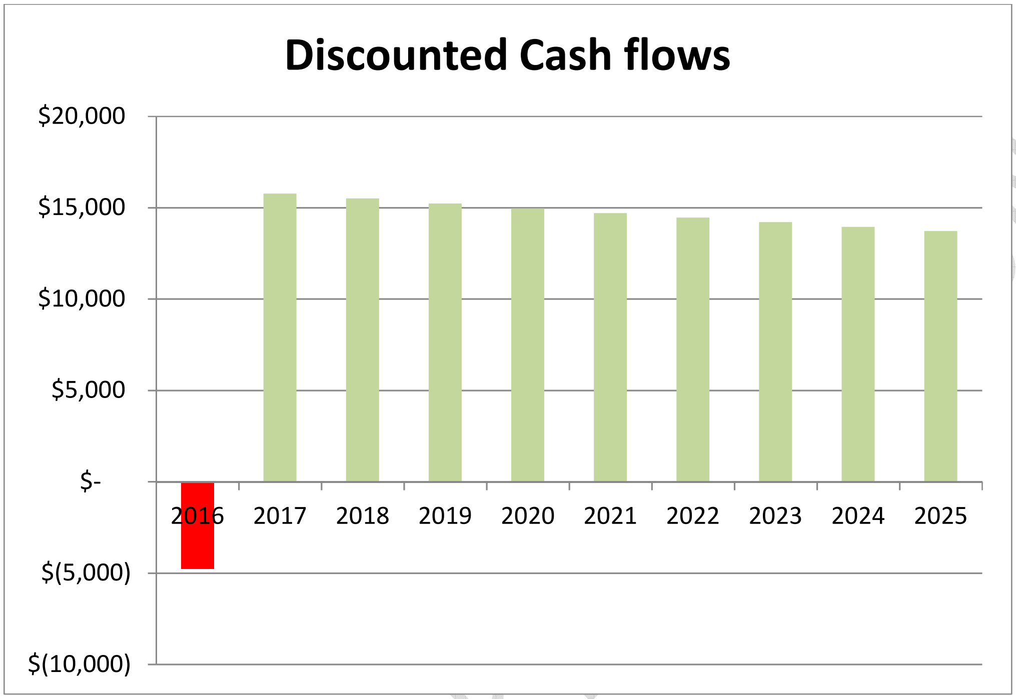
5,000 Square Foot Example:

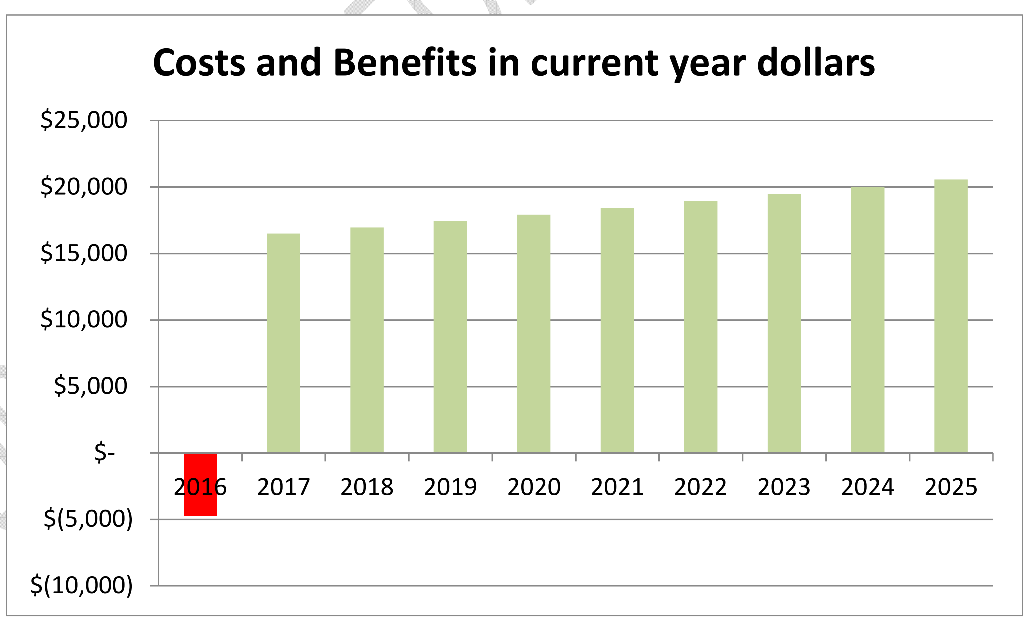
The cost of a new 5,000 ft² tract home is $570,000 in today's dollars net a projected 10 year benefit of $162,180 bringing the potential value of the home to $732,180 in 2025. The investment cost of a $4,750 residential fire suppression system has a payback period in the first year of home ownership. See table 2 below.

Table 2

5000 SF Single Family Home	$570,000									
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Fire Sprinkler Cost	$(4,750)									
Home Appreciation		$16,407	$16,866	$17,339	$17,824	$18,323	$18,836	$19,364	$19,906	$20,263
Insurance Premium Credit		$89	$89	$89	$89	$89	$89	$89	$89	$89
Total Benefits Per Year/FCF	$(4,750)	$16,496	$16,955	$17,238	$17,913	$18,412	$18,925	$19,453	$19,955	$20,552
Cumulative Benefits	$162,180									
Discount Factors										
Discount Rate	4.6%									
Base Year	2016									
Year Index	0	1	2	3	4	5	6	7	8	9
Discount Factor	1.0000	0.9560	0.9140	0.8738	0.8354	0.7986	0.7635	0.7299	0.6978	0.6671
Discounted FCF	$(4,750)	$15,771	$15,497	$15,228	$14,964	$14,704	$14,449	$14,199	$13,953	$13,711
Cumulative FCF	$(4,750)	$11,021	$26,517	$41,745	$56,709	$71,413	$85,863	$100,062	$114,015	$127,726
NPV	$127,734									
IRR	350%									




Discounted Cash flows
$20,000
$15,000
$10,000
$5,000
$-
$(5,000)
$(10,000)
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025


Costs and Benefits in current year dollars
$25,000
$20,000
$15,000
$10,000
$5,000
$-
$(5,000)
$(10,000)
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

Attachment 5

New Home Permits
Las Vegas Area
2001-2016

New Home Permits	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001
Boulder City	3	22	15	10	9	3	11	7	9	19	13	26	45	52	46	69
Clark County	4085	3593	3410	3567	2966	1604	2137	1931	2470	5859	9765	13535	14367	11132	10644	10329
Henderson	2223	1689	1222	1274	1117	799	707	505	1097	2387	4249	4923	4595	4267	3980	4109
Las Vegas	1454	1662	1438	1517	1233	808	926	744	1085	2356	2998	4268	6200	6861	4451	4281
Mesquite	246	202	196	202	169	134	201	106	379	487	303	599	429	387	289	404
North Las Vegas	794	630	471	497	618	510	648	498	834	2365	4262	7007	6105	4599	2735	2665
Totals	8805	7798	6752	7067	6112	3858	4630	3791	5874	13473	21590	30358	31741	27298	22145	21857

http://socds.huduser.gov/permits/

We, the undersigned, have read the Residential Fire Sprinkler Study – Final Copy (July 2017). We monitored the research throughout the study. We have reviewed and agree with the finding, and find that analysis to be sound and thoughtful in its approach. Therefore, we endorse the conclusions reached. Please let us know if you have any questions or need any additional clarifications.

Date: 7/27/17

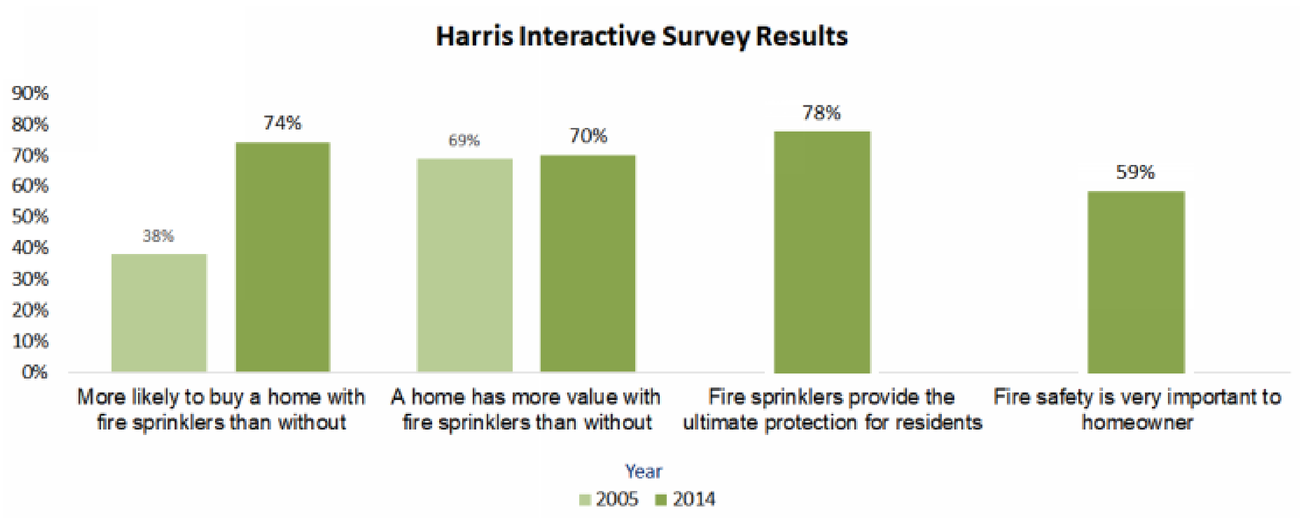
Christopher Stream, Ph.D.
Director
School of Public Policy and Leadership
Greenspun College of Urban Affairs
University of Nevada, Las Vegas (UNLV)

FACT SHEET

Homebuyer Interest in Residential Sprinkler Systems

Beginning with the 2009 edition, the International Residential Code (IRC) has required fire sprinkler systems as a standard feature in all newly constructed homes and townhouses. This document provides information to dispel myths regarding home buyer interest in residential fire sprinkler systems.

It is often stated by representatives of the home building industry that home buyers have little or no interest in purchasing a home with a residential sprinkler system, but surveys conducted in 2005 and 2014 by Harris Interactive say otherwise. The surveys, conducted for the Home Fire Sprinkler Coalition, show significant and increasing interest by homeowners in purchasing a home with sprinklers. The figure below summarizes key survey findings (some questions were new to 2014).



Nearly 3/4 of respondents to the 2014 survey stated that they would be more likely to buy a home with fire sprinklers than one without, and similar percentages agreed that a home with fire sprinklers has more value and provides “ultimate protection” for residents. The 2005 survey included 1,019 U.S. adults, of which 620 were homeowners. The 2014 survey focused exclusively on current homeowners and included 1,026 participants.

The home building industry justifies its claims of low interest based on data from localities where builders are required to offer sprinklers as an option, but these results are misleading because builders will inflate costs and scare buyers with claims of leaks, false activations and water damage in an effort to talk buyers out of installing fire sprinklers. Although builders will claim that they will install a sprinkler system if a buyer wants one, we have many documented examples of cases where that is simply untrue.

About IRC Fire Sprinkler Coalition

Founded in 2007, the IRC Fire Sprinkler Coalition has grown to include more than 100 international, national and regional public safety organizations, including associations representing 45 states, all of whom support the mission of promoting residential fire sprinkler systems in new home construction. More information can be found at www.IRCFireSprinkler.org.

INTERNATIONAL RESIDENTIAL CODE FIRE SPRINKLER COALITION

FACT SHEET
Fire Sprinkler Systems for Townhouses

Beginning with the 2009 edition, the International Residential Code (IRC) requires fire sprinkler systems to be provided as a standard feature in all newly constructed townhouses. This document provides information to dispel myths about the background and costs associated with townhouse fire sprinkler systems.

MYTH: Fire sprinkler systems are an expensive add-on in new townhouses that will negatively impact affordability.

FACTS: The IRC provides numerous financial offsets that reduce the cost of fire sprinklers. For example, townhouse separation walls are permitted to be 1-hour fire rated, rather than 2-hour, when sprinklers are provided. This single incentive can dramatically reduce the overall construction costs, when comparing the total cost of building a sprinklered townhouse with 1-hour separation walls vs an unsprinklered townhouse with 2-hour walls.

According to a 2010 estimate provided by a national “Top 10” multifamily builder, the cost savings associated with reducing a townhouse separation wall from a 2-hour rated assembly to a 1-hour rated assembly is approximately $2.20 per square foot of separation wall. Assuming a 2-story, 1,200 square foot townhouse measuring 20-feet by 30-feet with a pitched roof and attic, the incremental cost of providing a 2-hour wall versus a 1-hour wall would be $1,567. In comparison, the sprinkler system for this building, using the most recent national average cost of $1.35 per square foot cited by the National Fire Protection Research Foundation would be $1,620. Therefore, the firewall incentive alone could reduce the net cost of sprinklers to $53 in this example.

When other factors are considered, such as reduced fire access roadway widths, reduced fire hydrant and water main requirements, and the fact that sprinkler installation costs are often less for townhouses vs. single-family homes due to economies of scale, the overall cost of constructing a sprinklered townhouse community may be less than a non-sprinklered community.

MYTH: Residential sprinkler systems in townhouses are a new and unproven technology that is not yet ready for widespread use.

FACTS: The first residential sprinkler standard was written more than 45 years ago, in 1975, and according to U.S. government statistics, millions of families now live in sprinkler-properties. With respect to townhouses, the **Maryland Building Officials Association**, one of the original proponents of the IRC sprinkler requirement for townhouses in 2008, summed up their extensive experience with fire sprinklers in townhouses in their justification statement, as follows:

> “*Since 1990, townhouses in Maryland have been sprinklered and being so has not been detrimental to the home building industry, but has been a major success to saving lives over the past 18 years. To address reasonable fire protection and affordable housing, many Maryland jurisdictions over the years have permitted townhouse separation of one hour with sprinklers installed in accordance with NFPA 13D. Therefore, based on our past success with sprinklered townhouses with one-hour separations between the townhouses, MBOA is in support of mandatory sprinklers in townhouses with one-hour dwelling unit separations.*

MYTH: The IRC requirement to install fire sprinklers in townhouses was initiated by the fire service and the fire sprinkler industry and it was forced on builders.

FACTS: The code change proposal that added the IRC fire sprinkler requirement (Proposal RB66-07/08) was actually submitted by a major multifamily builder, AvalonBay Communities, and public comments supporting this change were submitted by the Maryland Building Officials Association and the New York State Building Officials Conference. As a major builder of multifamily residential properties, AvalonBay Communities developed extensive experience in installing fire sprinkler systems in townhouses and concluded that sprinkler systems were desirable, cost-effective and should be required as a standard feature in new townhouses.

MYTH: It's best to give home buyers the right to choose whether or not to have sprinklers, as opposed to having codes mandate these systems in all townhouses.

FACTS: It is a fundamental function of building codes to ensure safe housing. Home buyers don't get to choose whether their homes are built to withstand seismic forces, wind loads or snow loads. Likewise, home buyers aren't given the choice of having or not having safe electrical, plumbing, or mechanical systems or smoke alarms. Codes provide minimum requirements for all of these aspects of safe housing in the interest of public safety.

Fire sprinkler systems are no different. Just as car safety regulations have evolved over time from only requiring seat belts to now requiring air bags and backup cameras, building codes have evolved from requiring only smoke alarms to now requiring sprinkler systems for fire safety.

In the case of townhouses, it particularly makes sense for codes to require sprinkler systems because each family's safety is reliant on their neighbors. An accident or careless behavior in one unit often impacts multiple units in non-sprinklered townhouses. Fire sprinklers are the most effective way to ensure that a fire in one townhouse will not threaten families in adjacent units.

Furthermore, townhouses are typically constructed as "spec homes," without buyer involvement during the design or construction process. Adding sprinklers after-the-fact to a finished townhouse unit would greatly increase the cost and complexity of the installation, if it were feasible at all. Likewise, it makes no sense to allow an initial buyer, or the builder in the case of a speculative home, to opt out of fire sprinklers, knowing that such a choice will deny all future owners the option of having sprinklers, given that retrofit installations are typically not feasible.

About IRC Fire Sprinkler Coalition. Founded in 2007, the IRC Fire Sprinkler Coalition has grown to include more than 100 international, national and regional public safety organizations, including associations representing 45 states, all of whom support the mission of promoting residential fire sprinkler systems in new home construction. More information can be found at www.IRCFireSprinkler.org.

INTERNATIONAL RESIDENTIAL CODE
FIRE SPRINKLER COALITION

FACT SHEET

Water Supplies for Home Fire Sprinkler Systems

This document has been developed to dispel myths by providing factual information about water supply requirements for home fire sprinkler systems.

MYTH: ***Home fire sprinkler systems require expensive upgrades to a new home's water supply system.***

FACTS: Home fire sprinkler systems have become so efficient that they can often be designed to use the same or even less water than a new home's plumbing system.

- Fire sprinklers typically require only 7 pounds-per-square-inch (psi) to operate, which is less than the minimum required pressure for residential plumbing fixtures.

  Plumbing systems require:
  - 8 psi minimum pressure for any plumbing fixture.[1]
  - 20 psi minimum pressure for temperature controlled shower valves (these are mandatory in new homes).[2]
  - 40 psi minimum pressure for the main supply connection (applies to all homes with indoor plumbing, even those supplied by wells).[3]
- A single fire sprinkler can use as little as 8 gallons-per-minute (gpm). With home fire sprinkler systems typically designed to accommodate two simultaneously flowing sprinklers, 16 gpm may be all that's needed to supply fire sprinklers. This is actually less than the 18 gpm minimum that would be required by the Plumbing Code to supply plumbing fixtures in a typical entry-level home with 3 bedrooms, 2 bathrooms and 2 outdoor hose connections.[4]
- Fire sprinklers will typically require more water in larger, more expensive homes, but such homes tend to have more plumbing fixtures, which require an increased water supply for plumbing as well. One or two sprinklers must flow for a minimum of 7-10 minutes, which can be provided by a well and/or a small tank when sprinklers are not supplied by a water distribution system.

MYTH: ***Home fire sprinkler systems require big, expensive water meters.***

FACTS: When a fire sprinkler system is supplied by a water distribution system, water meter size is based on the required pressure and flow, which as stated above, may actually be greater for plumbing than for fire sprinklers. Fire sprinklers won't lead to increased meter or tap fees when the sprinkler system is able to be supplied by the same size meter that serves household plumbing.

A typical 5/8-inch meter will flow up to 20 gpm, which is adequate to operate a fire sprinkler system in many homes.[5] A 3/4-inch meter, which will flow well over 30 gpm, is capable of handling just about any home fire sprinkler system. Most often, the size of underground pipe leading to a house is much more limiting than the meter itself. Upsizing the underground piping

[1] International Residential Code (IRC) Table P2903.1
[2] IRC Section P2708
[3] IRC Section P2903.3
[4] IRC Table P2903.6 [17.5 fixture units: 2 bathroom groups, 1 kitchen group, 1 laundry group and 2 hose bibs], and IRC Table P2903.6(1)
[5] IRC Table P2904.6.2(2) [This is the prescriptive allowance for any meter. When a meter of known flow characteristics flows more, the higher flow may be used.]

between the meter and the house is an easy and inexpensive way to improve pressure and flow for all plumbing, including fire sprinklers, without a larger meter.

It's important to note some meter manufacturers' literature specify lesser flow limits, focusing on the range over which a meter will accurately measure continuous flow. With respect to supplying home fire sprinklers, meter flow limits should be evaluated based on the maximum flow rate rather than continuous flow accuracy limits. Water authorities should recognize that sprinklers will always use less water than fire hoses connected to unmetered fire hydrants that would otherwise be needed to put out a fire, so there is no legitimate value in requiring accurate measurement of sprinkler flow in the event of a fire

MYTH: Fire sprinkler systems require expensive backflow preventers.

FACTS: National plumbing codes never require backflow protection for home fire sprinkler systems fabricated with materials approved for household plumbing, such as CPVC, PEX or copper.[6] Occasionally, a local plumbing authority may nevertheless request a backflow preventer, not recognizing that fire sprinkler systems can be safety connected directly to a potable water supply.

Where backflow prevention is an issue because of a local requirement, there are several options whereby additional backflow controls for fire sprinklers can be avoided.

- Fire sprinklers can be incorporated as part of a multipurpose plumbing system that feeds both sprinklers and plumbing fixtures from a home's cold water plumbing pipes.
- Fire sprinklers can be supplied by a separate water connection, with a toilet connected to the end of sprinkler piping to ensure that the piping is occasionally purged by flushing the toilet to prevent stagnant water. This arrangement is referred to as "passive purge."
- Where a yard irrigation system is installed, backflow prevention will be required because such systems are subject to backflow of non-potable water. Fire sprinklers can share the irrigation backflow preventer; thereby, eliminating the need for an additional device.

MYTH: Rural water distribution systems and wells don't have enough water to supply home fire sprinklers.

FACTS: As indicated above, if the water distribution system or well provides enough water to supply household plumbing needs, the supply may be adequate for fire sprinklers. In some cases a larger pump or tank may be needed for sprinklers, but standard, off-the-shelf pumps and tanks suitable for plumbing systems are permitted. When such upgrades are provided, they actually benefit the owner on a daily basis beyond fire protection, because the home's plumbing system will be more robust. Additional water storage can also be invaluable for emergency use in the event of a natural disaster that interrupts utilities.

It should also be noted that, were a rural water distribution system found to be inadequate to supplying 16 gpm for fire sprinklers, it would probably fall short of the minimum code-required plumbing demand, and it would surely fall far short of the 1,000+ gpm needed from fire hydrants to support a fire department extinguishing a fire in an unsprinklered home.

About IRC Fire Sprinkler Coalition
Founded in 2007, the IRC Fire Sprinkler Coalition has grown to include more than 100 international, national and regional public safety organizations, including associations representing 45 states, all of whom support the mission of promoting residential fire sprinkler systems in new home construction. More information can be found at www.IRCFireSprinkler.org.

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[6] IRC Section P2904.1

The Home Fire Sprinkler Coalition outlines “Community Risk Reduction” strategies that include how trade ups (modifications) to existing building and fire codes offset the costs associated with installing sprinkler systems. These benefits to builders, developers, and communities are outlined here:

https://homefiresprinkler.org/community-risk-reduction/

The Home Fire Sprinkler Coalition has a number of community case studies where the developer incentive programs were utilized and has published case studies on those communities outlining the costs and benefits associated. Those case studies can be downloaded here:

https://homefiresprinkler.org/fire-sprinkler-incentives-case-studies/

The Home Fire Sprinkler Coalition has developed a number of educational resources for delivering the information about home fire sprinklers, targeting developers, builders, and home buyers. These include PowerPoint presentations, pdf documents, and videos. The can be accessed here:

https://homefiresprinkler.org/free-resources-stakeholders/

BENEFITS of RESIDENTIAL FIRE SPRINKLERS:

Prince George's County 15-Year History with its Single-Family Residential Dwelling Fire Sprinkler Ordinance

PRINCE GEORGE'S COUNTY
MARYLAND
FOUNDED 1634

Prepared by Steve Weatherby
August 2009

Produced in cooperation with the Home Fire Sprinkler Coalition, University of Maryland University College, Prince George's County Fire Department and the Maryland State Fire Marshal's Office.

Home Fire Sprinkler® COALITION
Protect What You Value Most™

HomeFireSprinkler.org

Acknowledgements

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Maryland Fire and Rescue Institute

Table of Contents

Executive Summary

In 1992, Prince George's County in Maryland enacted an ordinance mandating the installation of automatic fire sprinkler systems in new one- and two-family structures. Through a partnership with the Home Fire Sprinkler Coalition (HFSC), the Maryland State Fire Marshal's Office, the Prince George's County Fire Department, and the University of Maryland University College, a study was conducted to review Prince George's County's experience with this ordinance over the 15-year period of 1992-2007.

The most obvious benefit of the ordinance is the direct impact that home fire sprinkler systems have made in saving lives and reducing fire-related injuries.

From 1992-2007, there were 101 fire deaths and 328 civilian injuries in single-family or townhouse fires that were not protected with fire sprinkler systems. No fire deaths occurred in sprinklered-structure fires during the period studied, and there were only six civilian injuries.

Property protection is another important benefit. Looking at the average loss per event in a structure that did not have a residential sprinkler system installed, the damages averaged $9,983 per incident, and $49,503 per incident when there was a fatality. The average loss for a single-family/ townhouse structure protected by fire sprinklers was $4,883 per event. Having sprinklers cut the property loss by almost one-half.

Prince George's County experienced 13,494 single-family or townhouse fires during the period, with an average of 900 fires per year. The County's total fire loss for single-family/townhouse structures topped $134 million, averaging almost $9 million per year. Prince George's County's data indicates that more than 45,000 permits were issued for single-family/townhouse structures from 1992 through 2007, with an average issuance of 3,019 permits per year.

During the period studied, Prince George's County Fire Department (PGFD) recorded 245 sprinkler activations in single-family and townhouse structure fires. In the 245 activation incidents, PGFD recorded no lives lost and only six civilian injuries. PGFD reports 446 residents were present in the structures during the time of sprinkler activation. More than 80 of those residents were present when sprinklers activated during the hours of 10:00 p.m. to 5:59 a.m., which is the most common time for fire deaths to occur, according to NFPA fire data. In the 245 activation incidents, the PGFD estimated the fire loss at $1,352,820, compared to a total potential loss of $42,578,420.

The cost impact to developers/builders was determined by interviewing several Prince George's County sprinkler contractors, who indicated that the per-square-foot cost to install a fire protection system in a single-family home in the County has decreased over the years to under $2.00 per square foot. This is consistent with a recent NFPA study that found the average cost of installation nationally to be $1.61 per sprinklered square foot. ❖

Demographics

Prince George's County, Maryland, is roughly 500 square miles and is situated in close proximity to Washington, DC. Prince George's County has a mixture of light industrial, retail, residential and institutional structures that are protected by the county's fire department. Prince George's County is known for providing affordable living for many people who commute to work in the Washington, DC area(1).

Most of Prince George's County's population is concentrated in the northern two-thirds of the County(1). The southern part of the County is predominantly rural(1) but urban sprawl has pushed development into these areas, which are affected by Prince George's County's residential sprinkler code. According to Census figures(6), the average population in the County from 1992-2006 was 846,000 residents. In 2007, it was 828,770. The overall population of Price George's County has grown 11 percent on average since the enactment of the residential sprinkler ordinance(6).

The average median income in Prince George's County in 2004 was $55,129.00(6). The percentage of home ownership in Prince George's County is 61.8 percent, which is almost 6 percent less than the average for the State of Maryland and in 2008 the median value of a single-family dwelling in Prince George's County is $145,600(6).

YEAR	POPULATION	% CHANGE	No. of Permits
1992	740,390	N/A	3680
1993	743,156	1.00%	3858
1994	751,282	1.01%	2418
1995	757,795	1.00%	4344
1996	764,644	1.00%	3635
1997	769,840	1.00%	2920
1998	776,907	1.00%	2664
1999	781,781	1.00%	2927
2000	803,291	1.02%	2506
2001	815,203	1.01%	2467
2002	824,365	1.01%	3068
2003	830,513	1.00%	2088
2004	835,021	1.00%	2233
2005	838,156	1.00%	2782
2006	834,660	-1.00%	2233
2007	828,770	-1.00%	1462
		11.05%	**45,285**

Source: US Census Bureau Estimates

Source: Prince George's County Planning Department Estimates

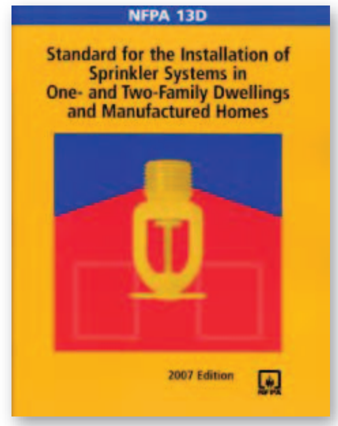
Since 1992, Prince George's County has issued more than 45,285 building permits for one- and two-family dwellings. The average yearly issuance of one- and two-family dwelling building permits is 3,019.

The Prince George's County Fire Department has 44 stations with a career staff of more than 800 individuals and a volunteer force of 2,000 members. There are 1,200 active emergency responders. In 2007, Prince George's County Fire Department responded to nearly 127,000 calls for service(7). ❖

Prince George's County Residential Sprinkler Ordinance

In 1987, Prince George's County signed a mandatory fire sprinkler law for all residential structures. This law covered every type of residential dwelling from multi-family structures to townhomes to one- and two-family structures. This law was to be phased in over the next five years with the final phase requiring all newly constructed single-family structures to be protected by an NFPA 13D fire sprinkler system(1).

The ordinance was phased as follows: one- and two-family model homes were to feature residential fire sprinklers by February 1, 1988. All newly constructed multi-family structures were to have residential fire sprinklers installed by January 1, 1989. In the final phase, January 1, 1992, all newly constructed single-family homes were to be fully protected by an NFPA 13D residential sprinkler system (1). ❖



Statistical Comparisons

This report consolidates the data collected from Prince George's County Fire Department. The fire department tracked each sprinkler activation by dispatching an on-duty Fire Marshal to the scene. The Fire Marshal was required to complete a Sprinkler Activation Report, which included the type of structure, documentation of the number of sprinklers activated, the potential cause, the type of sprinkler system, the room(s) involved, total dollar value of the property, the estimated dollar loss, and the number of residents present in the structure during activation.

From the years 1992 to 2007, Prince George's County recorded a total of 13,494 single family/ townhouse fires and 245 of those were protected by fire sprinkler systems. In those 245 incidents, no deaths were recorded and only six injuries were reported. In the 13,249 fires that occurred in homes that were not protected by sprinklers, 101 residents were killed and 328 were injured. Fire deaths in residential dwellings made up 89% of the fire deaths in Prince George's County during the years.

Four hundred forty-six persons were present in the structures at the time of sprinkler activation. According to the NFPA, the most vulnerable time of day for home fire deaths is between the hours of 10:00 p.m. and 6:00 a.m. Eighty-one occupants were present in their homes during this time period. Another 294 residents were home at the time of sprinkler activation between the hours 6:00 a.m. and 9:59 p.m. Seventy-one residents were home during activation at unrecorded times.

During the study period, there were 45 recorded residential fire deaths between the hours of 6:00 a.m. and 9:59 p.m., 38 recorded residential fire deaths between 10:00 p.m. and 5:59 a.m. and 18 recorded residential fire deaths where the timeframe was not known in residences without sprinklers.

Fire Deaths and Fire-Related Injuries

89% **of Total Fire Deaths Occurred in Residential Dwellings**

101 **people died in single-family and townhouse fires with no fire sprinklers**

328 **civilian injuries in single-family and townhouse fires with no fire sprinklers**

0 **fire deaths in homes protected with fire sprinklers**

These findings clearly show the benefits of an automatic sprinkler system. The most compelling data is that no deaths occurred in any fire where a fire sprinkler system was present. In a tragic contrast, 101 people lost their lives to fires in nonsprinklered home fires during the same period. When one looks at the large number of residents present during fires in sprinklered homes, the protective value of home fire sprinklers is underestimated even more. These residents would have been at a much higher risk of death due to flame and smoke spread had their residences not been sprinklered.

In some of the cases analyzed, residents were impaired or asleep at the time of the fires and were awakened by fire crews. In these instances, the sprinkler system's ability to keep the fire controlled with just one or two sprinklers allowed responding fire crews to rescue the residents in a

Statistical Comparisons *(continued)*

less hazardous environment. In 96 percent of the 245 reported fire-related sprinkler activations only one or two sprinklers operated.

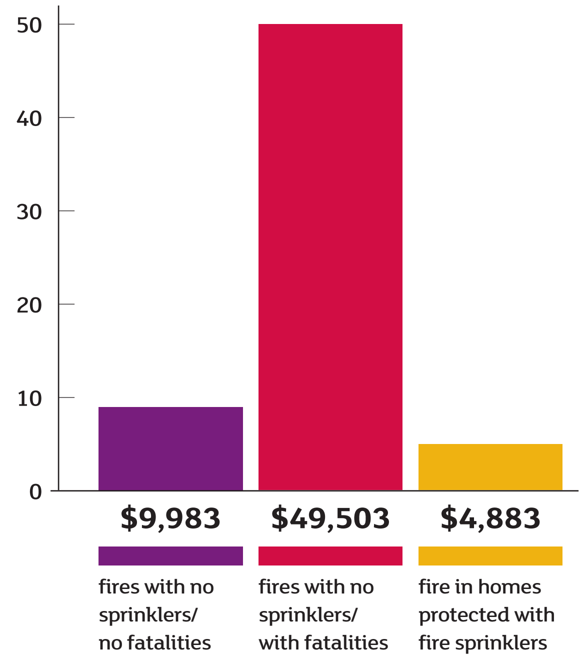
Another important advantage of home fire sprinklers is property protection. From the years 1992 to 2007, Prince George's County Fire Department recorded fire loss for single-family homes and townhouses at $134,711,199. Property loss from the 245 activated sprinkler events was $1,352,820. The average loss per event in a structure that did not have a sprinkler system installed averaged $9,983 per incident. The average fire loss in a structure that was not protected by a sprinkler system and resulted in a fatality came to $49,503. The average loss for a sprinklered single-family/townhouse structure was $4,883 per event. (See chart.) This cut the property loss by almost one-half in single-family and townhouse residences and is at least 10 times less than a fatal non-sprinklered residential fire.

The average water output of a residential fire sprinkler is between 13-15 gallons per minute. The average flow from a fire hose is 95 to 200 gallons per minute, under high pressure. Obviously, the activation of a fire sprinkler will create far less water damage.

Another benefit to the residents of Prince George's County is lower insurance costs for homeowners. Having a home fire sprinkler system helps protect the structure and its contents, lowering the replacement risk of the dwelling. When the sprinklered housing stock increases, the overall fire loss will decrease. which potentially decreases the insurance premiums for everyone.

The cost of installing a residential fire sprinkler system has long been debated. A 2008 study by the Fire Protection Research Foundation showed

Average Property Loss Per Incident



that the national average cost for fire sprinkler installation is $1.61 per sprinklered square foot. In the report, the average median sprinkler-protected area of a new construction single-family home is 4,124 square foot, which makes the cost of a full NFPA 13D system $6,640 for an average sprinklered structure(4). The Research Foundation study used Prince George's County as one of Its models and showed that within five years of the ordinance being enacted, the average installation cost dipped below $1.00 per square foot. At this price point, sprinkler installation should be less than a 5 percent increase over the entire cost of construction for the single-family structure. ❖

Conclusion

This study shows numerous benefits that residential fire sprinklers provide to the public. Prince George's County's residential sprinkler ordinance has had a significant impact on life safety and reduction of property damage. Prince George's County's experience of suffering no loss of life in a sprinklered home should provide ample justification for other jurisdictions throughout the country to pass similar ordinances. ❖

References

1 **Residential Sprinklers: One Community's Experience Twelve Years after Mandatory Implementation**
Fire Chief Ron Siarnicki, Prince George's County Fire Department, January 2001.

2 Source: **National Fire Protection Association: Fire Loss in the U.S. 2007** and **USFA's Firefighter Fatalities in the United States in 2007**

3 **Automatic Sprinklers: A 10-Year Study**
City of Scottsdale, AZ, Rural/Metro Fire Department and the Home Fire Sprinkler Coalition, 1997.

4 **Home Fire Sprinkler Cost Assessment**
The Fire Protection Research Foundation, Newport Partners, 2008.

5 **http://www.realestatemapsmdva.com/princegeorges.shtml**

6 **http://www.quickfacts.census.gov/qfd/states/24/24033.html**

7 **http://www.co.pg.md.us/Government/PublicSafety/Fire-EMS/index.asp**

Virginia Townhouse Sprinkler Price Survey

Compiled by Jeffrey Shapiro, P.E., FSFPE, IRC Fire Sprinkler Coalition 12/7/2020

The information below has been provided by two sprinkler contractors who were asked to provide Virginia-specific price histories for townhouse projects built in Virginia in the past few years. These are the prices charged to builders, exclude any builder markup that might increase the actual cost to consumers, and exclude permit fees that may be charged in addition to the base building permit cost.

Response from Contractor 1

- The following data reflects costs for 10 projects constructed between 2016 and 2019. Prices do not include added costs associated with local amendments exceeding what is required by the nationally recognized standard.

Job Location	Year	Cost per Unit	Average Cost Per Square Foot
Reston, VA	2019	$2,050.00	$1.33
Reston, VA	2017	$2,045.00	$1.27
Reston, VA	2017	$1,800.00	$1.17
Haymarket, VA	2016	$2,762.00	$1.25
Haymarket, VA	2016	$2,490.00	$1.13
Haymarket, VA	2016	$2,350.00	$1.16
Leesburg, VA	2020	$3,525.00	$1.21
Leesburg, VA	2020	$3,250.00	$1.25
Alexandria, VA	2019	$4,900.00	$1.48
Alexandria, VA	2019	$5,000.00	$1.41

- **Fairfax County average price is $1.26 per square foot (NFPA 13D).**
- **Prince William County average price is $1.18 per square foot (NFPA 13D).**
- **Loudon County average price is $1.23 per square foot (NFPA 13D).**
- **Arlington County average price is $1.31 per square foot (NFPA 13D).**

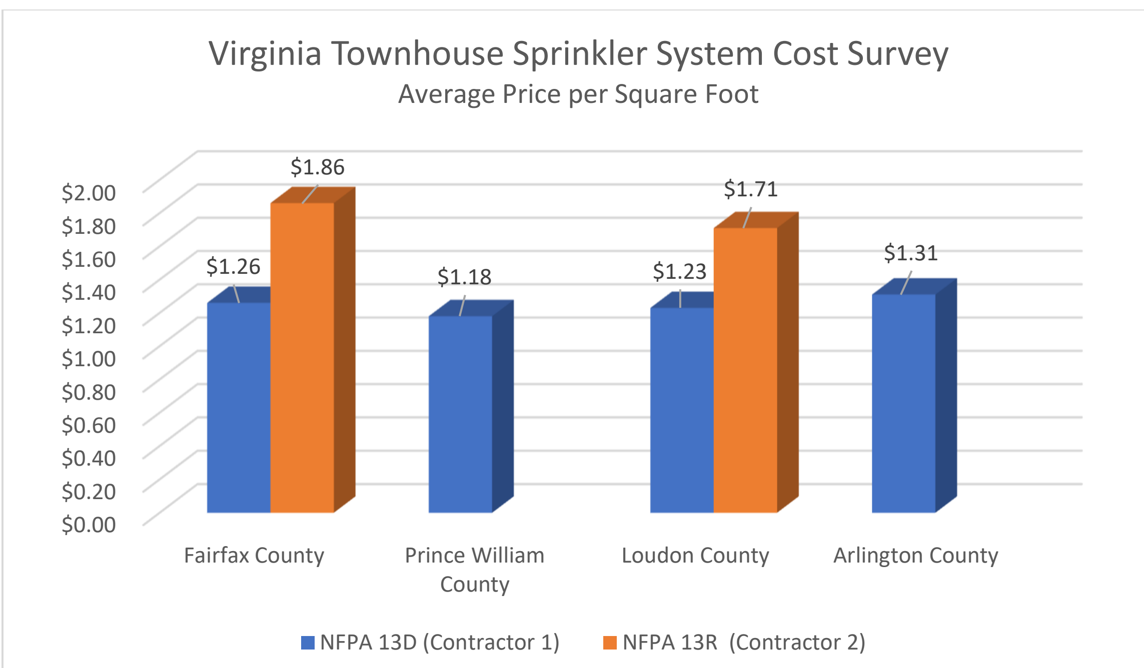
Response from Contractor 2

- **Loudoun County average price is $1.71 per square foot (NFPA 13R).**
  - $1.71 figure represents the average price for over 500 units constructed by four different builders in the past five years.
  - Loudoun permits a modified NFPA 13R design, that does not require a fire department connection and permits a design based on 2 sprinklers operating, rather than 4, which is ordinarily required under NFPA 13R.
- **Fairfax County average price is $1.86 per square foot (NFPA 13R)**
  - The $1.86 figure represents the average price for 220 units constructed by three different builders in the past four years

Costs provided by this contractor exceed what would be expected to comply with the proposed Virginia Residential Code because the costs reflect systems that were designed to the NFPA 13R standard, not the NFPA 13D standard, which the residential code will permit. NFPA 13R systems are typically used to protect large residential complexes and are more expensive than NFPA 13D systems, which are for protection of townhouses and one- and two-family dwellings.

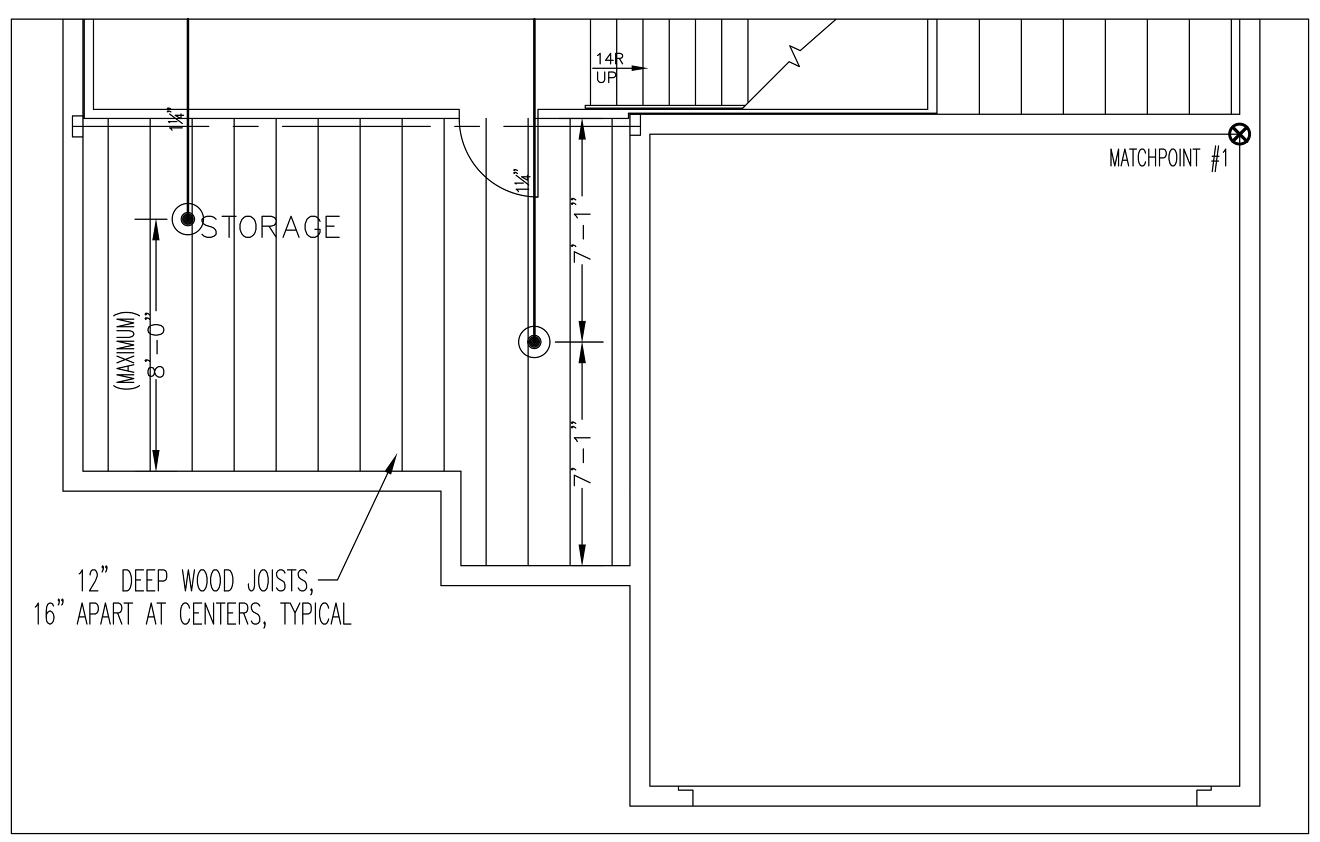
The table and figure on the following page summarize all results

Fairfax County	**NFPA 13D**	**$1.26**
Fairfax County	**NFPA 13R**	**$1.86**
Prince William County	**NFPA 13D**	**$1.18**
Loudon County	**NFPA 13D**	**$1.23**
Loudon County	**NFPA 13R**	**$1.71**
Arlington County	**NFPA 13D**	**$1.31**



ALL LINE PIPING TO BE 1¼" PIPE
ALL DROPS FOR PENDENT HEADS TO BE 1" PIPE

CPVC PIPE
STEEL PIPE



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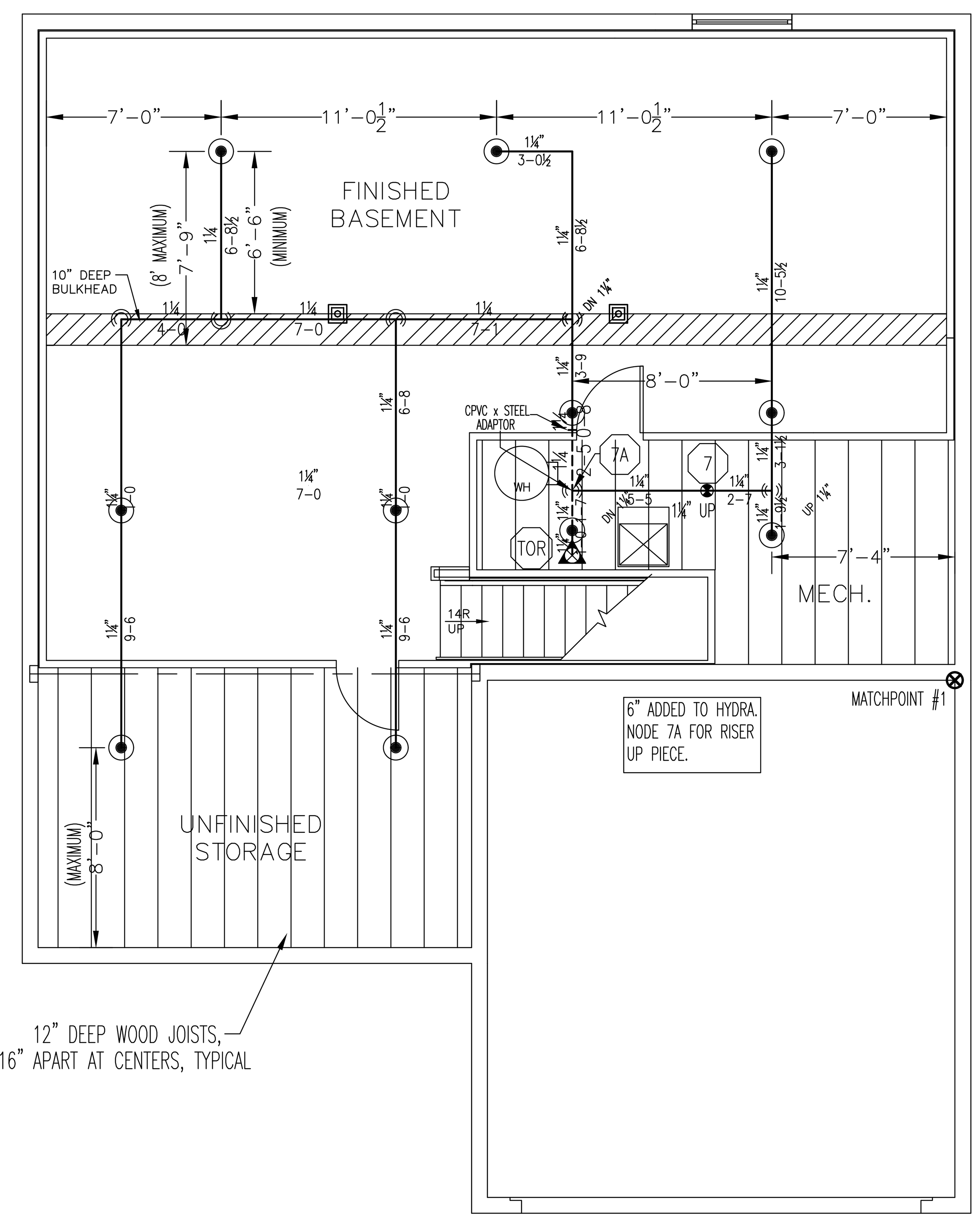
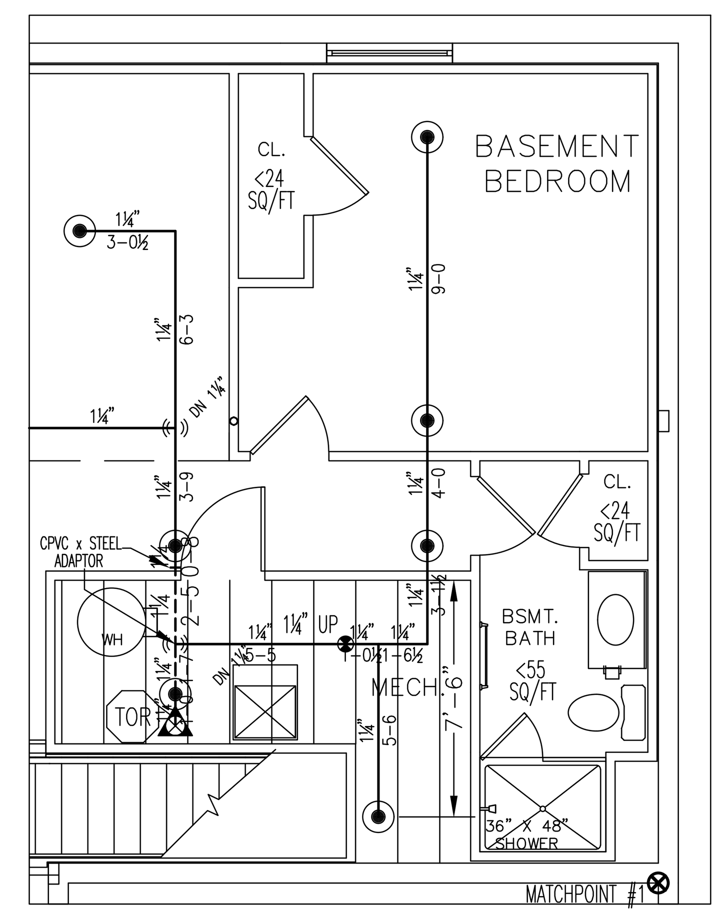
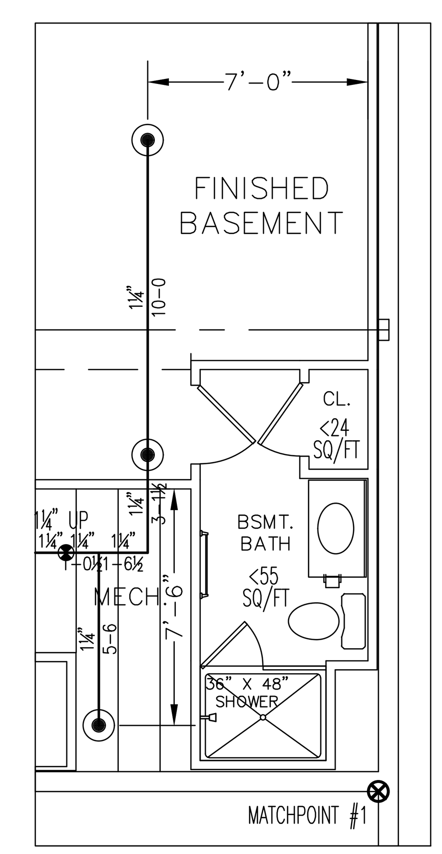


BASEMENT



OPT. BASEMENT BEDROOM W/BATH



OPT. BASEMENT BATH

AS-BUILT
01/25/2021
FPP2021-00386

SPRINKLERS				
SYMBOL	MANUF/MODEL	TEMP.	FINISH	TOTAL
½" REC. PEND.	VIKING / QR VK468	155 DEG	WHITE	11
½" REC. PEND.	VIKING / QR VK468	175 DEG	WHITE	0
½" REC SIDEWALL	VIKING / QR VK486	155 DEG	WHITE	0
½" REC SIDEWALL	VIKING / QR VK486	175 DEG	WHITE	0
JOB TOTAL	40	TOTAL THIS SHEET		11

DESIGN CRITERIA			
NFPA REF.	#13D	FLOW TEST:	
TYPE SYS.	WET	STATIC PSI	
HAZARD	LIGHT HAZARD	RESIDUAL PSI	
DENSITY	.05	@ FLOW	
REMOTE AREA	2 HEADS	HYDRANT ELEV.	
MAX. S.F./HD.	256–288	HYD. LOW GRAD.	
K FACTOR	4.0–4.9	HYD. HIGH GRAD.	
C FACTOR	120 – 150	ADJ STATIC PSI	
		ADJ RESID. PSI	
INSIDE HOSE	N/A	INFO BY	
OUTSIDE HOSE			

SPECIALTY ITEMS	
FIRE PUMP:	F.D.C.:
RATED FLOW:	TYPE:
RATED BOOST:	SIZE:
SUCT. X DIST.	FINISH:
RELIEF VALVE:	F.H.V.:
FUEL TANK:	FINISH:
MUFFLER:	ALARM VALVE:
TEST HEADER:	DRY VALVE:
TYPE:	OTHER:
SIZE:	
FINISH:	

SYMBOLS
RISER BETWEEN FLOORS
TOP OF SPRINKLER RISER ASSEMBLY
MATCH POINT FOR LAYOUT OPTIONS
RISE/DROP IN PIPE ELEVATION
HYDAULIC NODE

PLAN REVISIONS		
DATE:	BY:	DESCRIPTION:
01/25/21	WML	1.AS-BUILT OPTION LAYOUT HAS BEEN PROVIDED
		STUDY OPT WITH POWDER ROOM AND NOW A PANTRY
		THAT REQUIRED COVERAGE.

SCALE
1/4"=1'-0" 0' 5' 10' 15' 20'

JOB NAME: BLACKBURN HUDSON MODEL HOME 11249 WHEELER RIDGE DR MANASSAS, VA 20109					
DATE: 12-02-2020	SCALE: 1/4"=1'-0"	CONTRACT NO: 20-0158	APPROVALS: PRINCE WILLIAM COUNTY F.M.O.		
PLAN NORTH	DRAWN BY: WML	REVIEWED BY:	CONTRACTOR: NVR, INC.		
	AREA: LOT 71 BASEMENT			CAD FILE: BLACKBURNSUBMIT	DRWG NO: 1 OF 5
	PERMIT NO: BLD2021-03547		CONTRACTOR PHONE: 540-428-8712		

BFS
BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

ALL LINE PIPING TO BE 1¼" PIPE
ALL DROPS FOR PENDENT HEADS TO BE 1" PIPE

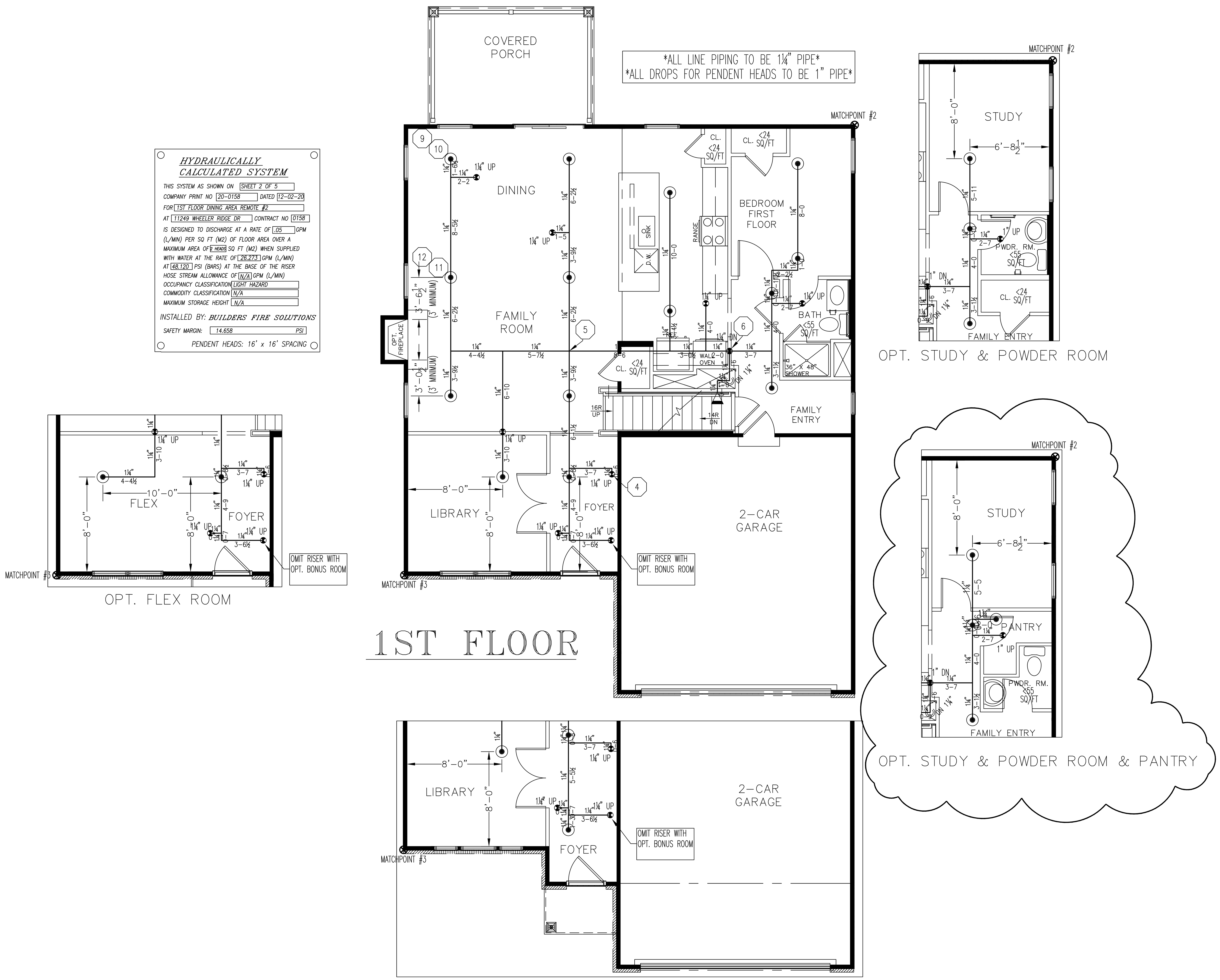
HYDRAULICALLY CALCULATED SYSTEM

THIS SYSTEM AS SHOWN ON SHEET 2 OF 5
COMPANY PRINT NO 20-0158 DATED 12-02-20
FOR 1ST FLOOR DINING AREA REMOTE #2
AT 11249 WHEELER RIDGE DR CONTRACT NO 0158
IS DESIGNED TO DISCHARGE AT A RATE OF .05 GPM (L/MIN) PER SQ FT (M2) OF FLOOR AREA OVER A MAXIMUM AREA OF 2 HEADS SQ FT (M2) WHEN SUPPLIED WITH WATER AT THE RATE OF 26.273 GPM (L/MIN) AT 48.120 PSI (BARS) AT THE BASE OF THE RISER
HOSE STREAM ALLOWANCE OF N/A GPM (L/MIN)
OCCUPANCY CLASSIFICATION LIGHT HAZARD
COMMODITY CLASSIFICATION N/A
MAXIMUM STORAGE HEIGHT N/A

INSTALLED BY: BUILDERS FIRE SOLUTIONS

SAFETY MARGIN: 14.658 PSI

PENDENT HEADS: 16' x 16' SPACING



OPT. FLEX ROOM

1ST FLOOR

OPT. STUDY & POWDER ROOM

OPT. STUDY & POWDER ROOM & PANTRY

OPT. FRONT ELEVATION "B"

AS-BUILT
01/25/2021
FPP2021-00386

SPRINKLERS

SYMBOL	MANUF/MODEL	TEMP.	FINISH	TOTAL
½" REC. PEND.	VIKING / QR VK468	155 DEG	WHITE	14
½" REC. PEND.	VIKING / QR VK468	175 DEG	WHITE	0
½" REC SIDEWALL	VIKING / QR VK486	155 DEG	WHITE	1
½" REC SIDEWALL	VIKING / QR VK486	175 DEG	WHITE	0
JOB TOTAL	40	TOTAL THIS SHEET		15

DESIGN CRITERIA

NFPA REF.	#13D	FLOW TEST:	
TYPE SYS.	WET	STATIC PSI	
HAZARD	LIGHT HAZARD	RESIDUAL PSI	
DENSITY	.05	@ FLOW	
REMOTE AREA	2 HEADS	HYDRANT ELEV.	
MAX. S.F./HD.	256-288	HYD. LOW GRAD.	
K FACTOR	4.0-4.9	HYD. HIGH GRAD.	
C FACTOR	120 - 150	ADJ STATIC PSI	
		ADJ RESID. PSI	
INSIDE HOSE	N/A	INFO BY	
OUTSIDE HOSE			

SPECIALTY ITEMS

FIRE PUMP:	F.D.C.:
RATED FLOW:	TYPE:
RATED BOOST:	SIZE:
SUCT. X DIST.	FINISH:
RELIEF VALVE:	F.H.V.:
FUEL TANK:	FINISH:
MUFFLER:	ALARM VALVE:
TEST HEADER:	DRY VALVE:
TYPE:	OTHER:
SIZE:	
FINISH:	

SYMBOLS

- RISER BETWEEN FLOORS
- TOP OF SPRINKLER RISER ASSEMBLY
- MATCH POINT FOR LAYOUT OPTIONS
- RISE/DROP IN PIPE ELEVATION
- HYDAULIC NODE

PLAN REVISIONS

DATE:	BY:	DESCRIPTION:
01/25/21	WML	1.AS-BUILT OPTION LAYOUT HAS BEEN PROVIDED STUDY OPT WITH POWDER ROOM AND NOW A PANTRY THAT REQUIRED COVERAGE.

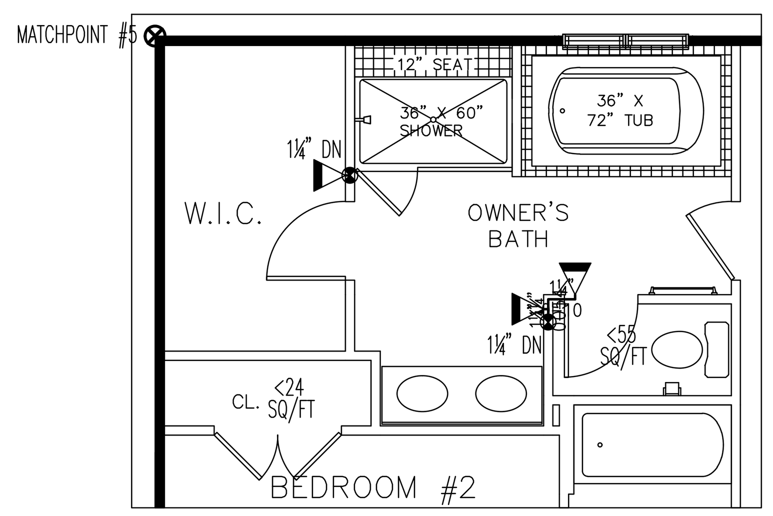
SCALE
1/4"=1'-0" 0' 5' 10' 15' 20'

JOB NAME:
BLACKBURN
HUDSON MODEL HOME
11249 WHEELER RIDGE DR
MANASSAS, VA 20109

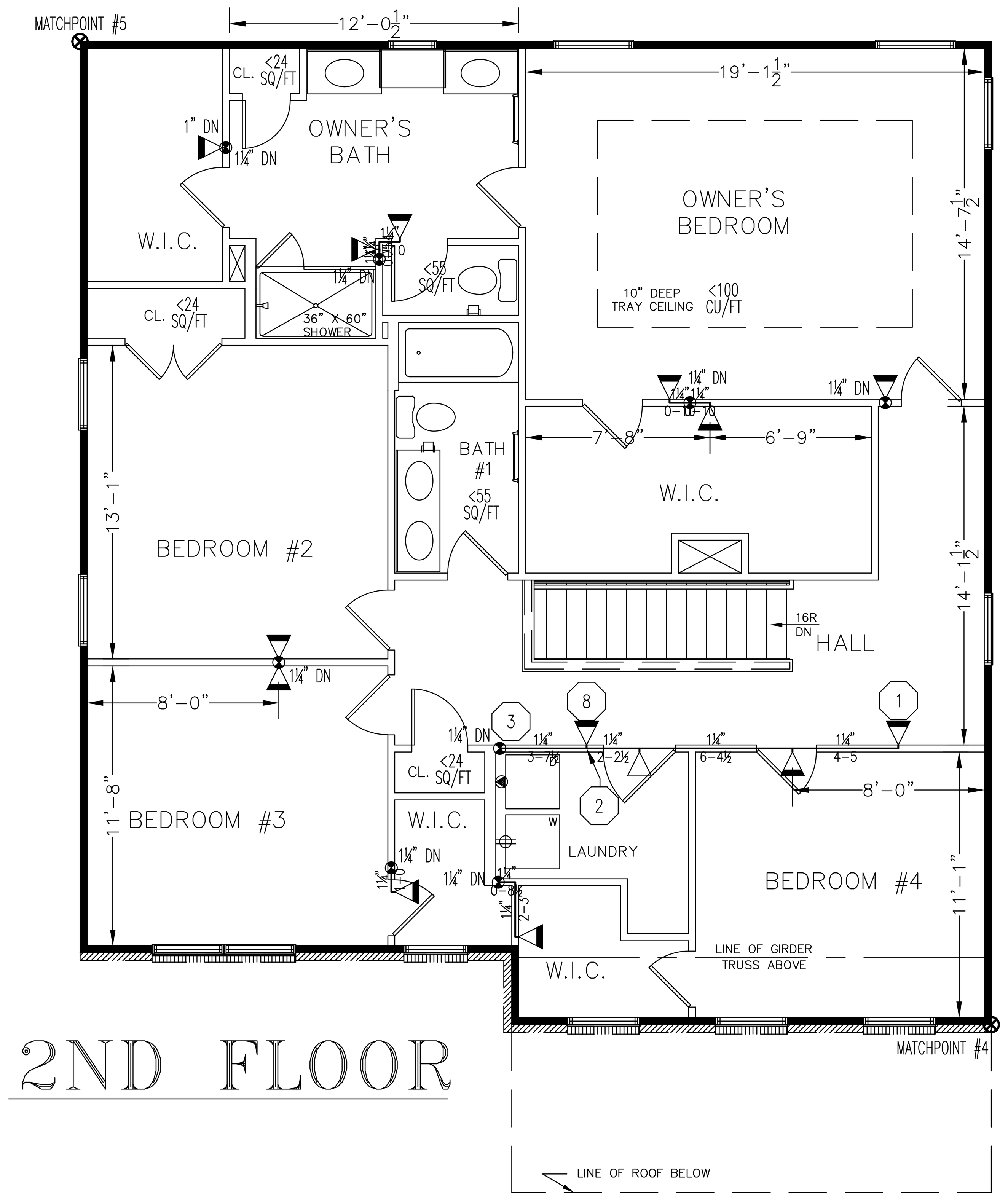
DATE:	SCALE:	CONTRACT NO:	APPROVALS:
12-02-2020	1/4"=1'-0"	20-0158	PRINCE WILLIAM COUNTY F.M.O.
PLAN NORTH	DRAWN BY: WML	REVIEWED BY:	CONTRACTOR: NVR, INC.
	AREA: LOT 71: 1ST FLOOR	CAD FILE: BLACKBURNSUBMIT	DRWG NO: 2 OF 5
	PERMIT NO: BLD2021-03547	CONTRACTOR PHONE: 540-428-8712	

BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

ALL LINE PIPING TO BE 1¼" PIPE
ALL DROPS FOR PENDENT HEADS TO BE 1" PIPE



ALT. OWNER'S BATH



2ND FLOOR

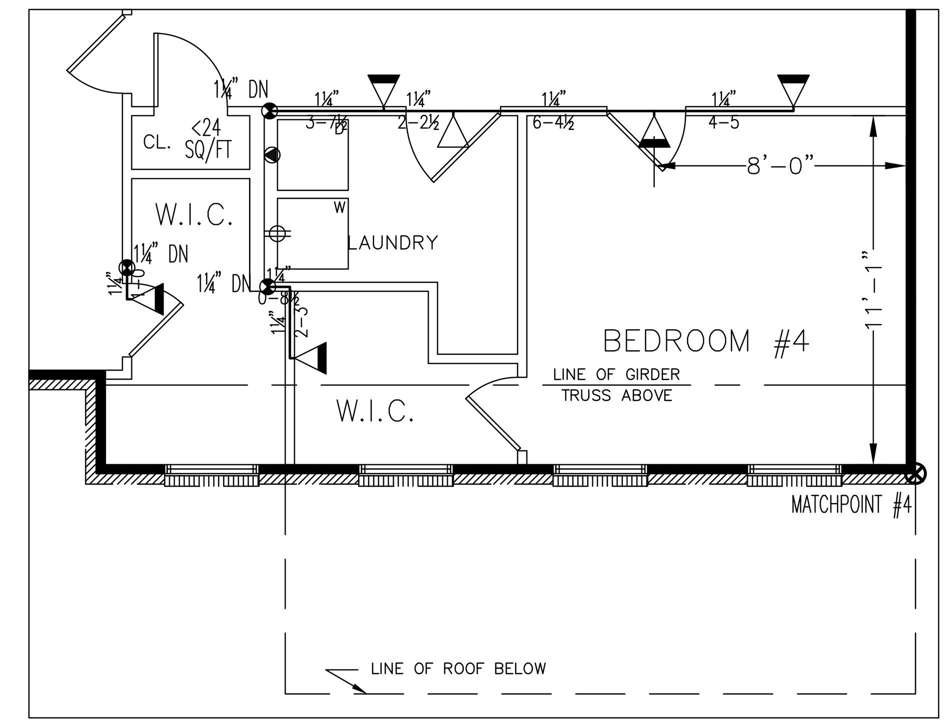
HYDRAULICALLY CALCULATED SYSTEM

THIS SYSTEM AS SHOWN ON SHEET 3 OF 5
COMPANY PRINT NO 20-0158 DATED 12-02-20
FOR 2ND FLOOR HALL REMOTE #1
AT 11249 WHEELER RIDGE DR CONTRACT NO 0158
IS DESIGNED TO DISCHARGE AT A RATE OF .05 GPM (L/MIN) PER SQ FT (M2) OF FLOOR AREA OVER A MAXIMUM AREA OF 2 HEADS SQ FT (M2) WHEN SUPPLIED WITH WATER AT THE RATE OF 26.152 GPM (L/MIN) AT 57.059 PSI (BARS) AT THE BASE OF THE RISER
HOSE STREAM ALLOWANCE OF N/A GPM (L/MIN)
OCCUPANCY CLASSIFICATION LIGHT HAZARD
COMMODITY CLASSIFICATION N/A
MAXIMUM STORAGE HEIGHT N/A

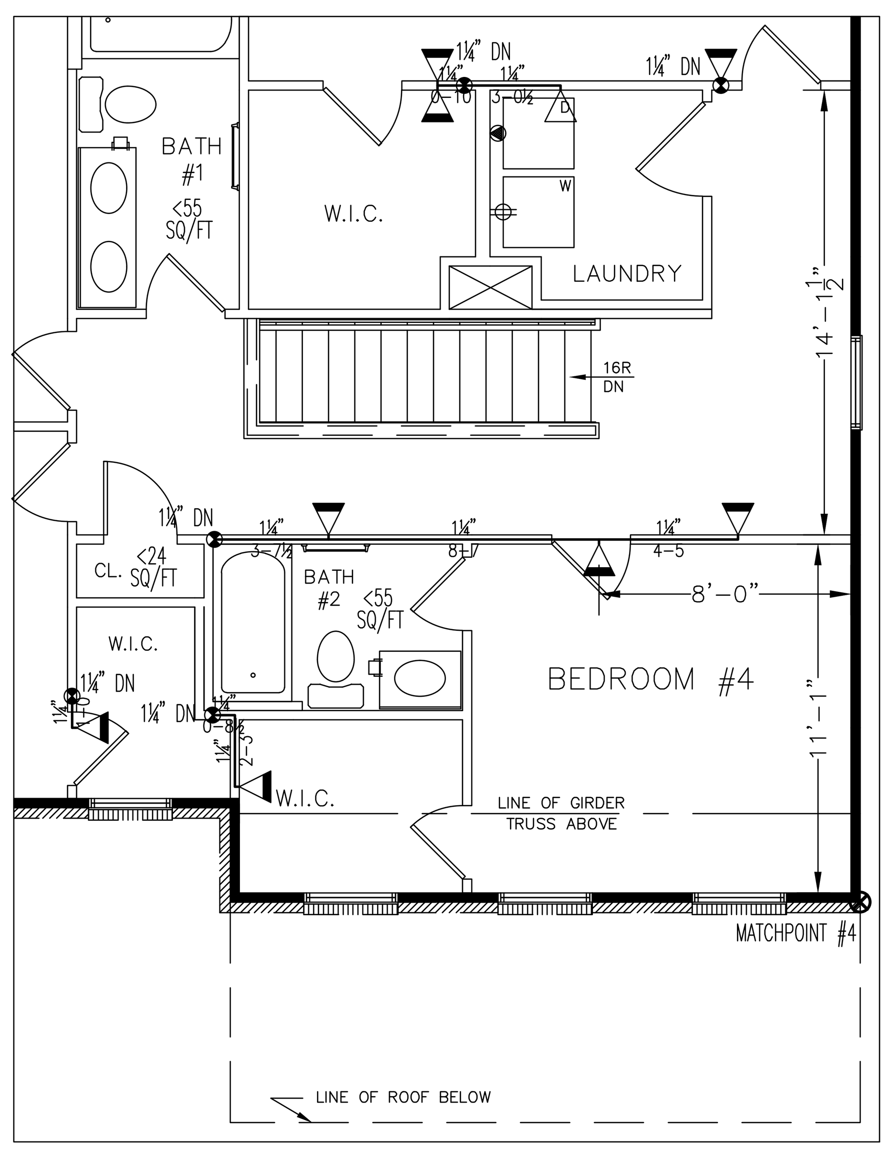
INSTALLED BY: BUILDERS FIRE SOLUTIONS

SAFETY MARGIN: 5.719 PSI

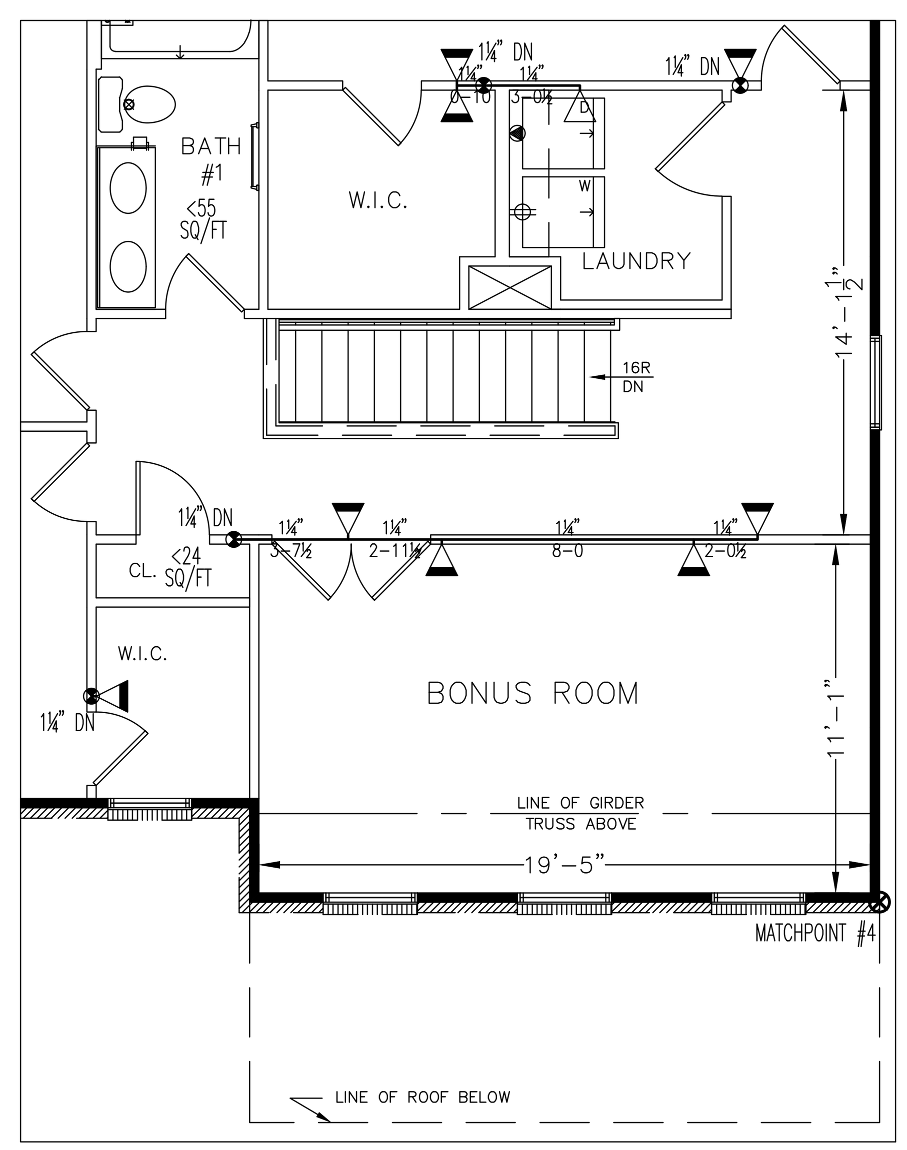
SIDEWALL HEADS: 16' x 16' SPACING



OPT. FRONT ELEVATION "B"



OPT. BEDROOM #4, W/BATH



OPT. BONUS ROOM

AS-BUILT
01/25/2021
FPP2021-00386

SPRINKLERS

SYMBOL	MANUF/MODEL	TEMP.	FINISH	TOTAL
½" REC. PEND.	VIKING / QR VK468	155 DEG	WHITE	0
½" REC. PEND.	VIKING / QR VK468	175 DEG	WHITE	0
½" REC SIDEWALL	VIKING / QR VK486	155 DEG	WHITE	13
½" REC SIDEWALL	VIKING / QR VK486	175 DEG	WHITE	1
JOB TOTAL	40	TOTAL THIS SHEET		14

DESIGN CRITERIA

NFPA REF.	#13D	FLOW TEST:	
TYPE SYS.	WET	STATIC PSI	
HAZARD	LIGHT HAZARD	RESIDUAL PSI	
DENSITY	.05	@ FLOW	
REMOTE AREA	2 HEADS	HYDRANT ELEV.	
MAX. S.F./HD.	256-288	HYD. LOW GRAD.	
K FACTOR	4.0-4.9	HYD. HIGH GRAD.	
C FACTOR	120 - 150	ADJ STATIC PSI	
		ADJ RESID. PSI	
INSIDE HOSE	N/A	INFO BY	
OUTSIDE HOSE			

SPECIALTY ITEMS

FIRE PUMP:	F.D.C.:
RATED FLOW:	TYPE:
RATED BOOST:	SIZE:
SUCT. X DIST.	FINISH:
RELIEF VALVE:	F.H.V.:
FUEL TANK:	FINISH:
MUFFLER:	ALARM VALVE:
TEST HEADER:	DRY VALVE:
TYPE:	OTHER:
SIZE:	
FINISH:	

SYMBOLS

- RISER BETWEEN FLOORS
- TOP OF SPRINKLER RISER ASSEMBLY
- MATCH POINT FOR LAYOUT OPTIONS
- RISE/DROP IN PIPE ELEVATION
- 0 HYDAULIC NODE

PLAN REVISIONS

DATE:	BY:	DESCRIPTION:
01/25/21	WML	1.AS-BUILT OPTION LAYOUT HAS BEEN PROVIDED STUDY OPT WITH POWDER ROOM AND NOW A PANTRY THAT REQUIRED COVERAGE.

SCALE
1/4"=1'-0"
0' 5' 10' 15' 20'

JOB NAME:
BLACKBURN
HUDSON MODEL HOME
11249 WHEELER RIDGE DR
MANASSAS, VA 20109

DATE: 12-02-2020	SCALE: 1/4"=1'-0"	CONTRACT NO: 20-0158	APPROVALS: PRINCE WILLIAM COUNTY F.M.O.
PLAN NORTH	DRAWN BY: WML	REVIEWED BY:	CONTRACTOR: NVR, INC.
	AREA: LOT 71: 2ND FLOOR	CAD FILE: BLACKBURNSUBMIT	DRWG NO: 3 OF 5
	PERMIT NO: BLD2021-03547	CONTRACTOR PHONE: 540-428-8712	

BFS
BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

VIKING®

TECHNICAL DATA

FREEDOM® RESIDENTIAL PENDENT SPRINKLER VK468 (K4.9)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

1. DESCRIPTION

Viking Freedom® Residential Pendent Sprinkler VK468 is a small, thermosensitive, glass-bulb residential sprinkler available in several different finishes and temperature ratings to meet varying design requirements. The Electroless Nickel PTFE (ENT) coating has been investigated for installation in corrosive atmospheres and is C-UL-US-EU Listed as corrosion resistant as indicated in the Approval Chart. The orifice design, with a K-Factor of 4.9 (70.6 metric†), allows efficient use of available water supplies for the hydraulically designed fire-protection system. The glass bulb operating element and special deflector characteristics meet the challenges of residential sprinkler standards.

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

2. LISTINGS AND APPROVALS

UL Listed (C-UL-US-EU): Category VKKW

VdS Approved

NYC Approved: MEA 89-92-E, Volume 35

UL Classified to: NSF/ANSI Standard 61, Drinking Water System Components (MH48034).

Refer to the Approval Chart and Design Criteria for C-UL-US-EU Listing requirements that must be followed.

3. TECHNICAL DATA

Specifications:
Available since 2006.
Minimum Operating Pressure: Refer to the Approval Chart.
Maximum Working Pressure: 175 psi (12 bar). Factory tested hydrostatically to 500 psi (34.5 bar).
Thread size: 1/2" (15 mm) NPT
Nominal K-Factor: 4.9 U.S. (70.6 metric†)
†Metric K-factor measurement shown is in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
Glass-bulb fluid temperature rated to -65 °F (-55 °C)
Overall Length: 2-1/4" (58 mm)

Material Standards:
Frame Casting: Brass UNS-C84400 or QM Brass
Deflector: Brass UNS-C23000, Phosphor Bronze UNS-C51000, or Brass UNS-C26000
Bulb: Glass, nominal 3 mm diameter
Belleville Spring Sealing Assembly: Nickel Alloy, coated on both sides with Polytetrafluoroethylene (PTFE) Tape
Pip Cap and Insert Assembly: Copper UNS-C11000 and Stainless Steel UNS-S30400
Compression Screw: Brass UNS-C36000
For ENT coated sprinklers: Belleville spring - Exposed, Screw and Pipcap - ENT plated.

Ordering Information: (Also refer to the current Viking price list.)
Sprinkler: Base Part No. 13637
Order Sprinkler VK468 by first adding the appropriate suffix for the sprinkler finish and then the appropriate suffix for the temperature rating to the sprinkler base part number.
Finish Suffix: Brass = A, Chrome = F, White Polyester = M-/W, Black Polyester = M-/B, and ENT = JN
Temperature Suffix: 155 °F (68 °C) = B, 175 °F (79 °C) = D
For example, sprinkler VK468 with a Brass finish and a 155 °F (68 °C) temperature rating = Part No. 13637AB.

Available Finishes And Temperature Ratings:
Refer to Table 1.

Accessories: (Also refer to the Viking website.)

Sprinkler Wrenches:
A. Standard Wrench: Part No. 21475M/B (available since 2017)
B. Wrench for recessed sprinklers: Part No. 13577W/B* (available since 2006)
C. Optional Protective Sprinkler Cap Remover/Escutcheon Installer Tool** Part No. 15915 (available since 2010.)
*A ½" ratchet is required (not available from Viking).
**Allows use from the floor by attaching a length of 1" diameter CPVC tubing to the tool. Ideal for sprinkler cabinets. Refer to Bulletin F_051808.

VIKING® | TECHNICAL DATA | FREEDOM® RESIDENTIAL PENDENT SPRINKLER VK468 (K4.9)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

Sprinkler Cabinets:
A. Six-head capacity: Part No. 01724A (available since 1971)
B. Twelve-head capacity: Part No. 01725A (available since 1971)

4. INSTALLATION
Refer to appropriate NFPA Installation Standards.

5. OPERATION
During fire conditions, the heat-sensitive liquid in the glass bulb expands, causing the glass to shatter, releasing the pip cap and sealing spring assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector, forming a uniform spray pattern to extinguish or control the fire.

6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
The Viking Model VK468 Sprinkler is available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

TABLE 1: AVAILABLE SPRINKLER TEMPERATURE RATINGS AND FINISHES

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[2]	Bulb Color
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow
Sprinkler Finishes: Brass, Chrome, White Polyester, Black Polyester, and ENT			
Corrosion Resistant Coatings[3]: ENT			

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector.

[2] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

[3] The corrosion resistant coatings have passed the standard corrosion test required by the approving agencies indicated in the Approval Chart. These tests cannot and do not represent all possible corrosive environments. Prior to installation, verify through the end-user that the coatings are compatible with or suitable for the proposed environment. For ENT coated sprinklers, the waterway is coated. Note that the spring is exposed on sprinklers with ENT coating.

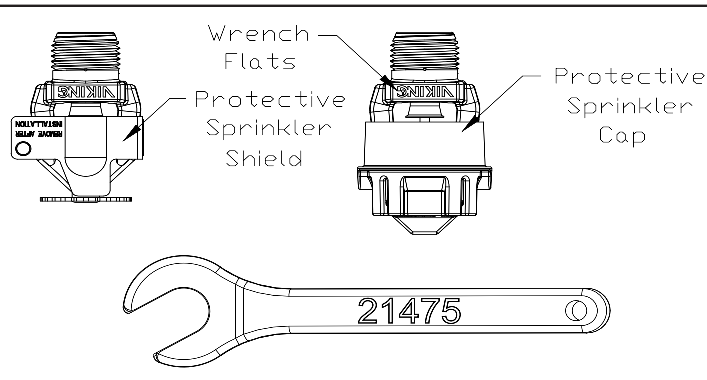


Figure 1: **Standard Sprinkler Wrench 21475M/B**

Approval Chart
Viking VK468, 4.9 K-Factor Residential Pendent Sprinkler

For systems designed to NFPA 13D or NFPA 13R. For systems designed to NFPA 13, refer to the design criteria. For Ceiling types refer to current editions of NFPA 13, 13R or 13D

Sprinkler Base Part Number[1]	SIN	NPT Thread Size		Nominal K-Factor		Maximum Water Working Pressure	Overall Length	
		Inches	mm	U.S.	metric[2]		Inches	mm
13637	VK468	1/2	15	4.9	70.6	175 psi (12 bar)	2-1/4	58

Max. Coverage Area[4] Ft.X Ft. (m X m)	Ordinary Temp Rating (155 °F/68 °C)		Intermediate Temp Rating (175 °F/79 °C)		Deflector to Ceiling	Installation Type	Listings and Approvals[3]				Minimum Spacing Ft. (m)
	Flow[4] GPM (L/min)	Pressure[4] PSI (bar)	Flow[4] GPM (L/min)	Pressure[4] PSI (bar)			C-UL-US-EU[5]	VdS	NYC[6]	NSF[8]	
12 X 12 (3.7 X 3.7)	13 (49.2)	7.0 (0.48)	13 (49.2)	7.0 (0.48)	1-1/8 to 2 inch	Standard surface-mounted escutcheons, or recessed with the Micromatic® Model E-1, E-2, or E-3 Recessed Escutcheon	See Footnotes 7 and 10.	See Footnotes 7 and 10.	See Footnote 7.	See Footnote 7.	8 (2.4)
14 X 14 (4.3 X 4.3)	13 (49.2)	7.0 (0.48)	13 (49.2)	7.0 (0.48)							
16 X 16 (4.9 X 4.9)	13 (49.2)	7.0 (0.48)	13 (49.2)	7.0 (0.48)							
18 X 18 (5.5 X 5.5)	17 (64.4)	12.0 (0.83)	17 (64.4)	12.0 (0.83)							
20 X 20 (6.1 X 6.1)	20 (75.7)	16.7 (1.15)	20 (75.7)	16.7 (1.15)							

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to Viking's current price schedule.

[2] Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.

[3] This chart shows the listings and approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals. Refer also to Design Criteria.

[4] For areas of coverage smaller than shown, use the "Flow" and "Pressure" for the next larger area listed. Flows and pressures listed are per sprinkler. The distance from sprinklers to walls shall not exceed one-half the sprinkler spacing indicated for the minimum "Flow" and "Pressure" used.

[5] Listed by Underwriter's Laboratories, Inc. for use in the U.S., Canada, and European Union.

[6] Accepted for use, City of New York Department of Buildings, MEA Number 89-92-E, Vol. 35.

[7] Approved Finishes are: Brass, Chrome, White Polyester, and Black Polyester[9]

[8] UL Classified to: NSF/ANSI Standard 61, Drinking Water System Components (MH48034).

[9] Other paint colors are available on request with the same C-UL-US-EU listings as the standard finish colors.

[10] Approved finish is Electroless Nickel PTFE (ENT). ENT is C-UL-US-EU Listed as corrosion resistant. ENT is available with standard surface-mounted escutcheons or the Micromatic Model E-1 Recessed Escutcheon.

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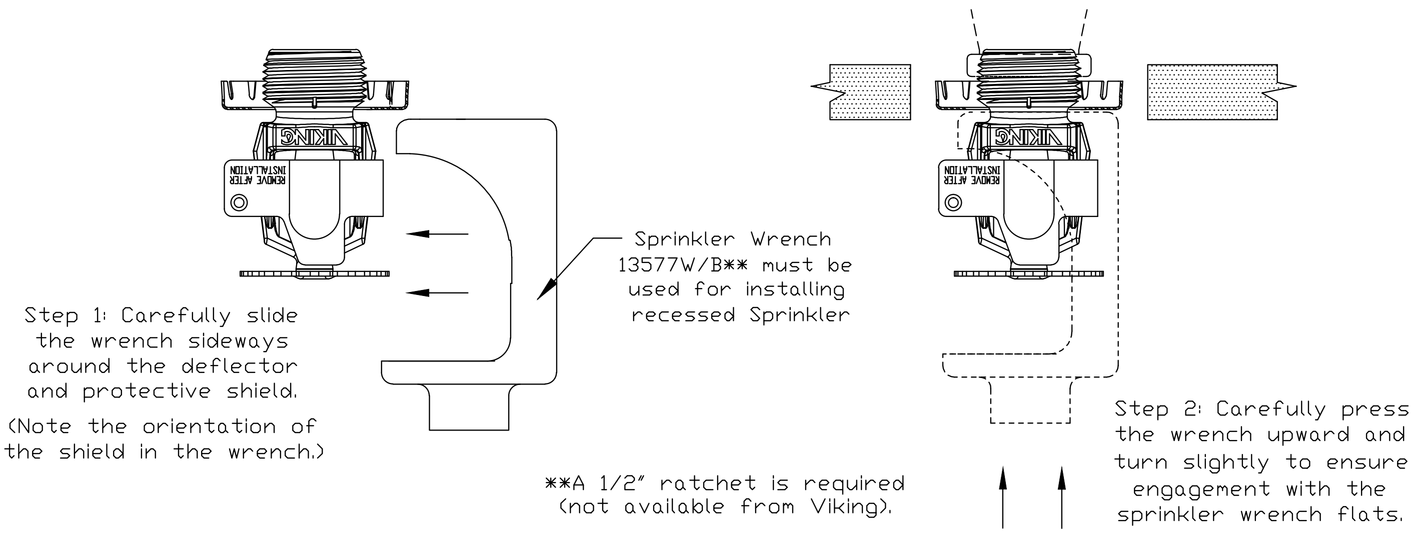

Figure 2: **Wrench 13577W/B for Recessed Sprinkler**

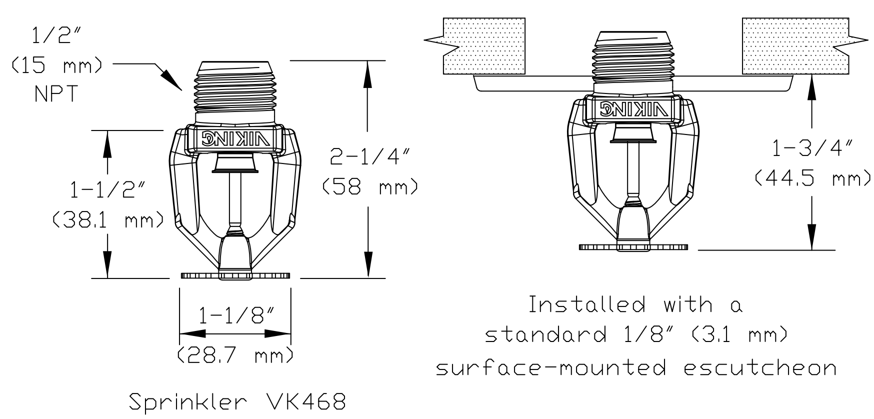

Figure 3: **Sprinkler VK468 Dimensions with a Standard Escutcheon**

VIKING®	TECHNICAL DATA	FREEDOM® RESIDENTIAL PENDENT SPRINKLER VK468 (K4.9)

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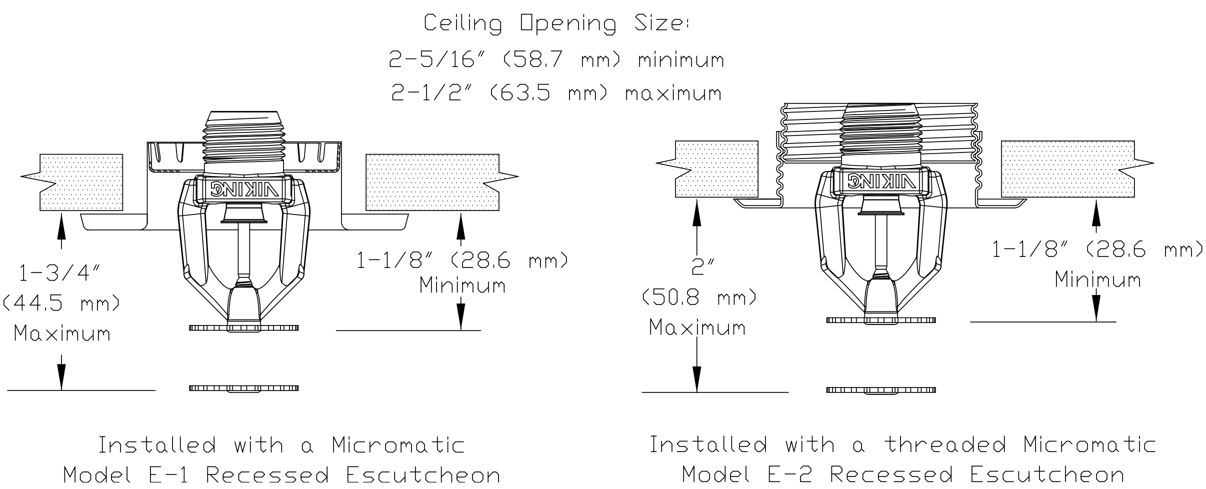

Figure 4: Sprinkler VK468 Dimensions with the Model E-1 and E-2 Recessed Escutcheons

DESIGN CRITERIA

(Also refer to the Approval Chart.)

UL Listing Requirements (C-UL-US-EU):

When using Viking Residential Pendent Sprinkler VK468 for systems designed to NFPA 13D or NFPA 13R, apply the listed areas of coverage and minimum water supply requirements shown in the Approval Chart.

For systems designed to NFPA 13: The number of design sprinklers is to be the four contiguous most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in the Approval Chart for NFPA 13D and NFPA13R applications for each listed area of coverage, **or**
- Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the “design area” in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13.
- Minimum distance between residential sprinklers: 8 ft. (2.4 m).

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to Form No. F_080614, F_080415 and F_080190 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, VdS, and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

Viking Residential Sprinkler Installation Guide

October 25, 2018

WARNING: Cancer and Reproductive Harm-
www.P65Warnings.ca.gov

VIKING	TECHNICAL DATA	FREEDOM® RESIDENTIAL SPRINKLER INSTALLATION GUIDE

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1. DESCRIPTION

Viking residential automatic sprinklers are equipped with a "fast response" heat-sensitive operating element designed to respond individually and quickly to a specific high temperature. Viking residential sprinklers are designed to combine speed of operation with water distribution characteristics to help in the control of residential fires and to improve life safety by prolonging the time available for occupants to escape or be evacuated.

2. LISTINGS AND APPROVALS

Refer to the Approval Charts on the appropriate sprinkler technical data page(s) and/or approval agency listings.

A. Viking residential sprinklers are intended for use in the following occupancies: one- and two-family dwellings and mobile homes with the fire protection sprinkler system installed in accordance with NFPA 13D; residential occupancies up to four stories in height with the fire protection system installed in accordance with NFPA 13R; or residential portions of any occupancy with the fire protection system installed in accordance with NFPA 13. Information contained in this guide is based on NFPA 13, "Standard for the Installation of Sprinkler Systems".

B. The design criteria for residential sprinklers contained in the NFPA installation standards must be followed except as modified by the individual UL 1626 listing information provided in the technical data pages and this Residential Sprinkler Installation Guide. For listed areas of coverage, technical data, and specific design and installation instructions, refer to the appropriate Viking technical data page for the sprinkler model used.

C. Viking residential sprinklers listed by Underwriters Laboratories, Inc. (UL) have passed fire tests designed to represent fire conditions for the sprinkler's listed area of coverage. The standards for residential sprinkler performance and spray patterns are printed in Underwriters Laboratories Publication UL 1626, "Standard for Residential Sprinklers for Fire Protection Service". All listed Viking residential sprinklers meet or exceed UL 1626 performance requirements and spray pattern criteria for their listed areas of coverage.

D. NFPA standards allow use of residential sprinklers with rates, design areas, areas of coverage, and minimum design pressures other than those specified in the standards when they have been listed for such specific residential installation conditions.

3. TECHNICAL DATA

Specifications:

Refer to the appropriate sprinkler technical data sheet.

Material Standards:

Refer to the appropriate sprinkler technical data sheet.

Viking Technical Data may be found on The Viking Corporation's Web site at http://www.vikinggroupinc.com. The Web site may include a more recent edition of this Technical Data Page.

4. INSTALLATION

NOTE:Take care not to over-tighten the sprinkler and/or damage its operating parts!

Maximum Torque: 1/2" NPT: 14 ft-lbs. (19.0 N-m) 3/4" NPT: 20 ft-lbs. (27.1 N-m)

A. Care and Handling (also refer to Bulletin - Care and Handling of Sprinklers, Form No. F_091699.)

Sprinklers must be handled with care and protected from mechanical damage during storage, transport, handling, and after installation. Store sprinklers in a cool, dry place in their original container.

Use care when locating sprinklers near fixtures that can generate heat.

Never install sprinklers that have been dropped, damaged in any way, or exposed to temperatures exceeding the maximum ambient temperature allowed (refer to Table 1.)

Never install any glass-bulb sprinkler if the bulb is cracked or if there is a loss of liquid from the bulb. A small air bubble should be present in the glass bulb. Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed immediately. (Note: Installing glass bulb sprinklers in direct sunlight (ultraviolet light) may affect the color of the dye used to color code the bulb. This color change does not affect the integrity of the bulb.)

Viking residential sprinklers are intended for use on wet pipe residential systems only. Adequate heat must be provided for wet-pipe systems. DO NOT use Viking residential sprinklers on dry systems unless specifically allowed by recognized installation standards or the Authority Having Jurisdiction.

Residential concealed sprinklers must be installed in neutral or negative pressure plenums only!

Corrosion-resistant sprinklers must be installed when subject to corrosive atmospheres. **NOTE:** Viking residential sprinklers are not intended for use in corrosive environments.

Replaces pages 1-17, dated December 1, 2016.
(Added P65 Warning.)

TECHNICAL DATA

FREEDOM® RESIDENTIAL SPRINKLER INSTALLATION GUIDE

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TABLE 1: RESIDENTIAL SPRINKLER TEMPERATURE RATINGS

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[3]	Bulb Color
Residential Glass Bulb Style Sprinklers			
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)[1]**	**Maximum Ambient Ceiling Temperature[3]**	
Residential Fusible Element Style Sprinklers			
Ordinary	165 °F (74 °C)	100 °F (38 °C)	
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)**	**Maximum Ambient Ceiling Temperature[3]**	**Temperature Identification Stamp**
Residential Flush Style Sprinklers			
Ordinary	165 °F (74 °C)	100 °F (38 °C)	On Cover or Sprinkler Inlet (VK476)
Intermediate	220 °F (104 °C)	150 °F (65 °C)	On Cover
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)**	**Maximum Ambient Ceiling Temperature[3]**	**Cover Plate Temperature Rating**
Residential Concealed Style Sprinklers			
Ordinary	135 °F (57 °C)[1], 140 °F (60 °C)[2], 155 °F (68 °C)[1], or 165 °F (74 °C)[1]	100 °F (38 °C)	135 °F (57 °C)

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector or flow shaper.

[2] The temperature rating is stamped on the sprinkler.

[3] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

B. Installation Instructions

Viking sprinklers are manufactured and tested to meet the rigid requirements of approving agencies. They are designed to be installed in accordance with recognized installation standards NFPA 13, NFPA 13R, and NFPA 13D, and any associated TIAs.

Deviation from the standards or any alteration to the sprinklers or cover plate assemblies after they leave the factory including, but not limited to: painting, plating, coating, or modification, may render the sprinklers inoperative and will automatically nullify the approval and any guarantee made by Viking.

The use of residential sprinklers may be limited due to occupancy and hazard. Residential fire protection systems must be designed and installed only by those who are completely familiar with the appropriate standards and codes, and thoroughly experienced in fire protection design, hydraulic calculations, and sprinkler system installation.

Before installation, be sure to have the appropriate sprinkler model and style, with the correct K-Factor, temperature rating, and response characteristics. Viking residential sprinklers must be installed after the piping is in place to prevent mechanical damage. Keep sprinklers with protective caps or bulb shields contained within the caps or shields during installation and testing, and any time the sprinkler is shipped or handled.

1a. For frame-style sprinklers, install escutcheon (if used), which is designed to thread onto the external threads of the sprinkler*.
*Refer to the appropriate sprinkler technical data page to determine approved escutcheons for use with specific sprinkler models.

1b. For flush and concealed style sprinklers: Cut the sprinkler nipple so that the ½” or 3/4” (15 mm or 20 mm) NPT** outlet of the reducing coupling is at the desired location and centered in the opening** in the ceiling or wall.
**Size depends on the sprinkler model used. Refer to appropriate sprinkler data page.

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DESIGN CRITERIA

For Systems Designed to NFPA 13D or NFPA 13R: Apply the listed areas of coverage and minimum water supply requirements shown in the approval charts on the residential sprinkler data pages. The sprinkler flow rate is the minimum required discharge from each of the total number of design sprinklers as specified in NFPA 13D or NFPA 13R.

For Systems Designed to the latest edition of NFPA 13: The number of design sprinklers is to be the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- **The flow rates given in the approval charts on the data pages for NFPA 13D and NFPA13R for each area of coverage listed, or**
- **Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the "design area" in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13. The greatest dimension of the coverage area cannot be any greater than the maximum areas of coverage shown on the data pages.**

Flow Rates

All residential sprinklers manufactured on or after July 12, 2002 are listed with a single minimum flow rate. Where rooms have more than one sprinkler, multiple-sprinkler calculations are still required, but the first sprinkler and any additional sprinkler or sprinklers must be calculated flowing at identical minimum flow rates, based on the area of sprinkler coverage, using the minimum flow and pressure listed for the sprinkler model used.

Consult the appropriate standards and the Authorities Having Jurisdiction to determine the number of sprinklers to hydraulically calculate to verify adequate water supply for multiple-sprinkler operation.

Operating Pressure: The minimum operating pressure of any sprinkler shall be the minimum operating pressure specified by the listing, or 7 psi (0.5 bar), whichever is greater. The maximum allowable operating pressure is 175 psi (12 bar).

Areas of Coverage

If the actual area of coverage is less than the listed area of coverage, use the minimum water supply for the next larger area of coverage listed. DO NOT interpolate. Residential sprinkler systems must be hydraulically calculated according to NFPA standards to verify that the water supply is adequate for proper operation of the sprinklers. Hydraulic calculations are required to verify adequate water supply at the hydraulically most remote single sprinkler when it is operating at the minimum gpm and psi listed for single-sprinkler operation for the sprinkler model used.

Viking residential sprinklers may be listed for more than one area of coverage. Suggested practice in selecting area of coverage is to select the one that can be adequately supplied by the available water supply and still allow for the installation of as few sprinklers in a compartment as possible while observing all guidelines pertaining to obstructions and spacing. This maximizes the use of the available water supply, which is often limited on residential fire protection systems. After selecting an appropriate area of coverage, sprinklers must be spaced according to guidelines set forth in the installation standards.

Definition of "COMPARTMENT": A space completely enclosed by walls and a ceiling. Openings to an adjoining space are allowed, provided the openings have a minimum lintel depth of 8 in. (203.2 mm) from the ceiling.

Spacing Guidelines

For guidelines concerning spacing of Viking residential sprinklers near beams, obstructions, heat sources, and sloped ceilings [slopes more than a 2/12 (9.5°) pitch], refer to the Viking residential sprinkler data pages and installation guide, the appropriate NFPA standard, and the Authority Having Jurisdiction. NOTE: Sloped, beamed, and pitched ceilings could require special design features such as larger flow, or a design for more sprinklers to operate in the compartment, or both.

Distance from Walls: Install not more than one-half the listed sprinkler spacing nor less than 4" (102 mm) from walls, partitions, or obstructions as defined in the standards.

Minimum Sprinkler Spacing: The minimum distance between residential sprinklers to prevent cold soldering (i.e., the spray from one operating sprinkler onto an adjacent sprinkler that could prevent its proper activation) is 8 ft. (2.4 m).

Maximum Sprinkler Spacing: Locate adjacent sprinklers no farther apart than the listed spacing.

Deflector Position: Install frame style residential *pendent* sprinklers with the deflector between 1" and 4" (25.4 mm to 102 mm) below smooth ceilings, unless the sprinkler data page indicates otherwise. Install pendent sprinklers in the pendent position only, with the deflector oriented parallel with the ceiling or roof.

Refer to the individual listings in the residential sprinkler data pages for horizontal sidewall sprinkler deflector or sprinkler centerline distance below the ceiling. Install horizontal sidewall sprinklers in the horizontal position only below smooth ceilings, with the leading edge of the deflector or element assembly oriented parallel with the ceiling.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to the appropriate sprinkler data page. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

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2. Apply a small amount of pipe-joint compound or tape to the external threads of the sprinkler only, taking care not to allow a build-up of compound in the sprinkler inlet. **NOTE:** Sprinklers with protective caps or bulb shields must be contained within the caps or shields before applying pipe-joint compound or tape. *Exception: For concealed sprinklers (i.e., VK457, VK458, VK468, VK474, and VK4570) the protective cap is removed for installation.*
3. Care must be taken when installing sprinklers on CPVC and copper piping systems. Never install the sprinkler into the reducing fitting before attaching the reducing fitting to the piping. Sprinklers must be installed on CPVC systems after the reducing fitting has been installed and the primer and/or cement manufacturer's recommended curing time has elapsed. When installing sprinklers on copper piping systems, take care to brush the inside of the sprinkler supply piping and reducing fitting to ensure that no flux accumulates in the sprinkler orifice. Excess flux can cause corrosion and may impair the ability of the sprinkler to operate properly.
4. Refer to the appropriate sprinkler technical data page to determine the correct sprinkler wrench for the model of sprinkler used. DO NOT use the sprinkler deflector or fusible element to start or thread the sprinkler into a fitting.
   a. Install the sprinkler onto the piping using the special sprinkler wrench only, while taking care not to over-tighten or damage the sprinkler operating parts.
   b. *Thread the flush or concealed sprinkler into the ½*" or 3/4" (15 mm or 20 mm) NPT** *outlet of the coupling by turning it clockwise with the special sprinkler wrench. NOTE: For flush and concealed sprinklers with protective shells, the internal diameter of the special flush and concealed sprinkler installation wrench is designed for use with the sprinkler contained within the shell. Exception: For concealed sprinklers VK457, VK458, VK468, VK474, and VK4570 the protective cap is removed for installation, and then placed back on the sprinkler temporarily.*
5. After installation, the entire sprinkler system must be tested. The test must be conducted to comply with the installation standards.
   a. Make sure the sprinkler has been properly tightened. If a thread leak occurs, normally the unit must be removed, new pipe-joint compound or tape applied, and then reinstalled. This is due to the fact that when the joint seal leaks, the sealing compound is washed out of the joint.
   b. **Remove plastic protective sprinkler caps or bulb shields AFTER the wall or ceiling finish work is completed where the sprinkler is installed and there no longer is a potential for mechanical damage to the sprinkler operating elements.** To remove the bulb shields, simply pull the ends of the shields apart where they are snapped together. To remove caps from frame style sprinklers, turn the caps slightly and pull them off the sprinklers. **SPRINKLER CAPS OR BULB SHIELDS MUST BE REMOVED FROM SPRINKLERS <u>BEFORE</u> PLACING THE SYSTEM IN SERVICE!** Retain a protective cap or shield in the spare sprinkler cabinet.
6. For residential flush sprinklers, the ceiling ring can now be installed onto the sprinkler body. Align the ceiling ring with the sprinkler body and thread on or push it on until the flange touches the ceiling. Note the maximum vertical adjustment is ½" (12,7 mm) for sprinkler VK420 and 5/8" for VK476. DO NOT MODIFY THE UNIT. If necessary, re-cut the sprinkler drop nipples as required.
7. For residential concealed sprinklers, the cover plate assembly can now be attached.
   a. Remove the cover plate assembly from the protective box, taking care not to damage the assembly.
   b. From below the ceiling, gently place the base of the cover plate assembly over the sprinkler protruding through the opening in the ceiling or wall.
   c. Carefully push the cover plate assembly onto the sprinkler, using even pressure with the palm of the hand, until the unfinished brass flange of the cover plate base touches the ceiling or wall.
   d. The maximum adjustment available for residential concealed sprinklers is ½" (12.7 mm) [1/4" (6.4 mm) for sprinkler VK480]. DO NOT MODIFY THE UNIT. If necessary, re-cut the sprinkler nipples.

NOTE: If it is necessary to remove the entire sprinkler unit, the system must be taken out of service. See Maintenance instructions below and follow all warnings and instructions.

5. OPERATION

During fire conditions, the operating element fuses or shatters (depending on the type of sprinkler), releasing the pip cap and sealing assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector or flow shaper, forming a uniform, high-wall wetting spray pattern to extinguish or control the fire.

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6. INSPECTIONS, TESTS AND MAINTENANCE

Refer to NFPA 25 for Inspection, Testing and Maintenance requirements. **NOTICE:** The owner is responsible for having the fire-protection system and devices inspected, tested, and maintained in proper operating condition in accordance with this guide, and applicable NFPA standards. In addition, the Authority Having Jurisdiction may have additional maintenance, testing, and inspection requirements that must be followed.

A. Sprinklers must be inspected on a regular basis for signs of corrosion, mechanical damage, obstructions, paint, etc. Frequency of the inspections may vary due to corrosive atmospheres, water supplies, and activity around the device.

B. Sprinklers or cover plate assemblies that have been field painted, caulked, or mechanically damaged must be replaced immediately. Sprinklers showing signs of corrosion shall be tested and/or replaced immediately as required. Installation standards require sprinklers to be tested and, if necessary, replaced immediately after a specified term of service. Refer to NFPA 25 and the Authorities Having Jurisdiction for the specified period of time after which testing and/or replacement of residential sprinklers is required. Never attempt to repair or reassemble a sprinkler. Sprinklers and cover assemblies that have operated cannot be reassembled or re-used, but must be replaced. When replacement is necessary, use only new sprinklers and cover assemblies with identical performance characteristics.

C. The sprinkler discharge pattern is critical for proper fire protection. Nothing should be hung from, attached to, or otherwise obstruct the discharge pattern of the sprinkler. All obstructions must be immediately removed or, if necessary, additional sprinklers installed.

D. When replacing existing sprinklers, the system must be removed from service. Refer to the appropriate system description and/or valve instructions. Prior to removing the system from service, notify all Authorities Having Jurisdiction. Consideration should be given to employment of a fire patrol in the effected area.

1. Remove the system from service, drain all water, and relieve all pressure on the piping.

2a. For frame-style sprinklers, use the special sprinkler wrench and remove the old sprinkler by turning it counterclockwise to unthread it from the piping.

2b. For residential flush pendent and concealed style sprinklers: Remove the ceiling ring or cover plate assembly before unthreading the sprinkler body from the piping. To remove a ceiling ring, grasp it from below the ceiling and gently turn it counterclockwise. Cover plates can be removed either by gently unthreading them or pulling them off the sprinkler body (depends on the sprinkler model used). After the ceiling ring or cover plate assembly has been removed from the sprinkler, use the sprinkler wrench to unthread the sprinkler from the piping. NOTE: For flush and concealed sprinklers with protective shells, the internal diameter of the special flush and concealed sprinkler installation wrench is designed for use with the sprinkler contained within the shell. Place a plastic protective shell (from the spare sprinkler cabinet) over the sprinkler to be removed and then fit the sprinkler wrench over the shell. Exception: Concealed sprinklers VK457, VK458, VK468, VK474, and VK4570 are removed without the plastic cap.

3. Follow instructions in section 4B. Installation Instructions to install the new unit. Be sure the replacement sprinkler is the correct model and style, with the appropriate K-Factor, temperature rating, and response characteristics. A fully stocked sprinkler cabinet should be provided for this purpose. *(For flush or concealed style sprinklers, stock of spare ceiling rings or cover plates should also be available in the spare sprinkler cabinet.)*

4. Place the system back in service and secure all valves. Check for and repair all leaks.

E. Sprinkler systems that have been subjected to a fire must be returned to service as soon as possible. The entire system must be inspected for damage, and repaired or replaced as necessary. Sprinklers that have been exposed to corrosive products of combustion or high ambient temperatures, but have not operated, should be replaced. Refer to the Authority Having Jurisdiction for minimum replacement requirements.

7. AVAILABILITY

Viking Residential Sprinklers are available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE

For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

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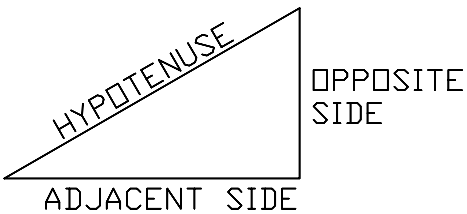
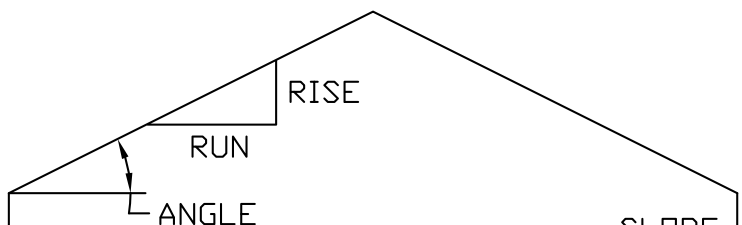


$$\text{TANGENT} = \frac{\text{OPPOSITE SIDE (RISE)}}{\text{ADJACENT SIDE (RUN)}}$$

$$\frac{\text{RISE}}{\text{RUN}} = \text{TANGENT}$$

$$\text{ANGLE} = \text{TAN}^{-1}\left(\frac{\text{RISE}}{\text{RUN}}\right)$$

$$\text{SLOPE DISTANCE} = \sqrt{(\text{RISE})^2 + (\text{RUN})^2}$$



RISE	RUN	TANGENT	ANGLE	SLOPE DISTANCE
2	12	.1666	9.45°	12.1
3	12	.2500	14°	12.3
4	12	.3333	18.4°	12.6
5	12	.4166	22.6°	13
6	12	.5000	26.5°	13.4
7	12	.5833	30.2°	13.8
8	12	.6666	33.6°	14.4
9	12	.7500	36.8°	15
10	12	.8333	39.8°	15.6
11	12	.9166	42.5°	16.2
12	12	1	45°	16.97

Table 2
Rise Over Run Conversion to Degrees of Slope

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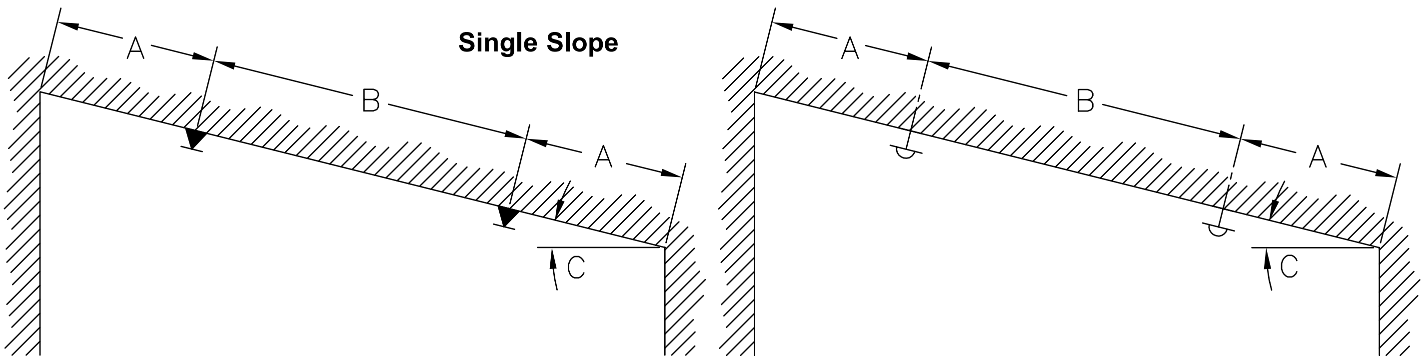
SPACING OF RESIDENTIAL SPRINKLERS LISTED FOR USE BELOW SLOPED CEILINGS UP TO AN 8/12 (33.7°) PITCH

(Refer to the appropriate residential sprinkler technical data page for listings.)



Pendent Sprinklers

Horizontal Sidewall Sprinklers (Spray Across the Slope)

Figure 1

(A) One-half listed spacing of sprinkler maximum, 0’-4” (0-102 mm) minimum.
(B) Listed spacing of sprinkler, maximum, 8’-0” (2.4 m) minimum.
(C) Where angle “C” is greater than an 8/12 (33.7°) pitch, see Figure 2 below.

SPACING OF RESIDENTIAL SPRINKLERS BELOW SLOPED CEILINGS WITH GREATER THAN 8/12 (33.7°) PITCH

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

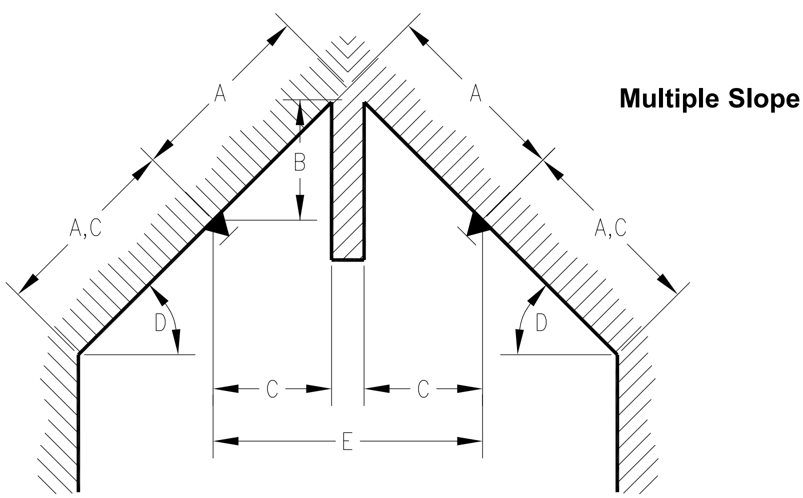


Figure 2

(A) One-half listed spacing of sprinkler, maximum.
(B) 3’-0” (.91 m) maximum.
(C) 0’-4” (0-102 mm) minimum.
(D) Slopes greater than an 8/12 (33.7°) pitch.
(E) For distance less than 8’-0” (2.4 m), baffle required.

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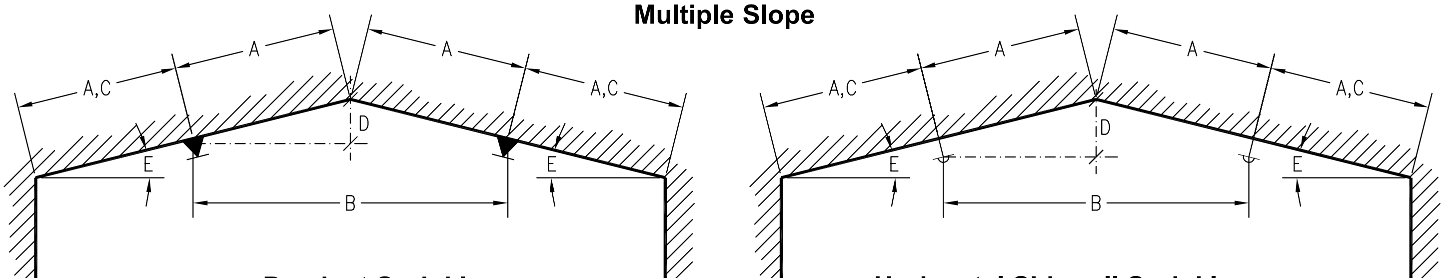
SPACING OF RESIDENTIAL SPRINKLERS LISTED FOR USE BELOW SLOPED CEILINGS UP TO AN 8/12 (33.7°) PITCH

(Refer to the appropriate residential sprinkler technical data page for listings.)

Multiple Slope



Pendent Sprinklers | **Horizontal Sidewall Sprinklers (Spray Across the Slope)**

Figure 3

(A) One-half listed spacing of sprinkler, maximum.
(B) 8’-0” (2.4 m) minimum.
(C) 0’-4” (0-102 mm) minimum.
(D) 3’-0” (.91 m) maximum.
(E) Acceptable for slopes of 0/12 to 8/12 (0° to 33.7°) pitch.

SPACING OF RESIDENTIAL PENDENT SPRINKLERS AT PEAK OF SLOPED CEILINGS WITH PITCH LESS THAN 8/12 (33.7°)

(Refer to the appropriate residential sprinkler technical data page for listings.)

Multiple Slope

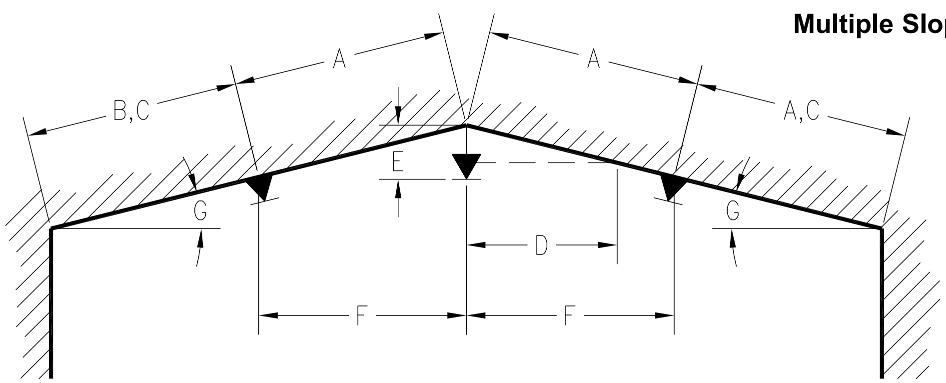


Figure 4

(A) Listed spacing of sprinkler, maximum.
(B) One-half listed spacing of sprinkler, maximum.
(C) 0’-4” minimum.
(D) Refer to page 10 for minimum distance between sprinkler and intersecting sloped ceiling.
(E) Refer to the appropriate residential sprinkler technical data page for deflector distance below ceiling.
(F) 8’-0” minimum.
(G) Reference: 4/12 (18.0°) pitch maximum for 12’ (3.7 m) spacing.
2.5/12 (12.0°) pitch maximum for 14’ (4.3 m) spacing.
2/12 (10.0°) pitch maximum for 16’ (4.9 m) spacing.
2/12 (10.0°) pitch maximum for 18’ (5.5 m) spacing.
1.9/12 (9.0°) pitch maximum for 20’ (6.1 m) spacing.
Angles based on sprinklers installed 0’-4” (0-102 mm) from peak.

NOTE: Whenever possible, utilize design as shown in Figure 3 above.

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SPACING OF RESIDENTIAL SPRINKLERS BELOW SLOPED CEILINGS WITH GREATER THAN 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 2 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

Multiple Slope

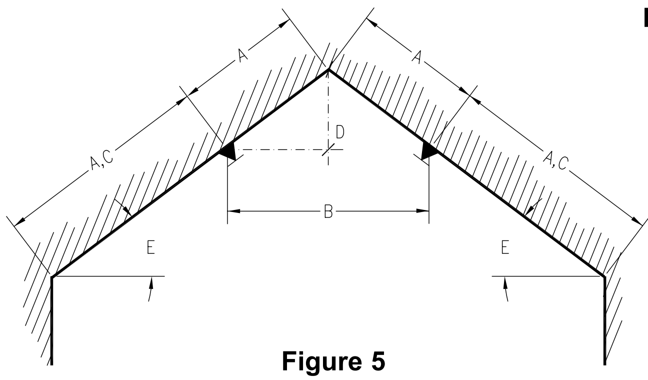

Figure 5

(A) One-half listed spacing of sprinkler, maximum.
(B) 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) 3'-0" (.91 m) maximum.
(E) Acceptable for slopes greater than an 8/12 (33.7°) pitch.
(F) When this design is used, refer to the appendices of NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction regarding the number of design sprinklers to hydraulically calculate.

SPACING OF RESIDENTIAL SPRINKLERS BELOW CEILINGS WITH SLOPES EXCEEDING 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 3 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

Multiple Slope

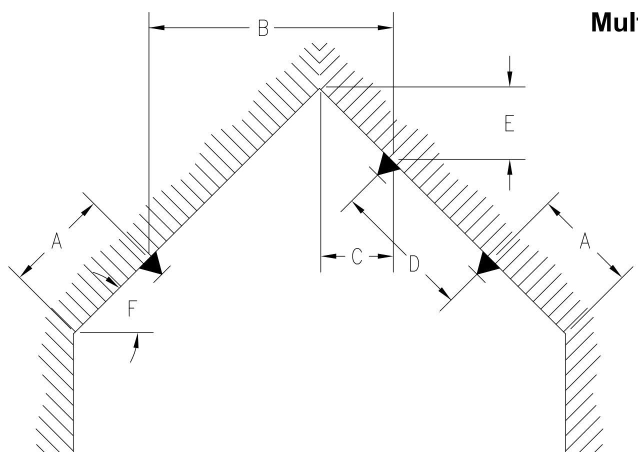

Figure 6

(A) 0'-4" (0-102 mm) minimum, to one-half listed spacing, maximum.
(B) One-half listed spacing, maximum, 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) Listed spacing maximum, 8'-0" (2.4 m) minimum.
(E) 3'-0" (.91 m) maximum.
(F) Slopes greater than 8/12 up to a 21/12 (33.7° up to 60°) pitch.

NOTES: In addition to the above limits, rooms requiring this type of installation must be hydraulically calculated to supply a minimum of three operating sprinklers. Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

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SPACING OF RESIDENTIAL SPRINKLERS BELOW CEILINGS WITH SLOPES EXCEEDING 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 2 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

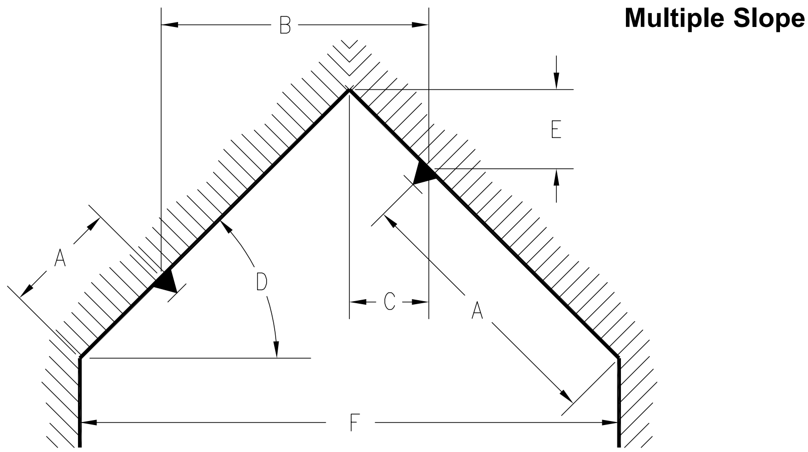

Figure 7

(A) 0’-4” (0-102 mm) minimum, to one-half listed spacing, maximum.
(B) One-half listed spacing, maximum, 8’-0” (2.4 m) minimum.
(C) 0’-4” (0-102 mm) minimum.
(D) Slopes greater than 8/12 pitch up to a 21/12 (33.7° up to a 60°) pitch.
(E) 3’-0” (.91 m) maximum.
(F) When dimension “F” exceeds 16’ (4.9 m), utilize design configuration shown in Figure 6.

NOTES: Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

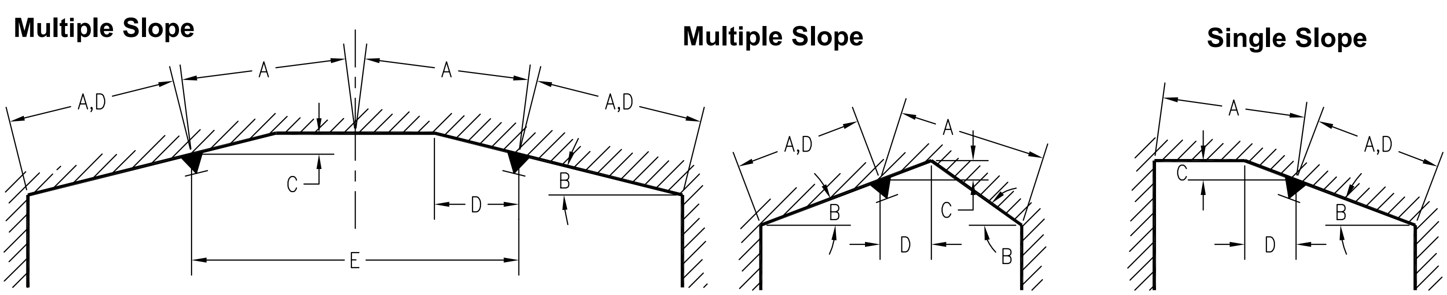

Figure 8

(A) One-half listed spacing, maximum.
(B) Refer to the appropriate residential sprinkler technical data pages for listings of sprinklers for use below slopes up to and including a 8/12 (33.7°) pitch.
(C) 3’-0” (.91 m) maximum.
(D) 0’-4” (0-102 mm) minimum.
(E) 8’-0” (2.4 m) minimum without baffle.

NOTES: Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

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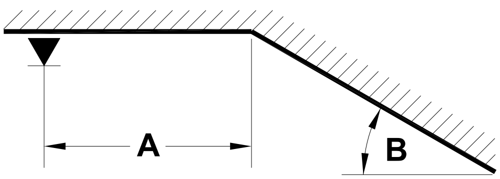
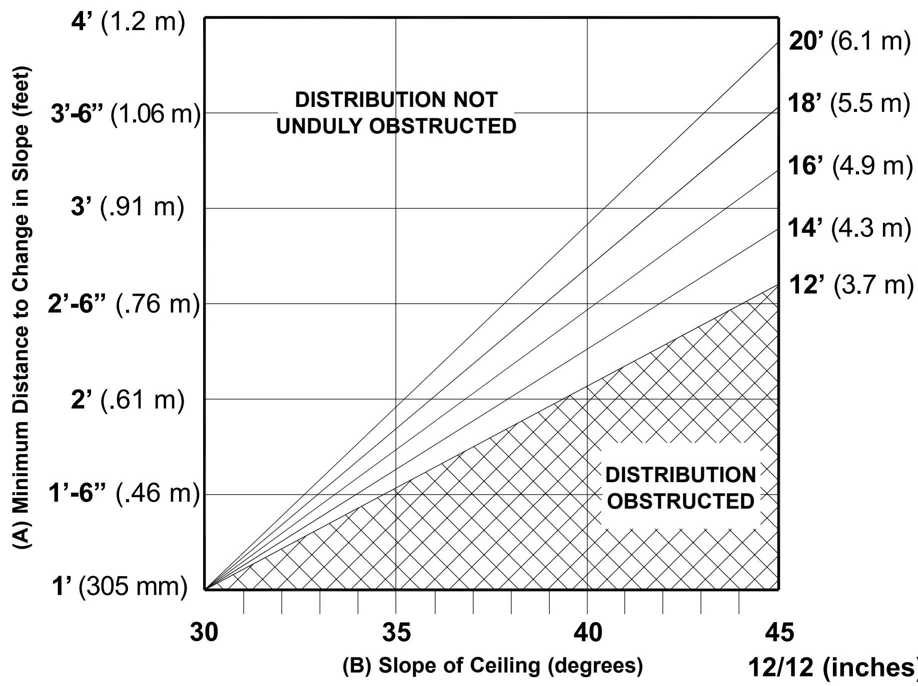
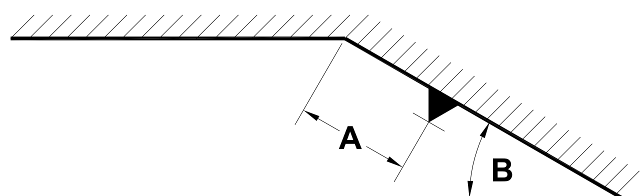
MINIMUM DISTANCE BETWEEN SPRINKLER AND INTERSECTING SLOPED CEILINGS

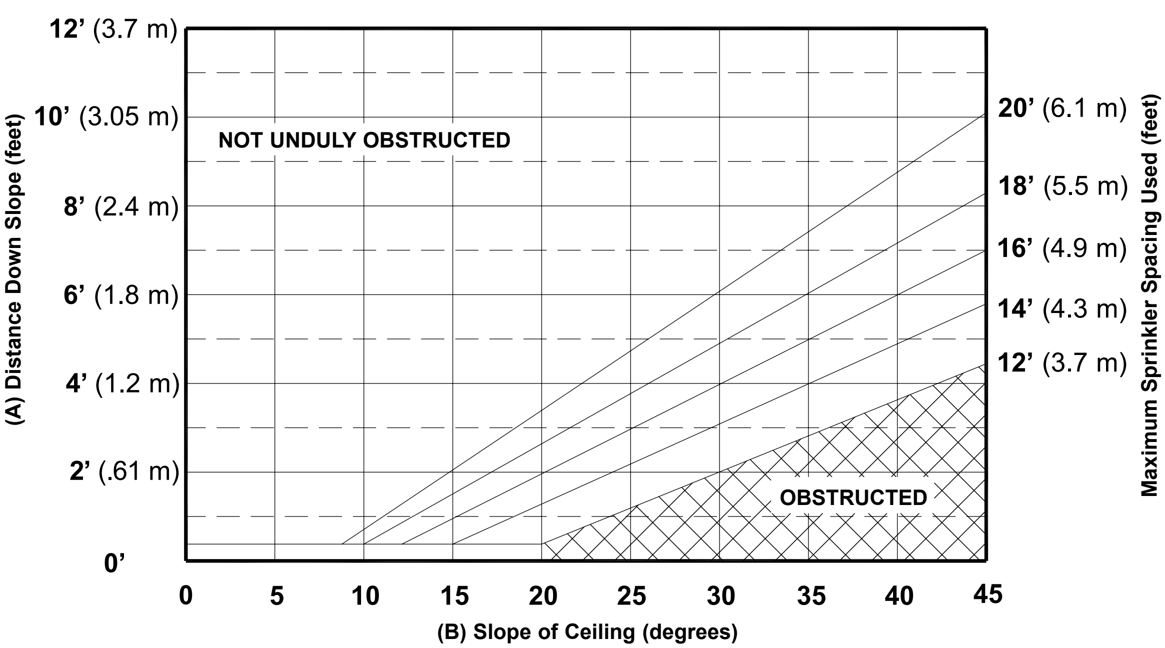


NOTES: For any ceiling slope under 7/12 (30°), distribution is considered Not Unduly Obstructed.



MAXIMUM DISTANCE DOWN SLOPE TO AVOID OBSTRUCTION TO SPRINKLER DISCHARGE





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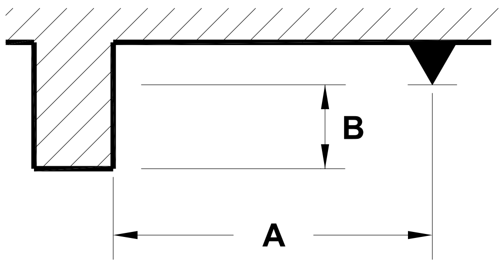
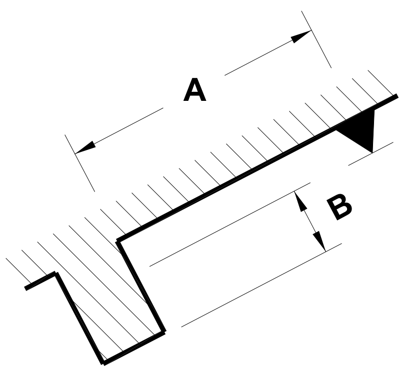
AVOIDING OBSTRUCTIONS TO SPRINKLER DISCHARGE

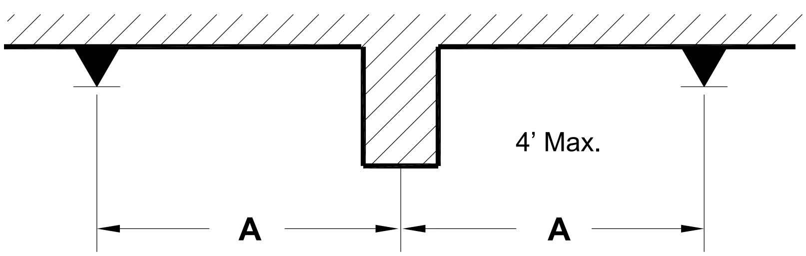
(Obstruction rules for residential sprinklers are found in section 8.10 of the 2010 edition of NFPA 13.)

Positioning Residential Pendent Sprinklers - Obstructions at the Ceiling



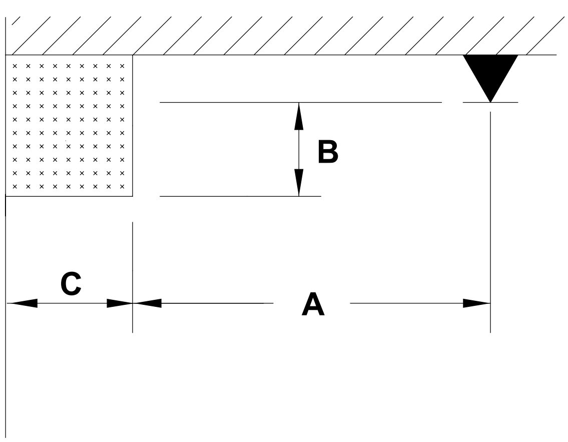


Distance from Sprinkler to Side of Ceiling Obstruction (Dimension A)	Maximum Distance from Deflector to Bottom of Ceiling Obstruction (Dimension B)	
	Inches	mm
Less than 1 ft. 6 in. (Less than 457 mm)	0	0
1 ft. 6 in. to less than 3 ft. (457 mm to less than .94 m)	1	25.4
3 ft. to less than 4 ft. (.91 m to less than 1.2 m)	3	76
4 ft. to less than 4 ft. 6 in. (1.2 m to less than 1.37 m)	5	127
4 ft. 6 in. to less than 6 ft. (1.37 m to less than 1.8 m)	7	178
6 ft. to less than 6 ft. 6 in. (1.8 m to less than 2 m)	9	229
6 ft. 6 in. to less than 7 ft. (2 m to less than 2.1 m)	11	279
7 ft. or greater (2.1 m or greater)	14	356



Residential pendent sprinklers may be located on opposite sides of continuous obstructions up to 4 ft. (1.2 m) wide at the ceiling, as long as the distance from the centerline of the obstruction to the sprinklers (A) does not exceed one-half the maximum spacing allowed between sprinklers.

Positioning Residential Pendent Sprinklers - Obstructions Along Walls



(A) Distance from centerline of sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.
(C) Width of the obstruction.

Obstructions up to 30 in. (.8 m) wide (C) located against the wall are permitted to be protected when (A) is greater than or equal to (C) minus 8 in. (.2 m) plus (B).

$C \leq 30$ in.
$A \geq (C - 8 \text{ in.}) + B$

for metric $C \leq .8$ m
$A \geq (C - .2 \text{ m}) + B$

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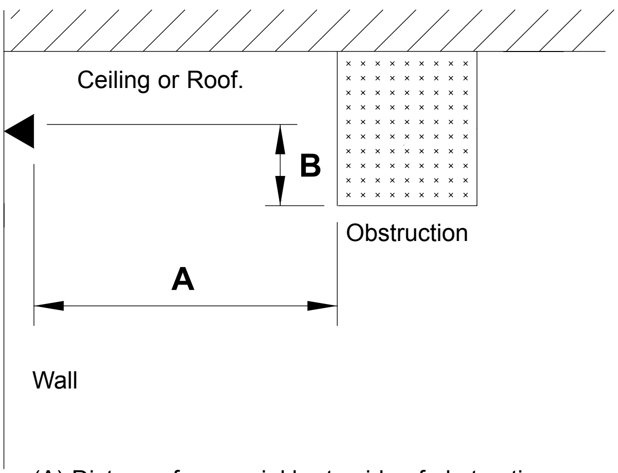
AVOIDING OBSTRUCTIONS TO SPRINKLER DISCHARGE

(Obstruction rules for residential sprinklers are found in section 8.10 of the 2010 edition of NFPA 13.)

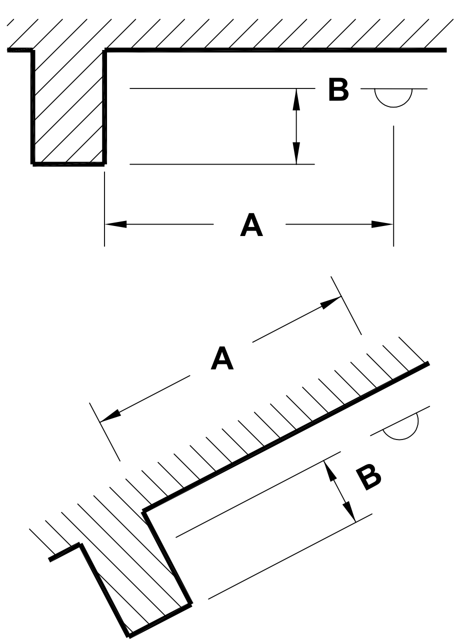
Positioning Residential Horizontal Sidewall Sprinklers - Obstructions at the Ceiling



(A) Distance from sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.

Distance from Sprinkler to Side of Ceiling Obstruction (Dimension A)	Maximum Distance from Deflector to Bottom of Ceiling Obstruction (Dimension B)	
	Inches	mm
Less than 8 ft. (Less than 2.4 m)	No Obstructions Allowed	
8 ft. to less than 10 ft. (2.4 m to less than 3.05 m)	1	25.4
10 ft. to less than 11 ft. (3.05 m to less than 3.35 m)	2	50.8
11 ft. to less than 12 ft. (3.35 m to less than 3.7 m)	3	76
12 ft. to less than 13 ft. (3.7 m to less than 4 m)	4	102
13 ft. to less than 14 ft. (4 m to less than 4.3 m)	6	152
14 ft. to less than 15 ft. (4.3 m to less than 4.6 m)	7	178
15 ft. to less than 16 ft. (4.6 m to less than 4.9 m)	9	229
16 ft. to less than 17 ft. (4.9 m to less than 5.2 m)	11	279
17 ft. or greater (5.2 m or greater)	14	356

Positioning Residential Horizontal Sidewall Sprinklers - Obstructions Along Walls



Distance from Sprinkler to Side of Obstruction Along Wall (Dimension A)	Maximum Distance from Deflector to Bottom of Obstruction (Dimension B)	
	Inches	mm
Less than 1 ft. 6 in. (Less than 457 mm)	0	0
1 ft. 6 in. to less than 3 ft. (457 mm to less than .94 m)	1	25.4
3 ft. to less than 4 ft. (.91 m to less than 1.2 m)	3	76
4 ft. to less than 4 ft. 6 in. (1.2 m to less than 1.37 m)	5	127
4 ft. 6 in. to less than 6 ft. (1.37 m to less than 1.8 m)	7	178
6 ft. to less than 6 ft. 6 in. (1.8 m to less than 2 m)	9	229
6 ft. 6 in. to less than 7 ft. (2 m to less than 2.1 m)	11	279
7 ft. or greater (2.1 m or greater)	14	356

(A) Distance from sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.

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LOCATING RESIDENTIAL SPRINKLERS NEAR HEAT SOURCES

Ordinary temperature rated residential sprinklers (135 °F to 170 °F rated) are only to be installed where the maximum ambient ceiling temperature will not exceed 100 °F. Where the maximum ambient ceiling temperature will be from 101 °F to 150 °F, use intermediate temperature rated residential sprinklers (175 °F to 225 °F rated).

Residential sprinklers must be positioned a sufficient distance away from heat sources that include fireplaces, stoves, kitchen ranges, wall ovens, hot water pipes, water heaters, furnaces and associated flues and ducts, and light fixtures. The following minimum distances must be maintained for both ordinary and intermediate temperature rated residential sprinklers as indicated.

Heat Source	Minimum Distance from Edge of Source to Ordinary Temperature Rated Sprinkler		Minimum Distance from Edge of Source to Intermediate Temperature Rated Sprinkler	
	Inches	metric	Inches	metric
Side of open or recessed fireplace	36	.91 m	12	305 mm
Front of recessed fire place	60	1.5 m	36	.91 m
Coal- or wood-burning stove	42	1.1 m	12	305 mm
Kitchen range	18	457 mm	9	229 mm
Wall oven	18	457 mm	9	229 mm
Hot air flues	18	457 mm	9	229 mm
Uninsulated heat ducts	18	457 mm	9	229 mm
Uninsulated hot water pipes	12	305 mm	6	152 mm
Side of ceiling- or wall-mounted hot air diffusers	24	.61 m	12	305 mm
Front of wall-mounted hot air diffusers	36	.91 m	18	457 mm
Hot water heater or furnace	6	152 mm	3	76 mm
Light fixture less than 250W	6	152 mm	3	76 mm
Light fixture 250W to 499W	12	305 mm	6	152 mm
Where residential sprinklers will be exposed to the rays of the sun passing through glass or plastic skylights, use intermediate temperature rated sprinklers.				
When locating residential sprinklers in an unventilated concealed compartment, under an unventilated attic or uninsulated roof, where the maximum ambient temperature does not exceed 150 °F, use intermediate temperature rated sprinklers.				

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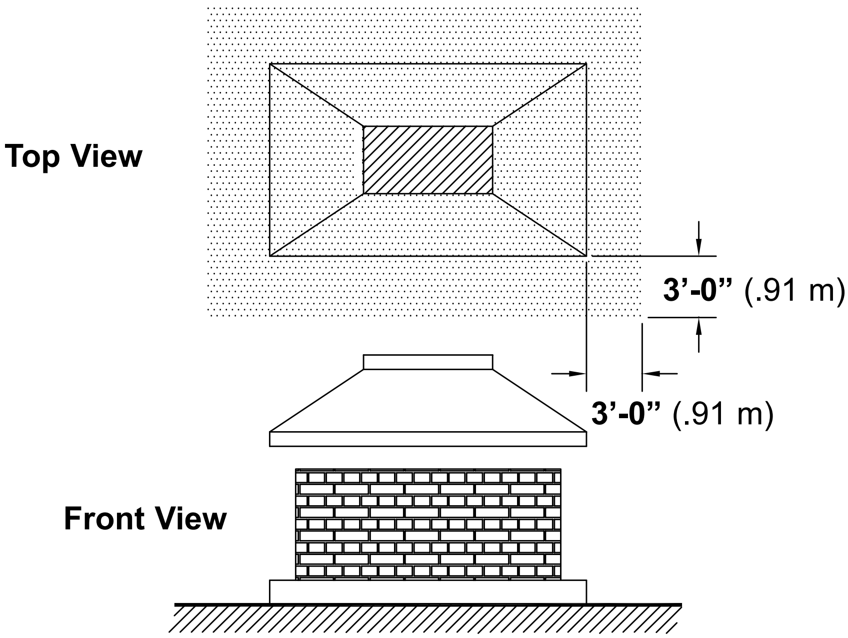
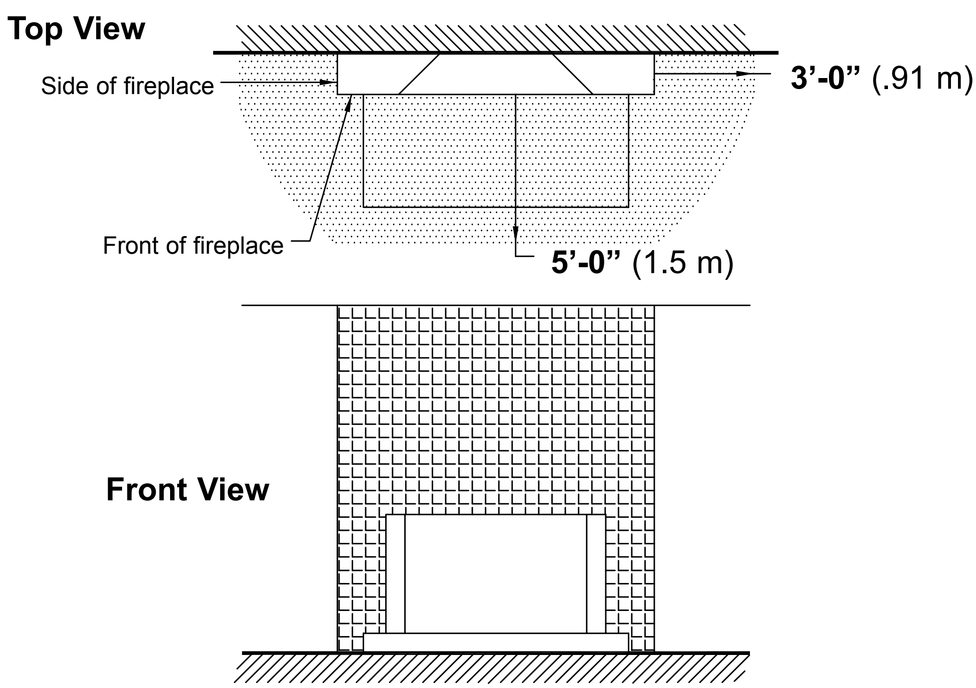
NOTE: The dimensions shown are intended to apply to residential sprinklers installed in ceilings above fireplaces used to burn products that cause elevated temperatures at or near the ceiling in areas surrounding the fireplace. The recommendations should not be construed to apply to decorative non-opening fireplaces such as gas fire units that will not cause elevated temperatures at the ceiling.



Sprinklers near an open hearth fireplace must be located outside of the shaded area or be intermediate degree rated.



Sprinklers near a recessed hearth fireplace must be located outside of the shaded area [at least 3'-0" (.91 m)] from the side of a recessed fireplace and at least 5'-0" (1.5 m) from the front) or be intermediate degree rated.

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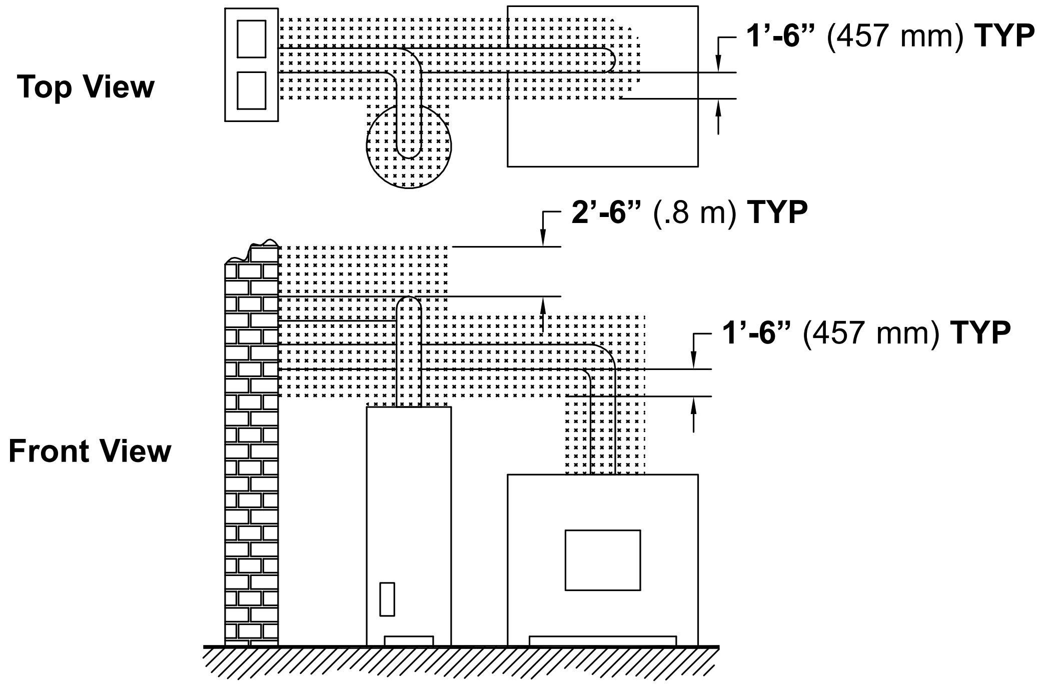
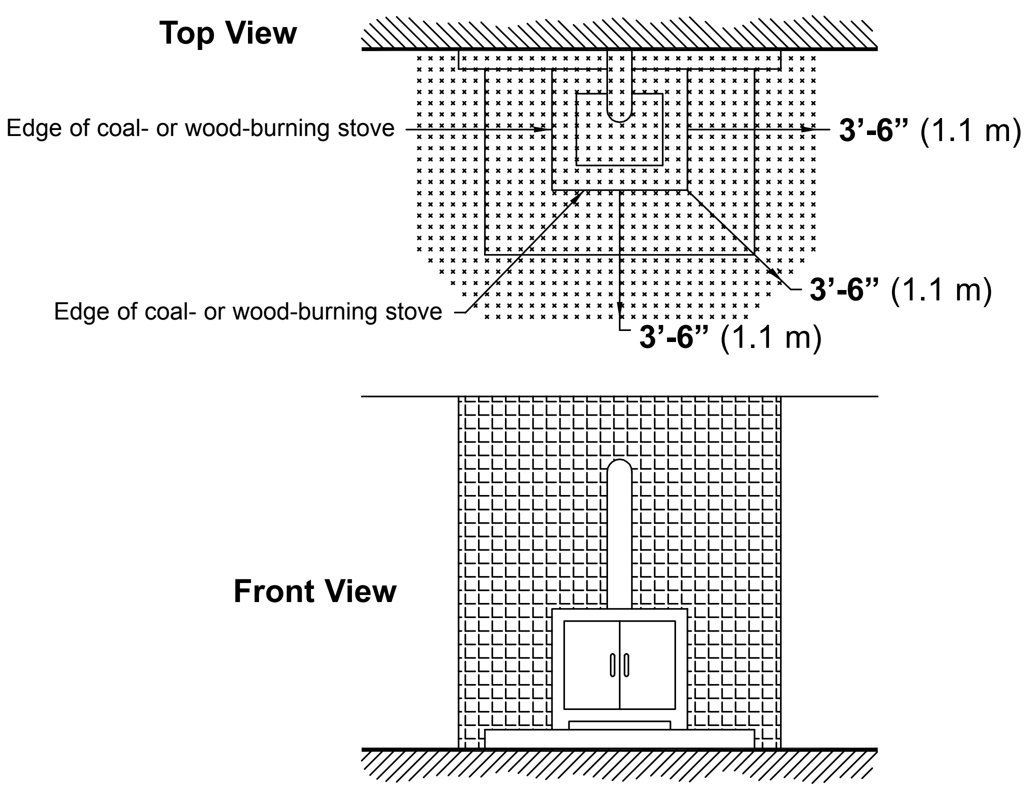


Sprinklers near a furnace or water heater must be located outside of the shaded area or be intermediate degree rated.



Sprinklers near a coal- or wood-burning stove must be located outside of shaded area or be intermediate degree rated.

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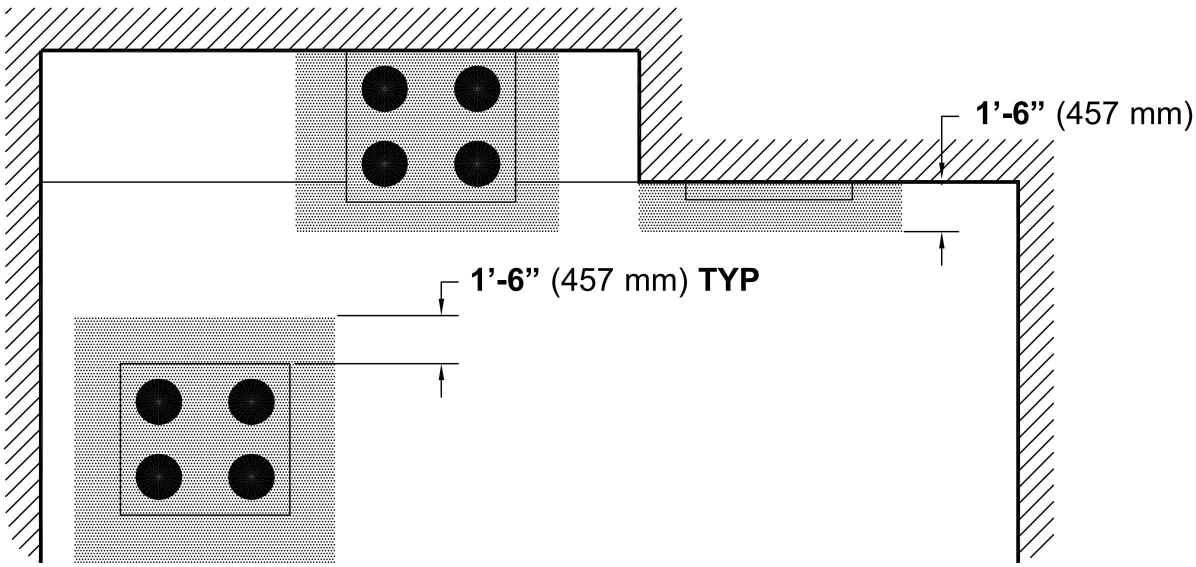
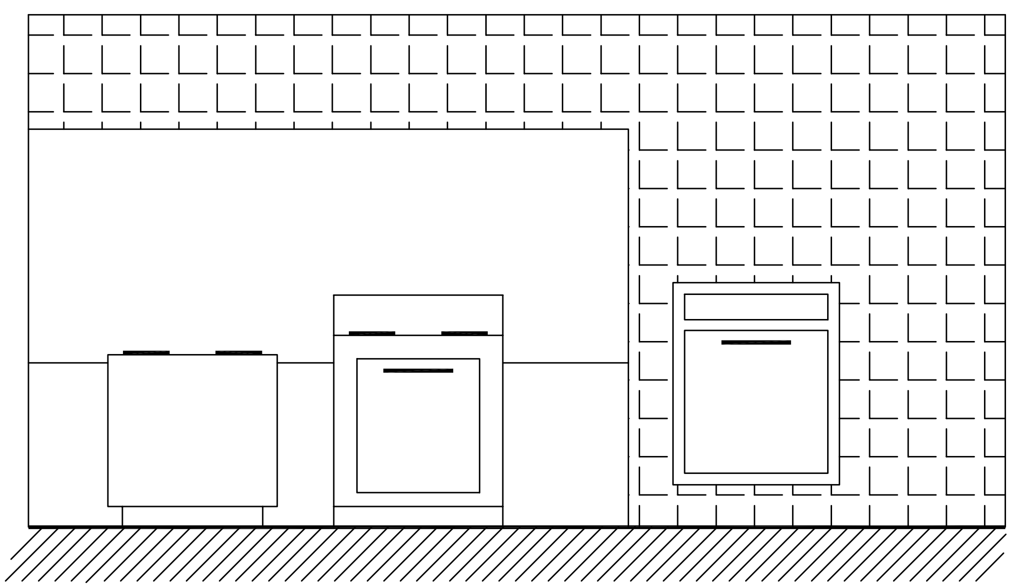
Top View



Front View



Sprinklers near a range or wall oven must be located outside of shaded areas or be intermediate degree rated.

VIKING

BULLETIN

CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

SPRINKLERS ARE FRAGILE - HANDLE WITH CARE!

General Handling and Storage:

- Store sprinklers in a cool, dry place.
- Protect sprinklers during storage, transport, handling, and after installation.
- Use the original shipping containers. DO NOT place sprinklers loose in boxes, bins, or buckets.
- Keep sprinklers separated at all times. DO NOT allow metal parts to contact sprinkler operating elements.

For Pre-Assembled Drops:

- Protect sprinklers during handling and after installation.
- For recessed assemblies, use the protective sprinkler cap (Viking Part Number 10364).

Sprinklers with Protective Shields or Caps:

- DO NOT remove shields or caps until after sprinkler installation and there no longer is potential for mechanical damage to the sprinkler operating elements.
- **Sprinkler shields or caps MUST be removed BEFORE placing the system in service!**
- Remove the sprinkler shield by carefully pulling it apart where it is snapped together.
- Remove the cap by turning it slightly and pulling it off the sprinkler.

Sprinkler Installation:

- DO NOT use the sprinkler deflector or operating element to start or thread the sprinkler into a fitting.
- **Use only the designated sprinkler head wrench!** Refer to the current sprinkler technical data page to determine the correct wrench for the model of sprinkler used.
- DO NOT install sprinklers onto piping at the floor level.
- Install sprinklers after the piping is in place to prevent mechanical damage.
- DO NOT allow impacts such as hammer blows directly to sprinklers or to fittings, pipe, or couplings in close proximity to sprinklers. Sprinklers can be damaged from direct or indirect impacts.
- DO NOT attempt to remove drywall, paint, etc., from sprinklers.
- **Take care not to over-tighten the sprinkler and/or damage its operating parts!**

Maximum Torque:

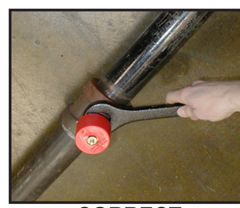
1/2" NPT:	**14 ft-lbs. (19.0 N-m)**
3/4" NPT:	**20 ft-lbs. (27.1 N-m)**
1" NPT:	**30 ft-lbs. (40.7 N-m)**

CORRECT
(Original container used)

INCORRECT
(Placed loose in box)

CORRECT
(Protected with caps)

INCORRECT
(Protective caps not used)



CORRECT
(Piping is in place at the ceiling)

INCORRECT
(Sprinkler at floor level)

CORRECT
(Special installation wrenches)

INCORRECT
(Designated wrench not used)

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

⚠ WARNING

Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed. Never install sprinklers that have been dropped, damaged, or exposed to temperatures exceeding the maximum ambient temperature allowed. Sprinklers that have been painted in the field must be replaced per NFPA 13. Protect sprinklers from paint and paint overspray in accordance with the installation standards. Do not clean sprinklers with soap and water, ammonia, or any other cleaning fluid. Do not use adhesives or solvents on sprinklers or their operating elements.

Refer to the appropriate technical data page and NFPA standards for complete care, handling, installation, and maintenance instructions. For additional product and system information Viking data pages and installation instructions are available on the Viking Web site at www.vikinggroupinc.com.

BULLETIN

CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

PROTECTIVE SPRINKLER SHIELDS AND CAPS

General Handling and Storage:

Many Viking sprinklers are available with a plastic protective cap or shield temporarily covering the operating elements. The snap-on shields and caps are factory installed and are intended to help protect the operating elements from mechanical damage during shipping, storage, and installation. NOTE: It is still necessary to follow the care and handling instructions on the appropriate sprinkler technical data sheets* when installing sprinklers with bulb shields or caps.

WHEN TO REMOVE THE SHIELDS AND CAPS:

NOTE: SHIELDS AND CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!

Remove the shield or cap from the sprinkler only after checking all of the following:

- The sprinkler has been installed*.
- The wall or ceiling finish work is completed where the sprinkler is installed and there no longer is a potential for mechanical damage to the sprinkler operating elements.

SHIELDS AND CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!

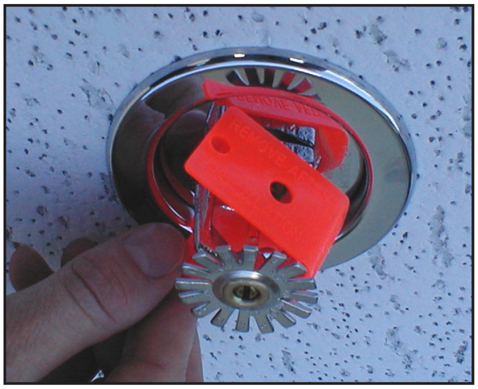


Figure 1: Sprinkler shield being removed from a pendent sprinkler.


Figure 2: Sprinkler cap being removed from a pendent sprinkler.


Figure 3: Sprinkler cap being removed from and upright sprinkler.

HOW TO REMOVE SHIELDS AND CAPS:

No tools are necessary to remove the shields or caps from sprinklers. DO NOT use any sharp objects to remove them! **Take care not to cause mechanical damage to sprinklers when removing the shields or caps.** When removing caps from fusible element sprinklers, use care to prevent dislodging ejector springs or damaging fusible elements. NOTE: Squeezing the sprinkler cap excessively could damage sprinkler fusible elements.

- To remove the shield, simply pull the ends of the shield apart where it is snapped together. Refer to Figure 1.
- To remove the cap, turn it slightly and pull it off the sprinkler. Refer to Figures 2 and 3.

NOTICE Refer to the current sprinkler technical data page to determine the correct sprinkler wrench for the model of sprinkler used.

WARNING Never install sprinklers that have been dropped, damaged, or exposed to temperatures in excess of the maximum ambient temperature allowed.

*** Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.**

VIKING	BULLETIN	CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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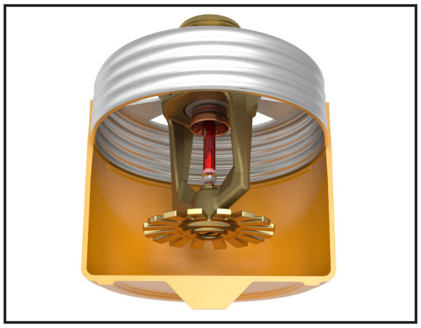
CAUTION CONCEALED COVER ASSEMBLIES ARE FRAGILE!
TO ASSURE SATISFACTORY PERFORMANCE OF THE PRODUCT, HANDLE WITH CARE.



Concealed Sprinkler and Adapter Assembly with Protective Cap

Concealed Sprinkler and Adapter Assembly (Protective Cap Removed)

Cover Plate Assembly (Pendent Cover 12381 shown)

GENERAL HANDLING AND STORAGE INSTRUCTIONS:

- Do not store in temperatures exceeding 100 °F (38 °C). Avoid direct sunlight and confined areas subject to heat.
- Protect sprinklers and cover assemblies during storage, transport, handling, and after installation.
  -- Use original shipping containers.
  -- Do not place sprinklers or cover assemblies loose in boxes, bins, or buckets.
- Keep the sprinkler bodies covered with the protective sprinkler cap any time the sprinklers are shipped or handled, during testing of the system, and while ceiling finish work is being completed.
- Use only the designated Viking recessed sprinkler wrench (refer to the appropriate sprinkler data page) to install these sprinklers. **NOTE:** The protective cap is temporarily removed during installation and then placed back on the sprinkler for protection until finish work is completed.
- Do not over-tighten the sprinklers into fittings during installation.
- Do not use the sprinkler deflector to start or thread the sprinklers into fittings during installation.
- Do not attempt to remove drywall, paint, etc., from the sprinklers.
- Remove the plastic protective cap from the sprinkler before attaching the cover plate assembly. **PROTECTIVE CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!**

Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.

VIKING | BULLETIN | CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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USE THE FOLLOWING PRECAUTIONS WHEN HANDLING WAX-COATED SPRINKLERS

Many of Viking's sprinklers are available with factory-applied wax coating for corrosion resistance. These sprinklers MUST receive appropriate care and handling to avoid damaging the wax coating and to assure satisfactory performance of the product.

General Handling and Storage of Wax-Coated Sprinklers:

- Store the sprinklers in a cool, dry place (in temperatures below the maximum ambient temperature allowed for the sprinkler temperature rating. Refer to Table 1 below.)
- Store containers of wax-coated sprinklers separate from other sprinklers.
- Protect the sprinklers during storage, transport, handling, and after installation.
- Use original shipping containers.
- Do not place sprinklers in loose boxes, bins, or buckets.

Installation of Wax-Coated Sprinklers:

Use only the special sprinkler head wrench designed for installing wax-coated Viking sprinklers (any other wrench may damage the unit).

- Take care not to crack the wax coating on the units.
- For touching up the wax coating after installation, wax is available from Viking in bar form. Refer to Table 1 below. The coating MUST be repaired after sprinkler installation to protect the corrosion-resistant properties of the sprinkler.
- Use care when locating sprinklers near fixtures that can generate heat. Do not install sprinklers where they would be exposed to temperatures exceeding the maximum recommended ambient temperature for the temperature rating used.
- Inspect the coated sprinklers frequently soon after installation to verify the integrity of the corrosion resistant coating. Thereafter, inspect representative samples of the coated sprinklers in accordance with NFPA 25. Close up visual inspections are necessary to determine whether the sprinklers are being affected by corrosive conditions.

TABLE 1

Sprinkler Temperature Rating (Fusing Point)	Wax Part Number	Wax Melting Point	Maximum Ambient Ceiling Temperature[1]	Wax Color
155 °F (68 °C) / 165 °F (74 °C)	02568A	148 °F (64 °C)	100 °F (38 °C)	Light Brown
175 °F (79 °C)	04146A	161 °F (71 °C)	150 °F (65 °C)	Brown
200 °F (93 °C)	04146A	161 °F (71 °C)	150 °F (65 °C)	Brown
220 °F (104 °C)	02569A	170 °F (76 °C)	150 °F (65 °C)	Dark Brown
286 °F (141 °C)	02569A	170 °F (76 °C)	150 °F (65 °C)	Dark Brown

[1] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

⚠WARNING Never install sprinklers that have been dropped, damaged, or exposed to temperatures in excess of the maximum ambient temperature allowed.

Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.

VIKING	TECHNICAL DATA	SPRINKLER OVERVIEW

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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1. DESCRIPTION

Viking fire sprinklers consist of a threaded frame with a specific waterway or orifice size and a deflector for distributing water in a specified pattern. A closed or sealed sprinkler refers to a complete assembly, including the thermosensitive operating element. An open sprinkler does not use an operating element and is open at all times. The distribution of water is intended to extinguish a fire or to control its spread.

Viking sprinklers are available in several models and styles. Refer to specific sprinkler technical data pages for available styles, finishes, temperature ratings, thread sizes, and nominal K-Factors for the particular model selected.

2. LISTINGS AND APPROVALS

Refer to the Approval Charts on the appropriate sprinkler technical data page(s) and/or approval agency listings.

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

3. TECHNICAL DATA

Pressure Ratings:

Maximum allowable water working pressure is 175 psig (12 Bar) unless rated and specified for high water working pressure [250 psig (17.2 bar)].

Sprinkler Identification:

Viking sprinklers are identified and marked with the word “Viking”, the sprinkler identification number (SIN) consisting of “VK” plus a three digit number*, the model letter, and the year of manufacture.

Available Finishes:

Viking sprinklers are available in several decorative finishes. Some models are available with corrosion-resistant coatings or are fabricated from non-corrosive material. Refer to the sprinkler technical data page for additional information.

Available Temperature Ratings:

Viking sprinklers are available in several temperature ratings that relate to a specific temperature classification. Applicable installation rules mandate the use and limitations of each temperature classification. In selecting the appropriate temperature classification, the maximum expected ceiling temperature must be known. When there is doubt as to the maximum temperature at the sprinkler location, a maximum-reading thermometer should be used to determine the temperature under conditions that would show the highest readings to be expected. In addition, recognized installation rules may require a higher temperature classification, depending upon sprinkler location, occupancy classification, commodity classification, storage height, and other hazards. In all cases, the maximum expected ceiling temperature dictates the lowest allowable temperature classification. Sprinklers located immediately adjacent to a heat source may require a higher temperature rating.

K-Factors:

Viking sprinklers are available in several orifice sizes with related K-Factors. The orifice is a tapered waterway and, therefore, the K-Factor given is nominal. Nominal U.S. K-Factors are provided in accordance with the 1999 edition of NFPA 13, Section 3-2.3. Refer to the specific data page for appropriate K-Factor information.

Available Styles:

Viking sprinklers are available for installation in several positions as indicated by a stamping on the deflector. The deflector style dictates the appropriate installation position of the sprinkler; it breaks the solid stream of water issuing from the sprinkler orifice to form a specific spray pattern. The following list indicates the various styles and identification of Viking sprinklers.

UPRIGHT SPRINKLER: A sprinkler intended to be installed with the deflector above the frame so water flows upward through the orifice, striking the deflector and forming an umbrella-shaped spray pattern downward. Marked “SSU” (Standard Sprinkler Upright) or “UPRIGHT” on the deflector.

PENDENT SPRINKLER: A sprinkler intended to be oriented with the deflector below the frame so water flows downward through the orifice, striking the deflector and forming an umbrella-shaped spray pattern downward. Marked “SSP” (Standard Sprinkler Pendent) or “PENDENT” on the deflector.

Viking Technical Data may be found on The Viking Corporation’s Web site at http://www.vikinggroupinc.com. The Web site may include a more recent edition of this Technical Data Page.

CONVENTIONAL SPRINKLER: An “old style” sprinkler intended to be installed with the deflector in either the upright or pendent position. The deflector provides a spherical type pattern with 40 to 60 percent of the water initially directed downward and a proportion directed upward. Must be installed in accordance with installation rules for conventional or old style sprinklers. DO NOT USE AS A REPLACEMENT FOR STANDARD SPRAY SPRINKLERS. Marked “C U/P” (Conventional Upright/Pendent) on the deflector.

TECHNICAL DATA

SPRINKLER OVERVIEW

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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VERTICAL SIDEWALL (VSW) SPRINKLER: A sprinkler intended for installation near the wall and ceiling. The deflector provides a water spray pattern outward in a quarter-spherical pattern and can be installed in the upright or pendent position with the flow arrow in the direction of discharge. Marked “SIDEWALL” on the deflector with an arrow and the word “FLOW”. (Note: Some vertical sidewall sprinklers can only be installed in the upright or pendent position—in this case, the sprinkler will also be marked “UPRIGHT” or “PENDENT”.)

HORIZONTAL SIDEWALL (HSW) SPRINKLER: A sprinkler intended for installation near the wall and ceiling. The special deflector provides a water spray pattern outward in a quarter-spherical pattern. Most of the water is directed away from the nearby wall with a small portion directed at the wall behind the sprinkler. The top of the deflector is oriented parallel with the ceiling or roof. The flow arrows point in the direction of discharge. Marked “SIDEWALL” and “TOP” with an arrow and the word “FLOW”.

EXTENDED COVERAGE (EC) SPRINKLER: A spray sprinkler designed to discharge water over an area having the maximum dimensions indicated in the individual listings. Maximum area of coverage, minimum flow rate, orifice size, and nominal K-Factor are specified in the individual listings. EC sprinklers are intended for Light-Hazard occupancies with smooth, flat, horizontal ceilings unless otherwise specified. In addition to the above markings, the sprinkler is marked “EC”.

QUICK RESPONSE (QR) SPRINKLER: A spray sprinkler with a fast- actuating operating element. The use of quick response sprinklers may be limited due to occupancy and hazard. Refer to the Authority Having Jurisdiction (AHJ) prior to installing.

QUICK RESPONSE EXTENDED COVERAGE (QREC) SPRINKLER: A spray sprinkler designed to discharge water over an area having the maximum dimensions indicated in the individual listing. This is a sprinkler with an operating element that meets the criteria for quick response. QREC sprinklers are only intended for Light Hazard occupancies. The sprinkler is marked “QREC”.

FLUSH SPRINKLER: A decorative spray sprinkler intended for installation with a concealed piping system. The unit is mounted flush with the ceiling or wall, with the fusible link exposed. Upon actuation, the deflector extends beyond the ceiling or wall to distribute water discharge. The sprinkler is marked “SSP”, “PEND”, or “SIDEWALL” and “TOP”.

CONCEALED SPRINKLER: A decorative spray sprinkler intended for installation with a concealed piping system. The sprinkler is hidden from view by a cover plate installed flush with the ceiling or wall. During fire conditions, the cover plate detaches, and upon sprinkler actuation, the deflector extends beyond the ceiling or wall to distribute water discharge. The sprinkler is marked “SSP”, “PEND”, or “SIDEWALL” and “TOP”.

RECESSED SPRINKLER: A spray sprinkler assembly intended for installation with a concealed piping system. The assembly consists of a sprinkler installed in a decorative adjustable recessed escutcheon that minimizes the protrusion of the sprinkler beyond the ceiling or wall without adversely affecting the sprinkler distribution or sensitivity. Refer to the appropriate technical data page for allowable sprinkler models, temperature ratings, and occupancy classifications. DO NOT RECESS ANY SPRINKLER NOT LISTED FOR USE WITH THE ESCUTCHEON.

CORROSION-RESISTANT SPRINKLER: A special service sprinkler with non-corrosive protective coatings, or that is fabricated from non-corrosive material, for use in atmospheres that would normally corrode sprinklers.

DRY SPRINKLER: A special-service sprinkler intended for installation on dry pipe systems or wet pipe systems where the sprinkler is subject to freezing temperatures. The unit consists of a sprinkler permanently secured to an extension nipple with a sealed inlet end to prevent water from entering the nipple until the sprinkler operates. The unit MUST be installed in a tee fitting. Dry upright sprinklers are marked with the “B” dimension [distance from the face of the fitting (tee) to the top of the deflector]. Dry pendent and sidewall sprinklers are marked with the “A” dimension [the distance from the face of fitting (tee) to the finished surface of the ceiling or wall].

LARGE DROP SPRINKLER: A type of special application sprinkler used to provide fire control of specific high-challenge fire hazards. Large drop sprinklers are designed to produce an umbrella-shaped spray pattern downward with a higher percentage of “large” water droplets than standard spray sprinklers. The sprinkler has an extra-large orifice with a nominal K-Factor of 11.2. Marked “HIGH CHALLENGE” and “UPRIGHT”.

EARLY SUPPRESSION FAST-RESPONSE (ESFR) SPRINKLER: A sprinkler intended to provide fire suppression of specific high-challenge fire hazards through the use of a fast response fusible link, 14.0, 16.8, or 25.2 nominal K-Factor, and special deflector. ESFR sprinklers are designed to produce high-momentum water droplets in a hemispherical pattern below the deflector. This permits penetration of the fire plume and direct wetting of the burning fuel surface while cooling the atmosphere early in the development of a high-challenge fire. Marked “ESFR” and “UPRIGHT” or “PEND”.

INTERMEDIATE LEVEL/RACK STORAGE SPRINKLER: A standard spray sprinkler assembly designed to protect its operating element from the spray of sprinklers installed at higher elevations. The assembly consists of a standard or large orifice upright or pendent sprinkler with an integral upright or pendent water shield and guard assembly. Use only those sprinklers that have been tested and listed for use with the assembly. Refer to the technical data page for allowable sprinkler models.

RESIDENTIAL SPRINKLER: A sprinkler intended for use in the following occupancies: one- and two-family dwellings with the fire protection sprinkler system installed in accordance with NFPA 13D; residential occupancies up to four stories in height with the fire protection system installed in accordance with NFPA 13R; and where allowed by the Authority Having Jurisdiction in residential portions of any occupancy with the fire protection system installed in accordance with NFPA 13.

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Residential sprinklers have a unique distribution pattern and utilize a “fast response” heat sensitive operating element. They enhance survivability in the room of fire origin and are designed to provide a life safety environment for a minimum of ten minutes. For this reason, residential sprinklers must not be used to replace standard sprinklers unless tested for and approved by the Authority Having Jurisdiction. In addition to standard markings, the unit is identified as “RESIDENTIAL SPRINKLER” or “RES”.

4. INSTALLATION

Refer to appropriate NFPA Installation Standards.

5. OPERATION

Refer to the appropriate sprinkler technical data page(s).

6. INSPECTIONS, TESTS AND MAINTENANCE

Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY

Viking sprinklers are available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE

For details of warranty, refer to Viking’s current list price schedule or contact Viking directly.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers and the appropriate sprinkler general care, installation, and maintenance guide. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, FM Global, LPCB, APSAD, VdS or other similar organizations, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. The sprinkler technical data page may contain installation requirements specific for the sprinkler model selected. The use of certain types of sprinklers may be limited due to occupancy and hazard. Refer to the Authority Having Jurisdiction prior to installation.

VIKING

BULLETIN

BEST PRACTICES FOR RESIDENTIAL SPRINKLER HANDLING & INSTALLATION

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page.

SPRINKLERS ARE FRAGILE - HANDLE WITH CARE!

- Always keep sprinklers in a cool dry place.
- Protect sprinklers during storage, transport and handling as well as before, during and after installation. Refer to Viking's Care and Handling of Sprinklers Bulletin Form No. F_091699[2].
- Proper transit, storage and installation of sprinklers in a high-heat environment is a must. Care should be taken to prevent sprinklers from being exposed to ambient heat conditions in excess of those referenced in installation standards.
- Do not stage or store sprinklers on the job site in advance in a non-conditioned space prior to installation.
- Keep sprinklers in the original packaging and check temperature indicators on box label prior to installation. If the indicator has turned black, DO NOT install any product contained in the box. Refer to Viking product return policies.
- Temperatures exceeding the maximum ambient temperature of the sprinkler temperature-rating during storage, transport, handling and installation must be avoided.
- Per NFPA standards 13, 13R, and 13D, sprinklers installed where maximum ambient temperatures are at or over 101 °F (38 °C) through 150 °F (66 °C) shall be intermediate temperature-rated sprinklers. Additionally, if sprinklers are installed in an unventilated concealed space under an uninsulated roof or in an unventilated attic, they shall be of intermediate temperature classification.
- Sprinklers installed where ambient temperatures are at or below 100 °F (38 °C) may be either ordinary or intermediate temperature-rated sprinklers. Refer to NFPA standards 13R 6.2.3.1 and 13D 7.5.6.1.
- Rough-in of sprinkler piping during hot weather conditions should not include the installation of sprinklers unless reasonable ambient temperatures can be maintained. Ambient temperatures that are considered when choosing the temperature rating for a sprinkler should take into account the range of ambient temperatures that are expected from installation through establishment and maintenance of temperature in a conditioned space. Appropriate insulation may be considered. **Example**: An ordinary temperature sprinkler should not be exposed to maximum ambient temperature higher than 100 °F (38 °C) or more. Refer to NFPA 13, Table 6.2.5.1, NFPA 13R, 6.2.3.1 and NFPA 13D, 7.5.6.1.
- CPVC fire sprinkler products exposed to high ambient temperatures (e.g. installed in unventilated, concealed spaces such as attics) should be insulated to maintain a cooler environment. Refer to Viking Plastics Installation and Design Manual, Form No. F_080712[2], for care and handling procedures.
- Protect all sprinklers and connecting CPVC piping in attic spaces and unvented concealed spaces from excessive heat exposure above 100 °F (38 °C). To separate excessive attic heat, properly tent and fully insulate all pipe in unconditioned spaces.
- Pressure relief valves should be installed on wet sprinkler systems where there is a risk of over-pressurization of a checked water supply, due to thermal expansion. Refer to NFPA 13, 7.1.2.1 and NFPA 13D, A.5.2.2.2.
- Fire sprinkler systems should be installed per current referenced editions of building codes and installation standards adopted in the jurisdiction where work is being performed.

INCORRECT
(Heat exposure)

INCORRECT
(Unconditioned at rough-in)

INCORRECT
(Exposed piping)

INCORRECT
(No pressure relief valve)

WARNING: Cancer and Reproductive Harm-
www.P65Warnings.ca.gov

[1]Hot weather condition is defined as temperatures that can reach the maximum ambient temperature-rating of the sprinkler.
[2]Clicking on blue hyperlink will open referenced document.

⚠ WARNING

Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed. Never install sprinklers that have been dropped, damaged, or exposed to temperatures exceeding the maximum ambient temperature allowed. Sprinklers that have been painted in the field must be replaced per NFPA 13. Protect sprinklers from paint and paint overspray in accordance with the installation standards. Do not clean sprinklers with soap and water, ammonia, or any other cleaning fluid. Do not use adhesives or solvents on sprinklers or their operating elements.

Refer to the appropriate technical data page and NFPA standards for complete care, handling, installation, and maintenance instructions. For additional product and system information Viking data pages and installation instructions are available on the Viking Web site at www.vikinggroupinc.com.

VIKING®

BULLETIN

REGULATORY AND HEALTH WARNINGS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

1. DESCRIPTION

Regulatory and Health Warnings applying to materials used in the manufacture and construction of fire protection products are provided herin as they relate to legally mandated jurisdictional regions.

⚠ WARNING
STATE OF CALIFORNIA, USA Installing or servicing fire protection products such as sprinklers, valves, piping etc. can expose you to chemicals including, but not limited to, lead, nickel, butadiene, titaninum dioxide, chromium, carbon black, and acrylonitrile which are known to the State of California to cause cancer or birth defects or other reproductive harm.
For more information, go to **www.P65Warnings.ca.gov**

2. WARRANTY TERMS AND CONDITIONS

For details of warranty, refer to Viking's current list price schedule at **www.vikinggroupinc.com** or contact Viking directly.

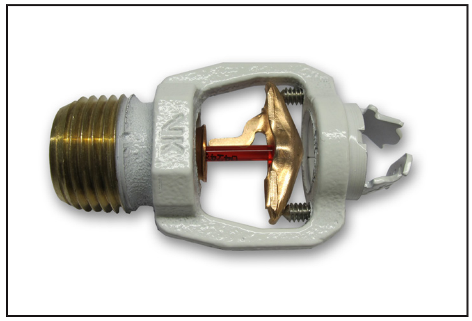
TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

1. DESCRIPTION

Viking Freedom® Residential Horizontal Sidewall Sprinkler VK486 is a small, thermosensitive, glass-bulb residential sprinkler available in several different finishes and temperature ratings to meet varying design requirements. The Electroless Nickel PTFE (ENT) coating has been investigated for installation in corrosive atmospheres and is C-UL-US-EU Listed as corrosion resistant as indicated in the Approval Chart. The sprinkler orifice design, with a K-Factor of 4.0 (57.7 metric†), allows efficient use of available water supplies for the hydraulically designed fire-protection system. The glass bulb operating element and special deflector characteristics meet the challenges of residential sprinkler standards.



WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

2. LISTINGS AND APPROVALS

UL Listed (C-UL-US-EU): Category VKKW

VdS Approved

Refer to the Approval Chart and Design Criteria for C-UL-US-EU Listing requirements that must be followed.

3. TECHNICAL DATA

Specifications:
Available since 2011.
Minimum Operating Pressure: Refer to the Approval Chart.
Maximum Working Pressure: 175 psi (12 bar). Factory tested hydrostatically to 500 psi (34.5 bar).
Thread size: 1/2” (15 mm) NPT
Nominal K-Factor: 4.0 U.S. (57.7 metric†)
† Metric K-factor measurement shown is in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
Glass-bulb fluid temperature rated to -65 °F (-55 °C)
Overall Length: 2-7/16” (62 mm)
Covered by the following US Patent numbers: 7,854,269 and 7,712,218

Material Standards:
Frame Casting: QM Brass and Brass UNS-C84400
Deflector: Phosphor Bronze UNS-C51000
Bulb: Glass, nominal 3 mm diameter
Belleville Spring Sealing Assembly: Nickel Alloy, coated on both sides with PTFE Tape
Pip Cap and Insert Assembly: Copper UNS-C11000 and Stainless Steel UNS-S30400
Compression Screws: 18-8 Stainless Steel
Yoke: Phosphor Bronze UNS-C51000

Ordering Information: (Also refer to the current Viking price list.)
Sprinkler: Base Part No. 17315
Order Sprinkler VK486 by first adding the appropriate suffix for the sprinkler finish and then the appropriate suffix for the temperature rating to the sprinkler base part number.
Finish Suffix: Brass = A, Chrome = F, White Polyester = M-/W, Black Polyester = M-/B
Temperature Suffix: 155 °F (68 °C) = B, 175 °F (79 °C) = D
For example, sprinkler VK486 with a Brass finish and a 155 °F (68 °C) temperature rating = Part No. 17315AB.

Available Finishes And Temperature Ratings:
Refer to Table 1.

Accessories: (Also refer to the Viking website.)

Sprinkler Wrenches:
A. Standard Wrench: Part No. 21475M/B (available since 2017)
B. Wrench for recessed sprinklers: Part No. 13655W/B* (available since 2006)
*A ½” ratchet is required (not available from Viking).

VIKING® | TECHNICAL DATA | **FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)**

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

Sprinkler Cabinets:
A. Six-head capacity: Part No. 01724A (available since 1971)
B. Twelve-head capacity: Part No. 01725A (available since 1971)

4. INSTALLATION
Refer to appropriate NFPA Installation Standards.

5. OPERATION
During fire conditions, the heat-sensitive liquid in the glass bulb expands, causing the glass to shatter, releasing the yoke, pip cap, and sealing spring assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector, forming a uniform spray pattern to extinguish or control the fire.

6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
Viking Sprinkler VK486 is available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

TABLE 1: AVAILABLE SPRINKLER TEMPERATURE RATINGS AND FINISHES

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[2]	Bulb Color
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow

Sprinkler Finishes: Brass, Chrome, White Polyester, and Black Polyester.

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector.

[2] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

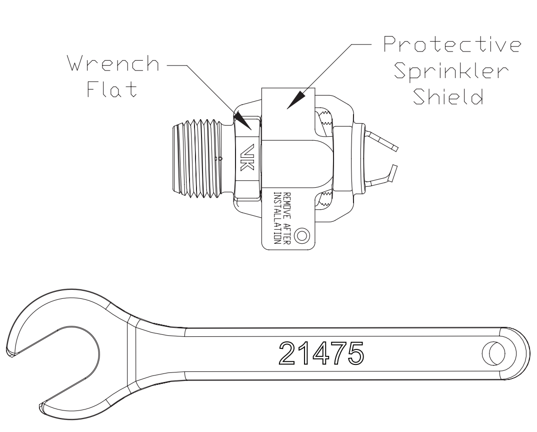


Figure 1:
Standard Sprinkler Wrench 21475M/B

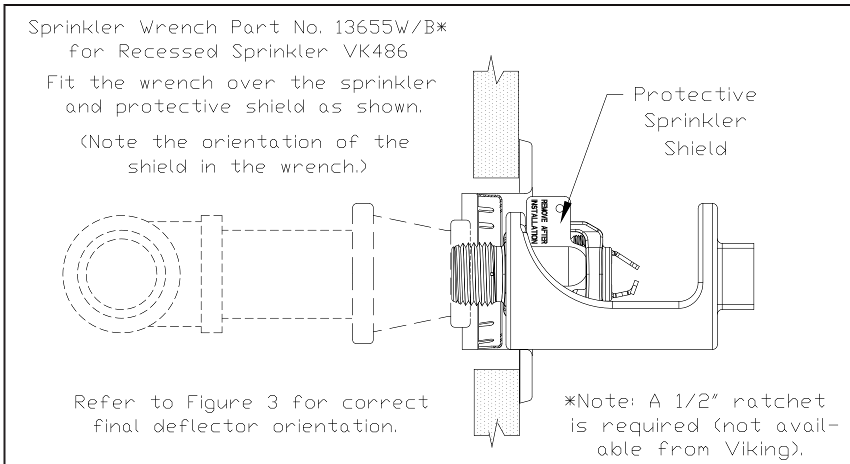


Figure 2:
Wrench 13655W/B for Recessed Sprinkler VK486

TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

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Approval Chart
Viking VK486, 4.0 K-Factor Residential Horizontal Sidewall Sprinkler

For systems designed to NFPA 13D or NFPA 13R. For systems designed to NFPA 13, refer to the design criteria. For Ceiling types refer to current Editions of NFPA 13, 13R or 13D

Sprinkler Base Part Number [1]	SIN	NPT Thread Size		Nominal K-Factor		Maximum Water Working Pressure	Overall Length	
		Inches	mm	U.S.	metric [2]		Inches	mm
17315	VK486	1/2	15	4.0	57.7	175 psi (12 bar)	2-7/16	62

Max. Coverage Area [3] Width X Length Ft. X Ft. (m X m)	Max. Spac-ing Ft. (m)	Ordinary Temp Rating (155 °F/68 °C)		Intermediate Temp Rating (175 °F/79 °C)		Top of Deflec-tor to Ceiling	Installation Type	Listings and Approvals [4]				Mini-mum Spacing Ft. (m)
		Flow [3] GPM (L/min)	Pressure [3] PSI (bar)	Flow [3] GPM (L/min)	Pressure [3] PSI (bar)			C-UL-US-EU [5]	VdS	NYC	NSF[9]	
12 X 12 (3.7 X 3.7)	12 (3.7)	11 (41.7)	7.6 (0.52)	11 (41.7)	7.6 (0.52)	4 to 6 inches	Standard surface-mounted escutch-eons or recessed with the Micromat-ic® Model E-1, E-2, E-3, or G-1 Recessed Escutcheon	See Foot-note 6 and 10.	See Foot-note 6.	See Foot-note 7.	See Foot-note 6.	8 (2.4)
14 X 14 (4.3 X 4.3)	14 (4.3)	12 (45.5)	9 (0.62)	12 (45.5)	9 (0.62)							
16 X 16 (4.9 X 4.9)	16 (4.9)	13 (49.3)	10.6 (0.73)	13 (49.3)	10.6 (0.73)							
16 X 18 (4.9 X 5.5)	16 (4.9)	16 (60.6)	16 (1.10)	16 (60.6)	16 (1.10)							
16 X 20 (4.9 X 6.1)	16 (4.9)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
16 X 22 (4.9 X 6.7)	16 (4.9)	24 (90.8)	36 (2.48)	24 (90.8)	36 (2.48)							
18 X 18 (5.5 X 5.5)	18 (5.5)	18 (68.1)	20.3 (1.40)	19 (71.9)	22.6 (1.60)							
18 X 20 (5.5 X 6.1)	18 (5.5)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
20 X 20 (6.1 X 6.1)	20 (6.1)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
12 X 12 (3.7 X 3.7)	12 (3.7)	12 (45.5)	9 (0.62)	12 (45.5)	9 (0.62)	6 to 12 inches						
14 X 14 (4.3 X 4.3)	14 (4.3)	12 (45.5)	9 (0.62)	13 (49.3)	10.6 (0.73)							
16 X 16 (4.9 X 4.9)	16 (4.9)	14 (53.0)	12.3 (0.84)	14 (53.0)	12.3 (0.84)							
16 X 18 (4.9 X 5.5)	16 (4.9)	16 (60.6)	16 (1.10)	16 (60.6)	16 (1.10)							
16 X 20 (4.9 X 6.1)	16 (4.9)	23 (87.1)	33.1 (2.28)	23 (87.1)	33.1 (2.28)							
16 X 22 (4.9 X 6.7)	16 (4.9)	26 (98.4)	42.3 (2.91)	26 (98.4)	42.3 (2.91)							
18 X 18 (5.5 X 5.5)	18 (5.5)	18 (68.1)	20.3 (1.40)	19 (71.9)	22.6 (1.60)							
18 X 20 (5.5 X 6.1)	18 (5.5)	23 (87.1)	33.1 (2.28)	23 (87.1)	33.1 (2.28)							
20 X 20 (6.1 X 6.1)	20 (6.1)	24 (90.8)	36 (2.48)	24 (90.8)	36 (2.48)							

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to Viking's current price schedule.
[2] Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
[3] For areas of coverage smaller than shown, use the "Flow" and "Pressure" for the next larger area listed. Flows and pressures listed are per sprinkler. The distance from sprinklers to walls shall not exceed one-half the sprinkler spacing indicated for the minimum "Flow" and "Pressure" used.
[4] This chart shows the listings and approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals. Refer also to Design Criteria.
[5] Listed by Underwriter's Laboratories, Inc. for use in the U.S., Canada, and European Union.
[6] Approved Finishes are: Brass, Chrome, White Polyester, and Black Polyester [8]
[7] Meets New York City requirements, effective July 1, 2008.
[8] Other paint colors are available on request with the same C-UL-US-EU listings as the standard finish colors.
[9] UL Classified to : NSF/ANSI Standard 61, Drinking Water System Components (MH48034)
[10] Approved finish is Electroless Nickel PTFE (ENT). ENT is C-UL-US-EU Listed as corrosion resistant. ENT is available with standard surface-mounted escutcheons or the Micromatic Model E-1 Recessed Escutcheon.

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DESIGN CRITERIA

(Also refer to the Approval Chart.)

UL Listing Requirements (C-UL-US-EU):

When using Viking Residential Horizontal Sidewall Sprinkler VK486 for systems designed to NFPA 13D or NFPA 13R, apply the listed areas of coverage and minimum water supply requirements shown in the Approval Chart.

For systems designed to NFPA 13: The number of design sprinklers is to be the four contiguous most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in the Approval Chart for NFPA 13D and NFPA 13R applications for each listed area of coverage, **or**
- Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the “design area” in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13.
- Minimum distance between residential sprinklers: 8 ft. (2.4 m).
- The VK486 horizontal sidewall sprinkler deflector shall be located a minimum of 1-1/4“ (31.8 mm) and a maximum of 6” (152 mm) from the wall on which it is installed.

DEFLECTOR POSITION: Install sprinkler VK486 with the leading edge of the deflector oriented parallel to the ceiling and the sprinkler frame arms oriented perpendicular to the ceiling (see Figure 4). **THE TOP SURFACE OF THE DEFLECTOR IS MARKED “TOP”.** The sprinkler must be oriented as shown in Figure 3 below.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to Form No. F_080190, F_080814, and F_080415 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

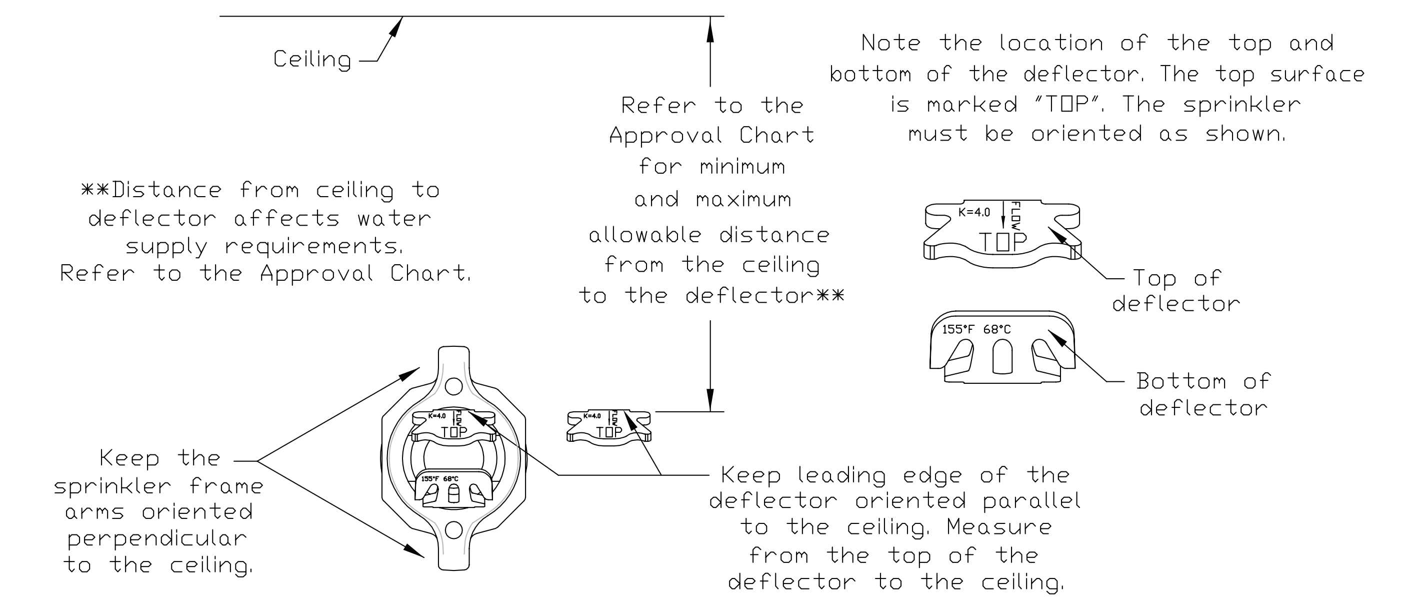

Figure 3:

Correct Orientation of the Deflector

TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

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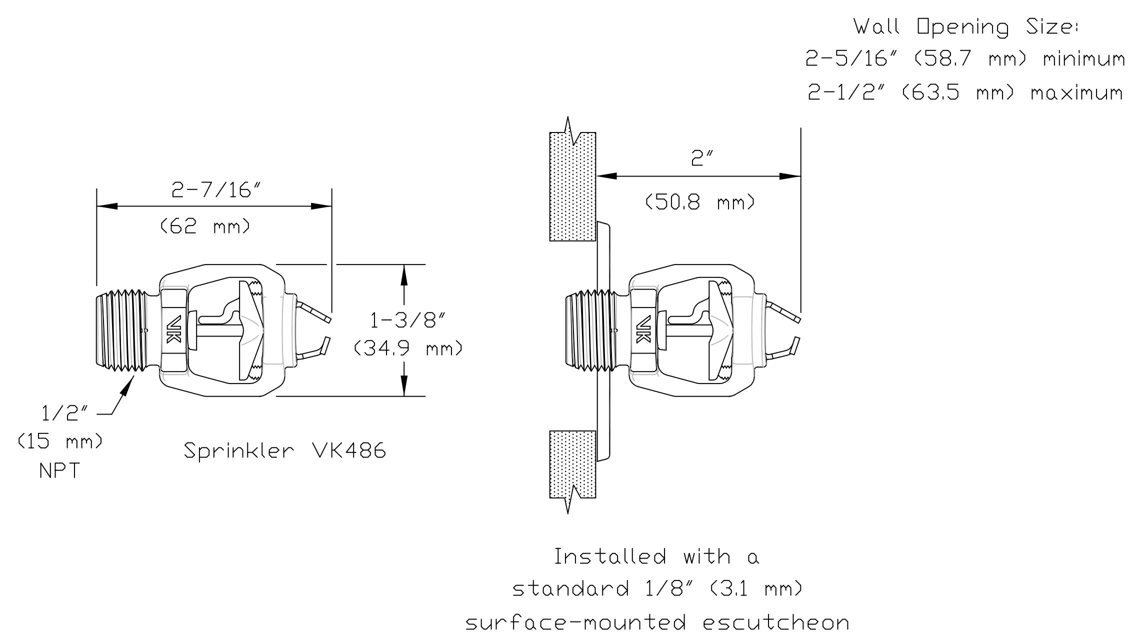

Figure 4:
Sprinkler VK486 Dimensions with a Standard Escutcheon and the Model F-1 Adjustable Escutcheon

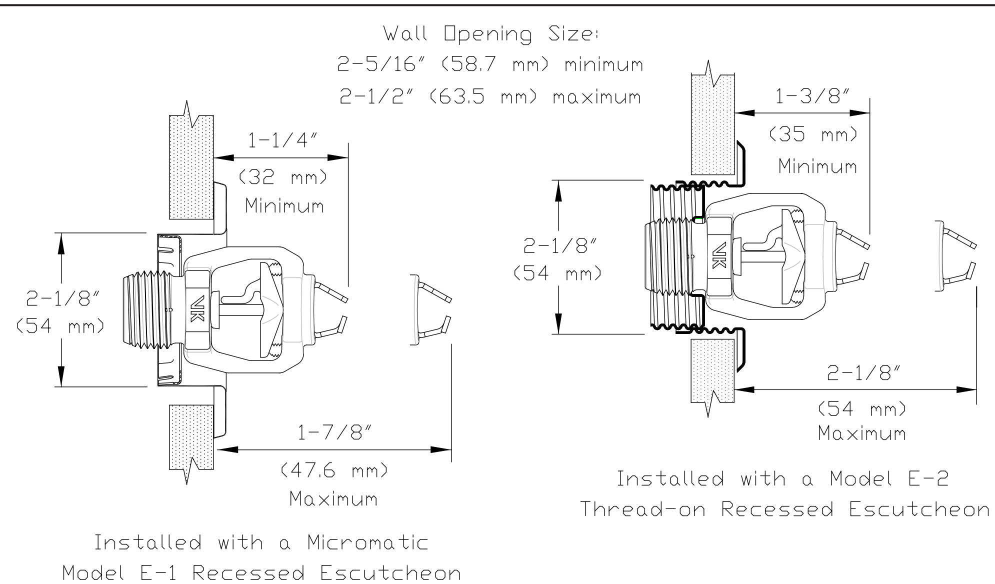

Figure 5:
Sprinkler VK486 Dimensions with the Model E-1 and E-2 Recessed Escutcheons

TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

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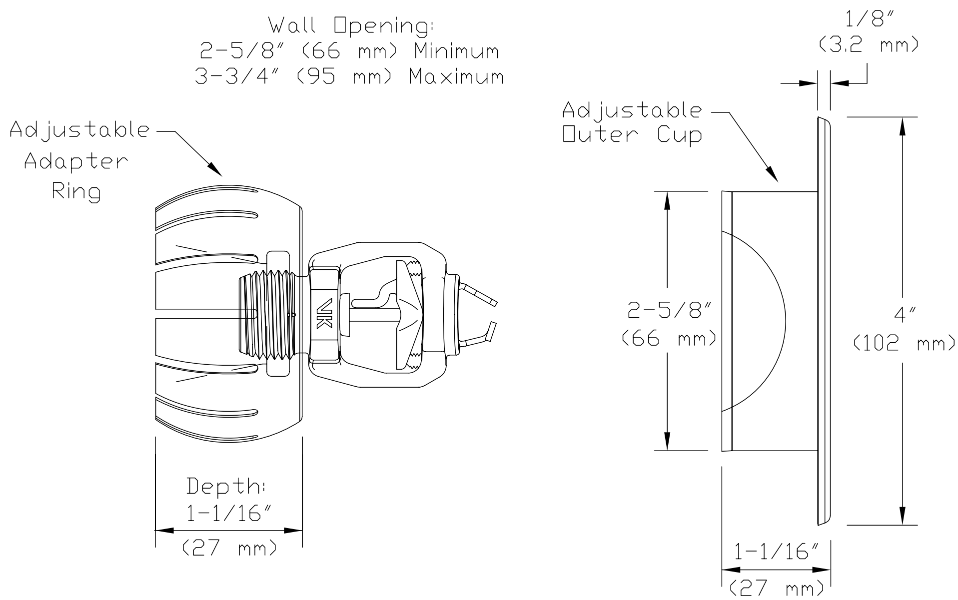
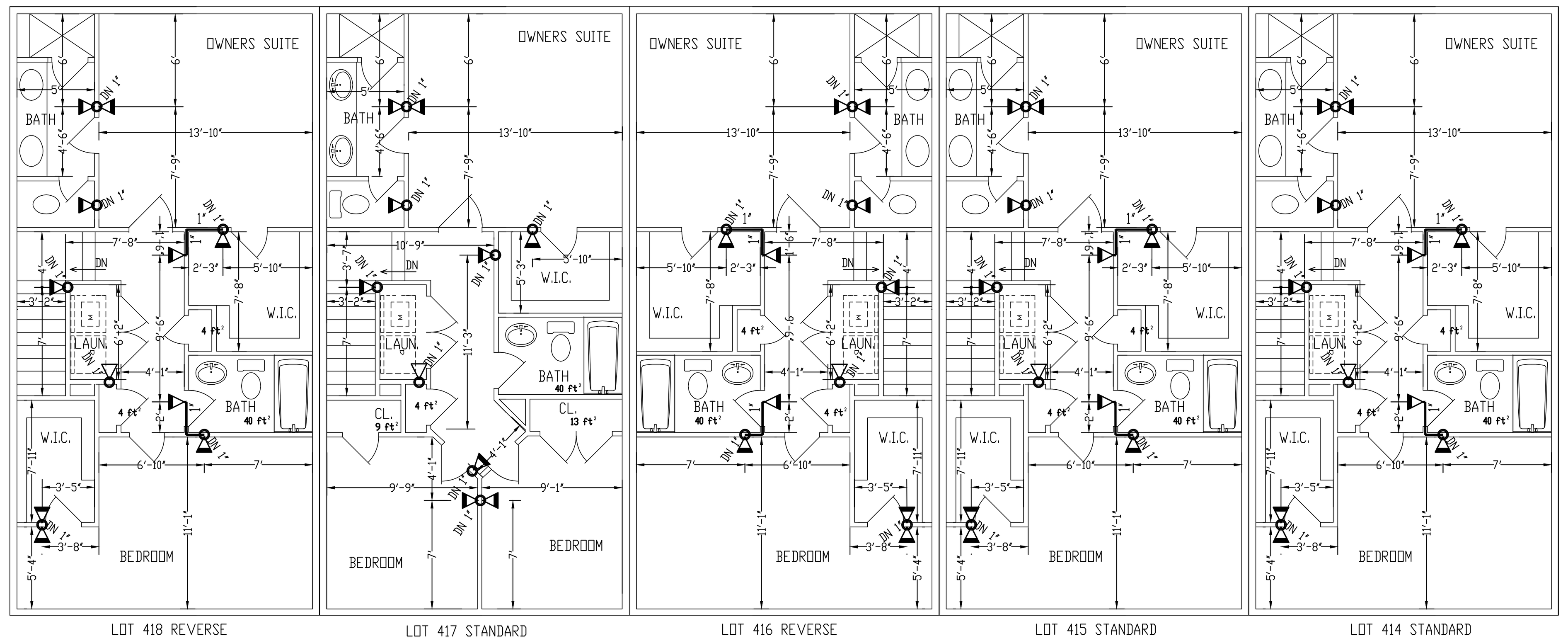
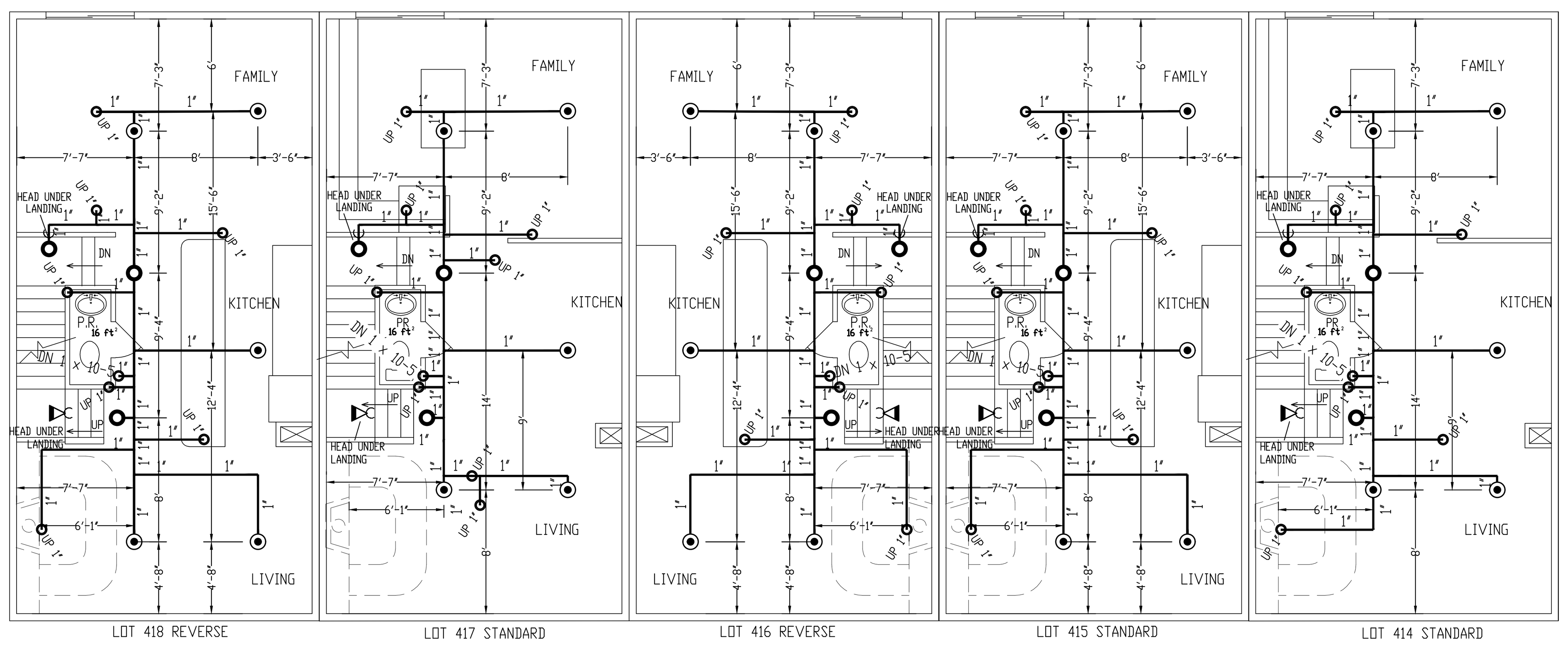
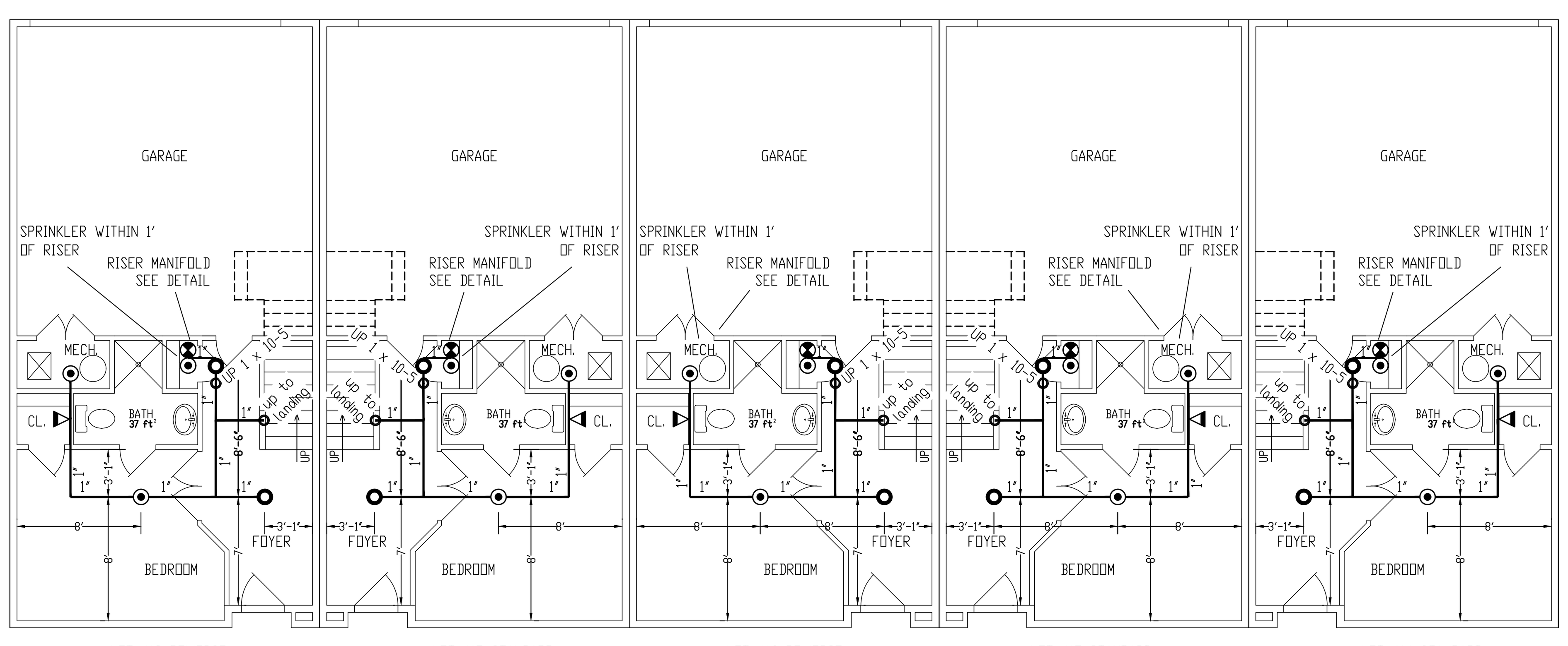


Figure 6: Sprinkler VK486 Dimensions with the Model G-1 Escutcheon







SPRINKLER OBSTRUCTION GUIDELINES

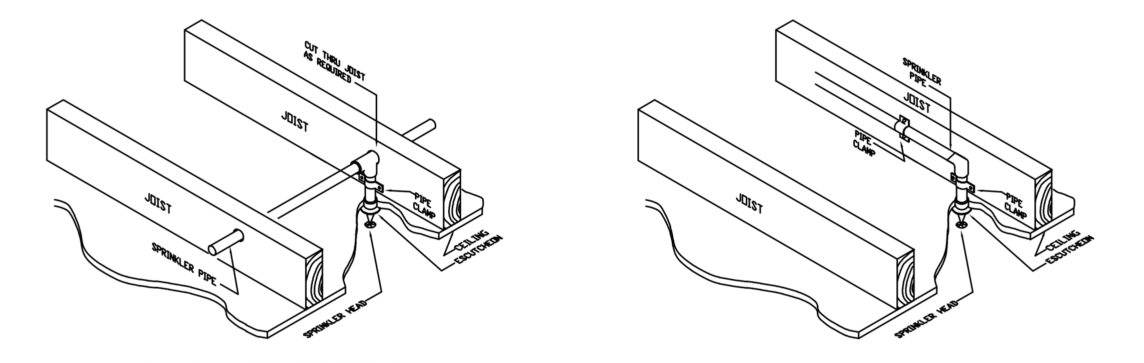
Table 8.2.5.4.2 Position of Sprinklers to Avoid Obstructions to Discharge (Residential Upright and Pendent Spray Sprinklers) NFPA 13D 2013

Distance From Sprinkler to Side of Obstruction (in.)	Maximum Allowable Distance of Deflector above Bottom of Obstruction (in.)
Less than 1ft	0
1 ft to less than 1 ft 6 in	0
1 ft 6 in to less than 3 ft	1
3 ft to less than 4 ft	3
4 ft to less than 4ft 6 in	5
4 ft 6 in to less than 6 ft	7
6 ft to less than 6 ft 6 in	9
6 ft 6 in to less than 7 ft	11
7 ft or more	14

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

CPVC HANGER
SPACING

PIPE DIA.	DISTANCE BETWEEN HANGER'S
¾"	5'–6"
1"	6'–0"
1¼"	6'–6"
1½"	7'–0"
2"	8'–0"
2½"	9'–0"
3"	10"–0"

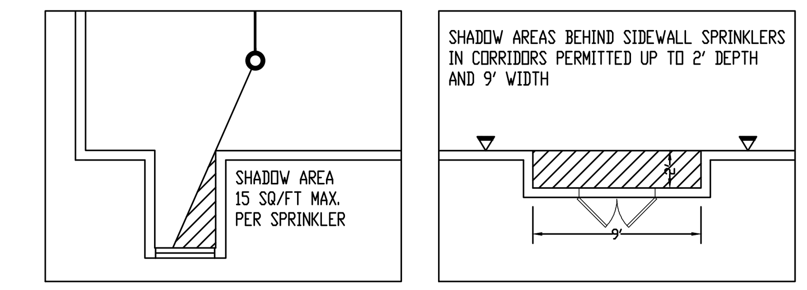


SPRINKLER RESTRAINT 1
NOT TO SCALE

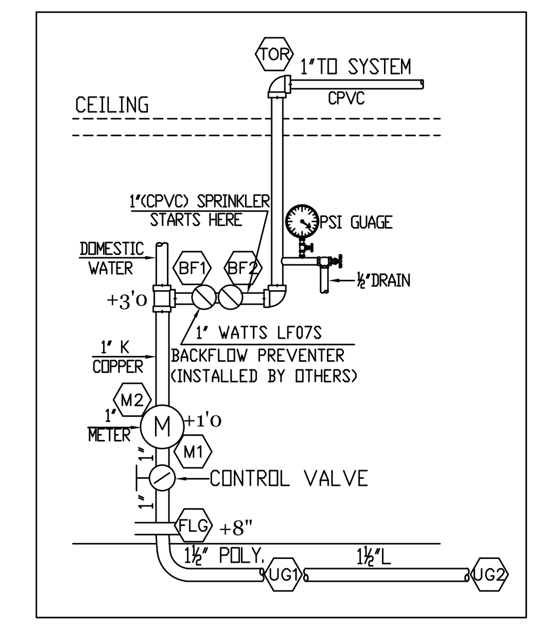
SPRINKLER RESTRAINT 2
NOT TO SCALE

HEAT SOURCES
NFPA 13D 2013

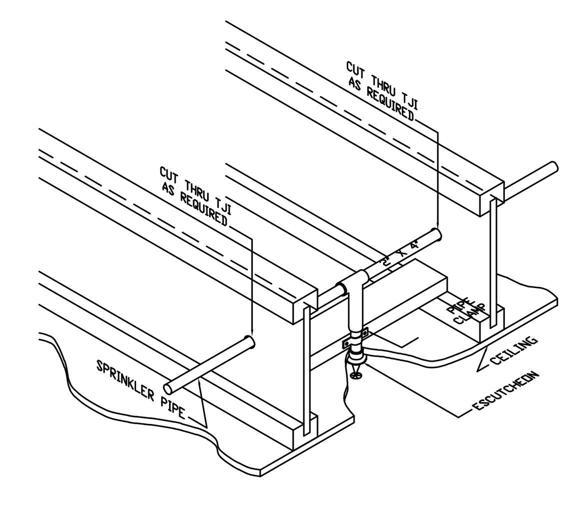
HEAT SOURCE	*Minimum Distance from Edge of Source to Ordinary–Temperature Sprinkler* in.	mm.	*Minimum Distance from Edge of Source to Intermediate–Temperature Sprinkler* in.	mm.
Side of open or recessed fireplace	36	914	12	305
Front of recessed fireplace	60	1524	36	914
Coal or wood burning stove	42	1067	12	305
Kitchen range	18	457	9	229
Wall oven	18	457	9	229
Hot air flues	18	457	9	229
uninsulated heat ducts	18	457	9	229
uninsulated hot water pipes	12	305	6	152
Side of ceiling/wall mounted hot air diffusers	24	607	12	305
Front of wall mounted hot air diffusers	36	914	18	457
Hot water heater or furnace	6	152	3	76
Light fixture				
0W/250W bulb	6	152	3	76
250W/499W	12	305	6	152



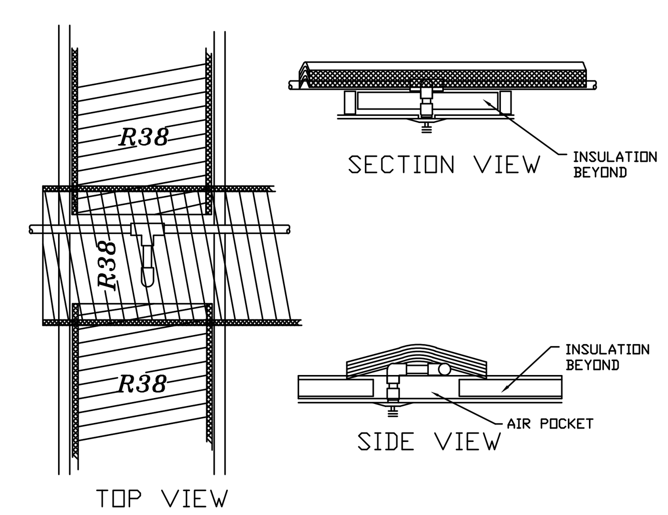
SHADOW AREA DETAIL



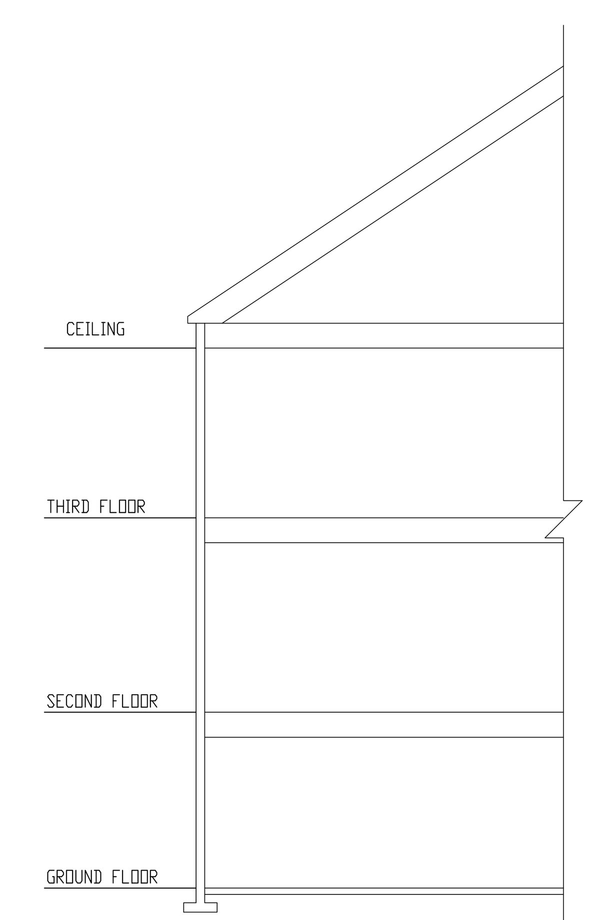
13D MANIFOLD DETAIL



TJI RESTRAINT
NOT TO SCALE



ATTIC INSULATION DETAIL 1
NOT TO SCALE



ARCADIA ELEVATION VIEW

GENERAL NOTES
AUTHORITY HAVING JURISDICTION
PRINCE GEORGES COUNTY, MD

1. DWELLING UNIT SHALL HAVE A COMPLETE FIRE PROTECTION SYSTEM IN COMPLIANCE WITH STATE AND LOCAL CODES AND REGULATIONS AND N.F.P.A.–13D 2013 EDITION.
2. ALL MATERIALS AND METHODS OF INSTALLATION SHALL BE IN COMPLIANCE WITH N.F.P.A.–13D
3. EXPOSED SPRINKLER PIPING LOCATED IN THE ATTIC SPACE SHALL BE COVERED WITH INSULATION (R–49) PLACED OVER THE PIPING TO PREVENT FREEZING. (INSULATION BY OTHERS).
4. ALL CPVC PIPE AND FITTINGS SHALL BE UL LISTED AND FM APPROVED.
5. CPVC HANGER SPACING IN COMPLIANCE WITH N.F.P.A.
6. ALL PIPING SHALL BE CPVC UNLESS NOTED OTHERWISE,
7. NO STORAGE ROOM IN ATTIC
8. UNPROTECTED CLOSETS SHALL NOT CONTAIN MECHANICAL EQUIPMENT.
9. WATER METERS SHALL BE (1") IN. UNLESS OTHERWISE NOTED.
10. SPRINKLER CONNECTIONS SHALL BE ON THE HOUSE SIDE OF WATER METER.
11. WHEN LINTELS EXCEED 8" DEEP AND 8'–0" WIDE, ROOMS WITHIN THESE LINTELS SHALL NOT BE CONSIDERED A SINGLE COMPARTMENT. SPRINKLERS SHALL BE 16 X 16 MAXIMUM SPACING.

LOTS	HOUSE TYPE	PERMIT #	ADDRESS
414	ARCADIA	25436-2019-00	12935 BRICKYARD BLVD.
415	ARCADIA	25437-2019-00	12937 BRICKYARD BLVD.
416	ARCADIA	25438-2019-00	12939 BRICKYARD BLVD.
417	ARCADIA	25439-2019-00	12941 BRICKYARD BLVD.
418	ARCADIA	25440-2019-00	12943 BRICKYARD BLVD.

SPRINKLER SPACING

Type	No. Head/Rm.	Spacing	Slope
Pendent	2+	16x16	8:12
Pendent	1	20x20	8:12
Sidewall	2+	16x16	8:12

TOTAL SPRINKLERS THIS DRAWING 129

FOREMAN NOTES:

1. CHANGES TO THIS PRINT MUST BE FOLLOWED UP WITH ASBUILTS AS THEY ARE MADE AND TAKEN TO THE OFFICE.
2. FOLLOW SPRINKLER SPACING SCHEDULE FOR THIS PRINT.
3. FOLLOW PIPE SCHEDULE FOR THIS PRINT.
4. ANY EXPOSED PIPE TO BE COPPER (M) OR STEEL SCH.10 / SCH.40 U.N.O.

D E S I G N C R I T E R I A

TYPE SYSTEM: ■ WET ☐ DRY NFPA STANDARD: ☐ #13 ☐ #13R ■ #13D

OCCUPANCY: Single Family Home
HAZARD: Light
DENSITY: .05 GPM/S.F.
REMOTE AREA: 2ND FLR S.F.
MAX. S.F./HD. See Note
HOSE REQ'MT.: ☐ 100 ☐ 250 ☐ 500
APPROVING AUTHORITY: P.G COUNTY

PIPE SCHEDULE

1"
1¼"
1½"
2"
INCOMING FROM STREET

PIPE SYMBOLS

RISER/MANIFOLD
ELBOW DOWN
BALL VALVE
REVISION

S P R I N K L E R S U M M A R Y

SYM	TYPE	FINISH	TEMP	ORIF.	"K"	NPT	Mfg.	MODEL#	ESCUTCHEON	QTY.
⦿	RES. PEND	WHITE	155°	½"	4.9	½"	VIKING	VK468	RECESSED	40
O	RES. PEND	WHITE	155°	½"	4.9	½"	VIKING	VK494	CONCEALED	25
◁	RES. SIDEWALL	WHITE	175°	½"	4.0	½"	VIKING	VK486	RECESSED	05
◀	RES. SIDEWALL	WHITE	155°	½"	4.0	½"	VIKING	VK486	RECESSED	59

R E V I S I O N S

BY	DESCRIPTION	DATE	#
			△
			△
			△
			△
			△
			△
			△

NOEL'S FIRE PROTECTION

12015 KEMPS MILL ROAD
WILLIAMSPORT, MD 21795
(240) 366–8287 FAX: (301) 223–8370

CONTRACTOR: CALATLANTIC
14280 PARK MEADOW DRIVE
CHANTILLY, VA 20151

PERMIT #		Model: TOWNS	JOB #: 336D	SHEET No.
DATE	6–12–20	BRICKYARD LOTS 414–418		1 OF 1
DESIGNER	C. MONROE	SEE ADDRESS BLOCK		
SCALE	1/8" = 1'–0"	BELTSVILLE, MD 20705		

TECHNICAL DATA

FREEDOM® RESIDENTIAL PENDENT SPRINKLER VK468 (K4.9)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

1. DESCRIPTION

Viking Freedom® Residential Pendent Sprinkler VK468 is a small, thermosensitive, glass-bulb residential sprinkler available in several different finishes and temperature ratings to meet varying design requirements. The Electroless Nickel PTFE (ENT) coating has been investigated for installation in corrosive atmospheres and is C-UL-US-EU Listed as corrosion resistant as indicated in the Approval Chart. The orifice design, with a K-Factor of 4.9 (70.6 metric†), allows efficient use of available water supplies for the hydraulically designed fire-protection system. The glass bulb operating element and special deflector characteristics meet the challenges of residential sprinkler standards.

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

2. LISTINGS AND APPROVALS

UL Listed (C-UL-US-EU): Category VKKW

VdS Approved

NYC Approved: MEA 89-92-E, Volume 35

UL Classified to: NSF/ANSI Standard 61, Drinking Water System Components (MH48034).

Refer to the Approval Chart and Design Criteria for C-UL-US-EU Listing requirements that must be followed.

3. TECHNICAL DATA

Specifications:
Available since 2006.
Minimum Operating Pressure: Refer to the Approval Chart.
Maximum Working Pressure: 175 psi (12 bar). Factory tested hydrostatically to 500 psi (34.5 bar).
Thread size: 1/2” (15 mm) NPT
Nominal K-Factor: 4.9 U.S. (70.6 metric†)
†Metric K-factor measurement shown is in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
Glass-bulb fluid temperature rated to -65 °F (-55 °C)
Overall Length: 2-1/4” (58 mm)

Material Standards:
Frame Casting: Brass UNS-C84400 or QM Brass
Deflector: Brass UNS-C23000, Phosphor Bronze UNS-C51000, or Brass UNS-C26000
Bulb: Glass, nominal 3 mm diameter
Belleville Spring Sealing Assembly: Nickel Alloy, coated on both sides with Polytetrafluoroethylene (PTFE) Tape
Pip Cap and Insert Assembly: Copper UNS-C11000 and Stainless Steel UNS-S30400
Compression Screw: Brass UNS-C36000
For ENT coated sprinklers: Belleville spring - Exposed, Screw and Pipcap - ENT plated.

Ordering Information: (Also refer to the current Viking price list.)
Sprinkler: Base Part No. 13637
Order Sprinkler VK468 by first adding the appropriate suffix for the sprinkler finish and then the appropriate suffix for the temperature rating to the sprinkler base part number.
Finish Suffix: Brass = A, Chrome = F, White Polyester = M-/W, Black Polyester = M-/B, and ENT = JN
Temperature Suffix: 155 °F (68 °C) = B, 175 °F (79 °C) = D
For example, sprinkler VK468 with a Brass finish and a 155 °F (68 °C) temperature rating = Part No. 13637AB.

Available Finishes And Temperature Ratings:
Refer to Table 1.

Accessories: (Also refer to the Viking website.)

Sprinkler Wrenches:
A. Standard Wrench: Part No. 21475M/B (available since 2017)
B. Wrench for recessed sprinklers: Part No. 13577W/B* (available since 2006)
C. Optional Protective Sprinkler Cap Remover/Escutcheon Installer Tool** Part No. 15915 (available since 2010.)
*A ½” ratchet is required (not available from Viking).
**Allows use from the floor by attaching a length of 1” diameter CPVC tubing to the tool. Ideal for sprinkler cabinets. Refer to Bulletin F_051808.

VIKING®	TECHNICAL DATA	FREEDOM® RESIDENTIAL PENDENT SPRINKLER VK468 (K4.9)

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Sprinkler Cabinets:
A. Six-head capacity: Part No. 01724A (available since 1971)
B. Twelve-head capacity: Part No. 01725A (available since 1971)

4. INSTALLATION
Refer to appropriate NFPA Installation Standards.

5. OPERATION
During fire conditions, the heat-sensitive liquid in the glass bulb expands, causing the glass to shatter, releasing the pip cap and sealing spring assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector, forming a uniform spray pattern to extinguish or control the fire.

6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
The Viking Model VK468 Sprinkler is available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

TABLE 1: AVAILABLE SPRINKLER TEMPERATURE RATINGS AND FINISHES

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[2]	Bulb Color
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow
Sprinkler Finishes: Brass, Chrome, White Polyester, Black Polyester, and ENT			
Corrosion Resistant Coatings[3]: ENT			

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector.
[2] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.
[3] The corrosion resistant coatings have passed the standard corrosion test required by the approving agencies indicated in the Approval Chart. These tests cannot and do not represent all possible corrosive environments. Prior to installation, verify through the end-user that the coatings are compatible with or suitable for the proposed environment. For ENT coated sprinklers, the waterway is coated. Note that the spring is exposed on sprinklers with ENT coating.

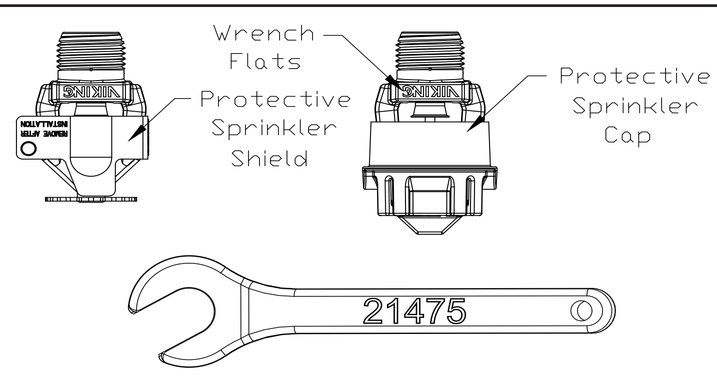

Figure 1: Standard Sprinkler Wrench 21475M/B

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Approval Chart
Viking VK468, 4.9 K-Factor Residential Pendent Sprinkler

For systems designed to NFPA 13D or NFPA 13R. For systems designed to NFPA 13, refer to the design criteria. For Ceiling types refer to current editions of NFPA 13, 13R or 13D

Sprinkler Base Part Number[1]	SIN	NPT Thread Size		Nominal K-Factor		Maximum Water Working Pressure	Overall Length	
		Inches	mm	U.S.	metric[2]		Inches	mm
13637	VK468	1/2	15	4.9	70.6	175 psi (12 bar)	2-1/4	58

Max. Coverage Area[4] Ft.X Ft. (m X m)	Ordinary Temp Rating (155 °F/68 °C)		Intermediate Temp Rating (175 °F/79 °C)		Deflector to Ceiling	Installation Type	Listings and Approvals[3]				Minimum Spacing Ft. (m)
	Flow[4] GPM (L/min)	Pressure[4] PSI (bar)	Flow[4] GPM (L/min)	Pressure[4] PSI (bar)			C-UL-US-EU[5]	VdS	NYC[6]	NSF[8]	
12 X 12 (3.7 X 3.7)	13 (49.2)	7.0 (0.48)	13 (49.2)	7.0 (0.48)	1-1/8 to 2 inch	Standard surface-mounted escutcheons, or recessed with the Micromatic® Model E-1, E-2, or E-3 Recessed Escutcheon	See Foot-notes 7 and 10.	See Foot-notes 7 and 10.	See Foot-note 7.	See Foot-note 7.	8 (2.4)
14 X 14 (4.3 X 4.3)	13 (49.2)	7.0 (0.48)	13 (49.2)	7.0 (0.48)							
16 X 16 (4.9 X 4.9)	13 (49.2)	7.0 (0.48)	13 (49.2)	7.0 (0.48)							
18 X 18 (5.5 X 5.5)	17 (64.4)	12.0 (0.83)	17 (64.4)	12.0 (0.83)							
20 X 20 (6.1 X 6.1)	20 (75.7)	16.7 (1.15)	20 (75.7)	16.7 (1.15)							

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to Viking's current price schedule.

[2] Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.

[3] This chart shows the listings and approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals. Refer also to Design Criteria.

[4] For areas of coverage smaller than shown, use the "Flow" and "Pressure" for the next larger area listed. Flows and pressures listed are per sprinkler. The distance from sprinklers to walls shall not exceed one-half the sprinkler spacing indicated for the minimum "Flow" and "Pressure" used.

[5] Listed by Underwriter's Laboratories, Inc. for use in the U.S., Canada, and European Union.

[6] Accepted for use, City of New York Department of Buildings, MEA Number 89-92-E, Vol. 35.

[7] Approved Finishes are: Brass, Chrome, White Polyester, and Black Polyester[9]

[8] UL Classified to: NSF/ANSI Standard 61, Drinking Water System Components (MH48034).

[9] Other paint colors are available on request with the same C-UL-US-EU listings as the standard finish colors.

[10] Approved finish is Electroless Nickel PTFE (ENT). ENT is C-UL-US-EU Listed as corrosion resistant. ENT is available with standard surface-mounted escutcheons or the Micromatic Model E-1 Recessed Escutcheon.

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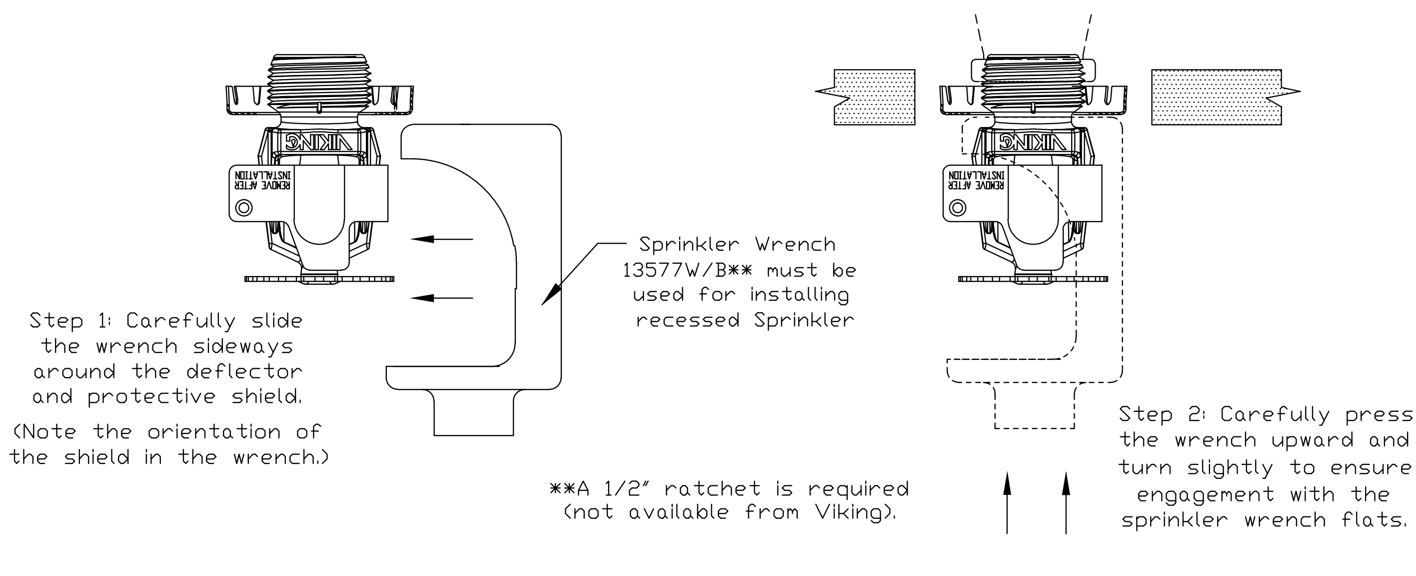

Figure 2: **Wrench 13577W/B for Recessed Sprinkler**

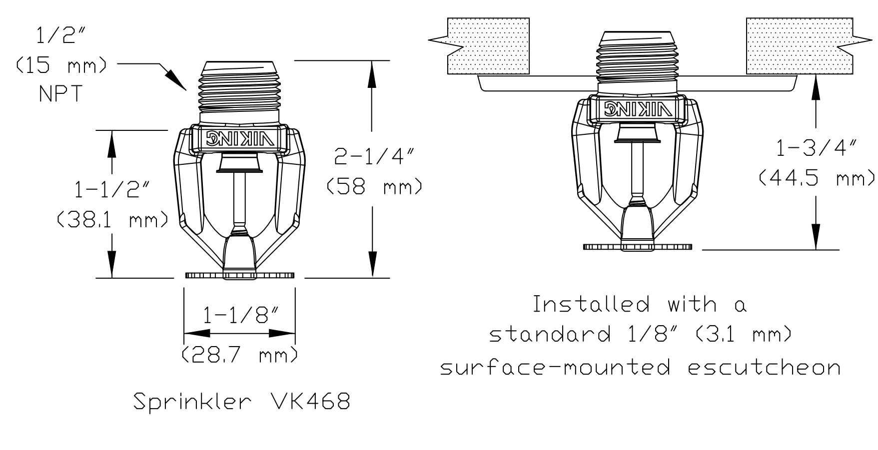

Figure 3: **Sprinkler VK468 Dimensions with a Standard Escutcheon**

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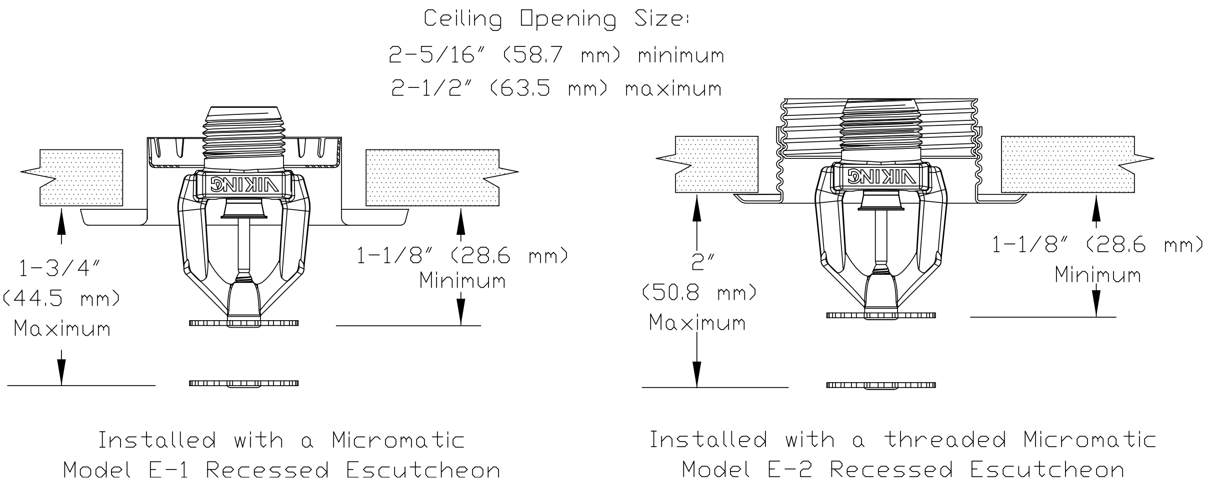

Figure 4: **Sprinkler VK468 Dimensions with the Model E-1 and E-2 Recessed Escutcheons**

DESIGN CRITERIA

(Also refer to the Approval Chart.)

UL Listing Requirements (C-UL-US-EU):

When using Viking Residential Pendent Sprinkler VK468 for systems designed to NFPA 13D or NFPA 13R, apply the listed areas of coverage and minimum water supply requirements shown in the Approval Chart.

For systems designed to NFPA 13: The number of design sprinklers is to be the four contiguous most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in the Approval Chart for NFPA 13D and NFPA13R applications for each listed area of coverage, **or**
- Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the “design area” in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13.
- Minimum distance between residential sprinklers: 8 ft. (2.4 m).

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to Form No. F_080614, F_080415 and F_080190 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, VdS, and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

Viking Residential Sprinkler Installation Guide

October 25, 2018

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

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1. DESCRIPTION

Viking residential automatic sprinklers are equipped with a "fast response" heat-sensitive operating element designed to respond individually and quickly to a specific high temperature. Viking residential sprinklers are designed to combine speed of operation with water distribution characteristics to help in the control of residential fires and to improve life safety by prolonging the time available for occupants to escape or be evacuated.

2. LISTINGS AND APPROVALS

Refer to the Approval Charts on the appropriate sprinkler technical data page(s) and/or approval agency listings.

A. Viking residential sprinklers are intended for use in the following occupancies: one- and two-family dwellings and mobile homes with the fire protection sprinkler system installed in accordance with NFPA 13D; residential occupancies up to four stories in height with the fire protection system installed in accordance with NFPA 13R; or residential portions of any occupancy with the fire protection system installed in accordance with NFPA 13. Information contained in this guide is based on NFPA 13, "Standard for the Installation of Sprinkler Systems".

B. The design criteria for residential sprinklers contained in the NFPA installation standards must be followed except as modified by the individual UL 1626 listing information provided in the technical data pages and this Residential Sprinkler Installation Guide. For listed areas of coverage, technical data, and specific design and installation instructions, refer to the appropriate Viking technical data page for the sprinkler model used.

C. Viking residential sprinklers listed by Underwriters Laboratories, Inc. (UL) have passed fire tests designed to represent fire conditions for the sprinkler's listed area of coverage. The standards for residential sprinkler performance and spray patterns are printed in Underwriters Laboratories Publication UL 1626, "Standard for Residential Sprinklers for Fire Protection Service". All listed Viking residential sprinklers meet or exceed UL 1626 performance requirements and spray pattern criteria for their listed areas of coverage.

D. NFPA standards allow use of residential sprinklers with rates, design areas, areas of coverage, and minimum design pressures other than those specified in the standards when they have been listed for such specific residential installation conditions.

3. TECHNICAL DATA

Specifications:

Refer to the appropriate sprinkler technical data sheet.

Material Standards:

Refer to the appropriate sprinkler technical data sheet.

Viking Technical Data may be found on The Viking Corporation's Web site at http://www.vikinggroupinc.com. The Web site may include a more recent edition of this Technical Data Page.

4. INSTALLATION

NOTE:Take care not to over-tighten the sprinkler and/or damage its operating parts!

Maximum Torque: 1/2" NPT: 14 ft-lbs. (19.0 N-m) 3/4" NPT: 20 ft-lbs. (27.1 N-m)

A. Care and Handling (also refer to Bulletin - Care and Handling of Sprinklers, Form No. F_091699.)

Sprinklers must be handled with care and protected from mechanical damage during storage, transport, handling, and after installation. Store sprinklers in a cool, dry place in their original container.

Use care when locating sprinklers near fixtures that can generate heat.

Never install sprinklers that have been dropped, damaged in any way, or exposed to temperatures exceeding the maximum ambient temperature allowed (refer to Table 1.)

Never install any glass-bulb sprinkler if the bulb is cracked or if there is a loss of liquid from the bulb. A small air bubble should be present in the glass bulb. Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed immediately. (Note: Installing glass bulb sprinklers in direct sunlight (ultraviolet light) may affect the color of the dye used to color code the bulb. This color change does not affect the integrity of the bulb.)

Viking residential sprinklers are intended for use on wet pipe residential systems only. Adequate heat must be provided for wet-pipe systems. DO NOT use Viking residential sprinklers on dry systems unless specifically allowed by recognized installation standards or the Authority Having Jurisdiction.

Residential concealed sprinklers must be installed in neutral or negative pressure plenums only!

Corrosion-resistant sprinklers must be installed when subject to corrosive atmospheres. **NOTE:** Viking residential sprinklers are not intended for use in corrosive environments.

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TABLE 1: RESIDENTIAL SPRINKLER TEMPERATURE RATINGS

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[3]	Bulb Color
Residential Glass Bulb Style Sprinklers			
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)[1]**	**Maximum Ambient Ceiling Temperature[3]**	
Residential Fusible Element Style Sprinklers			
Ordinary	165 °F (74 °C)	100 °F (38 °C)	
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)**	**Maximum Ambient Ceiling Temperature[3]**	**Temperature Identification Stamp**
Residential Flush Style Sprinklers			
Ordinary	165 °F (74 °C)	100 °F (38 °C)	On Cover or Sprinkler Inlet (VK476)
Intermediate	220 °F (104 °C)	150 °F (65 °C)	On Cover
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)**	**Maximum Ambient Ceiling Temperature[3]**	**Cover Plate Temperature Rating**
Residential Concealed Style Sprinklers			
Ordinary	135 °F (57 °C)[1], 140 °F (60 °C)[2], 155 °F (68 °C)[1], or 165 °F (74 °C)[1]	100 °F (38 °C)	135 °F (57 °C)

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector or flow shaper.

[2] The temperature rating is stamped on the sprinkler.

[3] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

B. Installation Instructions

Viking sprinklers are manufactured and tested to meet the rigid requirements of approving agencies. They are designed to be installed in accordance with recognized installation standards NFPA 13, NFPA 13R, and NFPA 13D, and any associated TIAs.

Deviation from the standards or any alteration to the sprinklers or cover plate assemblies after they leave the factory including, but not limited to: painting, plating, coating, or modification, may render the sprinklers inoperative and will automatically nullify the approval and any guarantee made by Viking.

The use of residential sprinklers may be limited due to occupancy and hazard. Residential fire protection systems must be designed and installed only by those who are completely familiar with the appropriate standards and codes, and thoroughly experienced in fire protection design, hydraulic calculations, and sprinkler system installation.

Before installation, be sure to have the appropriate sprinkler model and style, with the correct K-Factor, temperature rating, and response characteristics. Viking residential sprinklers must be installed after the piping is in place to prevent mechanical damage. Keep sprinklers with protective caps or bulb shields contained within the caps or shields during installation and testing, and any time the sprinkler is shipped or handled.

1a. For frame-style sprinklers, install escutcheon (if used), which is designed to thread onto the external threads of the sprinkler*.
*Refer to the appropriate sprinkler technical data page to determine approved escutcheons for use with specific sprinkler models.

1b. For flush and concealed style sprinklers: Cut the sprinkler nipple so that the ½" or 3/4" (15 mm or 20 mm) NPT** outlet of the reducing coupling is at the desired location and centered in the opening** in the ceiling or wall.
**Size depends on the sprinkler model used. Refer to appropriate sprinkler data page.

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DESIGN CRITERIA

<u>For Systems Designed to NFPA 13D or NFPA 13R:</u> Apply the listed areas of coverage and minimum water supply requirements shown in the approval charts on the residential sprinkler data pages. The sprinkler flow rate is the minimum required discharge from each of the total number of design sprinklers as specified in NFPA 13D or NFPA 13R.

<u>For Systems Designed to the latest edition of NFPA 13:</u> The number of design sprinklers is to be the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- **The flow rates given in the approval charts on the data pages for NFPA 13D and NFPA13R for each area of coverage listed, <u>or</u>**
- **Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the "design area" in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13. The greatest dimension of the coverage area cannot be any greater than the maximum areas of coverage shown on the data pages.**

Flow Rates

All residential sprinklers manufactured on or after July 12, 2002 are listed with a single minimum flow rate. Where rooms have more than one sprinkler, multiple-sprinkler calculations are still required, but the first sprinkler and any additional sprinkler or sprinklers must be calculated flowing at identical minimum flow rates, based on the area of sprinkler coverage, using the minimum flow and pressure listed for the sprinkler model used.

Consult the appropriate standards and the Authorities Having Jurisdiction to determine the number of sprinklers to hydraulically calculate to verify adequate water supply for multiple-sprinkler operation.

Operating Pressure: The minimum operating pressure of any sprinkler shall be the minimum operating pressure specified by the listing, or 7 psi (0.5 bar), whichever is greater. The maximum allowable operating pressure is 175 psi (12 bar).

Areas of Coverage

If the actual area of coverage is less than the listed area of coverage, use the minimum water supply for the next larger area of coverage listed. DO NOT interpolate. Residential sprinkler systems must be hydraulically calculated according to NFPA standards to verify that the water supply is adequate for proper operation of the sprinklers. Hydraulic calculations are required to verify adequate water supply at the hydraulically most remote single sprinkler when it is operating at the minimum gpm and psi listed for single-sprinkler operation for the sprinkler model used.

Viking residential sprinklers may be listed for more than one area of coverage. Suggested practice in selecting area of coverage is to select the one that can be adequately supplied by the available water supply and still allow for the installation of as few sprinklers in a compartment as possible while observing all guidelines pertaining to obstructions and spacing. This maximizes the use of the available water supply, which is often limited on residential fire protection systems. After selecting an appropriate area of coverage, sprinklers must be spaced according to guidelines set forth in the installation standards.

Definition of "COMPARTMENT": A space completely enclosed by walls and a ceiling. Openings to an adjoining space are allowed, provided the openings have a minimum lintel depth of 8 in. (203.2 mm) from the ceiling.

Spacing Guidelines

For guidelines concerning spacing of Viking residential sprinklers near beams, obstructions, heat sources, and sloped ceilings [slopes more than a 2/12 (9.5°) pitch], refer to the Viking residential sprinkler data pages and installation guide, the appropriate NFPA standard, and the Authority Having Jurisdiction. NOTE: Sloped, beamed, and pitched ceilings could require special design features such as larger flow, or a design for more sprinklers to operate in the compartment, or both.

Distance from Walls: Install not more than one-half the listed sprinkler spacing nor less than 4" (102 mm) from walls, partitions, or obstructions as defined in the standards.

Minimum Sprinkler Spacing: The minimum distance between residential sprinklers to prevent cold soldering (i.e., the spray from one operating sprinkler onto an adjacent sprinkler that could prevent its proper activation) is 8 ft. (2.4 m).

Maximum Sprinkler Spacing: Locate adjacent sprinklers no farther apart than the listed spacing.

Deflector Position: Install frame style residential *pendent* sprinklers with the deflector between 1" and 4" (25.4 mm to 102 mm) below smooth ceilings, unless the sprinkler data page indicates otherwise. Install pendent sprinklers in the pendent position only, with the deflector oriented parallel with the ceiling or roof.

Refer to the individual listings in the residential sprinkler data pages for horizontal sidewall sprinkler deflector or sprinkler centerline distance below the ceiling. Install horizontal sidewall sprinklers in the horizontal position only below smooth ceilings, with the leading edge of the deflector or element assembly oriented parallel with the ceiling.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to the appropriate sprinkler data page. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

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2. Apply a small amount of pipe-joint compound or tape to the external threads of the sprinkler only, taking care not to allow a build-up of compound in the sprinkler inlet. **NOTE:** Sprinklers with protective caps or bulb shields must be contained within the caps or shields before applying pipe-joint compound or tape. *Exception: For concealed sprinklers (i.e., VK457, VK458, VK468, VK474, and VK4570) the protective cap is removed for installation.*
3. Care must be taken when installing sprinklers on CPVC and copper piping systems. Never install the sprinkler into the reducing fitting before attaching the reducing fitting to the piping. Sprinklers must be installed on CPVC systems after the reducing fitting has been installed and the primer and/or cement manufacturer's recommended curing time has elapsed. When installing sprinklers on copper piping systems, take care to brush the inside of the sprinkler supply piping and reducing fitting to ensure that no flux accumulates in the sprinkler orifice. Excess flux can cause corrosion and may impair the ability of the sprinkler to operate properly.
4. Refer to the appropriate sprinkler technical data page to determine the correct sprinkler wrench for the model of sprinkler used. DO NOT use the sprinkler deflector or fusible element to start or thread the sprinkler into a fitting.
   a. Install the sprinkler onto the piping using the special sprinkler wrench only, while taking care not to over-tighten or damage the sprinkler operating parts.
   b. *Thread the flush or concealed sprinkler into the ½"* or 3/4" (15 mm or 20 mm) NPT** *outlet of the coupling by turning it clockwise with the special sprinkler wrench. NOTE: For flush and concealed sprinklers with protective shells, the internal diameter of the special flush and concealed sprinkler installation wrench is designed for use with the sprinkler contained within the shell. Exception: For concealed sprinklers VK457, VK458, VK468, VK474, and VK4570 the protective cap is removed for installation, and then placed back on the sprinkler temporarily.*
5. After installation, the entire sprinkler system must be tested. The test must be conducted to comply with the installation standards.
   a. Make sure the sprinkler has been properly tightened. If a thread leak occurs, normally the unit must be removed, new pipe-joint compound or tape applied, and then reinstalled. This is due to the fact that when the joint seal leaks, the sealing compound is washed out of the joint.
   b. **Remove plastic protective sprinkler caps or bulb shields AFTER the wall or ceiling finish work is completed where the sprinkler is installed and there no longer is a potential for mechanical damage to the sprinkler operating elements.** To remove the bulb shields, simply pull the ends of the shields apart where they are snapped together. To remove caps from frame style sprinklers, turn the caps slightly and pull them off the sprinklers. **SPRINKLER CAPS OR BULB SHIELDS MUST BE REMOVED FROM SPRINKLERS <u>BEFORE</u> PLACING THE SYSTEM IN SERVICE!** Retain a protective cap or shield in the spare sprinkler cabinet.
6. For residential flush sprinklers, the ceiling ring can now be installed onto the sprinkler body. Align the ceiling ring with the sprinkler body and thread on or push it on until the flange touches the ceiling. Note the maximum vertical adjustment is ½" (12,7 mm) for sprinkler VK420 and 5/8" for VK476. DO NOT MODIFY THE UNIT. If necessary, re-cut the sprinkler drop nipples as required.
7. For residential concealed sprinklers, the cover plate assembly can now be attached.
   a. Remove the cover plate assembly from the protective box, taking care not to damage the assembly.
   b. From below the ceiling, gently place the base of the cover plate assembly over the sprinkler protruding through the opening in the ceiling or wall.
   c. Carefully push the cover plate assembly onto the sprinkler, using even pressure with the palm of the hand, until the unfinished brass flange of the cover plate base touches the ceiling or wall.
   d. The maximum adjustment available for residential concealed sprinklers is ½" (12.7 mm) [1/4" (6.4 mm) for sprinkler VK480]. DO NOT MODIFY THE UNIT. If necessary, re-cut the sprinkler nipples.

NOTE: If it is necessary to remove the entire sprinkler unit, the system must be taken out of service. See Maintenance instructions below and follow all warnings and instructions.

5. OPERATION

During fire conditions, the operating element fuses or shatters (depending on the type of sprinkler), releasing the pip cap and sealing assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector or flow shaper, forming a uniform, high-wall wetting spray pattern to extinguish or control the fire.

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6. INSPECTIONS, TESTS AND MAINTENANCE

Refer to NFPA 25 for Inspection, Testing and Maintenance requirements. **NOTICE:** The owner is responsible for having the fire-protection system and devices inspected, tested, and maintained in proper operating condition in accordance with this guide, and applicable NFPA standards. In addition, the Authority Having Jurisdiction may have additional maintenance, testing, and inspection requirements that must be followed.

A. Sprinklers must be inspected on a regular basis for signs of corrosion, mechanical damage, obstructions, paint, etc. Frequency of the inspections may vary due to corrosive atmospheres, water supplies, and activity around the device.

B. Sprinklers or cover plate assemblies that have been field painted, caulked, or mechanically damaged must be replaced immediately. Sprinklers showing signs of corrosion shall be tested and/or replaced immediately as required. Installation standards require sprinklers to be tested and, if necessary, replaced immediately after a specified term of service. Refer to NFPA 25 and the Authorities Having Jurisdiction for the specified period of time after which testing and/or replacement of residential sprinklers is required. Never attempt to repair or reassemble a sprinkler. Sprinklers and cover assemblies that have operated cannot be reassembled or re-used, but must be replaced. When replacement is necessary, use only new sprinklers and cover assemblies with identical performance characteristics.

C. The sprinkler discharge pattern is critical for proper fire protection. Nothing should be hung from, attached to, or otherwise obstruct the discharge pattern of the sprinkler. All obstructions must be immediately removed or, if necessary, additional sprinklers installed.

D. When replacing existing sprinklers, the system must be removed from service. Refer to the appropriate system description and/or valve instructions. Prior to removing the system from service, notify all Authorities Having Jurisdiction. Consideration should be given to employment of a fire patrol in the effected area.

1. Remove the system from service, drain all water, and relieve all pressure on the piping.

2a. For frame-style sprinklers, use the special sprinkler wrench and remove the old sprinkler by turning it counterclockwise to unthread it from the piping.

2b. For residential flush pendent and concealed style sprinklers: Remove the ceiling ring or cover plate assembly before unthreading the sprinkler body from the piping. To remove a ceiling ring, grasp it from below the ceiling and gently turn it counterclockwise. Cover plates can be removed either by gently unthreading them or pulling them off the sprinkler body (depends on the sprinkler model used). After the ceiling ring or cover plate assembly has been removed from the sprinkler, use the sprinkler wrench to unthread the sprinkler from the piping. NOTE: For flush and concealed sprinklers with protective shells, the internal diameter of the special flush and concealed sprinkler installation wrench is designed for use with the sprinkler contained within the shell. Place a plastic protective shell (from the spare sprinkler cabinet) over the sprinkler to be removed and then fit the sprinkler wrench over the shell. Exception: Concealed sprinklers VK457, VK458, VK468, VK474, and VK4570 are removed without the plastic cap.

3. Follow instructions in section 4B. Installation Instructions to install the new unit. Be sure the replacement sprinkler is the correct model and style, with the appropriate K-Factor, temperature rating, and response characteristics. A fully stocked sprinkler cabinet should be provided for this purpose. *(For flush or concealed style sprinklers, stock of spare ceiling rings or cover plates should also be available in the spare sprinkler cabinet.)*

4. Place the system back in service and secure all valves. Check for and repair all leaks.

E. Sprinkler systems that have been subjected to a fire must be returned to service as soon as possible. The entire system must be inspected for damage, and repaired or replaced as necessary. Sprinklers that have been exposed to corrosive products of combustion or high ambient temperatures, but have not operated, should be replaced. Refer to the Authority Having Jurisdiction for minimum replacement requirements.

7. AVAILABILITY

Viking Residential Sprinklers are available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE

For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

TECHNICAL DATA

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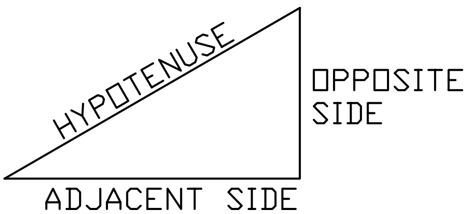


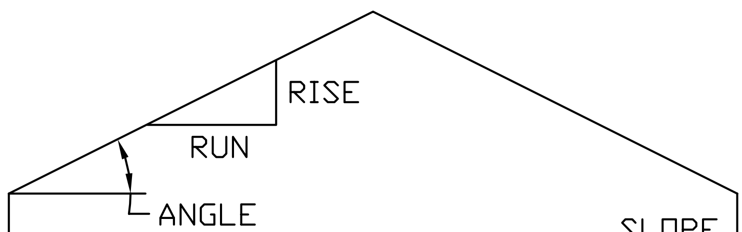
TANGENT =

$$\frac{\text{OPPOSITE SIDE (RISE)}}{\text{ADJACENT SIDE (RUN)}}$$

$$\frac{\text{RISE}}{\text{RUN}} = \text{TANGENT}$$

$$\text{ANGLE} = \text{TAN}^{-1}\left(\frac{\text{RISE}}{\text{RUN}}\right)$$

$$\text{SLOPE DISTANCE} = \sqrt{(\text{RISE})^2 + (\text{RUN})^2}$$



RISE	RUN	TANGENT	ANGLE	SLOPE DISTANCE
2	12	.1666	9.45°	12.1
3	12	.2500	14°	12.3
4	12	.3333	18.4°	12.6
5	12	.4166	22.6°	13
6	12	.5000	26.5°	13.4
7	12	.5833	30.2°	13.8
8	12	.6666	33.6°	14.4
9	12	.7500	36.8°	15
10	12	.8333	39.8°	15.6
11	12	.9166	42.5°	16.2
12	12	1	45°	16.97

Table 2
Rise Over Run Conversion to Degrees of Slope

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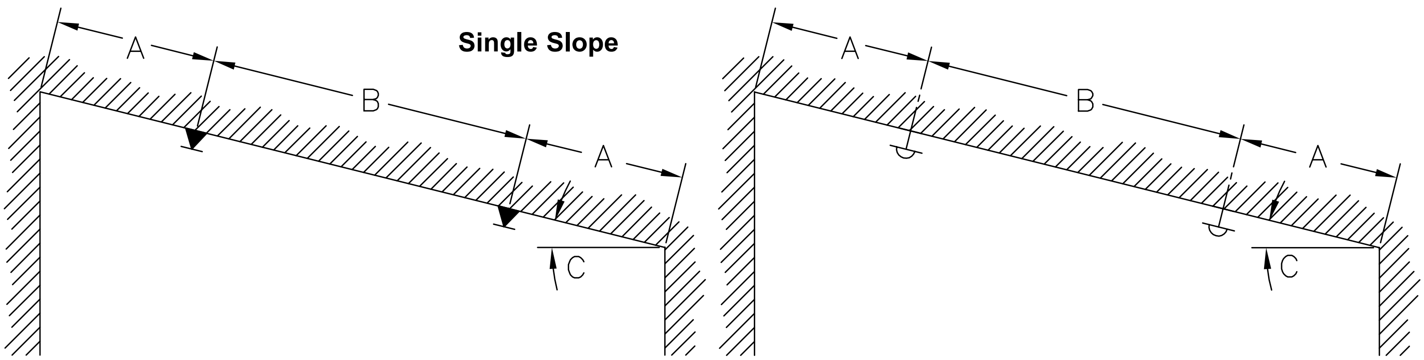
SPACING OF RESIDENTIAL SPRINKLERS LISTED FOR USE BELOW SLOPED CEILINGS UP TO AN 8/12 (33.7°) PITCH

(Refer to the appropriate residential sprinkler technical data page for listings.)



Pendent Sprinklers

Horizontal Sidewall Sprinklers (Spray Across the Slope)

Figure 1

(A) One-half listed spacing of sprinkler maximum, 0'-4" (0-102 mm) minimum.
(B) Listed spacing of sprinkler, maximum, 8'-0" (2.4 m) minimum.
(C) Where angle "C" is greater than an 8/12 (33.7°) pitch, see Figure 2 below.

SPACING OF RESIDENTIAL SPRINKLERS BELOW SLOPED CEILINGS WITH GREATER THAN 8/12 (33.7°) PITCH

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

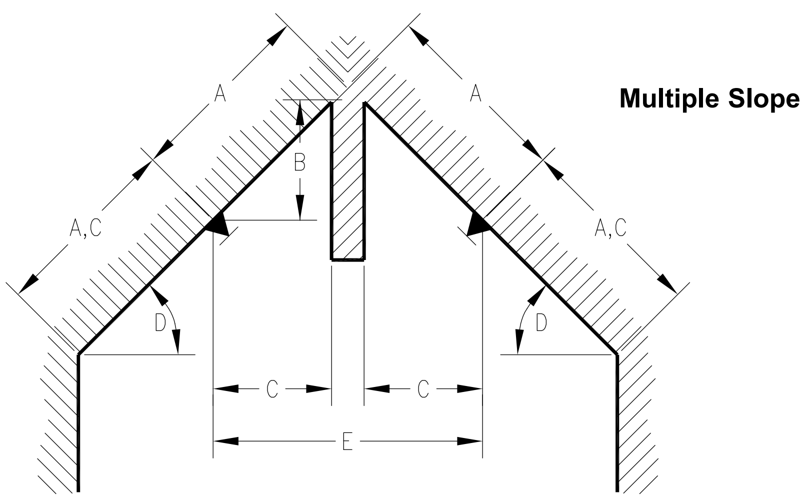


Figure 2

(A) One-half listed spacing of sprinkler, maximum.
(B) 3'-0" (.91 m) maximum.
(C) 0'-4" (0-102 mm) minimum.
(D) Slopes greater than an 8/12 (33.7°) pitch.
(E) For distance less than 8'-0" (2.4 m), baffle required.

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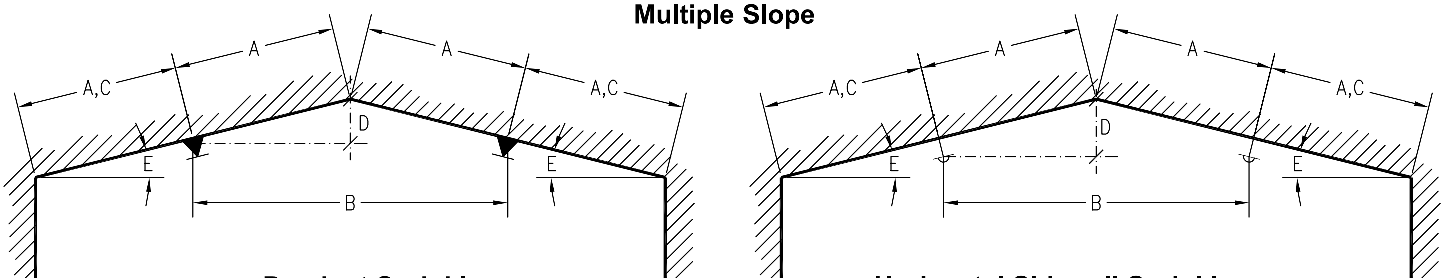
SPACING OF RESIDENTIAL SPRINKLERS LISTED FOR USE BELOW SLOPED CEILINGS UP TO AN 8/12 (33.7°) PITCH

(Refer to the appropriate residential sprinkler technical data page for listings.)

Multiple Slope



Pendent Sprinklers **Horizontal Sidewall Sprinklers (Spray Across the Slope)**

Figure 3

(A) One-half listed spacing of sprinkler, maximum.
(B) 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) 3'-0" (.91 m) maximum.
(E) Acceptable for slopes of 0/12 to 8/12 (0° to 33.7°) pitch.

SPACING OF RESIDENTIAL PENDENT SPRINKLERS AT PEAK OF SLOPED CEILINGS WITH PITCH LESS THAN 8/12 (33.7°)

(Refer to the appropriate residential sprinkler technical data page for listings.)

Multiple Slope

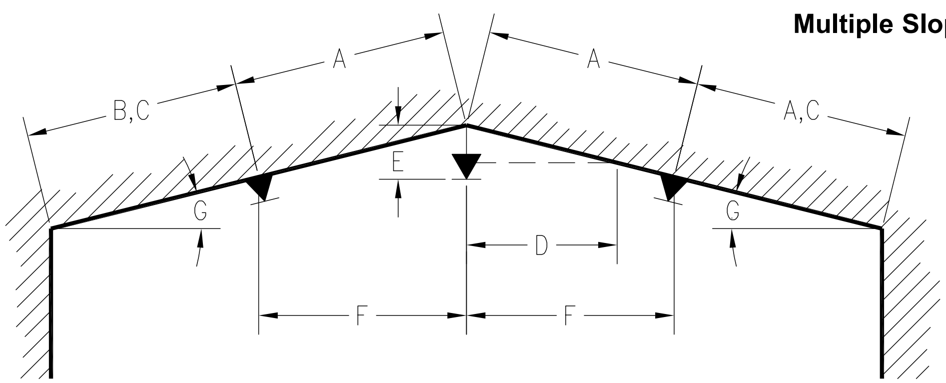


Figure 4

(A) Listed spacing of sprinkler, maximum.
(B) One-half listed spacing of sprinkler, maximum.
(C) 0'-4" minimum.
(D) Refer to page 10 for minimum distance between sprinkler and intersecting sloped ceiling.
(E) Refer to the appropriate residential sprinkler technical data page for deflector distance below ceiling.
(F) 8'-0" minimum.
(G) Reference: 4/12 (18.0°) pitch maximum for 12' (3.7 m) spacing.
2.5/12 (12.0°) pitch maximum for 14' (4.3 m) spacing.
2/12 (10.0°) pitch maximum for 16' (4.9 m) spacing.
2/12 (10.0°) pitch maximum for 18' (5.5 m) spacing.
1.9/12 (9.0°) pitch maximum for 20' (6.1 m) spacing.
Angles based on sprinklers installed 0'-4" (0-102 mm) from peak.

NOTE: Whenever possible, utilize design as shown in Figure 3 above.

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SPACING OF RESIDENTIAL SPRINKLERS BELOW SLOPED CEILINGS WITH GREATER THAN 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 2 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

Multiple Slope

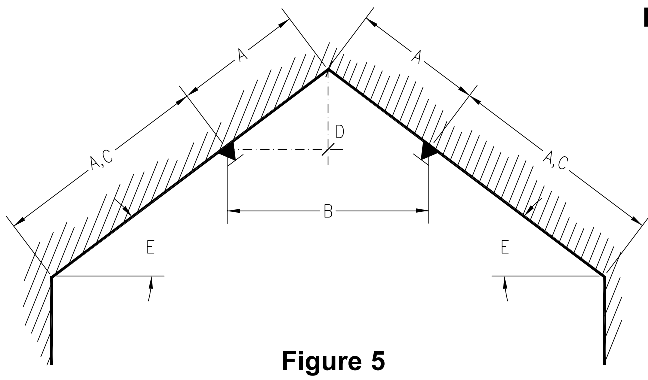

Figure 5

(A) One-half listed spacing of sprinkler, maximum.
(B) 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) 3'-0" (.91 m) maximum.
(E) Acceptable for slopes greater than an 8/12 (33.7°) pitch.
(F) When this design is used, refer to the appendices of NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction regarding the number of design sprinklers to hydraulically calculate.

SPACING OF RESIDENTIAL SPRINKLERS BELOW CEILINGS WITH SLOPES EXCEEDING 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 3 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

Multiple Slope

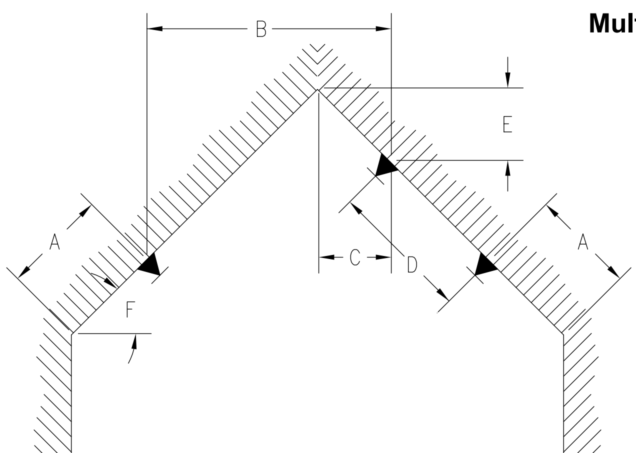

Figure 6

(A) 0'-4" (0-102 mm) minimum, to one-half listed spacing, maximum.
(B) One-half listed spacing, maximum, 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) Listed spacing maximum, 8'-0" (2.4 m) minimum.
(E) 3'-0" (.91 m) maximum.
(F) Slopes greater than 8/12 up to a 21/12 (33.7° up to 60°) pitch.

NOTES: In addition to the above limits, rooms requiring this type of installation must be hydraulically calculated to supply a minimum of three operating sprinklers. Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

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SPACING OF RESIDENTIAL SPRINKLERS BELOW CEILINGS WITH SLOPES EXCEEDING 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 2 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

Multiple Slope

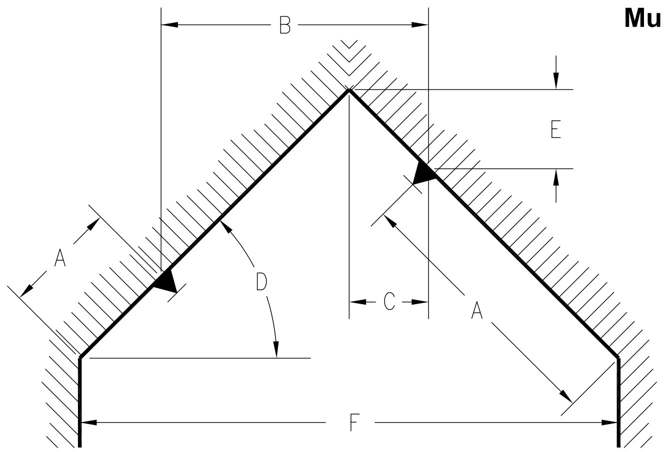

Figure 7

(A) 0'-4" (0-102 mm) minimum, to one-half listed spacing, maximum.
(B) One-half listed spacing, maximum, 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) Slopes greater than 8/12 pitch up to a 21/12 (33.7° up to a 60°) pitch.
(E) 3'-0" (.91 m) maximum.
(F) When dimension "F" exceeds 16' (4.9 m), utilize design configuration shown in Figure 6.

NOTES: Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

Multiple Slope

Multiple Slope

Single Slope

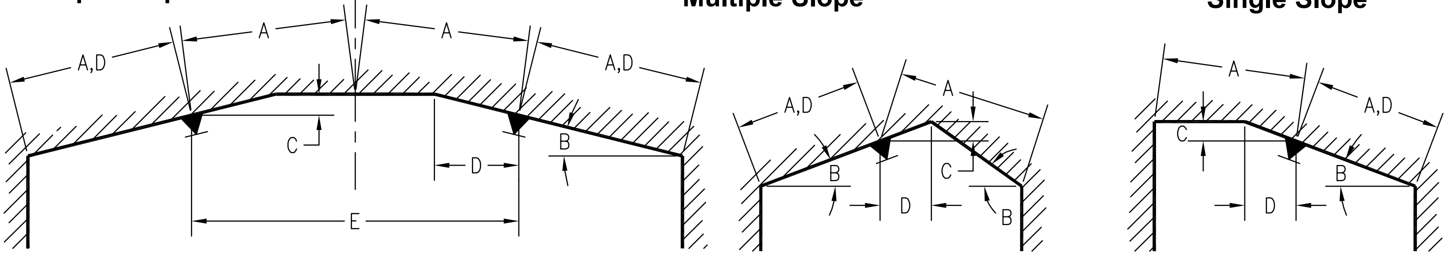

Figure 8

(A) One-half listed spacing, maximum.
(B) Refer to the appropriate residential sprinkler technical data pages for listings of sprinklers for use below slopes up to and including a 8/12 (33.7°) pitch.
(C) 3'-0" (.91 m) maximum.
(D) 0'-4" (0-102 mm) minimum.
(E) 8'-0" (2.4 m) minimum without baffle.

NOTES: Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

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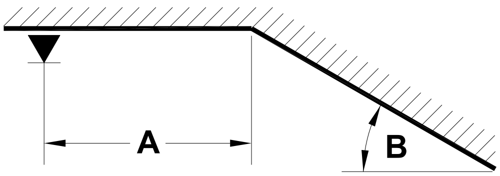
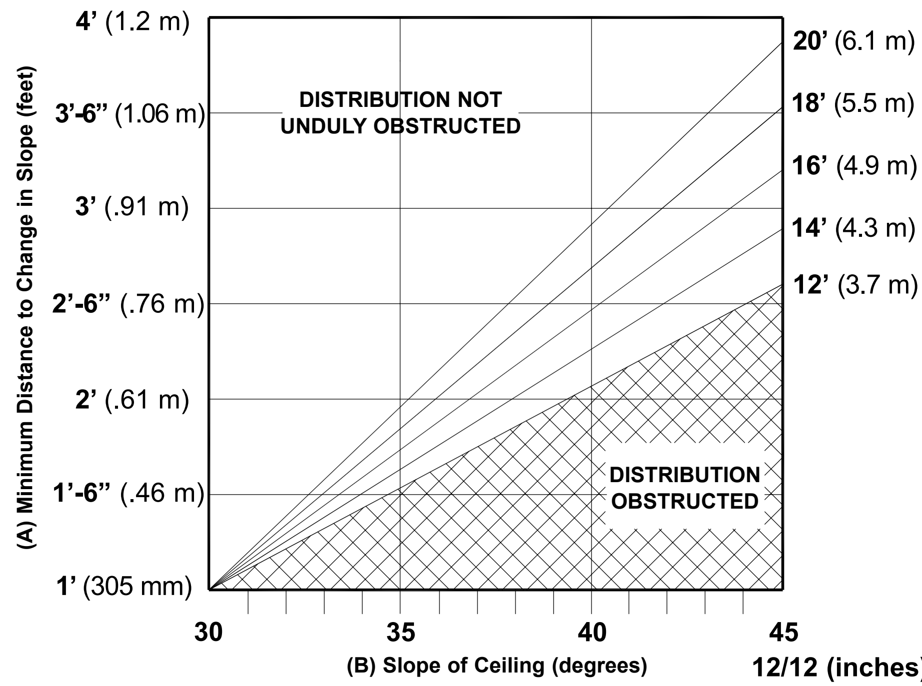
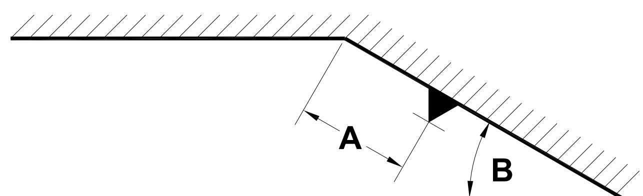
MINIMUM DISTANCE BETWEEN SPRINKLER AND INTERSECTING SLOPED CEILINGS

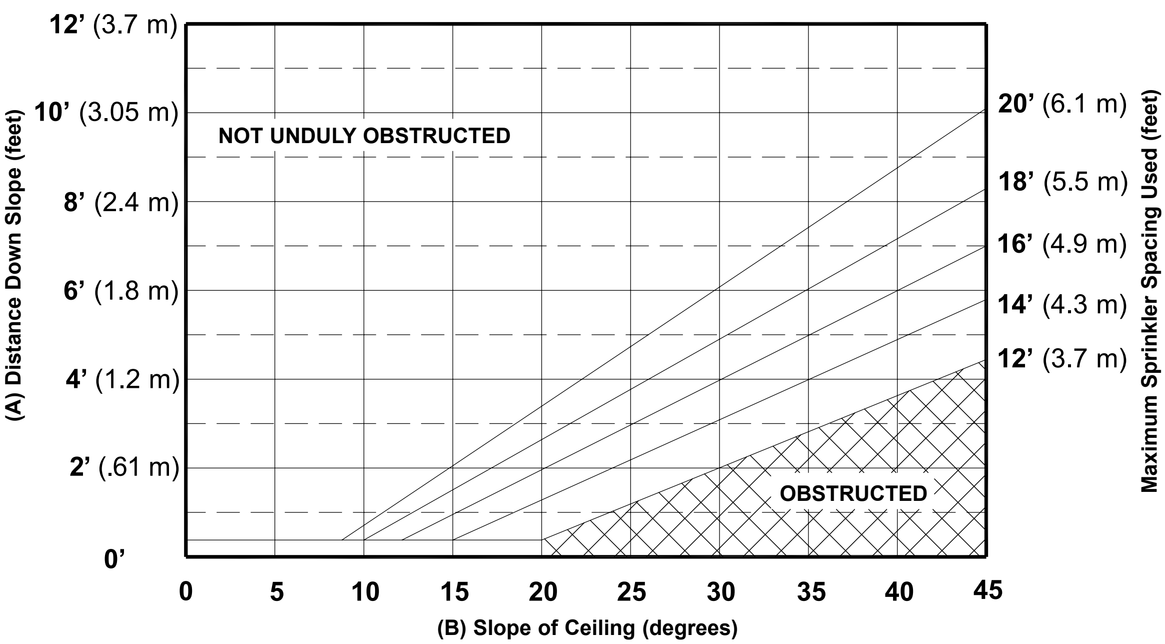


NOTES: For any ceiling slope under 7/12 (30°), distribution is considered Not Unduly Obstructed.



MAXIMUM DISTANCE DOWN SLOPE TO AVOID OBSTRUCTION TO SPRINKLER DISCHARGE





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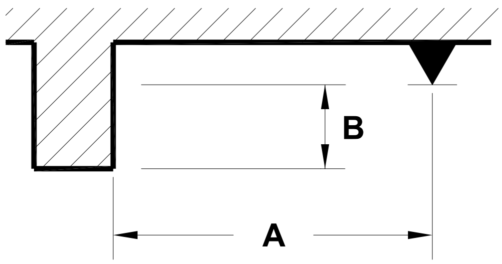
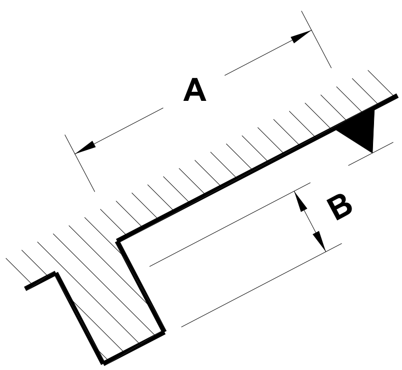
AVOIDING OBSTRUCTIONS TO SPRINKLER DISCHARGE

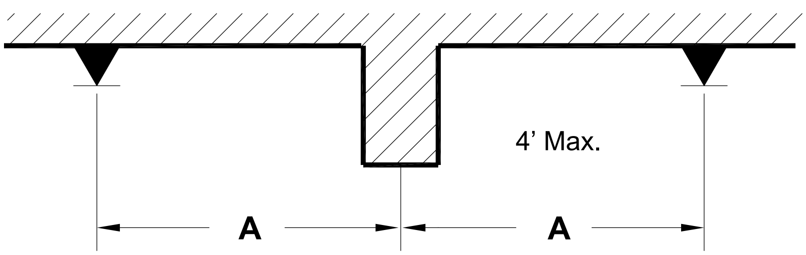
(Obstruction rules for residential sprinklers are found in section 8.10 of the 2010 edition of NFPA 13.)

Positioning Residential Pendent Sprinklers - Obstructions at the Ceiling



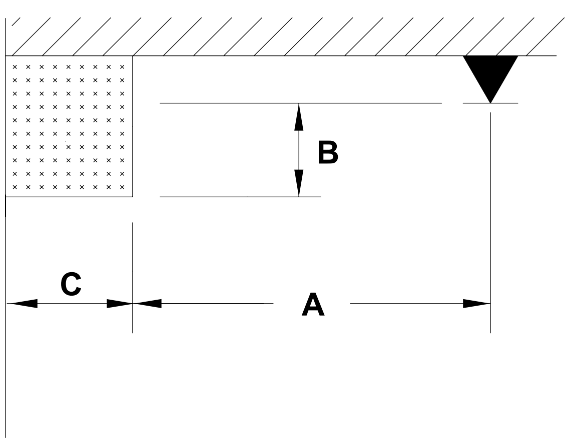


Distance from Sprinkler to Side of Ceiling Obstruction (Dimension A)	Maximum Distance from Deflector to Bottom of Ceiling Obstruction (Dimension B)	
	Inches	mm
Less than 1 ft. 6 in. (Less than 457 mm)	0	0
1 ft. 6 in. to less than 3 ft. (457 mm to less than .94 m)	1	25.4
3 ft. to less than 4 ft. (.91 m to less than 1.2 m)	3	76
4 ft. to less than 4 ft. 6 in. (1.2 m to less than 1.37 m)	5	127
4 ft. 6 in. to less than 6 ft. (1.37 m to less than 1.8 m)	7	178
6 ft. to less than 6 ft. 6 in. (1.8 m to less than 2 m)	9	229
6 ft. 6 in. to less than 7 ft. (2 m to less than 2.1 m)	11	279
7 ft. or greater (2.1 m or greater)	14	356



Residential pendent sprinklers may be located on opposite sides of continuous obstructions up to 4 ft. (1.2 m) wide at the ceiling, as long as the distance from the centerline of the obstruction to the sprinklers (A) does not exceed one-half the maximum spacing allowed between sprinklers.

Positioning Residential Pendent Sprinklers - Obstructions Along Walls



(A) Distance from centerline of sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.
(C) Width of the obstruction.

Obstructions up to 30 in. (.8 m) wide (C) located against the wall are permitted to be protected when (A) is greater than or equal to (C) minus 8 in. (.2 m) plus (B).

$C \leq 30$ in. — for metric $C \leq .8$ m

$A \geq (C - 8 \text{ in.}) + B$ — $A \geq (C - .2 \text{ m}) + B$

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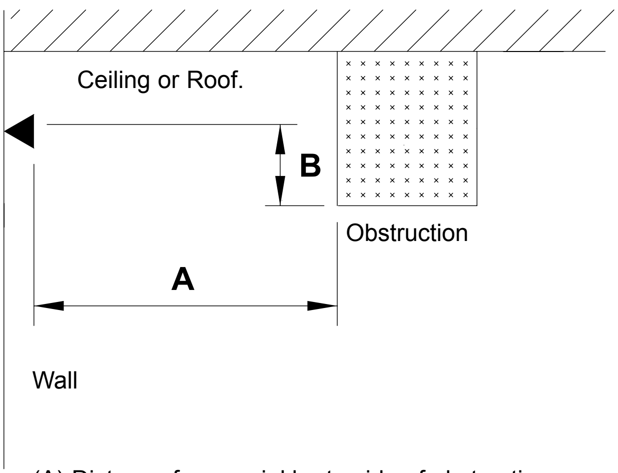
AVOIDING OBSTRUCTIONS TO SPRINKLER DISCHARGE

(Obstruction rules for residential sprinklers are found in section 8.10 of the 2010 edition of NFPA 13.)

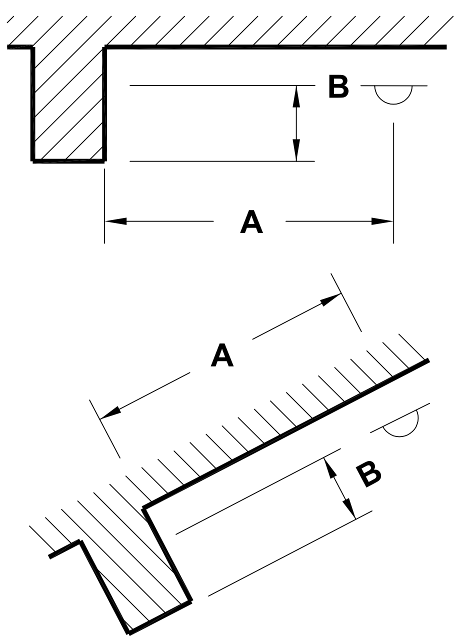
Positioning Residential Horizontal Sidewall Sprinklers - Obstructions at the Ceiling



(A) Distance from sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.

Distance from Sprinkler to Side of Ceiling Obstruction (Dimension A)	Maximum Distance from Deflector to Bottom of Ceiling Obstruction (Dimension B)	
	Inches	mm
Less than 8 ft. (Less than 2.4 m)	No Obstructions Allowed	
8 ft. to less than 10 ft. (2.4 m to less than 3.05 m)	1	25.4
10 ft. to less than 11 ft. (3.05 m to less than 3.35 m)	2	50.8
11 ft. to less than 12 ft. (3.35 m to less than 3.7 m)	3	76
12 ft. to less than 13 ft. (3.7 m to less than 4 m)	4	102
13 ft. to less than 14 ft. (4 m to less than 4.3 m)	6	152
14 ft. to less than 15 ft. (4.3 m to less than 4.6 m)	7	178
15 ft. to less than 16 ft. (4.6 m to less than 4.9 m)	9	229
16 ft. to less than 17 ft. (4.9 m to less than 5.2 m)	11	279
17 ft. or greater (5.2 m or greater)	14	356

Positioning Residential Horizontal Sidewall Sprinklers - Obstructions Along Walls



Distance from Sprinkler to Side of Obstruction Along Wall (Dimension A)	Maximum Distance from Deflector to Bottom of Obstruction (Dimension B)	
	Inches	mm
Less than 1 ft. 6 in. (Less than 457 mm)	0	0
1 ft. 6 in. to less than 3 ft. (457 mm to less than .94 m)	1	25.4
3 ft. to less than 4 ft. (.91 m to less than 1.2 m)	3	76
4 ft. to less than 4 ft. 6 in. (1.2 m to less than 1.37 m)	5	127
4 ft. 6 in. to less than 6 ft. (1.37 m to less than 1.8 m)	7	178
6 ft. to less than 6 ft. 6 in. (1.8 m to less than 2 m)	9	229
6 ft. 6 in. to less than 7 ft. (2 m to less than 2.1 m)	11	279
7 ft. or greater (2.1 m or greater)	14	356

(A) Distance from sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.

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LOCATING RESIDENTIAL SPRINKLERS NEAR HEAT SOURCES

Ordinary temperature rated residential sprinklers (135 °F to 170 °F rated) are only to be installed where the maximum ambient ceiling temperature will not exceed 100 °F. Where the maximum ambient ceiling temperature will be from 101 °F to 150 °F, use intermediate temperature rated residential sprinklers (175 °F to 225 °F rated).

Residential sprinklers must be positioned a sufficient distance away from heat sources that include fireplaces, stoves, kitchen ranges, wall ovens, hot water pipes, water heaters, furnaces and associated flues and ducts, and light fixtures. The following minimum distances must be maintained for both ordinary and intermediate temperature rated residential sprinklers as indicated.

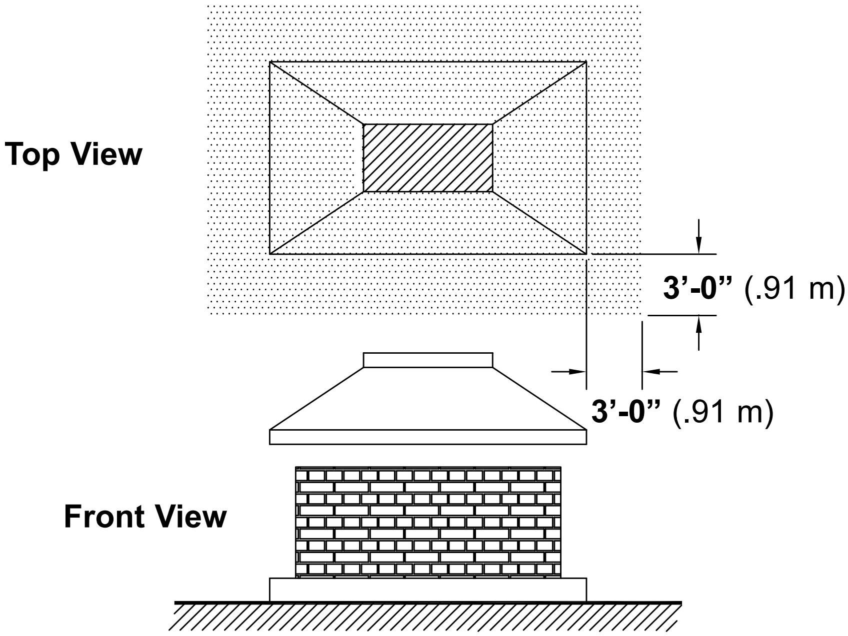
Heat Source	Minimum Distance from Edge of Source to Ordinary Temperature Rated Sprinkler		Minimum Distance from Edge of Source to Intermediate Temperature Rated Sprinkler	
	Inches	metric	Inches	metric
Side of open or recessed fireplace	36	.91 m	12	305 mm
Front of recessed fire place	60	1.5 m	36	.91 m
Coal- or wood-burning stove	42	1.1 m	12	305 mm
Kitchen range	18	457 mm	9	229 mm
Wall oven	18	457 mm	9	229 mm
Hot air flues	18	457 mm	9	229 mm
Uninsulated heat ducts	18	457 mm	9	229 mm
Uninsulated hot water pipes	12	305 mm	6	152 mm
Side of ceiling- or wall-mounted hot air diffusers	24	.61 m	12	305 mm
Front of wall-mounted hot air diffusers	36	.91 m	18	457 mm
Hot water heater or furnace	6	152 mm	3	76 mm
Light fixture less than 250W	6	152 mm	3	76 mm
Light fixture 250W to 499W	12	305 mm	6	152 mm
Where residential sprinklers will be exposed to the rays of the sun passing through glass or plastic skylights, use intermediate temperature rated sprinklers.				
When locating residential sprinklers in an unventilated concealed compartment, under an unventilated attic or uninsulated roof, where the maximum ambient temperature does not exceed 150 °F, use intermediate temperature rated sprinklers.				

TECHNICAL DATA

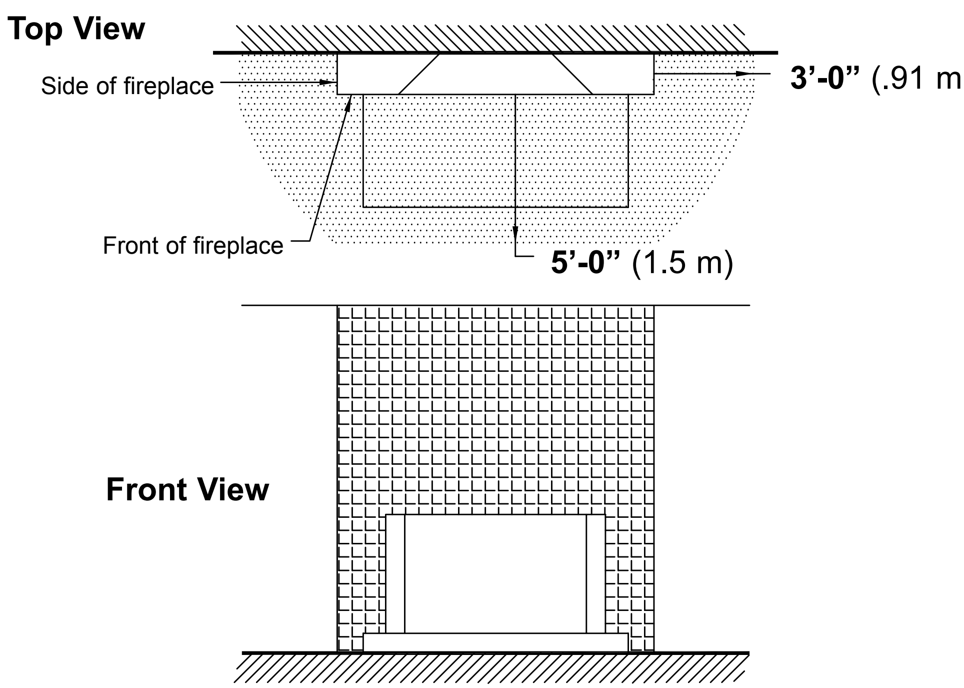
FREEDOM® RESIDENTIAL SPRINKLER INSTALLATION GUIDE

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

NOTE: The dimensions shown are intended to apply to residential sprinklers installed in ceilings above fireplaces used to burn products that cause elevated temperatures at or near the ceiling in areas surrounding the fireplace. The recommendations should not be construed to apply to decorative non-opening fireplaces such as gas fire units that will not cause elevated temperatures at the ceiling.



Sprinklers near an open hearth fireplace must be located outside of the shaded area or be intermediate degree rated.



Sprinklers near a recessed hearth fireplace must be located outside of the shaded area [at least 3’-0” (.91 m)] from the side of a recessed fireplace and at least 5’-0” (1.5 m) from the front) or be intermediate degree rated.

TECHNICAL DATA

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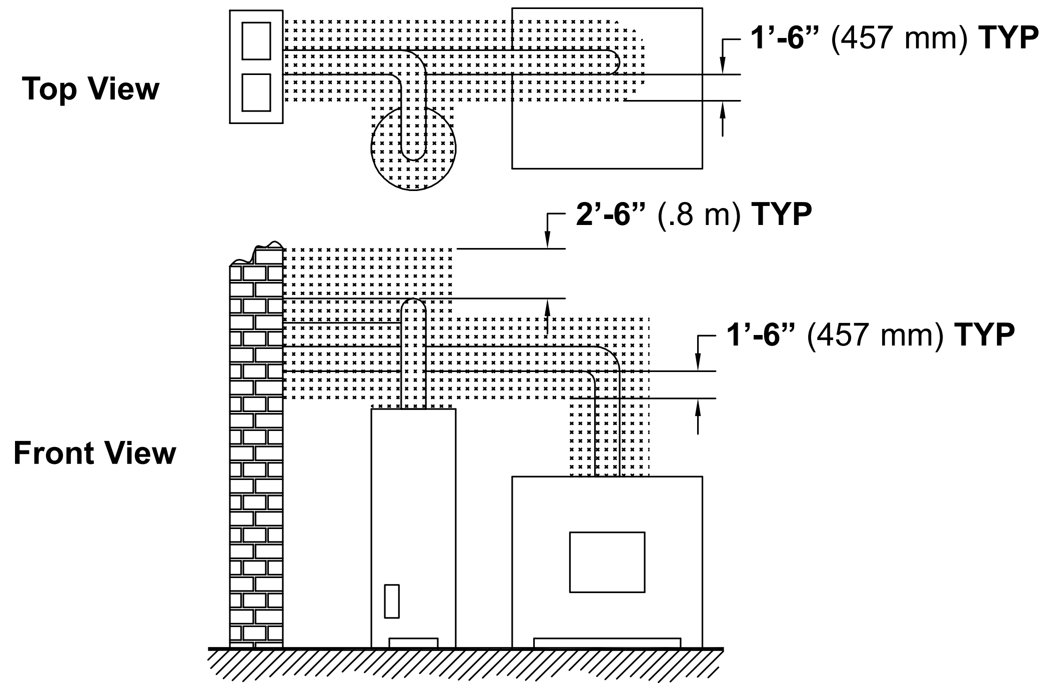
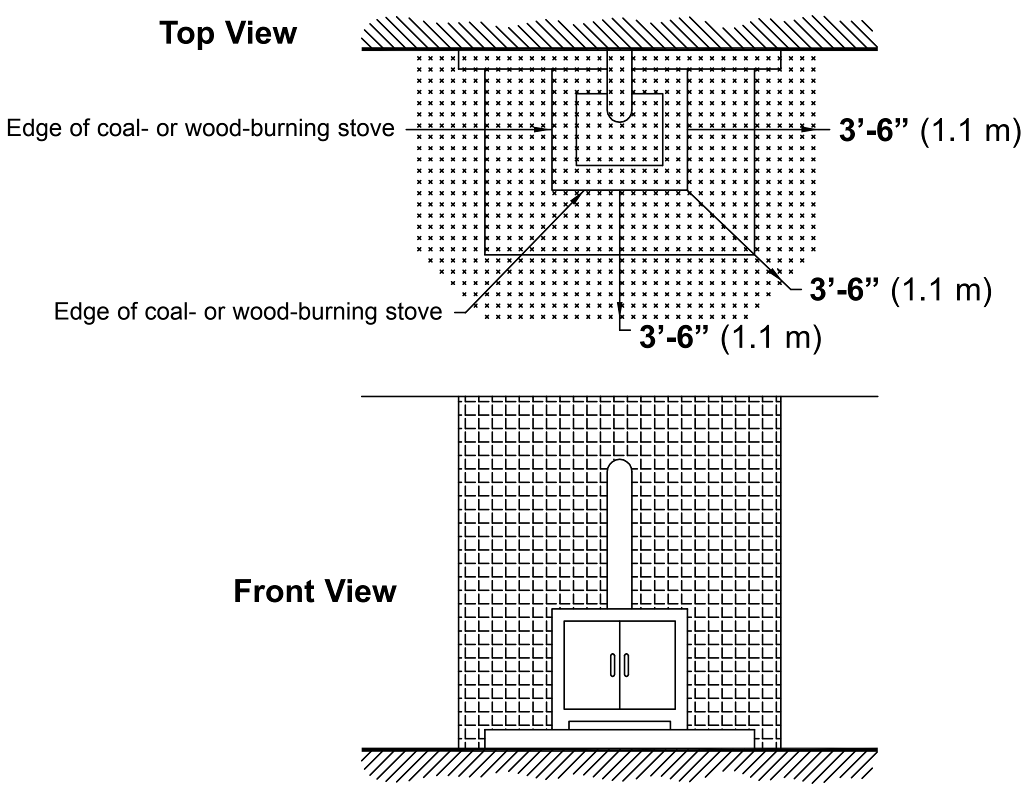


Sprinklers near a furnace or water heater must be located outside of the shaded area or be intermediate degree rated.



Sprinklers near a coal- or wood-burning stove must be located outside of shaded area or be intermediate degree rated.

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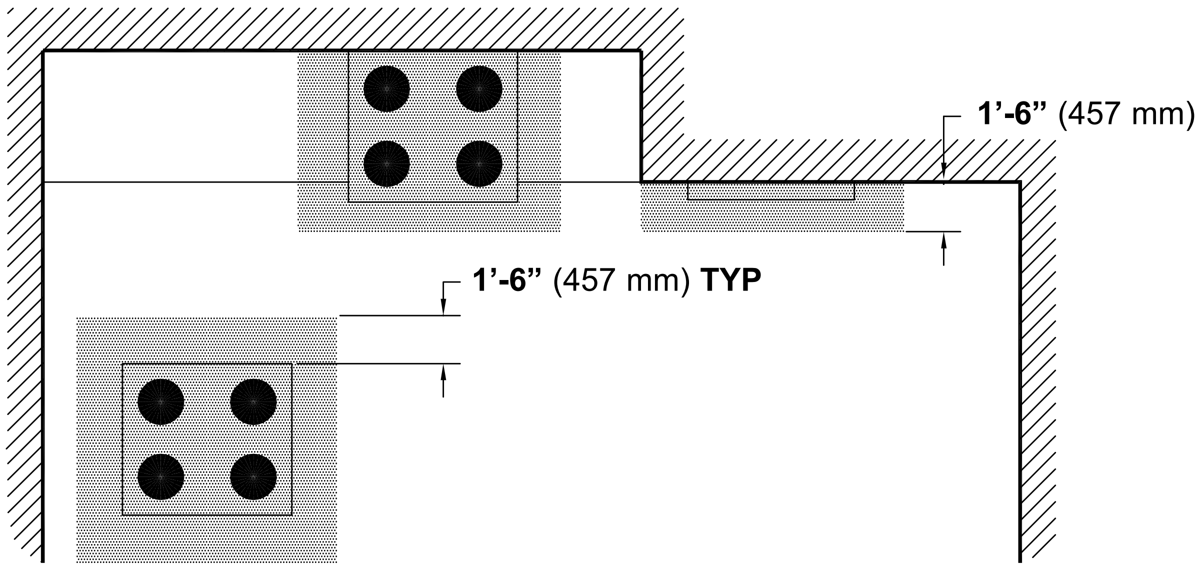
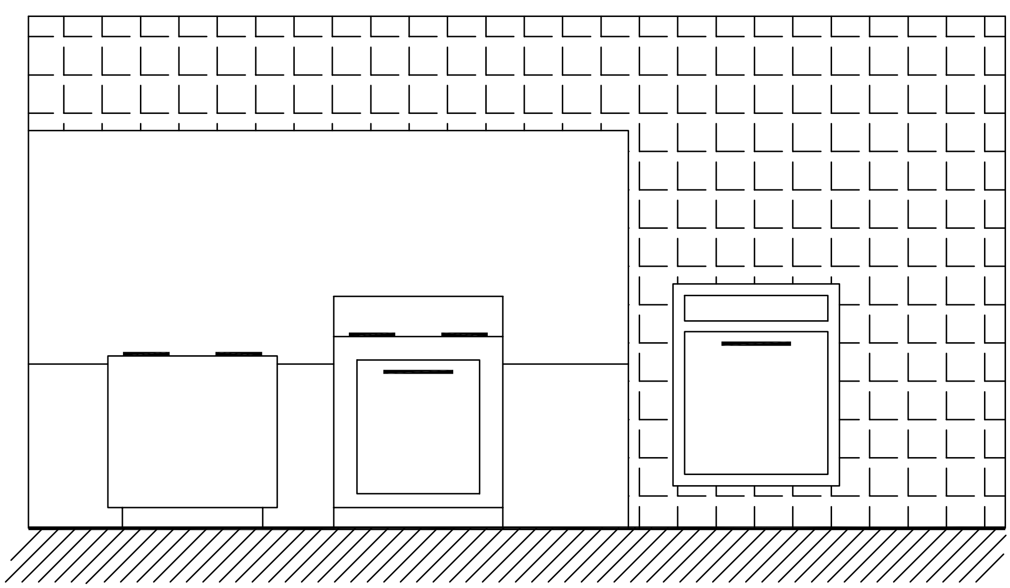
Top View



Front View



Sprinklers near a range or wall oven must be located outside of shaded areas or be intermediate degree rated.

VIKING

BULLETIN

CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

SPRINKLERS ARE FRAGILE - HANDLE WITH CARE!

General Handling and Storage:

- Store sprinklers in a cool, dry place.
- Protect sprinklers during storage, transport, handling, and after installation.
- Use the original shipping containers. DO NOT place sprinklers loose in boxes, bins, or buckets.
- Keep sprinklers separated at all times. DO NOT allow metal parts to contact sprinkler operating elements.

For Pre-Assembled Drops:

- Protect sprinklers during handling and after installation.
- For recessed assemblies, use the protective sprinkler cap (Viking Part Number 10364).

Sprinklers with Protective Shields or Caps:

- DO NOT remove shields or caps until after sprinkler installation and there no longer is potential for mechanical damage to the sprinkler operating elements.
- **Sprinkler shields or caps MUST be removed BEFORE placing the system in service!**
- Remove the sprinkler shield by carefully pulling it apart where it is snapped together.
- Remove the cap by turning it slightly and pulling it off the sprinkler.

Sprinkler Installation:

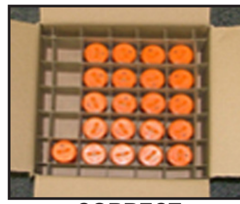
- DO NOT use the sprinkler deflector or operating element to start or thread the sprinkler into a fitting.
- **Use only the designated sprinkler head wrench!** Refer to the current sprinkler technical data page to determine the correct wrench for the model of sprinkler used.
- DO NOT install sprinklers onto piping at the floor level.
- Install sprinklers after the piping is in place to prevent mechanical damage.
- DO NOT allow impacts such as hammer blows directly to sprinklers or to fittings, pipe, or couplings in close proximity to sprinklers. Sprinklers can be damaged from direct or indirect impacts.
- DO NOT attempt to remove drywall, paint, etc., from sprinklers.
- **Take care not to over-tighten the sprinkler and/or damage its operating parts!**

Maximum Torque:

1/2" NPT:	**14 ft-lbs. (19.0 N-m)**
3/4" NPT:	**20 ft-lbs. (27.1 N-m)**
1" NPT:	**30 ft-lbs. (40.7 N-m)**

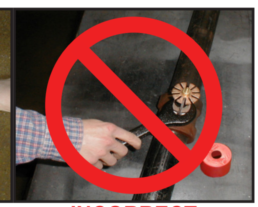
CORRECT
(Original container used)


INCORRECT
(Placed loose in box)


CORRECT
(Protected with caps)


INCORRECT
(Protective caps not used)


CORRECT
(Piping is in place at the ceiling)


INCORRECT
(Sprinkler at floor level)


CORRECT
(Special installation wrenches)


INCORRECT
(Designated wrench not used)

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

WARNING

Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed. Never install sprinklers that have been dropped, damaged, or exposed to temperatures exceeding the maximum ambient temperature allowed. Sprinklers that have been painted in the field must be replaced per NFPA 13. Protect sprinklers from paint and paint overspray in accordance with the installation standards. Do not clean sprinklers with soap and water, ammonia, or any other cleaning fluid. Do not use adhesives or solvents on sprinklers or their operating elements.

Refer to the appropriate technical data page and NFPA standards for complete care, handling, installation, and maintenance instructions. For additional product and system information Viking data pages and installation instructions are available on the Viking Web site at www.vikinggroupinc.com.

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PROTECTIVE SPRINKLER SHIELDS AND CAPS

General Handling and Storage:

Many Viking sprinklers are available with a plastic protective cap or shield temporarily covering the operating elements. The snap-on shields and caps are factory installed and are intended to help protect the operating elements from mechanical damage during shipping, storage, and installation. NOTE: It is still necessary to follow the care and handling instructions on the appropriate sprinkler technical data sheets* when installing sprinklers with bulb shields or caps.

WHEN TO REMOVE THE SHIELDS AND CAPS:

NOTE: SHIELDS AND CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!

Remove the shield or cap from the sprinkler only after checking all of the following:

- The sprinkler has been installed*.
- The wall or ceiling finish work is completed where the sprinkler is installed and there no longer is a potential for mechanical damage to the sprinkler operating elements.

SHIELDS AND CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!

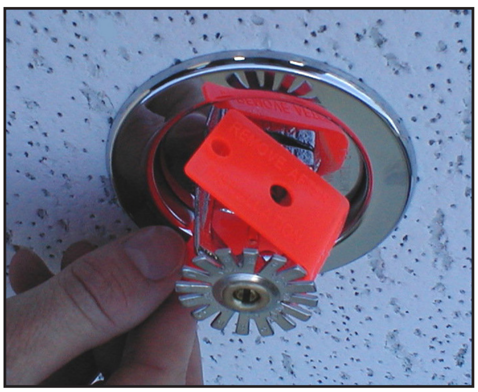


Figure 1: Sprinkler shield being removed from a pendent sprinkler.

Figure 2: Sprinkler cap being removed from a pendent sprinkler.

Figure 3: Sprinkler cap being removed from and upright sprinkler.

HOW TO REMOVE SHIELDS AND CAPS:

No tools are necessary to remove the shields or caps from sprinklers. DO NOT use any sharp objects to remove them! **Take care not to cause mechanical damage to sprinklers when removing the shields or caps.** When removing caps from fusible element sprinklers, use care to prevent dislodging ejector springs or damaging fusible elements. NOTE: Squeezing the sprinkler cap excessively could damage sprinkler fusible elements.

- To remove the shield, simply pull the ends of the shield apart where it is snapped together. Refer to Figure 1.
- To remove the cap, turn it slightly and pull it off the sprinkler. Refer to Figures 2 and 3.

NOTICE Refer to the current sprinkler technical data page to determine the correct sprinkler wrench for the model of sprinkler used.

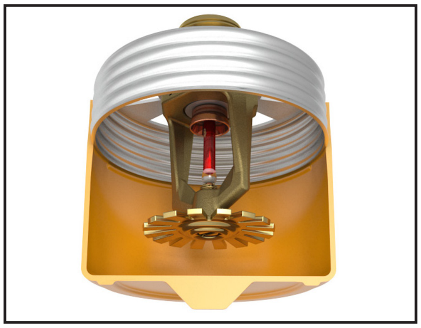
WARNING Never install sprinklers that have been dropped, damaged, or exposed to temperatures in excess of the maximum ambient temperature allowed.

*** Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.**

VIKING | BULLETIN | **CARE AND HANDLING OF SPRINKLERS**

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

⚠CAUTION CONCEALED COVER ASSEMBLIES ARE FRAGILE!
TO ASSURE SATISFACTORY PERFORMANCE OF THE PRODUCT, HANDLE WITH CARE.



Concealed Sprinkler and Adapter Assembly with Protective Cap

Concealed Sprinkler and Adapter Assembly (Protective Cap Removed)

Cover Plate Assembly (Pendent Cover 12381 shown)

GENERAL HANDLING AND STORAGE INSTRUCTIONS:

- Do not store in temperatures exceeding 100 °F (38 °C). Avoid direct sunlight and confined areas subject to heat.
- Protect sprinklers and cover assemblies during storage, transport, handling, and after installation.
  -- Use original shipping containers.
  -- Do not place sprinklers or cover assemblies loose in boxes, bins, or buckets.
- Keep the sprinkler bodies covered with the protective sprinkler cap any time the sprinklers are shipped or handled, during testing of the system, and while ceiling finish work is being completed.
- Use only the designated Viking recessed sprinkler wrench (refer to the appropriate sprinkler data page) to install these sprinklers. **NOTE:** The protective cap is temporarily removed during installation and then placed back on the sprinkler for protection until finish work is completed.
- Do not over-tighten the sprinklers into fittings during installation.
- Do not use the sprinkler deflector to start or thread the sprinklers into fittings during installation.
- Do not attempt to remove drywall, paint, etc., from the sprinklers.
- Remove the plastic protective cap from the sprinkler before attaching the cover plate assembly. **PROTECTIVE CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!**

Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.

VIKING | BULLETIN | CARE AND HANDLING OF SPRINKLERS

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USE THE FOLLOWING PRECAUTIONS WHEN HANDLING WAX-COATED SPRINKLERS

Many of Viking's sprinklers are available with factory-applied wax coating for corrosion resistance. These sprinklers MUST receive appropriate care and handling to avoid damaging the wax coating and to assure satisfactory performance of the product.

General Handling and Storage of Wax-Coated Sprinklers:

- Store the sprinklers in a cool, dry place (in temperatures below the maximum ambient temperature allowed for the sprinkler temperature rating. Refer to Table 1 below.)
- Store containers of wax-coated sprinklers separate from other sprinklers.
- Protect the sprinklers during storage, transport, handling, and after installation.
- Use original shipping containers.
- Do not place sprinklers in loose boxes, bins, or buckets.

Installation of Wax-Coated Sprinklers:

Use only the special sprinkler head wrench designed for installing wax-coated Viking sprinklers (any other wrench may damage the unit).

- Take care not to crack the wax coating on the units.
- For touching up the wax coating after installation, wax is available from Viking in bar form. Refer to Table 1 below. The coating MUST be repaired after sprinkler installation to protect the corrosion-resistant properties of the sprinkler.
- Use care when locating sprinklers near fixtures that can generate heat. Do not install sprinklers where they would be exposed to temperatures exceeding the maximum recommended ambient temperature for the temperature rating used.
- Inspect the coated sprinklers frequently soon after installation to verify the integrity of the corrosion resistant coating. Thereafter, inspect representative samples of the coated sprinklers in accordance with NFPA 25. Close up visual inspections are necessary to determine whether the sprinklers are being affected by corrosive conditions.

TABLE 1

Sprinkler Temperature Rating (Fusing Point)	Wax Part Number	Wax Melting Point	Maximum Ambient Ceiling Temperature[1]	Wax Color
155 °F (68 °C) / 165 °F (74 °C)	02568A	148 °F (64 °C)	100 °F (38 °C)	Light Brown
175 °F (79 °C)	04146A	161 °F (71 °C)	150 °F (65 °C)	Brown
200 °F (93 °C)	04146A	161 °F (71 °C)	150 °F (65 °C)	Brown
220 °F (104 °C)	02569A	170 °F (76 °C)	150 °F (65 °C)	Dark Brown
286 °F (141 °C)	02569A	170 °F (76 °C)	150 °F (65 °C)	Dark Brown

[1] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

⚠WARNING Never install sprinklers that have been dropped, damaged, or exposed to temperatures in excess of the maximum ambient temperature allowed.

Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.

VIKING	TECHNICAL DATA	SPRINKLER OVERVIEW

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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1. DESCRIPTION

Viking fire sprinklers consist of a threaded frame with a specific waterway or orifice size and a deflector for distributing water in a specified pattern. A closed or sealed sprinkler refers to a complete assembly, including the thermosensitive operating element. An open sprinkler does not use an operating element and is open at all times. The distribution of water is intended to extinguish a fire or to control its spread.

Viking sprinklers are available in several models and styles. Refer to specific sprinkler technical data pages for available styles, finishes, temperature ratings, thread sizes, and nominal K-Factors for the particular model selected.

2. LISTINGS AND APPROVALS

Refer to the Approval Charts on the appropriate sprinkler technical data page(s) and/or approval agency listings.

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

3. TECHNICAL DATA

Pressure Ratings:

Maximum allowable water working pressure is 175 psig (12 Bar) unless rated and specified for high water working pressure [250 psig (17.2 bar)].

Sprinkler Identification:

Viking sprinklers are identified and marked with the word “Viking”, the sprinkler identification number (SIN) consisting of “VK” plus a three digit number*, the model letter, and the year of manufacture.

Available Finishes:

Viking sprinklers are available in several decorative finishes. Some models are available with corrosion-resistant coatings or are fabricated from non-corrosive material. Refer to the sprinkler technical data page for additional information.

Available Temperature Ratings:

Viking sprinklers are available in several temperature ratings that relate to a specific temperature classification. Applicable installation rules mandate the use and limitations of each temperature classification. In selecting the appropriate temperature classification, the maximum expected ceiling temperature must be known. When there is doubt as to the maximum temperature at the sprinkler location, a maximum-reading thermometer should be used to determine the temperature under conditions that would show the highest readings to be expected. In addition, recognized installation rules may require a higher temperature classification, depending upon sprinkler location, occupancy classification, commodity classification, storage height, and other hazards. In all cases, the maximum expected ceiling temperature dictates the lowest allowable temperature classification. Sprinklers located immediately adjacent to a heat source may require a higher temperature rating.

K-Factors:

Viking sprinklers are available in several orifice sizes with related K-Factors. The orifice is a tapered waterway and, therefore, the K-Factor given is nominal. Nominal U.S. K-Factors are provided in accordance with the 1999 edition of NFPA 13, Section 3-2.3. Refer to the specific data page for appropriate K-Factor information.

Available Styles:

Viking sprinklers are available for installation in several positions as indicated by a stamping on the deflector. The deflector style dictates the appropriate installation position of the sprinkler; it breaks the solid stream of water issuing from the sprinkler orifice to form a specific spray pattern. The following list indicates the various styles and identification of Viking sprinklers.

UPRIGHT SPRINKLER: A sprinkler intended to be installed with the deflector above the frame so water flows upward through the orifice, striking the deflector and forming an umbrella-shaped spray pattern downward. Marked “SSU” (Standard Sprinkler Upright) or “UPRIGHT” on the deflector.

PENDENT SPRINKLER: A sprinkler intended to be oriented with the deflector below the frame so water flows downward through the orifice, striking the deflector and forming an umbrella-shaped spray pattern downward. Marked “SSP” (Standard Sprinkler Pendent) or “PENDENT” on the deflector.

Viking Technical Data may be found on The Viking Corporation’s Web site at http://www.vikinggroupinc.com. The Web site may include a more recent edition of this Technical Data Page.

CONVENTIONAL SPRINKLER: An “old style” sprinkler intended to be installed with the deflector in either the upright or pendent position. The deflector provides a spherical type pattern with 40 to 60 percent of the water initially directed downward and a proportion directed upward. Must be installed in accordance with installation rules for conventional or old style sprinklers. DO NOT USE AS A REPLACEMENT FOR STANDARD SPRAY SPRINKLERS. Marked “C U/P” (Conventional Upright/Pendent) on the deflector.

	TECHNICAL DATA	SPRINKLER OVERVIEW

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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VERTICAL SIDEWALL (VSW) SPRINKLER: A sprinkler intended for installation near the wall and ceiling. The deflector provides a water spray pattern outward in a quarter-spherical pattern and can be installed in the upright or pendent position with the flow arrow in the direction of discharge. Marked “SIDEWALL” on the deflector with an arrow and the word “FLOW”. (Note: Some vertical sidewall sprinklers can only be installed in the upright or pendent position—in this case, the sprinkler will also be marked “UPRIGHT” or “PENDENT”.)

HORIZONTAL SIDEWALL (HSW) SPRINKLER: A sprinkler intended for installation near the wall and ceiling. The special deflector provides a water spray pattern outward in a quarter-spherical pattern. Most of the water is directed away from the nearby wall with a small portion directed at the wall behind the sprinkler. The top of the deflector is oriented parallel with the ceiling or roof. The flow arrows point in the direction of discharge. Marked “SIDEWALL” and “TOP” with an arrow and the word “FLOW”.

EXTENDED COVERAGE (EC) SPRINKLER: A spray sprinkler designed to discharge water over an area having the maximum dimensions indicated in the individual listings. Maximum area of coverage, minimum flow rate, orifice size, and nominal K-Factor are specified in the individual listings. EC sprinklers are intended for Light-Hazard occupancies with smooth, flat, horizontal ceilings unless otherwise specified. In addition to the above markings, the sprinkler is marked “EC”.

QUICK RESPONSE (QR) SPRINKLER: A spray sprinkler with a fast- actuating operating element. The use of quick response sprinklers may be limited due to occupancy and hazard. Refer to the Authority Having Jurisdiction (AHJ) prior to installing.

QUICK RESPONSE EXTENDED COVERAGE (QREC) SPRINKLER: A spray sprinkler designed to discharge water over an area having the maximum dimensions indicated in the individual listing. This is a sprinkler with an operating element that meets the criteria for quick response. QREC sprinklers are only intended for Light Hazard occupancies. The sprinkler is marked “QREC”.

FLUSH SPRINKLER: A decorative spray sprinkler intended for installation with a concealed piping system. The unit is mounted flush with the ceiling or wall, with the fusible link exposed. Upon actuation, the deflector extends beyond the ceiling or wall to distribute water discharge. The sprinkler is marked “SSP”, “PEND”, or “SIDEWALL” and “TOP”.

CONCEALED SPRINKLER: A decorative spray sprinkler intended for installation with a concealed piping system. The sprinkler is hidden from view by a cover plate installed flush with the ceiling or wall. During fire conditions, the cover plate detaches, and upon sprinkler actuation, the deflector extends beyond the ceiling or wall to distribute water discharge. The sprinkler is marked “SSP”, “PEND”, or “SIDEWALL” and “TOP”.

RECESSED SPRINKLER: A spray sprinkler assembly intended for installation with a concealed piping system. The assembly consists of a sprinkler installed in a decorative adjustable recessed escutcheon that minimizes the protrusion of the sprinkler beyond the ceiling or wall without adversely affecting the sprinkler distribution or sensitivity. Refer to the appropriate technical data page for allowable sprinkler models, temperature ratings, and occupancy classifications. DO NOT RECESS ANY SPRINKLER NOT LISTED FOR USE WITH THE ESCUTCHEON.

CORROSION-RESISTANT SPRINKLER: A special service sprinkler with non-corrosive protective coatings, or that is fabricated from non-corrosive material, for use in atmospheres that would normally corrode sprinklers.

DRY SPRINKLER: A special-service sprinkler intended for installation on dry pipe systems or wet pipe systems where the sprinkler is subject to freezing temperatures. The unit consists of a sprinkler permanently secured to an extension nipple with a sealed inlet end to prevent water from entering the nipple until the sprinkler operates. The unit MUST be installed in a tee fitting. Dry upright sprinklers are marked with the “B” dimension [distance from the face of the fitting (tee) to the top of the deflector]. Dry pendent and sidewall sprinklers are marked with the “A” dimension [the distance from the face of fitting (tee) to the finished surface of the ceiling or wall].

LARGE DROP SPRINKLER: A type of special application sprinkler used to provide fire control of specific high-challenge fire hazards. Large drop sprinklers are designed to produce an umbrella-shaped spray pattern downward with a higher percentage of “large” water droplets than standard spray sprinklers. The sprinkler has an extra-large orifice with a nominal K-Factor of 11.2. Marked “HIGH CHALLENGE” and “UPRIGHT”.

EARLY SUPPRESSION FAST-RESPONSE (ESFR) SPRINKLER: A sprinkler intended to provide fire suppression of specific high-challenge fire hazards through the use of a fast response fusible link, 14.0, 16.8, or 25.2 nominal K-Factor, and special deflector. ESFR sprinklers are designed to produce high-momentum water droplets in a hemispherical pattern below the deflector. This permits penetration of the fire plume and direct wetting of the burning fuel surface while cooling the atmosphere early in the development of a high-challenge fire. Marked “ESFR” and “UPRIGHT” or “PEND”.

INTERMEDIATE LEVEL/RACK STORAGE SPRINKLER: A standard spray sprinkler assembly designed to protect its operating element from the spray of sprinklers installed at higher elevations. The assembly consists of a standard or large orifice upright or pendent sprinkler with an integral upright or pendent water shield and guard assembly. Use only those sprinklers that have been tested and listed for use with the assembly. Refer to the technical data page for allowable sprinkler models.

RESIDENTIAL SPRINKLER: A sprinkler intended for use in the following occupancies: one- and two-family dwellings with the fire protection sprinkler system installed in accordance with NFPA 13D; residential occupancies up to four stories in height with the fire protection system installed in accordance with NFPA 13R; and where allowed by the Authority Having Jurisdiction in residential portions of any occupancy with the fire protection system installed in accordance with NFPA 13.

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Residential sprinklers have a unique distribution pattern and utilize a “fast response” heat sensitive operating element. They enhance survivability in the room of fire origin and are designed to provide a life safety environment for a minimum of ten minutes. For this reason, residential sprinklers must not be used to replace standard sprinklers unless tested for and approved by the Authority Having Jurisdiction. In addition to standard markings, the unit is identified as “RESIDENTIAL SPRINKLER” or “RES”.

4. INSTALLATION

Refer to appropriate NFPA Installation Standards.

5. OPERATION

Refer to the appropriate sprinkler technical data page(s).

6. INSPECTIONS, TESTS AND MAINTENANCE

Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY

Viking sprinklers are available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE

For details of warranty, refer to Viking’s current list price schedule or contact Viking directly.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers and the appropriate sprinkler general care, installation, and maintenance guide. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, FM Global, LPCB, APSAD, VdS or other similar organizations, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. The sprinkler technical data page may contain installation requirements specific for the sprinkler model selected. The use of certain types of sprinklers may be limited due to occupancy and hazard. Refer to the Authority Having Jurisdiction prior to installation.

VIKING | BULLETIN

BEST PRACTICES FOR RESIDENTIAL SPRINKLER HANDLING & INSTALLATION

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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Visit the Viking website for the latest edition of this technical data page.

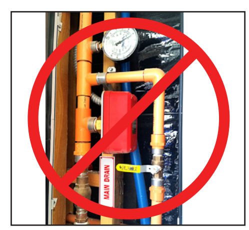
SPRINKLERS ARE FRAGILE - HANDLE WITH CARE!

- Always keep sprinklers in a cool dry place.
- Protect sprinklers during storage, transport and handling as well as before, during and after installation. Refer to Viking's Care and Handling of Sprinklers Bulletin Form No. F_091699[2].
- Proper transit, storage and installation of sprinklers in a high-heat environment is a must. Care should be taken to prevent sprinklers from being exposed to ambient heat conditions in excess of those referenced in installation standards.
- Do not stage or store sprinklers on the job site in advance in a non-conditioned space prior to installation.
- Keep sprinklers in the original packaging and check temperature indicators on box label prior to installation. If the indicator has turned black, DO NOT install any product contained in the box. Refer to Viking product return policies.
- Temperatures exceeding the maximum ambient temperature of the sprinkler temperature-rating during storage, transport, handling and installation must be avoided.
- Per NFPA standards 13, 13R, and 13D, sprinklers installed where maximum ambient temperatures are at or over 101 °F (38 °C) through 150 °F (66 °C) shall be intermediate temperature-rated sprinklers. Additionally, if sprinklers are installed in an unventilated concealed space under an uninsulated roof or in an unventilated attic, they shall be of intermediate temperature classification.
- Sprinklers installed where ambient temperatures are at or below 100 °F (38 °C) may be either ordinary or intermediate temperature-rated sprinklers. Refer to NFPA standards 13R 6.2.3.1 and 13D 7.5.6.1.
- Rough-in of sprinkler piping during hot weather conditions should not include the installation of sprinklers unless reasonable ambient temperatures can be maintained. Ambient temperatures that are considered when choosing the temperature rating for a sprinkler should take into account the range of ambient temperatures that are expected from installation through establishment and maintenance of temperature in a conditioned space. Appropriate insulation may be considered. **Example**: An ordinary temperature sprinkler should not be exposed to maximum ambient temperature higher than 100 °F (38 °C) or more. Refer to NFPA 13, Table 6.2.5.1, NFPA 13R, 6.2.3.1 and NFPA 13D, 7.5.6.1.
- CPVC fire sprinkler products exposed to high ambient temperatures (e.g. installed in unventilated, concealed spaces such as attics) should be insulated to maintain a cooler environment. Refer to Viking Plastics Installation and Design Manual, Form No. F_080712[2], for care and handling procedures.
- Protect all sprinklers and connecting CPVC piping in attic spaces and unvented concealed spaces from excessive heat exposure above 100 °F (38 °C). To separate excessive attic heat, properly tent and fully insulate all pipe in unconditioned spaces.
- Pressure relief valves should be installed on wet sprinkler systems where there is a risk of over-pressurization of a checked water supply, due to thermal expansion. Refer to NFPA 13, 7.1.2.1 and NFPA 13D, A.5.2.2.2.
- Fire sprinkler systems should be installed per current referenced editions of building codes and installation standards adopted in the jurisdiction where work is being performed.


INCORRECT
(Heat exposure)


INCORRECT
(Unconditioned at rough-in)


INCORRECT
(Exposed piping)


INCORRECT
(No pressure relief valve)

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

[1]Hot weather condition is defined as temperatures that can reach the maximum ambient temperature-rating of the sprinkler.
[2]Clicking on blue hyperlink will open referenced document.

⚠ WARNING

Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed. Never install sprinklers that have been dropped, damaged, or exposed to temperatures exceeding the maximum ambient temperature allowed. Sprinklers that have been painted in the field must be replaced per NFPA 13. Protect sprinklers from paint and paint overspray in accordance with the installation standards. Do not clean sprinklers with soap and water, ammonia, or any other cleaning fluid. Do not use adhesives or solvents on sprinklers or their operating elements.

Refer to the appropriate technical data page and NFPA standards for complete care, handling, installation, and maintenance instructions. For additional product and system information Viking data pages and installation instructions are available on the Viking Web site at www.vikinggroupinc.com.

VIKING®	BULLETIN	REGULATORY AND HEALTH WARNINGS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

1. DESCRIPTION

Regulatory and Health Warnings applying to materials used in the manufacture and construction of fire protection products are provided herin as they relate to legally mandated jurisdictional regions.

⚠ WARNING
STATE OF CALIFORNIA, USA Installing or servicing fire protection products such as sprinklers, valves, piping etc. can expose you to chemicals including, but not limited to, lead, nickel, butadiene, titaninum dioxide, chromium, carbon black, and acrylonitrile which are known to the State of California to cause cancer or birth defects or other reproductive harm.
For more information, go to **www.P65Warnings.ca.gov**

2. WARRANTY TERMS AND CONDITIONS

For details of warranty, refer to Viking's current list price schedule at **www.vikinggroupinc.com** or contact Viking directly.

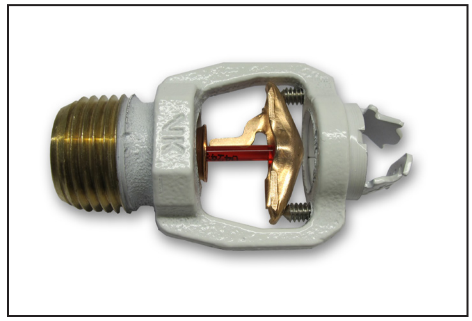
TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

1. DESCRIPTION

Viking Freedom® Residential Horizontal Sidewall Sprinkler VK486 is a small, thermosensitive, glass-bulb residential sprinkler available in several different finishes and temperature ratings to meet varying design requirements. The Electroless Nickel PTFE (ENT) coating has been investigated for installation in corrosive atmospheres and is C-UL-US-EU Listed as corrosion resistant as indicated in the Approval Chart. The sprinkler orifice design, with a K-Factor of 4.0 (57.7 metric†), allows efficient use of available water supplies for the hydraulically designed fire-protection system. The glass bulb operating element and special deflector characteristics meet the challenges of residential sprinkler standards.



WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

2. LISTINGS AND APPROVALS

UL Listed (C-UL-US-EU): Category VKKW

VdS Approved

Refer to the Approval Chart and Design Criteria for C-UL-US-EU Listing requirements that must be followed.

3. TECHNICAL DATA

Specifications:
Available since 2011.
Minimum Operating Pressure: Refer to the Approval Chart.
Maximum Working Pressure: 175 psi (12 bar). Factory tested hydrostatically to 500 psi (34.5 bar).
Thread size: 1/2" (15 mm) NPT
Nominal K-Factor: 4.0 U.S. (57.7 metric†)
† Metric K-factor measurement shown is in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
Glass-bulb fluid temperature rated to -65 °F (-55 °C)
Overall Length: 2-7/16" (62 mm)
Covered by the following US Patent numbers: 7,854,269 and 7,712,218

Material Standards:
Frame Casting: QM Brass and Brass UNS-C84400
Deflector: Phosphor Bronze UNS-C51000
Bulb: Glass, nominal 3 mm diameter
Belleville Spring Sealing Assembly: Nickel Alloy, coated on both sides with PTFE Tape
Pip Cap and Insert Assembly: Copper UNS-C11000 and Stainless Steel UNS-S30400
Compression Screws: 18-8 Stainless Steel
Yoke: Phosphor Bronze UNS-C51000

Ordering Information: (Also refer to the current Viking price list.)
Sprinkler: Base Part No. 17315
Order Sprinkler VK486 by first adding the appropriate suffix for the sprinkler finish and then the appropriate suffix for the temperature rating to the sprinkler base part number.
Finish Suffix: Brass = A, Chrome = F, White Polyester = M-/W, Black Polyester = M-/B
Temperature Suffix: 155 °F (68 °C) = B, 175 °F (79 °C) = D
For example, sprinkler VK486 with a Brass finish and a 155 °F (68 °C) temperature rating = Part No. 17315AB.

Available Finishes And Temperature Ratings:
Refer to Table 1.

Accessories: (Also refer to the Viking website.)

Sprinkler Wrenches:
A. Standard Wrench: Part No. 21475M/B (available since 2017)
B. Wrench for recessed sprinklers: Part No. 13655W/B* (available since 2006)
*A ½" ratchet is required (not available from Viking).

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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Sprinkler Cabinets:
A. Six-head capacity: Part No. 01724A (available since 1971)
B. Twelve-head capacity: Part No. 01725A (available since 1971)

4. INSTALLATION
Refer to appropriate NFPA Installation Standards.

5. OPERATION
During fire conditions, the heat-sensitive liquid in the glass bulb expands, causing the glass to shatter, releasing the yoke, pip cap, and sealing spring assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector, forming a uniform spray pattern to extinguish or control the fire.

6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
Viking Sprinkler VK486 is available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

TABLE 1: AVAILABLE SPRINKLER TEMPERATURE RATINGS AND FINISHES

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[2]	Bulb Color
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow

Sprinkler Finishes: Brass, Chrome, White Polyester, and Black Polyester.

Footnotes
[1] The sprinkler temperature rating is stamped on the deflector.
[2] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

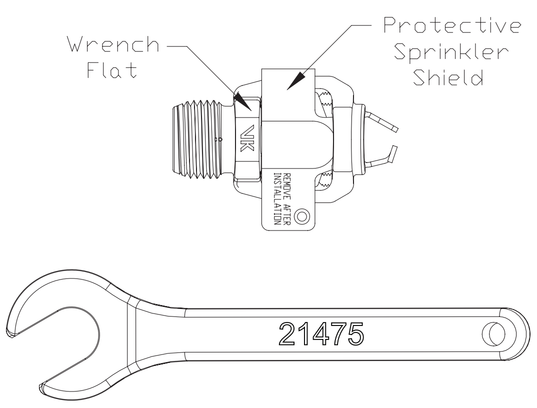

Figure 1:
Standard Sprinkler Wrench 21475M/B

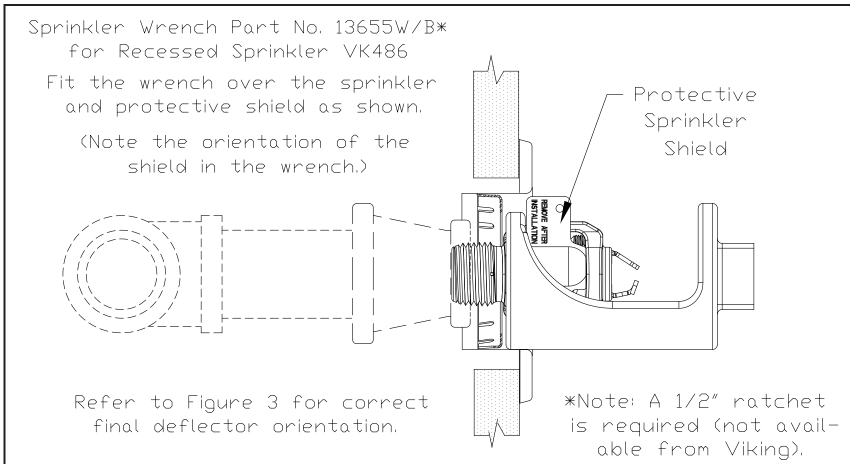

Figure 2:
Wrench 13655W/B for Recessed Sprinkler VK486

VIKING®

TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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Approval Chart
Viking VK486, 4.0 K-Factor Residential Horizontal Sidewall Sprinkler

For systems designed to NFPA 13D or NFPA 13R. For systems designed to NFPA 13, refer to the design criteria. For Ceiling types refer to current Editions of NFPA 13, 13R or 13D

Sprinkler Base Part Number [1]	SIN	NPT Thread Size		Nominal K-Factor		Maximum Water Working Pressure	Overall Length	
		Inches	mm	U.S.	metric [2]		Inches	mm
17315	VK486	1/2	15	4.0	57.7	175 psi (12 bar)	2-7/16	62

Max. Coverage Area [3] Width X Length Ft. X Ft. (m X m)	Max. Spacing Ft. (m)	Ordinary Temp Rating (155 °F/68 °C)		Intermediate Temp Rating (175 °F/79 °C)		Top of Deflector to Ceiling	Installation Type	Listings and Approvals [4]				Minimum Spacing Ft. (m)
		Flow [3] GPM (L/min)	Pressure [3] PSI (bar)	Flow [3] GPM (L/min)	Pressure [3] PSI (bar)			C-UL-US-EU [5]	VdS	NYC	NSF[9]	
12 X 12 (3.7 X 3.7)	12 (3.7)	11 (41.7)	7.6 (0.52)	11 (41.7)	7.6 (0.52)	4 to 6 inches	Standard surface-mounted escutcheons or recessed with the Micromatic® Model E-1, E-2, E-3, or G-1 Recessed Escutcheon	See Footnote 6 and 10.	See Footnote 6.	See Footnote 7.	See Footnote 6.	8 (2.4)
14 X 14 (4.3 X 4.3)	14 (4.3)	12 (45.5)	9 (0.62)	12 (45.5)	9 (0.62)							
16 X 16 (4.9 X 4.9)	16 (4.9)	13 (49.3)	10.6 (0.73)	13 (49.3)	10.6 (0.73)							
16 X 18 (4.9 X 5.5)	16 (4.9)	16 (60.6)	16 (1.10)	16 (60.6)	16 (1.10)							
16 X 20 (4.9 X 6.1)	16 (4.9)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
16 X 22 (4.9 X 6.7)	16 (4.9)	24 (90.8)	36 (2.48)	24 (90.8)	36 (2.48)							
18 X 18 (5.5 X 5.5)	18 (5.5)	18 (68.1)	20.3 (1.40)	19 (71.9)	22.6 (1.60)							
18 X 20 (5.5 X 6.1)	18 (5.5)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
20 X 20 (6.1 X 6.1)	20 (6.1)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
12 X 12 (3.7 X 3.7)	12 (3.7)	12 (45.5)	9 (0.62)	12 (45.5)	9 (0.62)	6 to 12 inches						
14 X 14 (4.3 X 4.3)	14 (4.3)	12 (45.5)	9 (0.62)	13 (49.3)	10.6 (0.73)							
16 X 16 (4.9 X 4.9)	16 (4.9)	14 (53.0)	12.3 (0.84)	14 (53.0)	12.3 (0.84)							
16 X 18 (4.9 X 5.5)	16 (4.9)	16 (60.6)	16 (1.10)	16 (60.6)	16 (1.10)							
16 X 20 (4.9 X 6.1)	16 (4.9)	23 (87.1)	33.1 (2.28)	23 (87.1)	33.1 (2.28)							
16 X 22 (4.9 X 6.7)	16 (4.9)	26 (98.4)	42.3 (2.91)	26 (98.4)	42.3 (2.91)							
18 X 18 (5.5 X 5.5)	18 (5.5)	18 (68.1)	20.3 (1.40)	19 (71.9)	22.6 (1.60)							
18 X 20 (5.5 X 6.1)	18 (5.5)	23 (87.1)	33.1 (2.28)	23 (87.1)	33.1 (2.28)							
20 X 20 (6.1 X 6.1)	20 (6.1)	24 (90.8)	36 (2.48)	24 (90.8)	36 (2.48)							

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to Viking's current price schedule.

[2] Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.

[3] For areas of coverage smaller than shown, use the "Flow" and "Pressure" for the next larger area listed. Flows and pressures listed are per sprinkler. The distance from sprinklers to walls shall not exceed one-half the sprinkler spacing indicated for the minimum "Flow" and "Pressure" used.

[4] This chart shows the listings and approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals. Refer also to Design Criteria.

[5] Listed by Underwriter's Laboratories, Inc. for use in the U.S., Canada, and European Union.

[6] Approved Finishes are: Brass, Chrome, White Polyester, and Black Polyester [8]

[7] Meets New York City requirements, effective July 1, 2008.

[8] Other paint colors are available on request with the same C-UL-US-EU listings as the standard finish colors.

[9] UL Classified to : NSF/ANSI Standard 61, Drinking Water System Components (MH48034)

[10] Approved finish is Electroless Nickel PTFE (ENT). ENT is C-UL-US-EU Listed as corrosion resistant. ENT is available with standard surface-mounted escutcheons or the Micromatic Model E-1 Recessed Escutcheon.

TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

DESIGN CRITERIA

(Also refer to the Approval Chart.)

UL Listing Requirements (C-UL-US-EU):

When using Viking Residential Horizontal Sidewall Sprinkler VK486 for systems designed to NFPA 13D or NFPA 13R, apply the listed areas of coverage and minimum water supply requirements shown in the Approval Chart.

For systems designed to NFPA 13: The number of design sprinklers is to be the four contiguous most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in the Approval Chart for NFPA 13D and NFPA 13R applications for each listed area of coverage, **or**
- Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the “design area” in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13.
- Minimum distance between residential sprinklers: 8 ft. (2.4 m).
- The VK486 horizontal sidewall sprinkler deflector shall be located a minimum of 1-1/4“ (31.8 mm) and a maximum of 6” (152 mm) from the wall on which it is installed.

DEFLECTOR POSITION: Install sprinkler VK486 with the leading edge of the deflector oriented parallel to the ceiling and the sprinkler frame arms oriented perpendicular to the ceiling (see Figure 4). **THE TOP SURFACE OF THE DEFLECTOR IS MARKED “TOP”.** The sprinkler must be oriented as shown in Figure 3 below.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to Form No. F_080190, F_080814, and F_080415 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

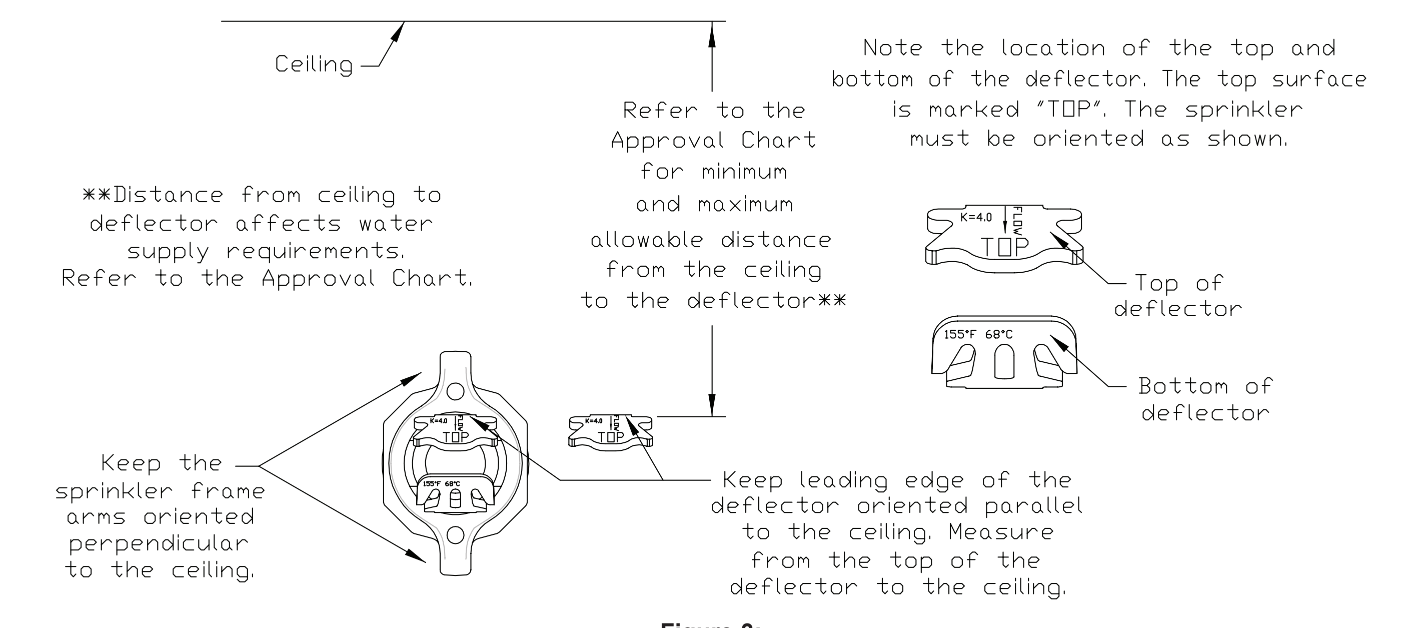

Figure 3:

Correct Orientation of the Deflector

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TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

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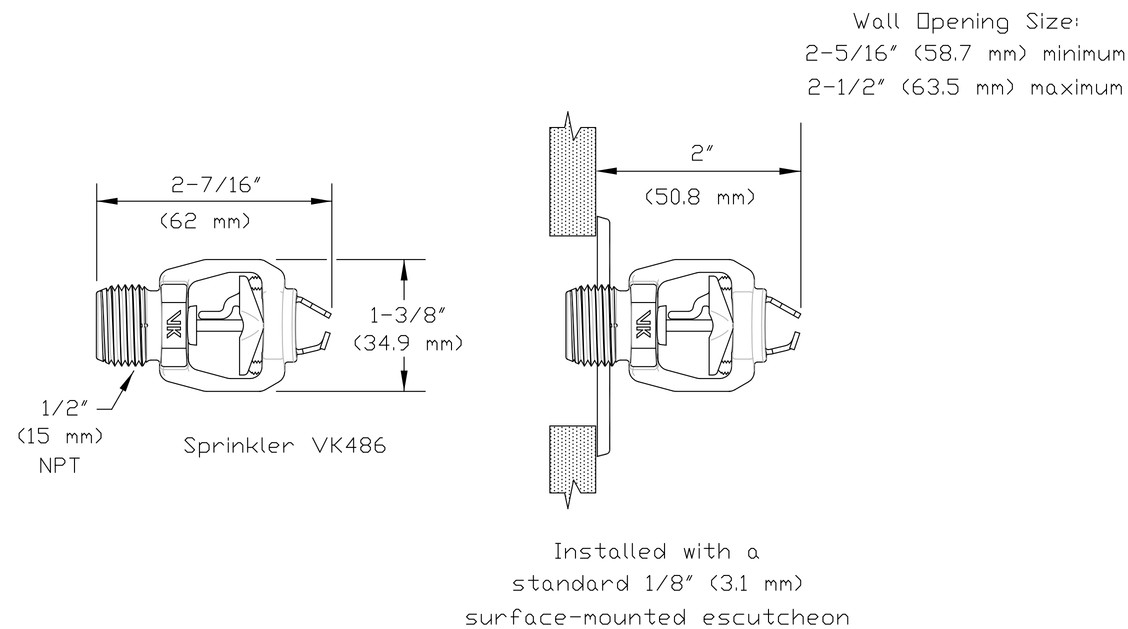

Figure 4:
Sprinkler VK486 Dimensions with a Standard Escutcheon and the Model F-1 Adjustable Escutcheon

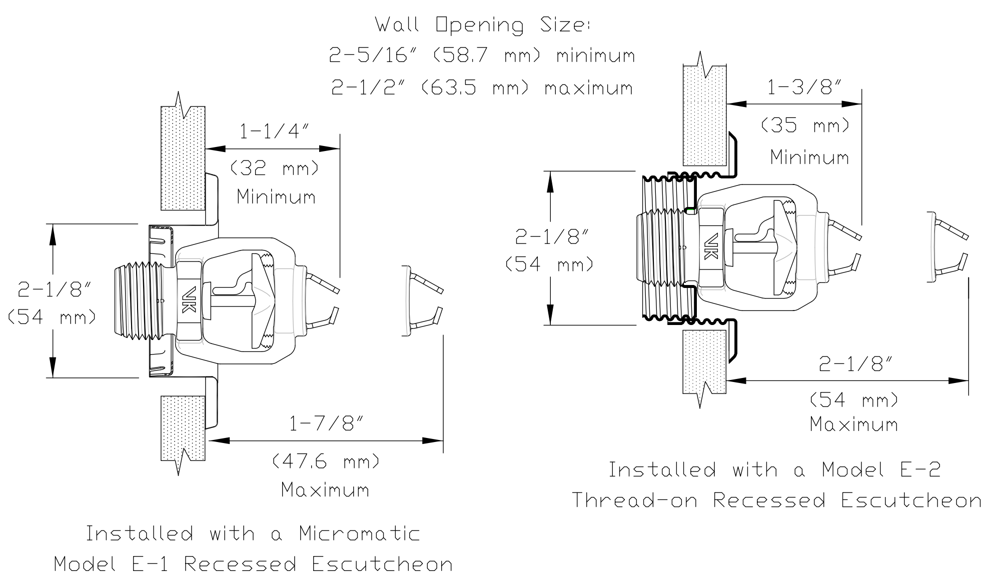

Figure 5:
Sprinkler VK486 Dimensions with the Model E-1 and E-2 Recessed Escutcheons

TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

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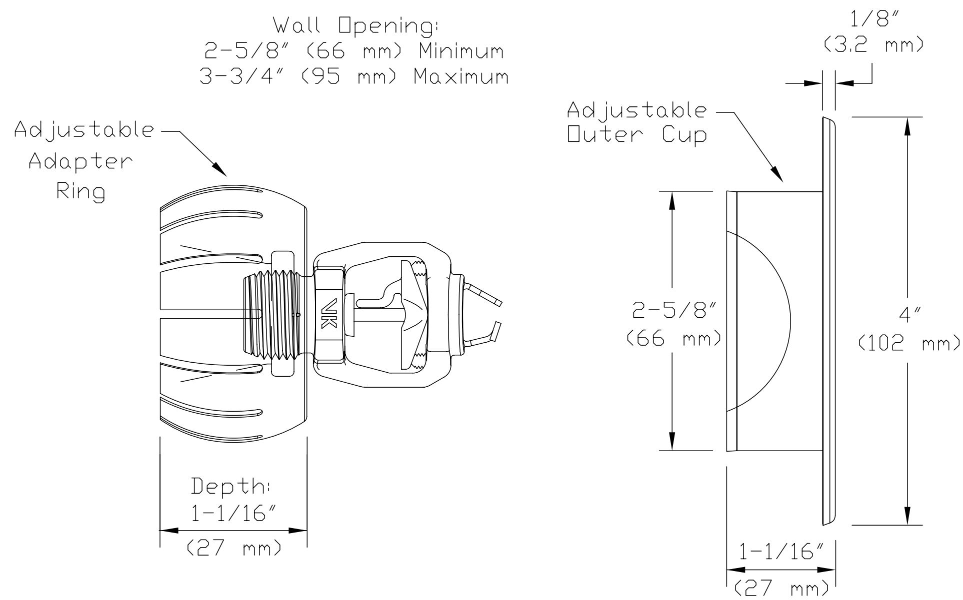

Figure 6: **Sprinkler VK486 Dimensions with the Model G-1 Escutcheon**

TECHNICAL DATA

FREEDOM® RESIDENTIAL CONCEALED PENDENT SPRINKLER VK494 (K4.9)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

1. DESCRIPTION

Viking Freedom® Residential Concealed Pendent Sprinkler VK494 is a small thermosensitive, glass-bulb residential sprinkler designed for installation on concealed pipe systems where the appearance of a smooth ceiling is desired. The orifice design allows the sprinkler's efficient use of available water supplies for the hydraulically designed fire-protection system. The glass bulb operating element and special deflector characteristics meet the challenges of residential sprinkler standards.

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

Features:

- K4.9 (70.6 metric)
- Fast response glass bulb operating element.
- Integral threaded adapter cup accepts push-on or thread-on cover plates.
- Low-profile, small diameter, removeable cover plates offer almost flush appearance upon installation and allow ease of maintenance.
- Protective cap prevents damage during installation and finishing and keeps errant overspray from coating internal parts.
- Various finishes available to meet design requirements.
- Optional Electroless Nickel PTFE (ENT) coating provides corrosion resistance (see Approval Chart).

2. LISTINGS AND APPROVALS

cULusEU Listed: Category VKKW
Refer to the Approval Charts and Design Criteria for C-UL-US-EU Listing requirements that must be followed.

3. TECHNICAL DATA

Specifications:
Minimum Operating Pressure: Refer to the Approval Chart.
Maximum Working Pressure: 175 psi (12 bar). Factory tested hydrostatically to 500 psi (34.5 bar).
Thread size: 1/2" (15 mm) NPT
Nominal K-factor: 4.9 U.S. (70.6 metric*)
Glass-bulb fluid temperature rating: to -65 °F (-55 °C)

* Metric K-factor measurement shown is in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.

Material Standards:
Sprinkler Body: Brass UNS-C84400 or QM Brass
Deflector: Phosphor Bronze UNS-C51000
Deflector Pins: Stainless Steel UNS-S30200
Button: Brass UNS-C36000
Pip Cap and Insert Assembly: Copper UNS-C11000 and Stainless Steel UNS-S30400
Compression Screw: 18-8 Stainless Steel
Yoke: Phosphor Bronze UNS-C51000
Belleville Spring Sealing Assembly: Beryllium Nickel Alloy, coated on both sides with PTFE Tape
Cover Adapter: Cold Rolled Steel JIS G3141 and Carbon Steel UNS-G10100 (per JIS G3141)
Shipping Cap: High Density Polyethylene
Vibration damper ring: Buna-N Rubber SAE AS-568-017

Cover Plate Materials:
Cover Plate Assembly: Copper UNS-C11000 and Brass UNS-C26800 or Stainless Steel UNS-S30400
Spring: Beryllium Nickel
Solder: Eutectic

4. INSTALLATION

Refer to appropriate NFPA Installation Standards.

5. OPERATION

During fire conditions, when the temperature around the sprinkler approaches the cover plate's nominal temperature rating, the cover plate detaches and releases the deflector. Continued heating of the exposed sprinkler causes the heat-sensitive liquid in the glass bulb to expand. When the temperature reaches the sprinkler's nominal temperature rating, the glass bulb shatters releasing the yoke, pip cap assembly and sealing spring. Water begins flowing through the sprinkler orifice and strikes the deflector forming a uniform spray pattern over a specific area of coverage, which is determined by the water supply pressure at the sprinkler, in order to extinguish or control the fire.

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6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
Viking Sprinkler Model VK494 is available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

TABLE 1: SPRINKLER ORDERING INFORMATION

Ordering Instructions:
(1) Select a sprinkler base part number
(2) Add the suffix for the desired finish
(3) Add the suffix for the desired sprinkler temperature rating
(4) Order a cover plate (Must be ordered separately; refer to Table 2)

Example:
23707AE = 200 °F (93 °C) Temperature rated sprinkler with a standard brass finish.

Sprinkler Base Part Number[1]	Size	1: Finishes		2: Temperature Ratings[7]			
	NPT Inch	Description	Suffix	Nominal Rating	Bulb Color	Max. Ambient Ceiling Temperature[2]	Suffix
23707	1/2	Brass	A	155 °F (68 °C)	Red	100 °F (38 °C)	B
		ENT[5,6]	JN	200 °F (93 °C)	Green	150 °F (65 °C)	E
		Corrosion resistant sprinkler finish: ENT					

Accessories

Sprinkler Wrenches and tools (See Figure 1):
A. Installation wrench: 24339[3]
B. Protective cap removal tool: 24340[4]
C. Concealed Cover Plate Installer Tool Part Number: 14412[8] (available since 2007)
D. Large Concealed Cover Plate Installer Tool Part No. 14867[8] (available since 2007)
Sprinkler Cabinet:
Holds up to 6 sprinklers: Part number 01731A (available since 1971).

Footnotes

1. Part number shown is the base part number. For complete part number, refer to the current Viking price list schedule.
2. Based on NFPA 13, NFPA 13R, and NFPA 13D. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.
3. Requires a ½" ratchet (not available from Viking).
4. Optional for removal of the protective cap; requires a small piece of CPVC pipe or similar to attach.
5. cULus Listed as corrosion resistant.
6. The corrosion resistant coatings have passed the standard corrosion test required by the approving agencies indicated in the Approval Charts. These tests cannot and do not represent all possible corrosive environments. Prior to installation, verify through the end-user that the coatings are compatible with or suitable for the proposed environment. For automatic sprinklers, the ENT coating is applied to all exposed exterior surfaces, including the waterway. For ENT coated sprinklers, the Belleville spring is exposed.
7. The sprinkler temperature rating is stamped on the deflector.
8. The installer tool is for push-on style cover plates only.
9. Requires a peice of 1" PVC pipe or similar to attach.

VIKING®

TECHNICAL DATA

FREEDOM® RESIDENTIAL CONCEALED PENDENT SPRINKLER VK494 (K4.9)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

TABLE 2: COVER PLATE ORDERING INFORMATION

Instructions:
(1) Select a cover plate base part number
(2) Add the suffix for the desired finish
(3) Add the suffix for the required cover plate nominal rating.

Example:
23190MC/W = 165 °F (74 °C) Temperature rated, 2-3/4" (70 mm) diameter, thread-on style, round cover plate with a painted white finish.

1: Select a Cover Plate Base Part Number[3]					
Thread-On Style			Push-On Style		
Base Part Number[1]	Size Inch (mm)	Type	Base Part Number	Size Inch (mm)	Type
23190	2-3/4 (70)	Round	23447	2-3/4 (70)	Round
23174	3-5/16 (84)	Round	23463	3-5/16 (84)	Round
23179	3-5/16 (84)	Square	23482	3-5/16 (84)	Square
23193[5]	2-3/4 (70)	Stainless Steel Round	23455[5]	2-3/4 (70)	Stainless Steel Round
23183[5]	3-5/16 (84)	Stainless Steel Round	23473[5]	3-5/16 (84)	Stainless Steel Round

2: Select a Finish	
Description	Suffix[5]
Polished Chrome	F
Brushed Chrome	F-/B
Bright Brass	B
Antique Brass	B-/A
Brushed Brass	B-/B
Brushed Copper	E-/B
Painted White	M-/W
Painted Ivory	M-/I
Painted Black	M-/B

3: Temperature Rating Matrix[1,2]				
Cover Plate Nominal Rating (Required)	Temperature Classification	Sprinkler Nominal Rating	Sprinkler Maximum Ambient Ceiling Temperature[2]	Suffix
135 °F (57 °C)	Ordinary	155 °F (68 °C)	100 °F (38 °C)	**A**
165 °F (74 °C)	Intermediate	200 °F (93 °C)	150 °F (65 °C)	**C**

Footnotes

1. Part number shown is the base part number. For complete part number, refer to the current Viking price list schedule.
2. The sprinkler temperature rating is stamped on the deflector.
3. Based on NFPA-13, NFPA 13R, and NFPA 13D. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.
4. Where a dash (-) is shown in the Finish suffix designation, insert the desired Temperature Rating suffix. See example above.
5. Stainless Steel versions are not available with any finishes or paint.

TECHNICAL DATA

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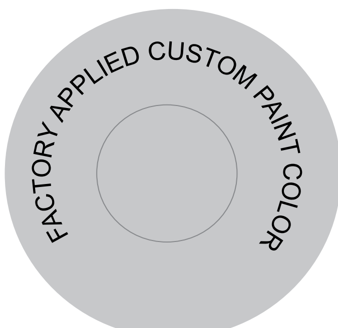
Installation Wrench

Cap Removal Tool

Figure 1: Sprinkler Wrench and Cap Removal Tool



All custom color painted cover plates will have an identifying label affixed to the inside of the cover that indicates the custom color and will have a representative sample (a paint dot) of the paint on the label.

Figure 2: Identification of Custom Paint

Figure 3: Square Cover Assembly

VIKING® **TECHNICAL DATA**

FREEDOM® RESIDENTIAL CONCEALED PENDENT SPRINKLER VK494 (K4.9)

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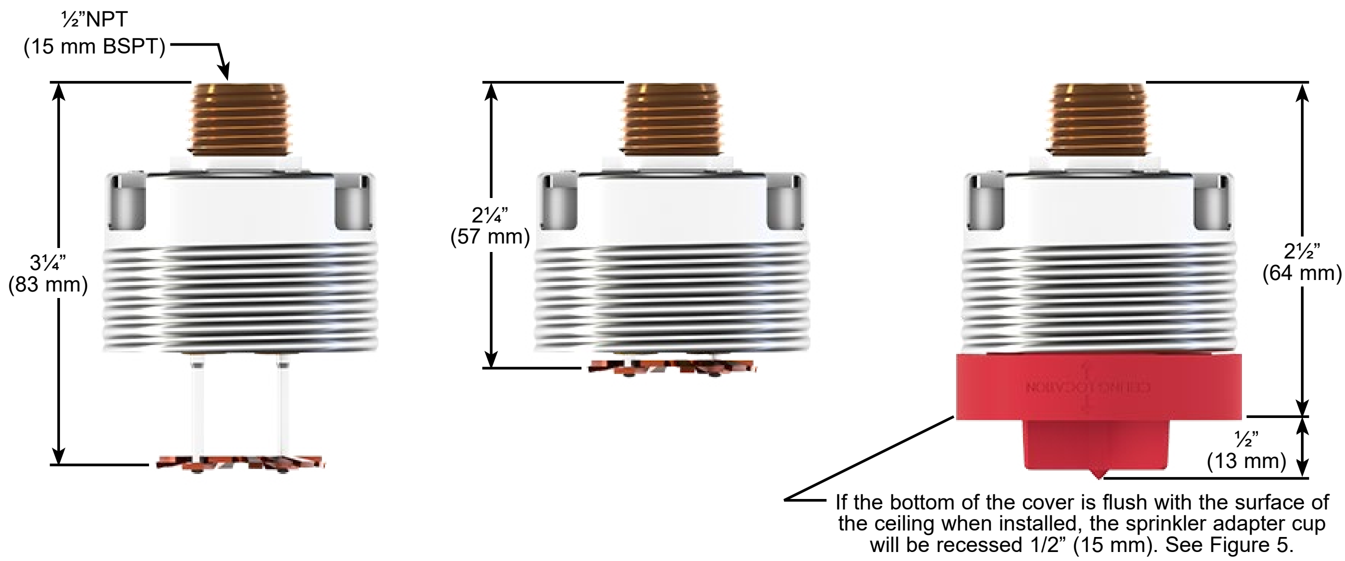
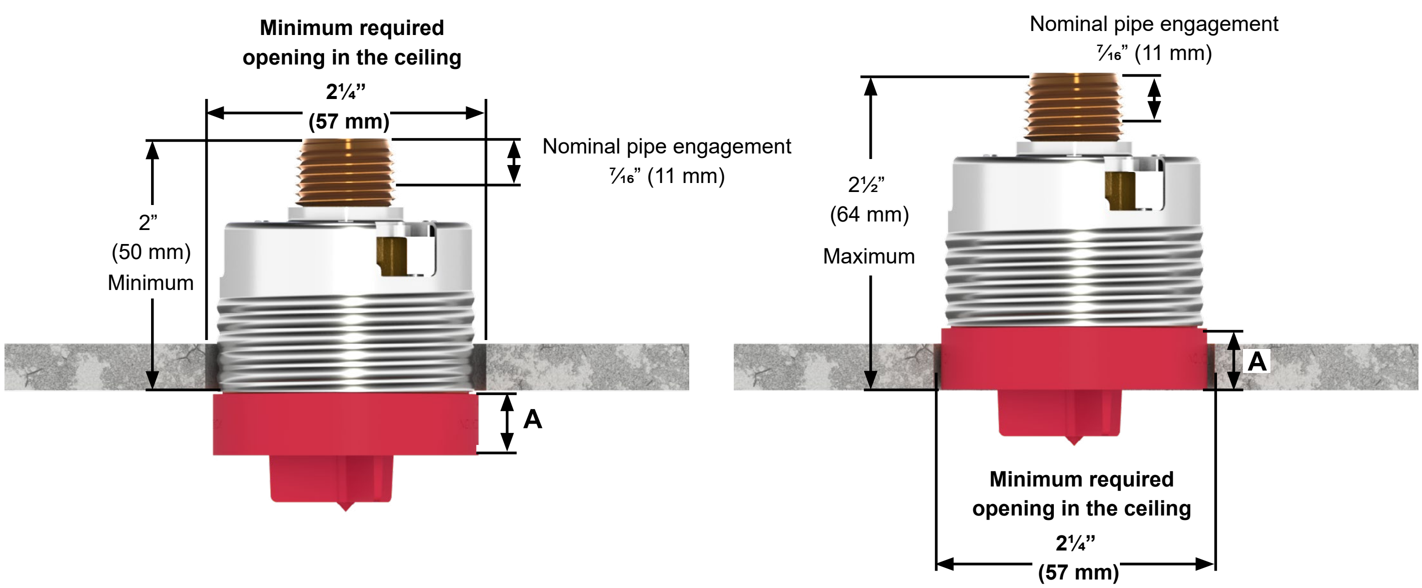


Figure 4: Sprinkler Dimensions



Install the sprinkler so the finished surface of the ceiling lines up within the marked ½" (13 mm) range on the protective cap (A).

Figure 5: Sprinkler Installation Dimensions

VIKING®	TECHNICAL DATA	FREEDOM® RESIDENTIAL CONCEALED PENDENT SPRINKLER VK494 (K4.9)

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Approval Chart
Viking VK494, 4.9 K-factor Residential Concealed Pendent Sprinkler

For systems designed to NFPA 13D or NFPA 13R. For systems designed to NFPA 13, refer to the Design Criteria. For Ceiling types refer to current editions of NFPA 13, 13R or 13D

Sprinkler Base Part Number [1]	SIN	Thread Size			Nominal K-factor		Maximum Water Working Pressure
		NPT	BSPT		U.S.	metric [2]	
20759	VK494	1/2”	15 mm		4.9	70.6	175 psi (12 bar)

Max. Coverage Area [6] W X L Ft. X Ft. (m X m)	Flow GPM (LPM)	Pressure PSI (bar)	Deflector to Ceiling	Installation Type	Listings and Approvals[3,5]	Minimum Spacing Ft. (m)
	155 °F (68 °C), 200 °F (93 °C) Temperature Rated Sprinklers				cULusEU[4]	
12 X 12 (3.7 X 3.7)	13 (49.2)	7.0 (0.48)	Refer to Figure 2	Concealed with Cover Plate Assembly. See Footnote 7.	See Footnotes 8, & 9	8 (2.4)
14 X 14 (4.3 X 4.3)	13 (49.2)	7.0 (0.48)				
16 X 16 (4.9 X 4.9)	13 (49.2)	7.0 (0.48)				
18 X 18 (5.5 X 5.5)	17 (64.4)	12.0 (0.83)				
20 X 20 (6.1 X 6.1)	20 (75.7)	16.7 (1.15)				

Footnotes

1. Part number shown is the base part number. For complete part number, refer to the current Viking price schedule.
2. Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
3. This chart shows the listings and approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals. Refer also to Design Criteria.
4. Listed by Underwriter’s Laboratories, Inc. for use in the U.S., Canada, and European Union.
5. Meets New York City requirements, effective July 1, 2008.
6. For areas of coverage smaller than shown, use the “Flow” and “Pressure” for the next larger area listed. Flows and pressures listed are per sprinkler. The distance from sprinklers to walls shall not exceed one-half the sprinkler spacing indicated for the minimum “Flow” and “Pressure” used.
7. Other paint colors are available on request with the same listings as the standard finish colors. Stainless Steel cover plates are not available with any finishes or paint. Listings and approvals apply for any paint manufacturer. Contact Viking for additional information. Custom colors are indicated on a label inside the cover assembly. Refer to Figure 2.
8. Accepted Cover Plate Finishes are: Polished Chrome, Brushed Chrome, Bright Brass, Antique Brass, Brushed Brass, Brushed Copper, Painted White, Painted Ivory, or Painted Black [7].
9. C-UL-US-EU Listed as corrosion resistant - Electroless Nickel PTFE (ENT)

DESIGN CRITERIA

(Also refer to the Approval Chart.)

UL Listing Requirements (C-UL-US-EU):

When using Viking Residential Concealed Pendent Sprinkler VK494 for systems designed to NFPA 13D or NFPA 13R, apply the listed areas of coverage and minimum water supply requirements shown in the Approval Chart.

For systems designed to NFPA 13: The number of design sprinklers is to be the four contiguous most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in the Approval Chart for NFPA 13D and NFPA 13R applications for each listed area of coverage, **or**
- Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the “design area” in accordance with sections 9.5.2.1 or 10.2.4.1.2 of the current edition of NFPA 13.
- Minimum distance between residential sprinklers: 8 ft. (2.4 m).

NOTE: Concealed sprinklers must be installed in neutral or negative pressure plenums only.

IMPORTANT: Always refer to Bulletin Form No. F_080415 - Best Practices for Residential Sprinkler Handling and Installation. Also refer to Form No. F_080614 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

TECHNICAL DATA

FREEDOM® RESIDENTIAL CONCEALED PENDENT SPRINKLER VK494 (K4.9)

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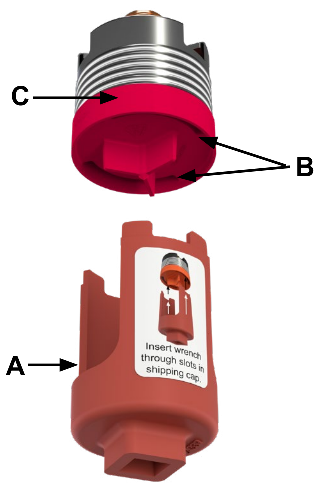
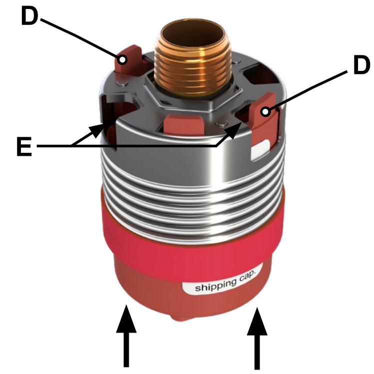
USE ONLY the designated sprinkler wrenches shown in this document. Permanent damage to the sprinkler assembly can occur if the proper wrench is not used. Other sprinkler wrenches available from Viking may fit into the sprinkler adapter cup; however, only the wrenches shown here are designed to properly install this sprinkler.

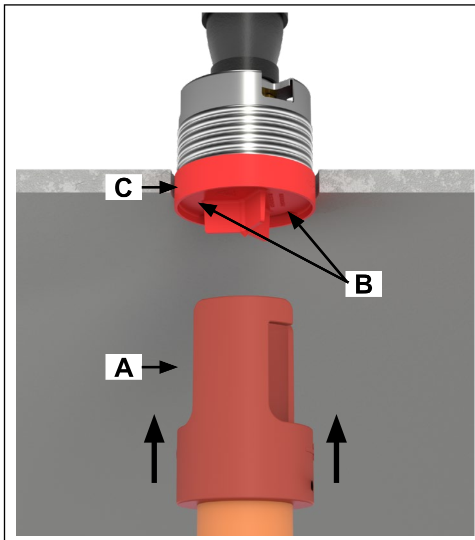


Step 1:
Insert the wrench (A) into the slots (B) on the protective cap (C).

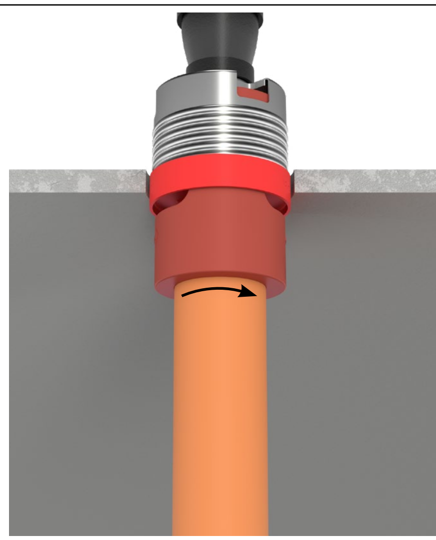


Step 2:
Rotate the wrench slightly in either direction until the tines on the wrench (D) line up with the vent openings (E) on the adapter cup and lock into place. NOTE: A leak tight seal must be achieved. Turn the sprinkler clockwise 1 to 1-½ turns past finger-tight.

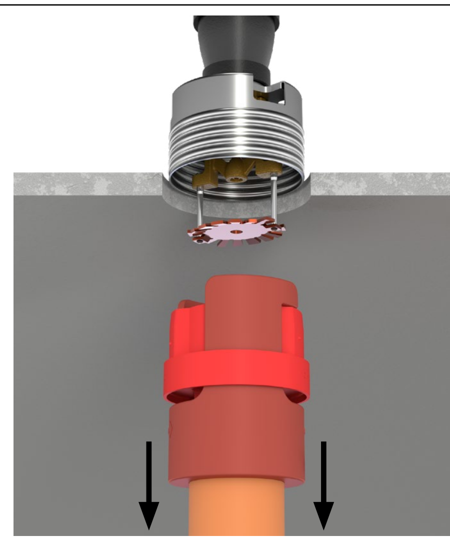
Figure 6: Using the Sprinkler Wrench



Step 1:
Attach a peice of plastic pipe as shown and tighten the thumb screw (not shown); then, insert the tool (A) into the slots (B) in the protective cap (C).



Step 2:
Rotate the tool slightly to lock into place.



Step 2:
Gently, pull downward to remove the protective cap. The deflector will slide downwards on the pins.

Figure 7: Using the Cap Removal Tool

VIKING®	TECHNICAL DATA	FREEDOM® RESIDENTIAL CONCEALED PENDENT SPRINKLER VK494 (K4.9)

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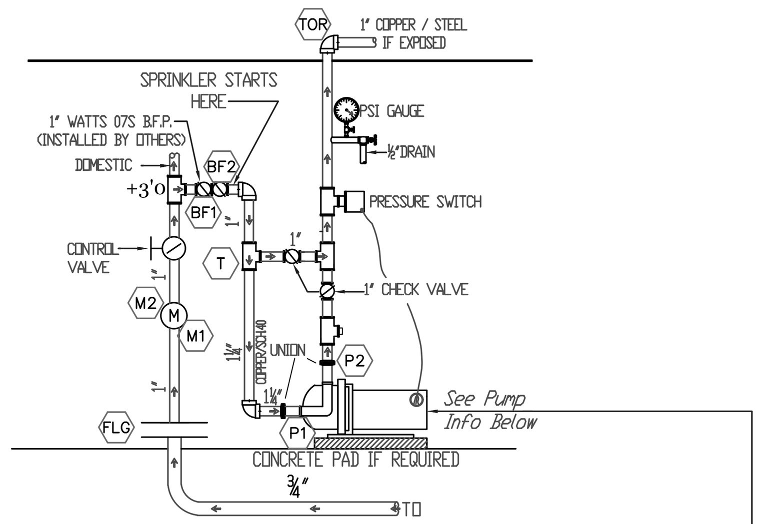
Minimum **Maximum**

Install the cover plate by inserting the adpater into the adapter cup and pushing or threading into place (depending on style). Snug the cover plate in place by rotating clockwise. Ensure the cover plate is flush with the ceiling as shown to allow airflow through the sprinkler assembly.

Figure 8: Installing the Cover Plate

FLOW TEST INFO:	
TEST DATE	6-18-2021
HYD. ELEV.	606.00
HYD. ADDRESS	FAIRCHILD AAVENUE
FLOW:	1588 gpm
STATIC:	53.00 PSI
RESID:	35.00 PSI



13D MANIFOLD DETAIL

N.T.S.

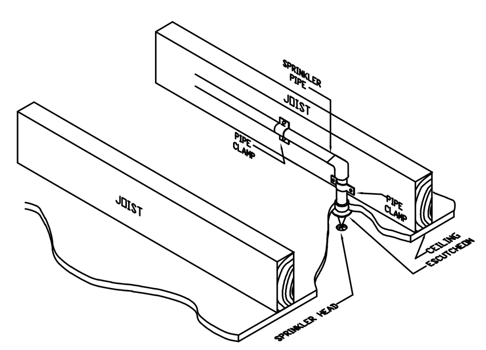
PUMP INFO:	
BRAND:	FLO-TECH
MODEL:	FP5500 SERIES
HORSEPOWER:	1 HP
VOLTAGE:	115/230
PHASE:	1 Phase
SUCT. PIPE:	1 1/4"
DISCH. PIPE:	1"
PUMP PERFORMANCE:	
20 gpm = 103.0 Total Hd in Ft X .433 = 45.0 psi	
28 gpm = 94.0 Total Hd in Ft X .433 = 41.0 psi	

1 PENDENT

FILE .sdf : 1 PENDENT
HAZARD : NFPA-13D
DESIGN AREA : 2ND FLR. REMOTE
AREA PER HEAD : 20 X 20
OF HEADS : 1
DEMAND : 20.0 GPM @ 40.29 PSI @ PUMP

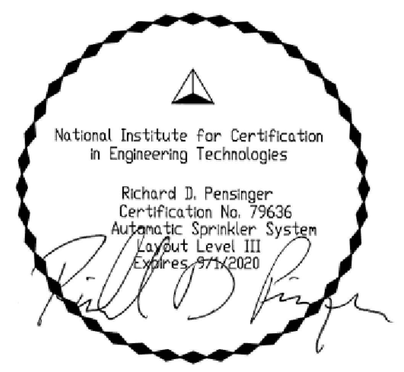
2 PENDENT

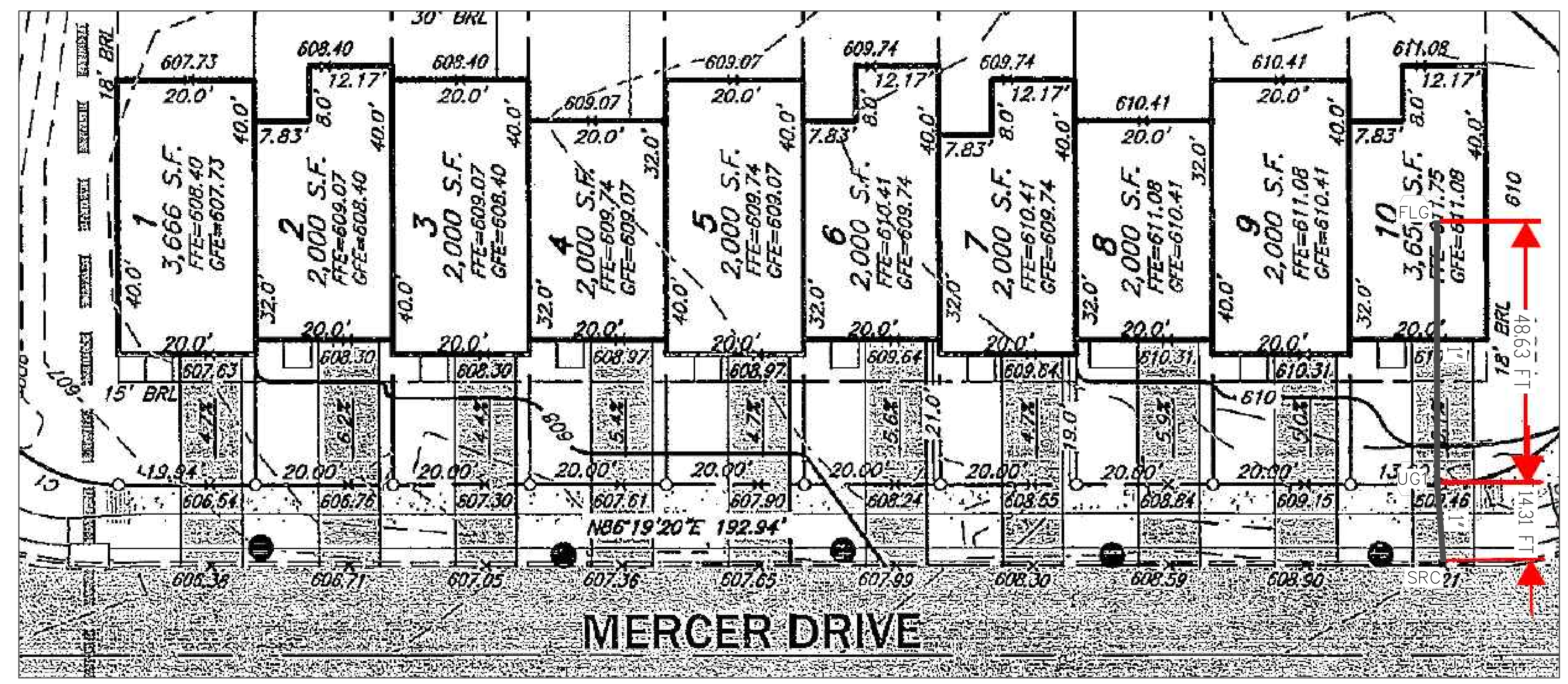
FILE .sdf : 2 PENDENT
HAZARD : NFPA-13D
DESIGN AREA : 2ND FLR. REMOTE
AREA PER HEAD : 16 X 16
OF HEADS : 2
DEMAND : 26.2 GPM @ 37.18 PSI @ PUMP



SPRINKLER RESTRAINT 2

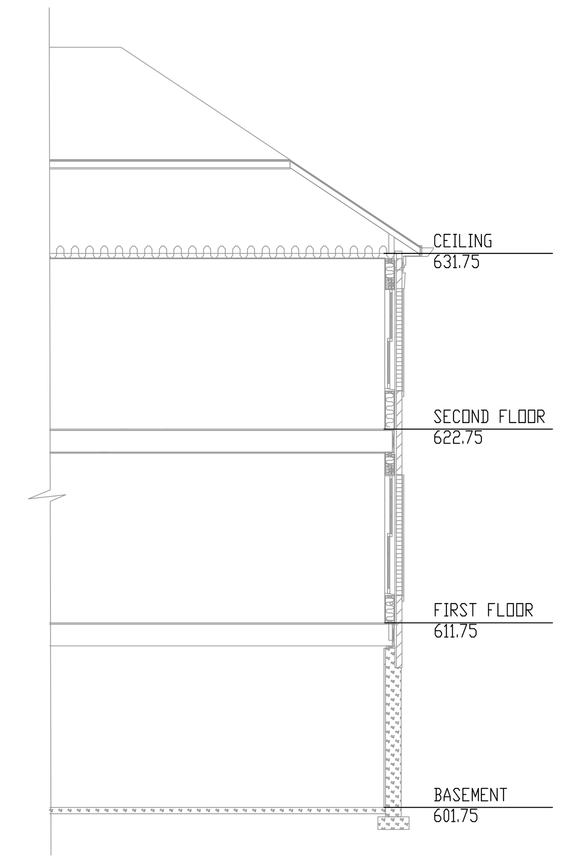
NOT TO SCALE





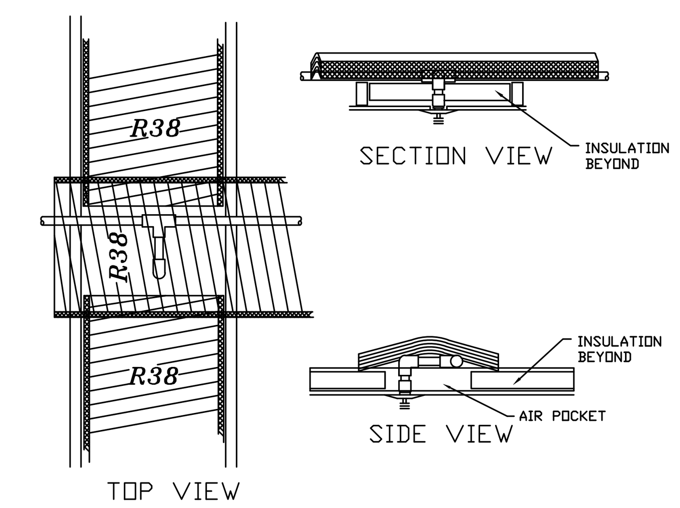
SITE PLAN

N.T.S.



ELEVATION VIEW

SCALE: 1/8"=1'-0"



ATTIC INSULATION DETAIL 1

NOT TO SCALE

SPRINKLER OBSTRUCTION GUIDELINES

Table 8.2.5.4.2 Position of Sprinklers to Avoid Obstructions to Discharge (Residential Upright and Pendent Spray Sprinklers) NFPA 13D 2016

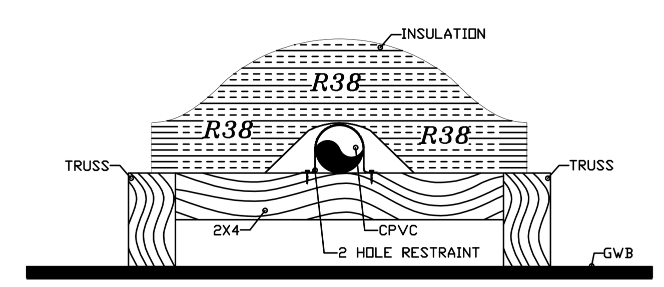
Distance From Sprinkler to Side of Obstruction (in.)	Maximum Allowable Distance of Deflector above Bottom of Obstruction (in.)
Less than 1ft	0
1 ft to less than 1 ft 6 in	0
1 ft 6 in to less than 3 ft	1
3 ft to less than 4 ft	3
4 ft to less than 4ft 6 in	5
4 ft 6 in to less than 6 ft	7
6 ft to less than 6 ft 6 in	9
6 ft 6 in to less than 7 ft	11
7 ft or more	14

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

CPVC HANGER

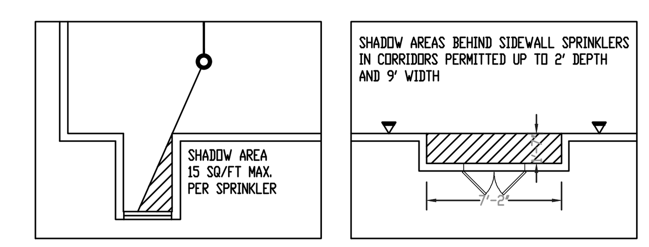
SPACING

PIPE DIA.	DISTANCE BETWEEN HANGER'S
3/4"	5'-6"
1"	6'-0"
1¼"	6'-6"
1½"	7'-0"
2"	8'-0"
2½"	9'-0"
3"	10"-0"



ATTIC INSULATION DETAIL 2

NOT TO SCALE



SHADOW AREA DETAIL

HEAT SOURCES

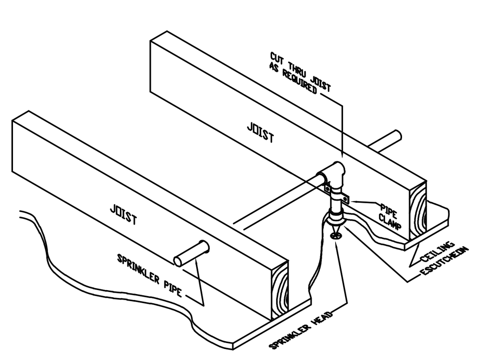
NFPA 13D 2016

HEAT SOURCE	Minimum Distance from Edge of Source to Ordinary-Temperature Sprinkler in.	mm.	Minimum Distance from Edge of Source to Intermediate-Temperature Sprinkler in.	mm.
Side of open or recessed fireplace	36	914	12	305
Front of recessed fireplace	60	1524	36	914
Coal or wood burning stove	42	1067	12	305
Kitchen range	18	457	9	229
Wall oven	18	457	9	229
Hot air flues	18	457	9	229
uninsulated heat ducts	18	457	9	229
uninsulated hot water pipes	12	305	6	152
Side of ceiling/wall mounted hot air diffusers	24	607	12	305
Front of wall mounted hot air diffusers	36	914	18	457
Hot water heater or furnace	6	152	3	76
Light fixture				
0W/250W bulb	6	152	3	76
250W/499W	12	305	6	152

Lot	House Type	Permit	Address	
1	York II	B-20213153	900	Mercer Drive
2	York II	B-20213154	904	Mercer Drive
3	York II	B-20213155	906	Mercer Drive
4	York II	B-20213156	908	Mercer Drive
5	York II	B-20213157	910	Mercer Drive
6	York II	B-20213158	912	Mercer Drive
7	York II	B-20213159	914	Mercer Drive
8	York II	B-20213160	916	Mercer Drive
9	York II	B-20213161	918	Mercer Drive
10	York II	B-20213162	922	Mercer Drive

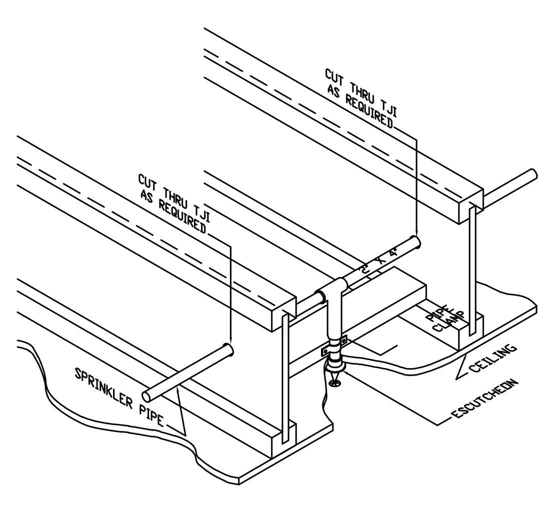
GENERAL NOTES

1. DWELLING UNIT SHALL HAVE A COMPLETE FIRE PROTECTION SYSTEM IN COMPLIANCE WITH STATE AND LOCAL CODES AND REGULATIONS AND N.F.P.A.-13D 2016 EDITION.
2. ALL MATERIALS AND METHODS OF INSTALLATION SHALL BE IN COMPLIANCE WITH N.F.P.A.-13D
3. EXPOSED SPRINKLER PIPING LOCATED IN THE ATTIC SPACE SHALL BE COVERED WITH INSULATION (R-38) PLACED OVER THE PIPING TO PREVENT FREEZING. (INSULATION BY OTHERS).
4. ALL CPVC PIPE AND FITTINGS SHALL BE UL LISTED AND FM APPROVED.
5. CPVC HANGER SPACING IN COMPLIANCE WITH N.F.P.A.
6. ALL PIPING SHALL BE CPVC UNLESS NOTED OTHERWISE.
7. NO STORAGE ROOM IN ATTIC
8. UNPROTECTED CLOSETS SHALL NOT CONTAIN MECHANICAL EQUIPMENT.
9. WATER METERS SHALL BE (1") IN. UNLESS OTHERWISE NOTED.
10. SPRINKLER CONNECTIONS SHALL BE ON THE HOUSE SIDE OF WATER METER.



SPRINKLER RESTRAINT 1

NOT TO SCALE



TJI RESTRAINT

NOT TO SCALE

SPRINKLER SPACING

Type	No. Head/Rm.	Spacing	Slope
Pendent	2+	16x16	8/12
Pendent	1	20x20	8/12
Sidewall	2+	16x16	8/12

TOTAL SPRINKLERS THIS DRAWING

FOREMAN NOTES:

1. CHANGES TO THIS PRINT MUST BE FOLLOWED UP WITH ASBUILTS AS THEY ARE MADE AND TAKEN TO THE OFFICE.
2. FOLLOW SPRINKLER SPACING SCHEDULE FOR THIS PRINT.
3. FOLLOW PIPE SCHEDULE FOR THIS PRINT.
4. ANY EXPOSED PIPE TO BE COPPER (M) OR STEEL SCH.10 / SCH.40 U.N.O.

IMPORTANT

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DESIGN CRITERIA

TYPE SYSTEM: ■ WET ☐ DRY NFPA STANDARD: ☐ #13 ☐ #13R ■ #13D

OCCUPANCY: Single Family Home
HAZARD: Light
DENSITY: .05 GPM/S.F.
REMOTE AREA: 2ND FLR S.F.
MAX. S.F./HD. See Note
HOSE REQ'MT.: ☐ 100 ☐ 250 ☐ 500
APPROVING AUTHORITY: City of Hagerstown

PIPE SCHEDULE: 1", 1¼", 1½", 2", INCOMING FROM STREET

PIPE SYMBOLS: RISER/MANIFOLD, ELBOW DOWN, BALL VALVE, REVISION

SPRINKLER SUMMARY

SYM	TYPE	FINISH	TEMP	ORIF.	"K"	NPT	Mfg.	MODEL#	ESCUTCHEON	QTY.

REVISIONS

BY	DESCRIPTION	DATE	#

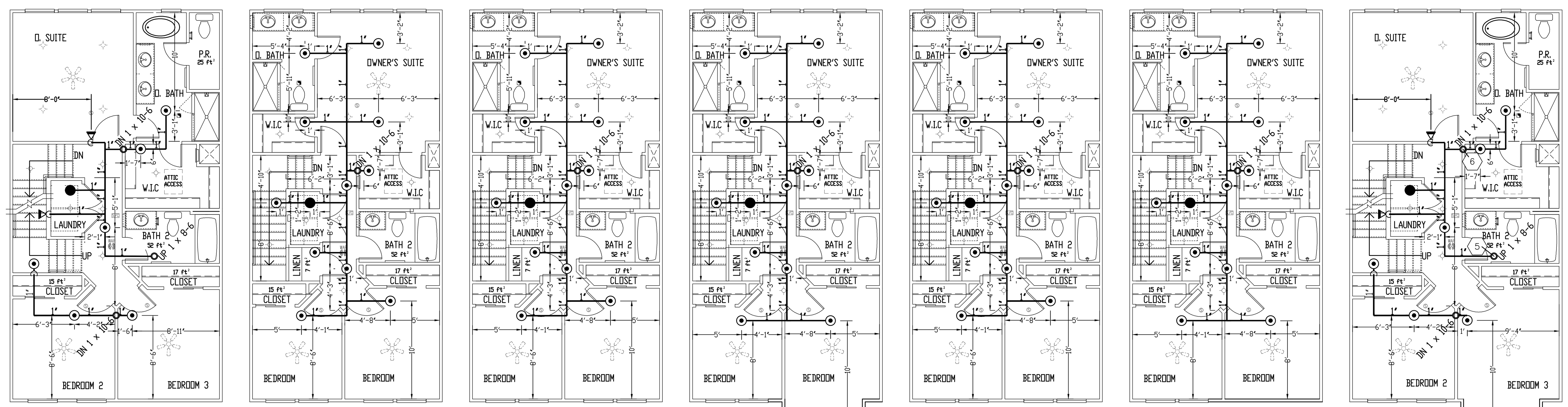
NOEL'S FIRE PROTECTION

12015 KEMPS MILL ROAD
Williamsport, Md 21795
(240) 366-8287 FAX: (301) 223-8370

CONTRACTOR: Dan Ryan Builders
64 Thomas Johnson Drive; Suite 110
Frederick, MD 21702

PERMIT #	See Address Block	Model: York II	Job# 366C
DATE	12-29-2021	Lots 1-10 Fairchild Heights Towns	
DESIGNER	Cory Andrews	See Address Block	
SCALE	1/8" = 1'-0"	Hagerstown, Maryland 21742	

SHEET No. 1 OF 2



LOT 226 (HALSTON LOFT) @ 3463 WATERSHED BOULEVARD

LOT 227 (FRANKTON) @ 3461 WATERSHED BOULEVARD

LOT 228 (FRANKTON) @ 3459 WATERSHED BOULEVARD

LOT 229 (FRANKTON) @ 3457 WATERSHED BOULEVARD

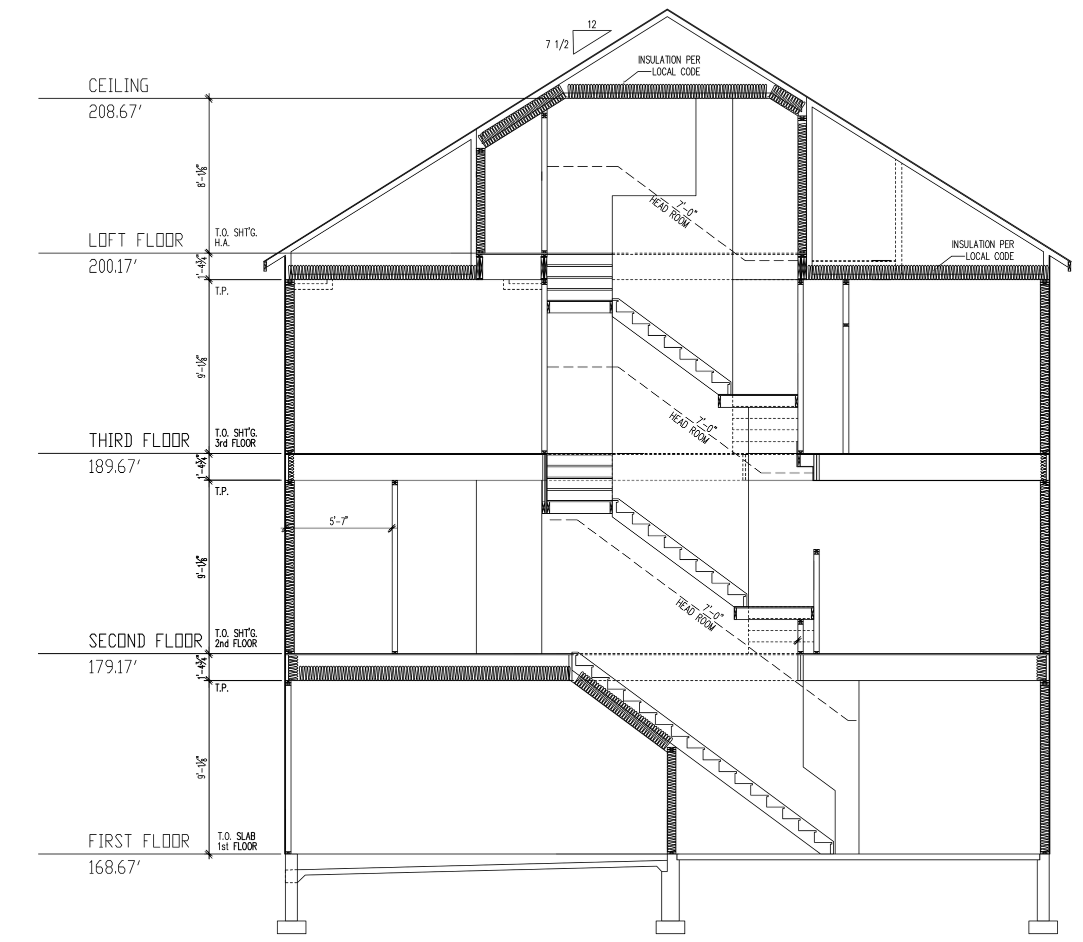
LOT 230 (FRANKTON) @ 3455 WATERSHED BOULEVARD

LOT 231 (FRANKTON) @ 3453 WATERSHED BOULEVARD

LOT 232 (HALSTON W/ LOFT) @ 3451 WATERSHED BOULEVARD

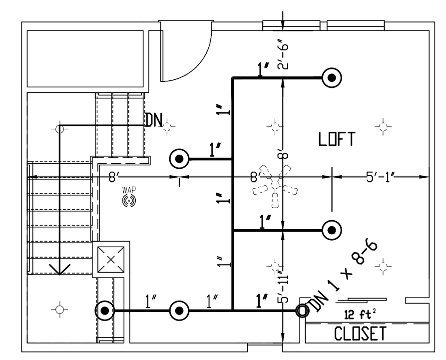
THIRD FLOOR PLAN

SCALE: ⅛"=1'-0"

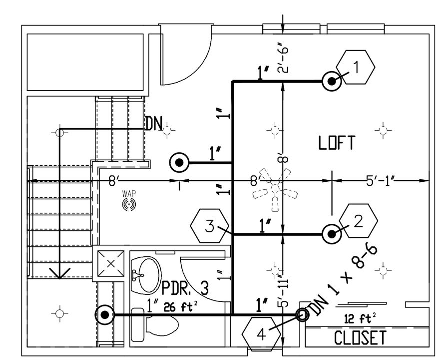


SECTION A–A

SCALE: N.T.S



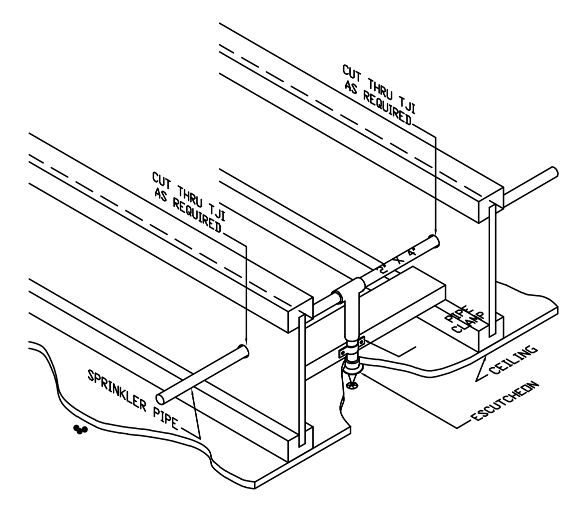
LOT 226 (HALSTON W/ LOFT) @ 3463 WATERSHED BOULEVARD



LOT 232 (HALSTON W/ LOFT) @ 3451 WATERSHED BOULEVARD

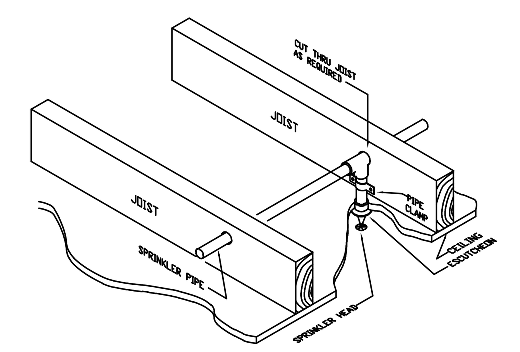
LOFT FLOOR PLAN

SCALE: ⅛"=1'-0"



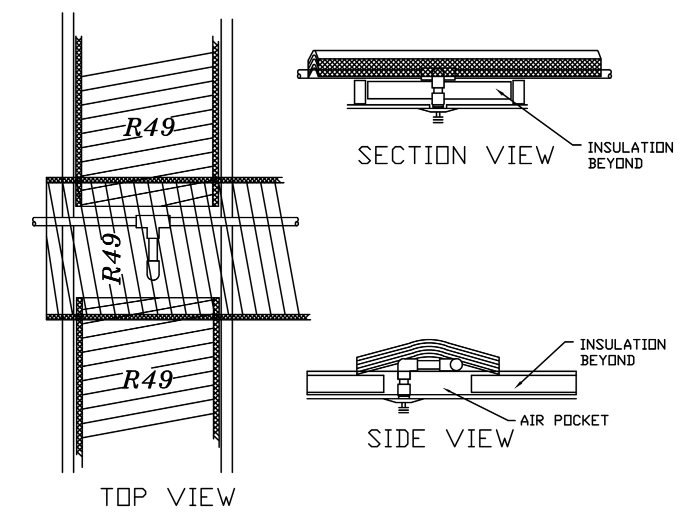
TJI RESTRAINT

NOT TO SCALE



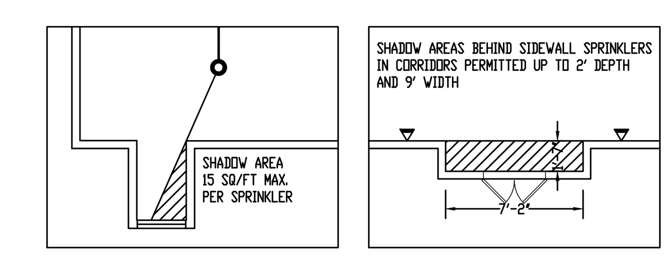
SPRINKLER RESTRAINT 1

NOT TO SCALE



ATTIC INSULATION DETAIL 1

NOT TO SCALE



SHADOW AREA DETAIL

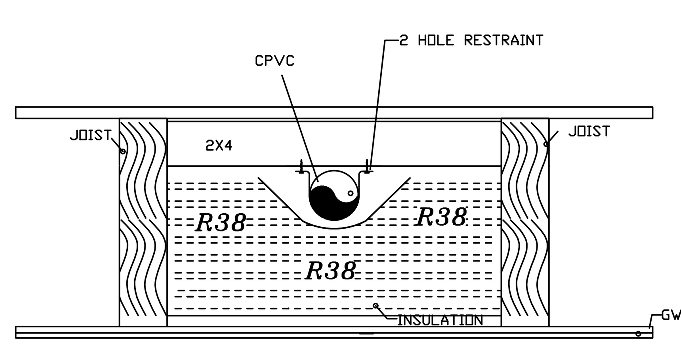
Lot	Model	Permit		Address	
226	Halston Loft	B-02400573	3463	Watershed Boulevard	
227	Frankton	B-02400574	3461		
228	Frankton	B-02400575	3459		
229	Frankton	B-02400576	3457		
230	Frankton	B-02400577	3455		
231	Frankton	B-02400578	3453		
232	Halston Loft	B-02400579	3451		

1 PENDENT

FILE .sdf	: 1 PENDENT
HAZARD	: NFPA-13D
DESIGN AREA	: LOFT FLR. REMOTE
AREA PER HEAD	: 20 X 20
# OF HEADS	: 1
DEMAND	: 25.0 GPM @ 61.8 PSI @ SRC
SAFETY	: 26.2 PSI --- 29.77%

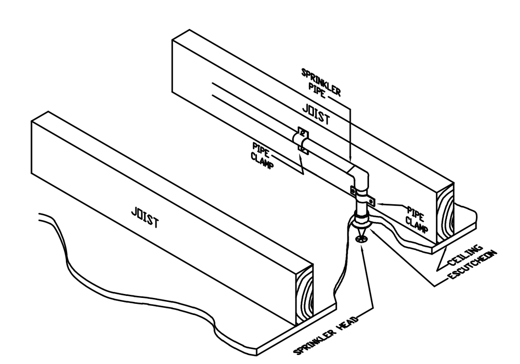
2 PENDENT

FILE .sdf	: 2 PENDENT
HAZARD	: NFPA-13D
DESIGN AREA	: LOFT FLR. REMOTE
AREA PER HEAD	: 16 X 16
# OF HEADS	: 2
DEMAND	: 31.3 GPM @ 64.2 PSI @ SRC
SAFETY	: 23.8 PSI --- 27.04%



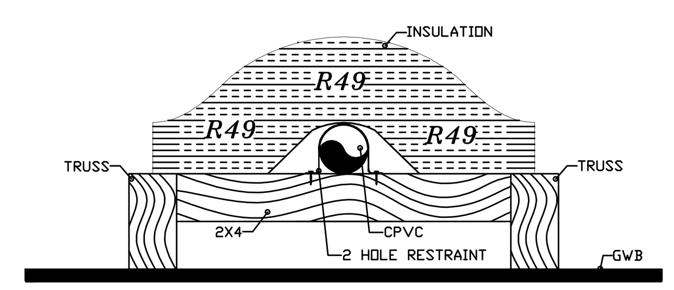
GARAGE INSULATION DETAIL

NOT TO SCALE



SPRINKLER RESTRAINT 2

NOT TO SCALE



ATTIC INSULATION DETAIL 2

NOT TO SCALE

SPRINKLER SPACING

Type	No. Head/Rm.	Spacing	Slope
Pendent	2+	16x16	8/12
Pendent	1	20x20	8/12
Sidewall	2+	16x16	8/12

TOTAL SPRINKLERS THIS DRAWING 88

FOREMAN NOTES:

1. CHANGES TO THIS PRINT MUST BE FOLLOWED UP WITH ASBUILTS AS THEY ARE MADE AND TAKEN TO THE OFFICE.

IMPORTANT

D E S I G N   C R I T E R I A

TYPE SYSTEM: ■ WET ☐ DRY   NFPA STANDARD: ☐ #13   ☐ #13R   ■ #13D

OCCUPANCY: Single Family Towns

HAZARD: Light

DENSITY: .05 GPM/S.F.

REMOTE AREA: LOFT FLR S.F.

MAX. S.F./HD. See Note

HOSE REQ'MT.: ☐ 100 ☐ 250 ☐ 500

APPROVING AUTHORITY: ANNE ARUNDEL COUNTY

PIPE SCHEDULE	PIPE SYMBOLS
1"	
1¼"	RISER/MANIFOLD
1½"	ELBOW DOWN
2"	BALL VALVE
INCOMING FROM STREET	REVISION

S P R I N K L E R   S U M M A R Y

SYM	TYPE	FINISH	TEMP	ORIF.	"K"	NPT	Mfg.	MODEL#	ESCUTCHEON	QTY.
⦿	RES. PEND	WHITE	155°	7/16"	4.9	½"	VICTAULIC	V2740	RECESSED	77
●	RES. PEND	WHITE	175°	7/16"	4.9	½"	VICTAULIC	V2740	RECESSED	07
◁	SIDEWALL	WHITE	155°	7/16"	4.0	½"	VIKING	VK486	RECESSED	04

R E V I S I O N S

BY	DESCRIPTION	DATE	#
			△
			△
			△
			△
			△
			△
			△

NOEL'S FIRE PROTECTION

12015 KEMPS MILL ROAD
WILLIAMSPORT, MD 21795
(240) 366-8287 FAX: (301) 223-8370

CONTRACTOR: PULTE GROUP MID-ATLANTIC MARKET
9302 LEE HIGHWAY; SUITE 1000
FAIRFAX, VA 22031

PERMIT #	See Address Block	Model: TOWNS / Job# 343-N	SHEET No.
DATE	12-1-2021	WATERSHED TOWNS, LOTS 226-232	2 OF 2
DESIGNER	Scott Mullendore	3463-3451 WATERSHED BOULEVARD	
SCALE	1/8" = 1'-0"	LAUREL, MD 20724	

Victaulic® FireLock™ Series FL-RES Residential, Quick Response Pendent and Recessed Pendent, K3.0 (4.3), K4.9 (7.0), K5.6 (8.0), K6.9 (9.9)




1.0 PRODUCT DESCRIPTION

RESIDENTIAL PENDENT/RECESSED PENDENT SPRINKLERS				
SIN	**V3010**	**V2740**	**V5610**	**V3426**
ORIENTATION	**PENDENT**	**PENDENT**	**PENDENT**	**PENDENT**
K-FACTOR[1]	3.0 Imp./4.2 S.I.	4.9 Imp./7.1 S.I.	5.6 Imp./8.1 S.I.	6.9 Imp./9.9 S.I.
CONNECTION	½" NPT/15 mm	½" NPT/15 mm	½" NPT/15 mm	¾" NPT/20 mm
MAX. WORKING PRESSURE	175 psi (1200 kPa)	175 psi (1200 kPa)	175 psi (1200 kPa)	175 psi (1200 kPa)
GLOBE RE-DESIGNATION	GL3010	–	GL5610	–
GLOBE EQUIVALENT	–	GL4910	–	–

AVAILABLE WRENCHES						
SPRINKLER	V27 Recessed	V27 Open End	V56 Recessed	V56 Open End	V34 Recessed	V34 Open End
V3010			■	■		
V2740	■	■				
V5610			■	■		
V3426					■	■

Factory Hydrostatic Test: 100% @ 500 psi/3447 kPa/34 bar

Min. Operating Pressure: UL: 7psi/48 kPa/.5 bar

Temperature Rating: See tables in section 2.0

[1] For K-Factor when pressure is measured in bar, multiply S.I. units by 10.0.

ALWAYS REFER TO ANY NOTIFICATIONS AT THE END OF THIS DOCUMENT REGARDING PRODUCT INSTALLATION, MAINTENANCE OR SUPPORT.

2.0 CERTIFICATION/LISTINGS

SIN	Nominal K Factor Imperial	 S.I.[2]	Listing Agency/ Approved Temperature Ratings 155°F/68°C	 175°F/79°C	 200°F/93°C	Max. Coverage Area Width X Length Ft. x Ft m x m	Flow GPM L/min	Pressure PSI kPa	Adjustment in mm	Deflector to Ceiling/ Mounting Surface Distance in (mm)	Minimum Spacing Ft. m
V3010	3.0	4.2	cULus EU	cULus	cULus	12 x 12 3.7 x 3.7	8 30.3	7.1 49	½ 15	Smooth Ceilings Recessed See Installation Detail Smooth Ceilings Exposed Max. 4 (101.6) Beamed Ceilings Adjacent per NFPA 13, 13D, or 13R as appropriate Beamed Ceilings In Beam 14 Max. Beam Depth Recessed in Beam: See Installation detail	8 2.4
						14 x 14 4.3 x 4.3	10 37.8	11.1 76.5			
V2740	4.9	7.1	cULus	cULus	N/A	12 x 12 3.7 x 3.7	13 49.2	7.0 48	½ and ¾ 15 and 20		
						14 x 14 4.3 x 4.3	13 49.2	7.0 48			
						16 x 16 4.9 x 4.9	13 49.2	7.0 48			
						18 x 18 5.5 x 5.5	17 64.3	12.0 83			
						20 x 20 6.1 x 6.1	20 75.7	16.7 115	½ 15		
V5610	5.6	8.1	cULus	NA	N/A	12 x 12 3.7 x 3.7	15 57	7.2 50	½ 15		
						16 x 16 4.9 x 4.9	19 72	11.5 79			
						18 x 18 5.5 x 5.5	21 79	14.1 97			
						20 x 20 6.1 x 6.1	24 91	18.4 127			
V3426	6.9	9.9	cULus	cULus	N/A	12 x 12 3.7 x 3.7	20 75.7	8.4 58	½ and ¾ 15 and 20		
						14 x 14 4.3 x 4.3	20 75.7	8.4 58			
						16 x 16 4.9 x 4.9	20 75.7	8.4 58			
						18 x 18 5.5 x 5.5	20 75.7	8.4 58			
						20 x 20 6.1 x 6.1	22 83.3	10.2 70			

NOTE

- Listings and approval as of printing.

3.0 SPECIFICATIONS – MATERIAL

Deflector: Bronze

Bulb Nominal Diameter: 3.0mm

Load Screw: Bronze

Pip Cap: Bronze

Spring Seal Assembly: PTFE coated Beryllium nickel alloy

Frame: Brass

Lodgement Spring: Stainless Steel

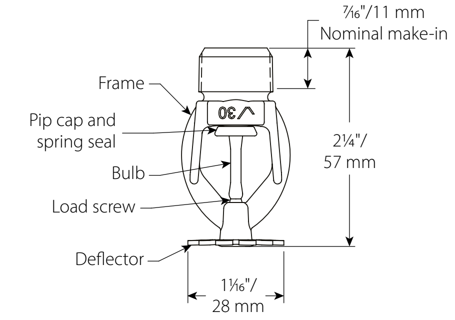
Installation Wrench: Ductile iron

Sprinkler Frame Finishes:

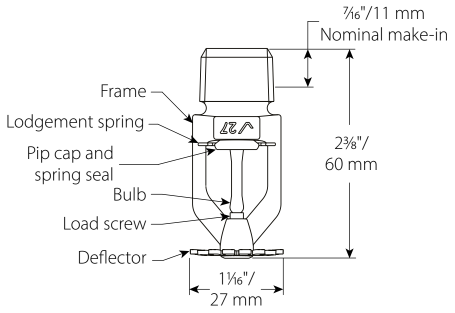
- Plain brass
- Chrome plated
- White polyester painted
- Flat black polyester painted
- Custom polyester painted

NOTE

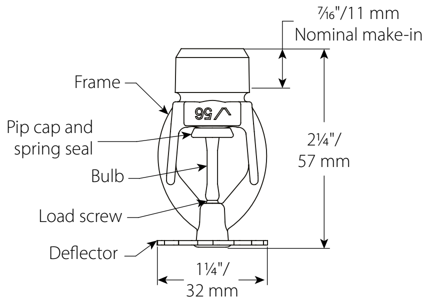
- For cabinets and other accessories refer to separate sheet.



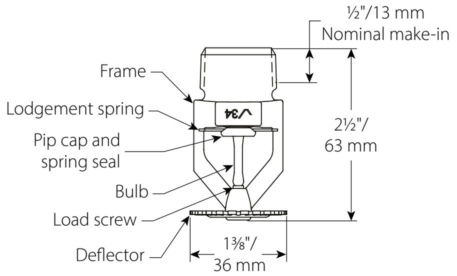
V3010



V2740

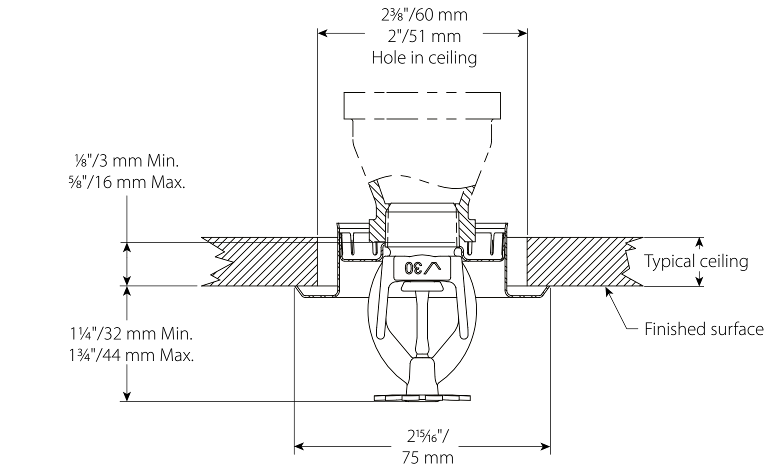


V5610

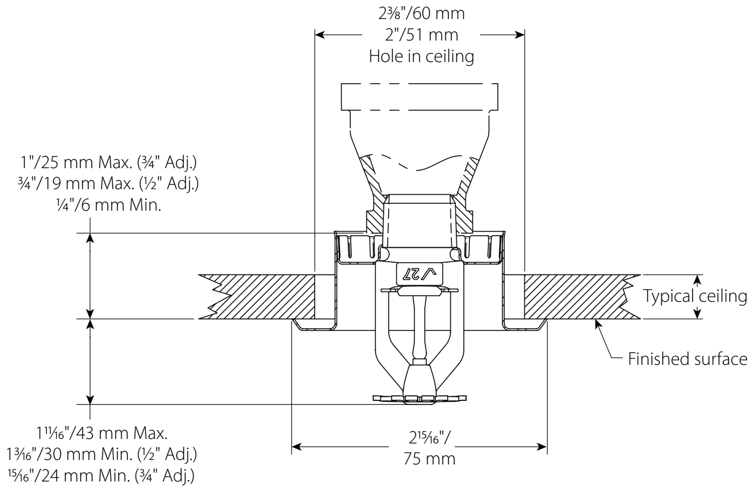


V3426

4.0 DIMENSIONS

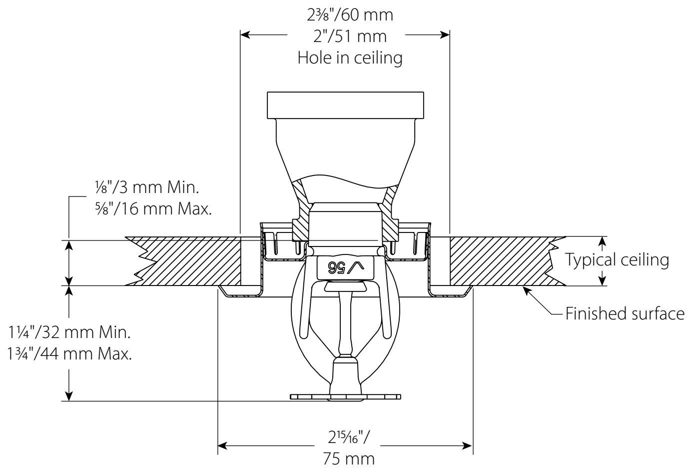


V3010

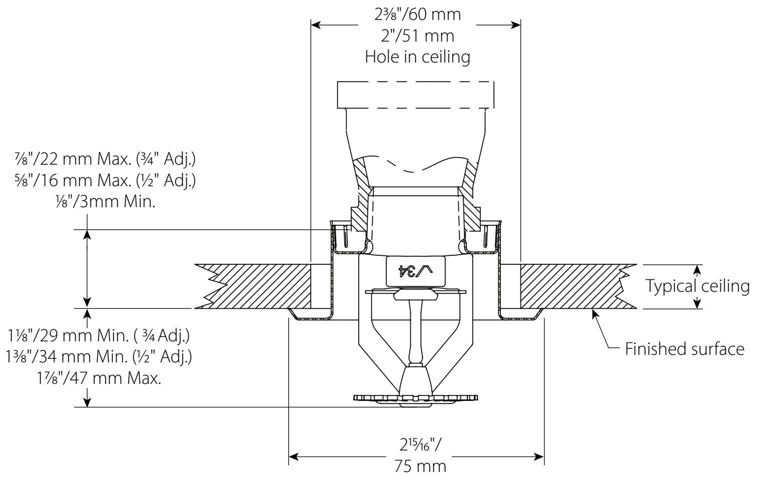


V2740

4.0 DIMENSIONS (CONTINUED)



V5610



V3426

5.0 PERFORMANCE

Sprinkler is to be installed and designed as per NFPA, FM Datasheets, or any local standards.

6.0 NOTIFICATIONS

WARNING

- **Read and understand all instructions before attempting to install any Victaulic products.**
- **Always verify that the piping system has been completely depressurized and drained immediately prior to installation, removal, adjustment, or maintenance of any Victaulic products.**
- **Wear safety glasses, hardhat, and foot protection.**

Failure to follow these instructions could result in death or serious personal injury and property damage.

- **These products shall be used only in fire protection systems that are designed and installed in accordance with current, applicable National Fire Protection Association (NFPA 13, 13D, 13R, etc.) standards, or equivalent standards, and in accordance with applicable building and fire codes. These standards and codes contain important information regarding protection of systems from freezing temperatures, corrosion, mechanical damage, etc.**
- **The installer shall understand the use of this product and why it was specified for the particular application.**
- **The installer shall understand common industry safety standards and potential consequences of improper product installation.**
- **It is the system designer's responsibility to verify suitability of materials for use with the intended fluid media within the piping system and external environment.**
- **The material specifier shall evaluate the effect of chemical composition, pH level, operating temperature, chloride level, oxygen level, and flow rate on materials to confirm system life will be acceptable for the intended service.**

Failure to follow installation requirements and local and national codes and standards could compromise system integrity or cause system failure, resulting in death or serious personal injury and property damage.

7.0 REFERENCE MATERIALS

Ratings: All glass bulbs are rated for temperatures from -67°F/-55°C.

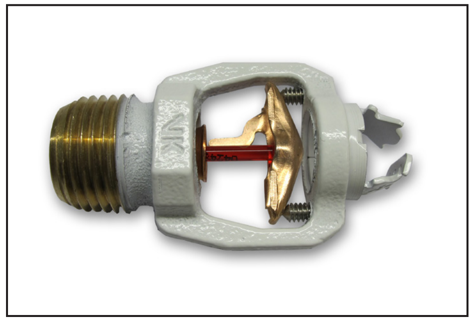
TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

1. DESCRIPTION

Viking Freedom® Residential Horizontal Sidewall Sprinkler VK486 is a small, thermosensitive, glass-bulb residential sprinkler available in several different finishes and temperature ratings to meet varying design requirements. The Electroless Nickel PTFE (ENT) coating has been investigated for installation in corrosive atmospheres and is C-UL-US-EU Listed as corrosion resistant as indicated in the Approval Chart. The sprinkler orifice design, with a K-Factor of 4.0 (57.7 metric†), allows efficient use of available water supplies for the hydraulically designed fire-protection system. The glass bulb operating element and special deflector characteristics meet the challenges of residential sprinkler standards.



WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

2. LISTINGS AND APPROVALS

UL Listed (C-UL-US-EU): Category VKKW

VdS Approved

Refer to the Approval Chart and Design Criteria for C-UL-US-EU Listing requirements that must be followed.

3. TECHNICAL DATA

Specifications:
Available since 2011.
Minimum Operating Pressure: Refer to the Approval Chart.
Maximum Working Pressure: 175 psi (12 bar). Factory tested hydrostatically to 500 psi (34.5 bar).
Thread size: 1/2" (15 mm) NPT
Nominal K-Factor: 4.0 U.S. (57.7 metric†)
† Metric K-factor measurement shown is in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
Glass-bulb fluid temperature rated to -65 °F (-55 °C)
Overall Length: 2-7/16" (62 mm)
Covered by the following US Patent numbers: 7,854,269 and 7,712,218

Material Standards:
Frame Casting: QM Brass and Brass UNS-C84400
Deflector: Phosphor Bronze UNS-C51000
Bulb: Glass, nominal 3 mm diameter
Belleville Spring Sealing Assembly: Nickel Alloy, coated on both sides with PTFE Tape
Pip Cap and Insert Assembly: Copper UNS-C11000 and Stainless Steel UNS-S30400
Compression Screws: 18-8 Stainless Steel
Yoke: Phosphor Bronze UNS-C51000

Ordering Information: (Also refer to the current Viking price list.)
Sprinkler: Base Part No. 17315
Order Sprinkler VK486 by first adding the appropriate suffix for the sprinkler finish and then the appropriate suffix for the temperature rating to the sprinkler base part number.
Finish Suffix: Brass = A, Chrome = F, White Polyester = M-/W, Black Polyester = M-/B
Temperature Suffix: 155 °F (68 °C) = B, 175 °F (79 °C) = D
For example, sprinkler VK486 with a Brass finish and a 155 °F (68 °C) temperature rating = Part No. 17315AB.

Available Finishes And Temperature Ratings:
Refer to Table 1.

Accessories: (Also refer to the Viking website.)

Sprinkler Wrenches:
A. Standard Wrench: Part No. 21475M/B (available since 2017)
B. Wrench for recessed sprinklers: Part No. 13655W/B* (available since 2006)
*A ½" ratchet is required (not available from Viking).

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

Sprinkler Cabinets:
A. Six-head capacity: Part No. 01724A (available since 1971)
B. Twelve-head capacity: Part No. 01725A (available since 1971)

4. INSTALLATION
Refer to appropriate NFPA Installation Standards.

5. OPERATION
During fire conditions, the heat-sensitive liquid in the glass bulb expands, causing the glass to shatter, releasing the yoke, pip cap, and sealing spring assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector, forming a uniform spray pattern to extinguish or control the fire.

6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
Viking Sprinkler VK486 is available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

TABLE 1: AVAILABLE SPRINKLER TEMPERATURE RATINGS AND FINISHES

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[2]	Bulb Color
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow

Sprinkler Finishes: Brass, Chrome, White Polyester, and Black Polyester.

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector.

[2] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

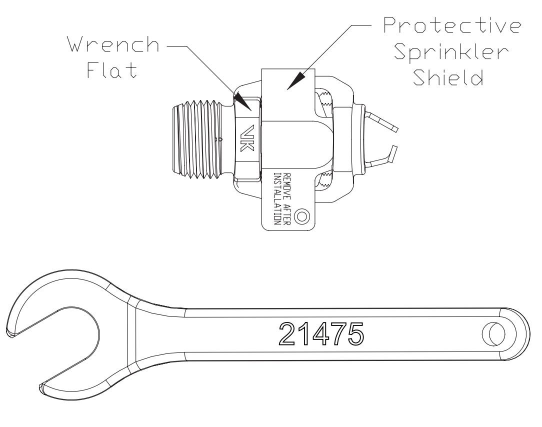


Figure 1:
Standard Sprinkler Wrench 21475M/B

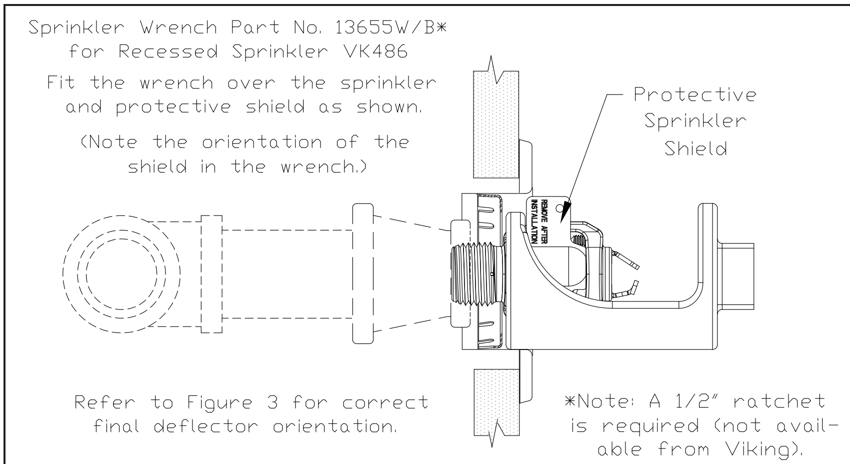


Figure 2:
Wrench 13655W/B for Recessed Sprinkler VK486

VIKING®

TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

Approval Chart
Viking VK486, 4.0 K-Factor Residential Horizontal Sidewall Sprinkler

For systems designed to NFPA 13D or NFPA 13R. For systems designed to NFPA 13, refer to the design criteria. For Ceiling types refer to current Editions of NFPA 13, 13R or 13D

Sprinkler Base Part Number [1]	SIN	NPT Thread Size		Nominal K-Factor		Maximum Water Working Pressure	Overall Length	
		Inches	mm	U.S.	metric [2]		Inches	mm
17315	VK486	1/2	15	4.0	57.7	175 psi (12 bar)	2-7/16	62

Max. Coverage Area [3] Width X Length Ft. X Ft. (m X m)	Max. Spacing Ft. (m)	Ordinary Temp Rating (155 °F/68 °C)		Intermediate Temp Rating (175 °F/79 °C)		Top of Deflector to Ceiling	Installation Type	Listings and Approvals [4]				Minimum Spacing Ft. (m)
		Flow [3] GPM (L/min)	Pressure [3] PSI (bar)	Flow [3] GPM (L/min)	Pressure [3] PSI (bar)			C-UL-US-EU [5]	VdS	NYC	NSF[9]	
12 X 12 (3.7 X 3.7)	12 (3.7)	11 (41.7)	7.6 (0.52)	11 (41.7)	7.6 (0.52)	4 to 6 inches	Standard surface-mounted escutcheons or recessed with the Micromatic® Model E-1, E-2, E-3, or G-1 Recessed Escutcheon	See Footnote 6 and 10.	See Footnote 6.	See Footnote 7.	See Footnote 6.	8 (2.4)
14 X 14 (4.3 X 4.3)	14 (4.3)	12 (45.5)	9 (0.62)	12 (45.5)	9 (0.62)							
16 X 16 (4.9 X 4.9)	16 (4.9)	13 (49.3)	10.6 (0.73)	13 (49.3)	10.6 (0.73)							
16 X 18 (4.9 X 5.5)	16 (4.9)	16 (60.6)	16 (1.10)	16 (60.6)	16 (1.10)							
16 X 20 (4.9 X 6.1)	16 (4.9)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
16 X 22 (4.9 X 6.7)	16 (4.9)	24 (90.8)	36 (2.48)	24 (90.8)	36 (2.48)							
18 X 18 (5.5 X 5.5)	18 (5.5)	18 (68.1)	20.3 (1.40)	19 (71.9)	22.6 (1.60)							
18 X 20 (5.5 X 6.1)	18 (5.5)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
20 X 20 (6.1 X 6.1)	20 (6.1)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
12 X 12 (3.7 X 3.7)	12 (3.7)	12 (45.5)	9 (0.62)	12 (45.5)	9 (0.62)	6 to 12 inches						
14 X 14 (4.3 X 4.3)	14 (4.3)	12 (45.5)	9 (0.62)	13 (49.3)	10.6 (0.73)							
16 X 16 (4.9 X 4.9)	16 (4.9)	14 (53.0)	12.3 (0.84)	14 (53.0)	12.3 (0.84)							
16 X 18 (4.9 X 5.5)	16 (4.9)	16 (60.6)	16 (1.10)	16 (60.6)	16 (1.10)							
16 X 20 (4.9 X 6.1)	16 (4.9)	23 (87.1)	33.1 (2.28)	23 (87.1)	33.1 (2.28)							
16 X 22 (4.9 X 6.7)	16 (4.9)	26 (98.4)	42.3 (2.91)	26 (98.4)	42.3 (2.91)							
18 X 18 (5.5 X 5.5)	18 (5.5)	18 (68.1)	20.3 (1.40)	19 (71.9)	22.6 (1.60)							
18 X 20 (5.5 X 6.1)	18 (5.5)	23 (87.1)	33.1 (2.28)	23 (87.1)	33.1 (2.28)							
20 X 20 (6.1 X 6.1)	20 (6.1)	24 (90.8)	36 (2.48)	24 (90.8)	36 (2.48)							

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to Viking's current price schedule.
[2] Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
[3] For areas of coverage smaller than shown, use the "Flow" and "Pressure" for the next larger area listed. Flows and pressures listed are per sprinkler. The distance from sprinklers to walls shall not exceed one-half the sprinkler spacing indicated for the minimum "Flow" and "Pressure" used.
[4] This chart shows the listings and approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals. Refer also to Design Criteria.
[5] Listed by Underwriter's Laboratories, Inc. for use in the U.S., Canada, and European Union.
[6] Approved Finishes are: Brass, Chrome, White Polyester, and Black Polyester [8]
[7] Meets New York City requirements, effective July 1, 2008.
[8] Other paint colors are available on request with the same C-UL-US-EU listings as the standard finish colors.
[9] UL Classified to : NSF/ANSI Standard 61, Drinking Water System Components (MH48034)
[10] Approved finish is Electroless Nickel PTFE (ENT). ENT is C-UL-US-EU Listed as corrosion resistant. ENT is available with standard surface-mounted escutcheons or the Micromatic Model E-1 Recessed Escutcheon.

VIKING®	TECHNICAL DATA	FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

DESIGN CRITERIA

(Also refer to the Approval Chart.)

UL Listing Requirements (C-UL-US-EU):

When using Viking Residential Horizontal Sidewall Sprinkler VK486 for systems designed to NFPA 13D or NFPA 13R, apply the listed areas of coverage and minimum water supply requirements shown in the Approval Chart.

For systems designed to NFPA 13: The number of design sprinklers is to be the four contiguous most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in the Approval Chart for NFPA 13D and NFPA 13R applications for each listed area of coverage, **or**
- Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the “design area” in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13.
- Minimum distance between residential sprinklers: 8 ft. (2.4 m).
- The VK486 horizontal sidewall sprinkler deflector shall be located a minimum of 1-1/4“ (31.8 mm) and a maximum of 6” (152 mm) from the wall on which it is installed.

DEFLECTOR POSITION: Install sprinkler VK486 with the leading edge of the deflector oriented parallel to the ceiling and the sprinkler frame arms oriented perpendicular to the ceiling (see Figure 4). **THE TOP SURFACE OF THE DEFLECTOR IS MARKED “TOP”.** The sprinkler must be oriented as shown in Figure 3 below.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to Form No. F_080190, F_080814, and F_080415 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

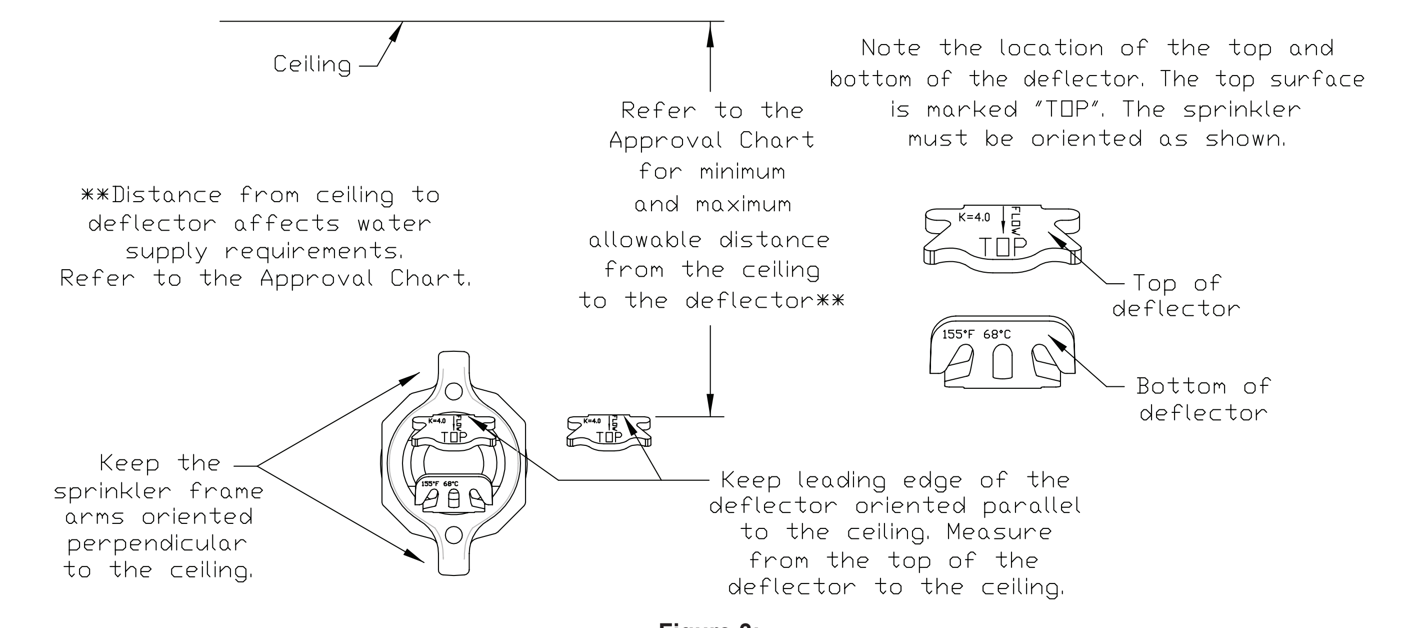


Figure 3:

Correct Orientation of the Deflector

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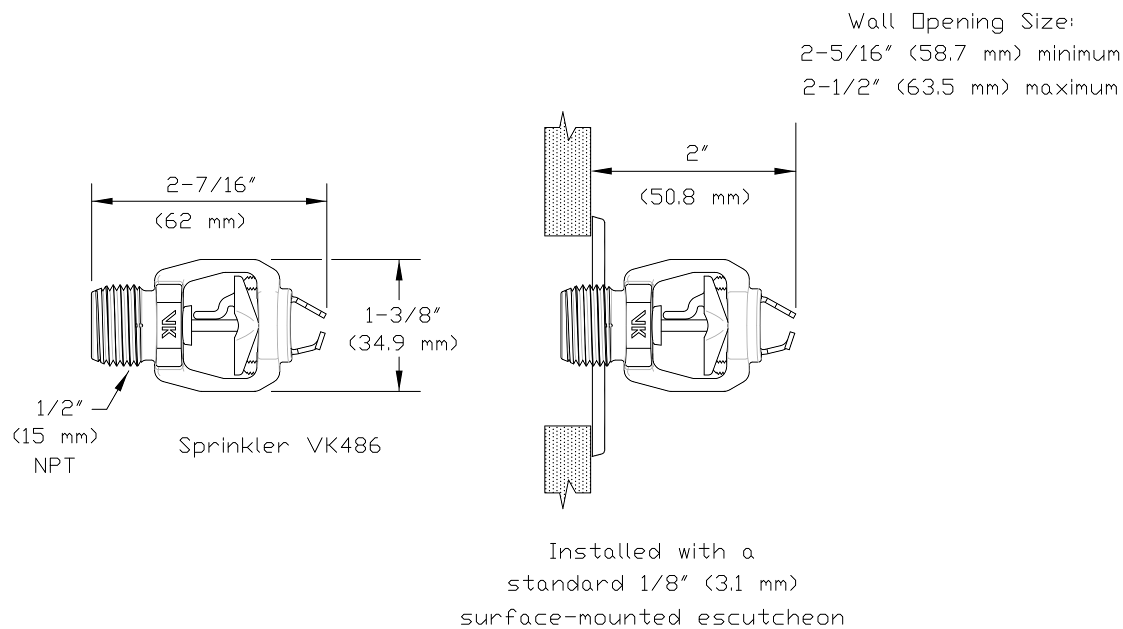

Figure 4:
Sprinkler VK486 Dimensions with a Standard Escutcheon and the Model F-1 Adjustable Escutcheon

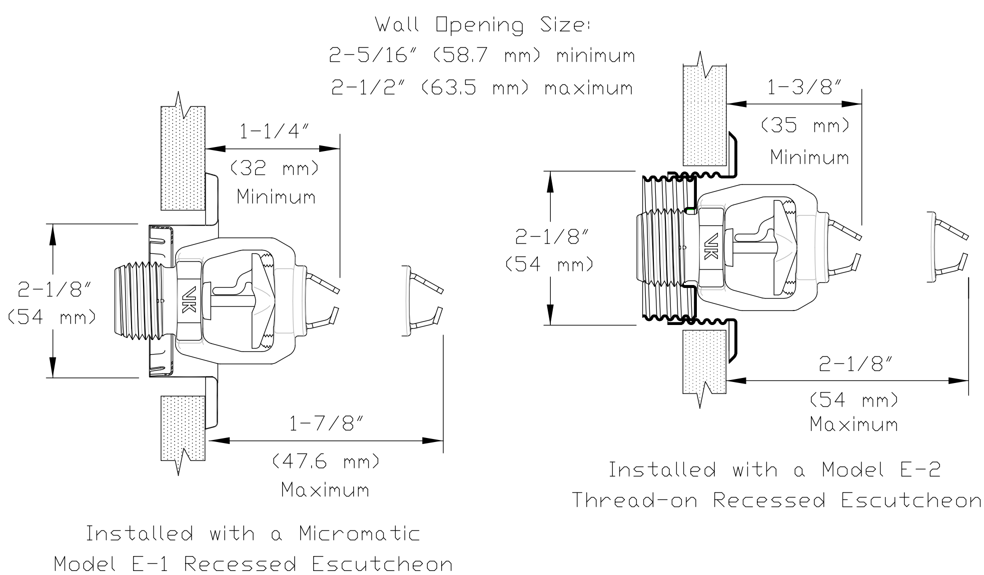

Figure 5:
Sprinkler VK486 Dimensions with the Model E-1 and E-2 Recessed Escutcheons

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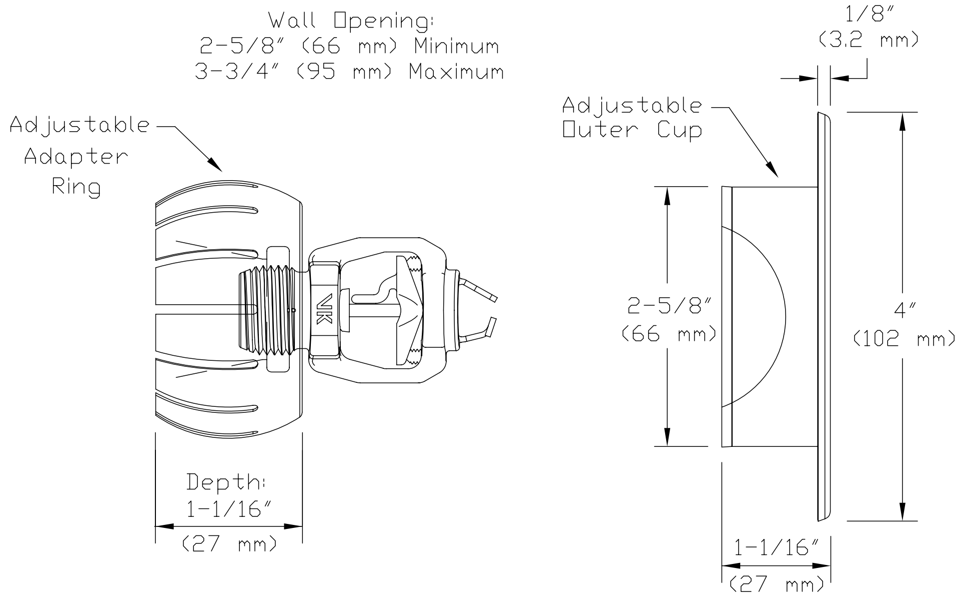

Figure 6: Sprinkler VK486 Dimensions with the Model G-1 Escutcheon

Viking Residential Sprinkler Installation Guide

October 25, 2018

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

TECHNICAL DATA

FREEDOM® RESIDENTIAL SPRINKLER INSTALLATION GUIDE

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1. DESCRIPTION

Viking residential automatic sprinklers are equipped with a "fast response" heat-sensitive operating element designed to respond individually and quickly to a specific high temperature. Viking residential sprinklers are designed to combine speed of operation with water distribution characteristics to help in the control of residential fires and to improve life safety by prolonging the time available for occupants to escape or be evacuated.

2. LISTINGS AND APPROVALS

Refer to the Approval Charts on the appropriate sprinkler technical data page(s) and/or approval agency listings.

A. Viking residential sprinklers are intended for use in the following occupancies: one- and two-family dwellings and mobile homes with the fire protection sprinkler system installed in accordance with NFPA 13D; residential occupancies up to four stories in height with the fire protection system installed in accordance with NFPA 13R; or residential portions of any occupancy with the fire protection system installed in accordance with NFPA 13. Information contained in this guide is based on NFPA 13, "Standard for the Installation of Sprinkler Systems".

B. The design criteria for residential sprinklers contained in the NFPA installation standards must be followed except as modified by the individual UL 1626 listing information provided in the technical data pages and this Residential Sprinkler Installation Guide. For listed areas of coverage, technical data, and specific design and installation instructions, refer to the appropriate Viking technical data page for the sprinkler model used.

C. Viking residential sprinklers listed by Underwriters Laboratories, Inc. (UL) have passed fire tests designed to represent fire conditions for the sprinkler's listed area of coverage. The standards for residential sprinkler performance and spray patterns are printed in Underwriters Laboratories Publication UL 1626, "Standard for Residential Sprinklers for Fire Protection Service". All listed Viking residential sprinklers meet or exceed UL 1626 performance requirements and spray pattern criteria for their listed areas of coverage.

D. NFPA standards allow use of residential sprinklers with rates, design areas, areas of coverage, and minimum design pressures other than those specified in the standards when they have been listed for such specific residential installation conditions.

3. TECHNICAL DATA

Specifications:

Refer to the appropriate sprinkler technical data sheet.

Material Standards:

Refer to the appropriate sprinkler technical data sheet.

Viking Technical Data may be found on The Viking Corporation's Web site at http://www.vikinggroupinc.com. The Web site may include a more recent edition of this Technical Data Page.

4. INSTALLATION

NOTE:Take care not to over-tighten the sprinkler and/or damage its operating parts!

Maximum Torque: 1/2" NPT: 14 ft-lbs. (19.0 N-m) 3/4" NPT: 20 ft-lbs. (27.1 N-m)

A. Care and Handling (also refer to Bulletin - Care and Handling of Sprinklers, Form No. F_091699.)

Sprinklers must be handled with care and protected from mechanical damage during storage, transport, handling, and after installation. Store sprinklers in a cool, dry place in their original container.

Use care when locating sprinklers near fixtures that can generate heat.

Never install sprinklers that have been dropped, damaged in any way, or exposed to temperatures exceeding the maximum ambient temperature allowed (refer to Table 1.)

Never install any glass-bulb sprinkler if the bulb is cracked or if there is a loss of liquid from the bulb. A small air bubble should be present in the glass bulb. Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed immediately. (Note: Installing glass bulb sprinklers in direct sunlight (ultraviolet light) may affect the color of the dye used to color code the bulb. This color change does not affect the integrity of the bulb.)

Viking residential sprinklers are intended for use on wet pipe residential systems only. Adequate heat must be provided for wet-pipe systems. DO NOT use Viking residential sprinklers on dry systems unless specifically allowed by recognized installation standards or the Authority Having Jurisdiction.

Residential concealed sprinklers must be installed in neutral or negative pressure plenums only!

Corrosion-resistant sprinklers must be installed when subject to corrosive atmospheres. **NOTE:** Viking residential sprinklers are not intended for use in corrosive environments.

VIKING | TECHNICAL DATA | **FREEDOM® RESIDENTIAL SPRINKLER INSTALLATION GUIDE**

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TABLE 1: RESIDENTIAL SPRINKLER TEMPERATURE RATINGS			
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating[1]**	**Maximum Ambient Ceiling Temperature[3]**	**Bulb Color**
Residential Glass Bulb Style Sprinklers			
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)[1]**	**Maximum Ambient Ceiling Temperature[3]**	
Residential Fusible Element Style Sprinklers			
Ordinary	165 °F (74 °C)	100 °F (38 °C)	
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)**	**Maximum Ambient Ceiling Temperature[3]**	**Temperature Identification Stamp**
Residential Flush Style Sprinklers			
Ordinary	165 °F (74 °C)	100 °F (38 °C)	On Cover or Sprinkler Inlet (VK476)
Intermediate	220 °F (104 °C)	150 °F (65 °C)	On Cover
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)**	**Maximum Ambient Ceiling Temperature[3]**	**Cover Plate Temperature Rating**
Residential Concealed Style Sprinklers			
Ordinary	135 °F (57 °C)[1], 140 °F (60 °C)[2], 155 °F (68 °C)[1], or 165 °F (74 °C)[1]	100 °F (38 °C)	135 °F (57 °C)

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector or flow shaper.

[2] The temperature rating is stamped on the sprinkler.

[3] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

B. Installation Instructions

Viking sprinklers are manufactured and tested to meet the rigid requirements of approving agencies. They are designed to be installed in accordance with recognized installation standards NFPA 13, NFPA 13R, and NFPA 13D, and any associated TIAs.

Deviation from the standards or any alteration to the sprinklers or cover plate assemblies after they leave the factory including, but not limited to: painting, plating, coating, or modification, may render the sprinklers inoperative and will automatically nullify the approval and any guarantee made by Viking.

The use of residential sprinklers may be limited due to occupancy and hazard. Residential fire protection systems must be designed and installed only by those who are completely familiar with the appropriate standards and codes, and thoroughly experienced in fire protection design, hydraulic calculations, and sprinkler system installation.

Before installation, be sure to have the appropriate sprinkler model and style, with the correct K-Factor, temperature rating, and response characteristics. Viking residential sprinklers must be installed after the piping is in place to prevent mechanical damage. Keep sprinklers with protective caps or bulb shields contained within the caps or shields during installation and testing, and any time the sprinkler is shipped or handled.

1a. For frame-style sprinklers, install escutcheon (if used), which is designed to thread onto the external threads of the sprinkler*.
*Refer to the appropriate sprinkler technical data page to determine approved escutcheons for use with specific sprinkler models.

1b. For flush and concealed style sprinklers: Cut the sprinkler nipple so that the ½” or 3/4” (15 mm or 20 mm) NPT** outlet of the reducing coupling is at the desired location and centered in the opening** in the ceiling or wall.
**Size depends on the sprinkler model used. Refer to appropriate sprinkler data page.

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DESIGN CRITERIA

<u>For Systems Designed to NFPA 13D or NFPA 13R:</u> Apply the listed areas of coverage and minimum water supply requirements shown in the approval charts on the residential sprinkler data pages. The sprinkler flow rate is the minimum required discharge from each of the total number of design sprinklers as specified in NFPA 13D or NFPA 13R.

<u>For Systems Designed to the latest edition of NFPA 13:</u> The number of design sprinklers is to be the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- **The flow rates given in the approval charts on the data pages for NFPA 13D and NFPA13R for each area of coverage listed, <u>or</u>**
- **Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the "design area" in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13. The greatest dimension of the coverage area cannot be any greater than the maximum areas of coverage shown on the data pages.**

Flow Rates

All residential sprinklers manufactured on or after July 12, 2002 are listed with a single minimum flow rate. Where rooms have more than one sprinkler, multiple-sprinkler calculations are still required, but the first sprinkler and any additional sprinkler or sprinklers must be calculated flowing at identical minimum flow rates, based on the area of sprinkler coverage, using the minimum flow and pressure listed for the sprinkler model used.

Consult the appropriate standards and the Authorities Having Jurisdiction to determine the number of sprinklers to hydraulically calculate to verify adequate water supply for multiple-sprinkler operation.

Operating Pressure: The minimum operating pressure of any sprinkler shall be the minimum operating pressure specified by the listing, or 7 psi (0.5 bar), whichever is greater. The maximum allowable operating pressure is 175 psi (12 bar).

Areas of Coverage

If the actual area of coverage is less than the listed area of coverage, use the minimum water supply for the next larger area of coverage listed. DO NOT interpolate. Residential sprinkler systems must be hydraulically calculated according to NFPA standards to verify that the water supply is adequate for proper operation of the sprinklers. Hydraulic calculations are required to verify adequate water supply at the hydraulically most remote single sprinkler when it is operating at the minimum gpm and psi listed for single-sprinkler operation for the sprinkler model used.

Viking residential sprinklers may be listed for more than one area of coverage. Suggested practice in selecting area of coverage is to select the one that can be adequately supplied by the available water supply and still allow for the installation of as few sprinklers in a compartment as possible while observing all guidelines pertaining to obstructions and spacing. This maximizes the use of the available water supply, which is often limited on residential fire protection systems. After selecting an appropriate area of coverage, sprinklers must be spaced according to guidelines set forth in the installation standards.

Definition of "COMPARTMENT": A space completely enclosed by walls and a ceiling. Openings to an adjoining space are allowed, provided the openings have a minimum lintel depth of 8 in. (203.2 mm) from the ceiling.

Spacing Guidelines

For guidelines concerning spacing of Viking residential sprinklers near beams, obstructions, heat sources, and sloped ceilings [slopes more than a 2/12 (9.5°) pitch], refer to the Viking residential sprinkler data pages and installation guide, the appropriate NFPA standard, and the Authority Having Jurisdiction. NOTE: Sloped, beamed, and pitched ceilings could require special design features such as larger flow, or a design for more sprinklers to operate in the compartment, or both.

Distance from Walls: Install not more than one-half the listed sprinkler spacing nor less than 4" (102 mm) from walls, partitions, or obstructions as defined in the standards.

Minimum Sprinkler Spacing: The minimum distance between residential sprinklers to prevent cold soldering (i.e., the spray from one operating sprinkler onto an adjacent sprinkler that could prevent its proper activation) is 8 ft. (2.4 m).

Maximum Sprinkler Spacing: Locate adjacent sprinklers no farther apart than the listed spacing.

Deflector Position: Install frame style residential *pendent* sprinklers with the deflector between 1" and 4" (25.4 mm to 102 mm) below smooth ceilings, unless the sprinkler data page indicates otherwise. Install pendent sprinklers in the pendent position only, with the deflector oriented parallel with the ceiling or roof.

Refer to the individual listings in the residential sprinkler data pages for horizontal sidewall sprinkler deflector or sprinkler centerline distance below the ceiling. Install horizontal sidewall sprinklers in the horizontal position only below smooth ceilings, with the leading edge of the deflector or element assembly oriented parallel with the ceiling.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to the appropriate sprinkler data page. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

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2. Apply a small amount of pipe-joint compound or tape to the external threads of the sprinkler only, taking care not to allow a build-up of compound in the sprinkler inlet. **NOTE:** Sprinklers with protective caps or bulb shields must be contained within the caps or shields before applying pipe-joint compound or tape. *Exception: For concealed sprinklers (i.e., VK457, VK458, VK468, VK474, and VK4570) the protective cap is removed for installation.*
3. Care must be taken when installing sprinklers on CPVC and copper piping systems. Never install the sprinkler into the reducing fitting before attaching the reducing fitting to the piping. Sprinklers must be installed on CPVC systems after the reducing fitting has been installed and the primer and/or cement manufacturer's recommended curing time has elapsed. When installing sprinklers on copper piping systems, take care to brush the inside of the sprinkler supply piping and reducing fitting to ensure that no flux accumulates in the sprinkler orifice. Excess flux can cause corrosion and may impair the ability of the sprinkler to operate properly.
4. Refer to the appropriate sprinkler technical data page to determine the correct sprinkler wrench for the model of sprinkler used. DO NOT use the sprinkler deflector or fusible element to start or thread the sprinkler into a fitting.
   a. Install the sprinkler onto the piping using the special sprinkler wrench only, while taking care not to over-tighten or damage the sprinkler operating parts.
   b. *Thread the flush or concealed sprinkler into the ½*" or 3/4" (15 mm or 20 mm) NPT** *outlet of the coupling by turning it clockwise with the special sprinkler wrench. NOTE: For flush and concealed sprinklers with protective shells, the internal diameter of the special flush and concealed sprinkler installation wrench is designed for use with the sprinkler contained within the shell. Exception: For concealed sprinklers VK457, VK458, VK468, VK474, and VK4570 the protective cap is removed for installation, and then placed back on the sprinkler temporarily.*
5. After installation, the entire sprinkler system must be tested. The test must be conducted to comply with the installation standards.
   a. Make sure the sprinkler has been properly tightened. If a thread leak occurs, normally the unit must be removed, new pipe-joint compound or tape applied, and then reinstalled. This is due to the fact that when the joint seal leaks, the sealing compound is washed out of the joint.
   b. **Remove plastic protective sprinkler caps or bulb shields AFTER the wall or ceiling finish work is completed where the sprinkler is installed and there no longer is a potential for mechanical damage to the sprinkler operating elements.** To remove the bulb shields, simply pull the ends of the shields apart where they are snapped together. To remove caps from frame style sprinklers, turn the caps slightly and pull them off the sprinklers. **SPRINKLER CAPS OR BULB SHIELDS MUST BE REMOVED FROM SPRINKLERS <u>BEFORE</u> PLACING THE SYSTEM IN SERVICE!** Retain a protective cap or shield in the spare sprinkler cabinet.
6. For residential flush sprinklers, the ceiling ring can now be installed onto the sprinkler body. Align the ceiling ring with the sprinkler body and thread on or push it on until the flange touches the ceiling. Note the maximum vertical adjustment is ½" (12,7 mm) for sprinkler VK420 and 5/8" for VK476. DO NOT MODIFY THE UNIT. If necessary, re-cut the sprinkler drop nipples as required.
7. For residential concealed sprinklers, the cover plate assembly can now be attached.
   a. Remove the cover plate assembly from the protective box, taking care not to damage the assembly.
   b. From below the ceiling, gently place the base of the cover plate assembly over the sprinkler protruding through the opening in the ceiling or wall.
   c. Carefully push the cover plate assembly onto the sprinkler, using even pressure with the palm of the hand, until the unfinished brass flange of the cover plate base touches the ceiling or wall.
   d. The maximum adjustment available for residential concealed sprinklers is ½" (12.7 mm) [1/4" (6.4 mm) for sprinkler VK480]. DO NOT MODIFY THE UNIT. If necessary, re-cut the sprinkler nipples.

NOTE: If it is necessary to remove the entire sprinkler unit, the system must be taken out of service. See Maintenance instructions below and follow all warnings and instructions.

5. OPERATION

During fire conditions, the operating element fuses or shatters (depending on the type of sprinkler), releasing the pip cap and sealing assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector or flow shaper, forming a uniform, high-wall wetting spray pattern to extinguish or control the fire.

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6. INSPECTIONS, TESTS AND MAINTENANCE

Refer to NFPA 25 for Inspection, Testing and Maintenance requirements. **NOTICE:** The owner is responsible for having the fire-protection system and devices inspected, tested, and maintained in proper operating condition in accordance with this guide, and applicable NFPA standards. In addition, the Authority Having Jurisdiction may have additional maintenance, testing, and inspection requirements that must be followed.

A. Sprinklers must be inspected on a regular basis for signs of corrosion, mechanical damage, obstructions, paint, etc. Frequency of the inspections may vary due to corrosive atmospheres, water supplies, and activity around the device.

B. Sprinklers or cover plate assemblies that have been field painted, caulked, or mechanically damaged must be replaced immediately. Sprinklers showing signs of corrosion shall be tested and/or replaced immediately as required. Installation standards require sprinklers to be tested and, if necessary, replaced immediately after a specified term of service. Refer to NFPA 25 and the Authorities Having Jurisdiction for the specified period of time after which testing and/or replacement of residential sprinklers is required. Never attempt to repair or reassemble a sprinkler. Sprinklers and cover assemblies that have operated cannot be reassembled or re-used, but must be replaced. When replacement is necessary, use only new sprinklers and cover assemblies with identical performance characteristics.

C. The sprinkler discharge pattern is critical for proper fire protection. Nothing should be hung from, attached to, or otherwise obstruct the discharge pattern of the sprinkler. All obstructions must be immediately removed or, if necessary, additional sprinklers installed.

D. When replacing existing sprinklers, the system must be removed from service. Refer to the appropriate system description and/or valve instructions. Prior to removing the system from service, notify all Authorities Having Jurisdiction. Consideration should be given to employment of a fire patrol in the effected area.

1. Remove the system from service, drain all water, and relieve all pressure on the piping.

2a. For frame-style sprinklers, use the special sprinkler wrench and remove the old sprinkler by turning it counterclockwise to unthread it from the piping.

2b. For residential flush pendent and concealed style sprinklers: Remove the ceiling ring or cover plate assembly before unthreading the sprinkler body from the piping. To remove a ceiling ring, grasp it from below the ceiling and gently turn it counterclockwise. Cover plates can be removed either by gently unthreading them or pulling them off the sprinkler body (depends on the sprinkler model used). After the ceiling ring or cover plate assembly has been removed from the sprinkler, use the sprinkler wrench to unthread the sprinkler from the piping. NOTE: For flush and concealed sprinklers with protective shells, the internal diameter of the special flush and concealed sprinkler installation wrench is designed for use with the sprinkler contained within the shell. Place a plastic protective shell (from the spare sprinkler cabinet) over the sprinkler to be removed and then fit the sprinkler wrench over the shell. Exception: Concealed sprinklers VK457, VK458, VK468, VK474, and VK4570 are removed without the plastic cap.

3. Follow instructions in section 4B. Installation Instructions to install the new unit. Be sure the replacement sprinkler is the correct model and style, with the appropriate K-Factor, temperature rating, and response characteristics. A fully stocked sprinkler cabinet should be provided for this purpose. *(For flush or concealed style sprinklers, stock of spare ceiling rings or cover plates should also be available in the spare sprinkler cabinet.)*

4. Place the system back in service and secure all valves. Check for and repair all leaks.

E. Sprinkler systems that have been subjected to a fire must be returned to service as soon as possible. The entire system must be inspected for damage, and repaired or replaced as necessary. Sprinklers that have been exposed to corrosive products of combustion or high ambient temperatures, but have not operated, should be replaced. Refer to the Authority Having Jurisdiction for minimum replacement requirements.

7. AVAILABILITY

Viking Residential Sprinklers are available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE

For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

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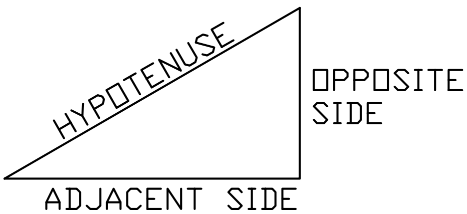
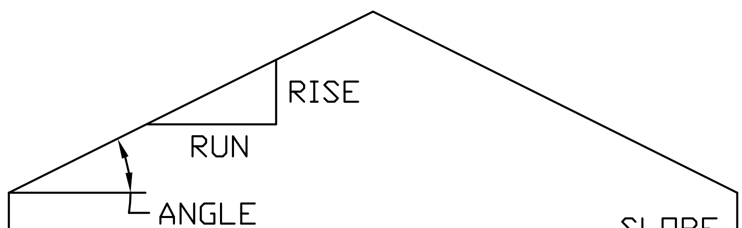


$$\text{TANGENT} = \frac{\text{OPPOSITE SIDE (RISE)}}{\text{ADJACENT SIDE (RUN)}}$$

$$\frac{\text{RISE}}{\text{RUN}} = \text{TANGENT}$$

$$\text{ANGLE} = \text{TAN}^{-1}\left(\frac{\text{RISE}}{\text{RUN}}\right)$$

$$\text{SLOPE DISTANCE} = \sqrt{(\text{RISE})^2 + (\text{RUN})^2}$$



RISE	RUN	TANGENT	ANGLE	SLOPE DISTANCE
2	12	.1666	9.45°	12.1
3	12	.2500	14°	12.3
4	12	.3333	18.4°	12.6
5	12	.4166	22.6°	13
6	12	.5000	26.5°	13.4
7	12	.5833	30.2°	13.8
8	12	.6666	33.6°	14.4
9	12	.7500	36.8°	15
10	12	.8333	39.8°	15.6
11	12	.9166	42.5°	16.2
12	12	1	45°	16.97

Table 2
Rise Over Run Conversion to Degrees of Slope

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SPACING OF RESIDENTIAL SPRINKLERS LISTED FOR USE BELOW SLOPED CEILINGS UP TO AN 8/12 (33.7°) PITCH

(Refer to the appropriate residential sprinkler technical data page for listings.)

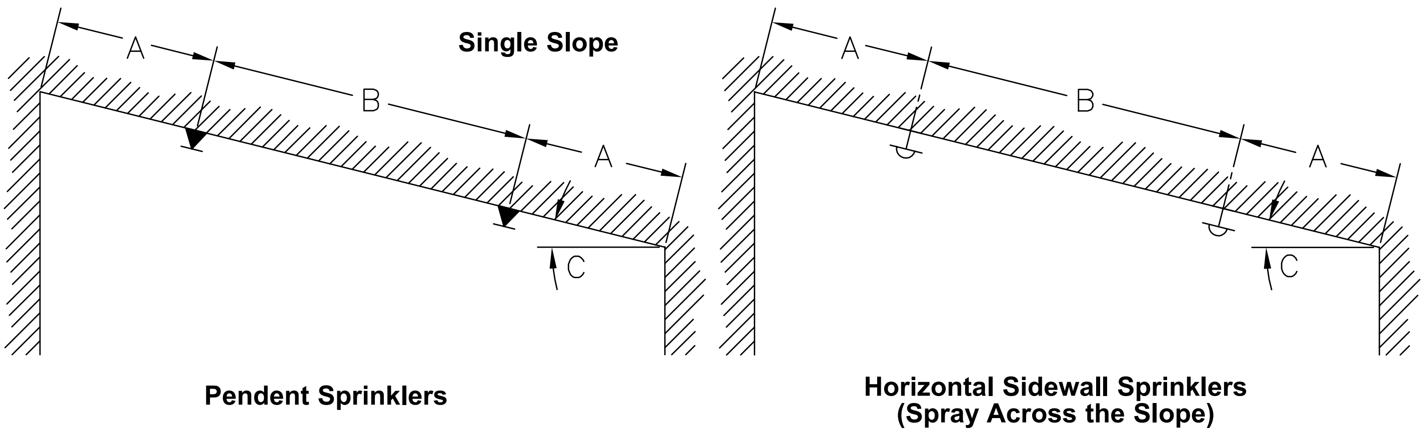

Figure 1

(A) One-half listed spacing of sprinkler maximum, 0'-4" (0-102 mm) minimum.
(B) Listed spacing of sprinkler, maximum, 8'-0" (2.4 m) minimum.
(C) Where angle "C" is greater than an 8/12 (33.7°) pitch, see Figure 2 below.

SPACING OF RESIDENTIAL SPRINKLERS BELOW SLOPED CEILINGS WITH GREATER THAN 8/12 (33.7°) PITCH

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

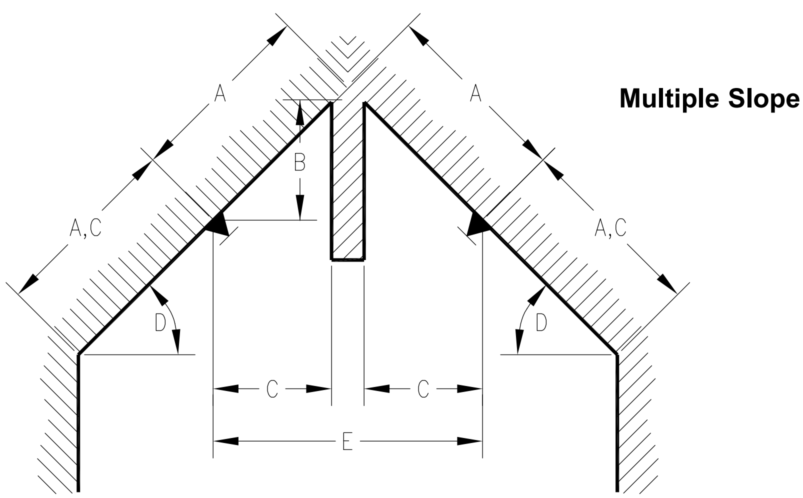

Figure 2

(A) One-half listed spacing of sprinkler, maximum.
(B) 3'-0" (.91 m) maximum.
(C) 0'-4" (0-102 mm) minimum.
(D) Slopes greater than an 8/12 (33.7°) pitch.
(E) For distance less than 8'-0" (2.4 m), baffle required.

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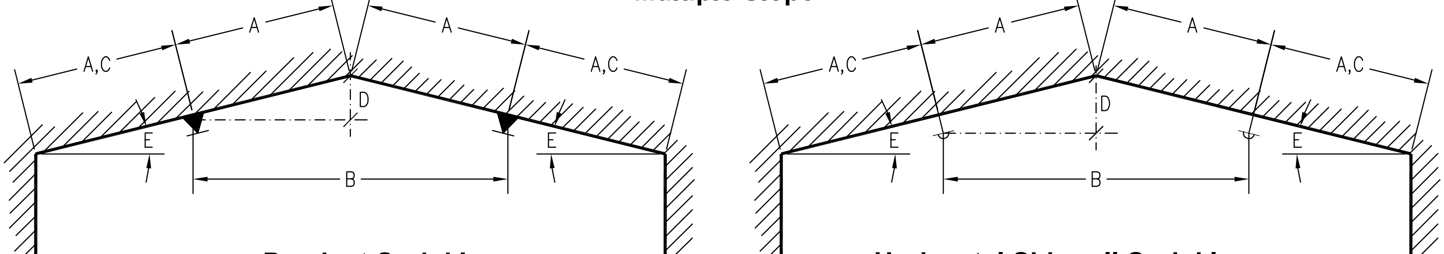
SPACING OF RESIDENTIAL SPRINKLERS LISTED FOR USE BELOW SLOPED CEILINGS UP TO AN 8/12 (33.7°) PITCH

(Refer to the appropriate residential sprinkler technical data page for listings.)

Multiple Slope



Pendent Sprinklers

Horizontal Sidewall Sprinklers (Spray Across the Slope)

Figure 3

(A) One-half listed spacing of sprinkler, maximum.
(B) 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) 3'-0" (.91 m) maximum.
(E) Acceptable for slopes of 0/12 to 8/12 (0° to 33.7°) pitch.

SPACING OF RESIDENTIAL PENDENT SPRINKLERS AT PEAK OF SLOPED CEILINGS WITH PITCH LESS THAN 8/12 (33.7°)

(Refer to the appropriate residential sprinkler technical data page for listings.)

Multiple Slope

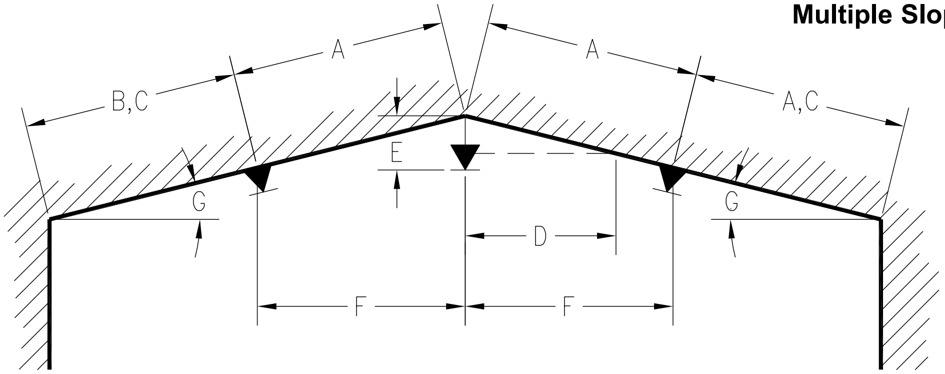


Figure 4

(A) Listed spacing of sprinkler, maximum.
(B) One-half listed spacing of sprinkler, maximum.
(C) 0'-4" minimum.
(D) Refer to page 10 for minimum distance between sprinkler and intersecting sloped ceiling.
(E) Refer to the appropriate residential sprinkler technical data page for deflector distance below ceiling.
(F) 8'-0" minimum.
(G) Reference: 4/12 (18.0°) pitch maximum for 12' (3.7 m) spacing.
2.5/12 (12.0°) pitch maximum for 14' (4.3 m) spacing.
2/12 (10.0°) pitch maximum for 16' (4.9 m) spacing.
2/12 (10.0°) pitch maximum for 18' (5.5 m) spacing.
1.9/12 (9.0°) pitch maximum for 20' (6.1 m) spacing.
Angles based on sprinklers installed 0'-4" (0-102 mm) from peak.

NOTE: Whenever possible, utilize design as shown in Figure 3 above.

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SPACING OF RESIDENTIAL SPRINKLERS BELOW SLOPED CEILINGS WITH GREATER THAN 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 2 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

Multiple Slope

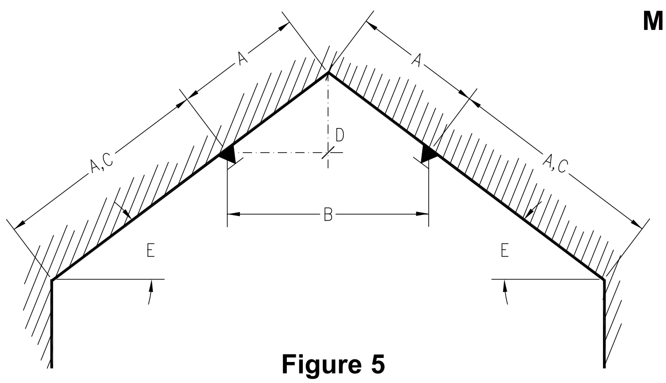

Figure 5

(A) One-half listed spacing of sprinkler, maximum.
(B) 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) 3'-0" (.91 m) maximum.
(E) Acceptable for slopes greater than an 8/12 (33.7°) pitch.
(F) When this design is used, refer to the appendices of NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction regarding the number of design sprinklers to hydraulically calculate.

SPACING OF RESIDENTIAL SPRINKLERS BELOW CEILINGS WITH SLOPES EXCEEDING 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 3 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

Multiple Slope

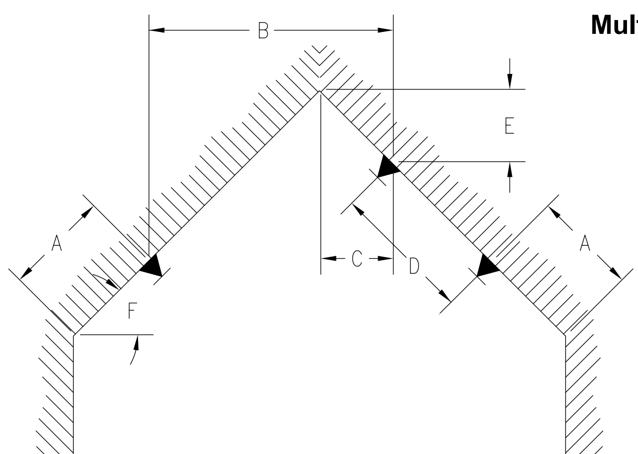

Figure 6

(A) 0'-4" (0-102 mm) minimum, to one-half listed spacing, maximum.
(B) One-half listed spacing, maximum, 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) Listed spacing maximum, 8'-0" (2.4 m) minimum.
(E) 3'-0" (.91 m) maximum.
(F) Slopes greater than 8/12 up to a 21/12 (33.7° up to 60°) pitch.

NOTES: In addition to the above limits, rooms requiring this type of installation must be hydraulically calculated to supply a minimum of three operating sprinklers. Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

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SPACING OF RESIDENTIAL SPRINKLERS BELOW CEILINGS WITH SLOPES EXCEEDING 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 2 SPRINKLERS IN THE ROOM
(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

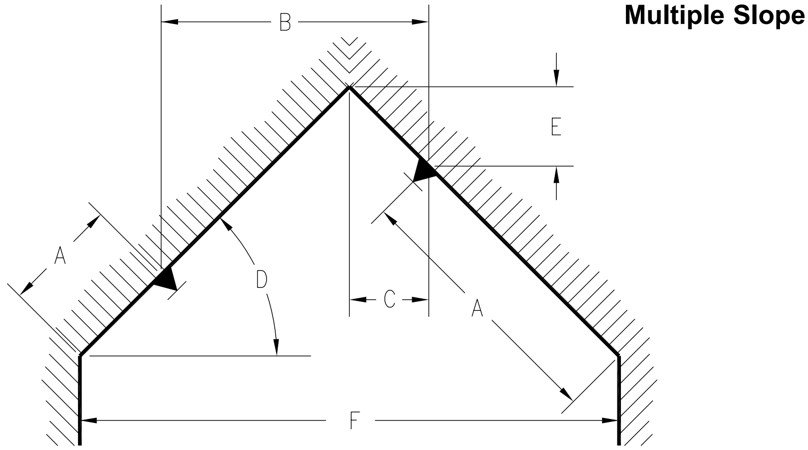

Figure 7

(A) 0'-4" (0-102 mm) minimum, to one-half listed spacing, maximum.
(B) One-half listed spacing, maximum, 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) Slopes greater than 8/12 pitch up to a 21/12 (33.7° up to a 60°) pitch.
(E) 3'-0" (.91 m) maximum.
(F) When dimension "F" exceeds 16' (4.9 m), utilize design configuration shown in Figure 6.

NOTES: Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

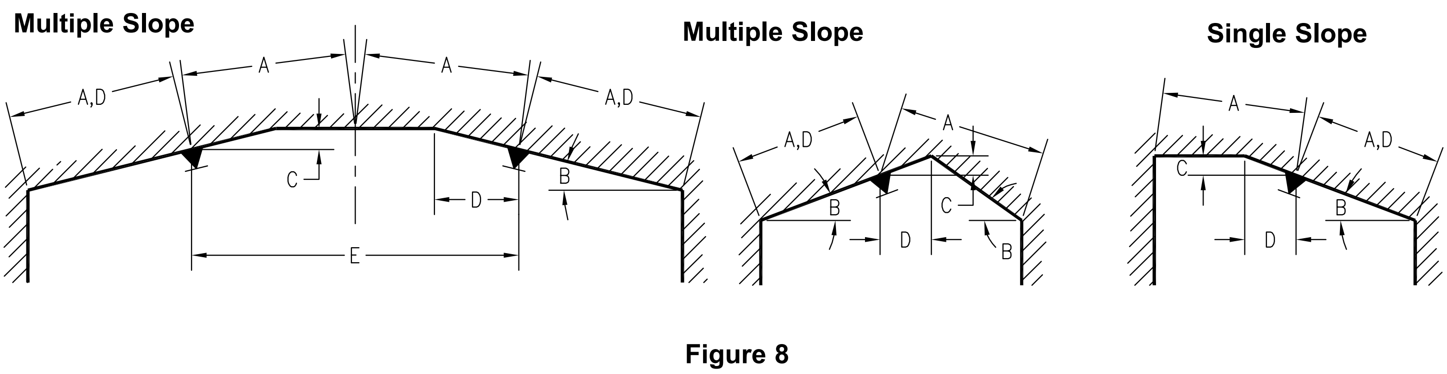

Figure 8

(A) One-half listed spacing, maximum.
(B) Refer to the appropriate residential sprinkler technical data pages for listings of sprinklers for use below slopes up to and including a 8/12 (33.7°) pitch.
(C) 3'-0" (.91 m) maximum.
(D) 0'-4" (0-102 mm) minimum.
(E) 8'-0" (2.4 m) minimum without baffle.

NOTES: Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

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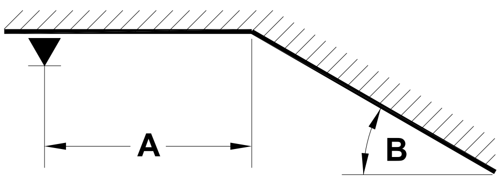
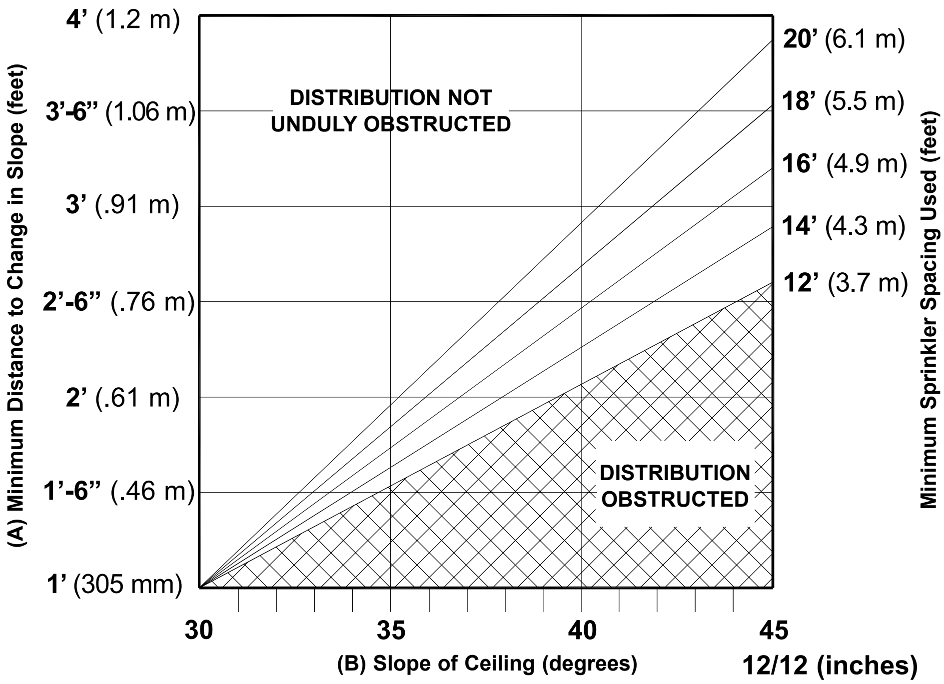
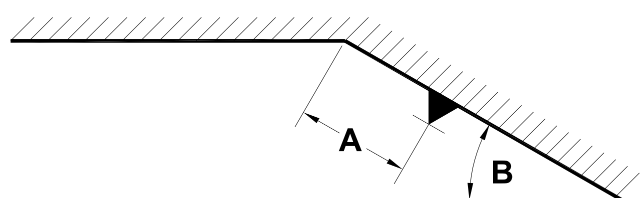
MINIMUM DISTANCE BETWEEN SPRINKLER AND INTERSECTING SLOPED CEILINGS

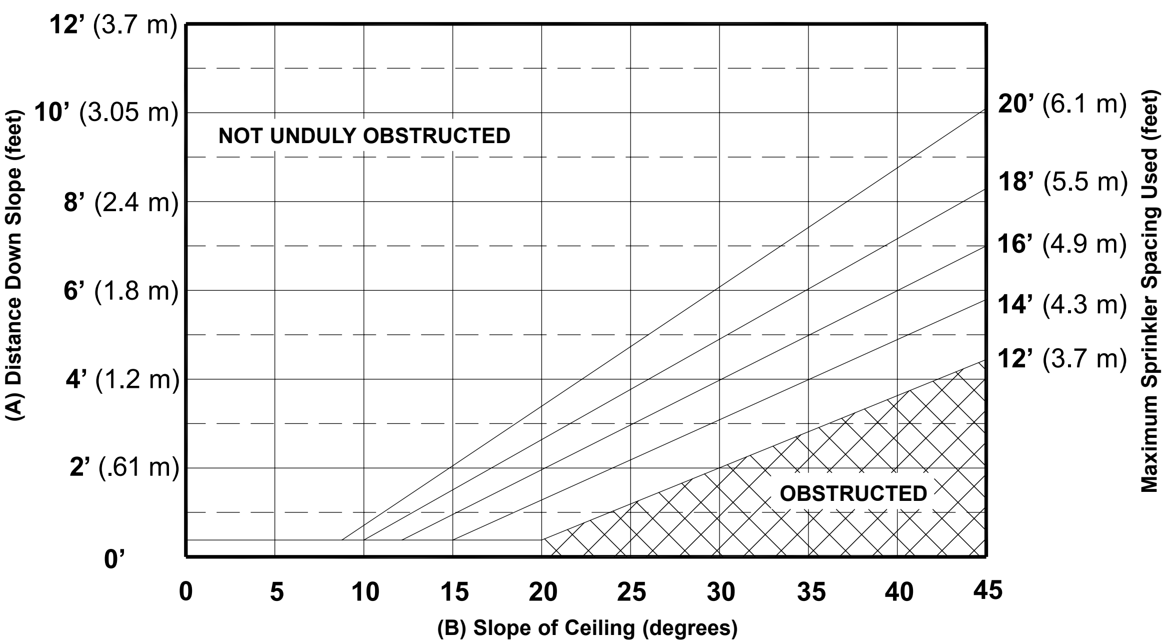


NOTES: For any ceiling slope under 7/12 (30°), distribution is considered Not Unduly Obstructed.



MAXIMUM DISTANCE DOWN SLOPE TO AVOID OBSTRUCTION TO SPRINKLER DISCHARGE





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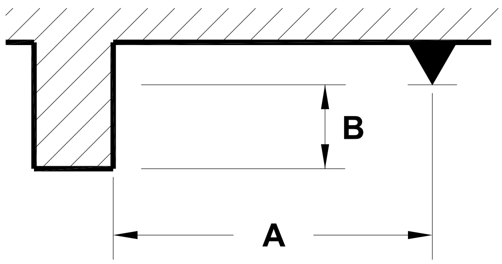
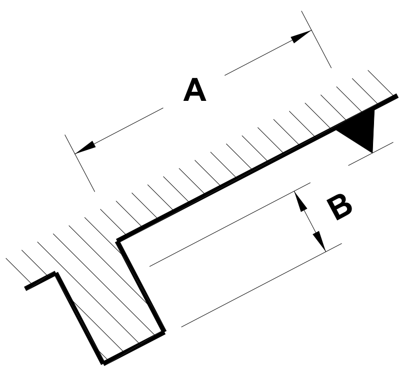
AVOIDING OBSTRUCTIONS TO SPRINKLER DISCHARGE

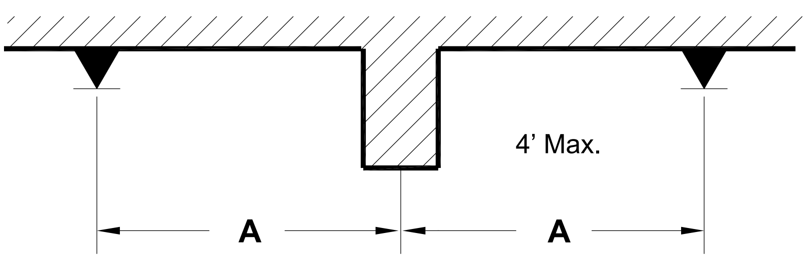
(Obstruction rules for residential sprinklers are found in section 8.10 of the 2010 edition of NFPA 13.)

Positioning Residential Pendent Sprinklers - Obstructions at the Ceiling



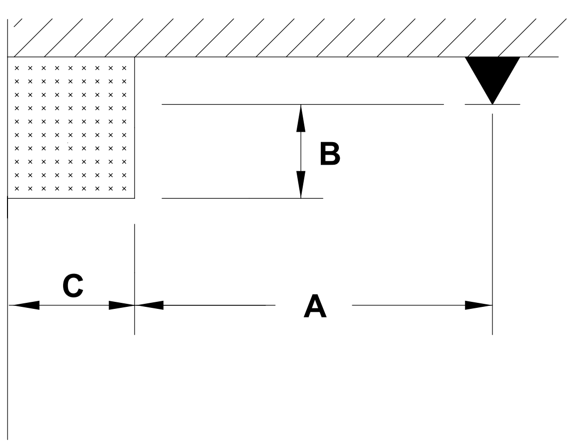


Distance from Sprinkler to Side of Ceiling Obstruction (Dimension A)	Maximum Distance from Deflector to Bottom of Ceiling Obstruction (Dimension B)	
	Inches	mm
Less than 1 ft. 6 in. (Less than 457 mm)	0	0
1 ft. 6 in. to less than 3 ft. (457 mm to less than .94 m)	1	25.4
3 ft. to less than 4 ft. (.91 m to less than 1.2 m)	3	76
4 ft. to less than 4 ft. 6 in. (1.2 m to less than 1.37 m)	5	127
4 ft. 6 in. to less than 6 ft. (1.37 m to less than 1.8 m)	7	178
6 ft. to less than 6 ft. 6 in. (1.8 m to less than 2 m)	9	229
6 ft. 6 in. to less than 7 ft. (2 m to less than 2.1 m)	11	279
7 ft. or greater (2.1 m or greater)	14	356



Residential pendent sprinklers may be located on opposite sides of continuous obstructions up to 4 ft. (1.2 m) wide at the ceiling, as long as the distance from the centerline of the obstruction to the sprinklers (A) does not exceed one-half the maximum spacing allowed between sprinklers.

Positioning Residential Pendent Sprinklers - Obstructions Along Walls



(A) Distance from centerline of sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.
(C) Width of the obstruction.

Obstructions up to 30 in. (.8 m) wide (C) located against the wall are permitted to be protected when (A) is greater than or equal to (C) minus 8 in. (.2 m) plus (B).

$C \le 30$ in. $\quad$ for metric $C \le .8$ m
$A \ge (C - 8 \text{ in.}) + B$ $\quad$ $A \ge (C - .2 \text{ m}) + B$

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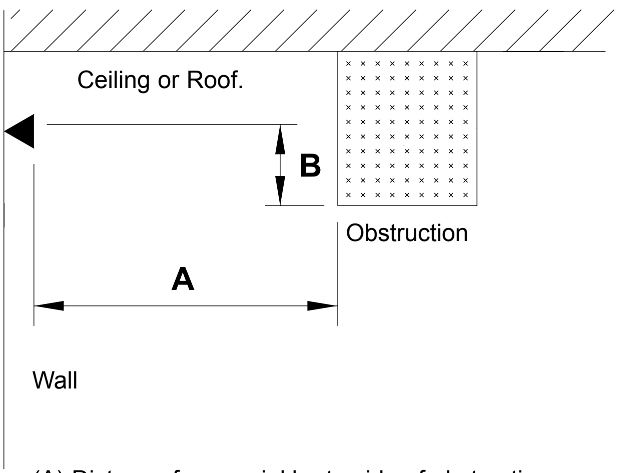
AVOIDING OBSTRUCTIONS TO SPRINKLER DISCHARGE

(Obstruction rules for residential sprinklers are found in section 8.10 of the 2010 edition of NFPA 13.)

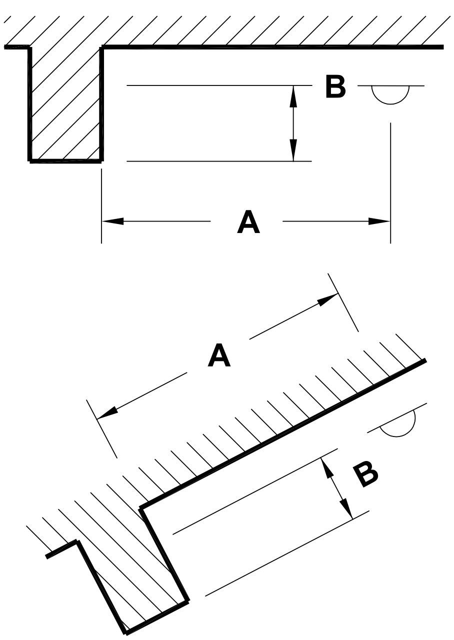
Positioning Residential Horizontal Sidewall Sprinklers - Obstructions at the Ceiling



(A) Distance from sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.

Distance from Sprinkler to Side of Ceiling Obstruction (Dimension A)	Maximum Distance from Deflector to Bottom of Ceiling Obstruction (Dimension B)	
	Inches	mm
Less than 8 ft. (Less than 2.4 m)	No Obstructions Allowed	
8 ft. to less than 10 ft. (2.4 m to less than 3.05 m)	1	25.4
10 ft. to less than 11 ft. (3.05 m to less than 3.35 m)	2	50.8
11 ft. to less than 12 ft. (3.35 m to less than 3.7 m)	3	76
12 ft. to less than 13 ft. (3.7 m to less than 4 m)	4	102
13 ft. to less than 14 ft. (4 m to less than 4.3 m)	6	152
14 ft. to less than 15 ft. (4.3 m to less than 4.6 m)	7	178
15 ft. to less than 16 ft. (4.6 m to less than 4.9 m)	9	229
16 ft. to less than 17 ft. (4.9 m to less than 5.2 m)	11	279
17 ft. or greater (5.2 m or greater)	14	356

Positioning Residential Horizontal Sidewall Sprinklers - Obstructions Along Walls



Distance from Sprinkler to Side of Obstruction Along Wall (Dimension A)	Maximum Distance from Deflector to Bottom of Obstruction (Dimension B)	
	Inches	mm
Less than 1 ft. 6 in. (Less than 457 mm)	0	0
1 ft. 6 in. to less than 3 ft. (457 mm to less than .94 m)	1	25.4
3 ft. to less than 4 ft. (.91 m to less than 1.2 m)	3	76
4 ft. to less than 4 ft. 6 in. (1.2 m to less than 1.37 m)	5	127
4 ft. 6 in. to less than 6 ft. (1.37 m to less than 1.8 m)	7	178
6 ft. to less than 6 ft. 6 in. (1.8 m to less than 2 m)	9	229
6 ft. 6 in. to less than 7 ft. (2 m to less than 2.1 m)	11	279
7 ft. or greater (2.1 m or greater)	14	356

(A) Distance from sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.

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LOCATING RESIDENTIAL SPRINKLERS NEAR HEAT SOURCES

Ordinary temperature rated residential sprinklers (135 °F to 170 °F rated) are only to be installed where the maximum ambient ceiling temperature will not exceed 100 °F. Where the maximum ambient ceiling temperature will be from 101 °F to 150 °F, use intermediate temperature rated residential sprinklers (175 °F to 225 °F rated).

Residential sprinklers must be positioned a sufficient distance away from heat sources that include fireplaces, stoves, kitchen ranges, wall ovens, hot water pipes, water heaters, furnaces and associated flues and ducts, and light fixtures. The following minimum distances must be maintained for both ordinary and intermediate temperature rated residential sprinklers as indicated.

Heat Source	Minimum Distance from Edge of Source to Ordinary Temperature Rated Sprinkler		Minimum Distance from Edge of Source to Intermediate Temperature Rated Sprinkler	
	Inches	metric	Inches	metric
Side of open or recessed fireplace	36	.91 m	12	305 mm
Front of recessed fire place	60	1.5 m	36	.91 m
Coal- or wood-burning stove	42	1.1 m	12	305 mm
Kitchen range	18	457 mm	9	229 mm
Wall oven	18	457 mm	9	229 mm
Hot air flues	18	457 mm	9	229 mm
Uninsulated heat ducts	18	457 mm	9	229 mm
Uninsulated hot water pipes	12	305 mm	6	152 mm
Side of ceiling- or wall-mounted hot air diffusers	24	.61 m	12	305 mm
Front of wall-mounted hot air diffusers	36	.91 m	18	457 mm
Hot water heater or furnace	6	152 mm	3	76 mm
Light fixture less than 250W	6	152 mm	3	76 mm
Light fixture 250W to 499W	12	305 mm	6	152 mm
Where residential sprinklers will be exposed to the rays of the sun passing through glass or plastic skylights, use intermediate temperature rated sprinklers.				
When locating residential sprinklers in an unventilated concealed compartment, under an unventilated attic or uninsulated roof, where the maximum ambient temperature does not exceed 150 °F, use intermediate temperature rated sprinklers.				

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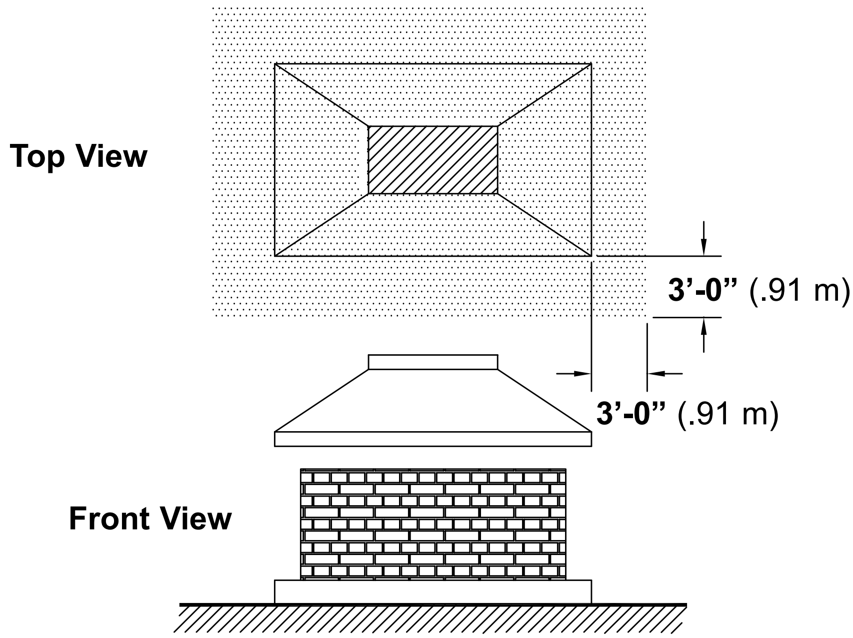
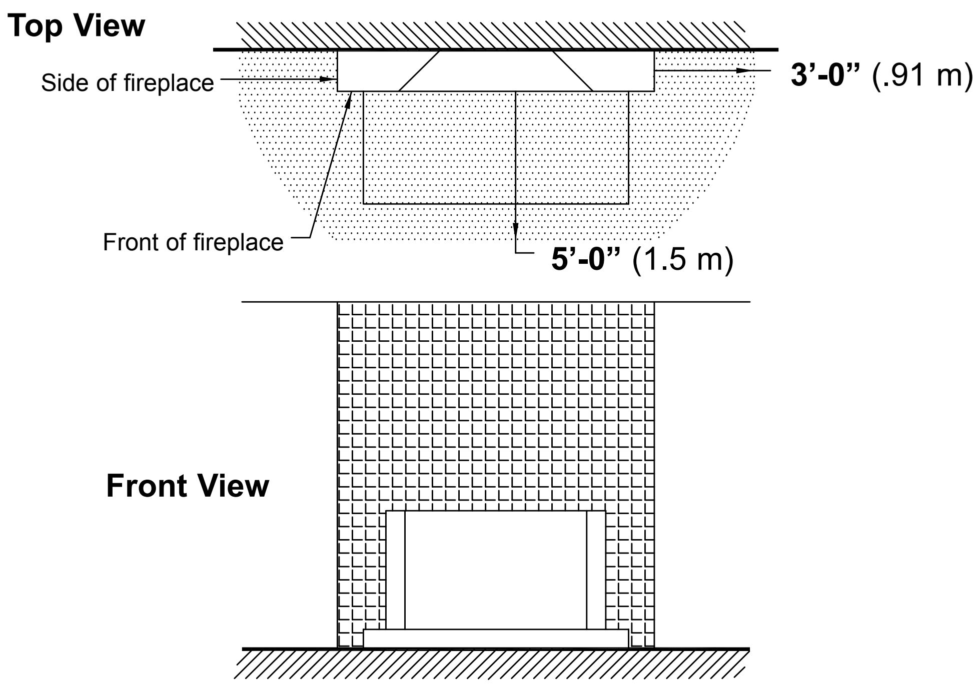
NOTE: The dimensions shown are intended to apply to residential sprinklers installed in ceilings above fireplaces used to burn products that cause elevated temperatures at or near the ceiling in areas surrounding the fireplace. The recommendations should not be construed to apply to decorative non-opening fireplaces such as gas fire units that will not cause elevated temperatures at the ceiling.



Sprinklers near an open hearth fireplace must be located outside of the shaded area or be intermediate degree rated.



Sprinklers near a recessed hearth fireplace must be located outside of the shaded area [at least 3'-0" (.91 m)] from the side of a recessed fireplace and at least 5'-0" (1.5 m) from the front) or be intermediate degree rated.

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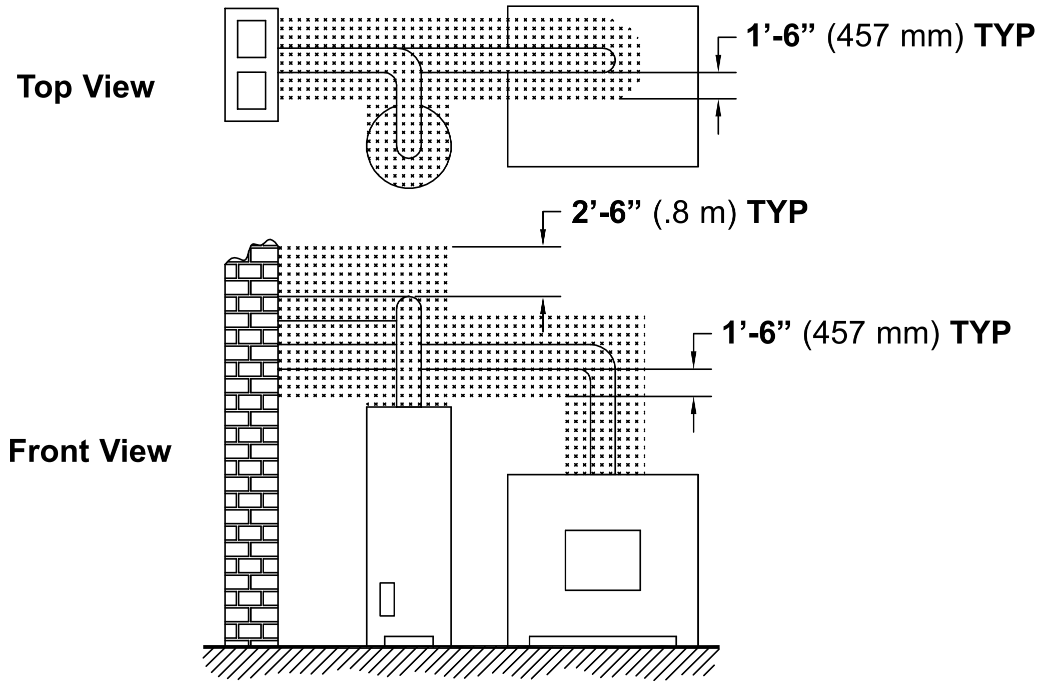
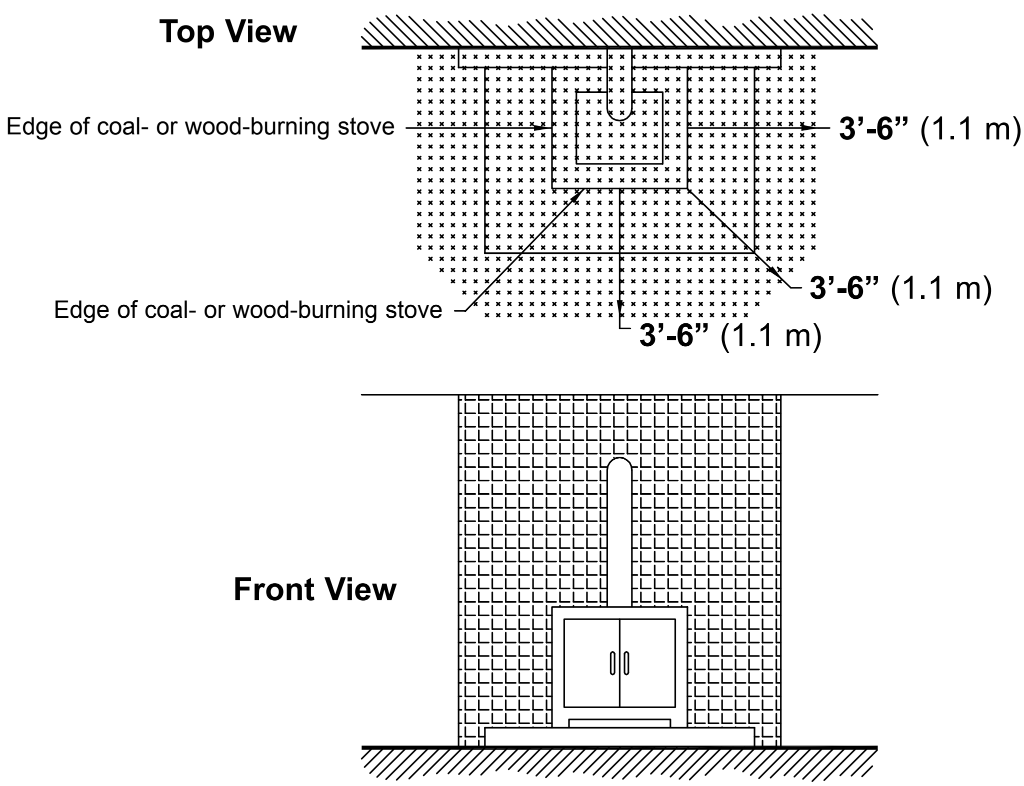


Sprinklers near a furnace or water heater must be located outside of the shaded area or be intermediate degree rated.



Sprinklers near a coal- or wood-burning stove must be located outside of shaded area or be intermediate degree rated.

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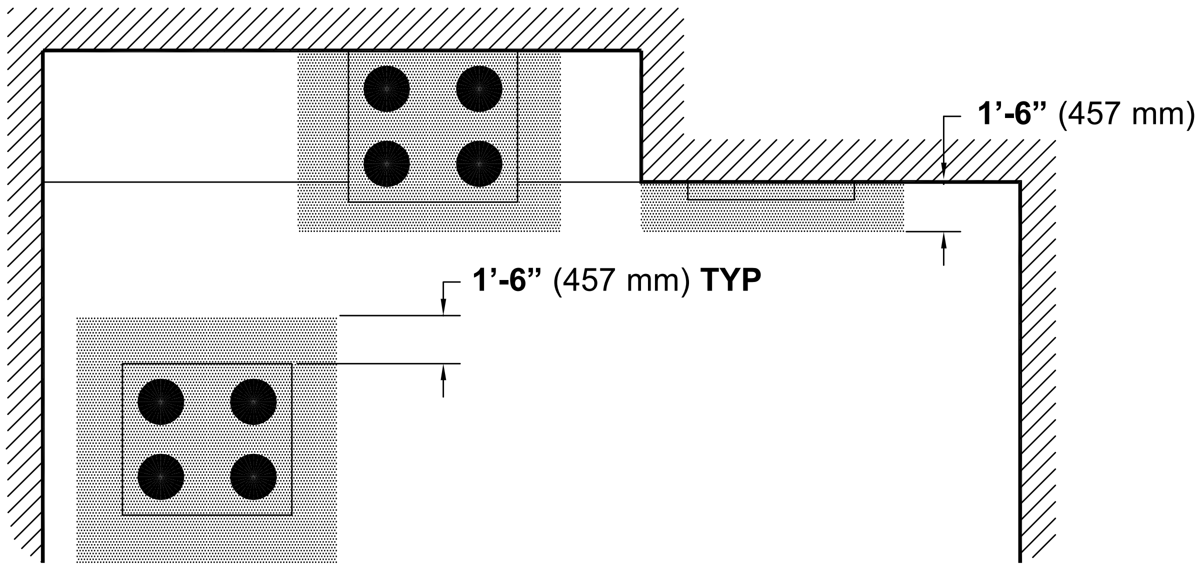
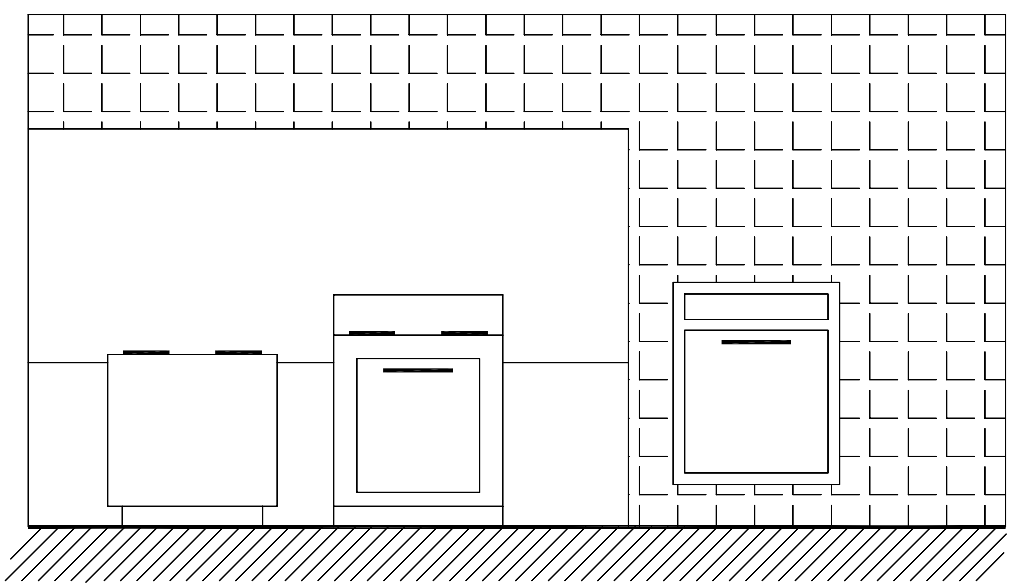
Top View



Front View



Sprinklers near a range or wall oven must be located outside of shaded areas or be intermediate degree rated.

VIKING

BULLETIN

CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

SPRINKLERS ARE FRAGILE - HANDLE WITH CARE!

General Handling and Storage:

- Store sprinklers in a cool, dry place.
- Protect sprinklers during storage, transport, handling, and after installation.
- Use the original shipping containers. DO NOT place sprinklers loose in boxes, bins, or buckets.
- Keep sprinklers separated at all times. DO NOT allow metal parts to contact sprinkler operating elements.

For Pre-Assembled Drops:

- Protect sprinklers during handling and after installation.
- For recessed assemblies, use the protective sprinkler cap (Viking Part Number 10364).

Sprinklers with Protective Shields or Caps:

- DO NOT remove shields or caps until after sprinkler installation and there no longer is potential for mechanical damage to the sprinkler operating elements.
- **Sprinkler shields or caps MUST be removed BEFORE placing the system in service!**
- Remove the sprinkler shield by carefully pulling it apart where it is snapped together.
- Remove the cap by turning it slightly and pulling it off the sprinkler.

Sprinkler Installation:

- DO NOT use the sprinkler deflector or operating element to start or thread the sprinkler into a fitting.
- **Use only the designated sprinkler head wrench!** Refer to the current sprinkler technical data page to determine the correct wrench for the model of sprinkler used.
- DO NOT install sprinklers onto piping at the floor level.
- Install sprinklers after the piping is in place to prevent mechanical damage.
- DO NOT allow impacts such as hammer blows directly to sprinklers or to fittings, pipe, or couplings in close proximity to sprinklers. Sprinklers can be damaged from direct or indirect impacts.
- DO NOT attempt to remove drywall, paint, etc., from sprinklers.
- **Take care not to over-tighten the sprinkler and/or damage its operating parts!**

Maximum Torque:

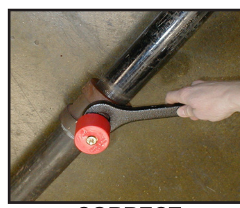
1/2" NPT:	**14 ft-lbs. (19.0 N-m)**
3/4" NPT:	**20 ft-lbs. (27.1 N-m)**
1" NPT:	**30 ft-lbs. (40.7 N-m)**

CORRECT
(Original container used)

INCORRECT
(Placed loose in box)

CORRECT
(Protected with caps)

INCORRECT
(Protective caps not used)



CORRECT
(Piping is in place at the ceiling)

INCORRECT
(Sprinkler at floor level)

CORRECT
(Special installation wrenches)

INCORRECT
(Designated wrench not used)

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

WARNING

Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed. Never install sprinklers that have been dropped, damaged, or exposed to temperatures exceeding the maximum ambient temperature allowed. Sprinklers that have been painted in the field must be replaced per NFPA 13. Protect sprinklers from paint and paint overspray in accordance with the installation standards. Do not clean sprinklers with soap and water, ammonia, or any other cleaning fluid. Do not use adhesives or solvents on sprinklers or their operating elements.

Refer to the appropriate technical data page and NFPA standards for complete care, handling, installation, and maintenance instructions. For additional product and system information Viking data pages and installation instructions are available on the Viking Web site at www.vikinggroupinc.com.

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

PROTECTIVE SPRINKLER SHIELDS AND CAPS

General Handling and Storage:

Many Viking sprinklers are available with a plastic protective cap or shield temporarily covering the operating elements. The snap-on shields and caps are factory installed and are intended to help protect the operating elements from mechanical damage during shipping, storage, and installation. NOTE: It is still necessary to follow the care and handling instructions on the appropriate sprinkler technical data sheets* when installing sprinklers with bulb shields or caps.

WHEN TO REMOVE THE SHIELDS AND CAPS:

NOTE: SHIELDS AND CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!

Remove the shield or cap from the sprinkler only after checking all of the following:

- The sprinkler has been installed*.
- The wall or ceiling finish work is completed where the sprinkler is installed and there no longer is a potential for mechanical damage to the sprinkler operating elements.

SHIELDS AND CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!

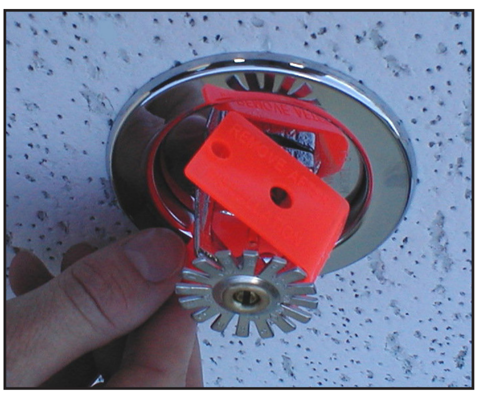


Figure 1: Sprinkler shield being removed from a pendent sprinkler.

Figure 2: Sprinkler cap being removed from a pendent sprinkler.

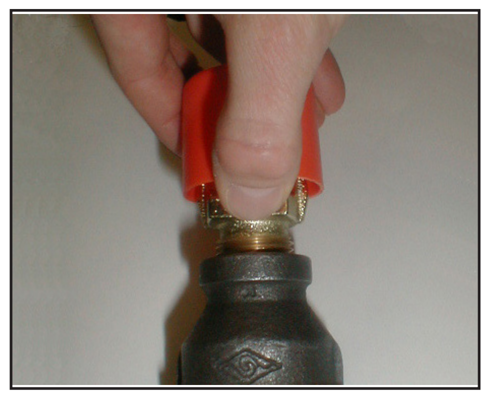


Figure 3: Sprinkler cap being removed from and upright sprinkler.

HOW TO REMOVE SHIELDS AND CAPS:

No tools are necessary to remove the shields or caps from sprinklers. DO NOT use any sharp objects to remove them! **Take care not to cause mechanical damage to sprinklers when removing the shields or caps.** When removing caps from fusible element sprinklers, use care to prevent dislodging ejector springs or damaging fusible elements. NOTE: Squeezing the sprinkler cap excessively could damage sprinkler fusible elements.

- To remove the shield, simply pull the ends of the shield apart where it is snapped together. Refer to Figure 1.
- To remove the cap, turn it slightly and pull it off the sprinkler. Refer to Figures 2 and 3.

NOTICE Refer to the current sprinkler technical data page to determine the correct sprinkler wrench for the model of sprinkler used.

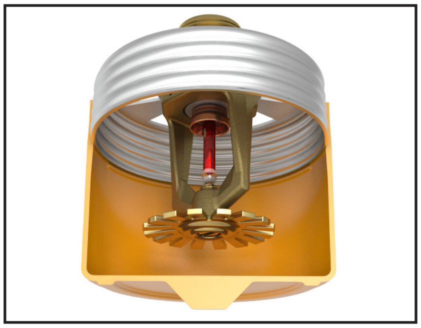
WARNING Never install sprinklers that have been dropped, damaged, or exposed to temperatures in excess of the maximum ambient temperature allowed.

*** Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.**

VIKING | BULLETIN | **CARE AND HANDLING OF SPRINKLERS**

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

CAUTION CONCEALED COVER ASSEMBLIES ARE FRAGILE!
TO ASSURE SATISFACTORY PERFORMANCE OF THE PRODUCT, HANDLE WITH CARE.



Concealed Sprinkler and Adapter Assembly with Protective Cap

Concealed Sprinkler and Adapter Assembly (Protective Cap Removed)

Cover Plate Assembly (Pendent Cover 12381 shown)

GENERAL HANDLING AND STORAGE INSTRUCTIONS:

- Do not store in temperatures exceeding 100 °F (38 °C). Avoid direct sunlight and confined areas subject to heat.
- Protect sprinklers and cover assemblies during storage, transport, handling, and after installation.
  -- Use original shipping containers.
  -- Do not place sprinklers or cover assemblies loose in boxes, bins, or buckets.
- Keep the sprinkler bodies covered with the protective sprinkler cap any time the sprinklers are shipped or handled, during testing of the system, and while ceiling finish work is being completed.
- Use only the designated Viking recessed sprinkler wrench (refer to the appropriate sprinkler data page) to install these sprinklers. **NOTE:** The protective cap is temporarily removed during installation and then placed back on the sprinkler for protection until finish work is completed.
- Do not over-tighten the sprinklers into fittings during installation.
- Do not use the sprinkler deflector to start or thread the sprinklers into fittings during installation.
- Do not attempt to remove drywall, paint, etc., from the sprinklers.
- Remove the plastic protective cap from the sprinkler before attaching the cover plate assembly. **PROTECTIVE CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!**

Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.

VIKING | BULLETIN | CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

USE THE FOLLOWING PRECAUTIONS WHEN HANDLING WAX-COATED SPRINKLERS

Many of Viking's sprinklers are available with factory-applied wax coating for corrosion resistance. These sprinklers MUST receive appropriate care and handling to avoid damaging the wax coating and to assure satisfactory performance of the product.

General Handling and Storage of Wax-Coated Sprinklers:

- Store the sprinklers in a cool, dry place (in temperatures below the maximum ambient temperature allowed for the sprinkler temperature rating. Refer to Table 1 below.)
- Store containers of wax-coated sprinklers separate from other sprinklers.
- Protect the sprinklers during storage, transport, handling, and after installation.
- Use original shipping containers.
- Do not place sprinklers in loose boxes, bins, or buckets.

Installation of Wax-Coated Sprinklers:

Use only the special sprinkler head wrench designed for installing wax-coated Viking sprinklers (any other wrench may damage the unit).

- Take care not to crack the wax coating on the units.
- For touching up the wax coating after installation, wax is available from Viking in bar form. Refer to Table 1 below. The coating MUST be repaired after sprinkler installation to protect the corrosion-resistant properties of the sprinkler.
- Use care when locating sprinklers near fixtures that can generate heat. Do not install sprinklers where they would be exposed to temperatures exceeding the maximum recommended ambient temperature for the temperature rating used.
- Inspect the coated sprinklers frequently soon after installation to verify the integrity of the corrosion resistant coating. Thereafter, inspect representative samples of the coated sprinklers in accordance with NFPA 25. Close up visual inspections are necessary to determine whether the sprinklers are being affected by corrosive conditions.

TABLE 1

Sprinkler Temperature Rating (Fusing Point)	Wax Part Number	Wax Melting Point	Maximum Ambient Ceiling Temperature[1]	Wax Color
155 °F (68 °C) / 165 °F (74 °C)	02568A	148 °F (64 °C)	100 °F (38 °C)	Light Brown
175 °F (79 °C)	04146A	161 °F (71 °C)	150 °F (65 °C)	Brown
200 °F (93 °C)	04146A	161 °F (71 °C)	150 °F (65 °C)	Brown
220 °F (104 °C)	02569A	170 °F (76 °C)	150 °F (65 °C)	Dark Brown
286 °F (141 °C)	02569A	170 °F (76 °C)	150 °F (65 °C)	Dark Brown

[1] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

⚠WARNING Never install sprinklers that have been dropped, damaged, or exposed to temperatures in excess of the maximum ambient temperature allowed.

Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.

VIKING	TECHNICAL DATA	SPRINKLER OVERVIEW

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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1. DESCRIPTION

Viking fire sprinklers consist of a threaded frame with a specific waterway or orifice size and a deflector for distributing water in a specified pattern. A closed or sealed sprinkler refers to a complete assembly, including the thermosensitive operating element. An open sprinkler does not use an operating element and is open at all times. The distribution of water is intended to extinguish a fire or to control its spread.

Viking sprinklers are available in several models and styles. Refer to specific sprinkler technical data pages for available styles, finishes, temperature ratings, thread sizes, and nominal K-Factors for the particular model selected.

2. LISTINGS AND APPROVALS

Refer to the Approval Charts on the appropriate sprinkler technical data page(s) and/or approval agency listings.

> **WARNING**: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

3. TECHNICAL DATA

Pressure Ratings:

Maximum allowable water working pressure is 175 psig (12 Bar) unless rated and specified for high water working pressure [250 psig (17.2 bar)].

Sprinkler Identification:

Viking sprinklers are identified and marked with the word “Viking”, the sprinkler identification number (SIN) consisting of “VK” plus a three digit number*, the model letter, and the year of manufacture.

Available Finishes:

Viking sprinklers are available in several decorative finishes. Some models are available with corrosion-resistant coatings or are fabricated from non-corrosive material. Refer to the sprinkler technical data page for additional information.

Available Temperature Ratings:

Viking sprinklers are available in several temperature ratings that relate to a specific temperature classification. Applicable installation rules mandate the use and limitations of each temperature classification. In selecting the appropriate temperature classification, the maximum expected ceiling temperature must be known. When there is doubt as to the maximum temperature at the sprinkler location, a maximum-reading thermometer should be used to determine the temperature under conditions that would show the highest readings to be expected. In addition, recognized installation rules may require a higher temperature classification, depending upon sprinkler location, occupancy classification, commodity classification, storage height, and other hazards. In all cases, the maximum expected ceiling temperature dictates the lowest allowable temperature classification. Sprinklers located immediately adjacent to a heat source may require a higher temperature rating.

K-Factors:

Viking sprinklers are available in several orifice sizes with related K-Factors. The orifice is a tapered waterway and, therefore, the K-Factor given is nominal. Nominal U.S. K-Factors are provided in accordance with the 1999 edition of NFPA 13, Section 3-2.3. Refer to the specific data page for appropriate K-Factor information.

Available Styles:

Viking sprinklers are available for installation in several positions as indicated by a stamping on the deflector. The deflector style dictates the appropriate installation position of the sprinkler; it breaks the solid stream of water issuing from the sprinkler orifice to form a specific spray pattern. The following list indicates the various styles and identification of Viking sprinklers.

<u>UPRIGHT SPRINKLER:</u> A sprinkler intended to be installed with the deflector above the frame so water flows upward through the orifice, striking the deflector and forming an umbrella-shaped spray pattern downward. Marked “SSU” (Standard Sprinkler Upright) or “UPRIGHT” on the deflector.

<u>PENDENT SPRINKLER:</u> A sprinkler intended to be oriented with the deflector below the frame so water flows downward through the orifice, striking the deflector and forming an umbrella-shaped spray pattern downward. Marked “SSP” (Standard Sprinkler Pendent) or “PENDENT” on the deflector.

> **Viking Technical Data may be found on The Viking Corporation’s Web site at http://www.vikinggroupinc.com. The Web site may include a more recent edition of this Technical Data Page.**

<u>CONVENTIONAL SPRINKLER:</u> An “old style” sprinkler intended to be installed with the deflector in either the upright or pendent position. The deflector provides a spherical type pattern with 40 to 60 percent of the water initially directed downward and a proportion directed upward. Must be installed in accordance with installation rules for conventional or old style sprinklers. DO NOT USE AS A REPLACEMENT FOR STANDARD SPRAY SPRINKLERS. Marked “C U/P” (Conventional Upright/Pendent) on the deflector.

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VERTICAL SIDEWALL (VSW) SPRINKLER: A sprinkler intended for installation near the wall and ceiling. The deflector provides a water spray pattern outward in a quarter-spherical pattern and can be installed in the upright or pendent position with the flow arrow in the direction of discharge. Marked “SIDEWALL” on the deflector with an arrow and the word “FLOW”. (Note: Some vertical sidewall sprinklers can only be installed in the upright or pendent position—in this case, the sprinkler will also be marked “UPRIGHT” or “PENDENT”.)

HORIZONTAL SIDEWALL (HSW) SPRINKLER: A sprinkler intended for installation near the wall and ceiling. The special deflector provides a water spray pattern outward in a quarter-spherical pattern. Most of the water is directed away from the nearby wall with a small portion directed at the wall behind the sprinkler. The top of the deflector is oriented parallel with the ceiling or roof. The flow arrows point in the direction of discharge. Marked “SIDEWALL” and “TOP” with an arrow and the word “FLOW”.

EXTENDED COVERAGE (EC) SPRINKLER: A spray sprinkler designed to discharge water over an area having the maximum dimensions indicated in the individual listings. Maximum area of coverage, minimum flow rate, orifice size, and nominal K-Factor are specified in the individual listings. EC sprinklers are intended for Light-Hazard occupancies with smooth, flat, horizontal ceilings unless otherwise specified. In addition to the above markings, the sprinkler is marked “EC”.

QUICK RESPONSE (QR) SPRINKLER: A spray sprinkler with a fast- actuating operating element. The use of quick response sprinklers may be limited due to occupancy and hazard. Refer to the Authority Having Jurisdiction (AHJ) prior to installing.

QUICK RESPONSE EXTENDED COVERAGE (QREC) SPRINKLER: A spray sprinkler designed to discharge water over an area having the maximum dimensions indicated in the individual listing. This is a sprinkler with an operating element that meets the criteria for quick response. QREC sprinklers are only intended for Light Hazard occupancies. The sprinkler is marked “QREC”.

FLUSH SPRINKLER: A decorative spray sprinkler intended for installation with a concealed piping system. The unit is mounted flush with the ceiling or wall, with the fusible link exposed. Upon actuation, the deflector extends beyond the ceiling or wall to distribute water discharge. The sprinkler is marked “SSP”, “PEND”, or “SIDEWALL” and “TOP”.

CONCEALED SPRINKLER: A decorative spray sprinkler intended for installation with a concealed piping system. The sprinkler is hidden from view by a cover plate installed flush with the ceiling or wall. During fire conditions, the cover plate detaches, and upon sprinkler actuation, the deflector extends beyond the ceiling or wall to distribute water discharge. The sprinkler is marked “SSP”, “PEND”, or “SIDEWALL” and “TOP”.

RECESSED SPRINKLER: A spray sprinkler assembly intended for installation with a concealed piping system. The assembly consists of a sprinkler installed in a decorative adjustable recessed escutcheon that minimizes the protrusion of the sprinkler beyond the ceiling or wall without adversely affecting the sprinkler distribution or sensitivity. Refer to the appropriate technical data page for allowable sprinkler models, temperature ratings, and occupancy classifications. DO NOT RECESS ANY SPRINKLER NOT LISTED FOR USE WITH THE ESCUTCHEON.

CORROSION-RESISTANT SPRINKLER: A special service sprinkler with non-corrosive protective coatings, or that is fabricated from non-corrosive material, for use in atmospheres that would normally corrode sprinklers.

DRY SPRINKLER: A special-service sprinkler intended for installation on dry pipe systems or wet pipe systems where the sprinkler is subject to freezing temperatures. The unit consists of a sprinkler permanently secured to an extension nipple with a sealed inlet end to prevent water from entering the nipple until the sprinkler operates. The unit MUST be installed in a tee fitting. Dry upright sprinklers are marked with the “B” dimension [distance from the face of the fitting (tee) to the top of the deflector]. Dry pendent and sidewall sprinklers are marked with the “A” dimension [the distance from the face of fitting (tee) to the finished surface of the ceiling or wall].

LARGE DROP SPRINKLER: A type of special application sprinkler used to provide fire control of specific high-challenge fire hazards. Large drop sprinklers are designed to produce an umbrella-shaped spray pattern downward with a higher percentage of “large” water droplets than standard spray sprinklers. The sprinkler has an extra-large orifice with a nominal K-Factor of 11.2. Marked “HIGH CHALLENGE” and “UPRIGHT”.

EARLY SUPPRESSION FAST-RESPONSE (ESFR) SPRINKLER: A sprinkler intended to provide fire suppression of specific high-challenge fire hazards through the use of a fast response fusible link, 14.0, 16.8, or 25.2 nominal K-Factor, and special deflector. ESFR sprinklers are designed to produce high-momentum water droplets in a hemispherical pattern below the deflector. This permits penetration of the fire plume and direct wetting of the burning fuel surface while cooling the atmosphere early in the development of a high-challenge fire. Marked “ESFR” and “UPRIGHT” or “PEND”.

INTERMEDIATE LEVEL/RACK STORAGE SPRINKLER: A standard spray sprinkler assembly designed to protect its operating element from the spray of sprinklers installed at higher elevations. The assembly consists of a standard or large orifice upright or pendent sprinkler with an integral upright or pendent water shield and guard assembly. Use only those sprinklers that have been tested and listed for use with the assembly. Refer to the technical data page for allowable sprinkler models.

RESIDENTIAL SPRINKLER: A sprinkler intended for use in the following occupancies: one- and two-family dwellings with the fire protection sprinkler system installed in accordance with NFPA 13D; residential occupancies up to four stories in height with the fire protection system installed in accordance with NFPA 13R; and where allowed by the Authority Having Jurisdiction in residential portions of any occupancy with the fire protection system installed in accordance with NFPA 13.

VIKING | TECHNICAL DATA | SPRINKLER OVERVIEW

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

Residential sprinklers have a unique distribution pattern and utilize a “fast response” heat sensitive operating element. They enhance survivability in the room of fire origin and are designed to provide a life safety environment for a minimum of ten minutes. For this reason, residential sprinklers must not be used to replace standard sprinklers unless tested for and approved by the Authority Having Jurisdiction. In addition to standard markings, the unit is identified as “RESIDENTIAL SPRINKLER” or “RES”.

4. INSTALLATION
Refer to appropriate NFPA Installation Standards.

5. OPERATION
Refer to the appropriate sprinkler technical data page(s).

6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
Viking sprinklers are available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking’s current list price schedule or contact Viking directly.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers and the appropriate sprinkler general care, installation, and maintenance guide. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, FM Global, LPCB, APSAD, VdS or other similar organizations, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. The sprinkler technical data page may contain installation requirements specific for the sprinkler model selected. The use of certain types of sprinklers may be limited due to occupancy and hazard. Refer to the Authority Having Jurisdiction prior to installation.

VIKING | BULLETIN

BEST PRACTICES FOR RESIDENTIAL SPRINKLER HANDLING & INSTALLATION

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page.

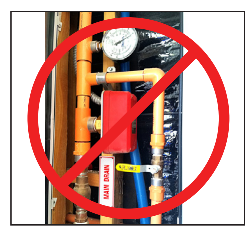
SPRINKLERS ARE FRAGILE - HANDLE WITH CARE!

- Always keep sprinklers in a cool dry place.
- Protect sprinklers during storage, transport and handling as well as before, during and after installation. Refer to Viking's Care and Handling of Sprinklers Bulletin Form No. F_091699[2].
- Proper transit, storage and installation of sprinklers in a high-heat environment is a must. Care should be taken to prevent sprinklers from being exposed to ambient heat conditions in excess of those referenced in installation standards.
- Do not stage or store sprinklers on the job site in advance in a non-conditioned space prior to installation.
- Keep sprinklers in the original packaging and check temperature indicators on box label prior to installation. If the indicator has turned black, DO NOT install any product contained in the box. Refer to Viking product return policies.
- Temperatures exceeding the maximum ambient temperature of the sprinkler temperature-rating during storage, transport, handling and installation must be avoided.
- Per NFPA standards 13, 13R, and 13D, sprinklers installed where maximum ambient temperatures are at or over 101 °F (38 °C) through 150 °F (66 °C) shall be intermediate temperature-rated sprinklers. Additionally, if sprinklers are installed in an unventilated concealed space under an uninsulated roof or in an unventilated attic, they shall be of intermediate temperature classification.
- Sprinklers installed where ambient temperatures are at or below 100 °F (38 °C) may be either ordinary or intermediate temperature-rated sprinklers. Refer to NFPA standards 13R 6.2.3.1 and 13D 7.5.6.1.
- Rough-in of sprinkler piping during hot weather conditions should not include the installation of sprinklers unless reasonable ambient temperatures can be maintained. Ambient temperatures that are considered when choosing the temperature rating for a sprinkler should take into account the range of ambient temperatures that are expected from installation through establishment and maintenance of temperature in a conditioned space. Appropriate insulation may be considered. **Example**: An ordinary temperature sprinkler should not be exposed to maximum ambient temperature higher than 100 °F (38 °C) or more. Refer to NFPA 13, Table 6.2.5.1, NFPA 13R, 6.2.3.1 and NFPA 13D, 7.5.6.1.
- CPVC fire sprinkler products exposed to high ambient temperatures (e.g. installed in unventilated, concealed spaces such as attics) should be insulated to maintain a cooler environment. Refer to Viking Plastics Installation and Design Manual, Form No. F_080712[2], for care and handling procedures.
- Protect all sprinklers and connecting CPVC piping in attic spaces and unvented concealed spaces from excessive heat exposure above 100 °F (38 °C). To separate excessive attic heat, properly tent and fully insulate all pipe in unconditioned spaces.
- Pressure relief valves should be installed on wet sprinkler systems where there is a risk of over-pressurization of a checked water supply, due to thermal expansion. Refer to NFPA 13, 7.1.2.1 and NFPA 13D, A.5.2.2.2.
- Fire sprinkler systems should be installed per current referenced editions of building codes and installation standards adopted in the jurisdiction where work is being performed.

INCORRECT
(Heat exposure)

INCORRECT
(Unconditioned at rough-in)

INCORRECT
(Exposed piping)



INCORRECT
(No pressure relief valve)

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

[1]Hot weather condition is defined as temperatures that can reach the maximum ambient temperature-rating of the sprinkler.
[2]Clicking on blue hyperlink will open referenced document.

⚠ WARNING

Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed. Never install sprinklers that have been dropped, damaged, or exposed to temperatures exceeding the maximum ambient temperature allowed. Sprinklers that have been painted in the field must be replaced per NFPA 13. Protect sprinklers from paint and paint overspray in accordance with the installation standards. Do not clean sprinklers with soap and water, ammonia, or any other cleaning fluid. Do not use adhesives or solvents on sprinklers or their operating elements.

Refer to the appropriate technical data page and NFPA standards for complete care, handling, installation, and maintenance instructions. For additional product and system information Viking data pages and installation instructions are available on the Viking Web site at www.vikinggroupinc.com.

VIKING®	BULLETIN	REGULATORY AND HEALTH WARNINGS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

1. DESCRIPTION

Regulatory and Health Warnings applying to materials used in the manufacture and construction of fire protection products are provided herin as they relate to legally mandated jurisdictional regions.

⚠ WARNING
STATE OF CALIFORNIA, USA Installing or servicing fire protection products such as sprinklers, valves, piping etc. can expose you to chemicals including, but not limited to, lead, nickel, butadiene, titaninum dioxide, chromium, carbon black, and acrylonitrile which are known to the State of California to cause cancer or birth defects or other reproductive harm.
For more information, go to **www.P65Warnings.ca.gov**

2. WARRANTY TERMS AND CONDITIONS

For details of warranty, refer to Viking's current list price schedule at **www.vikinggroupinc.com** or contact Viking directly.

58" (4'-10") MAXIMUM LENGTH OF THE FLEX DRY BARREL, PER THE MANUFACTURER.
DASHED SPRINKLER LINES INDICATE FLEX PIPING.

FOR TYPICAL HYDRAULIC CALCULATION INFORMATION FOR THIS MODEL HOUSE, SEE SHEET 6 OF 8.

Plans APPROVED by Fire Marshal

- Fire Marshal field inspection REQUIRED for final approval.
- No inspection without approved, color-print plans onsite.
- Approval of this plan does not constitute approval to omit, amend, or otherwise not comply with any of the provisions in the adopted codes, standards, or manufacturer's installation requirements.

Date: 07/15/2020
Reviewed by: M. Long
Permit #: Multiple Permits

AP#:
201840100
201840102
201840103
201840105
201840107
201840108

GROUND FLOOR PLAN   SECOND FLOOR PLAN   THIRD FLOOR PLAN   LOFT FLOOR PLAN

GENERAL NOTE

"Sprinklers are not required when multiple bathrooms are adjacent to each other and are considered separate rooms, provided they contain a lintel of a minimum of 8" and they are dedicated to personal hygiene, or a water closet, or bathing capability such as a shower or tub, or any combination of facilities thereof. NFPA #13R, 2016 was used as a future reference guide for clarification."

CEILING HEIGHTS (UNLESS NOTED OTHERWISE)
1ST FLOOR - 9'-1 1/8"
2ND FLOOR - 10'-1 1/8"
3RD FLOOR - 9'-1 1/8"
4TH FLOOR - 9'-1 1/8"

MAXIMUM SPACING OF ALL RESIDENTIAL SPRINKLERS

PENDENT HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

SIDEWALL HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 4" TO 6" FROM CEILING

DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

FLEX DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

SCALE 1/4"=1'-0" 0' 5' 10' 15' 20'

JOB NAME: FARADAY PARK
1870 EASTERLY RD.
RESTON, VA. 20190

DATE: 6-25-2020	SCALE: 1/4"=1'-0"	CONTRACT NO: 20-0073	APPROVALS: FAIRFAX COUNTY F.M.O.
PLAN NORTH	DRAWN BY: CMS	REVIEWED BY:	CONTRACTOR: KNUTSON COMPANIES
	AREA: LOT 3	CAD FILE: FARADAYSUBMIT	DRWG NO: 1 OF 8
	PERMIT NO: 200580056	CONTRACTOR PHONE: 703-996-4246	

BFS
BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

Plans APPROVED by Fire Marshal

Date: 07/15/2020

Permit #: Multiple Permits

AP#:
201840100
201840102
201840103
201840105
201840107
201840108

58" (4'-10") MAXIMUM LENGTH OF THE FLEX DRY BARREL, PER THE MANUFACTURER.
DASHED SPRINKLER LINES INDICATE FLEX PIPING.

FOR TYPICAL HYDRAULIC CALCULATION INFORMATION FOR THIS MODEL HOUSE, SEE SHEET 6 OF 8.

ONLY NIBCO 5012-S-BI CPVC TEE TO BE USED ON DRY SPRINKLER HEADS.

GROUND FLOOR PLAN

SECOND FLOOR PLAN

THIRD FLOOR PLAN

LOFT FLOOR PLAN

GENERAL NOTE

"Sprinklers are not required when multiple bathrooms are adjacent to each other and are considered separate rooms, provided they contain a lintel of a minimum of 8" and they are dedicated to personal hygiene, or a water closet, or bathing capability such as a shower or tub, or any combination of facilities thereof. NFPA #13R, 2016 was used as a future reference guide for clarification."

CEILING HEIGHTS (UNLESS NOTED OTHERWISE)

1ST FLOOR – 9'-1 1/8"
2ND FLOOR – 10'-1 1/8"
3RD FLOOR – 9'-1 1/8"
4TH FLOOR – 9'-1 1/8"

MAXIMUM SPACING OF ALL RESIDENTIAL SPRINKLERS

PENDENT HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

SIDEWALL HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 4" TO 6" FROM CEILING

DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

FLEX DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

PLAN REVISIONS

DATE:	BY:	DESCRIPTION:

ABBREVIATIONS

CLG	CEILING
UNO	UNLESS NOTED OTHERWISE
UH	UNIT HEATER
GB	GYPSUM BOARD
AT	ACCOUSTICAL TILE CEILING
CIF	CUT IN FIELD
CL	CENTER LINE
BD	BELOW DECK
AFF	ABOVE FINISHED FLOOR
TYP	TYPICAL

SYMBOLS

⊗	RISER SYMBOL
●	PIPE DROP
○	PIPE RISE
/	HANGER
<	SLOPE PIPE
0'-0"	DIMENSIONS
D	CAP
◁	PLUG
*	HEAD-GUARDS
	HEAT SHIELD
	GROOVED COUPLING
+0'-0"	CENTER OF PIPE ELEVATION
⬡	HYDRAULIC REFERENCE POINT
BTAG	BRANCH LINE TAG NUMBER
MTAG	MAIN TAG NUMBER
	GRVD RED CPLG / FORCED CPLG
ABD	AUTOMATIC BALL DRIP
	FLOW SWITCH
	FIRE HOSE VALVE

SPECIALTY ITEMS

FIRE PUMP:	F.D.C.:
RATED FLOW:	TYPE:
RATED BOOST:	SIZE:
SUCT. X DIST.	FINISH:
RELIEF VALVE:	F.H.V.:
FUEL TANK:	FINISH:
MUFFLER:	ALARM VALVE:
TEST HEADER:	DRY VALVE:
TYPE:	OTHER:
SIZE:	
FINISH:	

DESIGN CRITERIA

NFPA REF.: #13R	FLOW TEST:
TYPE SYS.: WET	STATIC PSI
HAZARD: LIGHT HAZARD	RESIDUAL PSI
DENSITY: .05, .10	@ FLOW
REMOTE AREA: 2-4 HEADS	HYDRANT ELEV.
MAX. S.F./HD.: 196, 256	HYD. LOW GRAD.
K FACTOR: 4.0-5.6	HYD. HIGH GRAD.
C FACTOR: 120 – 150	ADJ STATIC PSI
	ADJ RESID. PSI
INSIDE HOSE: N/A	INFO BY
OUTSIDE HOSE:	

SPRINKLERS

SYMBOL	MANUF/MODEL	TEMP.	FINISH	TOTAL
½" REC. PEND.	VIKING / QR VK468	155 DEG	WHITE	19
½" REC. PEND.	VIKING / QR VK468	175 DEG	WHITE	2
½" REC SIDEWALL	VIKING / QR VK486	155 DEG	WHITE	8
½" REC SIDEWALL	VIKING / QR VK486	175 DEG	WHITE	1
½" DRY PEND.	VIKING / QR VK180	155 DEG	WHITE	5
½" FLEX DRY PEND.	VICTAULIC/ QR V3506	155 DEG	WHITE	3
JOB TOTAL	38	TOTAL THIS SHEET		38

SCALE

1/4"=1'-0" 0' 5' 10' 15' 20'

JOB NAME:
FARADAY PARK
1872 EASTERLY RD.
RESTON, VA. 20190

DATE: 6-25-2020	SCALE: 1/4"=1'-0"	CONTRACT NO: 20-0073	APPROVALS: FAIRFAX COUNTY F.M.O.
PLAN NORTH	DRAWN BY: CMS	REVIEWED BY:	CONTRACTOR: KNUTSON COMPANIES
	AREA: LOT 4	CAD FILE: FARADAYSUBMIT	DRWG NO: 2 OF 8
	PERMIT NO: 200580057	CONTRACTOR PHONE: 703-996-4246	

BFS

BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

58" (4'-10") MAXIMUM LENGTH OF THE FLEX DRY BARREL, PER THE MANUFACTURER.
DASHED SPRINKLER LINES INDICATE FLEX PIPING.

FOR TYPICAL HYDRAULIC CALCULATION INFORMATION FOR THIS MODEL HOUSE, SEE SHEET 6 OF 8.

ONLY NIBCO 5012-S-BI CPVC TEE TO BE USED ON DRY SPRINKLER HEADS.

GROUND FLOOR PLAN

SECOND FLOOR PLAN

THIRD FLOOR PLAN

LOFT FLOOR PLAN

GENERAL NOTE

"Sprinklers are not required when multiple bathrooms are adjacent to each other and are considered separate rooms, provided they contain a lintel of a minimum of 8" and they are dedicated to personal hygiene, or a water closet, or bathing capability such as a shower or tub, or any combination of facilities thereof. NFPA #13R, 2016 was used as a future reference guide for clarification."

CEILING HEIGHTS (UNLESS NOTED OTHERWISE)
1ST FLOOR - 9'-1 1/8"
2ND FLOOR - 10'-1 1/8"
3RD FLOOR - 9'-1 1/8"
4TH FLOOR - 9'-1 1/8"

MAXIMUM SPACING OF ALL RESIDENTIAL SPRINKLERS

PENDENT HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

SIDEWALL HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 4" TO 6" FROM CEILING

DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

FLEX DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

SCALE 1/4"=1'-0" 0' 5' 10' 15' 20'

JOB NAME: FARADAY PARK
1874 EASTERLY RD.
RESTON, VA. 20190

DATE: 6-25-2020	SCALE: 1/4"=1'-0"	CONTRACT NO: 20-0073	APPROVALS: FAIRFAX COUNTY F.M.O.
PLAN NORTH	DRAWN BY: CMS	REVIEWED BY:	CONTRACTOR: KNUTSON COMPANIES
	AREA: LOT 5	CAD FILE: FARADAYSUBMIT	DRWG NO: 3 OF 8
	PERMIT NO: 200580058	CONTRACTOR PHONE: 703-996-4246	

BFS
BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

Plans APPROVED by Fire Marshal

Date: 07/15/2020

Permit #: Multiple Permits

AP#:
201840100
201840102
201840103
201840105
201840107
201840108

58" (4'-10") MAXIMUM LENGTH OF THE FLEX DRY BARREL, PER THE MANUFACTURER.
DASHED SPRINKLER LINES INDICATE FLEX PIPING.

FOR TYPICAL HYDRAULIC CALCULATION INFORMATION FOR THIS MODEL HOUSE, SEE SHEET 6 OF 8.

ONLY NIBCO 5012-S-BI CPVC TEE TO BE USED ON DRY SPRINKLER HEADS.

GROUND FLOOR PLAN

SECOND FLOOR PLAN

THIRD FLOOR PLAN

LOFT FLOOR PLAN

GENERAL NOTE

"Sprinklers are not required when multiple bathrooms are adjacent to each other and are considered separate rooms, provided they contain a lintel of a minimum of 8" and they are dedicated to personal hygiene, or a water closet, or bathing capability such as a shower or tub, or any combination of facilities thereof. NFPA #13R, 2016 was used as a future reference guide for clarification."

CEILING HEIGHTS (UNLESS NOTED OTHERWISE)

1ST FLOOR – 9'-1 1/8"
2ND FLOOR – 10'-1 1/8"
3RD FLOOR – 9'-1 1/8"
4TH FLOOR – 9'-1 1/8"

MAXIMUM SPACING OF ALL RESIDENTIAL SPRINKLERS

PENDENT HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

SIDEWALL HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 4" TO 6" FROM CEILING

DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

FLEX DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

SCALE 1/4"=1'-0"

JOB NAME: FARADAY PARK
1876 EASTERLY RD.
RESTON, VA. 20190

DATE: 6-25-2020	SCALE: 1/4"=1'-0"	CONTRACT NO: 20-0073	APPROVALS: FAIRFAX COUNTY F.M.O.
PLAN NORTH	DRAWN BY: CMS	REVIEWED BY:	CONTRACTOR: KNUTSON COMPANIES
	AREA: LOT 6		CAD FILE: FARADAYSUBMIT
	PERMIT NO: 200580059	CONTRACTOR PHONE: 703-996-4246	DRWG NO: 4 OF 8

BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

PLAN REVISIONS — DATE: BY: DESCRIPTION:

ABBREVIATIONS: CLG CEILING; UNO UNLESS NOTED OTHERWISE; UH UNIT HEATER; GB GYPSUM BOARD; AT ACCOUSTICAL TILE CEILING; CIF CUT IN FIELD; CL CENTER LINE; BD BELOW DECK; AFF ABOVE FINISHED FLOOR; TYP TYPICAL

SPRINKLERS — TOTAL THIS SHEET 38; JOB TOTAL 38

Plans APPROVED by Fire Marshal

Date: 07/15/2020

Permit #: Multiple Permits

AP#: 201840100 201840102 201840103 201840105 201840107 201840108

58" (4'–10") MAXIMUM LENGTH OF THE FLEX DRY BARREL, PER THE MANUFACTURER.
DASHED SPRINKLER LINES INDICATE FLEX PIPING.

FOR TYPICAL HYDRAULIC CALCULATION INFORMATION FOR THIS MODEL HOUSE, SEE SHEET 6 OF 8.

ONLY NIBCO 5012-S-BI CPVC TEE TO BE USED ON DRY SPRINKLER HEADS.

GROUND FLOOR PLAN

SECOND FLOOR PLAN

THIRD FLOOR PLAN

LOFT FLOOR PLAN

GENERAL NOTE

"Sprinklers are not required when multiple bathrooms are adjacent to each other and are considered separate rooms, provided they contain a lintel of a minimum of 8" and they are dedicated to personal hygiene, or a water closet, or bathing capability such as a shower or tub, or any combination of facilities thereof. NFPA #13R, 2016 was used as a future reference guide for clarification."

CEILING HEIGHTS (UNLESS NOTED OTHERWISE)

1ST FLOOR – 9'-1 1/8"
2ND FLOOR – 10'-1 1/8"
3RD FLOOR – 9'-1 1/8"
4TH FLOOR – 9'-1 1/8"

MAXIMUM SPACING OF ALL RESIDENTIAL SPRINKLERS

PENDENT HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

SIDEWALL HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 4" TO 6" FROM CEILING

DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

FLEX DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

PLAN REVISIONS

DATE:	BY:	DESCRIPTION:

ABBREVIATIONS

CLG	CEILING
UNO	UNLESS NOTED OTHERWISE
UH	UNIT HEATER
GB	GYPSUM BOARD
AT	ACCOUSTICAL TILE CEILING
CIF	CUT IN FIELD
CL	CENTER LINE
BD	BELOW DECK
AFF	ABOVE FINISHED FLOOR
TYP	TYPICAL

SYMBOLS

⊗	RISER SYMBOL	+0'-0"	CENTER OF PIPE ELEVATION
●	PIPE DROP	⬡	HYDRAULIC REFERENCE POINT
○	PIPE RISE	BTAG	BRANCH LINE TAG NUMBER
/	HANGER	MTAG	MAIN TAG NUMBER
<	SLOPE PIPE		GRVD RED CPLG / FORCED CPLG
0'-0"	DIMENSIONS	ABD	AUTOMATIC BALL DRIP
D	CAP		FLOW SWITCH
◁	PLUG		FIRE HOSE VALVE
*	HEAD-GUARDS		
	HEAT SHIELD		
	GROOVED COUPLING		

SPECIALTY ITEMS

FIRE PUMP:	F.D.C.:
RATED FLOW:	TYPE:
RATED BOOST:	SIZE:
SUCT. X DIST.	FINISH:
RELIEF VALVE:	F.H.V.:
FUEL TANK:	FINISH:
MUFFLER:	ALARM VALVE:
TEST HEADER:	DRY VALVE:
TYPE:	OTHER:
SIZE:	
FINISH:	

DESIGN CRITERIA

FLOW TEST:	NFPA REF.: #13R
STATIC PSI:	TYPE SYS.: WET
RESIDUAL PSI:	HAZARD: LIGHT HAZARD
@ FLOW:	DENSITY: .05, .10
HYDRANT ELEV.:	REMOTE AREA: 2–4 HEADS
HYD. LOW GRAD.:	MAX. S.F./HD.: 196, 256
HYD. HIGH GRAD.:	K FACTOR: 4.0–5.6
ADJ STATIC PSI:	C FACTOR: 120 – 150
ADJ RESID. PSI:	
INFO BY:	INSIDE HOSE: N/A
	OUTSIDE HOSE:

SPRINKLERS

SYMBOL	MANUF/MODEL	TEMP.	FINISH	TOTAL
½" REC. PEND.	VIKING / QR VK468	155 DEG	WHITE	19
½" REC. PEND.	VIKING / QR VK468	175 DEG	WHITE	2
½" REC SIDEWALL	VIKING / QR VK486	155 DEG	WHITE	8
½" REC SIDEWALL	VIKING / QR VK486	175 DEG	WHITE	1
½" DRY PEND.	VIKING / QR VK180	155 DEG	WHITE	5
½" FLEX DRY PEND.	VICTAULIC/ QR V3506	155 DEG	WHITE	3
JOB TOTAL	38	TOTAL THIS SHEET		38

SCALE 1/4"=1'-0" 0' 5' 10' 15' 20'

JOB NAME: FARADAY PARK 1878 EASTERLY RD. RESTON, VA. 20190

DATE: 6-25-2020	SCALE: 1/4"=1'-0"	CONTRACT NO: 20-0073	APPROVALS: FAIRFAX COUNTY F.M.O.
PLAN NORTH	DRAWN BY: CMS	REVIEWED BY:	CONTRACTOR: KNUTSON COMPANIES
	AREA: LOT 7		CAD FILE: FARADAYSUBMIT
	PERMIT NO: 200570028	CONTRACTOR PHONE: 703-996-4246	DRWG NO: 5 OF 8

BFS BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

HYDRAULICALLY CALCULATED SYSTEM

THIS SYSTEM AS SHOWN ON SHEET 6 OF 8
COMPANY PRINT NO 20-0073 DATED 6-25-20
FOR 1ST FLOOR GARAGE REMOTE #4
AT 1880 EASTERLY RD. CONTRACT NO 0073
IS DESIGNED TO DISCHARGE AT A RATE OF .10 GPM (L/MIN) PER SQ FT (M2) OF FLOOR AREA OVER A MAXIMUM AREA OF 4 HEADS SQ FT (M2) WHEN SUPPLIED WITH WATER AT THE RATE OF 65.453 GPM (L/MIN) AT 36.047 PSI (BARS) AT THE BASE OF THE RISER
HOSE STREAM ALLOWANCE OF 25 GPM (L/MIN)
OCCUPANCY CLASSIFICATION LIGHT HAZARD
COMMODITY CLASSIFICATION N/A
MAXIMUM STORAGE HEIGHT N/A
INSTALLED BY: BUILDERS FIRE SOLUTIONS
SAFETY MARGIN: 14.906 PSI
DRY PENDENT HEADS: 14' x 14' SPACING

HYDRAULICALLY CALCULATED SYSTEM

THIS SYSTEM AS SHOWN ON SHEET 6 OF 8
COMPANY PRINT NO 20-0073 DATED 6-25-20
FOR 2ND FLOOR GREAT ROOM REMOTE #3
AT 1880 EASTERLY RD. CONTRACT NO 0073
IS DESIGNED TO DISCHARGE AT A RATE OF .05 GPM (L/MIN) PER SQ FT (M2) OF FLOOR AREA OVER A MAXIMUM AREA OF 4 HEADS SQ FT (M2) WHEN SUPPLIED WITH WATER AT THE RATE OF 61.24 GPM (L/MIN) AT 44.351 PSI (BARS) AT THE BASE OF THE RISER
HOSE STREAM ALLOWANCE OF 25 GPM (L/MIN)
OCCUPANCY CLASSIFICATION LIGHT HAZARD
COMMODITY CLASSIFICATION N/A
MAXIMUM STORAGE HEIGHT N/A
INSTALLED BY: BUILDERS FIRE SOLUTIONS
SAFETY MARGIN: 6.606 PSI
PENDENT HEADS: 16' x 16' SPACING

HYDRAULICALLY CALCULATED SYSTEM

THIS SYSTEM AS SHOWN ON SHEET 6 OF 8
COMPANY PRINT NO 20-0073 DATED 6-25-20
FOR 3RD FLOOR BEDROOM REMOTE #2
AT 1880 EASTERLY RD. CONTRACT NO 0073
IS DESIGNED TO DISCHARGE AT A RATE OF .05 GPM (L/MIN) PER SQ FT (M2) OF FLOOR AREA OVER A MAXIMUM AREA OF 2 HEADS SQ FT (M2) WHEN SUPPLIED WITH WATER AT THE RATE OF 26.275 GPM (L/MIN) AT 37.371 PSI (BARS) AT THE BASE OF THE RISER
HOSE STREAM ALLOWANCE OF 25 GPM (L/MIN)
OCCUPANCY CLASSIFICATION LIGHT HAZARD
COMMODITY CLASSIFICATION N/A
MAXIMUM STORAGE HEIGHT N/A
INSTALLED BY: BUILDERS FIRE SOLUTIONS
SAFETY MARGIN: 13.612 PSI
PENDENT HEADS: 16' x 16' SPACING

HYDRAULICALLY CALCULATED SYSTEM

THIS SYSTEM AS SHOWN ON SHEET 6 OF 8
COMPANY PRINT NO 20-0073 DATED 6-25-20
FOR 3RD FLOOR HALL REMOTE #5
AT 1880 EASTERLY RD. CONTRACT NO 0073
IS DESIGNED TO DISCHARGE AT A RATE OF .05 GPM (L/MIN) PER SQ FT (M2) OF FLOOR AREA OVER A MAXIMUM AREA OF 3 HEADS SQ FT (M2) WHEN SUPPLIED WITH WATER AT THE RATE OF 45.962 GPM (L/MIN) AT 45.657 PSI (BARS) AT THE BASE OF THE RISER
HOSE STREAM ALLOWANCE OF 25 GPM (L/MIN)
OCCUPANCY CLASSIFICATION LIGHT HAZARD
COMMODITY CLASSIFICATION N/A
MAXIMUM STORAGE HEIGHT N/A
INSTALLED BY: BUILDERS FIRE SOLUTIONS
SAFETY MARGIN: 5.313 PSI
SIDEWALL HEADS: 16' x 16' SPACING
PENDENT HEADS: 16' x 16' SPACING

HYDRAULICALLY CALCULATED SYSTEM

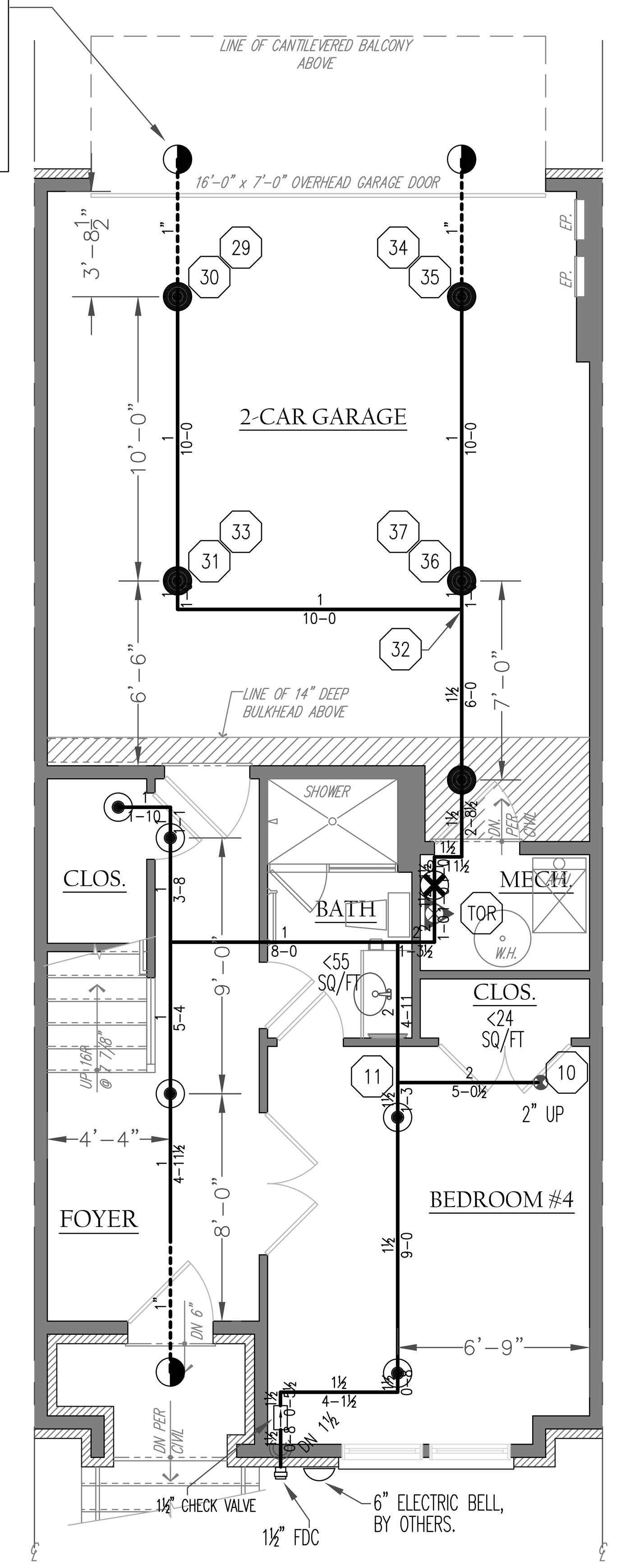
THIS SYSTEM AS SHOWN ON SHEET 6 OF 8
COMPANY PRINT NO 20-0073 DATED 6-25-20
FOR 4TH FLOOR LOFT REMOTE #1
AT 1880 EASTERLY RD. CONTRACT NO 0073
IS DESIGNED TO DISCHARGE AT A RATE OF .05 GPM (L/MIN) PER SQ FT (M2) OF FLOOR AREA OVER A MAXIMUM AREA OF 3 HEADS SQ FT (M2) WHEN SUPPLIED WITH WATER AT THE RATE OF 26.33 GPM (L/MIN) AT 45.271 PSI (BARS) AT THE BASE OF THE RISER
HOSE STREAM ALLOWANCE OF 25 GPM (L/MIN)
OCCUPANCY CLASSIFICATION LIGHT HAZARD
COMMODITY CLASSIFICATION N/A
MAXIMUM STORAGE HEIGHT N/A
INSTALLED BY: BUILDERS FIRE SOLUTIONS
SAFETY MARGIN: 5.713 PSI
SIDEWALL HEADS: 16' x 16' SPACING

Plans APPROVED by Fire Marshal
Date: 07/15/2020
Permit #: Multiple Permits
AP#: 201840100 201840102 201840103 201840105 201840107 201840108

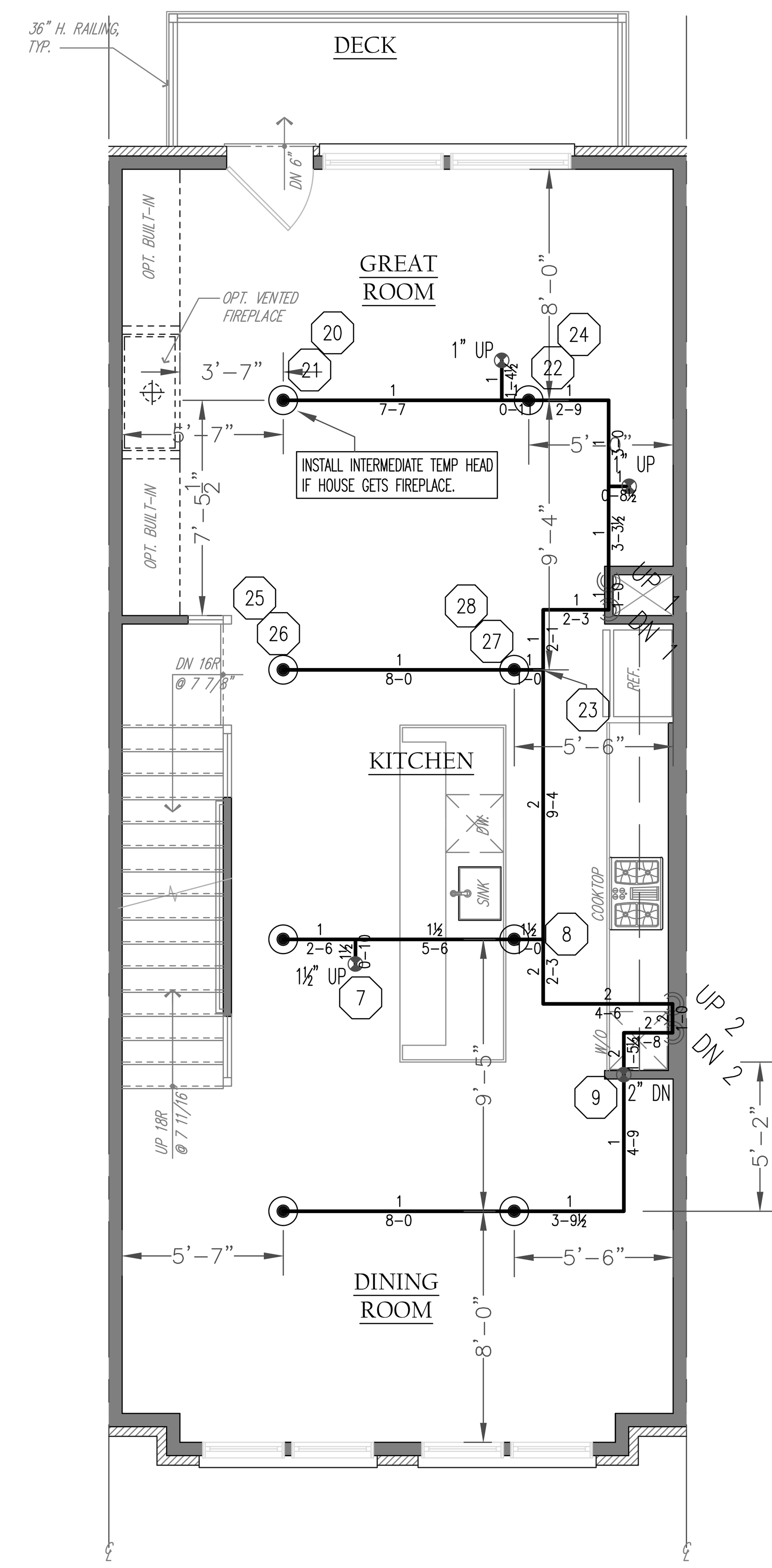
58" (4'-10") MAXIMUM LENGTH OF THE FLEX DRY BARREL, PER THE MANUFACTURER.
DASHED SPRINKLER LINES INDICATE FLEX PIPING.

ONLY NIBCO 5012-S-BI CPVC TEE TO BE USED ON DRY SPRINKLER HEADS.

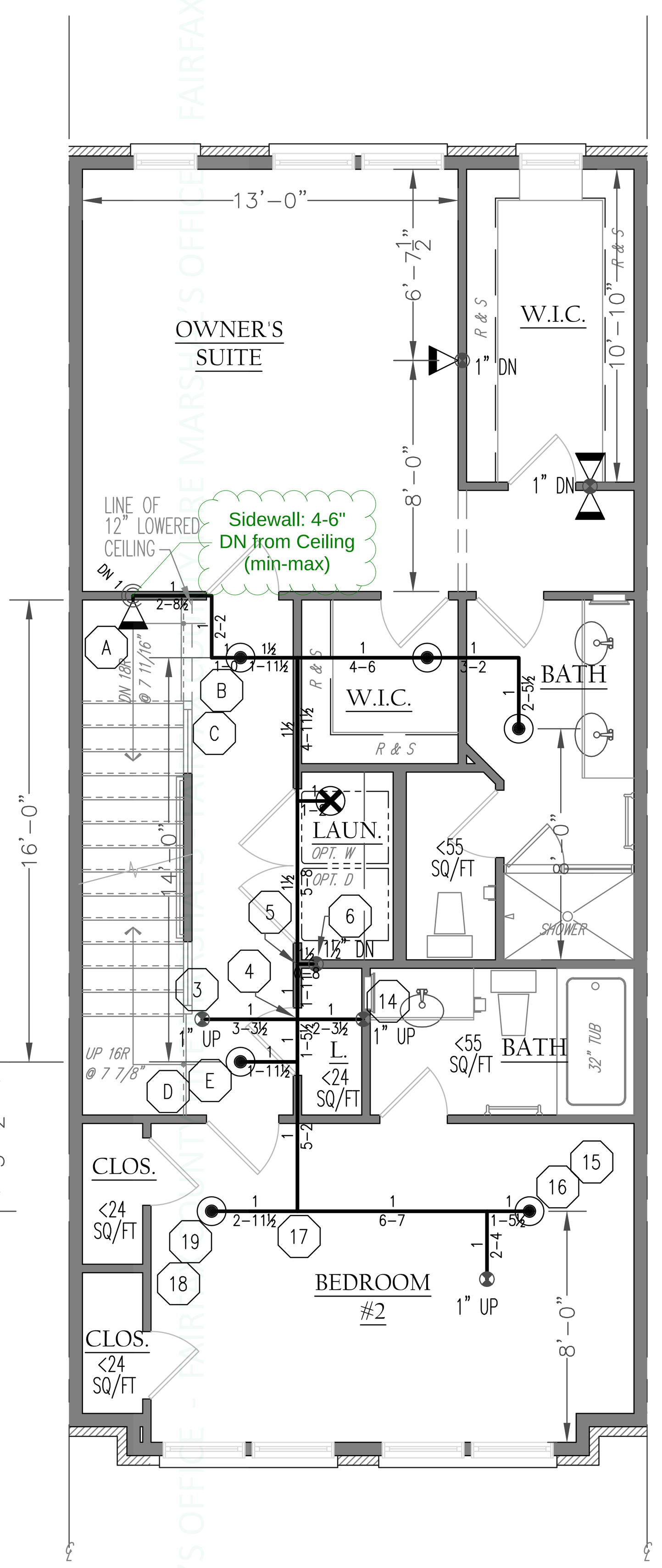
A TOTAL ESTIMATED DOMESTIC DEMAND OF 25 GPM WILL BE ADDED TO EACH REMOTE AREA HYDRAULIC CALCULATION PER NFPA 13R 2013 EDITION, SECTION 9.6, TABLES A.9.6(a) AND A.9.6(b). SEE PAGE 7 OF 8.



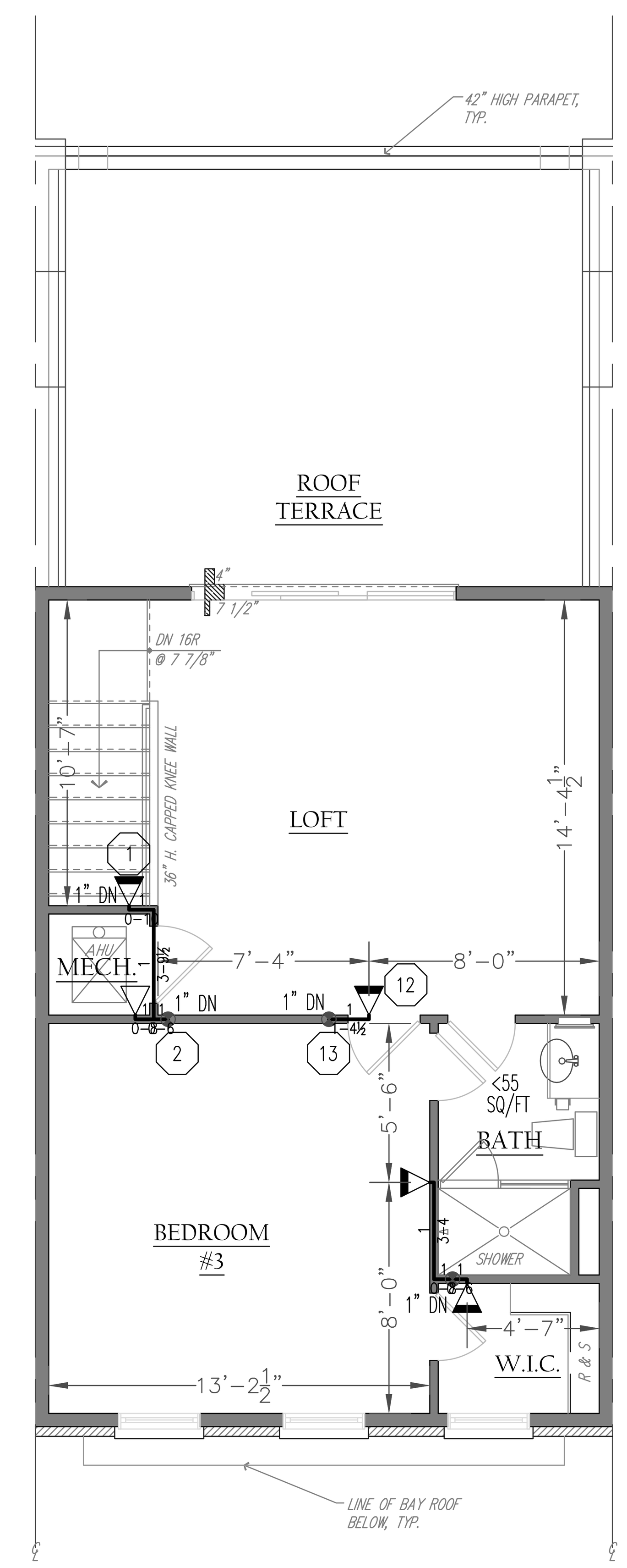
GROUND FLOOR PLAN



SECOND FLOOR PLAN



THIRD FLOOR PLAN



LOFT FLOOR PLAN

GENERAL NOTE

"Sprinklers are not required when multiple bathrooms are adjacent to each other and are considered separate rooms, provided they contain a lintel of a minimum of 8" and they are dedicated to personal hygiene, or a water closet, or bathing capability such as a shower or tub, or any combination of facilities thereof. NFPA #13R, 2016 was used as a future reference guide for clarification."

CEILING HEIGHTS (UNLESS NOTED OTHERWISE)
1ST FLOOR – 9'-1 1/8"
2ND FLOOR – 10'-1 1/8"
3RD FLOOR – 9'-1 1/8"
4TH FLOOR – 9'-1 1/8"

MAXIMUM SPACING OF ALL RESIDENTIAL SPRINKLERS

PENDENT HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

SIDEWALL HEADS: 16' X 16' AND 8' FROM WALL, W/ DEFLECTOR 4" TO 6" FROM CEILING

DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

FLEX DRY PENDENT HEADS: 14' X 14' AND 7' FROM WALL, W/ DEFLECTOR 1" TO 4" FROM CEILING

SPRINKLERS

SYMBOL	MANUF/MODEL	TEMP.	FINISH	TOTAL
½" REC. PEND.	VIKING / QR VK468	155 DEG	WHITE	19
½" REC. PEND.	VIKING / QR VK468	175 DEG	WHITE	2
½" REC SIDEWALL	VIKING / QR VK486	155 DEG	WHITE	8
½" REC SIDEWALL	VIKING / QR VK486	175 DEG	WHITE	1
½" DRY PEND.	VIKING / QR VK180	155 DEG	WHITE	5
½" FLEX DRY PEND.	VICTAULIC/ QR V3506	155 DEG	WHITE	3
JOB TOTAL	38	TOTAL THIS SHEET		38

DESIGN CRITERIA
NFPA REF.: #13R
TYPE SYS.: WET
HAZARD: LIGHT HAZARD
DENSITY: .05, .10
REMOTE AREA: 2-4 HEADS
MAX. S.F./HD.: 196, 256
K FACTOR: 4.0-5.6
C FACTOR: 120 – 150
INSIDE HOSE: N/A
OUTSIDE HOSE:

SCALE 1/4"=1'-0"

JOB NAME: FARADAY PARK, 1880 EASTERLY RD., RESTON, VA. 20190
DATE: 6-25-2020 | SCALE: 1/4"=1'-0" | CONTRACT NO: 20-0073 | APPROVALS: FAIRFAX COUNTY F.M.O.
DRAWN BY: CMS | REVIEWED BY: | CONTRACTOR: KNUTSON COMPANIES
AREA: LOT 8 | CAD FILE: FARADAYSUBMIT | DRWG NO: 6 OF 8
PERMIT NO: 200580055 | CONTRACTOR PHONE: 703-996-4246

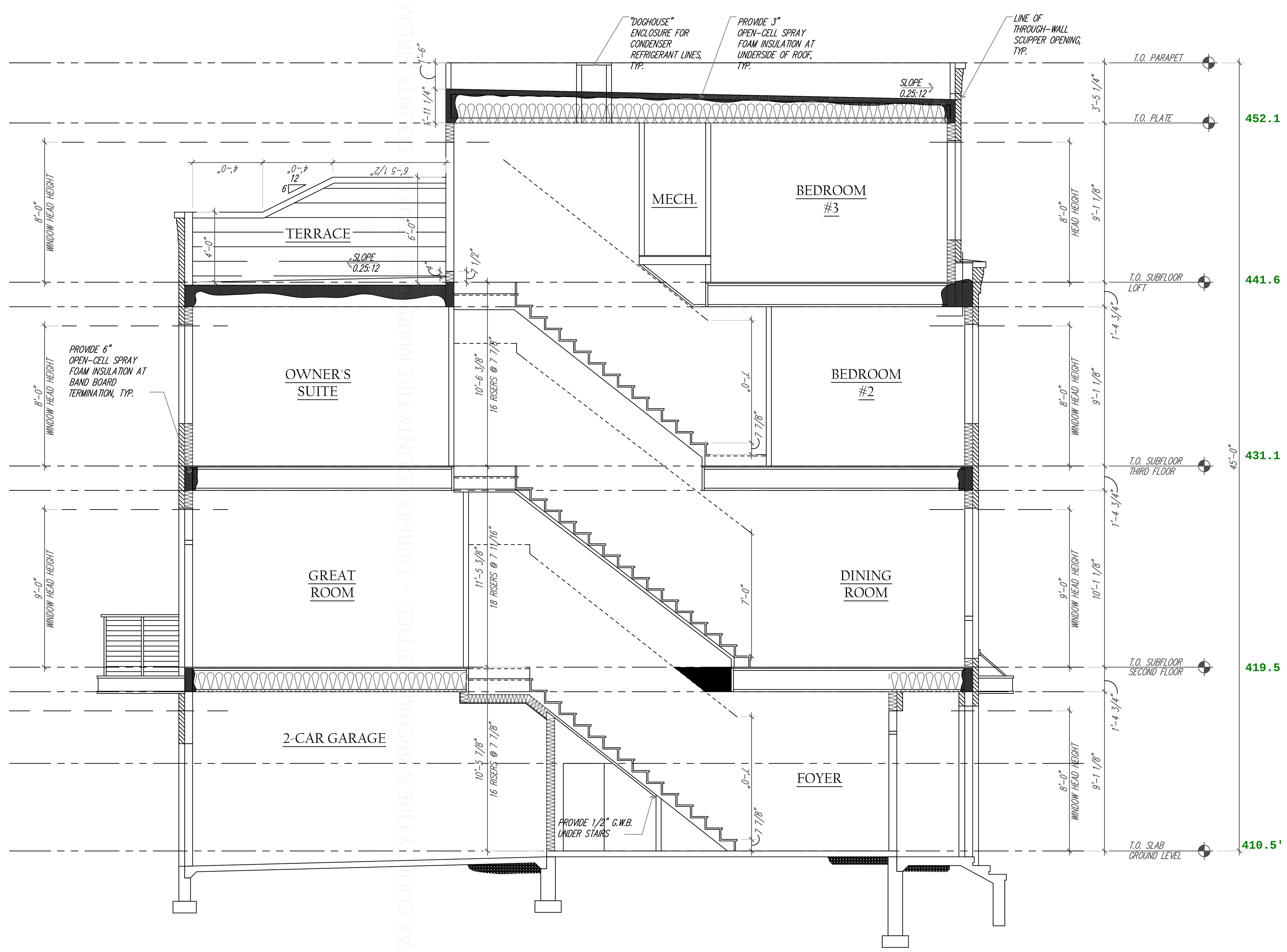
BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

Plans APPROVED by Fire Marshal

Date: 07/15/2020

Permit #: Multiple Permits

AP#:
201840100
201840102
201840103
201840105
201840107
201840108



NFPA 13R 2013 EDITION
TABLE A.9.6(a) FIXTURE LOAD VALUES

PRIVATE FACILITIES (THOSE WITHIN INDIVIDUAL DWELLING UNITS)

FACILITY TYPE	UNIT
–BATHROOM GROUP W/FLUSH TANK (INCLUDING LAVATORY, WATER CLOSET, AND BATHTUB W/SHOWER)	6
–BATHROOM GROUP W/FLUSH VALVE	8
–BATHTUB	2
–DISHWASHER	1
–KITCHEN SINK	2
–LAUNDRY TRAYS	3
–LAVATORY	1
–SHOWER STALL	2
–WASHING MACHINE	2
–WATER CLOSET W/FLUSH VALVE	6
–WATER CLOSET W/FLUSH TANK	3

PUBLIC FACILITIES

FACILITY TYPE	UNIT
–BATHTUB	4
–DRINKING FOUNTAIN	0
–KITCHEN SINK	4
–LAVATORY	2
–SERVICE SINK	3
–SHOWER HEAD	4
–URINAL W/ 1 in. (25.4mm) FLUSH VALVE	10
–URINAL W/ 3/4 in. (19mm) FLUSH VALVE	5
–URINAL W/ FLUSH TANK	3
–WASHING MACHINE 8 lb (3.63 kg)	3
–WASHING MACHINE 16 lb (7.26 kg)	4
–WATER CLOSET W/FLUSH VALVE	10
–WATER CLOSET W/FLUSH TANK	5

NFPA 13R 2013 EDITION
9.6 DOMESTIC DEMAND

DOMESTIC DEMAND SHALL BE INCLUDED AS PART OF THE OVERALL SYSTEM DEMAND FOR SYSTEMS WITH COMMON DOMESTIC/FIRE MAINS WHERE NO PROVISIONS ARE MADE TO PREVENT THE DOMESTIC WATER FLOW UPON SPRINKLER SYSTEM ACTIVATION.

A.9.6

TABLE A.9.6(a) AND TABLE A.9.6(b) CAN BE USED TO DETERMINE A DOMESTIC DESIGN DEMAND. USING TABLE A.9.6(a), THE TOTAL NUMBER OF WATER SUPPLY FIXTURE UNITS DOWNSTREAM OF ANY POINT IN THE PIPING SERVING BOTH SPRINKLER AND DOMESTIC NEEDS IS DETERMINED. USING TABLE A.9.6(b), THE APPROPRIATE TOTAL FLOW ALLOWANCE IS DETERMINED AND ADDED TO THE SPRINKLER DEMAND AT THE TOTAL PRESSURE REQUIRED FOR THE SPRINKLER SYSTEM AT THAT POINT.

NFPA 13R 2013 EDITION
TABLE A.9.6(b) TOTAL ESTIMATED DOMESTIC DEMAND

	TOTAL DEMAND			
TOTAL FIXTURE LOAD UNITS FROM TABLE A.9.5(a)	FOR SYSTEMS W/PREDOMINATELY FLUSH TANKS		FOR SYSTEMS W/PREDOMINATELY FLUSH VALVES	
	gpm	L/min	gpm	L/min
1	3	11.25	--	--
2	5	18.75	--	--
5	10	37.5	15	56
10	15	56	25	94
20	20	75	35	13
35	25	94	45	169
50	30	113	50	187
70	35	131	60	225
100	45	169	70	262
150	55	200	80	300
200	65	244	90	337
250	75	261	100	375
350	100	375	125	469
500	125	469	150	562
750	175	656	175	656
1000	200	750	200	750
1500	275	1031	275	1031
2000	325	1219	325	1219
3500	500	1875	500	1875

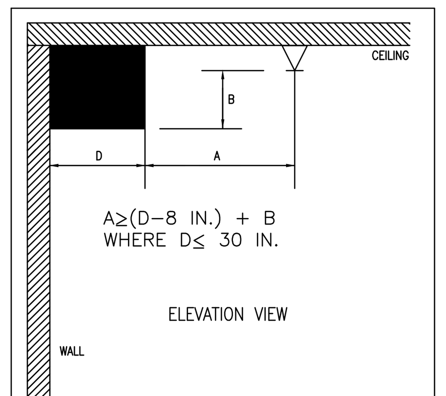
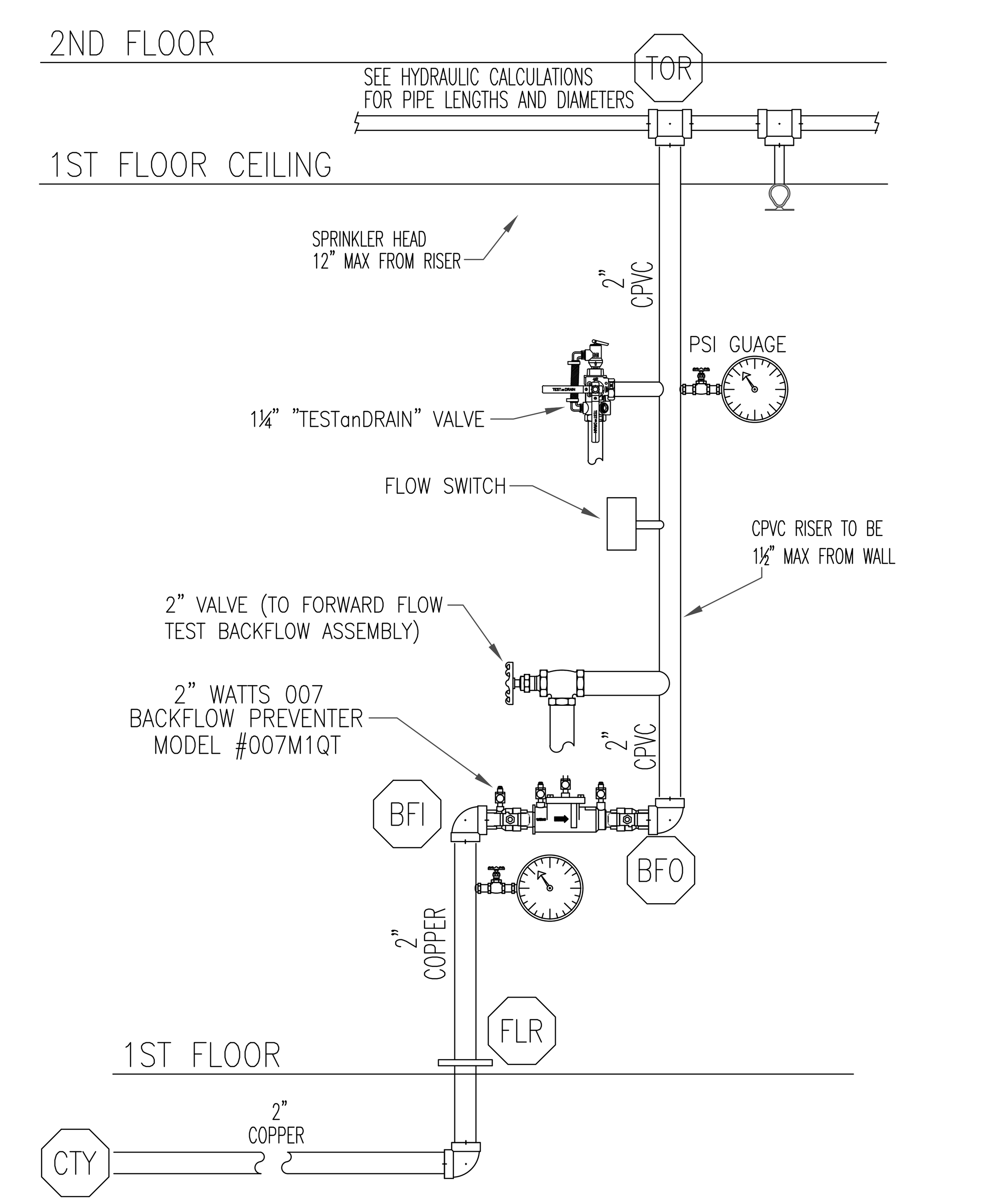


FIGURE 6.4.6.3.6.3
OBSTRUCTIONS AGAINST WALLS (STANDARD SPRINKLERS)

NFPA 13R 2013 EDITION FIGURE 6.4.6.3.6.2

DISTANCE FROM SPRINKLERS TO SIDE OF OBSTRUCTION	MAXIMUM ALLOWABLE DISTANCE OF DEFLECTOR ABOVE BOTTOM OF OBSTRUCTION
LESS THAN 1 FT	0
ONE FT TO LESS THAN 1 FT 6 IN.	0"
1 FT 6 IN. TO LESS THAN 2 FT	1"
2 FT TO LESS THAN 2 FT 6 IN.	1"
2 FT 6 IN. TO LESS THAN 3 FT	1"
3 FT TO LESS THAN 3 FT 6 IN.	3"
3 FT 6 IN. TO LESS THAN 4 FT	3"
4 FT TO LESS THAN 4 FT 6 IN.	5"
4 FT 6 IN. TO LESS THAN 5 FT	7"
5 FT TO LESS THAN 5 FT 6 IN.	7"
5 FT 6 IN. TO LESS THAN 6 FT	7"
6 FT TO LESS THAN 6 FT 6 IN.	9"
6 FT 6 IN. TO LESS THAN 7 FT	11"
7 FT AND GREATER	14"

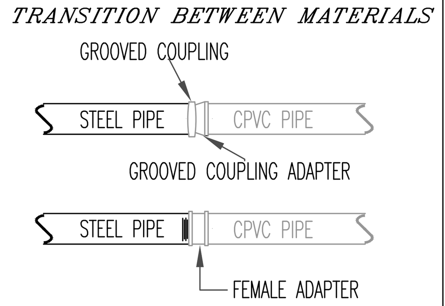


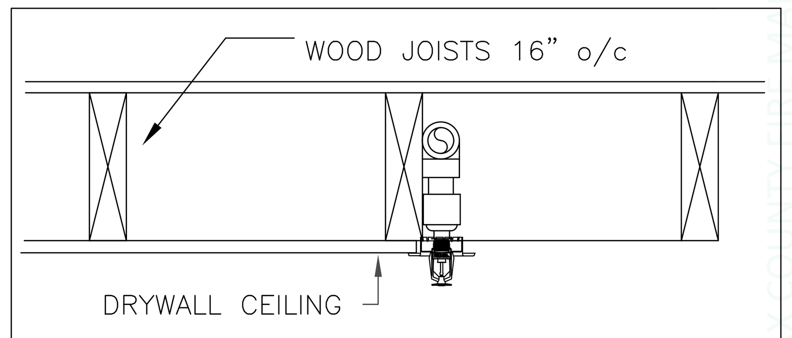
NFPA 13R SPRINKLER RISER DETAIL

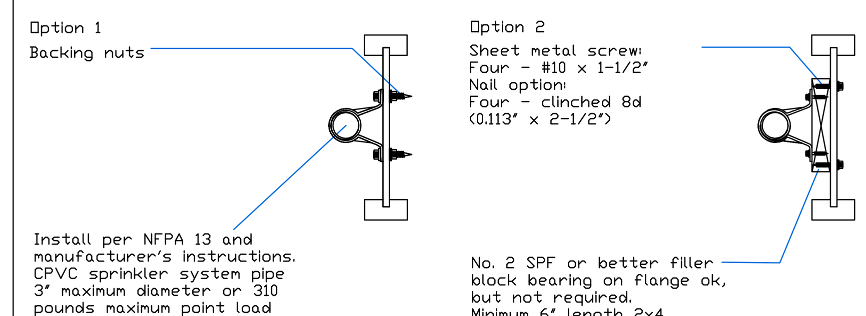
SEE HYDRAULIC CALCULATIONS FOR ALL PIPE LENGTHS

NOT TO SCALE

CPVC
TRANSITION BETWEEN MATERIALS







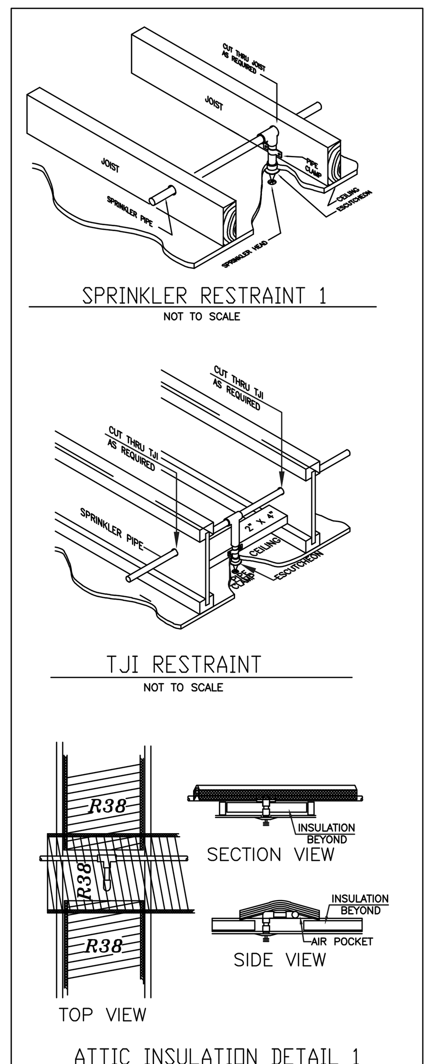
TEST INFO FROM FAIRFAX WATER AUTHORITY

HYDRANT #191
TEST DATED: 10/1/2018
STATIC = 51 PSI
RESIDUAL= 47 PSI
FLOW = 1000 GPM
LOW GRADIENT= 525 FT

TEST ADJUSTED TO TEST HYDRANT
LOW GRADIENT 525'
HYDRANT ELEV. –402'
123'
X .433
ADJUSTED STATIC 53.25 PSI
ADJUSTED RESIDUAL 49.25 PSI
FLOW 1000 GPM

GENERAL NOTES & SYMBOLS:

1. ALL MATERIAL, EQUIPMENT, FITTINGS AND DEVICES USED AND INSTALLED IN THIS SPRINKLER SYSTEM INSTALLATION SHALL BE NEW AND COMPLY WITH THE INSTALLATION STANDARDS OF THE NATIONAL FIRE PROTECTION ASSOCIATION PAMPHLET NO 13R 2013 EDITION AND SHALL BE LISTED FOR SUCH USE.
2. THE FIRE SPRINKLER SYSTEM SHALL BE SIZED PER HYDRAULICALLY DESIGNED CALCULATIONS. SEE DESIGN CRITERIA THIS DRAWING.
3. ALL SPRINKLER PIPE HANGERS SHALL BE U.L. LISTED OR F.M. APPROVED AND SHALL BE IN ACCORDANCE WITH N.F.P.A. 13R. SEE DETAILS THIS DRAWING.
4. ALL SPRINKLER PIPE WHICH PASSES THROUGH FIRE WALLS, FIRE RATED PARTITIONS OR FLOORS SHALL BE INSTALLED AND CAULKED PER U.L. LISTED OR F.M. APPROVED STANDARDS.
5. UNPROTECTED CLOSETS SHALL NOT CONTAIN MECHANICAL EQUIPMENT.
6. CENTERLINE OF PIPING ABOVE FINISHED FLOOR IS NOTED IN HYDRAULIC CALCULATIONS
7. ① DENOTES HYDRAULIC REFERENCED POINTS.
8. ALL UNSPRINKLERED BATHROOMS SHALL BE 55 SQ. FT. OR LESS.
9. BUILDING TO BE EQUIPPED THROUGHOUT WITH AN AUTOMATIC SPRINKLER SYSTEM EXCEPT WHERE OMISSION IS PERMITTED BY 8.6.2 THROUGH 8.6.7.
10. BUILDERS FIRE SOLUTIONS EXCLUDES THE FOLLOWING ITEMS:
    A. PIPE PAINTING.
    B. ALL ELECTRICAL WIRING. (POWER OR ALARM)
    C. SEISMIC BRACING.
    D. CUTTING AND PATCHING.
    E. ANY SOFFITS NEEDED TO CONCEAL PIPE.
    F. UNDERGROUND PIPE
    G. FREEZE PROTECTION OF ANY TYPE INCLUDING. TENTING AND INSULATING PIPE
    H. INSULATION OF ANY TYPE INCULDING COMBUSTIBLE CONCEALED SPACES
    I. MONITORING OF SPRINKLER SYSTEM.



NFPA 13R 2013 EDITION
TABLE 6.2.3.3.3 MINIMUM DISTANCES FOR ORDINARY AND INTERMEDIATE TEMPERATURE RESIDENTIAL SPRINKLERS

HEAT SOURCE	FROM EDGE OF SOURCE TO ORDINARY TEMPERATURE SPRINKLER IN.	MM	FROM EDGE OF SOURCE TO INTERMEDIATE TEMPERATURE SPRINKLER IN.	MM
SIDE OF OPEN OR RECESSED FIREPLACE	36	914	12	305
FRONT OF RECESSED FIREPLACE	60	1524	36	914
COAL-OR-WOOD-BURNING STOVE	42	1067	12	305
KITCHEN RANGE	18	457	9	229
WALL OVEN	18	457	9	229
HOT AIR FLUES	18	457	9	229
UNINSULATED HEAT DUCTS	18	457	9	229
UNINSULATED HOT WATER PIPES	12	305	6	152
SIDE OF CEILING-OR-WALL-MOUNTED HOT AIR DIFFUSERS	24	607	12	305
FRONT OF WALL-MOUNTED HOT AIR DIFFUSERS	36	914	18	457
HOT WATER HEATER OR FURNACE	6	152	3	76
LIGHT FIXTURE:				
0 W - 250 W	6	152	3	76
250 W - 499 W	12	305	6	152

CURE TIMES WITH ONE STEP SOLVENT CEMENT

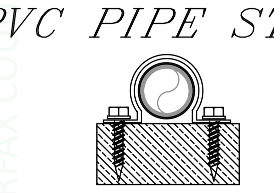
PIPE SIZE	60°F TO 120°F	40°F TO 59°F	0°F TO 39°F
1"	45 MINS.	1½ HRS.	24 HRS.
1¼"	1½ HRS.	16 HRS.	120 HRS.
1½"	1½ HRS.	16 HRS.	120 HRS.
2"	6 HRS.	36 HRS.	NOTE 1
2½' & 3"	8 HRS.	72 HRS.	NOTE 1

NOTE 1: FOR THESE SIZES, THE SOLVENT CEMENT CAN BE APPLIED AT TEMPERATURES BELOW 40° F, HOWEVER, THE SPRINKLER SYSTEM TEMPERATURE MUST BE RAISED TO A TEMPERATURE OF 40° F OR ABOVE AND ALLOWED TO CURE PER THE ABOVE RECOMMENDATIONS PRIOR TO PRESSURE TESTING.

CPVC HANGER SPACING

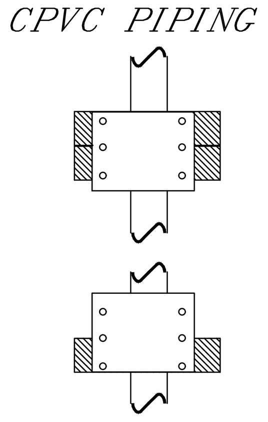
PIPE SIZE	PIPE SIZE
1"	6'-0"
1¼"	6'-6"
1½"	7'-0"
2"	8'-0"

CPVC PIPE STRAP

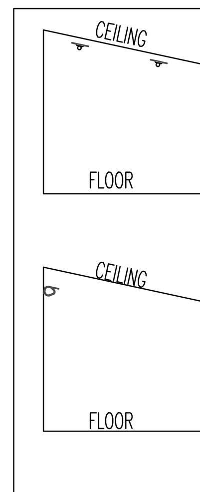


(NO SCALE)

NAIL PLATE DETAIL FOR CPVC PIPING



5" X 8" 16 GAUGE
NO SCALE



LISTED AREA OF COVERAGE CORRESPONDS TO CEILING SLOPE TOP OF DEFLECTOR MUST BE LOCATED 4" TO 6" BELOW SLOPED CEILING. THE TOP OF THE DEFLECTOR MUST BE PARALLEL WITH THE PLANE OF THE CEILING. DISCHARGE IS ACROSS THE SLOPE.

LISTED AREA OF COVERAGE CORRESPONDS TO CEILING SLOPE TOP OF DEFLECTOR MUST BE LOCATED 4" TO 6" BELOW SLOPED CEILING. THE TOP OF THE DEFLECTOR MUST BE PARALLEL WITH THE PLANE OF THE CEILING. DISCHARGE IS DOWN THE SLOPE.

SLOPED CEILING DETAILS
NO SCALE

IMPORTANT
THE OWNER HAS THE RESPONSIBILITY OF PROVIDING FREEZE PROTECTION IN AREAS THAT HAVE A WET PIPE SPRINKLER AND IN ENCLOSURES FOR DRY, DELUGE OR ANY OTHER TYPE OF VALVES CONTROLLING WATER SUPPLIES TO AUTOMATIC SPRINKLER SYSTEMS.

JOB NAME:
FARADAY PARK
1870–1880 EASTERLY RD.
RESTON, VA. 20190

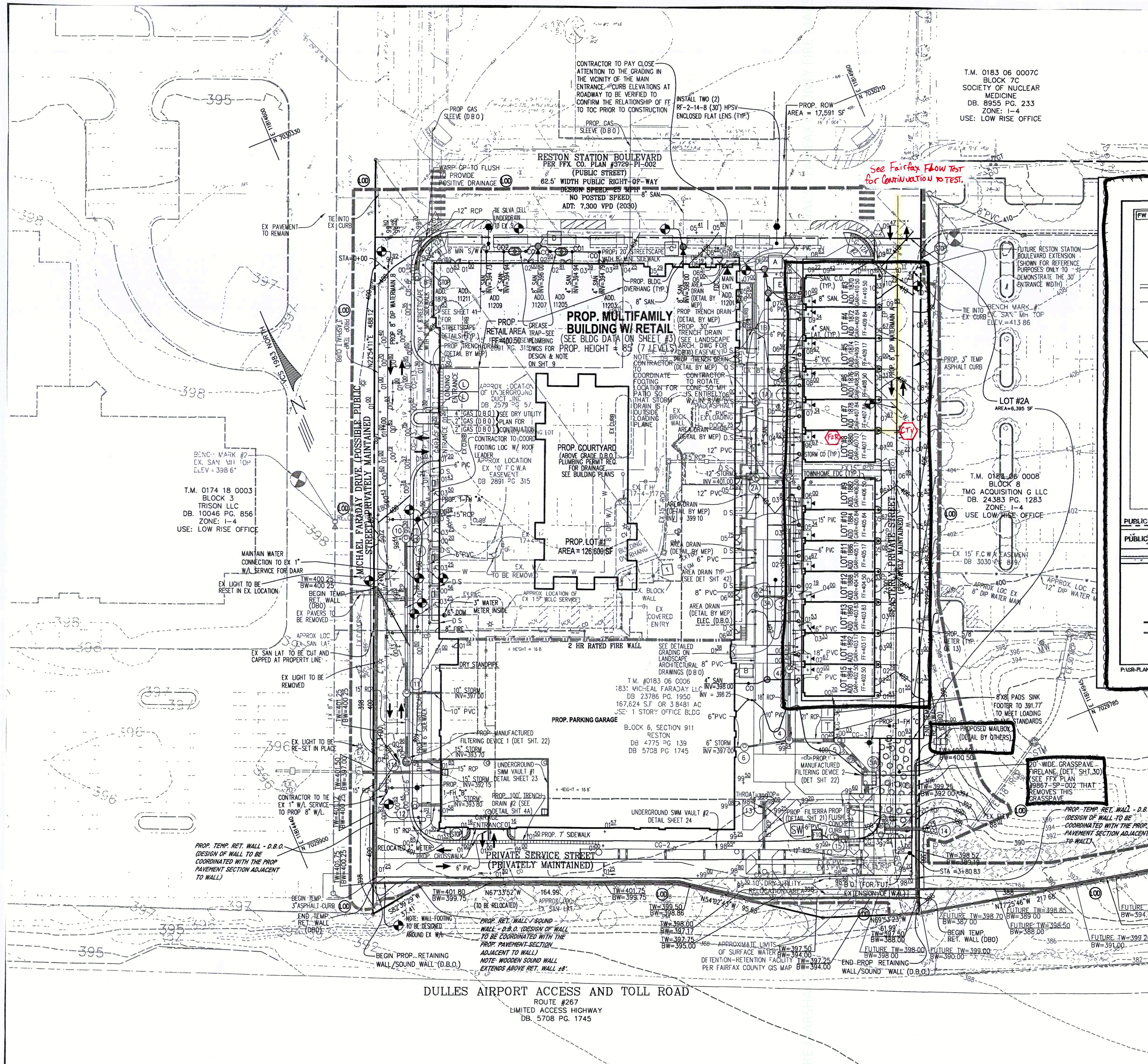
DATE: 6-25-2020	SCALE: AS NOTED	CONTRACT NO: 20-0073	APPROVALS: FAIRFAX COUNTY F.M.O.
PLAN NORTH	DRAWN BY: CMS	REVIEWED BY:	CONTRACTOR: KNUTSON COMPANIES
	AREA: DETAILS: LOTS 3-8	CAD FILE: FARADAYSUBMIT	DRWG NO: 7 OF 8
	PERMIT NO: SEE SHEETS 1-6	CONTRACTOR PHONE: 703-996-4246	

BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

Plans APPROVED by Fire Marshal
Date: 07/15/2020
Permit #: Multiple Permits

AP#:
201840100
201840102
201840103
201840105
201840107
201840108

NOTE: This sheet for sprinkler reference only.

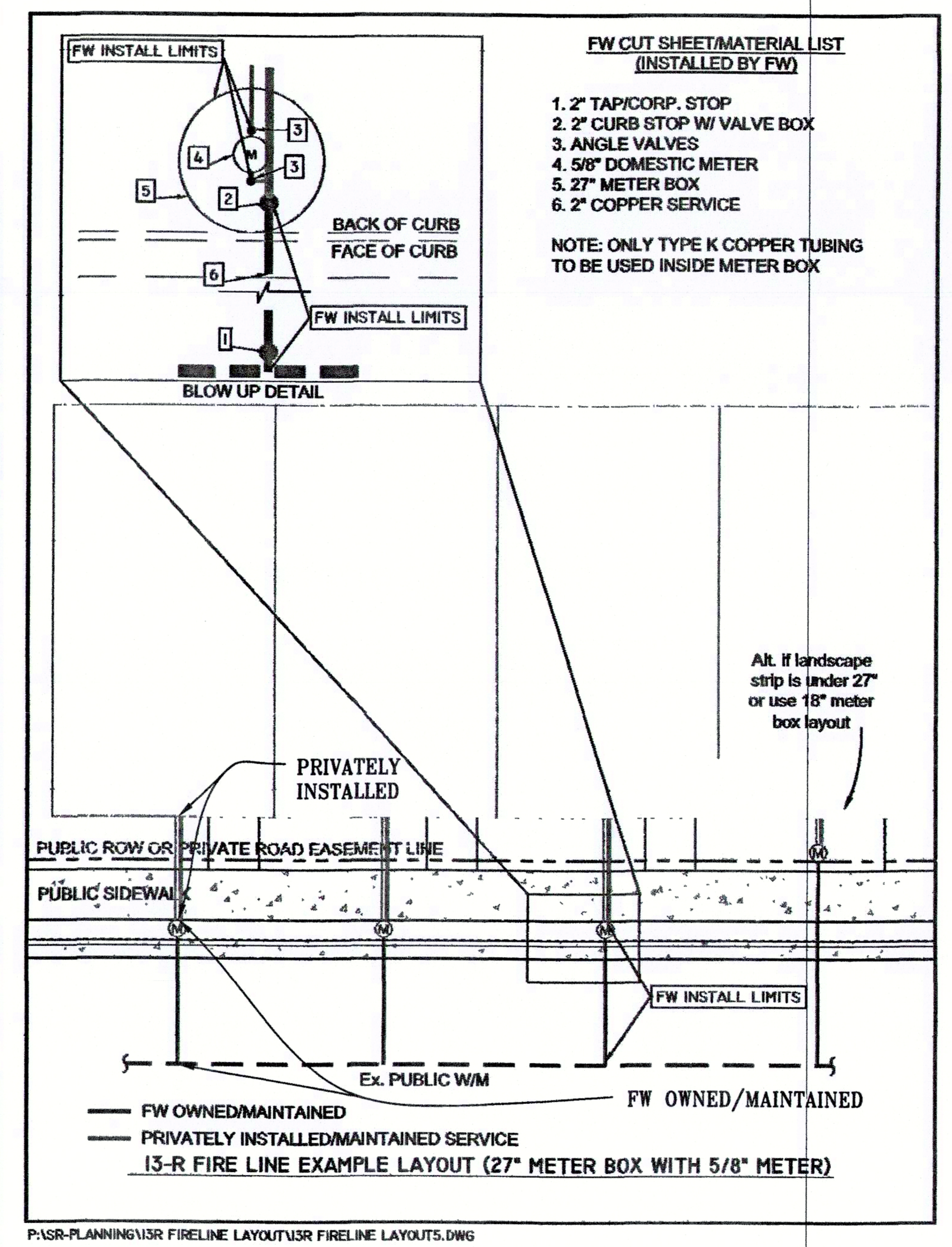


NOTE: REMOVAL OF EX. SANITARY SEWER BUILDING LATERAL SHALL MEET SECTION 65-6-9 OF FAIRFAX COUNTY CODE.

NOTE: SEE LANDSCAPE PLAN (SHEET 38) FOR SIDEWALK AREAS.

NOTE TO CONTRACTOR:

1.) BECAUSE RESTON STATION BOULEVARD HAS NOT BEEN CONSTRUCTED PRIOR TO THE PREPARATION OF THIS SITE PLAN, CONTRACTOR TO AS-BLT CURB ON RESTON STATION BOULEVARD PRIOR TO CONSTRUCTION AND SHALL NOTIFY THE ENGINEER AND OWNER/DEVELOPER IMMEDIATELY, AND PRIOR TO CONSTRUCTION OF ANY DIFFERENCES IN ELEVATION BETWEEN THE AS-BLT AND THE GRADES SHOWN ON RESTON STATION BOULEVARD.
2.) CONTRACTOR TO COORDINATE FOOTING LOCATIONS WITH UTILITIES
3.) CONTRACTOR TO FIELD LOCATE AND ADJUST SANITARY LATERAL CLEANOUTS OUTSIDE OF LEAD WALK FOR TOWNHOMES
4.) CONTRACTOR TO COORDINATE SIZE OF TAP TO WATERMAIN "A" FOR FIRE AND DOMESTIC SERVICE TO TOWNHOMES



FW CUT SHEET/MATERIAL LIST (INSTALLED BY FW)

1. 2" TAP/CORP. STOP
2. 2" CURB STOP W/ VALVE BOX
3. ANGLE VALVES
4. 5/8" DOMESTIC METER
5. 27" METER BOX
6. 2" COPPER SERVICE

NOTE: ONLY TYPE K COPPER TUBING TO BE USED INSIDE METER BOX

Alt. if landscape strip is under 27" or use 18" meter box layout

P:\SR-PLANNING\SR FIRELINE LAYOUT\SR FIRELINE LAYOUTS.DWG

NOTE: THIS SHEET SHOWN FOR REFERENCE AND TO BE MODIFIED PER SITE SPECIFIC CONDITIONS. METER BOX IS TO BE PLACED WITH DRIVEWAY APRON AND BE VEHICULAR RATED. SEE SECTION SHEET 4A

No	DATE	DESCRIPTION	REV BY	APPROVED	DATE
1	03-11-19	REVISION A			
2	07-31-19	REVISION B			

REVISION APPROVED BY DIVISION OF DESIGN

Urban, Ltd.
7712 Little River Turnpike
Annandale, Virginia 22003
Planners Engineers Landscape Architects Land Surveyors

GRADING PLAN
RESTON SECTION 911, BLOCK 6 REDEVELOPMENT
HUNTER MILL DISTRICT
FAIRFAX COUNTY, VIRGINIA

C.I. 2'
SCALE: 1"=30'
DATE: OCT, 2017

SHEET 7 OF 49
FILE No. SP-2217

JOB NAME: FARADAY PARK, 1870-1880 EASTERLY RD., RESTON, VA. 20190				
DATE: 6-25-2020	SCALE: AS NOTED	CONTRACT NO: 20-0073	APPROVALS: FAIRFAX COUNTY F.M.O.	
PLAN NORTH: AS NOTED	DRAWN BY: CMS	REVIEWED BY:	CONTRACTOR: KNUTSON COMPANIES	
	AREA: SITE PLAN: LOTS 3-8		CAD FILE: FARADAYSUBMIT	DRWG NO: 8 OF 8
	PERMIT NO: SEE SHEETS 1-6	CONTRACTOR PHONE: 703-996-4246		

BUILDERS FIRE SOLUTIONS
225 ELM STREET, WARRENTON, VA 20186 (540) 428-8712
AUTOMATIC FIRE PROTECTION SYSTEMS
DESIGN INSTALLATION SERVICE

VIKING®

TECHNICAL DATA

FREEDOM® RESIDENTIAL PENDENT SPRINKLER VK468 (K4.9)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

1. DESCRIPTION

Viking Freedom® Residential Pendent Sprinkler VK468 is a small, thermosensitive, glass-bulb residential sprinkler available in several different finishes and temperature ratings to meet varying design requirements. The Electroless Nickel PTFE (ENT) coating has been investigated for installation in corrosive atmospheres and is C-UL-US-EU Listed as corrosion resistant as indicated in the Approval Chart. The orifice design, with a K-Factor of 4.9 (70.6 metric†), allows efficient use of available water supplies for the hydraulically designed fire-protection system. The glass bulb operating element and special deflector characteristics meet the challenges of residential sprinkler standards.

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

2. LISTINGS AND APPROVALS

UL Listed (C-UL-US-EU): Category VKKW

VdS Approved

NYC Approved: MEA 89-92-E, Volume 35

UL Classified to: NSF/ANSI Standard 61, Drinking Water System Components (MH48034).

Refer to the Approval Chart and Design Criteria for C-UL-US-EU Listing requirements that must be followed.

3. TECHNICAL DATA

Specifications:
Available since 2006.
Minimum Operating Pressure: Refer to the Approval Chart.
Maximum Working Pressure: 175 psi (12 bar). Factory tested hydrostatically to 500 psi (34.5 bar).
Thread size: 1/2” (15 mm) NPT
Nominal K-Factor: 4.9 U.S. (70.6 metric†)
†Metric K-factor measurement shown is in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
Glass-bulb fluid temperature rated to -65 °F (-55 °C)
Overall Length: 2-1/4” (58 mm)

Material Standards:
Frame Casting: Brass UNS-C84400 or QM Brass
Deflector: Brass UNS-C23000, Phosphor Bronze UNS-C51000, or Brass UNS-C26000
Bulb: Glass, nominal 3 mm diameter
Belleville Spring Sealing Assembly: Nickel Alloy, coated on both sides with Polytetrafluoroethylene (PTFE) Tape
Pip Cap and Insert Assembly: Copper UNS-C11000 and Stainless Steel UNS-S30400
Compression Screw: Brass UNS-C36000
For ENT coated sprinklers: Belleville spring - Exposed, Screw and Pipcap - ENT plated.

Ordering Information: (Also refer to the current Viking price list.)
Sprinkler: Base Part No. 13637
Order Sprinkler VK468 by first adding the appropriate suffix for the sprinkler finish and then the appropriate suffix for the temperature rating to the sprinkler base part number.
Finish Suffix: Brass = A, Chrome = F, White Polyester = M-/W, Black Polyester = M-/B, and ENT = JN
Temperature Suffix: 155 °F (68 °C) = B, 175 °F (79 °C) = D
For example, sprinkler VK468 with a Brass finish and a 155 °F (68 °C) temperature rating = Part No. 13637AB.

Available Finishes And Temperature Ratings:
Refer to Table 1.

Accessories: (Also refer to the Viking website.)

Sprinkler Wrenches:
A. Standard Wrench: Part No. 21475M/B (available since 2017)
B. Wrench for recessed sprinklers: Part No. 13577W/B* (available since 2006)
C. Optional Protective Sprinkler Cap Remover/Escutcheon Installer Tool** Part No. 15915 (available since 2010.)
*A ½” ratchet is required (not available from Viking).
**Allows use from the floor by attaching a length of 1” diameter CPVC tubing to the tool. Ideal for sprinkler cabinets. Refer to Bulletin F_051808.

VIKING®	TECHNICAL DATA	FREEDOM® RESIDENTIAL PENDENT SPRINKLER VK468 (K4.9)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

Sprinkler Cabinets:
A. Six-head capacity: Part No. 01724A (available since 1971)
B. Twelve-head capacity: Part No. 01725A (available since 1971)

4. INSTALLATION
Refer to appropriate NFPA Installation Standards.

5. OPERATION
During fire conditions, the heat-sensitive liquid in the glass bulb expands, causing the glass to shatter, releasing the pip cap and sealing spring assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector, forming a uniform spray pattern to extinguish or control the fire.

6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
The Viking Model VK468 Sprinkler is available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

TABLE 1: AVAILABLE SPRINKLER TEMPERATURE RATINGS AND FINISHES

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[2]	Bulb Color
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow
Sprinkler Finishes: Brass, Chrome, White Polyester, Black Polyester, and ENT			
Corrosion Resistant Coatings[3]: ENT			

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector.

[2] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

[3] The corrosion resistant coatings have passed the standard corrosion test required by the approving agencies indicated in the Approval Chart. These tests cannot and do not represent all possible corrosive environments. Prior to installation, verify through the end-user that the coatings are compatible with or suitable for the proposed environment. For ENT coated sprinklers, the waterway is coated. Note that the spring is exposed on sprinklers with ENT coating.

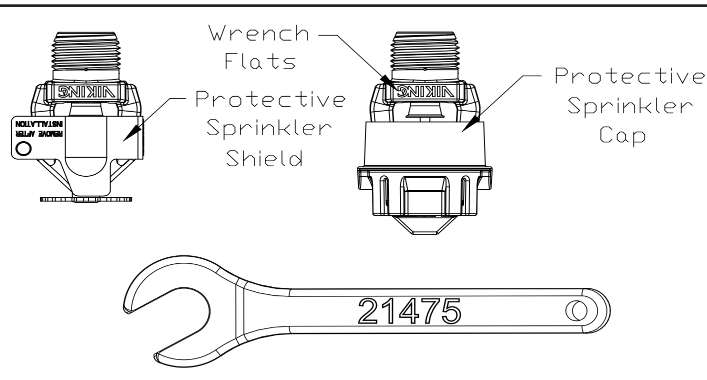


Figure 1: Standard Sprinkler Wrench 21475M/B

VIKING®

TECHNICAL DATA

FREEDOM® RESIDENTIAL PENDENT SPRINKLER VK468 (K4.9)

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Approval Chart
Viking VK468, 4.9 K-Factor Residential Pendent Sprinkler

For systems designed to NFPA 13D or NFPA 13R. For systems designed to NFPA 13, refer to the design criteria. For Ceiling types refer to current editions of NFPA 13, 13R or 13D

Sprinkler Base Part Number[1]	SIN	NPT Thread Size		Nominal K-Factor		Maximum Water Working Pressure	Overall Length	
		Inches	mm	U.S.	metric[2]		Inches	mm
13637	VK468	1/2	15	4.9	70.6	175 psi (12 bar)	2-1/4	58

Max. Coverage Area[4] Ft.X Ft. (m X m)	Ordinary Temp Rating (155 °F/68 °C)		Intermediate Temp Rating (175 °F/79 °C)		Deflector to Ceiling	Installation Type	Listings and Approvals[3]				Minimum Spacing Ft. (m)
	Flow[4] GPM (L/min)	Pressure[4] PSI (bar)	Flow[4] GPM (L/min)	Pressure[4] PSI (bar)			C-UL-US-EU[5]	VdS	NYC[6]	NSF[8]	
12 X 12 (3.7 X 3.7)	13 (49.2)	7.0 (0.48)	13 (49.2)	7.0 (0.48)	1-1/8 to 2 inch	Standard surface-mounted escutcheons, or recessed with the Micromatic® Model E-1, E-2, or E-3 Recessed Escutcheon	See Foot-notes 7 and 10.	See Foot-notes 7 and 10.	See Foot-note 7.	See Foot-note 7.	8 (2.4)
14 X 14 (4.3 X 4.3)	13 (49.2)	7.0 (0.48)	13 (49.2)	7.0 (0.48)							
16 X 16 (4.9 X 4.9)	13 (49.2)	7.0 (0.48)	13 (49.2)	7.0 (0.48)							
18 X 18 (5.5 X 5.5)	17 (64.4)	12.0 (0.83)	17 (64.4)	12.0 (0.83)							
20 X 20 (6.1 X 6.1)	20 (75.7)	16.7 (1.15)	20 (75.7)	16.7 (1.15)							

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to Viking's current price schedule.

[2] Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.

[3] This chart shows the listings and approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals. Refer also to Design Criteria.

[4] For areas of coverage smaller than shown, use the "Flow" and "Pressure" for the next larger area listed. Flows and pressures listed are per sprinkler. The distance from sprinklers to walls shall not exceed one-half the sprinkler spacing indicated for the minimum "Flow" and "Pressure" used.

[5] Listed by Underwriter's Laboratories, Inc. for use in the U.S., Canada, and European Union.

[6] Accepted for use, City of New York Department of Buildings, MEA Number 89-92-E, Vol. 35.

[7] Approved Finishes are: Brass, Chrome, White Polyester, and Black Polyester[9]

[8] UL Classified to: NSF/ANSI Standard 61, Drinking Water System Components (MH48034).

[9] Other paint colors are available on request with the same C-UL-US-EU listings as the standard finish colors.

[10] Approved finish is Electroless Nickel PTFE (ENT). ENT is C-UL-US-EU Listed as corrosion resistant. ENT is available with standard surface-mounted escutcheons or the Micromatic Model E-1 Recessed Escutcheon.

VIKING®

TECHNICAL DATA

FREEDOM® RESIDENTIAL PENDENT SPRINKLER VK468 (K4.9)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

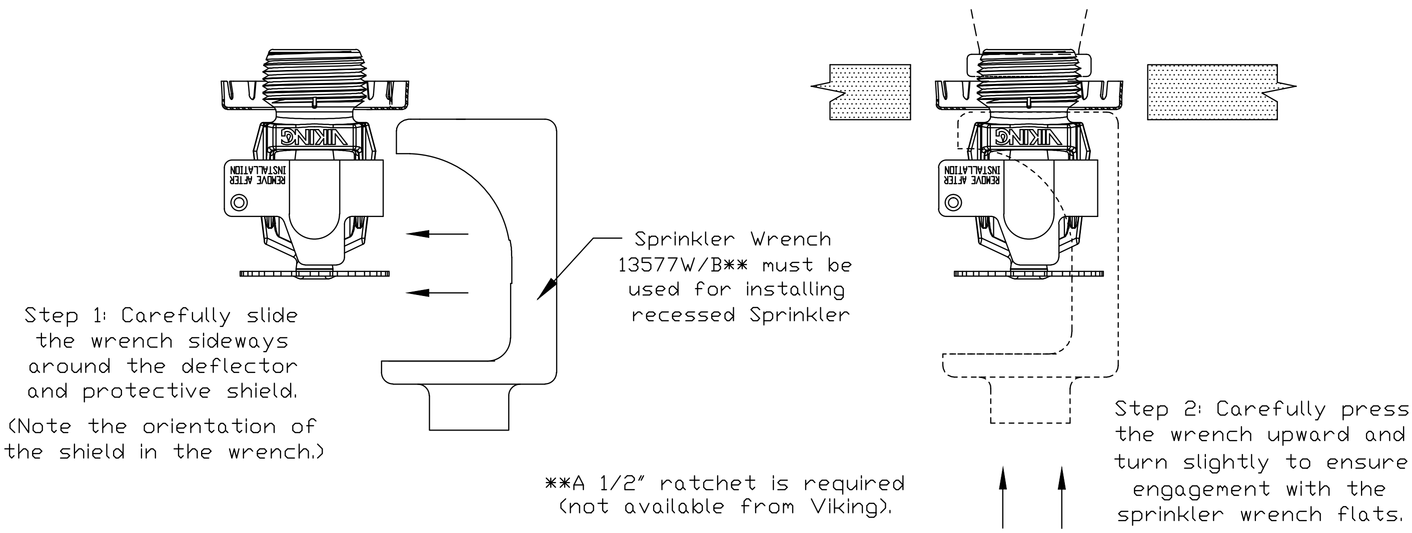

Figure 2: **Wrench 13577W/B for Recessed Sprinkler**

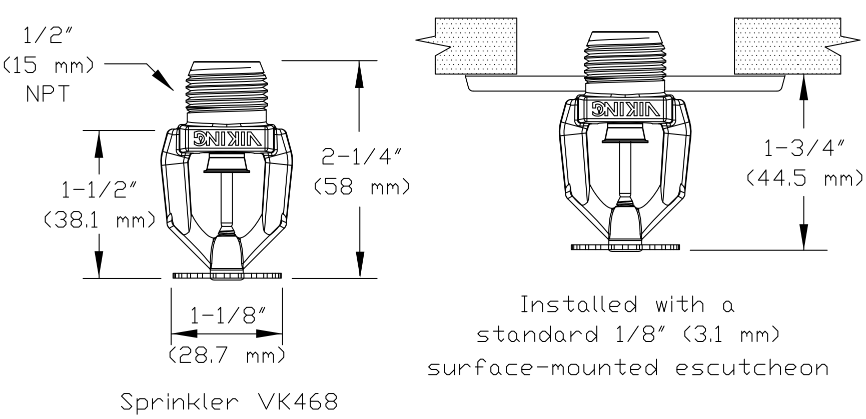

Figure 3: **Sprinkler VK468 Dimensions with a Standard Escutcheon**

VIKING®

TECHNICAL DATA

FREEDOM® RESIDENTIAL PENDENT SPRINKLER VK468 (K4.9)

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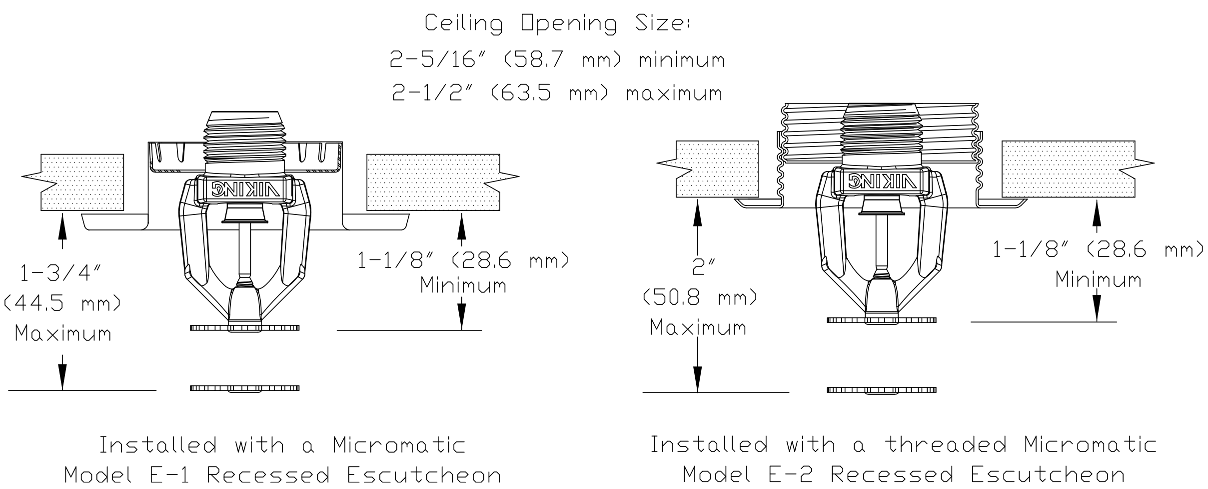

Figure 4: Sprinkler VK468 Dimensions with the Model E-1 and E-2 Recessed Escutcheons

DESIGN CRITERIA

(Also refer to the Approval Chart.)

UL Listing Requirements (C-UL-US-EU):

When using Viking Residential Pendent Sprinkler VK468 for systems designed to NFPA 13D or NFPA 13R, apply the listed areas of coverage and minimum water supply requirements shown in the Approval Chart.

For systems designed to NFPA 13: The number of design sprinklers is to be the four contiguous most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in the Approval Chart for NFPA 13D and NFPA13R applications for each listed area of coverage, **or**
- Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the “design area” in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13.
- Minimum distance between residential sprinklers: 8 ft. (2.4 m).

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to Form No. F_080614, F_080415 and F_080190 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, VdS, and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

Viking Residential Sprinkler Installation Guide

October 25, 2018

WARNING: Cancer and Reproductive Harm-
www.P65Warnings.ca.gov

VIKING	TECHNICAL DATA	**FREEDOM® RESIDENTIAL SPRINKLER INSTALLATION GUIDE**

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

1. DESCRIPTION

Viking residential automatic sprinklers are equipped with a "fast response" heat-sensitive operating element designed to respond individually and quickly to a specific high temperature. Viking residential sprinklers are designed to combine speed of operation with water distribution characteristics to help in the control of residential fires and to improve life safety by prolonging the time available for occupants to escape or be evacuated.

2. LISTINGS AND APPROVALS

Refer to the Approval Charts on the appropriate sprinkler technical data page(s) and/or approval agency listings.

A. Viking residential sprinklers are intended for use in the following occupancies: one- and two-family dwellings and mobile homes with the fire protection sprinkler system installed in accordance with NFPA 13D; residential occupancies up to four stories in height with the fire protection system installed in accordance with NFPA 13R; or residential portions of any occupancy with the fire protection system installed in accordance with NFPA 13. Information contained in this guide is based on NFPA 13, "Standard for the Installation of Sprinkler Systems".

B. The design criteria for residential sprinklers contained in the NFPA installation standards must be followed except as modified by the individual UL 1626 listing information provided in the technical data pages and this Residential Sprinkler Installation Guide. For listed areas of coverage, technical data, and specific design and installation instructions, refer to the appropriate Viking technical data page for the sprinkler model used.

C. Viking residential sprinklers listed by Underwriters Laboratories, Inc. (UL) have passed fire tests designed to represent fire conditions for the sprinkler's listed area of coverage. The standards for residential sprinkler performance and spray patterns are printed in Underwriters Laboratories Publication UL 1626, "Standard for Residential Sprinklers for Fire Protection Service". All listed Viking residential sprinklers meet or exceed UL 1626 performance requirements and spray pattern criteria for their listed areas of coverage.

D. NFPA standards allow use of residential sprinklers with rates, design areas, areas of coverage, and minimum design pressures other than those specified in the standards when they have been listed for such specific residential installation conditions.

3. TECHNICAL DATA

Specifications:

Refer to the appropriate sprinkler technical data sheet.

Material Standards:

Refer to the appropriate sprinkler technical data sheet.

Viking Technical Data may be found on The Viking Corporation's Web site at http://www.vikinggroupinc.com. The Web site may include a more recent edition of this Technical Data Page.

4. INSTALLATION

NOTE:Take care not to over-tighten the sprinkler and/or damage its operating parts!

Maximum Torque: 1/2" NPT: 14 ft-lbs. (19.0 N-m) 3/4" NPT: 20 ft-lbs. (27.1 N-m)

A. Care and Handling (also refer to Bulletin - Care and Handling of Sprinklers, Form No. F_091699.)

Sprinklers must be handled with care and protected from mechanical damage during storage, transport, handling, and after installation. Store sprinklers in a cool, dry place in their original container.

Use care when locating sprinklers near fixtures that can generate heat.

Never install sprinklers that have been dropped, damaged in any way, or exposed to temperatures exceeding the maximum ambient temperature allowed (refer to Table 1.)

Never install any glass-bulb sprinkler if the bulb is cracked or if there is a loss of liquid from the bulb. A small air bubble should be present in the glass bulb. Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed immediately. (Note: Installing glass bulb sprinklers in direct sunlight (ultraviolet light) may affect the color of the dye used to color code the bulb. This color change does not affect the integrity of the bulb.)

Viking residential sprinklers are intended for use on wet pipe residential systems only. Adequate heat must be provided for wet-pipe systems. DO NOT use Viking residential sprinklers on dry systems unless specifically allowed by recognized installation standards or the Authority Having Jurisdiction.

Residential concealed sprinklers must be installed in neutral or negative pressure plenums only!

Corrosion-resistant sprinklers must be installed when subject to corrosive atmospheres. **NOTE:** Viking residential sprinklers are not intended for use in corrosive environments.

Replaces pages 1-17, dated December 1, 2016.
(Added P65 Warning.)

VIKING	TECHNICAL DATA	FREEDOM® RESIDENTIAL SPRINKLER INSTALLATION GUIDE

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TABLE 1: RESIDENTIAL SPRINKLER TEMPERATURE RATINGS

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[3]	Bulb Color
Residential Glass Bulb Style Sprinklers			
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)[1]**	**Maximum Ambient Ceiling Temperature[3]**	
Residential Fusible Element Style Sprinklers			
Ordinary	165 °F (74 °C)	100 °F (38 °C)	
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)**	**Maximum Ambient Ceiling Temperature[3]**	**Temperature Identification Stamp**
Residential Flush Style Sprinklers			
Ordinary	165 °F (74 °C)	100 °F (38 °C)	On Cover or Sprinkler Inlet (VK476)
Intermediate	220 °F (104 °C)	150 °F (65 °C)	On Cover
Sprinkler Temperature Classification	**Sprinkler Nominal Temperature Rating (Fusing Point)**	**Maximum Ambient Ceiling Temperature[3]**	**Cover Plate Temperature Rating**
Residential Concealed Style Sprinklers			
Ordinary	135 °F (57 °C)[1], 140 °F (60 °C)[2], 155 °F (68 °C)[1], or 165 °F (74 °C)[1]	100 °F (38 °C)	135 °F (57 °C)

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector or flow shaper.

[2] The temperature rating is stamped on the sprinkler.

[3] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

B. Installation Instructions

Viking sprinklers are manufactured and tested to meet the rigid requirements of approving agencies. They are designed to be installed in accordance with recognized installation standards NFPA 13, NFPA 13R, and NFPA 13D, and any associated TIAs.

Deviation from the standards or any alteration to the sprinklers or cover plate assemblies after they leave the factory including, but not limited to: painting, plating, coating, or modification, may render the sprinklers inoperative and will automatically nullify the approval and any guarantee made by Viking.

The use of residential sprinklers may be limited due to occupancy and hazard. Residential fire protection systems must be designed and installed only by those who are completely familiar with the appropriate standards and codes, and thoroughly experienced in fire protection design, hydraulic calculations, and sprinkler system installation.

Before installation, be sure to have the appropriate sprinkler model and style, with the correct K-Factor, temperature rating, and response characteristics. Viking residential sprinklers must be installed after the piping is in place to prevent mechanical damage. Keep sprinklers with protective caps or bulb shields contained within the caps or shields during installation and testing, and any time the sprinkler is shipped or handled.

1a. For frame-style sprinklers, install escutcheon (if used), which is designed to thread onto the external threads of the sprinkler*.
*Refer to the appropriate sprinkler technical data page to determine approved escutcheons for use with specific sprinkler models.

1b. For flush and concealed style sprinklers: Cut the sprinkler nipple so that the ½” or 3/4” (15 mm or 20 mm) NPT** outlet of the reducing coupling is at the desired location and centered in the opening** in the ceiling or wall.
**Size depends on the sprinkler model used. Refer to appropriate sprinkler data page.

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DESIGN CRITERIA

<u>For Systems Designed to NFPA 13D or NFPA 13R:</u> Apply the listed areas of coverage and minimum water supply requirements shown in the approval charts on the residential sprinkler data pages. The sprinkler flow rate is the minimum required discharge from each of the total number of design sprinklers as specified in NFPA 13D or NFPA 13R.

<u>For Systems Designed to the latest edition of NFPA 13:</u> The number of design sprinklers is to be the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- **The flow rates given in the approval charts on the data pages for NFPA 13D and NFPA13R for each area of coverage listed, <u>or</u>**
- **Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the "design area" in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13. The greatest dimension of the coverage area cannot be any greater than the maximum areas of coverage shown on the data pages.**

Flow Rates

All residential sprinklers manufactured on or after July 12, 2002 are listed with a single minimum flow rate. Where rooms have more than one sprinkler, multiple-sprinkler calculations are still required, but the first sprinkler and any additional sprinkler or sprinklers must be calculated flowing at identical minimum flow rates, based on the area of sprinkler coverage, using the minimum flow and pressure listed for the sprinkler model used.

Consult the appropriate standards and the Authorities Having Jurisdiction to determine the number of sprinklers to hydraulically calculate to verify adequate water supply for multiple-sprinkler operation.

Operating Pressure: The minimum operating pressure of any sprinkler shall be the minimum operating pressure specified by the listing, or 7 psi (0.5 bar), whichever is greater. The maximum allowable operating pressure is 175 psi (12 bar).

Areas of Coverage

If the actual area of coverage is less than the listed area of coverage, use the minimum water supply for the next larger area of coverage listed. DO NOT interpolate. Residential sprinkler systems must be hydraulically calculated according to NFPA standards to verify that the water supply is adequate for proper operation of the sprinklers. Hydraulic calculations are required to verify adequate water supply at the hydraulically most remote single sprinkler when it is operating at the minimum gpm and psi listed for single-sprinkler operation for the sprinkler model used.

Viking residential sprinklers may be listed for more than one area of coverage. Suggested practice in selecting area of coverage is to select the one that can be adequately supplied by the available water supply and still allow for the installation of as few sprinklers in a compartment as possible while observing all guidelines pertaining to obstructions and spacing. This maximizes the use of the available water supply, which is often limited on residential fire protection systems. After selecting an appropriate area of coverage, sprinklers must be spaced according to guidelines set forth in the installation standards.

Definition of "COMPARTMENT": A space completely enclosed by walls and a ceiling. Openings to an adjoining space are allowed, provided the openings have a minimum lintel depth of 8 in. (203.2 mm) from the ceiling.

Spacing Guidelines

For guidelines concerning spacing of Viking residential sprinklers near beams, obstructions, heat sources, and sloped ceilings [slopes more than a 2/12 (9.5°) pitch], refer to the Viking residential sprinkler data pages and installation guide, the appropriate NFPA standard, and the Authority Having Jurisdiction. NOTE: Sloped, beamed, and pitched ceilings could require special design features such as larger flow, or a design for more sprinklers to operate in the compartment, or both.

Distance from Walls: Install not more than one-half the listed sprinkler spacing nor less than 4" (102 mm) from walls, partitions, or obstructions as defined in the standards.

Minimum Sprinkler Spacing: The minimum distance between residential sprinklers to prevent cold soldering (i.e., the spray from one operating sprinkler onto an adjacent sprinkler that could prevent its proper activation) is 8 ft. (2.4 m).

Maximum Sprinkler Spacing: Locate adjacent sprinklers no farther apart than the listed spacing.

Deflector Position: Install frame style residential *pendent* sprinklers with the deflector between 1" and 4" (25.4 mm to 102 mm) below smooth ceilings, unless the sprinkler data page indicates otherwise. Install pendent sprinklers in the pendent position only, with the deflector oriented parallel with the ceiling or roof.

Refer to the individual listings in the residential sprinkler data pages for horizontal sidewall sprinkler deflector or sprinkler centerline distance below the ceiling. Install horizontal sidewall sprinklers in the horizontal position only below smooth ceilings, with the leading edge of the deflector or element assembly oriented parallel with the ceiling.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to the appropriate sprinkler data page. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

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2. Apply a small amount of pipe-joint compound or tape to the external threads of the sprinkler only, taking care not to allow a build-up of compound in the sprinkler inlet. **NOTE:** Sprinklers with protective caps or bulb shields must be contained within the caps or shields before applying pipe-joint compound or tape. *Exception: For concealed sprinklers (i.e., VK457, VK458, VK468, VK474, and VK4570) the protective cap is removed for installation.*
3. Care must be taken when installing sprinklers on CPVC and copper piping systems. Never install the sprinkler into the reducing fitting before attaching the reducing fitting to the piping. Sprinklers must be installed on CPVC systems after the reducing fitting has been installed and the primer and/or cement manufacturer's recommended curing time has elapsed. When installing sprinklers on copper piping systems, take care to brush the inside of the sprinkler supply piping and reducing fitting to ensure that no flux accumulates in the sprinkler orifice. Excess flux can cause corrosion and may impair the ability of the sprinkler to operate properly.
4. Refer to the appropriate sprinkler technical data page to determine the correct sprinkler wrench for the model of sprinkler used. DO NOT use the sprinkler deflector or fusible element to start or thread the sprinkler into a fitting.
   a. Install the sprinkler onto the piping using the special sprinkler wrench only, while taking care not to over-tighten or damage the sprinkler operating parts.
   b. *Thread the flush or concealed sprinkler into the ½*" or 3/4" (15 mm or 20 mm) NPT** *outlet of the coupling by turning it clockwise with the special sprinkler wrench. NOTE: For flush and concealed sprinklers with protective shells, the internal diameter of the special flush and concealed sprinkler installation wrench is designed for use with the sprinkler contained within the shell. Exception: For concealed sprinklers VK457, VK458, VK468, VK474, and VK4570 the protective cap is removed for installation, and then placed back on the sprinkler temporarily.*
5. After installation, the entire sprinkler system must be tested. The test must be conducted to comply with the installation standards.
   a. Make sure the sprinkler has been properly tightened. If a thread leak occurs, normally the unit must be removed, new pipe-joint compound or tape applied, and then reinstalled. This is due to the fact that when the joint seal leaks, the sealing compound is washed out of the joint.
   b. **Remove plastic protective sprinkler caps or bulb shields AFTER the wall or ceiling finish work is completed where the sprinkler is installed and there no longer is a potential for mechanical damage to the sprinkler operating elements.** To remove the bulb shields, simply pull the ends of the shields apart where they are snapped together. To remove caps from frame style sprinklers, turn the caps slightly and pull them off the sprinklers. **SPRINKLER CAPS OR BULB SHIELDS MUST BE REMOVED FROM SPRINKLERS <u>BEFORE</u> PLACING THE SYSTEM IN SERVICE!** Retain a protective cap or shield in the spare sprinkler cabinet.
6. For residential flush sprinklers, the ceiling ring can now be installed onto the sprinkler body. Align the ceiling ring with the sprinkler body and thread on or push it on until the flange touches the ceiling. Note the maximum vertical adjustment is ½" (12,7 mm) for sprinkler VK420 and 5/8" for VK476. DO NOT MODIFY THE UNIT. If necessary, re-cut the sprinkler drop nipples as required.
7. For residential concealed sprinklers, the cover plate assembly can now be attached.
   a. Remove the cover plate assembly from the protective box, taking care not to damage the assembly.
   b. From below the ceiling, gently place the base of the cover plate assembly over the sprinkler protruding through the opening in the ceiling or wall.
   c. Carefully push the cover plate assembly onto the sprinkler, using even pressure with the palm of the hand, until the unfinished brass flange of the cover plate base touches the ceiling or wall.
   d. The maximum adjustment available for residential concealed sprinklers is ½" (12.7 mm) [1/4" (6.4 mm) for sprinkler VK480]. DO NOT MODIFY THE UNIT. If necessary, re-cut the sprinkler nipples.

NOTE: If it is necessary to remove the entire sprinkler unit, the system must be taken out of service. See Maintenance instructions below and follow all warnings and instructions.

5. OPERATION

During fire conditions, the operating element fuses or shatters (depending on the type of sprinkler), releasing the pip cap and sealing assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector or flow shaper, forming a uniform, high-wall wetting spray pattern to extinguish or control the fire.

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6. INSPECTIONS, TESTS AND MAINTENANCE

Refer to NFPA 25 for Inspection, Testing and Maintenance requirements. **NOTICE:** The owner is responsible for having the fire-protection system and devices inspected, tested, and maintained in proper operating condition in accordance with this guide, and applicable NFPA standards. In addition, the Authority Having Jurisdiction may have additional maintenance, testing, and inspection requirements that must be followed.

A. Sprinklers must be inspected on a regular basis for signs of corrosion, mechanical damage, obstructions, paint, etc. Frequency of the inspections may vary due to corrosive atmospheres, water supplies, and activity around the device.

B. Sprinklers or cover plate assemblies that have been field painted, caulked, or mechanically damaged must be replaced immediately. Sprinklers showing signs of corrosion shall be tested and/or replaced immediately as required. Installation standards require sprinklers to be tested and, if necessary, replaced immediately after a specified term of service. Refer to NFPA 25 and the Authorities Having Jurisdiction for the specified period of time after which testing and/or replacement of residential sprinklers is required. Never attempt to repair or reassemble a sprinkler. Sprinklers and cover assemblies that have operated cannot be reassembled or re-used, but must be replaced. When replacement is necessary, use only new sprinklers and cover assemblies with identical performance characteristics.

C. The sprinkler discharge pattern is critical for proper fire protection. Nothing should be hung from, attached to, or otherwise obstruct the discharge pattern of the sprinkler. All obstructions must be immediately removed or, if necessary, additional sprinklers installed.

D. When replacing existing sprinklers, the system must be removed from service. Refer to the appropriate system description and/or valve instructions. Prior to removing the system from service, notify all Authorities Having Jurisdiction. Consideration should be given to employment of a fire patrol in the effected area.

1. Remove the system from service, drain all water, and relieve all pressure on the piping.

2a. For frame-style sprinklers, use the special sprinkler wrench and remove the old sprinkler by turning it counterclockwise to unthread it from the piping.

2b. For residential flush pendent and concealed style sprinklers: Remove the ceiling ring or cover plate assembly before unthreading the sprinkler body from the piping. To remove a ceiling ring, grasp it from below the ceiling and gently turn it counterclockwise. Cover plates can be removed either by gently unthreading them or pulling them off the sprinkler body (depends on the sprinkler model used). After the ceiling ring or cover plate assembly has been removed from the sprinkler, use the sprinkler wrench to unthread the sprinkler from the piping. NOTE: For flush and concealed sprinklers with protective shells, the internal diameter of the special flush and concealed sprinkler installation wrench is designed for use with the sprinkler contained within the shell. Place a plastic protective shell (from the spare sprinkler cabinet) over the sprinkler to be removed and then fit the sprinkler wrench over the shell. Exception: Concealed sprinklers VK457, VK458, VK468, VK474, and VK4570 are removed without the plastic cap.

3. Follow instructions in section 4B. Installation Instructions to install the new unit. Be sure the replacement sprinkler is the correct model and style, with the appropriate K-Factor, temperature rating, and response characteristics. A fully stocked sprinkler cabinet should be provided for this purpose. *(For flush or concealed style sprinklers, stock of spare ceiling rings or cover plates should also be available in the spare sprinkler cabinet.)*

4. Place the system back in service and secure all valves. Check for and repair all leaks.

E. Sprinkler systems that have been subjected to a fire must be returned to service as soon as possible. The entire system must be inspected for damage, and repaired or replaced as necessary. Sprinklers that have been exposed to corrosive products of combustion or high ambient temperatures, but have not operated, should be replaced. Refer to the Authority Having Jurisdiction for minimum replacement requirements.

7. AVAILABILITY

Viking Residential Sprinklers are available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE

For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

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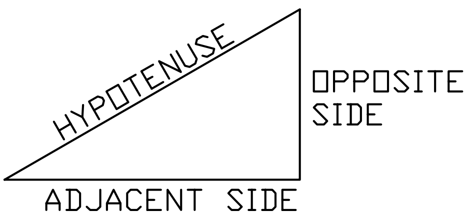
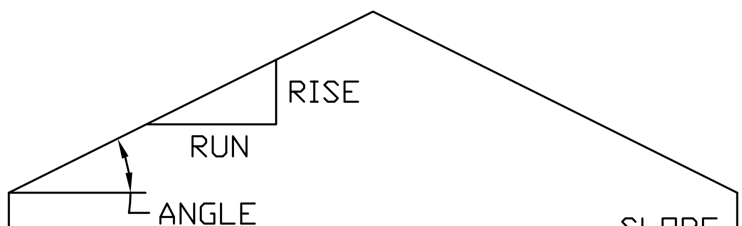


$$\text{TANGENT} = \frac{\text{OPPOSITE SIDE (RISE)}}{\text{ADJACENT SIDE (RUN)}}$$

$$\frac{\text{RISE}}{\text{RUN}} = \text{TANGENT}$$

$$\text{ANGLE} = \text{TAN}^{-1}\left(\frac{\text{RISE}}{\text{RUN}}\right)$$

$$\text{SLOPE DISTANCE} = \sqrt{(\text{RISE})^2 + (\text{RUN})^2}$$



RISE	RUN	TANGENT	ANGLE	SLOPE DISTANCE
2	12	.1666	9.45°	12.1
3	12	.2500	14°	12.3
4	12	.3333	18.4°	12.6
5	12	.4166	22.6°	13
6	12	.5000	26.5°	13.4
7	12	.5833	30.2°	13.8
8	12	.6666	33.6°	14.4
9	12	.7500	36.8°	15
10	12	.8333	39.8°	15.6
11	12	.9166	42.5°	16.2
12	12	1	45°	16.97

Table 2
Rise Over Run Conversion to Degrees of Slope

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SPACING OF RESIDENTIAL SPRINKLERS LISTED FOR USE BELOW SLOPED CEILINGS UP TO AN 8/12 (33.7°) PITCH

(Refer to the appropriate residential sprinkler technical data page for listings.)

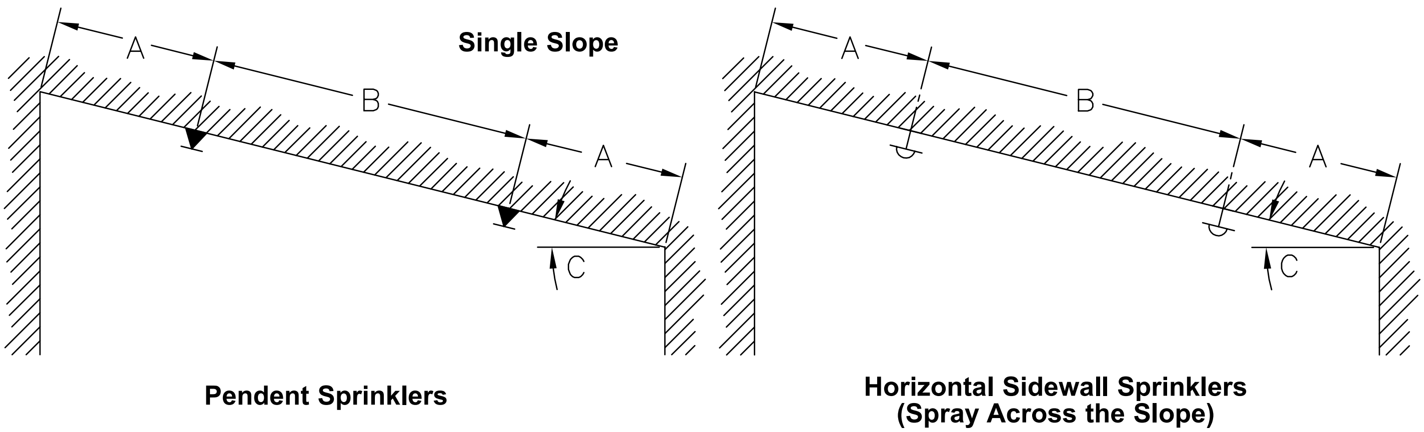

Figure 1

(A) One-half listed spacing of sprinkler maximum, 0'-4" (0-102 mm) minimum.
(B) Listed spacing of sprinkler, maximum, 8'-0" (2.4 m) minimum.
(C) Where angle "C" is greater than an 8/12 (33.7°) pitch, see Figure 2 below.

SPACING OF RESIDENTIAL SPRINKLERS BELOW SLOPED CEILINGS WITH GREATER THAN 8/12 (33.7°) PITCH

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

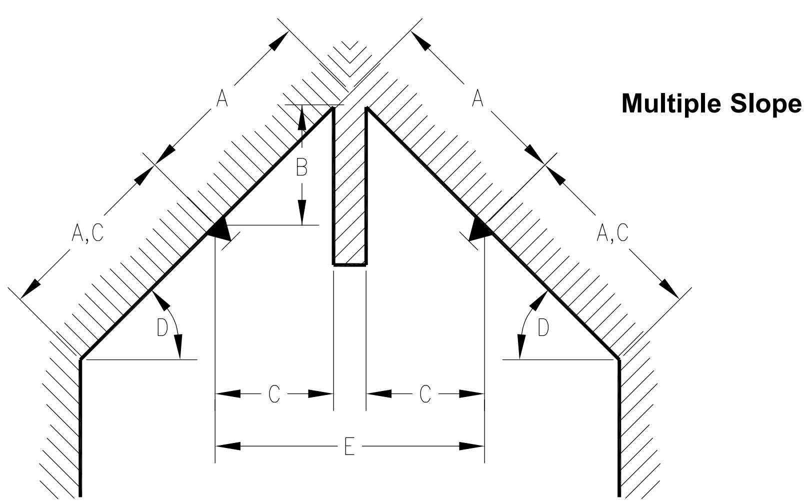

Figure 2

(A) One-half listed spacing of sprinkler, maximum.
(B) 3'-0" (.91 m) maximum.
(C) 0'-4" (0-102 mm) minimum.
(D) Slopes greater than an 8/12 (33.7°) pitch.
(E) For distance less than 8'-0" (2.4 m), baffle required.

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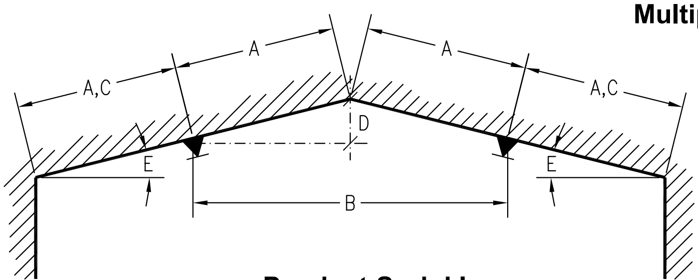
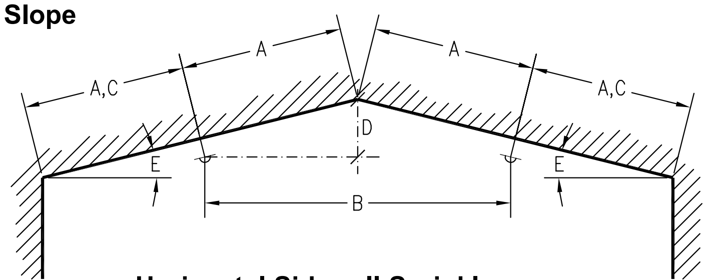
SPACING OF RESIDENTIAL SPRINKLERS LISTED FOR USE BELOW SLOPED CEILINGS UP TO AN 8/12 (33.7°) PITCH

(Refer to the appropriate residential sprinkler technical data page for listings.)

Multiple Slope



Pendent Sprinklers



Horizontal Sidewall Sprinklers (Spray Across the Slope)

Figure 3

(A) One-half listed spacing of sprinkler, maximum.
(B) 8’-0” (2.4 m) minimum.
(C) 0’-4” (0-102 mm) minimum.
(D) 3’-0” (.91 m) maximum.
(E) Acceptable for slopes of 0/12 to 8/12 (0° to 33.7°) pitch.

SPACING OF RESIDENTIAL PENDENT SPRINKLERS AT PEAK OF SLOPED CEILINGS WITH PITCH LESS THAN 8/12 (33.7°)

(Refer to the appropriate residential sprinkler technical data page for listings.)

Multiple Slope

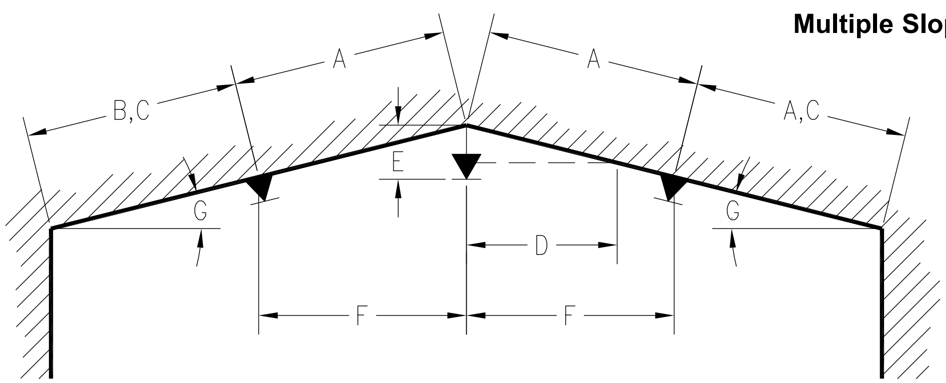


Figure 4

(A) Listed spacing of sprinkler, maximum.
(B) One-half listed spacing of sprinkler, maximum.
(C) 0’-4” minimum.
(D) Refer to page 10 for minimum distance between sprinkler and intersecting sloped ceiling.
(E) Refer to the appropriate residential sprinkler technical data page for deflector distance below ceiling.
(F) 8’-0” minimum.
(G) Reference: 4/12 (18.0°) pitch maximum for 12’ (3.7 m) spacing.
2.5/12 (12.0°) pitch maximum for 14’ (4.3 m) spacing.
2/12 (10.0°) pitch maximum for 16’ (4.9 m) spacing.
2/12 (10.0°) pitch maximum for 18’ (5.5 m) spacing.
1.9/12 (9.0°) pitch maximum for 20’ (6.1 m) spacing.
Angles based on sprinklers installed 0’-4” (0-102 mm) from peak.

NOTE: Whenever possible, utilize design as shown in Figure 3 above.

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SPACING OF RESIDENTIAL SPRINKLERS BELOW SLOPED CEILINGS WITH GREATER THAN 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 2 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

Multiple Slope

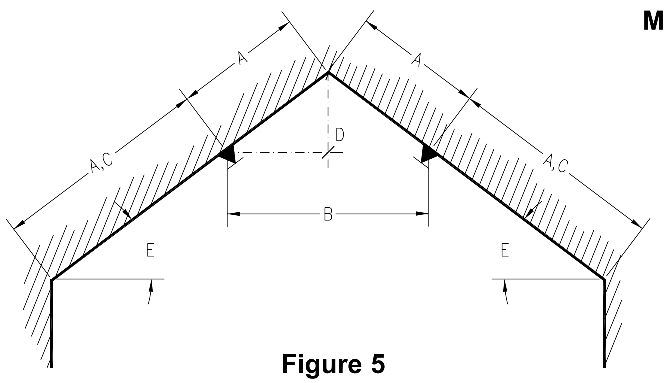

Figure 5

(A) One-half listed spacing of sprinkler, maximum.
(B) 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) 3'-0" (.91 m) maximum.
(E) Acceptable for slopes greater than an 8/12 (33.7°) pitch.
(F) When this design is used, refer to the appendices of NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction regarding the number of design sprinklers to hydraulically calculate.

SPACING OF RESIDENTIAL SPRINKLERS BELOW CEILINGS WITH SLOPES EXCEEDING 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 3 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

Multiple Slope

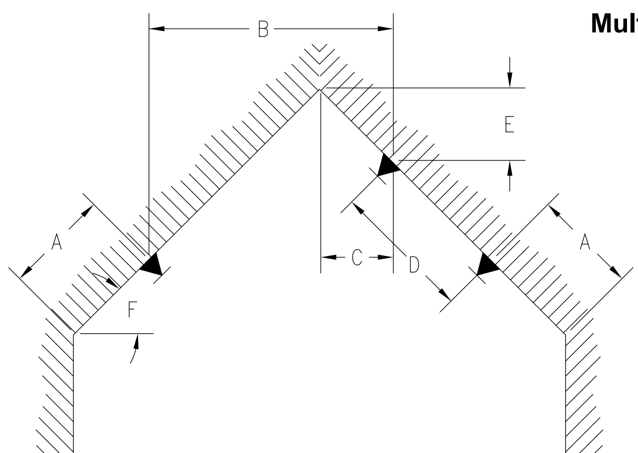

Figure 6

(A) 0'-4" (0-102 mm) minimum, to one-half listed spacing, maximum.
(B) One-half listed spacing, maximum, 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) Listed spacing maximum, 8'-0" (2.4 m) minimum.
(E) 3'-0" (.91 m) maximum.
(F) Slopes greater than 8/12 up to a 21/12 (33.7° up to 60°) pitch.

NOTES: In addition to the above limits, rooms requiring this type of installation must be hydraulically calculated to supply a minimum of three operating sprinklers. Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

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SPACING OF RESIDENTIAL SPRINKLERS BELOW CEILINGS WITH SLOPES EXCEEDING 8/12 (33.7°) PITCH WITH NO BAFFLE AND A MAXIMUM OF 2 SPRINKLERS IN THE ROOM

(NOTE: Refer to NFPA 13D or NFPA 13R, and the Authority Having Jurisdiction.)

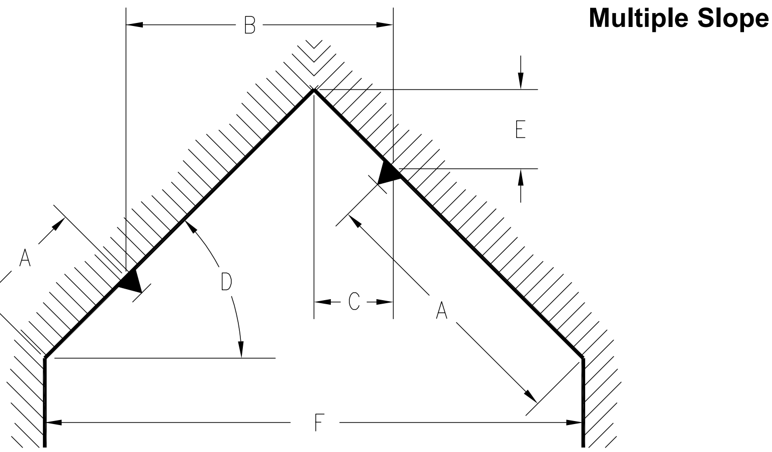

Figure 7

(A) 0'-4" (0-102 mm) minimum, to one-half listed spacing, maximum.
(B) One-half listed spacing, maximum, 8'-0" (2.4 m) minimum.
(C) 0'-4" (0-102 mm) minimum.
(D) Slopes greater than 8/12 pitch up to a 21/12 (33.7° up to a 60°) pitch.
(E) 3'-0" (.91 m) maximum.
(F) When dimension "F" exceeds 16' (4.9 m), utilize design configuration shown in Figure 6.

NOTES: Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

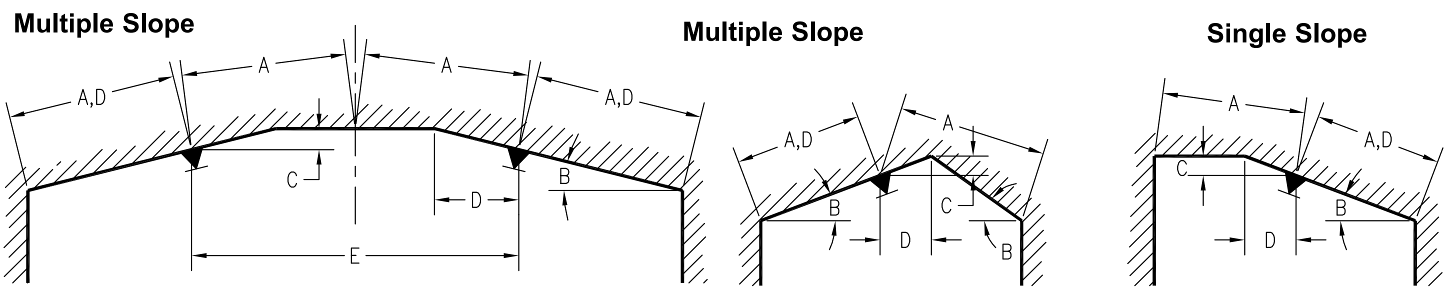

Figure 8

(A) One-half listed spacing, maximum.
(B) Refer to the appropriate residential sprinkler technical data pages for listings of sprinklers for use below slopes up to and including a 8/12 (33.7°) pitch.
(C) 3'-0" (.91 m) maximum.
(D) 0'-4" (0-102 mm) minimum.
(E) 8'-0" (2.4 m) minimum without baffle.

NOTES: Layout similar for horizontal sidewall sprinklers with throw across slope. Refer to the appropriate residential sprinkler technical data sheets.

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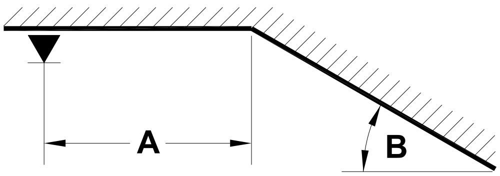
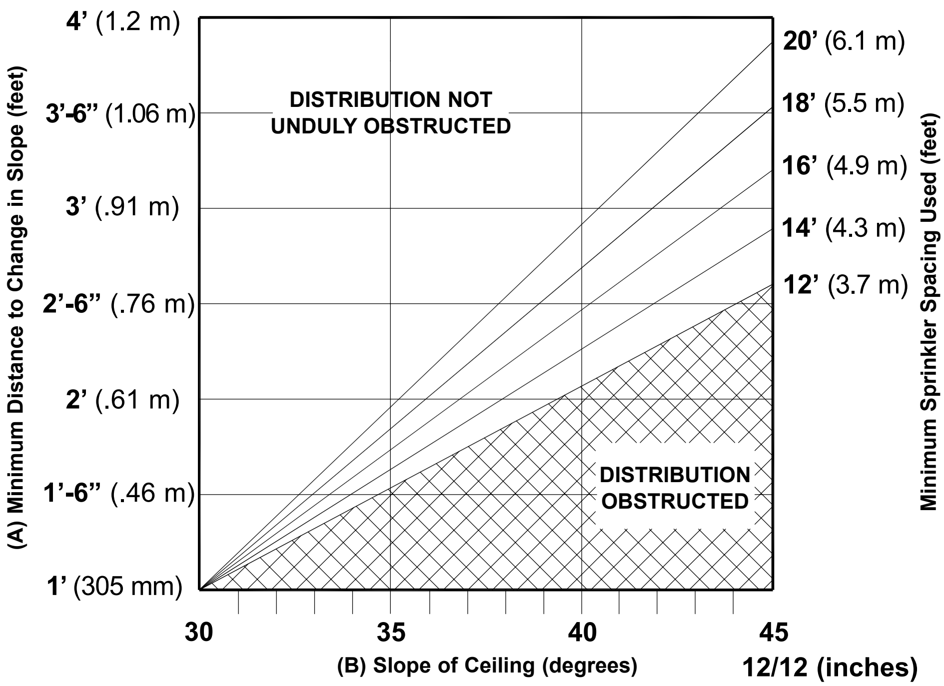
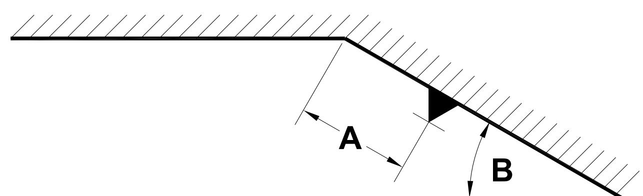
MINIMUM DISTANCE BETWEEN SPRINKLER AND INTERSECTING SLOPED CEILINGS

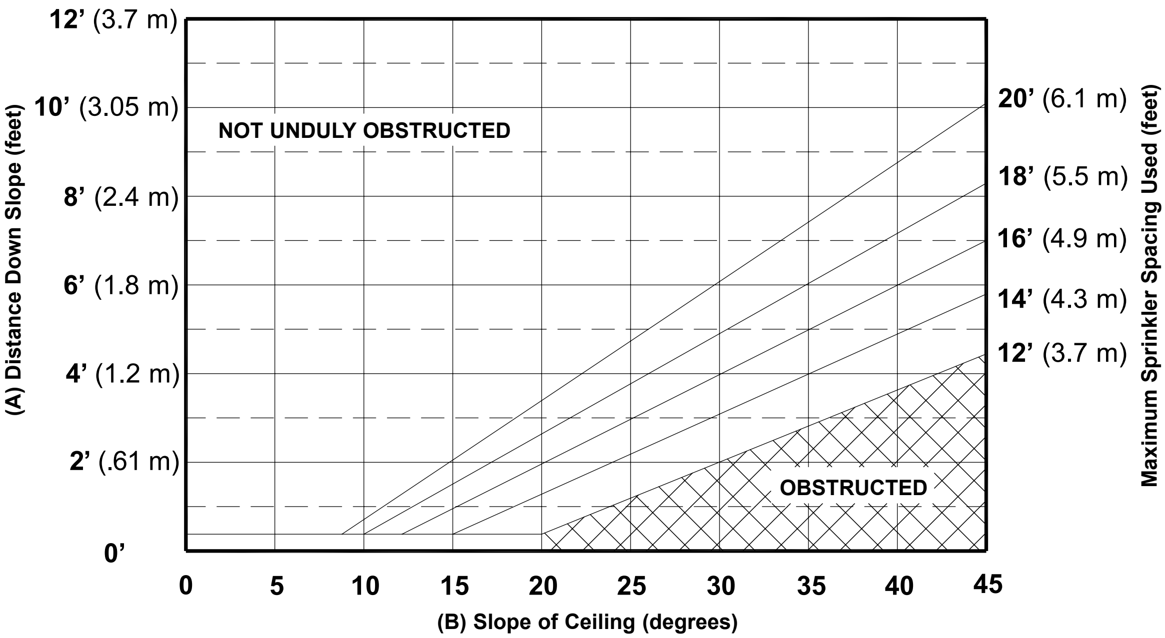


NOTES: For any ceiling slope under 7/12 (30°), distribution is considered Not Unduly Obstructed.



MAXIMUM DISTANCE DOWN SLOPE TO AVOID OBSTRUCTION TO SPRINKLER DISCHARGE





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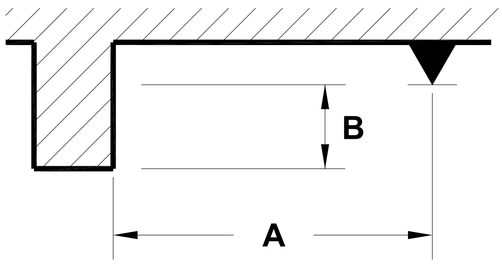
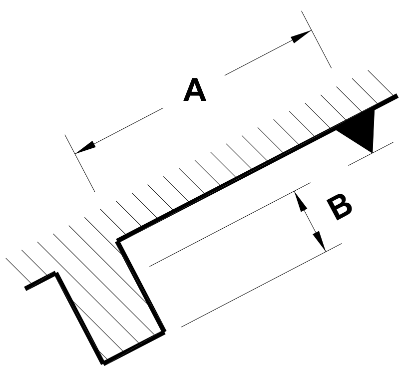
AVOIDING OBSTRUCTIONS TO SPRINKLER DISCHARGE

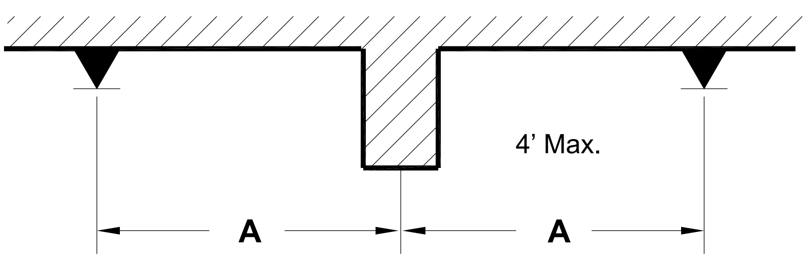
(Obstruction rules for residential sprinklers are found in section 8.10 of the 2010 edition of NFPA 13.)

Positioning Residential Pendent Sprinklers - Obstructions at the Ceiling



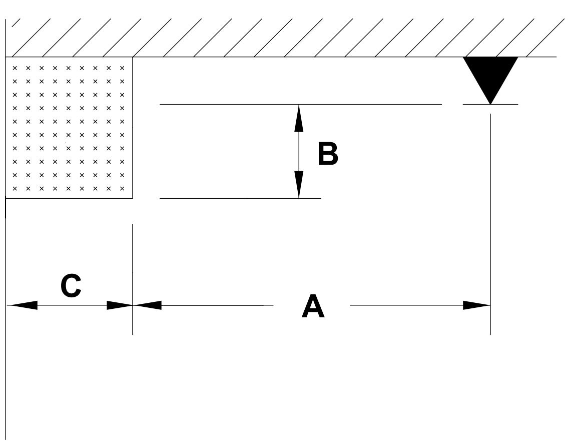


Distance from Sprinkler to Side of Ceiling Obstruction (Dimension A)	Maximum Distance from Deflector to Bottom of Ceiling Obstruction (Dimension B)	
	Inches	mm
Less than 1 ft. 6 in. (Less than 457 mm)	0	0
1 ft. 6 in. to less than 3 ft. (457 mm to less than .94 m)	1	25.4
3 ft. to less than 4 ft. (.91 m to less than 1.2 m)	3	76
4 ft. to less than 4 ft. 6 in. (1.2 m to less than 1.37 m)	5	127
4 ft. 6 in. to less than 6 ft. (1.37 m to less than 1.8 m)	7	178
6 ft. to less than 6 ft. 6 in. (1.8 m to less than 2 m)	9	229
6 ft. 6 in. to less than 7 ft. (2 m to less than 2.1 m)	11	279
7 ft. or greater (2.1 m or greater)	14	356



Residential pendent sprinklers may be located on opposite sides of continuous obstructions up to 4 ft. (1.2 m) wide at the ceiling, as long as the distance from the centerline of the obstruction to the sprinklers (A) does not exceed one-half the maximum spacing allowed between sprinklers.

Positioning Residential Pendent Sprinklers - Obstructions Along Walls



(A) Distance from centerline of sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.
(C) Width of the obstruction.

Obstructions up to 30 in. (.8 m) wide (C) located against the wall are permitted to be protected when (A) is greater than or equal to (C) minus 8 in. (.2 m) plus (B).

$C \leq 30$ in.   for metric $C \leq .8$ m
$A \geq (C - 8 \text{ in.}) + B$ $A \geq (C - .2 \text{ m}) + B$

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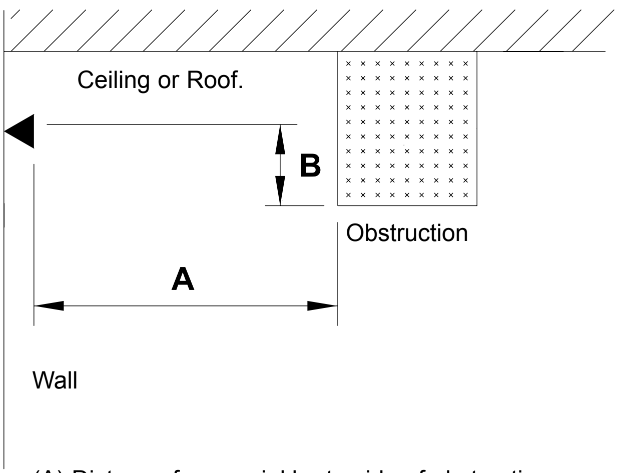
AVOIDING OBSTRUCTIONS TO SPRINKLER DISCHARGE

(Obstruction rules for residential sprinklers are found in section 8.10 of the 2010 edition of NFPA 13.)

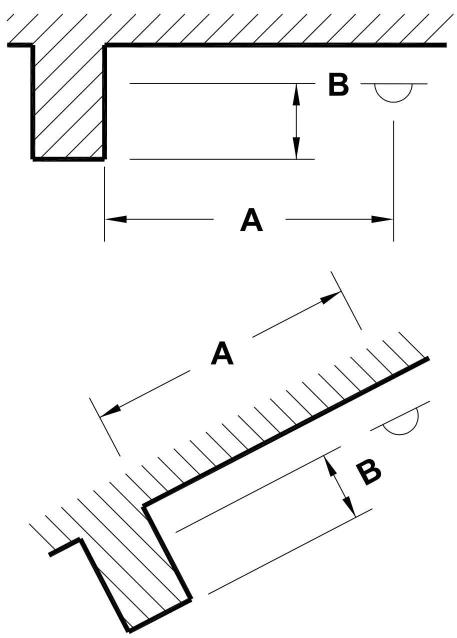
Positioning Residential Horizontal Sidewall Sprinklers - Obstructions at the Ceiling



(A) Distance from sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.

Distance from Sprinkler to Side of Ceiling Obstruction (Dimension A)	Maximum Distance from Deflector to Bottom of Ceiling Obstruction (Dimension B)	
	Inches	mm
Less than 8 ft. (Less than 2.4 m)	No Obstructions Allowed	
8 ft. to less than 10 ft. (2.4 m to less than 3.05 m)	1	25.4
10 ft. to less than 11 ft. (3.05 m to less than 3.35 m)	2	50.8
11 ft. to less than 12 ft. (3.35 m to less than 3.7 m)	3	76
12 ft. to less than 13 ft. (3.7 m to less than 4 m)	4	102
13 ft. to less than 14 ft. (4 m to less than 4.3 m)	6	152
14 ft. to less than 15 ft. (4.3 m to less than 4.6 m)	7	178
15 ft. to less than 16 ft. (4.6 m to less than 4.9 m)	9	229
16 ft. to less than 17 ft. (4.9 m to less than 5.2 m)	11	279
17 ft. or greater (5.2 m or greater)	14	356

Positioning Residential Horizontal Sidewall Sprinklers - Obstructions Along Walls



Distance from Sprinkler to Side of Obstruction Along Wall (Dimension A)	Maximum Distance from Deflector to Bottom of Obstruction (Dimension B)	
	Inches	mm
Less than 1 ft. 6 in. (Less than 457 mm)	0	0
1 ft. 6 in. to less than 3 ft. (457 mm to less than .94 m)	1	25.4
3 ft. to less than 4 ft. (.91 m to less than 1.2 m)	3	76
4 ft. to less than 4 ft. 6 in. (1.2 m to less than 1.37 m)	5	127
4 ft. 6 in. to less than 6 ft. (1.37 m to less than 1.8 m)	7	178
6 ft. to less than 6 ft. 6 in. (1.8 m to less than 2 m)	9	229
6 ft. 6 in. to less than 7 ft. (2 m to less than 2.1 m)	11	279
7 ft. or greater (2.1 m or greater)	14	356

(A) Distance from sprinkler to side of obstruction.
(B) Distance from deflector to bottom of obstruction.

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LOCATING RESIDENTIAL SPRINKLERS NEAR HEAT SOURCES

Ordinary temperature rated residential sprinklers (135 °F to 170 °F rated) are only to be installed where the maximum ambient ceiling temperature will not exceed 100 °F. Where the maximum ambient ceiling temperature will be from 101 °F to 150 °F, use intermediate temperature rated residential sprinklers (175 °F to 225 °F rated).

Residential sprinklers must be positioned a sufficient distance away from heat sources that include fireplaces, stoves, kitchen ranges, wall ovens, hot water pipes, water heaters, furnaces and associated flues and ducts, and light fixtures. The following minimum distances must be maintained for both ordinary and intermediate temperature rated residential sprinklers as indicated.

Heat Source	Minimum Distance from Edge of Source to Ordinary Temperature Rated Sprinkler		Minimum Distance from Edge of Source to Intermediate Temperature Rated Sprinkler	
	Inches	metric	Inches	metric
Side of open or recessed fireplace	36	.91 m	12	305 mm
Front of recessed fire place	60	1.5 m	36	.91 m
Coal- or wood-burning stove	42	1.1 m	12	305 mm
Kitchen range	18	457 mm	9	229 mm
Wall oven	18	457 mm	9	229 mm
Hot air flues	18	457 mm	9	229 mm
Uninsulated heat ducts	18	457 mm	9	229 mm
Uninsulated hot water pipes	12	305 mm	6	152 mm
Side of ceiling- or wall-mounted hot air diffusers	24	.61 m	12	305 mm
Front of wall-mounted hot air diffusers	36	.91 m	18	457 mm
Hot water heater or furnace	6	152 mm	3	76 mm
Light fixture less than 250W	6	152 mm	3	76 mm
Light fixture 250W to 499W	12	305 mm	6	152 mm
Where residential sprinklers will be exposed to the rays of the sun passing through glass or plastic skylights, use intermediate temperature rated sprinklers.				
When locating residential sprinklers in an unventilated concealed compartment, under an unventilated attic or uninsulated roof, where the maximum ambient temperature does not exceed 150 °F, use intermediate temperature rated sprinklers.				

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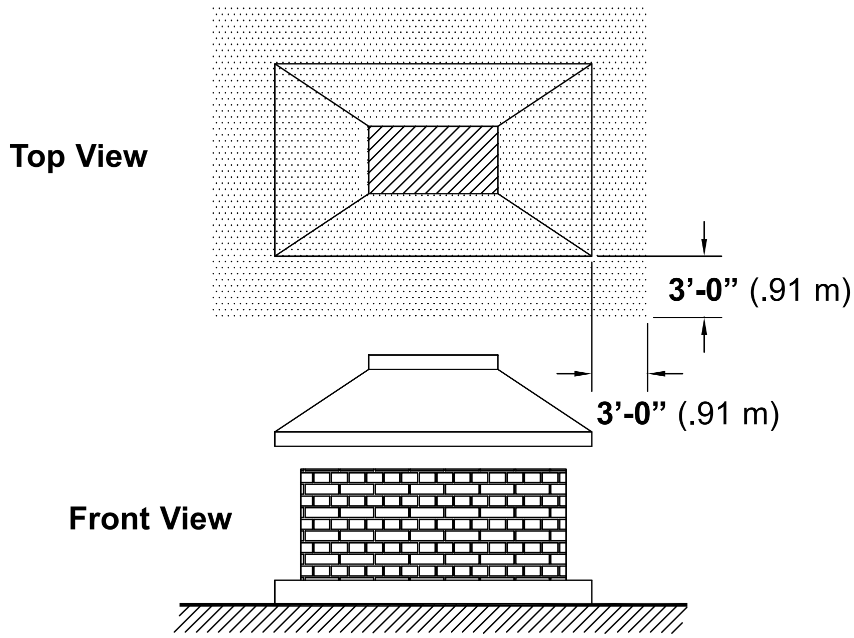
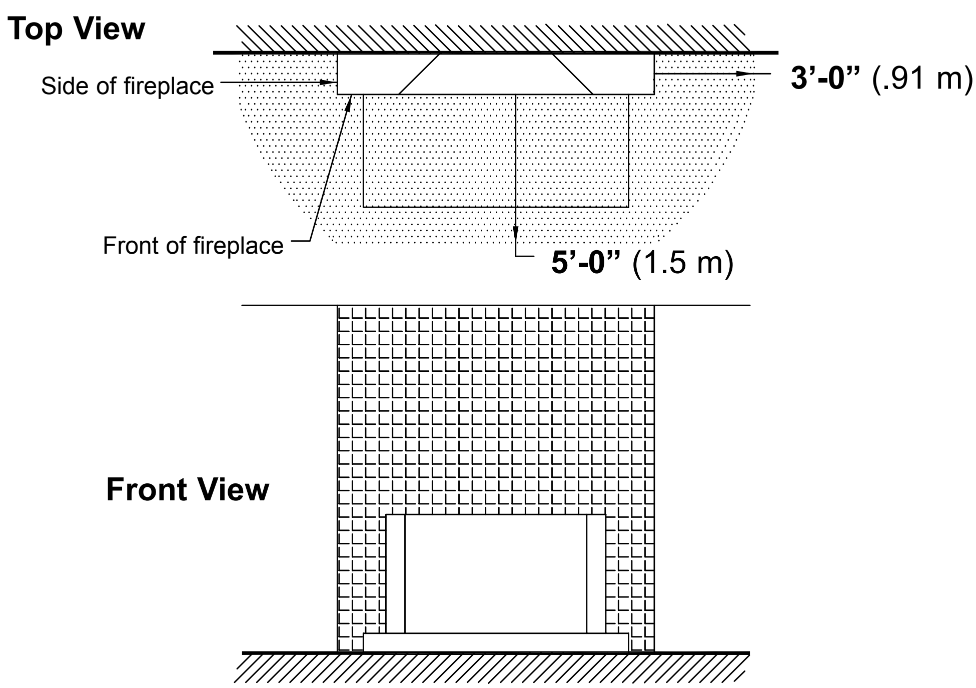
NOTE: The dimensions shown are intended to apply to residential sprinklers installed in ceilings above fireplaces used to burn products that cause elevated temperatures at or near the ceiling in areas surrounding the fireplace. The recommendations should not be construed to apply to decorative non-opening fireplaces such as gas fire units that will not cause elevated temperatures at the ceiling.



Sprinklers near an open hearth fireplace must be located outside of the shaded area or be intermediate degree rated.



Sprinklers near a recessed hearth fireplace must be located outside of the shaded area [at least 3'-0" (.91 m)] from the side of a recessed fireplace and at least 5'-0" (1.5 m) from the front) or be intermediate degree rated.

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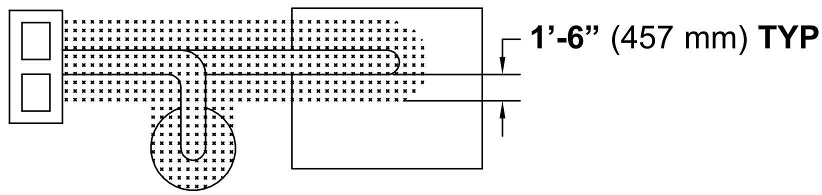
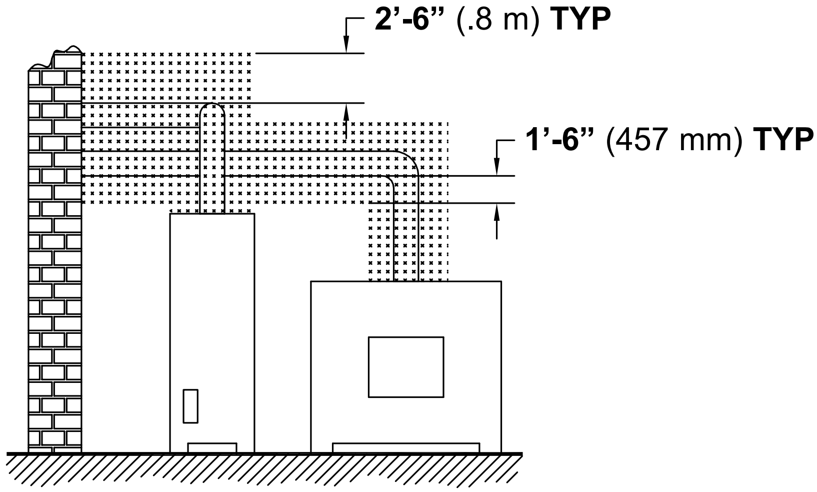
Top View

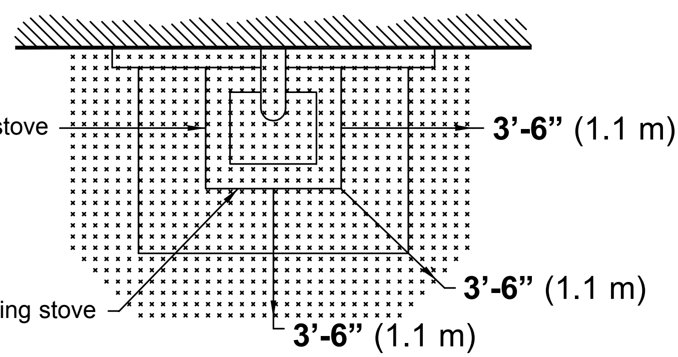


Front View

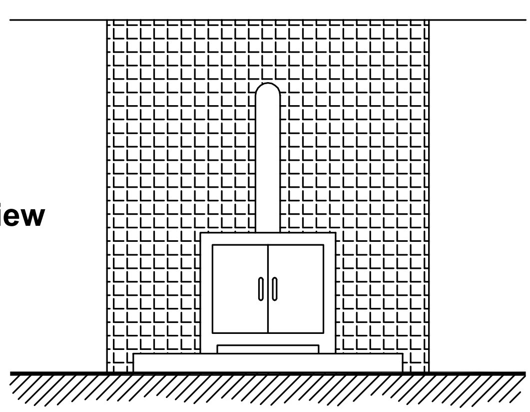


Sprinklers near a furnace or water heater must be located outside of the shaded area or be intermediate degree rated.

Top View



Front View



Sprinklers near a coal- or wood-burning stove must be located outside of shaded area or be intermediate degree rated.

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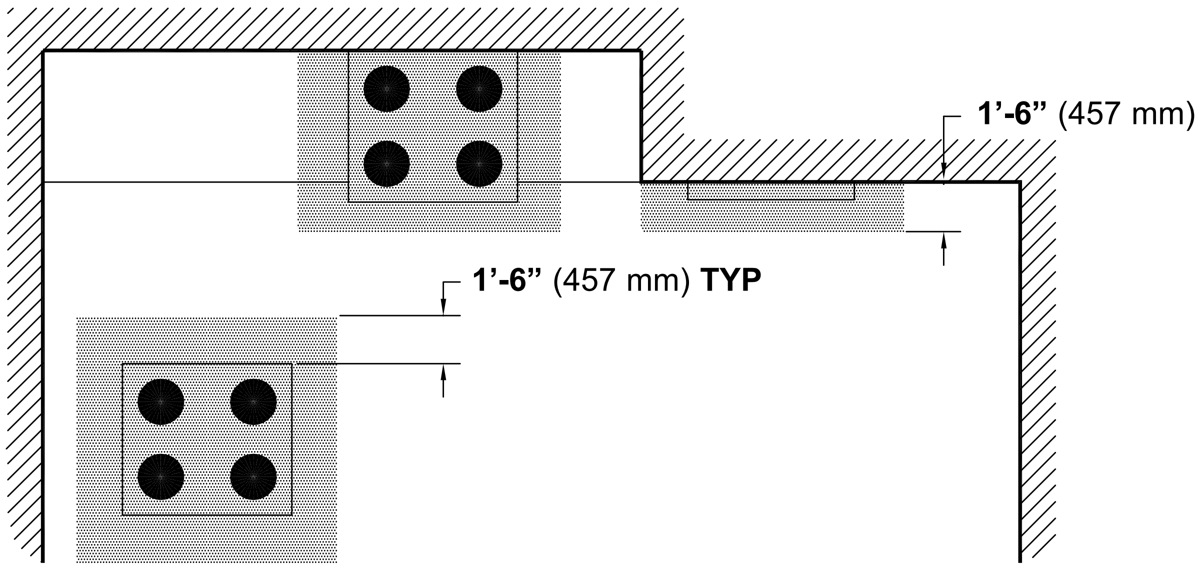
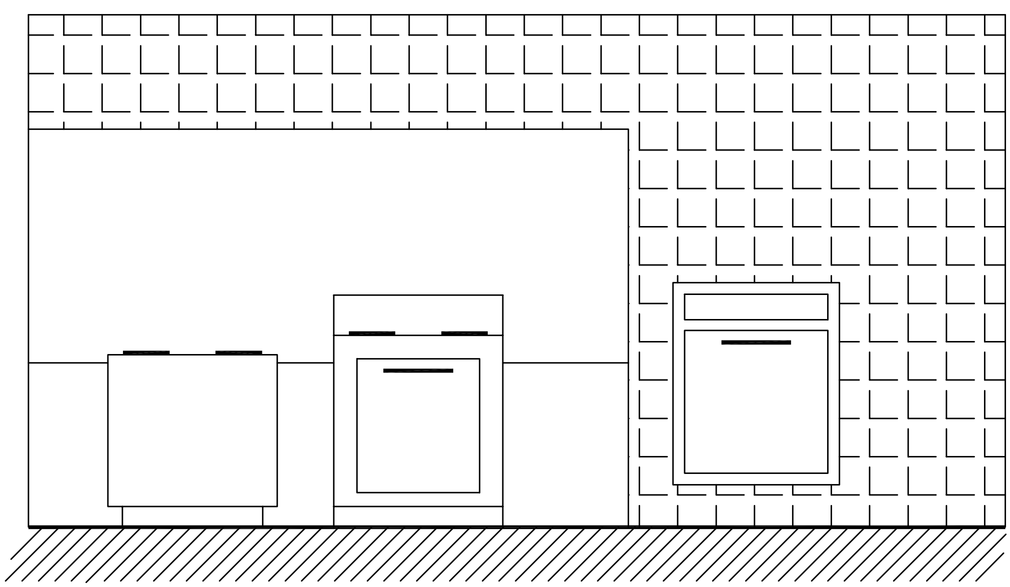
Top View



Front View



Sprinklers near a range or wall oven must be located outside of shaded areas or be intermediate degree rated.

BULLETIN

CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

SPRINKLERS ARE FRAGILE - HANDLE WITH CARE!

General Handling and Storage:

- Store sprinklers in a cool, dry place.
- Protect sprinklers during storage, transport, handling, and after installation.
- Use the original shipping containers. DO NOT place sprinklers loose in boxes, bins, or buckets.
- Keep sprinklers separated at all times. DO NOT allow metal parts to contact sprinkler operating elements.

For Pre-Assembled Drops:

- Protect sprinklers during handling and after installation.
- For recessed assemblies, use the protective sprinkler cap (Viking Part Number 10364).

Sprinklers with Protective Shields or Caps:

- DO NOT remove shields or caps until after sprinkler installation and there no longer is potential for mechanical damage to the sprinkler operating elements.
- **Sprinkler shields or caps MUST be removed BEFORE placing the system in service!**
- Remove the sprinkler shield by carefully pulling it apart where it is snapped together.
- Remove the cap by turning it slightly and pulling it off the sprinkler.

Sprinkler Installation:

- DO NOT use the sprinkler deflector or operating element to start or thread the sprinkler into a fitting.
- **Use only the designated sprinkler head wrench!** Refer to the current sprinkler technical data page to determine the correct wrench for the model of sprinkler used.
- DO NOT install sprinklers onto piping at the floor level.
- Install sprinklers after the piping is in place to prevent mechanical damage.
- DO NOT allow impacts such as hammer blows directly to sprinklers or to fittings, pipe, or couplings in close proximity to sprinklers. Sprinklers can be damaged from direct or indirect impacts.
- DO NOT attempt to remove drywall, paint, etc., from sprinklers.
- **Take care not to over-tighten the sprinkler and/or damage its operating parts!**

Maximum Torque:

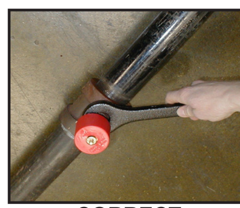
1/2" NPT:	**14 ft-lbs. (19.0 N-m)**
3/4" NPT:	**20 ft-lbs. (27.1 N-m)**
1" NPT:	**30 ft-lbs. (40.7 N-m)**

CORRECT
(Original container used)

INCORRECT
(Placed loose in box)

CORRECT
(Protected with caps)

INCORRECT
(Protective caps not used)



CORRECT
(Piping is in place at the ceiling)

INCORRECT
(Sprinkler at floor level)

CORRECT
(Special installation wrenches)

INCORRECT
(Designated wrench not used)

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

WARNING

Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed. Never install sprinklers that have been dropped, damaged, or exposed to temperatures exceeding the maximum ambient temperature allowed. Sprinklers that have been painted in the field must be replaced per NFPA 13. Protect sprinklers from paint and paint overspray in accordance with the installation standards. Do not clean sprinklers with soap and water, ammonia, or any other cleaning fluid. Do not use adhesives or solvents on sprinklers or their operating elements.

Refer to the appropriate technical data page and NFPA standards for complete care, handling, installation, and maintenance instructions. For additional product and system information Viking data pages and installation instructions are available on the Viking Web site at www.vikinggroupinc.com.

VIKING | BULLETIN | CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

PROTECTIVE SPRINKLER SHIELDS AND CAPS

General Handling and Storage:

Many Viking sprinklers are available with a plastic protective cap or shield temporarily covering the operating elements. The snap-on shields and caps are factory installed and are intended to help protect the operating elements from mechanical damage during shipping, storage, and installation. NOTE: It is still necessary to follow the care and handling instructions on the appropriate sprinkler technical data sheets* when installing sprinklers with bulb shields or caps.

WHEN TO REMOVE THE SHIELDS AND CAPS:

NOTE: SHIELDS AND CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!

Remove the shield or cap from the sprinkler only after checking all of the following:

- The sprinkler has been installed*.
- The wall or ceiling finish work is completed where the sprinkler is installed and there no longer is a potential for mechanical damage to the sprinkler operating elements.

SHIELDS AND CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!

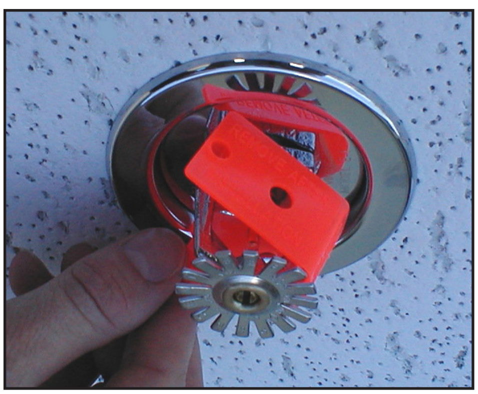


Figure 1: Sprinkler shield being removed from a pendent sprinkler.

Figure 2: Sprinkler cap being removed from a pendent sprinkler.

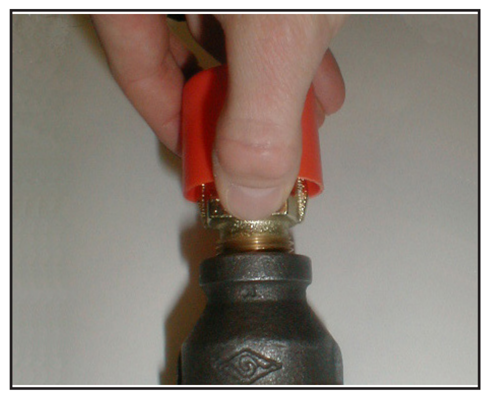


Figure 3: Sprinkler cap being removed from and upright sprinkler.

HOW TO REMOVE SHIELDS AND CAPS:

No tools are necessary to remove the shields or caps from sprinklers. DO NOT use any sharp objects to remove them! **Take care not to cause mechanical damage to sprinklers when removing the shields or caps.** When removing caps from fusible element sprinklers, use care to prevent dislodging ejector springs or damaging fusible elements. NOTE: Squeezing the sprinkler cap excessively could damage sprinkler fusible elements.

- To remove the shield, simply pull the ends of the shield apart where it is snapped together. Refer to Figure 1.
- To remove the cap, turn it slightly and pull it off the sprinkler. Refer to Figures 2 and 3.

NOTICE Refer to the current sprinkler technical data page to determine the correct sprinkler wrench for the model of sprinkler used.

WARNING Never install sprinklers that have been dropped, damaged, or exposed to temperatures in excess of the maximum ambient temperature allowed.

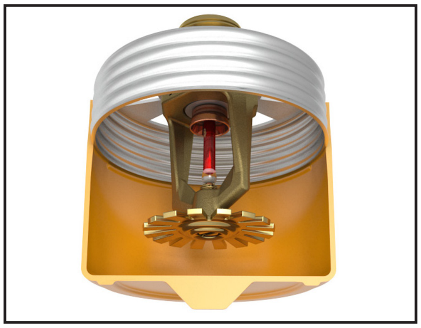
*** Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.**

BULLETIN

CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

CAUTION CONCEALED COVER ASSEMBLIES ARE FRAGILE!
TO ASSURE SATISFACTORY PERFORMANCE OF THE PRODUCT, HANDLE WITH CARE.



Concealed Sprinkler and Adapter Assembly with Protective Cap

Concealed Sprinkler and Adapter Assembly (Protective Cap Removed)

Cover Plate Assembly (Pendent Cover 12381 shown)

GENERAL HANDLING AND STORAGE INSTRUCTIONS:

- Do not store in temperatures exceeding 100 °F (38 °C). Avoid direct sunlight and confined areas subject to heat.
- Protect sprinklers and cover assemblies during storage, transport, handling, and after installation.
  -- Use original shipping containers.
  -- Do not place sprinklers or cover assemblies loose in boxes, bins, or buckets.
- Keep the sprinkler bodies covered with the protective sprinkler cap any time the sprinklers are shipped or handled, during testing of the system, and while ceiling finish work is being completed.
- Use only the designated Viking recessed sprinkler wrench (refer to the appropriate sprinkler data page) to install these sprinklers. **NOTE:** The protective cap is temporarily removed during installation and then placed back on the sprinkler for protection until finish work is completed.
- Do not over-tighten the sprinklers into fittings during installation.
- Do not use the sprinkler deflector to start or thread the sprinklers into fittings during installation.
- Do not attempt to remove drywall, paint, etc., from the sprinklers.
- Remove the plastic protective cap from the sprinkler before attaching the cover plate assembly. **PROTECTIVE CAPS MUST BE REMOVED FROM SPRINKLERS BEFORE PLACING THE SYSTEM IN SERVICE!**

Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.

VIKING	BULLETIN	CARE AND HANDLING OF SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

USE THE FOLLOWING PRECAUTIONS WHEN HANDLING WAX-COATED SPRINKLERS

Many of Viking's sprinklers are available with factory-applied wax coating for corrosion resistance. These sprinklers MUST receive appropriate care and handling to avoid damaging the wax coating and to assure satisfactory performance of the product.

General Handling and Storage of Wax-Coated Sprinklers:

- Store the sprinklers in a cool, dry place (in temperatures below the maximum ambient temperature allowed for the sprinkler temperature rating. Refer to Table 1 below.)
- Store containers of wax-coated sprinklers separate from other sprinklers.
- Protect the sprinklers during storage, transport, handling, and after installation.
- Use original shipping containers.
- Do not place sprinklers in loose boxes, bins, or buckets.

Installation of Wax-Coated Sprinklers:

Use only the special sprinkler head wrench designed for installing wax-coated Viking sprinklers (any other wrench may damage the unit).

- Take care not to crack the wax coating on the units.
- For touching up the wax coating after installation, wax is available from Viking in bar form. Refer to Table 1 below. The coating MUST be repaired after sprinkler installation to protect the corrosion-resistant properties of the sprinkler.
- Use care when locating sprinklers near fixtures that can generate heat. Do not install sprinklers where they would be exposed to temperatures exceeding the maximum recommended ambient temperature for the temperature rating used.
- Inspect the coated sprinklers frequently soon after installation to verify the integrity of the corrosion resistant coating. Thereafter, inspect representative samples of the coated sprinklers in accordance with NFPA 25. Close up visual inspections are necessary to determine whether the sprinklers are being affected by corrosive conditions.

TABLE 1

Sprinkler Temperature Rating (Fusing Point)	Wax Part Number	Wax Melting Point	Maximum Ambient Ceiling Temperature[1]	Wax Color
155 °F (68 °C) / 165 °F (74 °C)	02568A	148 °F (64 °C)	100 °F (38 °C)	Light Brown
175 °F (79 °C)	04146A	161 °F (71 °C)	150 °F (65 °C)	Brown
200 °F (93 °C)	04146A	161 °F (71 °C)	150 °F (65 °C)	Brown
220 °F (104 °C)	02569A	170 °F (76 °C)	150 °F (65 °C)	Dark Brown
286 °F (141 °C)	02569A	170 °F (76 °C)	150 °F (65 °C)	Dark Brown

[1] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

⚠WARNING Never install sprinklers that have been dropped, damaged, or exposed to temperatures in excess of the maximum ambient temperature allowed.

Refer to the appropriate current technical data pages for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found on the Web site at www.vikinggroupinc.com.

VIKING	TECHNICAL DATA	SPRINKLER OVERVIEW

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

1. DESCRIPTION

Viking fire sprinklers consist of a threaded frame with a specific waterway or orifice size and a deflector for distributing water in a specified pattern. A closed or sealed sprinkler refers to a complete assembly, including the thermosensitive operating element. An open sprinkler does not use an operating element and is open at all times. The distribution of water is intended to extinguish a fire or to control its spread.

Viking sprinklers are available in several models and styles. Refer to specific sprinkler technical data pages for available styles, finishes, temperature ratings, thread sizes, and nominal K-Factors for the particular model selected.

2. LISTINGS AND APPROVALS

Refer to the Approval Charts on the appropriate sprinkler technical data page(s) and/or approval agency listings.

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

3. TECHNICAL DATA

Pressure Ratings:

Maximum allowable water working pressure is 175 psig (12 Bar) unless rated and specified for high water working pressure [250 psig (17.2 bar)].

Sprinkler Identification:

Viking sprinklers are identified and marked with the word “Viking”, the sprinkler identification number (SIN) consisting of “VK” plus a three digit number*, the model letter, and the year of manufacture.

Available Finishes:

Viking sprinklers are available in several decorative finishes. Some models are available with corrosion-resistant coatings or are fabricated from non-corrosive material. Refer to the sprinkler technical data page for additional information.

Available Temperature Ratings:

Viking sprinklers are available in several temperature ratings that relate to a specific temperature classification. Applicable installation rules mandate the use and limitations of each temperature classification. In selecting the appropriate temperature classification, the maximum expected ceiling temperature must be known. When there is doubt as to the maximum temperature at the sprinkler location, a maximum-reading thermometer should be used to determine the temperature under conditions that would show the highest readings to be expected. In addition, recognized installation rules may require a higher temperature classification, depending upon sprinkler location, occupancy classification, commodity classification, storage height, and other hazards. In all cases, the maximum expected ceiling temperature dictates the lowest allowable temperature classification. Sprinklers located immediately adjacent to a heat source may require a higher temperature rating.

K-Factors:

Viking sprinklers are available in several orifice sizes with related K-Factors. The orifice is a tapered waterway and, therefore, the K-Factor given is nominal. Nominal U.S. K-Factors are provided in accordance with the 1999 edition of NFPA 13, Section 3-2.3. Refer to the specific data page for appropriate K-Factor information.

Available Styles:

Viking sprinklers are available for installation in several positions as indicated by a stamping on the deflector. The deflector style dictates the appropriate installation position of the sprinkler; it breaks the solid stream of water issuing from the sprinkler orifice to form a specific spray pattern. The following list indicates the various styles and identification of Viking sprinklers.

<u>UPRIGHT SPRINKLER:</u> A sprinkler intended to be installed with the deflector above the frame so water flows upward through the orifice, striking the deflector and forming an umbrella-shaped spray pattern downward. Marked “SSU” (Standard Sprinkler Upright) or “UPRIGHT” on the deflector.

<u>PENDENT SPRINKLER:</u> A sprinkler intended to be oriented with the deflector below the frame so water flows downward through the orifice, striking the deflector and forming an umbrella-shaped spray pattern downward. Marked “SSP” (Standard Sprinkler Pendent) or “PENDENT” on the deflector.

Viking Technical Data may be found on The Viking Corporation’s Web site at http://www.vikinggroupinc.com. The Web site may include a more recent edition of this Technical Data Page.

<u>CONVENTIONAL SPRINKLER:</u> An “old style” sprinkler intended to be installed with the deflector in either the upright or pendent position. The deflector provides a spherical type pattern with 40 to 60 percent of the water initially directed downward and a proportion directed upward. Must be installed in accordance with installation rules for conventional or old style sprinklers. DO NOT USE AS A REPLACEMENT FOR STANDARD SPRAY SPRINKLERS. Marked “C U/P” (Conventional Upright/Pendent) on the deflector.

TECHNICAL DATA | **SPRINKLER OVERVIEW**

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

VERTICAL SIDEWALL (VSW) SPRINKLER: A sprinkler intended for installation near the wall and ceiling. The deflector provides a water spray pattern outward in a quarter-spherical pattern and can be installed in the upright or pendent position with the flow arrow in the direction of discharge. Marked “SIDEWALL” on the deflector with an arrow and the word “FLOW”. (Note: Some vertical sidewall sprinklers can only be installed in the upright or pendent position—in this case, the sprinkler will also be marked “UPRIGHT” or “PENDENT”.)

HORIZONTAL SIDEWALL (HSW) SPRINKLER: A sprinkler intended for installation near the wall and ceiling. The special deflector provides a water spray pattern outward in a quarter-spherical pattern. Most of the water is directed away from the nearby wall with a small portion directed at the wall behind the sprinkler. The top of the deflector is oriented parallel with the ceiling or roof. The flow arrows point in the direction of discharge. Marked “SIDEWALL” and “TOP” with an arrow and the word “FLOW”.

EXTENDED COVERAGE (EC) SPRINKLER: A spray sprinkler designed to discharge water over an area having the maximum dimensions indicated in the individual listings. Maximum area of coverage, minimum flow rate, orifice size, and nominal K-Factor are specified in the individual listings. EC sprinklers are intended for Light-Hazard occupancies with smooth, flat, horizontal ceilings unless otherwise specified. In addition to the above markings, the sprinkler is marked “EC”.

QUICK RESPONSE (QR) SPRINKLER: A spray sprinkler with a fast- actuating operating element. The use of quick response sprinklers may be limited due to occupancy and hazard. Refer to the Authority Having Jurisdiction (AHJ) prior to installing.

QUICK RESPONSE EXTENDED COVERAGE (QREC) SPRINKLER: A spray sprinkler designed to discharge water over an area having the maximum dimensions indicated in the individual listing. This is a sprinkler with an operating element that meets the criteria for quick response. QREC sprinklers are only intended for Light Hazard occupancies. The sprinkler is marked “QREC”.

FLUSH SPRINKLER: A decorative spray sprinkler intended for installation with a concealed piping system. The unit is mounted flush with the ceiling or wall, with the fusible link exposed. Upon actuation, the deflector extends beyond the ceiling or wall to distribute water discharge. The sprinkler is marked “SSP”, “PEND”, or “SIDEWALL” and “TOP”.

CONCEALED SPRINKLER: A decorative spray sprinkler intended for installation with a concealed piping system. The sprinkler is hidden from view by a cover plate installed flush with the ceiling or wall. During fire conditions, the cover plate detaches, and upon sprinkler actuation, the deflector extends beyond the ceiling or wall to distribute water discharge. The sprinkler is marked “SSP”, “PEND”, or “SIDEWALL” and “TOP”.

RECESSED SPRINKLER: A spray sprinkler assembly intended for installation with a concealed piping system. The assembly consists of a sprinkler installed in a decorative adjustable recessed escutcheon that minimizes the protrusion of the sprinkler beyond the ceiling or wall without adversely affecting the sprinkler distribution or sensitivity. Refer to the appropriate technical data page for allowable sprinkler models, temperature ratings, and occupancy classifications. DO NOT RECESS ANY SPRINKLER NOT LISTED FOR USE WITH THE ESCUTCHEON.

CORROSION-RESISTANT SPRINKLER: A special service sprinkler with non-corrosive protective coatings, or that is fabricated from non-corrosive material, for use in atmospheres that would normally corrode sprinklers.

DRY SPRINKLER: A special-service sprinkler intended for installation on dry pipe systems or wet pipe systems where the sprinkler is subject to freezing temperatures. The unit consists of a sprinkler permanently secured to an extension nipple with a sealed inlet end to prevent water from entering the nipple until the sprinkler operates. The unit MUST be installed in a tee fitting. Dry upright sprinklers are marked with the “B” dimension [distance from the face of the fitting (tee) to the top of the deflector]. Dry pendent and sidewall sprinklers are marked with the “A” dimension [the distance from the face of fitting (tee) to the finished surface of the ceiling or wall].

LARGE DROP SPRINKLER: A type of special application sprinkler used to provide fire control of specific high-challenge fire hazards. Large drop sprinklers are designed to produce an umbrella-shaped spray pattern downward with a higher percentage of “large” water droplets than standard spray sprinklers. The sprinkler has an extra-large orifice with a nominal K-Factor of 11.2. Marked “HIGH CHALLENGE” and “UPRIGHT”.

EARLY SUPPRESSION FAST-RESPONSE (ESFR) SPRINKLER: A sprinkler intended to provide fire suppression of specific high-challenge fire hazards through the use of a fast response fusible link, 14.0, 16.8, or 25.2 nominal K-Factor, and special deflector. ESFR sprinklers are designed to produce high-momentum water droplets in a hemispherical pattern below the deflector. This permits penetration of the fire plume and direct wetting of the burning fuel surface while cooling the atmosphere early in the development of a high-challenge fire. Marked “ESFR” and “UPRIGHT” or “PEND”.

INTERMEDIATE LEVEL/RACK STORAGE SPRINKLER: A standard spray sprinkler assembly designed to protect its operating element from the spray of sprinklers installed at higher elevations. The assembly consists of a standard or large orifice upright or pendent sprinkler with an integral upright or pendent water shield and guard assembly. Use only those sprinklers that have been tested and listed for use with the assembly. Refer to the technical data page for allowable sprinkler models.

RESIDENTIAL SPRINKLER: A sprinkler intended for use in the following occupancies: one- and two-family dwellings with the fire protection sprinkler system installed in accordance with NFPA 13D; residential occupancies up to four stories in height with the fire protection system installed in accordance with NFPA 13R; and where allowed by the Authority Having Jurisdiction in residential portions of any occupancy with the fire protection system installed in accordance with NFPA 13.

VIKING	TECHNICAL DATA	SPRINKLER OVERVIEW

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

Residential sprinklers have a unique distribution pattern and utilize a “fast response” heat sensitive operating element. They enhance survivability in the room of fire origin and are designed to provide a life safety environment for a minimum of ten minutes. For this reason, residential sprinklers must not be used to replace standard sprinklers unless tested for and approved by the Authority Having Jurisdiction. In addition to standard markings, the unit is identified as “RESIDENTIAL SPRINKLER” or “RES”.

4. INSTALLATION
Refer to appropriate NFPA Installation Standards.

5. OPERATION
Refer to the appropriate sprinkler technical data page(s).

6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
Viking sprinklers are available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking’s current list price schedule or contact Viking directly.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers and the appropriate sprinkler general care, installation, and maintenance guide. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, FM Global, LPCB, APSAD, VdS or other similar organizations, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. The sprinkler technical data page may contain installation requirements specific for the sprinkler model selected. The use of certain types of sprinklers may be limited due to occupancy and hazard. Refer to the Authority Having Jurisdiction prior to installation.

VIKING

BULLETIN

BEST PRACTICES FOR RESIDENTIAL SPRINKLER HANDLING & INSTALLATION

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page.

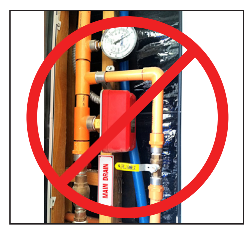
SPRINKLERS ARE FRAGILE - HANDLE WITH CARE!

- Always keep sprinklers in a cool dry place.
- Protect sprinklers during storage, transport and handling as well as before, during and after installation. Refer to Viking's Care and Handling of Sprinklers Bulletin Form No. F_091699[2].
- Proper transit, storage and installation of sprinklers in a high-heat environment is a must. Care should be taken to prevent sprinklers from being exposed to ambient heat conditions in excess of those referenced in installation standards.
- Do not stage or store sprinklers on the job site in advance in a non-conditioned space prior to installation.
- Keep sprinklers in the original packaging and check temperature indicators on box label prior to installation. If the indicator has turned black, DO NOT install any product contained in the box. Refer to Viking product return policies.
- Temperatures exceeding the maximum ambient temperature of the sprinkler temperature-rating during storage, transport, handling and installation must be avoided.
- Per NFPA standards 13, 13R, and 13D, sprinklers installed where maximum ambient temperatures are at or over 101 °F (38 °C) through 150 °F (66 °C) shall be intermediate temperature-rated sprinklers. Additionally, if sprinklers are installed in an unventilated concealed space under an uninsulated roof or in an unventilated attic, they shall be of intermediate temperature classification.
- Sprinklers installed where ambient temperatures are at or below 100 °F (38 °C) may be either ordinary or intermediate temperature-rated sprinklers. Refer to NFPA standards 13R 6.2.3.1 and 13D 7.5.6.1.
- Rough-in of sprinkler piping during hot weather conditions should not include the installation of sprinklers unless reasonable ambient temperatures can be maintained. Ambient temperatures that are considered when choosing the temperature rating for a sprinkler should take into account the range of ambient temperatures that are expected from installation through establishment and maintenance of temperature in a conditioned space. Appropriate insulation may be considered. **Example**: An ordinary temperature sprinkler should not be exposed to maximum ambient temperature higher than 100 °F (38 °C) or more. Refer to NFPA 13, Table 6.2.5.1, NFPA 13R, 6.2.3.1 and NFPA 13D, 7.5.6.1.
- CPVC fire sprinkler products exposed to high ambient temperatures (e.g. installed in unventilated, concealed spaces such as attics) should be insulated to maintain a cooler environment. Refer to Viking Plastics Installation and Design Manual, Form No. F_080712[2], for care and handling procedures.
- Protect all sprinklers and connecting CPVC piping in attic spaces and unvented concealed spaces from excessive heat exposure above 100 °F (38 °C). To separate excessive attic heat, properly tent and fully insulate all pipe in unconditioned spaces.
- Pressure relief valves should be installed on wet sprinkler systems where there is a risk of over-pressurization of a checked water supply, due to thermal expansion. Refer to NFPA 13, 7.1.2.1 and NFPA 13D, A.5.2.2.2.
- Fire sprinkler systems should be installed per current referenced editions of building codes and installation standards adopted in the jurisdiction where work is being performed.

INCORRECT
(Heat exposure)

INCORRECT
(Unconditioned at rough-in)

INCORRECT
(Exposed piping)



INCORRECT
(No pressure relief valve)

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

[1]Hot weather condition is defined as temperatures that can reach the maximum ambient temperature-rating of the sprinkler.
[2]Clicking on blue hyperlink will open referenced document.

⚠ WARNING

Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed. Never install sprinklers that have been dropped, damaged, or exposed to temperatures exceeding the maximum ambient temperature allowed. Sprinklers that have been painted in the field must be replaced per NFPA 13. Protect sprinklers from paint and paint overspray in accordance with the installation standards. Do not clean sprinklers with soap and water, ammonia, or any other cleaning fluid. Do not use adhesives or solvents on sprinklers or their operating elements.

Refer to the appropriate technical data page and NFPA standards for complete care, handling, installation, and maintenance instructions. For additional product and system information Viking data pages and installation instructions are available on the Viking Web site at www.vikinggroupinc.com.

VIKING®	BULLETIN	REGULATORY AND HEALTH WARNINGS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page www.vikinggroupinc.com

1. DESCRIPTION

Regulatory and Health Warnings applying to materials used in the manufacture and construction of fire protection products are provided herin as they relate to legally mandated jurisdictional regions.

⚠ WARNING
STATE OF CALIFORNIA, USA Installing or servicing fire protection products such as sprinklers, valves, piping etc. can expose you to chemicals including, but not limited to, lead, nickel, butadiene, titaninum dioxide, chromium, carbon black, and acrylonitrile which are known to the State of California to cause cancer or birth defects or other reproductive harm.
For more information, go to **www.P65Warnings.ca.gov**

2. WARRANTY TERMS AND CONDITIONS

For details of warranty, refer to Viking's current list price schedule at **www.vikinggroupinc.com** or contact Viking directly.

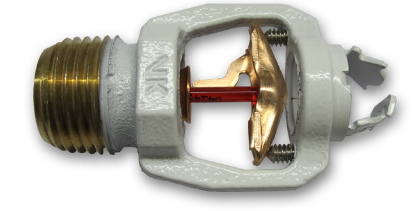
TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

1. DESCRIPTION

Viking Freedom® Residential Horizontal Sidewall Sprinkler VK486 is a small, thermosensitive, glass-bulb residential sprinkler available in several different finishes and temperature ratings to meet varying design requirements. The Electroless Nickel PTFE (ENT) coating has been investigated for installation in corrosive atmospheres and is C-UL-US-EU Listed as corrosion resistant as indicated in the Approval Chart. The sprinkler orifice design, with a K-Factor of 4.0 (57.7 metric†), allows efficient use of available water supplies for the hydraulically designed fire-protection system. The glass bulb operating element and special deflector characteristics meet the challenges of residential sprinkler standards.



WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

2. LISTINGS AND APPROVALS

UL Listed (C-UL-US-EU): Category VKKW

VdS Approved

Refer to the Approval Chart and Design Criteria for C-UL-US-EU Listing requirements that must be followed.

3. TECHNICAL DATA

Specifications:
Available since 2011.
Minimum Operating Pressure: Refer to the Approval Chart.
Maximum Working Pressure: 175 psi (12 bar). Factory tested hydrostatically to 500 psi (34.5 bar).
Thread size: 1/2" (15 mm) NPT
Nominal K-Factor: 4.0 U.S. (57.7 metric†)
† Metric K-factor measurement shown is in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
Glass-bulb fluid temperature rated to -65 °F (-55 °C)
Overall Length: 2-7/16" (62 mm)
Covered by the following US Patent numbers: 7,854,269 and 7,712,218

Material Standards:
Frame Casting: QM Brass and Brass UNS-C84400
Deflector: Phosphor Bronze UNS-C51000
Bulb: Glass, nominal 3 mm diameter
Belleville Spring Sealing Assembly: Nickel Alloy, coated on both sides with PTFE Tape
Pip Cap and Insert Assembly: Copper UNS-C11000 and Stainless Steel UNS-S30400
Compression Screws: 18-8 Stainless Steel
Yoke: Phosphor Bronze UNS-C51000

Ordering Information: (Also refer to the current Viking price list.)
Sprinkler: Base Part No. 17315
Order Sprinkler VK486 by first adding the appropriate suffix for the sprinkler finish and then the appropriate suffix for the temperature rating to the sprinkler base part number.
Finish Suffix: Brass = A, Chrome = F, White Polyester = M-/W, Black Polyester = M-/B
Temperature Suffix: 155 °F (68 °C) = B, 175 °F (79 °C) = D
For example, sprinkler VK486 with a Brass finish and a 155 °F (68 °C) temperature rating = Part No. 17315AB.

Available Finishes And Temperature Ratings:
Refer to Table 1.

Accessories: (Also refer to the Viking website.)

Sprinkler Wrenches:
A. Standard Wrench: Part No. 21475M/B (available since 2017)
B. Wrench for recessed sprinklers: Part No. 13655W/B* (available since 2006)
*A ½" ratchet is required (not available from Viking).

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
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Sprinkler Cabinets:
A. Six-head capacity: Part No. 01724A (available since 1971)
B. Twelve-head capacity: Part No. 01725A (available since 1971)

4. INSTALLATION
Refer to appropriate NFPA Installation Standards.

5. OPERATION
During fire conditions, the heat-sensitive liquid in the glass bulb expands, causing the glass to shatter, releasing the yoke, pip cap, and sealing spring assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector, forming a uniform spray pattern to extinguish or control the fire.

6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
Viking Sprinkler VK486 is available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

TABLE 1: AVAILABLE SPRINKLER TEMPERATURE RATINGS AND FINISHES

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[2]	Bulb Color
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow
Sprinkler Finishes: Brass, Chrome, White Polyester, and Black Polyester.			

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector.

[2] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

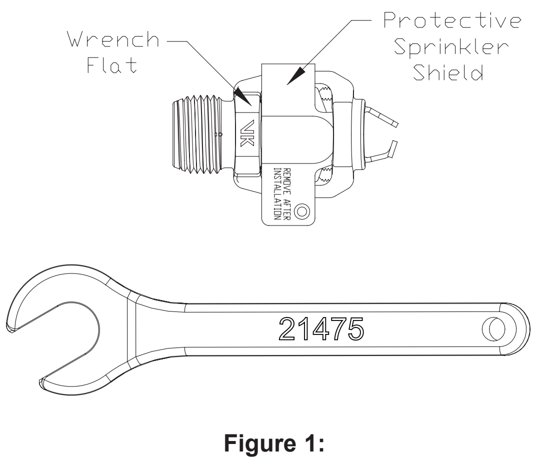

Figure 1:
Standard Sprinkler Wrench 21475M/B

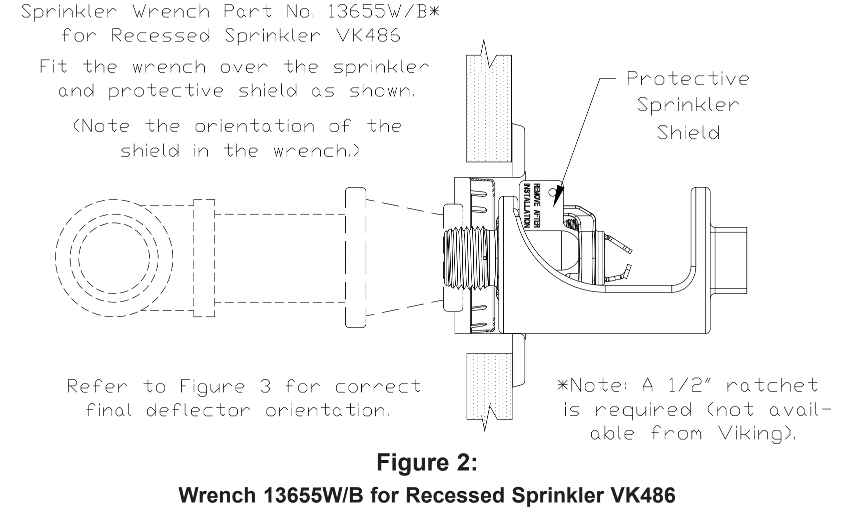

Figure 2:
Wrench 13655W/B for Recessed Sprinkler VK486

TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
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Approval Chart
Viking VK486, 4.0 K-Factor Residential Horizontal Sidewall Sprinkler

For systems designed to NFPA 13D or NFPA 13R. For systems designed to NFPA 13, refer to the design criteria. For Ceiling types refer to current Editions of NFPA 13, 13R or 13D

Sprinkler Base Part Number [1]	SIN	NPT Thread Size		Nominal K-Factor		Maximum Water Working Pressure	Overall Length	
		Inches	mm	U.S.	metric [2]		Inches	mm
17315	VK486	1/2	15	4.0	57.7	175 psi (12 bar)	2-7/16	62

Max. Coverage Area [3] Width X Length Ft. X Ft. (m X m)	Max. Spacing Ft. (m)	Ordinary Temp Rating (155 °F/68 °C)		Intermediate Temp Rating (175 °F/79 °C)		Top of Deflector to Ceiling	Installation Type	Listings and Approvals [4]				Minimum Spacing Ft. (m)
		Flow [3] GPM (L/min)	Pressure [3] PSI (bar)	Flow [3] GPM (L/min)	Pressure [3] PSI (bar)			C-UL-US-EU [5]	VdS	NYC	NSF[9]	
12 X 12 (3.7 X 3.7)	12 (3.7)	11 (41.7)	7.6 (0.52)	11 (41.7)	7.6 (0.52)	4 to 6 inches	Standard surface-mounted escutcheons or recessed with the Micromatic® Model E-1, E-2, E-3, or G-1 Recessed Escutcheon	See Footnote 6 and 10.	See Footnote 6.	See Footnote 7.	See Footnote 6.	8 (2.4)
14 X 14 (4.3 X 4.3)	14 (4.3)	12 (45.5)	9 (0.62)	12 (45.5)	9 (0.62)							
16 X 16 (4.9 X 4.9)	16 (4.9)	13 (49.3)	10.6 (0.73)	13 (49.3)	10.6 (0.73)							
16 X 18 (4.9 X 5.5)	16 (4.9)	16 (60.6)	16 (1.10)	16 (60.6)	16 (1.10)							
16 X 20 (4.9 X 6.1)	16 (4.9)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
16 X 22 (4.9 X 6.7)	16 (4.9)	24 (90.8)	36 (2.48)	24 (90.8)	36 (2.48)							
18 X 18 (5.5 X 5.5)	18 (5.5)	18 (68.1)	20.3 (1.40)	19 (71.9)	22.6 (1.60)							
18 X 20 (5.5 X 6.1)	18 (5.5)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
20 X 20 (6.1 X 6.1)	20 (6.1)	22 (83.3)	30.3 (2.09)	22 (83.3)	30.3 (2.09)							
12 X 12 (3.7 X 3.7)	12 (3.7)	12 (45.5)	9 (0.62)	12 (45.5)	9 (0.62)	6 to 12 inches						
14 X 14 (4.3 X 4.3)	14 (4.3)	12 (45.5)	9 (0.62)	13 (49.3)	10.6 (0.73)							
16 X 16 (4.9 X 4.9)	16 (4.9)	14 (53.0)	12.3 (0.84)	14 (53.0)	12.3 (0.84)							
16 X 18 (4.9 X 5.5)	16 (4.9)	16 (60.6)	16 (1.10)	16 (60.6)	16 (1.10)							
16 X 20 (4.9 X 6.1)	16 (4.9)	23 (87.1)	33.1 (2.28)	23 (87.1)	33.1 (2.28)							
16 X 22 (4.9 X 6.7)	16 (4.9)	26 (98.4)	42.3 (2.91)	26 (98.4)	42.3 (2.91)							
18 X 18 (5.5 X 5.5)	18 (5.5)	18 (68.1)	20.3 (1.40)	19 (71.9)	22.6 (1.60)							
18 X 20 (5.5 X 6.1)	18 (5.5)	23 (87.1)	33.1 (2.28)	23 (87.1)	33.1 (2.28)							
20 X 20 (6.1 X 6.1)	20 (6.1)	24 (90.8)	36 (2.48)	24 (90.8)	36 (2.48)							

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to Viking's current price schedule.
[2] Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
[3] For areas of coverage smaller than shown, use the "Flow" and "Pressure" for the next larger area listed. Flows and pressures listed are per sprinkler. The distance from sprinklers to walls shall not exceed one-half the sprinkler spacing indicated for the minimum "Flow" and "Pressure" used.
[4] This chart shows the listings and approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals. Refer also to Design Criteria.
[5] Listed by Underwriter's Laboratories, Inc. for use in the U.S., Canada, and European Union.
[6] Approved Finishes are: Brass, Chrome, White Polyester, and Black Polyester [8]
[7] Meets New York City requirements, effective July 1, 2008.
[8] Other paint colors are available on request with the same C-UL-US-EU listings as the standard finish colors.
[9] UL Classified to : NSF/ANSI Standard 61, Drinking Water System Components (MH48034)
[10] Approved finish is Electroless Nickel PTFE (ENT). ENT is C-UL-US-EU Listed as corrosion resistant. ENT is available with standard surface-mounted escutcheons or the Micromatic Model E-1 Recessed Escutcheon.

TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

DESIGN CRITERIA

(Also refer to the Approval Chart.)

UL Listing Requirements (C-UL-US-EU):

When using Viking Residential Horizontal Sidewall Sprinkler VK486 for systems designed to NFPA 13D or NFPA 13R, apply the listed areas of coverage and minimum water supply requirements shown in the Approval Chart.

For systems designed to NFPA 13: The number of design sprinklers is to be the four contiguous most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in the Approval Chart for NFPA 13D and NFPA 13R applications for each listed area of coverage, **or**
- Calculated based on a minimum discharge of 0.1 gpm/sq. ft. over the "design area" in accordance with sections 8.5.2.1 or 8.6.2.1.2 of NFPA 13.
- Minimum distance between residential sprinklers: 8 ft. (2.4 m).
- The VK486 horizontal sidewall sprinkler deflector shall be located a minimum of 1-1/4" (31.8 mm) and a maximum of 6" (152 mm) from the wall on which it is installed.

DEFLECTOR POSITION: Install sprinkler VK486 with the leading edge of the deflector oriented parallel to the ceiling and the sprinkler frame arms oriented perpendicular to the ceiling (see Figure 4). **THE TOP SURFACE OF THE DEFLECTOR IS MARKED "TOP".** The sprinkler must be oriented as shown in Figure 3 below.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to Form No. F_080190, F_080814, and F_080415 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA and any other similar Authorities Having Jurisdiction, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable. Final approval and acceptance of all residential sprinkler installations must be obtained from the Authorities Having Jurisdiction.

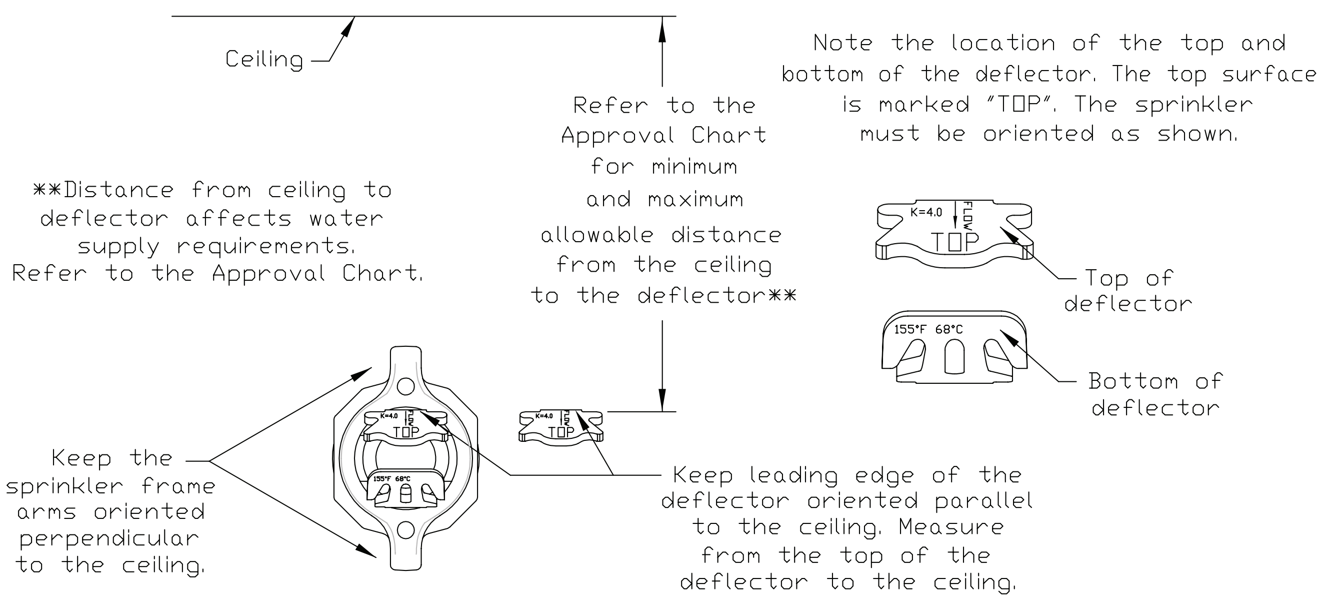

Figure 3:

Correct Orientation of the Deflector

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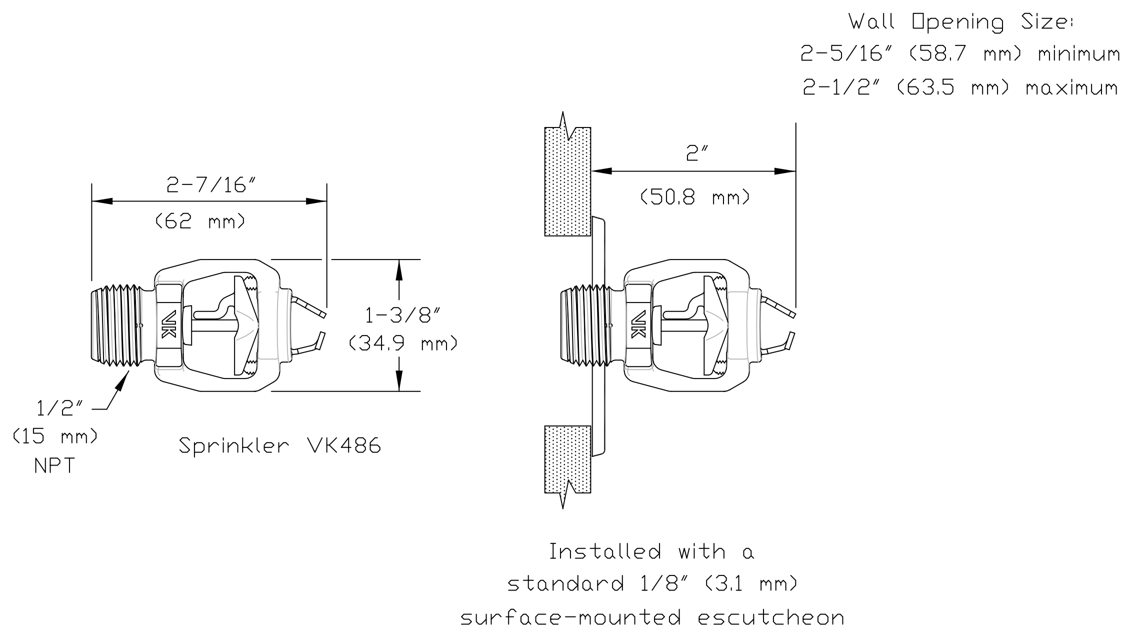

Figure 4:
Sprinkler VK486 Dimensions with a Standard Escutcheon and the Model F-1 Adjustable Escutcheon

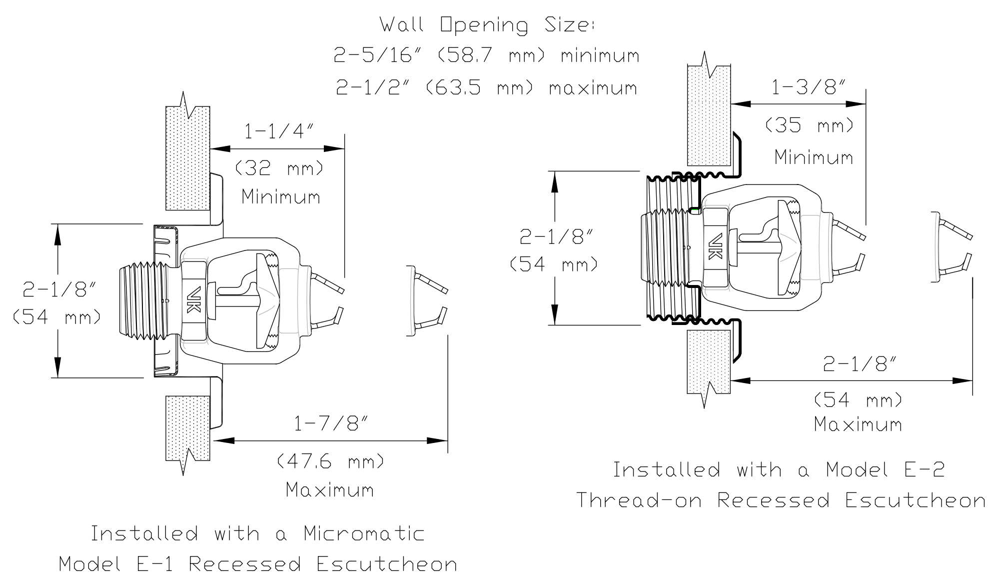

Figure 5:
Sprinkler VK486 Dimensions with the Model E-1 and E-2 Recessed Escutcheons

TECHNICAL DATA

FREEDOM® RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER VK486 (K4.0)

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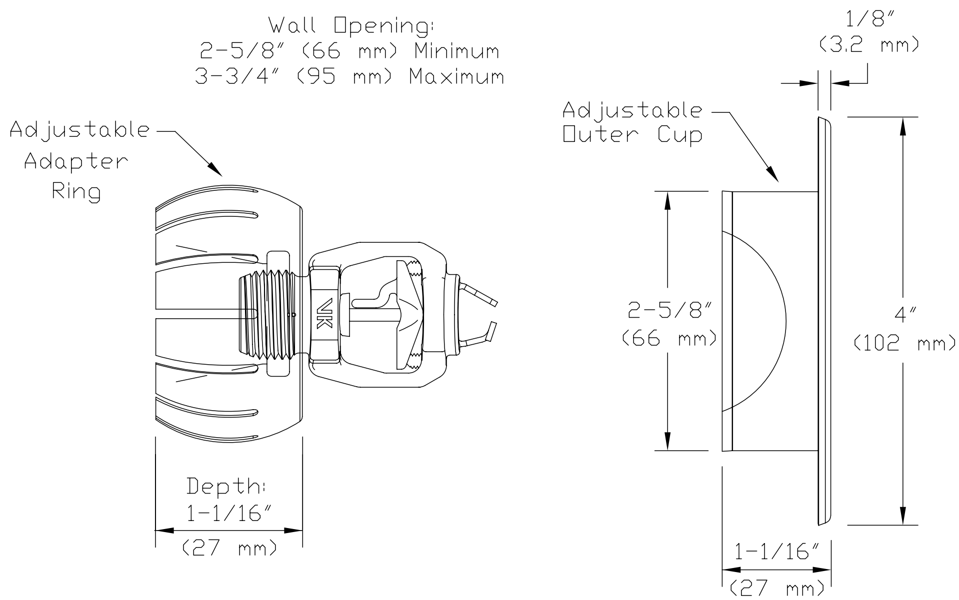

Figure 6: Sprinkler VK486 Dimensions with the Model G-1 Escutcheon

TECHNICAL DATA

QUICK RESPONSE DRY PENDENT SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
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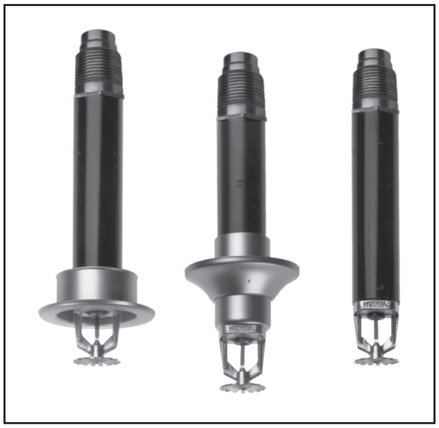
1. DESCRIPTION



Viking Quick Response Dry Pendent Sprinklers are thermosensitive spray sprinklers suitable for use in areas subject to freezing. The sprinklers are designed for dry systems and preaction systems where it is necessary to prevent water or condensation from entering the drop nipple before sprinkler operation. They may also be installed in spaces subject to freezing and supplied from a wet system in an adjacent heated area.

Viking Quick Response Dry Pendent Sprinklers are available in various finishes and temperature ratings to meet design requirements. The special Polyester and Electroless Nickel PTFE (ENT) coatings have been investigated for installation in corrosive atmospheres and are listed/approved as corrosion resistant as indicated in the Approval Charts. (Note: FM Global has no approval classification for Polyester coatings as corrosion resistant.)

WARNING: Cancer and Reproductive Harm- www.P65Warnings.ca.gov

2. LISTINGS AND APPROVALS

cULus Listed: Category VNIV

FM Approved: Classes 2013 and 2015

NYC Approved: MEA 89-92-E Volume 15

Refer to Approval Chart 1 and Design Criteria on page 105d for cULus Listing requirements, and refer to Approval Chart 2 and Design Criteria on page 105e for FM Approval requirements that must be followed.

3. TECHNICAL DATA

Specifications:
Minimum Operating Pressure: 7 psi (0.5 bar)
Maximum Working Pressure: 175 psi (12 bar).
Factory tested hydrostatically to 500 psi (34.5 bar)
Thread size: 1” NPT or 25 mm BSP
Nominal K-Factor: 5.6 U.S. (80.6 metric*) for all listed and approved lengths.

* Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.

Glass-bulb fluid temperature rated to -65 °F (-55 °C)
Covered by the following U.S. Patents: 8,636,075 and 10,220,231

Material Standards:
Frame Casting: Brass UNS-C84400
Deflector: Brass UNS-C26000
Bulb: Glass, nominal 3 mm diameter
Belleville Spring Sealing Assembly: Nickel Alloy, coated on both sides with PTFE Tape
Compression Screw: Brass UNS-C36000
Pip Cap: Brass UNS-C31400 or UNS-C31600
Pip Cap Adapter: Brass UNS-C36000
Orifice: Copper UNS-C22000 or UNS-C11000
Tube: ERW Hydraulic Steel Tube
Support (Internal): Stainless Steel UNS-S30400
Barrel: Steel Pipe UNS-G10260, Electrodeposited Epoxy Base finish
Barrel End and Threads: QM Brass
Sleeve (for Adjustable Standard style only): Brass UNS-C26000 or UNS-C26800

Escutcheon Materials:
Adjustable Standard Dry Escutcheons: Brass UNS-C26000 or UNS-C26800
Recessed Dry Escutcheons: Cold Rolled Steel UNS-G10080
ENT Coated Adjustable and Recessed Escutcheons: Stainless Steel UNS-S30400

Ordering Information: (Also refer to the current Viking price list.)

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Order Quick Response Dry Pendent Sprinklers by first adding the appropriate suffix for the sprinkler finish, the appropriate suffix for the temperature rating, and then the suffix for the length ("A" dimension) to sprinkler base part number. Order in a specific length noted as the "A" dimension. The "A" dimension is the distance from the face of the fitting (tee) to the desired finished surface of the ceiling.

These sprinklers are listed and approved in lengths from 1-1/2" to 45-1/2" (38.1 mm to 1,156 mm) for the adjustable standard style, 3" to 47" (76.2 mm to 1,194 mm) for the plain barrel style, and 3-1/4" to 47-1/2" (82.5 mm to 1,207 mm) for the adjustable recessed style.

Lengths exceeding the standard lengths are available, with no approvals, on a "made-to-order" basis: Recessed Dry Pendent up to 65-1/2" (1,664 mm). Adjustable Standard Dry Pendent up to 63-1/2" (1,613 mm). Plain Barrel Dry Pendent up to 65" (1,651 mm). Contact the manufacturer for more information.

Finish Suffix: Brass = A, Chrome = F, White Polyester = M-/W, and ENT = JN

Temperature Suffix: 155 °F (68 °C) = B, 175 °F (79 °C) = D, 200 °F (93 °C) = E, 286 °F (141 °C) = G

For example, sprinkler VK176 with a Chrome finish and a 155 °F (68 °C) temperature rating, and "A" length of 10" = Part No. 08383UFB10.

Available Finishes And Temperature Ratings: Refer to Table 1.

Accessories: (Also refer to the "Sprinkler Accessories" section of the Viking data book.)

Sprinkler Wrenches:

A. Standard Wrench: Part No. 07297W/B (available since 1991)
B. Wrench for recessed sprinklers: Part No. 07565W/B** (available since 1991)
**A ½" ratchet is required (not available from Viking).

Sprinkler Guard: Chrome, with no listings or approvals, for installation on dry pendent sprinklers made after May 1994 only (Part No. 08954).

Replacement Escutcheons:

A. Adjustable Standard Dry Escutcheon: Base Part No. 07741
B. Recessed Dry Escutcheon Cup: Base Part No. 05459A

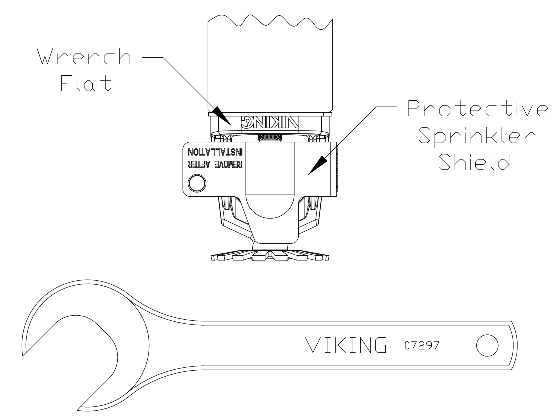

Figure 1: Standard Sprinkler Wrench 07297W/B

4. INSTALLATION

Refer to appropriate NFPA Installation Standards.

5. OPERATION

During fire conditions, the heat-sensitive liquid in the glass bulb expands, causing the glass to shatter, releasing the internal parts to open the waterway. Water flowing through the sprinkler orifice strikes the sprinkler deflector, forming a uniform spray pattern to extinguish or control the fire.

6. INSPECTIONS, TESTS & MAINTENANCE

Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY

The Viking Quick Response Dry Pendent Sprinkler is available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE

For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

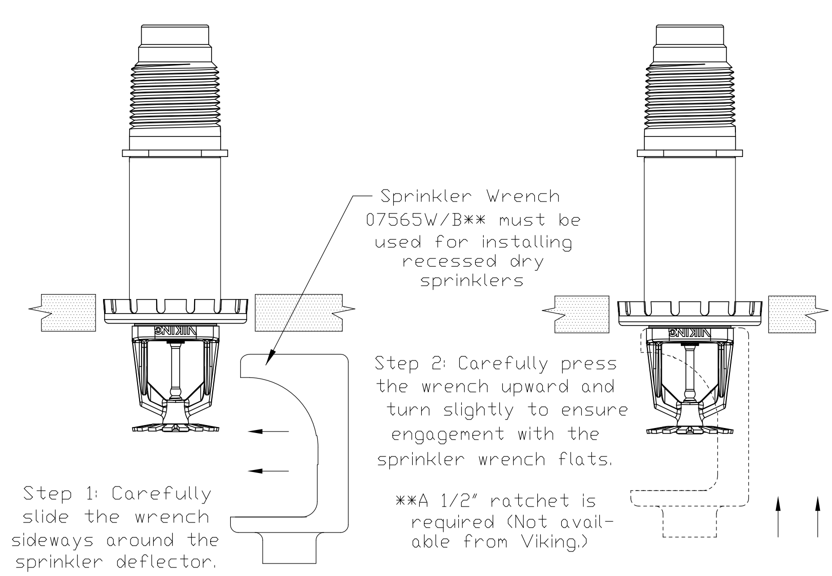

Figure 2: Wrench 07565W/B for Adjustable Recessed Dry Pendent Sprinklers

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TABLE 1: AVAILABLE SPRINKLER TEMPERATURE RATINGS AND FINISHES

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[2]	Bulb Color
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow
Intermediate	200 °F (93 °C)	150 °F (65 °C)	Green
High	286 °F (141 °C)	225 °F (107 °C)	Blue

Sprinkler Finishes: Brass, Chrome, White Polyester, and ENT
Corrosion-Resistant Coating[3,4]: White Polyester and ENT in all temperature ratings

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector.

[2] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

[3] The corrosion-resistant Polyester and ENT coatings have passed the standard corrosion test required by the approving agencies indicated in the Approval Charts. These tests cannot and do not represent all possible corrosive environments. Note: These coatings are NOT corrosion proof. Prior to installation, verify through the end-user that the coatings are compatible with or suitable for the proposed environment. Polyester and ENT coatings are applied to the exposed exterior surfaces only. Note that the spring is exposed on sprinklers with Polyester and ENT coatings.

[4] When installed in some corrosive environments, the Polyester finish may change color. This natural discoloration over time is not in itself an indication of corrosion and should not be treated as such. All sprinklers installed in corrosive environments should be replaced or tested as described in NFPA 25 on a more frequent basis.

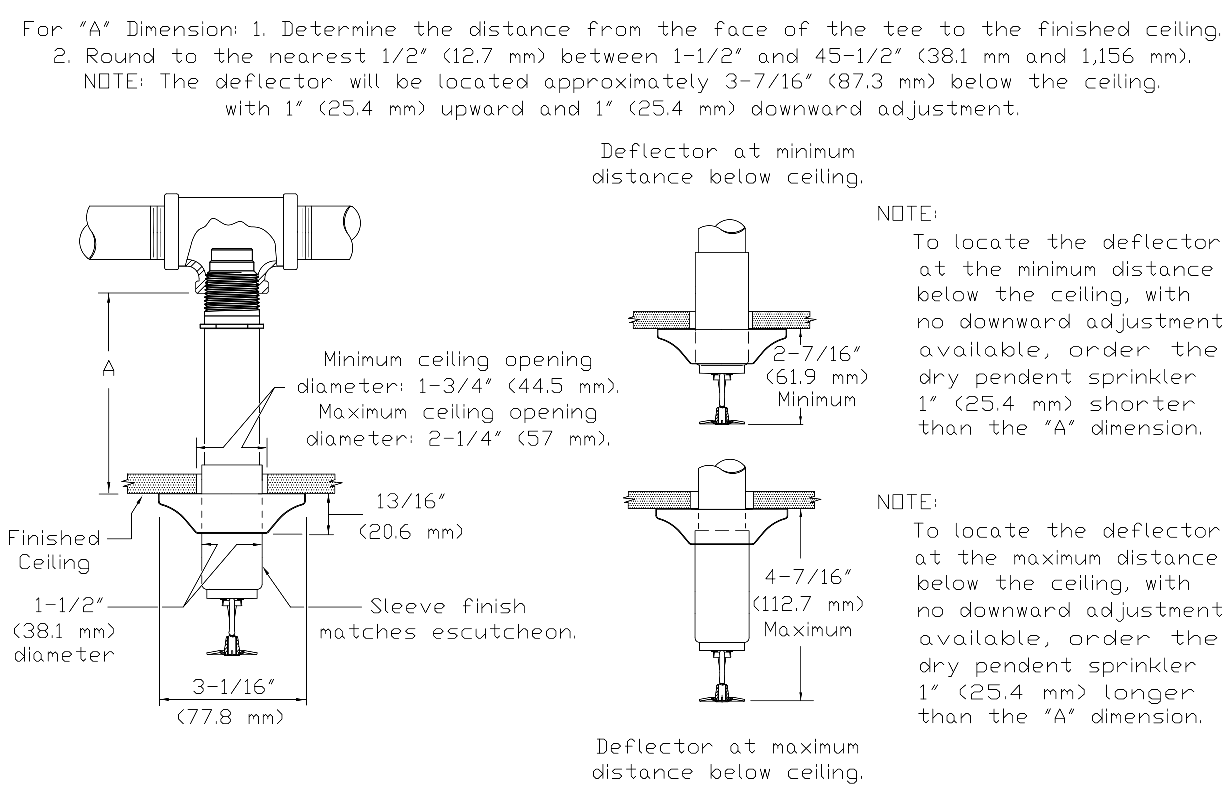

Figure 3: Adjustable Standard Dry Pendent Sprinkler

VIKING® | TECHNICAL DATA | QUICK RESPONSE DRY PENDENT SPRINKLERS

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Approval Chart 1 (UL)

Quick Response Dry Pendent Sprinklers
Maximum 175 PSI (12 bar) WWP

KEY: A1X — A: Temperature; 1: Finish; X: Escutcheon (if applicable)

Sprinkler Base Part No.[1]	SIN	Style	Thread Size		Nominal K-Factor[2]		Order Length Increment		Listings and Approvals[4] (Refer also to Design Criteria below.)					
			NPT	BSP	U.S.	metric[3]	Inches	mm	cULus[5]	NYC[6]	VdS	LPCB	CE	⚙
08383U	VK176	Adjustable Standard	1”	--	5.6	80.6	1/2”	12.7	A1, A5	A1	--	--	--	--
16457U			--	25 mm	--	80.6	1/2”	12.7	A1, A5	--	--	--	--	--
08385U	VK180	Adjustable Recessed	1”	--	5.6	80.6	1/4”	6.35	B2, B6	B2	--	--	--	--
16453U			--	25 mm	--	80.6	1/4”	6.35	B2, B6	--	--	--	--	--
08387U	VK172	Plain Barrel	1”	--	5.6	80.6	1/2”	12.7	A3	A4	--	--	--	--
16455U			--	25 mm	--	80.6	1/2”	12.7	A3	--	--	--	--	--

Approved Temperature Ratings

A - 155 °F (68 °C), 175 °F (79°C), 200 °F (93 °C), and 286 °F (141 °C)
B - 155 °F (68 °C), 175 °F (79°C), and 200 °F (93 °C)

Approved Finishes and “A” Dimensions

1 - Chrome or White Polyester[7] sprinkler with a Chrome or White Polyester Sleeve and Escutcheon with “A” dimensions 1-1/2” to 45-1/2” (38.1 mm to 1,156 mm)
2 - Chrome or White Polyester[7] with “A” dimensions 3-1/4” to 47-1/2” (82.5 mm to 1,207 mm)
3 - Chrome, Brass, White Polyester[7], or ENT[7] with “A” dimensions 3” to 47” (76.2 mm to 1,194 mm)
4 - Chrome or Brass with “A” dimensions 3” to 47” (76.2 mm to 1,194 mm)
5 - ENT[7] sprinkler with an ENT[7] Sleeve and Escutcheon with “A” dimensions 1-1/2” to 45-1/2” (38.1 mm to 1,156 mm)
6 - ENT[7] with “A” dimensions 3-1/4” to 47-1/2” (82.5 mm to 1,207 mm)

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to current Viking price list schedule.
[2] K-Factor applies for standard lengths (“A” Dimensions indicated above).
[3] Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
[4] This chart shows the listings and approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals.
[5] Listed by Underwriter’s Laboratories for use in the U.S. and Canada.
[6] Accepted for use, City of New York Department of Buildings, MEA Number 89-92-E, Vol. 15.
[7] cULus Listed as corrosion resistant.

DESIGN CRITERIA - UL

(Also refer to Approval Chart 1 above.)

NOTE: When using CPVC fittings with Viking dry sprinklers, use only new Nibco Model 5012-S-BI tees. When selecting other CPVC fittings, contact Viking Technical Services.

cULus Listing Requirements:

Standard Dry Pendent Sprinklers are cULus Listed as indicated in Approval Chart 1 for installation in accordance with the latest edition of NFPA 13 for standard spray sprinklers.

- Designed for use in Light and Ordinary Hazard occupancies.
- The sprinkler installation and obstruction rules contained in NFPA 13 for standard spray pendent sprinklers must be followed.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to Form F_080614 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, LPCB, APSAD, VdS or other similar organizations, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable.

VIKING®

TECHNICAL DATA

QUICK RESPONSE DRY PENDENT SPRINKLERS

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

Approval Chart 2 (FM)

Quick Response Dry Pendent Sprinklers
Maximum 175 PSI (12 bar) WWP

KEY: A1X — A = Temperature, 1 = Finish, X = Escutcheon (if applicable)

Sprinkler Base Part No.[1]	SIN	Style	Thread Size		Nominal K-Factor[2]		Order Length Increment		FM Approvals[4] (Refer also to Design Criteria below.)
			NPT	BSP	U.S.	metric[3]	Inches	mm	
08383U	VK176	Adjustable Standard	1”	--	5.6	80.6	1/2”	12.7	A1
16457U			--	25 mm	--	80.6	1/2”	12.7	A1
08385U	VK180	Adjustable Recessed	1”	--	5.6	80.6	1/4”	6.35	B2
16453U			--	25 mm	--	80.6	1/4”	6.35	B2
08387U	VK172	Plain Barrel	1”	--	5.6	80.6	1/2”	12.7	A3
16455U			--	25 mm	--	80.6	1/2”	12.7	A3

Approved Temperature Ratings

A - 155 °F (68 °C), 175 °F (79 °C), 200 °F (93 °C), and 286 °F (141 °C)
B - 155 °F (68 °C), 175 °F (79°C), and 200 °F (93 °C)

Approved Finishes and “A” Dimensions

1 - Brass, Chrome, White Polyester, or ENT[5] sprinkler with a Brass, Chrome, White Polyester, or ENT[5] Sleeve and Escutcheon with “A” dimensions 1-1/2” to 45-1/2” (38.1 mm to 1,156 mm)
2 - Brass, Chrome, White Polyester, or ENT[5] with “A” dimensions 3-1/4” to 47-1/2” (82.5 mm to 1,207 mm)
3 - Brass, Chrome, White Polyester, or ENT[5] with “A” dimensions 3” to 47” (76.2 mm to 1,194 mm)

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to current Viking price list schedule.
[2] K-Factor applies for standard lengths (“A” Dimensions indicated above).
[3] Metric K-Factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
[4] This chart shows the FM Approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals.
[5] FM approved as corrosion resistant.

DESIGN CRITERIA - FM

(Also refer to Approval Chart 2 above.)

NOTE: When using CPVC fittings with Viking dry sprinklers, use only new Nibco Model 5012-S-BI tees. When selecting other CPVC fittings, contact Viking Technical Services.

FM Approval Requirements:

The Dry Pendent Sprinklers in the Approval Chart above are FM Approved as quick response **Non-storage** standard spray sprinklers as indicated in the FM Approval Guide. For specific application and installation requirements, reference the latest applicable FM Loss Prevention Data Sheets (including 2-0) and Technical Advisory Bulletins. FM Global Loss Prevention Data Sheets and Technical Advisory Bulletins contain guidelines relating to, but not limited to: minimum water supply requirements, hydraulic design, ceiling slope and obstructions, minimum and maximum allowable spacing, and deflector distance below the ceiling.

NOTE: The FM installation guidelines may differ from cULus and/or NFPA criteria.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to Form F_080614 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, FM Global, LPCB, APSAD, VdS or other similar organizations, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable.

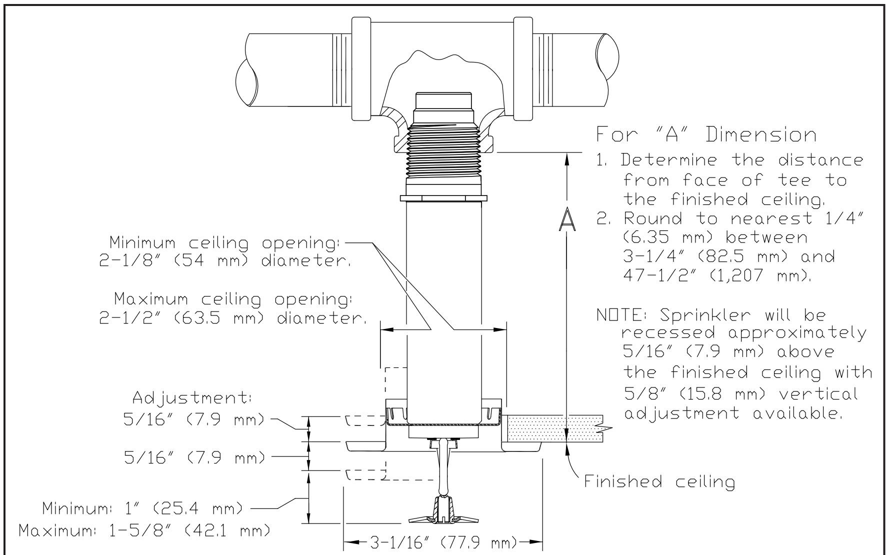


Figure 4: Adjustable Recessed Dry Pendent Sprinkler

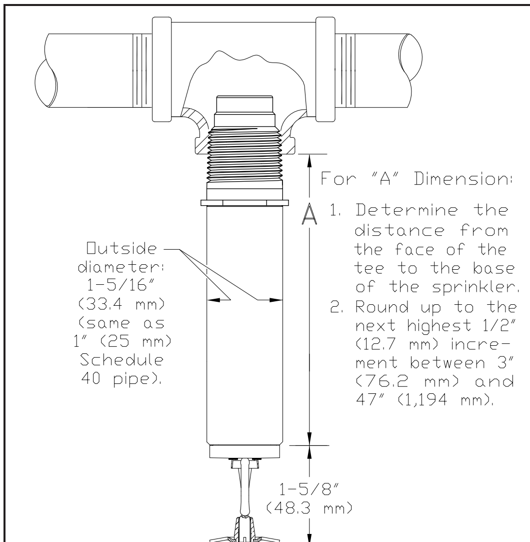
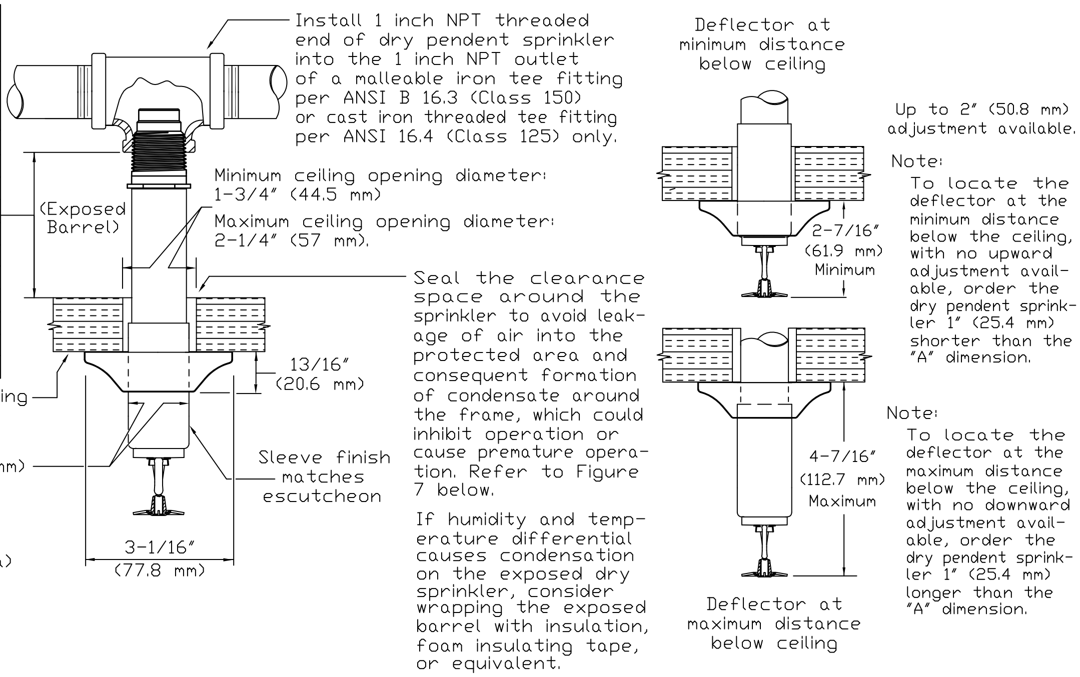


Figure 5: Plain Barrel Dry Pendent Sprinkler

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com
Visit the Viking website for the latest edition of this technical data page: www.vikinggroupinc.com

Ambient Temperature of Protected Area* at the Discharge End of the Sprinkler	Exposed Barrel Ambient Temperature 40°F/4°C	50°F/10°C	60°F/16°C
	Exposed Minimum Barrel Length** Face of Tee to Top of Ceiling In. (mm)	In. (mm)	In. (mm)
40°F (4°C)	0	0	0
30°F (-1°C)	0	0	0
20°F (-7°C)	4 (100)	0	0
10°F (-12°C)	8 (203)	1 (25.4)	0
0°F (-18°C)	12 (305)	3 (76)	0
-10°F (-23°C)	14 (356)	4 (102)	1 (25.4)
-20°F (-29°C)	14 (356)	6 (152)	3 (76)
-30°F (-34°C)	16 (406)	8 (203)	4 (102)
-40°F (-40°C)	18 (457)	8 (203)	4 (102)
-50°F (-46°C)	20 (508)	10 (254)	6 (152)
-60°F (-51°C)	20 (508)	10 (254)	6 (152)



*The protected area refers to the area below the ceiling.
The ambient temperature is the temperature at the discharge end of the sprinkler.
For protected area temperatures that occur between the values listed, use the next cooler temperature.

**The minimum required barrel length is not the same as the "A" dimension. Refer to Figures 3-5 for the "A" dimension.
NOTE: Exposed minimum barrel lengths are inclusive up to 30 mph wind velocities.

Figure 6: **Dry Pendent Sprinkler Required Minimum Barrel Length Based on Ambient Temperature in the Protected Area (Adjustable Standard Dry Pendent Sprinkler is Shown)**

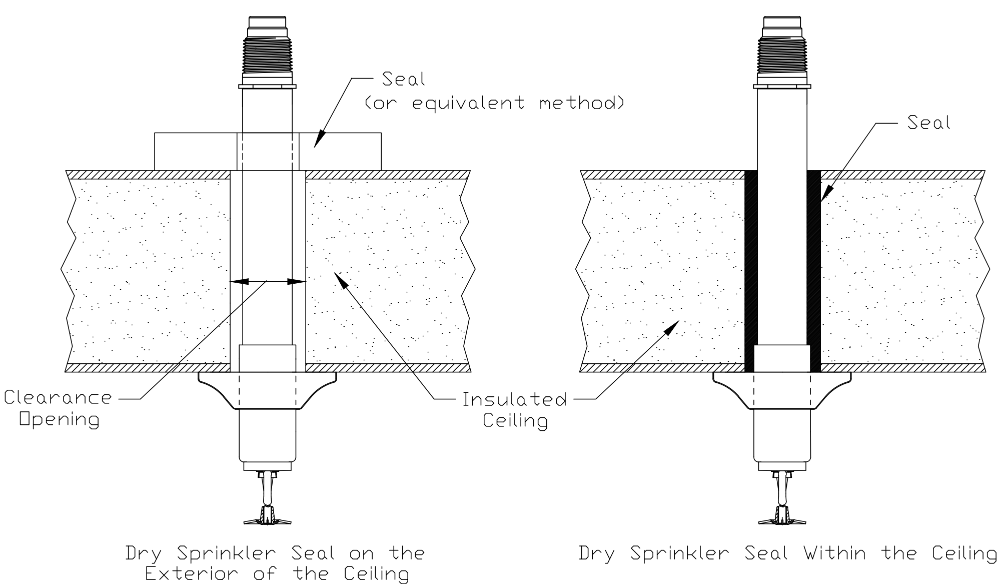


Figure 7: **Dry Sprinkler Seal (Adjustable Standard Dry Pendent Sprinkler is Shown)**

Replaces Form F_031793 Rev. 19.1
(Added ENT; updated FM language.)

VicFlex™ Style VS1 Dry Sprinkler
Models V3505, V3506, V3509, V3510, V3517, V3518

1.0 PRODUCT DESCRIPTION

Style
- Pendent, Concealed Pendent, Horizontal Sidewall

K Factor
- 5.6/8.1 S.I.
  For system design purposes, no equivalent length calculations are required.

Sprinkler Length
- 38"/965 mm, 50"/1270 mm, 58"/1475 mm

Nominal Orifice Size
- ½"/13 mm

Maximum Working Pressure
- 175 psi/1200 kPa

Factory Hydrostatic Test
- 100% @ 500 psi/3450 kPa

Minimum Operating Pressure
- 7 psi/48 kPa

Connections
- To branch line (inlet) via 1"/25 mm NPT or 1" BSPT

Minimum Bend Radius:
- **UL:** 2"/51 mm
- **FM**: 7"/178 mm

Maximum Number of 90° Bends:
- **UL:** 4
- **FM**: 2 bends for 38", 3 bends for 50", 4 bends for 58"

Hazard Classifications
- Light and Ordinary Hazard

NOTE
- The VS1 is classified as a dry sprinkler and has no equivalent length.

ALWAYS REFER TO ANY NOTIFICATIONS AT THE END OF THIS DOCUMENT REGARDING PRODUCT INSTALLATION, MAINTENANCE OR SUPPORT.

System No.		Location	
Submitted By		Date	

Spec Section		Paragraph	
Approved		Date	

2.0 CERTIFICATION/LISTINGS

Approvals/Listings	Model								
	V3505	V3505	V3506	V3506	V3509	V3509	V3510	V3517	V3518
Orifice Size (inches)	½"	½"	½"	½"	½"	½"	½"	½"	½"
Orifice Size (mm)	13	13	13	13	13	13	13	13	13
Nominal K Factor Imperial	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Nominal K Factor S.I.	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Response	Standard	Standard	Quick	Quick	Standard	Standard	Quick	Standard	Quick[1]
Deflector Type	Pendent	Recessed	Pendent	Recessed	Hor. SW	Rec. Hor. SW	Hor. SW, Recessed Hor. Sidewall	Conc. Pend.	Conc. Pend. w/Clean room gasket
Approved Temperature Ratings	F°/C°								
FM	135/57	135/57	135/57	135/57	135/57	135/57	135/57	–	135/57
	155/68	155/68	155/68	155/68	155/68	155/68	155/68	–	155/68
	175/79	175/79	175/79	175/79	175/79	175/79	175/79	–	175/79
	200/93	200/93	200/93	200/93	200/93	200/93	200/93	–	200/93
	286/141	–	–	–	286/141	–	–	–	–
UL	135/57	135/57	135/57	135/57	135/57	135/57	135/57	135/57	135/57
	155/68	155/68	155/68	155/68	155/68	155/68	155/68	155/68	155/68
	175/79	175/79	175/79	175/79	175/79	175/79	175/79	175/79	175/79
	200/93	200/93	200/93	200/93	200/93	200/93	200/93	200/93	200/93
	286/141	286/141	286/141	286/141	286/141	–	286/141	–	–

1 Model V3518 is a Standard Response FM sprinkler.

3.0 MATERIAL SPECIFICATIONS

Deflector: Brass

Bulb: Glass with glycerin solution

Bulb Nominal Diameter:

☐ **Quick Response:** 3.0 mm

☐ **Standard Response:** 5.0 mm

Split Spacers: Stainless steel

Load Screw: Brass

Pip Cap: Stainless steel

Spring Seal Assembly: PTFE tape coated beryllium nickel and stainless steel

Frame: Brass

Flexible Hose: Stainless steel

Collar/Weld Fitting: Stainless steel

Gasket Seal: Victaulic EPDM

Isolation Ring: Nylon

Hose Fittings: Carbon steel, zinc-plated

Inlet Fitting: Brass

Outer Tube: Stainless steel

Concealed Cup: Carbon steel, zinc-plated

Brackets: Carbon steel, zinc-plated

3.1 ACCESSORIES SPECIFICATIONS

Sprinkler Finishes:

☐ **Standard:** VC-250

☐ White painted RAL 9010

4.0 DIMENSIONS

Product Details and Optional Components

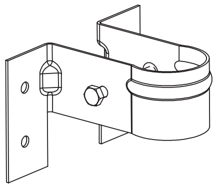
Style VS1 Dry Sprinkler

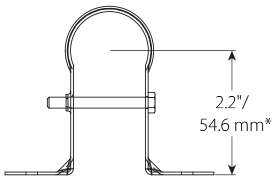
Sprinkler Length inches mm	Overall Length (pendent) L inches mm	Live Length B inches mm	Outlet End Length C inches mm	Maximum OD D inches mm
38 965	39.2 995	25.1 638	6.5 165	2.2 56
50 1270	51.2 1300	37.1 943	6.5 165	2.2 56
58 1475	59.2 1505	45.1 1145	6.5 165	2.2 56

NOTE

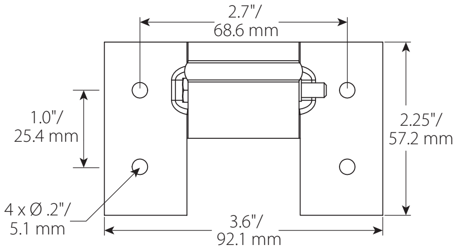
- Add ½" to Overall Length and Outlet End Length for increased length of sidewall deflector

Style VB1 Bracket





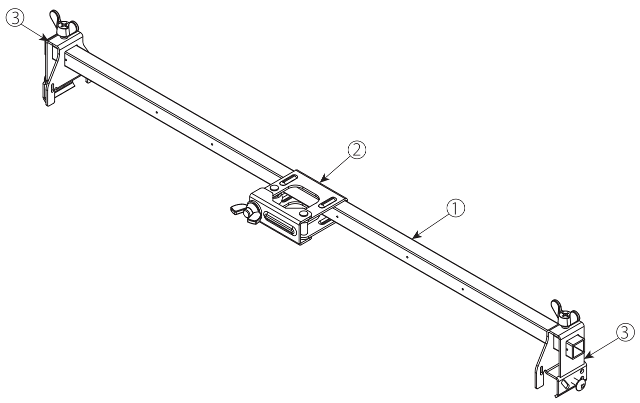
*Note: Theoretical center point of sprinkler in bracket.



4.0 DIMENSIONS (CONTINUED)

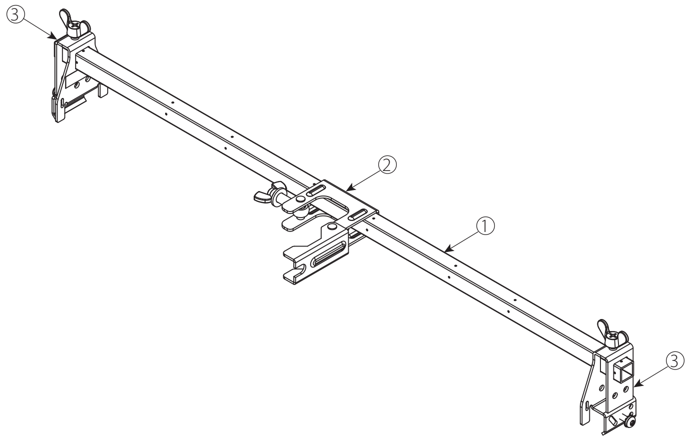
Style VB2 Bracket
Recessed Pendent, Suspended Ceilings

Item	Description
1	24"/610 mm or 48"/1220 mm Square Bar
2	Patented 1-Bee Center Bracket
3	End Bracket



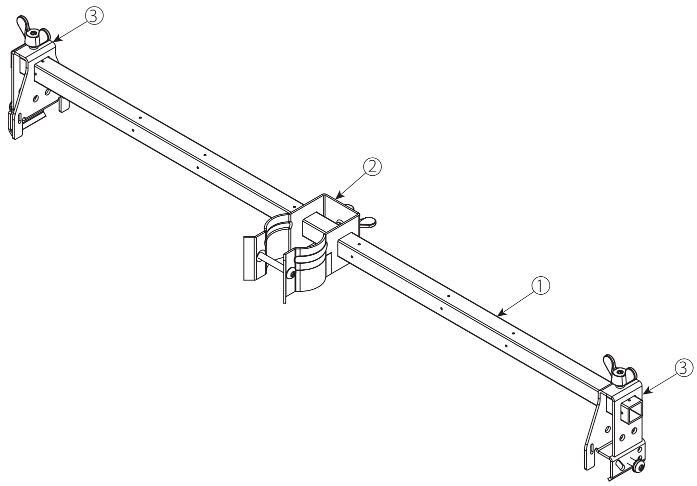
Style VB3 Bracket
Concealed Pendent, Suspended Ceilings

Item	Description
1	24"/610 mm or 48"/1220 mm Square Bar
2	Patented 1-Bee Center Bracket
3	End Bracket



Style VB4 Bracket
Sleeve and Skirt Pendent, Suspended Ceilings

Item	Description
1	24"/610 mm or 48"/1220 mm Square Bar
2	Center Bracket
3	End Bracket



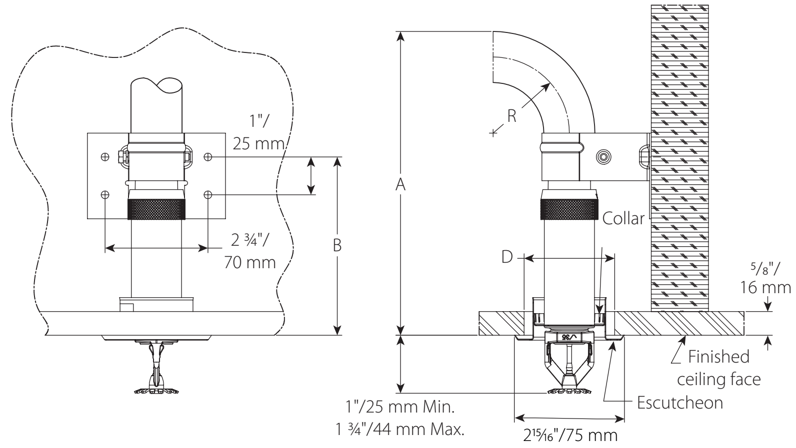
4.1 DIMENSIONS

Sprinkler Finishes: Dimensions and Mounting Conditions

NOTE

- Drawings are shown with ⅝" finished ceiling thickness. Adjustments to "B" and "C" dimensions will be required if finished ceiling thickness deviate from drawing.

Recessed Pendent:



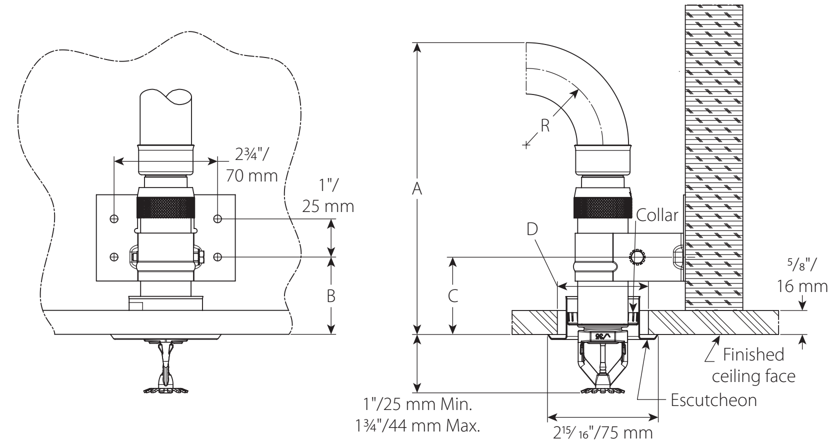
Clearance Chart		
Dimension	inches mm	
"R" Minimum Bend Radius	2 50	7 175
"A" Minimum Required Installation Space	7 ⅝ 193	12 ⅝ 320
"B" Mounting Screw Hole Location	4 ¾ 119	
Ceiling Hole Diameter "D"	2 – 2⅜ 50 – 60	

NOTE

- Dimensions are shown with ¾" escutcheon at middle of height adjustment range.

4.2 DIMENSIONS

Recessed Pendent Alternative Bracket Location



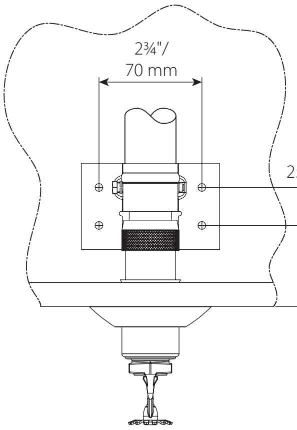
Clearance Chart		
Dimension	inches mm	
"R" Minimum Bend Radius	2 50	7 175
"A" Minimum Required Installation Space	7⅝ 193	12⅝ 320
"B" Mounting Screw Hole Location	2 50	
Ceiling Hole Diameter "D"	2 – 2⅜ 50 – 60	

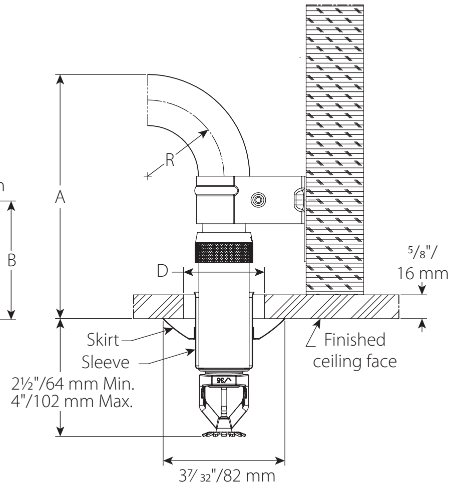
NOTE

- Dimensions are shown with ¾" escutcheon at middle of height adjustment range.

4.3 DIMENSIONS

Sleeve and Skirt Pendent

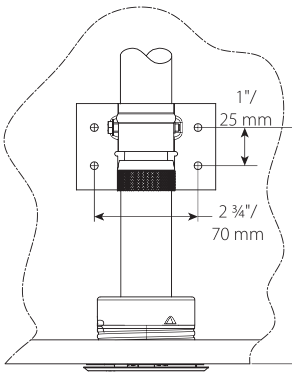


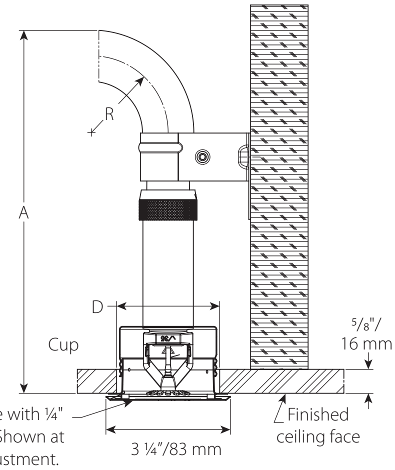


Clearance Chart		
Dimension	inches mm	
"R" Minimum Bend Radius	2 50	7 175
"A" Minimum Required Installation Space	6 ½ 163	11 ½ 290
"B" Mounting Screw Hole Location	3 ⅛ 79	
Ceiling Hole Diameter "D"	1 ¾ – 2 ⅛ 44 – 54	

4.4 DIMENSIONS

Concealed Pendent



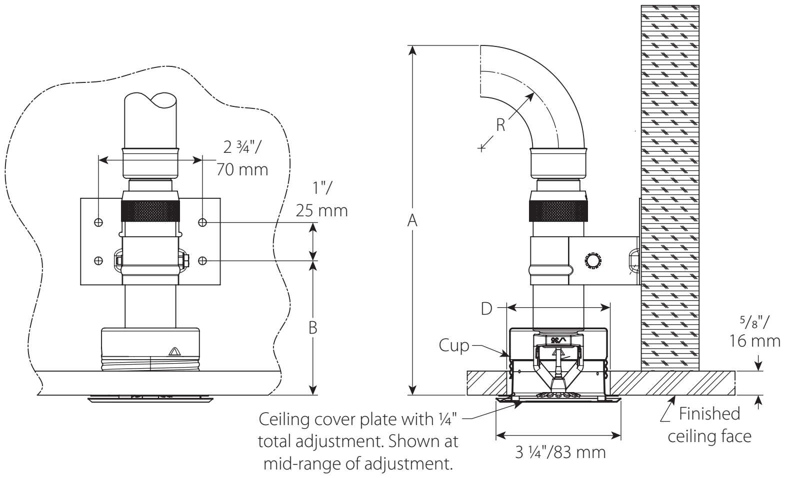


Ceiling cover plate with ¼" total adjustment. Shown at mid-range of adjustment.

Clearance Chart		
Dimension	inches mm	
"R" Minimum Bend Radius	2 50	7 175
"A" Minimum Required Installation Space	9 ½ 241	14 ½ 369
"B" Mounting Screw Hole Location	6 ¼ 157	
Ceiling Hole Diameter "D"	2 ⅝ – 2 ¾ 67 – 70	

4.5 DIMENSIONS

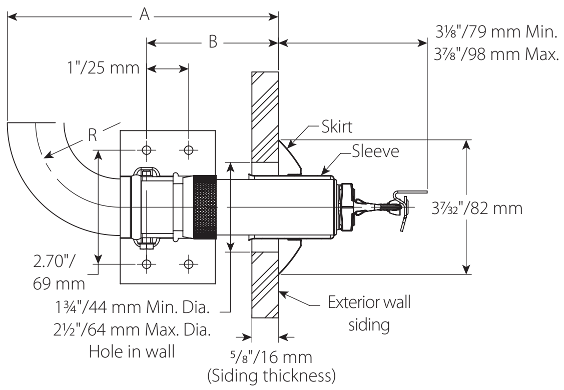
Concealed Pendent Alternative Bracket Location



Clearance Chart		
Dimension	inches mm	
"R" Minimum Bend Radius	2 50	7 175
"A" Minimum Required Installation Space	9 ⅛ 231	14 ⅛ 358
"B" Mounting Screw Hole Location	3 ½ 89	
Ceiling Hole Diameter "D"	2 ⅝ – 2 ¾ 67 – 70	

4.6 DIMENSIONS

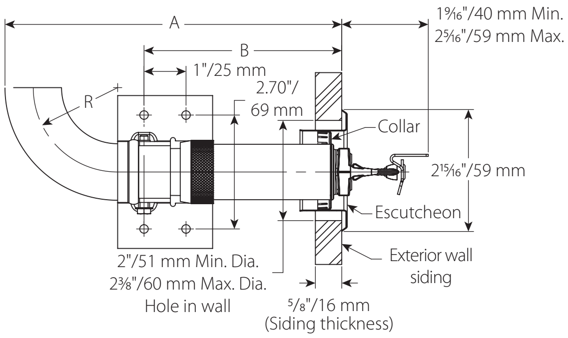
Sleeve and Skirt Sidewall



Clearance Chart		
Dimension	inches mm	
"R" Minimum Bend Radius	2 50	7 175
"A" Minimum Required Installation Space	6 ½ 163	11 ½ 290
"B" Mounting Screw Hole Location	3 ⅛ 79	
Ceiling Hole Diameter "D"	1 ¾ – 2 ⅛ 44 – 54	

4.7 DIMENSIONS

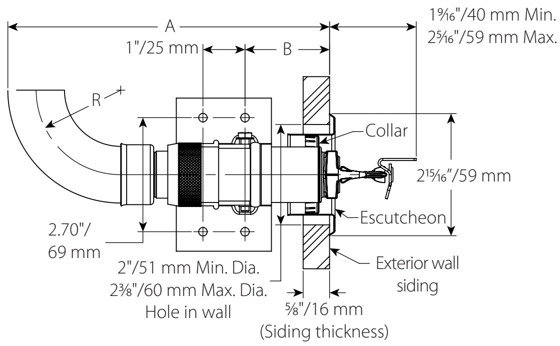
Recessed Sidewall



Clearance Chart		
Dimension	inches mm	
"R" Minimum Bend Radius	2 50	7 175
"A" Minimum Required Installation Space	8 203	13 330
"B" Mounting Screw Hole Location	4 ¾ 119	
Ceiling Hole Diameter "D"	2 – 2⅜ 51 – 60	

4.8 DIMENSIONS

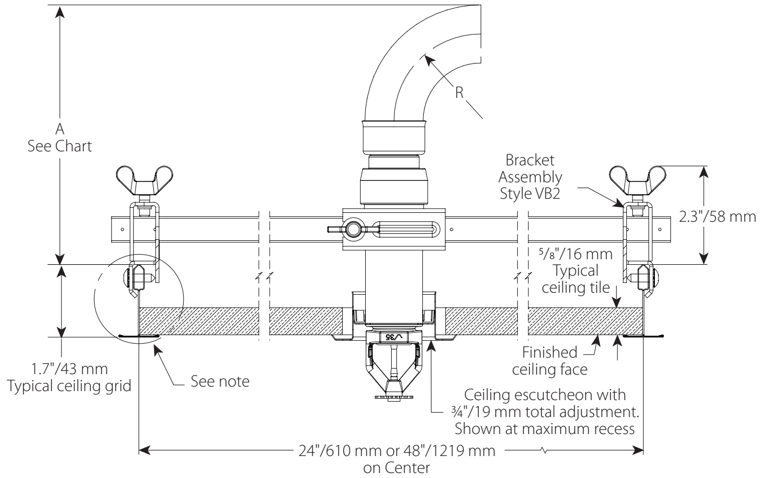
Recessed Sidewall Alternative Bracket Location



Clearance Chart		
Dimension	inches mm	
"R" Minimum Bend Radius	2 50	7 175
"A" Minimum Required Installation Space	8 203	13 330
"B" Mounting Screw Hole Location	2 51	
Ceiling Hole Diameter "D"	2 – 2⅜ 51 – 60	

4.9 DIMENSIONS

VB2 Recessed Pendent



Recessed Pendent

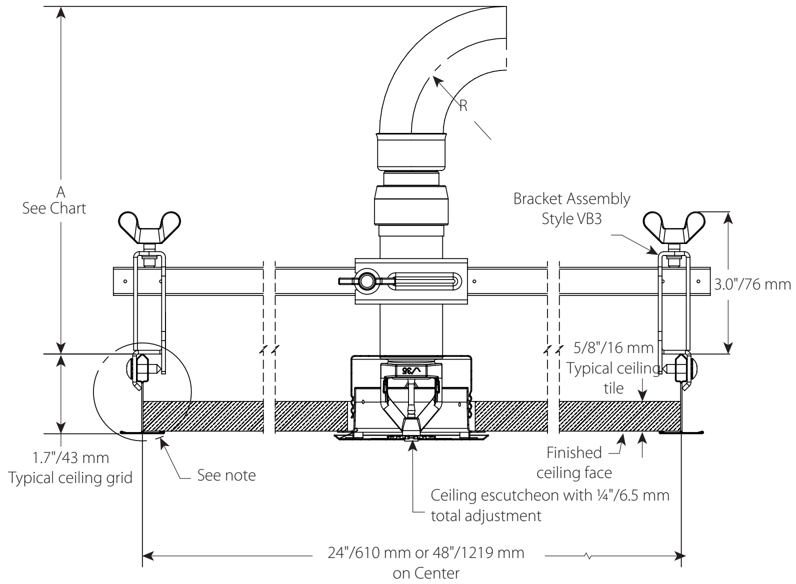
Clearance Chart		
Dimension	inches mm	
"R" Minimum Bend Radius	2 50	7 175
"A" Minimum Required Installation Space	6½ 163	11½ 290

NOTE

- Victaulic *VicFlex* Style VB2 Bracket assemblies shall be used only with Style VS1 recessed pendent sprinklers.

4.10 DIMENSIONS

VB3 Concealed Pendent



Concealed Pendent

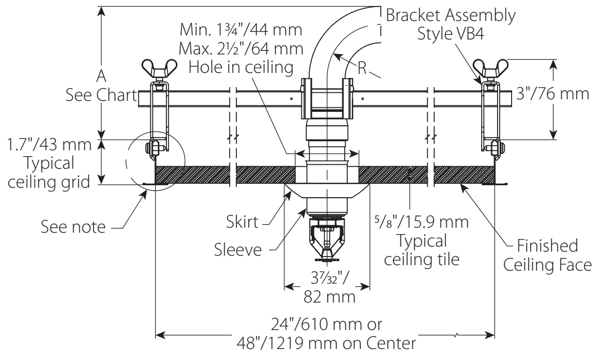
Clearance Chart		
Dimension	inches mm	
"R" Minimum Bend Radius	2 50	7 175
"A" Minimum Required Installation Space	7⅝ 193	12⅝ 320

NOTE

- Victaulic *VicFlex* Style VB3 Bracket assemblies shall be used only with Style VS1 concealed pendent sprinklers.

4.11 DIMENSIONS

VB4 Sleeve and Skirt Pendent



Sleeve and Skirt Pendent

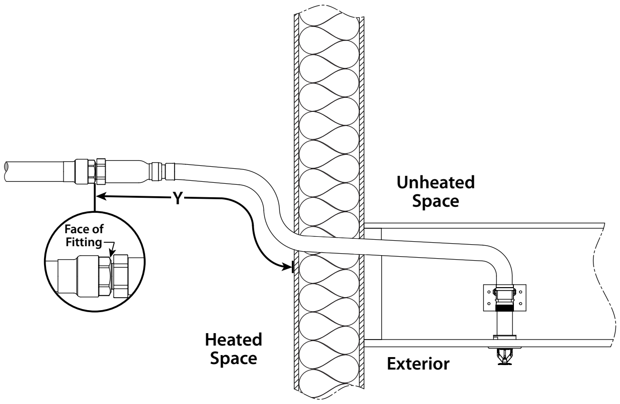
Clearance Chart		
Bend Radius		
	inches mm	inches mm
"R" Minimum Bend Radius	2 51	7 178
"A" Minimum Required Installation Space	5 127	10 254

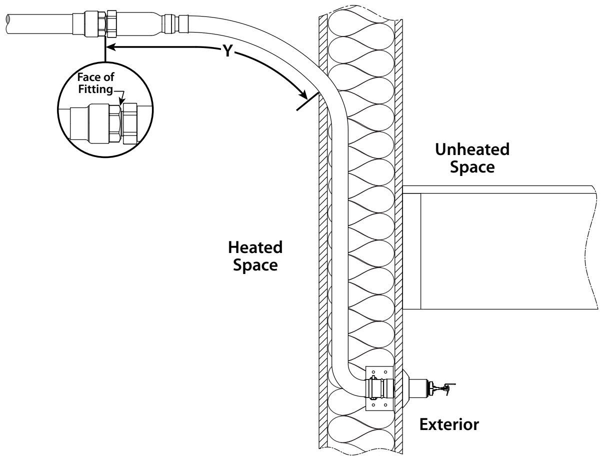
NOTE

- Victaulic *VicFlex* Style VB2 Bracket assemblies shall be used only with Style VS1 recessed pendent sprinklers.

5.0 PERFORMANCE

Freeze Protection





Ambient Temperature Exposed to Discharge End of Sprinkler °F °C	Exposed Minimum Barrel Length "Y" inches mm		
	40°F/4°C	50°F/10°C	60°F/16°C
40 4	0 0	0 0	0 0
30 -1	0 0	0 0	0 0
20 -7	4 100	0 0	0 0
10 -12	8 200	1 25	0 0
0 -18	12 300	3 75	0 0
-10 -23	14 350	4 100	1 25
-20 -29	14 350	6 150	3 75
-30 -34	16 400	8 200	4 100
-40 -40	18 450	8 200	4 100
-50 -46	20 500	10 250	6 150
-60 -51	20 500	10 250	6 150

NOTE
- Exposed minimum barrel lengths are inclusive up to 30-mph/48-kph wind velocities.

Maximum Allowable Number of Bends

Sprinkler Length inches mm	Maximum Allowable Number of 90° Bends at 2"/51mm Bend Radius for UL Listing	Maximum Allowable Number of 90° Bends at 7"/178mm Bend Radius for FM Approval
38 965	4	2
50 1270	4	3
58 1475	4	4

6.0 NOTIFICATIONS

⚠ WARNING

- **Read and understand all instructions before attempting to install any Victaulic products.**
- **Always verify that the piping system has been completely depressurized and drained immediately prior to installation, removal, adjustment, or maintenance of any Victaulic products.**
- **Wear safety glasses, hardhat, and foot protection.**

- **These products shall be used only in fire protection systems that are designed and installed in accordance with current, applicable National Fire Protection Association (NFPA 13, 13D, 13R, etc.) standards, or equivalent standards, and in accordance with applicable building and fire codes. These standards and codes contain important information regarding protection of systems from freezing temperatures, corrosion, mechanical damage, etc.**
- **The installer shall understand the use of this product and why it was specified for the particular application.**
- **The installer shall understand common industry safety standards and potential consequences of improper product installation.**

⚠ WARNING

- **It is the responsibility of the system designer to verify suitability of 300-series stainless steel flexible hose for use with the intended fluid media within the piping system and external environments.**
- **The effect of chemical composition, pH level, operating temperature, chloride level, oxygen level, and flow rate on 300-series stainless steel flexible hose must be evaluated by the material specifier to confirm system life will be acceptable for the intended service.**
- **It is the responsibility of the owner of a building or their authorized agent to provide the sprinkler system installer with any knowledge that the water supply might be contaminated with or conducive to the development of microbiologically influenced corrosion (MIC), including as required by NFPA 13. Failure to identify adverse water quality issues may affect the VicFlex product and void the manufacturer's warranty.**

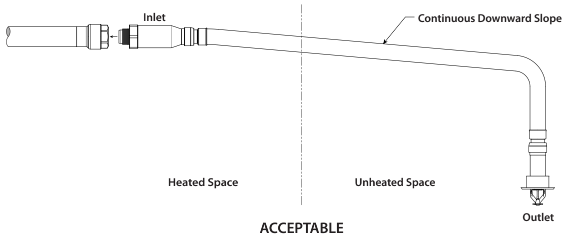
Failure to follow these instructions could cause product failure, resulting in serious personal injury and/or property damage.

DO NOT paint, coat, or firestop the outlet/inlet portion of the Style VS1 Dry Sprinkler. Braided hose and fitting portions of the Style VS1 Dry Sprinkler may be painted or coated, provided that the paint or coating is compatible with stainless steel material. This includes penetration through firestop-filled annular space of a firewall. The firestop material in direct contact with the flexible braided hose will not impede functionality of the Style VS1 Dry Sprinkler, provided that the components are installed in accordance with Victaulic's installation instructions.

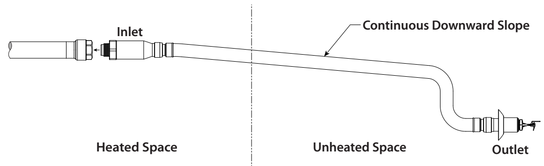
6.0 NOTIFICATIONS (CONTINUED)

Important Installation Notes:

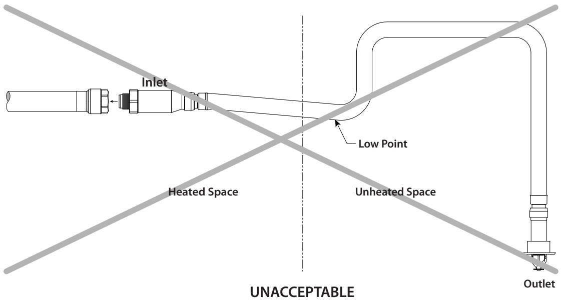
1. Shall be installed only in accordance with NFPA 13 Standard for the the Installation of Sprinkler Systems and applicable FM Data Sheets.
2. Install and tighten swivel hex nut at inlet of sprinkler fitting only.
3. Do not remove deflector or inlet end of sprinkler.



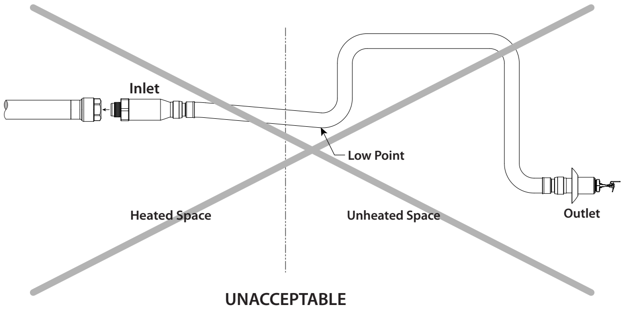
ACCEPTABLE



ACCEPTABLE



UNACCEPTABLE



UNACCEPTABLE

6.0 NOTIFICATIONS (CONTINUED)

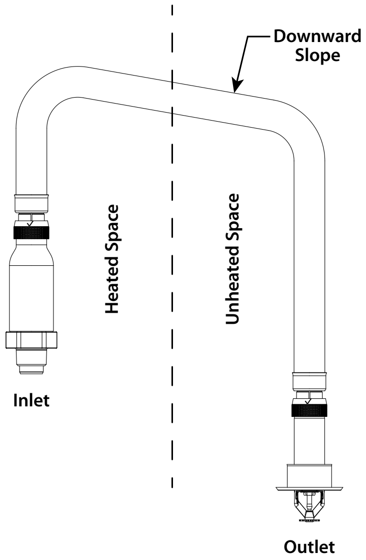
FOR DRY SYSTEMS ONLY:

- The Style VS1 Dry Sprinkler's inlet shall be installed only into the outlet of a fitting (excluding elbows) or welded outlet that meets the dimensional requirements of ANSI B16.3 and ANSI B16.4, Class 125 and Class 150. Use a sample fitting to confirm proper engagement and to verify that there is no interference between the sprinkler and the fitting.

Style VS1 Dry Sprinklers in an unheated space shall be installed with a continuous downward slope along its entire length from the branch line fitting to the sprinkler. No localized low points shall be present along the length of the Style VS1 Dry Sprinkler.

Style VS1 Dry Sprinklers in an unheated space are not permitted to be installed into the top of the branch line piping. Style VS1 Dry Sprinklers shall be installed into the side or from the bottom of the branch line piping.

In a heated space, if a portion of the Style VS1 Dry Sprinkler is installed from the top of a branch line and then extends into an unheated space, it shall be installed with a continuous downward slope along the entire length from the inside wall to the outlet of the sprinkler. No localized low points shall be present along the length of the sprinkler in the unheated space. Refer to the drawing below.



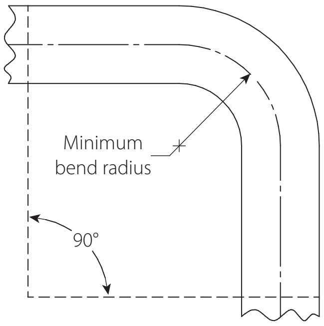
FOR WET SYSTEMS ONLY:

- **DO NOT** install Victaulic® VicFlex™ Style VS1 Dry Sprinklers into any threaded elbow, threaded-by-thread coupling, or fitting that interferes with thread penetration. The inlet of the Victaulic® VicFlex™ Style VS1 Dry Sprinkler **SHALL NOT** bottom out in the fitting. Use a sample fitting to confirm proper engagement.
- To ensure unobstructed flow during operation, the Victaulic® VicFlex™ Style VS1 Dry Sprinkler shall be installed into a fitting that will prevent water and debris from accumulating at the dry sprinkler's inlet.
- Verify that the exposed minimum barrel length in the heated space is measured and maintained in accordance with the table on page 1.

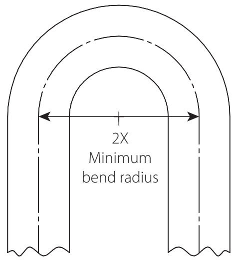
In a heated space, if a portion of the Style VS1 Dry Sprinkler extends into an unheated space, it shall be installed with a continuous downward slope along the entire length from the inside wall to the outlet end of the dry sprinkler. No localized low points shall be present along the length of the sprinkler in the unheated space. Refer to the drawing above.

7.0 REFERENCE MATERIALS

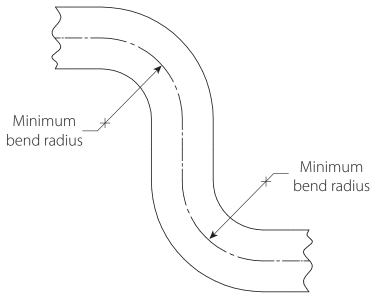
ONE BEND

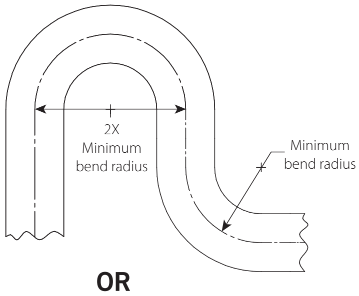


TWO BENDS

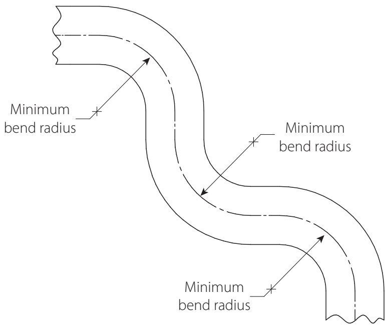


OR





OR



NOTE

For out-of-plane (three-dimensional) bends, care must be taken to avoid imparting torsional stress on the sprinkler.

Bill To:

Company Name	
Address	
State/Province	Zip Code/Postal Code
Phone No.	Email
Fax No.	

Ship To:

Order No.	Date
Company Name	
Address	
State/Province	Zip Code/Postal Code
Tag	

Quantity (as specified below): ☐ If units of different size, type or other option are required, please attach additional form(s) with their specification(s) separately.

VicFlex™ Dry Sprinkler Model VS1

A – 3F – ☐ – ☐ – ☐ – ☐ – 4 – ☐ – ☐ – ☐ – ☐

Class	Style	Thread	Deflector Style	Temperature	Response	K Factor	Finish	Recessed Escutcheon Material	Size: Code = Inches	Escutcheon Style †
A	3F = V35	3 = 1" NPT 8 = 25 mm BSP	B = Pendent C = Horizontal Sidewall P - Concealed	A = 135°F/57°C C = 155°F/68°C E = 175°F/79°C F = 200°F/93°C J = 286°F/141°C	Q = Quick S = Std.	4 = K5.6	4 = White N = VC-250 ‡	W = White Stainless Steel X = Stainless Steel 0 = Concealed	380 = 38" 500 = 50" 580 = 58"	12 = Recessed 13 = Sleeve and Skirt 15 = Concealed

‡ VC-250 sprinkler finish sold standard on the VicFlex Dry Sprinkler Model VS1.

7.0 REFERENCE MATERIALS (CONTINUED)

29.01: Victaulic Terms and Conditions of Sale

I-VICFLEX.VS1: Victaulic® VicFlex™ Style VS1 Dry Sprinkler Installation Instructions

Submitted By:
Andrew Clark
Vice President of Government Affairs
Home Builders Association of Virginia

Access to Virginia-Specific Fire Data is Lacking:

All stakeholders should have equal access to data related to residential home fire incidents, deaths, injuries, causes, and other relevant information. Currently, the US Fire Administration dashboard contains informative, but surface level, data regarding the fire casualties by incident type, residential structure fire casualties, and a handful of other data points. However, there is a dearth of publicly available, substantive, and comprehensive data that would inform stakeholders about residential home fire trends in Virginia. According to their website, the US Fire Administration annually collects data from 24,112 fire departments across the country – however, that data is only available by 1) ordering a "CD or DVD" – free of charge. Some stakeholders have the option to download the data from the USFA website – however, the information is provided in countless raw data files that require a "…database management system and expertise in SQL and/or other database programming language" to access[1]. The USFA also has a disclaimer that the database is for "researchers and fire data analysts" and that users "should have considerable experience with fire data analysis and NFIRS data to properly use the PDR".

I understand that this is a complex data set with 24,000 fire departments inputting a lot of data set – but there is little-to-no ability for non-fire data analysts to dive into the numbers, aside from the relatively high-level reports published by the NFPA. Additionally, unless I'm missing something, the NFPA does not make publicly available any reports specific to Virginia – it's all national-level data.

I have also attempted to find more Virginia-specific data on the Virginia Department of Fire Programs (VDFP) website – my assumption being that USFA and NFPA focus on national data, leaving the state-level data to VDFP to analyze and publish. There are currently several pages on VDFP's website devoted to data:

> **Fire and Data Statistics:** https://www.vafire.com/fire-and-data-statistics-2/ - There is a high-level chart which summarizes incidents between 2013-2018. However, the summary data has not been updated since 2018 – and there is little information that would be relevant to the discussion of townhome fire sprinklers. There also appears to be more substantive reports re: residential structure fire causes, incident types, etc – but those reports stopped being published on the VDFP website in 2015. And currently, there are only reports for 2013, 2014, and 2015.
>
> **VFIRS Facts and Figures**: https://www.vafire.com/vfirs-facts-and-figures/ - Same as above – this page contains high-level information.
>
> **VFIRS Annual Reports**: https://www.vafire.com/vfirs-annual-reports/ - The annual reports are probably the most substantive data set on the VDFP website, but the annual reports stopped being published in 2014. To the VDFP's credit, they have uploaded the annual reports for every

[1] USFA Website – NFIRS Data Download: https://www.usfa.fema.gov/nfirs/order/

year between 2007 to 2014, but there is no ability to look at all of this data over time, unless someone is willing to aggregate every data point from each report into a single spreadsheet.

As stated on the USFA's website, the purpose of having fire departments contribute to NFIRS is to:

- Analyze the severity and reach of the nation's fire problem.
- Use NFIRS information to develop national public education campaigns.
- Make recommendations for national codes and standards.
- Determine consumer product failures.
- Identify the focus for research efforts.
- Support federal legislation.

I imagine that the purpose of the VFIRS data is similar, if not identical. However, in its current "lock box form" where very few people can actually access it, it is extremely difficult to see how fire services representatives, local governments, legislators, or stakeholders can actually utilize that data to accomplish any of the goals mentioned above.

Again – I understand that this is an incredibly complex data set that probably requires a significant investment of time and resources by VDFP staff to collect, analyze, and publish. <u>I also understand that the VDFP may not have the staff or resources available to undertake that endeavor – if that is the case, there should be a concerted effort by the stakeholders to advocate for a significant increase in state financial resources so that the VDFP can publish the data that would benefit local and state elected officials, local and state government staff, fire departments, and others.</u>

Virginia-Specific Data is Needed to Inform Discussion re: Fire Sprinklers

The decision to require residential fire sprinkler systems in townhomes or single-family structures is a significant public policy decision that would have a direct impact on the cost of housing in Virginia. Although some stakeholders will debate the actual cost of the proposal, the very low number of states that have adopted some form of the requirement reflects the substantial nature of the public policy decision to require or not require residential fire sprinklers.

Given the impact that this proposal would have on the cost of housing – at a time where the housing affordability crisis is a top priority for local and state officials – this code proposal should not be adopted without a thorough review of Virginia-specific fire data – that level of review would allow the stakeholders and the Board of Housing and Community Development the opportunity to weigh the costs of potentially exclusionary market requirements against the public health benefits of raising the baseline standard of all new townhomes – and furthermore, would allow the stakeholders to determine whether a similar public safety benefit could be accomplished through a more cost-effective means for consumers.

Phrased differently – The stakeholders and the Board deserve the opportunity to evaluate Virginia-specific data to determine if, as some stakeholders claim, new homes are actually more susceptible to fires – or if the predominant number of residential fires (and death/injury resulting from a residential fire) are actually occurring in older structures built to a lesser standard. If the data demonstrates that the majority of residential home fires are occurring in older existing structures - or structures where smoke alarms are not installed or outdated/removed - we should focus our efforts on reducing/mitigating that risk by increasing consumer education about the importance of smoke alarms, establishing more “touch points” between fire services and renters/homeowners in areas known to be at a greater risk of home fires, and ensuring that localities and local fire departments have the resources they need to test and install modern smoke alarm technology in those structures, free of cost to the resident or tenant.

There is a large body of evidence which demonstrates that the proliferation of smoke alarms in residential structures has saved lives with virtually zero impact to the cost of housing for consumers – reports from both NFPA, NAHB, and third parties substantiate this claim. Similarly, advancements in smoke alarm technology have virtually eliminated the possibility of the battery being removed to power other electronic devices or to “stop the beeping” when a battery is running low – and as a result, has further reduced the number of fatalities in residential home fires. However, according to data that has been released by the NFPA, 41% of the home fire deaths were caused by fires in properties ***with no smoke alarms[2].*** Furthermore, an additional 16% of home fire deaths occurred in properties where the smoke alarm failed to operate. Smoke alarms are a proven, cost-effective means of increasing public safety in residential structures – and the national data from the NFPA shows that there are still a large number of homes that are under-protected or unprotected.

The purpose of the Virginia Uniform Statewide Building Code is to establish a baseline standard of safety, quality, and efficiency in new residential structures. All residents deserve to be safe and secure in their homes or apartments – and the data shows that advancements in building codes coupled with the homebuilding industry’s response to consumer expectations have contributed to safer structures. However, not all homebuyers or renters can afford the additional costs of a residential fire sprinkler system – and the proposal to require these systems in all new townhomes would disproportionately impact individuals and families in the lower to middle end of the income spectrum.

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[2] NFPA Smoke Alarm Report (2021): https://www.nfpa.org//-/media/Files/News-and-Research/Fire-statistics-and-reports/Detection-and-signaling/ossmokealarms.pdf

Overview from Home Builders Association of Virginia:

The purpose of the Virginia Uniform Statewide Building Code is to establish a baseline standard of safety, quality, and efficiency in new residential structures. Proposed building codes should not be rejected outright because there may be associated costs, however, the Board of Housing and Community Development must weigh the effects of potentially exclusionary market requirements on the supply and access to housing for households across the income spectrum; and furthermore, identify other code requirements that may accomplish an identical public safety benefit through less exclusionary means.

Proponents of the proposal to mandate fire sprinkler systems in new single-family homes and townhomes have discounted concerns raised by the housing industry and other stakeholders regarding the proposal's impact on housing affordability and housing accessibility in Virginia. The housing crisis, both nationally and in Virginia, is well documented and has been identified as a top policy priority for state and local elected officials.

The Home Builders Association of Virginia has compiled several reports/studies regarding the housing affordability challenges in the Commonwealth and ask that the study group and the Board of Housing and Community Development consider this information while discussing the code proposal.

- Joint Legislative Audit and Review Committee (JLARC) Report: Affordable Housing in Virginia (December 2021)
- Metropolitan Washington Council of Governments: The Future of Housing in Greater Washington
- Virginia Housing Policy Advisory Council: Addressing the Impact of Housing for Virginia's Economy (November 2017)
- National Low Income Housing Coalition – Out of Reach Report, Virginia (2021)
- National Association of Home Builders – Priced Out Report (2022)

Joint Legislative Audit and Review Committee Report: Affordable Housing in Virginia

The Joint Legislative Audit and Review Commission (JLARC) conducts program evaluation, policy analysis, and oversight of state agencies on behalf of the Virginia General Assembly. In 2020, the Joint Legislative Audit and Review Commission (JLARC) directed staff to "conduct a review of affordable housing in Virginia. JLARC staff were asked to report on the "number of Virginia households that are housing cost burdened; the supply of affordable quality housing statewide and by region; the state's efforts to increase the supply of affordable housing and make existing housing more affordable through direct financial assistance; and the effectiveness of the management of the state's housing assistance programs."[1]

The report, which was released in December 2021, is a comprehensive analysis of the housing market in Virginia and, over the course of it's 200 pages, refutes any claims that housing affordability is not a dire crisis and challenge for localities and regions across the Commonwealth.

Summary of Report's Findings:

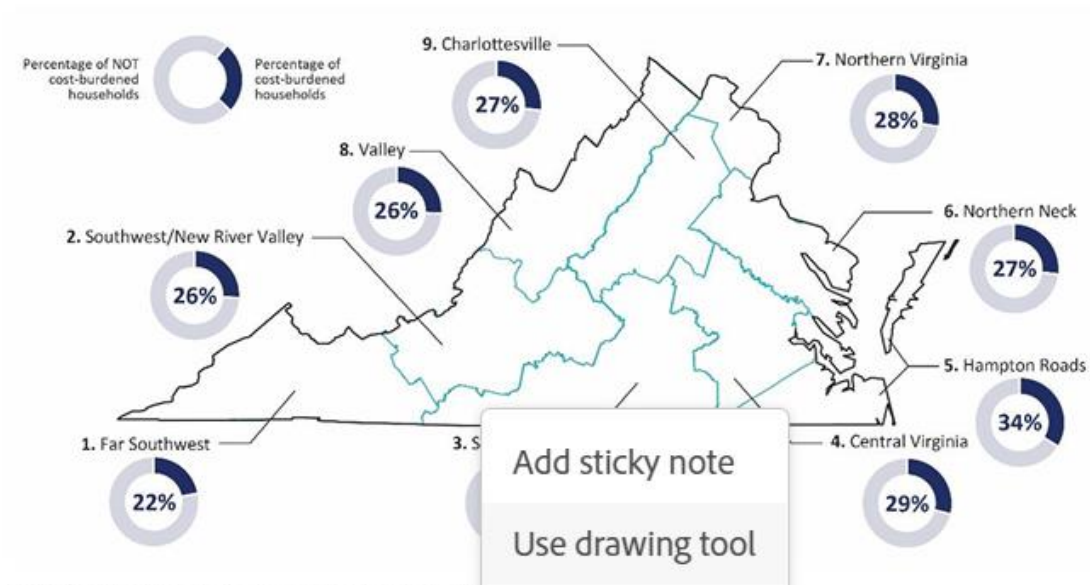
- "Approximately 29 percent of Virginia households (905,000) were housing cost burdened in 2019, and nearly half of these households spent more than 50 percent of their income on housing. Virginia

[1] JLARC Report: Affordable Housing in Virginia: http://jlarc.virginia.gov/landing-2021-affordable-housing-in-virginia.asp

ranks near the middle of states in terms of the percentage of households that are cost burdened." ([JLARC Report: PDF Page 5]())

- "Households are considered housing cost burdened when they spend more than 30 percent of their income on housing expenses. Housing cost burden constrains households' budgets, making it difficult for households to afford other necessities and making eviction more likely." ([JLARC Report: PDF Page 5]())

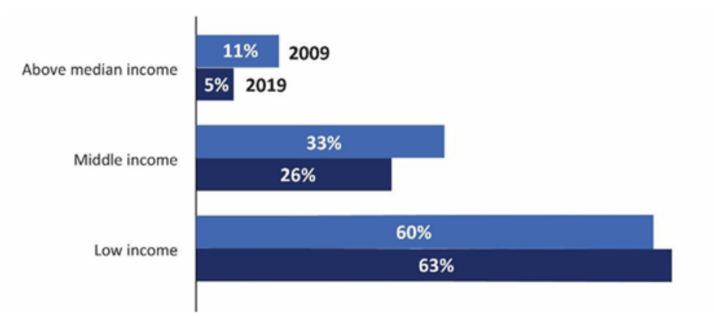
- Every region of the Commonwealth has a high percentage of households who are cost-burdened – see chart on next page



SOURCE: JLARC analysis of American Community Survey, 5 year data, 2015–2019.

- The Percentage of Cost Burdened Low-Income Households is Growing:
  - While the proportion and number of Virginia households that are cost burdened declined between 2009 and 2019, the prevalence of housing cost burden among low-income Virginians increased slightly from 60 percent to 63 percent over this period (Figure 2-6). This affects Virginians who work in common occupations that are essential to the state's economy and are paid low wages. For example, the median income for a home health aide in Virginia is approximately $22,000, which is considered very low income for a single person household (income between 31 and 50 percent AMI) (Figure 2-7). In another example, the median income for a bus driver is $45,000, which is considered low income for a single person household (income between 51 and 80 percent AMI). ([JLARC Report: PDF Page 35]())

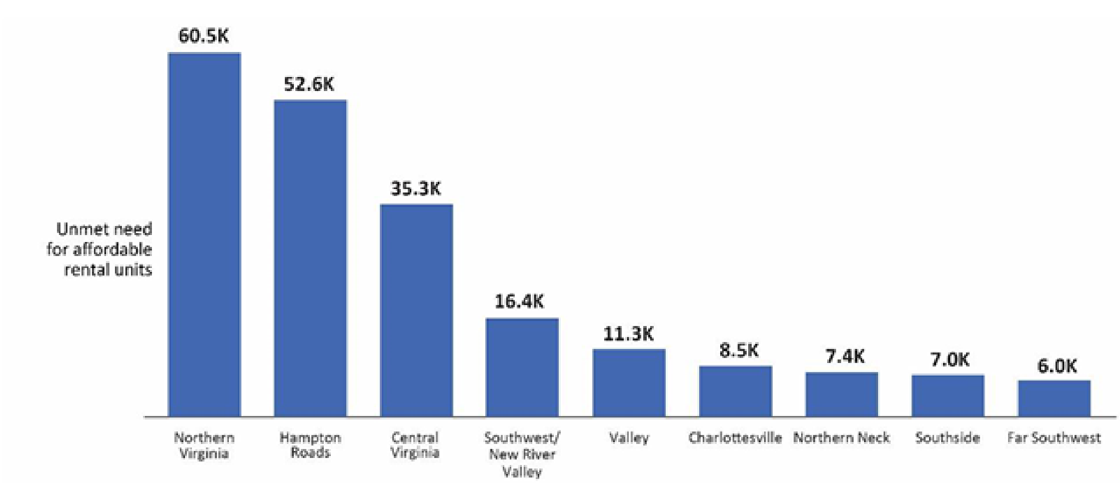
FIGURE 2-6
Percentage of cost burdened households grew among lower income households, 2009–2019



SOURCE: JLARC analysis of American Community Survey, 5 year data, 2005–2009 and 2015–2019.

- “Declining number of Virginians can afford to buy a home, and state has a shortage of at least 200,000 affordable rental units” (JLARC Report: PDF Page 5)
    - “Rising home prices have made it more difficult for Virginians to own their homes. The median home sales price in Virginia has risen 28 percent over the past four years to $270,000 in 2021. Virginia’s stock of homes that would be affordable to low- and middle-income households has declined substantially in the past few years.”
    - “Low- and middle-income households may have incomes that could support mortgage payments but lack the savings to cover the upfront costs of purchasing a home. Rising home prices mean that down payments and closing costs can be over $10,000 on even moderately priced homes.” (JLARC Report: PDF Page 6)
- Shortage of Affordable Units is Statewide – Every Region Needs AT LEAST 6,000 new affordable units
    - Virginia has a statewide shortage of at least 200,000 affordable rental units for extremely and very low income households. Only 42 out of every 100 extremely and very low income households can find affordable housing. The actual number of needed affordable rental units likely exceeds 200,000 because this figure is based on data from several years ago and assumptions about the most affordable units that can be created through programs like the federal Low Income Housing Tax Credit pro-gram (LIHTC) (JLARC Report: PDF Page 38)

FIGURE 2-8
Majority of affordable rental units are needed in Urban Crescent



SOURCE: JLARC analysis of American Community Survey, 5 year data, 2015–2019.
NOTE: All figures are rounded to the nearest 100. Figures may not add because of rounding.

- Median Home Sales Prices Have Risen Significantly between 2016-2021, 2020-2021

TABLE 2-4
Median home sales prices increased substantially, and especially rapidly in the past year

	Median home sales prices			Percentage change	
	2016	**2020**	**2021**	**2016 to 2021**	**2020 to 2021**
Northern Virginia	$508,000	$582,000	$650,000	28%	12%
Charlottesville	290,000	319,000	350,000	21	10
Hampton Roads	254,000	234,000	330,000	30	41
Northern Neck	267,000	270,000	325,000	22	20
Central Virginia	210,000	257,000	299,000	42	16
Valley	233,000	241,000	285,000	22	18
Southwest/New River Valley	192,000	196,000	217,000	13	11
Southside	125,000	134,000	177,000	42	32
Far Southwest	98,000	117,000	160,000	63	37
Statewide	$204,000	$234,000	$270,000	32%	15%

SOURCE: JLARC analysis of Monthly Median Sales Prices by County/Independent City, 2016 – present. Virginia REALTORS, updated July 15, 2021.
NOTE: Median cost home sales prices reflect the median prices in July of each year. Adjusted to 2021 dollars.

Metropolitan Washington Council of Governments – The Future of Housing in Greater Washington

Report can be found here: https://www.mwcog.org/documents/2019/09/10/the-future-of-housing-in-greater-washington/

The Metropolitan Washington Council of Governments (MWCOG) is an independent, nonprofit association, with a membership of 300 elected officials from 24 local governments, the Maryland and Virginia state legislatures, and U.S. Congress.

Key Findings:

- Continued growth and an increased demand to live here, "…the region now finds itself in a challenging situation. There is an imbalance between the number of jobs and the amount of housing available to the workforce. This gap is expected to widen without intervention; the region is forecast to add approximately 413,000 new jobs to its employment base between 2020 and 2030, but only approximately 245,000 new housing units over the same period."
- The Metropolitan Washington Council of Governments analysis "…showed the region needs, between 2020 and 2030, more than 75,000 additional households than what is currently anticipated (245,000 households). If the timeframe is stretched from 2020 to 2045, more than 100,000 additional households will be needed beyond the new households anticipated."
- "At least 75% of new housing should be affordable to low-and middle-income households."

Virginia Housing Policy Advisory Council – Addressing the Impact of Housing for Virginia's Economy (November 2017)

Report can be found here:
https://www.vchr.vt.edu/virginiahousingeconomiclinkages#:~:text=In%20October%202014%2C%20Governor%20McAuliffe,Council%20(HPAC)%20was%20thus%20established

Background:
In October 2014, Governor McAuliffe issued Executive Order (EO) 32, "Advancing Virginia's Housing Policy," to "identify and implement actions to enable quality, affordable housing, which will strengthen families and communities and foster economic growth." The Housing Policy Advisory Council (HPAC) was thus established under the leadership of the Secretary of Commerce and Trade to help guide the development and implementation of Virginia's housing policy.

A key directive of EO 32 was identifying the links between housing and economic and community development. To this end, the HPAC commissioned a study from a consortium of researchers at Virginia Tech, George Mason University, The College of William and Mary, and Virginia Commonwealth University, with the premise that successful housing policy must be based on independent analytic findings and best practices. The collaborative research of the four universities provides key information on the Commonwealth housing sector, focusing on the economic impact of housing, future scenarios impacting housing needs, and links between housing and other key policy sectors.

This report summarizes the research conducted by the four universities and the implications for Virginia's housing policy development. The report is designed to assist stakeholders and policymakers think more creatively and collaborate more intensely at the state, regional, and local levels as Virginia strives to build on the successes of the past and meet the pressing housing challenges facing the commonwealth. The entirety of the research is included in nine papers presented here.

Key Findings:

1. Virginia has a shortage of housing affordable to a substantial share of households. All regions of the state are experiencing significant shortages of affordable housing, as evidenced by the large share of households experiencing housing cost burdens across urban, suburban, and rural areas. Statewide, one in three households is cost burdened, spending more than 30 percent of their income for housing.

2. Failure to address affordable housing needs adequately has significantly affected key priorities of state policy, including economic and workforce development, transportation, education, and health.

3. Virginia needs to produce substantial new affordable housing to accommodate anticipated workforce growth. Virginia will need to house over 350,000 new workers in the next 10 years. The retirement of Baby Boomers and the entry of millennials into the workforce implies that a large share of new workers will be young with relatively low incomes and in need of affordable rental and homeownership units.

4. The homebuilding industry faces major challenges in meeting affordable housing needs. Nationally and in Virginia, the homebuilding industry faces challenges in affordable housing production for the following reasons:

a. Developable residential site shortages and high land costs near major employment centers

b. Construction labor supply constraints (especially in skilled trades)

c. Limited means for reducing rapid increases in development costs

5. Regions with lower combined housing and transportation costs have experienced better economic performance.

6. Virginia can no longer rely on the federal government to address critical housing needs. Federal housing appropriations are severely constrained, and fiscal stress is expected to further reduce federal housing expenditures and increase the likelihood of devolution of housing assistance responsibilities to the states.

Appendix 2 of the report provides estimates of the amount, type (single-family and multi-family), tenure (owner and renter), price or rent, and location of housing that the Commonwealth of Virginia will need to accommodate new workers over the next decade. During this time Virginia will add 357,800 net new jobs, but to ensure that this employment growth can occur, a sufficient supply of housing must be available for these new workers—in the right locations, of the right types, and at affordable prices and rents. The analysis produced estimates for the Commonwealth and 11 Virginia regions.

Table 7. Net New Households by Home Price Affordable to Net New Households, Hampton Roads Region (2015 $s)

	2014-2024 Change		Share of Current Owner Households
	Households	Share of New Owner Households	
Less than $100,000	2,550	12.3%	9.3%
$100,000-199,999	7,250	35.2%	30.1%
$200,000-299,999	6,650	32.1%	29.2%
$300,000-399,999	2,850	13.8%	16.1%
$400,000+	1,350	6.6%	15.3%
Total	**20,600**	**100.0%**	**100.0%**

Numbers may not sum due to rounding.
Source: GMU Center for Regional Analysis

As shown in Table 8, the majority of new renters will earn over $25,000, and will be likely to find apartments that will suit their needs based on the current distribution of rents. A gap is likely to increase for homes renting for less than $625 per month, which would be affordable to households earning less than $25,000. Over a quarter (26.7 percent or 5,600 households) of the new renter households formed by the new workers

Table 3. Net New Households by Home Price Affordable to Net New Households, Charlottesville Region (2015 $s)

	2014-2024 Change		Share of Current Owner Households
	Households	Share of New Owner Households	
Less than $100,000	900	15.5%	9.7%
$100,000-199,999	1,800	31.7%	23.6%
$200,000-299,999	1,800	31.9%	23.6%
$300,000-399,999	850	15.0%	16.0%
$400,000+	350	5.9%	27.1%
Total	**5,650**	**100.0%**	**100.0%**

Numbers may not sum due to rounding.
Source: GMU Center for Regional Analysis

Similarly, some new renter households may have difficulty finding apartments at rents affordable to them. As shown in Table 4, about 1,200 new renter households will earn less than $25,000, and need rental units below $625 in order to spend less than 30 percent of their income on rent. An additional 1,500 renters will earn between $25,000 and $49,999, and can afford rents up to $1,249.

Table 11. Net New Households by Home Price Affordable to Net New Households, Lynchburg Region (2015 $s)

	2014-2024 Change		Share of Current Owner Households
	Households	Share of New Owner Households	
Less than $100,000	950	41.5%	25.5%
$100,000-199,999	650	28.0%	39.0%
$200,000-299,999	500	22.3%	19.9%
$300,000-399,999	150	6.4%	6.8%
$400,000+	50	1.9%	8.8%
Total	**2,300**	**100.0%**	**100.0%**

Numbers may not sum due to rounding.
Source: GMU Center for Regional Analysis

Likewise, the vast majority of new renter households will earn less than $25,000 (Table 12). These 1,150 new renter households will be able to afford rents under $625, and may have difficulty finding units. Currently, about 7,800 households rent for less than $625, and the nearly 15 percent increase in demand for this product may be difficult to meet through new construction.

Table 19. Net New Households by Home Price Affordable to Net New Households, Richmond Region (2015 $s)

	2014-2024 Change		Share of Current Owner Households
	Households	Share of New Owner Households	
Less than $100,000	2,150	9.0%	10.6%
$100,000-199,999	8,850	37.1%	35.7%
$200,000-299,999	6,700	28.1%	27.3%
$300,000-399,999	4,600	19.4%	13.4%
$400,000+	1,550	6.4%	13.0%
Total	**23,800**	**100.0%**	**100.0%**

Numbers may not sum due to rounding.
Source: GMU Center for Regional Analysis

As shown in Table 20, the new renter households will have more difficulty finding housing that is affordable to them. A quarter of new renters will be able to afford a maximum of $625 in rent, but only 12.2 percent of current units rent in that range. Similar to other markets, new product in this price range may be difficult to build, forcing many of the new households to pay more than 30 percent of their income on rent.

National Low Income Housing Coalition – Out of Reach Report (2021)

The National Low Income Housing Coalition's Out of Reach report documents the significant gap between renters' wages and the cost of rental housing across the United States. The report's central statistic, the Housing Wage, is an estimate of the hourly wage a full-time worker must earn to afford a modest rental home at HUD's fair market rent (FMR) without spending more than 30% of his or her income on housing costs, the accepted standard of affordability. The FMR is an estimate of what a family moving today can expect to pay for a modestly priced rental home in a given area.

Virginia Report Card can be found here:
https://reports.nlihc.org/sites/default/files/oor/files/reports/state/va-2021-oor.pdf

In Virginia, the Fair Market Rent (FMR) for a two-bedroom apartment is $1,269. In order to afford this level of rent and utilities — without paying more than 30% of income on housing — a household must earn $4,231 monthly or $50,767 annually. Assuming a 40-hour work week, 52 weeks per year, this level of income translates into an hourly Housing Wage of $24.41 per hour.

That translates into:

- 103 work hours per week at minimum wage to afford a two-bedroom rental home (at FMR)
- 88 work hours per week at minimum wage to afford a one-bedroom rental home (at FMR)
- 2.6 full time jobs at minimum wage to afford a two-bedroom rental home (at FMR)
- 2.2 full-time jobs at minimum wage to afford a one-bedroom rental home (at FMR)

National Association of Home Builders – "Priced Out" Report (2022)

This article presents the NAHB's "priced out estimates" for 2022, showing how higher prices and interest rates affect housing affordability. The 2022 US estimates indicate that a $1,000 increase in the median new home price ($412,5051) would price 117,932 households out of the market. As a benchmark, 87.5 million households (roughly 69 percent of all U.S. households) are not able to afford a new median priced new home. A $1,000 home price increase would make 117,932 more households disqualify for the new home mortgage. Home prices surged during the pandemic, creating affordability challenges, particularly for first-time buyers.

Other NAHB estimates in this paper show that for 2022, 25 basis points added to the mortgage rate at 30-year fixed rate of 3.5% would price out around 1.1 million households. In addition to the national numbers, NAHB once again is providing priced out estimates for individual states and more than 300 metropolitan areas. Other Key Findings:

- 87 million households in the US (and 1.7 million households in Virginia) are not able to afford a new median priced new home in 2022
- 36 Million Households Can't Afford a $150,000 Home:
    - Using the same standard underwriting criterion as the priced-out estimates to determine affordability (that the sum of mortgage payments, property taxes, home owners and private mortgage insurance premiums should be no more than 28% of the household income), the minimum income required to purchase a $150,000 home is $36,074. In 2022, about 36 million U.S. households are estimated to have incomes at or below that threshold. Another 24.4 million can only afford a home priced between $150,000 and $250,000 (the second step on the pyramid). Each step represents a maximum affordable price range for fewer and fewer households.
- In Virginia, a $1,000 increase in the median home price would price over 3,800 households out of the market

Report can be found here: https://www.nahb.org/-/media/05E9E223D0514B56B56F798CAA9EBB34.ashx?_ga=2.213243421.805995588.1647882212-336051620.1620423394

Richmond Region Builder

Direct/Tangible costs:

1. Cost to install system within each unit – $2.55-$2.75/sq. feet
    a. 2,015 sq. feet townhome would be $5,125.50 to $5,541.25
2. Infrastructure cost – 6" dedicated waterline for fire sprinkler distribution – very dependent on density and efficiency of layout - $2,100/townhome minimum. We are fairly dense and efficiently configured. This number could easily double or worse depending on the site constraints.

Intangible costs – these items add cost, but difficult to determine specific dollar amount.

1. Sitework prolonged: Fire line and domestic water line are not installed in the same trench. Increased exposure to weather, damage etc. due to added installation of materials and installation means and methods.
2. Vertical construction prolonged: Adds an additional trade to the construction process, adds firestopping complexity, insulation complexity and increases the number of inspections required to obtain a certificate of occupancy.
3. If static pressure of surrounding waterlines is insufficient booster pumps will be required to maintain minimum pressures on the upper levels of the home. Booster pump requires the construction of a heated, weather proof enclosure, power supply, and meter; **adding a minimum cost $20,000 if required.** This has happened in several of our projects in the Richmond Region.
4. Damage to system during construction creates catastrophic losses, usually passed on to insurance, raising premiums which then get passed on to future purchasers. This has also occurred at several of our properties.
5. Damages/failures after occupancy, creates catastrophic losses to homeowner and potentially neighboring homes and personal property. This has also happened at several properties.

Additional Notes:

- I've included sprinklers in several of our projects in the area – and can say that it certainly adds cost to the units – which is fine for us/the builder – but it does have the effect of shifting the price point of the units up, which means a different set a buyers are moving in. Units that may have been in line with "market rate" become above-market rate – and in some cases, they become "luxury units".
- We have noticed that several potential buyers have been uncomfortable about moving into a unit that has sprinklers in it – these have typically been consumers that have done some research and found stories about sprinklers going off when there isn't a fire, etc; in some of the larger townhome units, we've had some people concerned about their kids and their friends throwing toys at the sprinkler heads. The other frequent question that we get is if a homeowner has the ability to turn off the sprinkler after its been activated. We try to educate the potential buyer but are not always successful.
- Backflow Testing – we get questions about whether localities require annual inspection and if so, how expensive it is
- Longevity of the equipment – Most people live in their townhome for maybe 5-7 years; some go longer. But we have received questions about how long the infrastructure lasts and whether it will need to be replaced or updated after 5 years or so.

Stand Alone System - Public Water Supply

Item	Cost	Notes
Additional tap fees	$ 5,600.00	Cost of permit and tap of 1" non-metered water supply - per TOB Public Works Dept.
Exterior ditching and water pipe	$ 1,450.00	Secondary waterline install to the dwelling - established cost of water line install
Additional backflow preventer	$ 500.00	Backflow preventer and shutoff for sprinkler supply line
Sprinkler System Rough-In	$ 10,000.00	Piping, pressure testing, sprinkler heads, etc. - estimation by Fire Protection Services
Water flow alarm	$ 400.00	Reporting alarm system triggred by water flow - average from market research
Additional attic frost protection	$ 1,200.00	Water line encapsulation and crush protection in freezing area
Drain for water supply	$ 200.00	Cost for hub drain at point of supply
	$ 19,350.00	

Multi-Purpose System - Public Water Supply

Item	Cost	Notes
Additional tap fees	$ 6,960.00	Cost 1" water supply minus cost of standard 5/8" water meter - per TOB Public Works Dept.
Larger backflow preventer	$ 300.00	2" Backflow preventer and shutoff for multi-purpose system
Sprinkler System Rough-In	$ 10,000.00	Piping, pressure testing, sprinkler heads, etc.
Water flow alarm	$ 400.00	Reporting alarm system triggred by water flow
Additional attic frost protection	$ 1,200.00	Water line encapsulation and crush protection in freezing area
Drain for water supply	$ 200.00	Cost for hub drain at point of supply
	$ 19,060.00	

Private Water Supply - Costs are similar for both installation types

Item	Cost	Notes
Underground water storage	$ 4,200.00	Cost of cistern storage tank (1200 gallons), pump, and installation
Sprinkler System Rough-In	$ 10,000.00	Piping, pressure testing, sprinkler heads, etc.
Water flow alarm	$ 400.00	Reporting alarm system triggred by water flow
Additional attic frost protection	$ 1,200.00	Water line encapsulation and crush protection in freezing area
Back up power supply	$ 6,000.00	Power to pump
Drain for water supply	$ 200.00	Cost for hub drain at point of supply
	$ 22,000.00	

HFSC Fact Sheet

Formed in 1996, HFSC is a 501(c)(3) charitable organization and the leading resource for independent, noncommercial information about home fire sprinklers, their installation and operation, and their proven protection of people, pets and property. HFSC strives to improve and increase awareness of home fire dangers and the life safety benefits of sprinklers for residents and responding firefighters. HFSC creates original and effective educational content and advocacy resources and offers them at no cost. HFSC's BUILT FOR LIFE FIRE DEPARTMENT program (BFLFD) is a free resource that supports fire service public sprinkler education as a method to achieve local Community Risk Reduction goals. More than 3,200 BFLFD members routinely demonstrate how access to the right information and tools drives more and better home fire sprinkler education.

Home Fire Risk in One- and Two-Family Homes
Six people die in home fires every day. According to the National Fire Protection Association (NFPA) Fire Loss in the U.S. During 2020, home fires caused:

- 2,230 civilian fire deaths, 85% of all residential fire deaths.
- 8,600 injuries.
- $6.8 billion in direct property damage.

Today's one- and two-family homes are dangerous for residents and first responders (UL/NIST), burning faster and failing quicker (even collapsing). A home fire can become deadly in as little as two minutes. Homes burn faster due to modern home furnishings, more open spaces and unprotected lightweight wood construction.

Home Fire Mitigation
Fire sprinkler technology has been protecting a wide range of structures for more than a century, but their use has been slow to catch on in homes. The NFPA found that sprinklers were present in only 7% of 2021 home fires. Only California, Maryland and Washington, D.C. require statewide installation of sprinklers in new-home construction.

Broader installation of home fire sprinklers would save thousands of lives (USFA). Installing home fire sprinklers uniquely protects residents, property and the firefighters who respond to fires in these structures. According to the NFPA, the 2021 civilian fire death rate was 89% lower in structures with installed fire sprinklers. The rate of firefighter injuries was 60% lower in fires with sprinklers than in fires without sprinklers.

Home Fire Activation

If a fire occurs, the sprinkler closest to it activates automatically, in response to the high heat from a fire. That controls (often extinguishes) the flames, reduces the spread of toxic and damaging smoke, and provides time for occupants to escape. When sprinklers are present, fire is kept to the room of origin 96% of the time (NFPA). In most home fires, only one or two sprinklers will control the blaze. In fires in unsprinklered homes, the toxic smoke spreads widely and more area is exposed to heat, smoke and fire. This requires more water to be used for suppression with powerful fire department hoses. This greatly increases water and fire damages to the structure and contents.

First Responders

Installing home fire sprinklers helps communities in many ways, including protecting first responders from fire and exposure hazards. Today's home fires are dangerous for firefighters as well as occupants. Firefighters are 11 times more likely to be injured fighting structure fires; 87% of their injuries occur there (USFA 2019). The risk is not limited to fire exposure. Firefighters today face a 9% increase in cancer diagnoses and a 14% increase in cancer-related deaths, compared to the general population in the U.S. (National Institute for Occupational Safety and Health 2017)

Environment

Home fire sprinklers also protect property and the environment. In 2010, FM Global conducted a groundbreaking study of the environmental impact of fire sprinklers. Their research proved that sprinklers are green:

- Greenhouse gas emissions were cut by 97.8%
- Water usage was reduced between 50% and 91%
- Fewer persistent pollutants, such as heavy metals, were found in sprinkler wastewater versus fire hose water
- The high pH level and pollutant load of non-sprinkler wastewater are an environmental concern

In 2021, FM Global reaffirmed this important study, publishing *Environmental Impact of Residential Fires Review*, documenting that since 2010**:**

- 1.8 billion lbs. of greenhouse gases have been emitted into the atmosphere **due to the lack of home fire sprinklers**.
- **Installed home fire sprinklers would have reduced** greenhouse gas emissions by 97% to 54 million lbs.

Homebuyers

Today's homebuyers want smarter homes. In a recent national fire safety survey* of more than 2000 adults of all ages, 86% said fire safety was important as they look to buy a new home. After learning how home fire sprinklers work, 80 percent of millennials, the largest age group buying homes, said they would prefer to buy a home with fire sprinklers.

- HFSC Omnibus survey with Opinium, surveying a nationally representative sample of more than 2,000 US adults.

NFPA Reports:

US Experience with Sprinklers, Marty Ahrens October 2021: https://www.nfpa.org/News-and-Research/Data-research-and-tools/Suppression/US-Experience-with-Sprinklers

Fire Loss in the United States During 2020, Marty Ahrens and Ben Evarts September 2021: https://www.nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Fire-loss-in-the-United-States

US Experience with Sprinklers

Marty Ahrens
October 2021

KEY FINDINGS

Sprinklers in Reported Structure Fires: All Occupancies

From 2015 to 2019, local fire departments responded to an estimated average of 51,000 structure fires per year (10 percent) in which sprinklers were present. These fires caused an average of 36 civilian deaths (1 percent) and $1 billion in direct property damage (9 percent) annually.

Sprinklers reduce the impact of fires. Compared to reported fires in properties with no automatic extinguishing systems (AES), when sprinklers were present, the civilian fire death and injury rates per fire were 89 percent and 27 percent lower, respectively. The rate of firefighter injuries per fire was 60 percent lower.

Fire spread was confined to the object or room of origin in 95 percent of reported structure fires in which sprinkler systems were present compared to 71 percent in properties with no AES.

Sprinklers have proven to be reliable in reported structure fires considered large enough to activate them. From 2015 to 2019, sprinklers operated in 92 percent of such fires and were effective at controlling the fire in 96 percent of the incidents in which they operated. Overall, sprinkler systems operated and were effective in 88 percent of the fires considered large enough to activate them.

The most common reason that sprinklers failed to operate was the system being shut off at some point before the fire.

One sprinkler is usually enough to control a fire. In 77 percent of the structure fires where sprinklers operated, only one operated. In 97 percent, five or fewer operated. In 99 percent, 10 or fewer operated.

Sprinklers in Reported Home Fires

Sprinklers were present in an estimated average of 23,600 of the reported home[i] structure fires per year in 2015–2019, resulting in an average of 23 civilian deaths, 555 civilian injuries, and $194 million in direct property damage annually.

The 7 percent of reported home structure fires that occurred in properties with sprinklers accounted for 1 percent of home fire deaths, 5 percent of home fire injuries, and 3 percent of home property loss.

Sprinklers operated in 95 percent of the home fires in which the systems were present and the fires were considered large enough to activate them. They were effective at controlling the fire in 97 percent of the fires in which they operated. Taken together, sprinklers operated effectively in 92 percent of the fires large enough to trigger them.

In 89 percent of the home fires with operating sprinklers, only one operated. In 99.5 percent, five or fewer operated.

Sprinklers save lives and reduce injuries and property loss. From 2015 to 2019, the civilian death and injury rates per reported home fire were 88 and 28 percent lower, respectively, and average property loss per home fire was 62 percent lower in reported home fires in which sprinklers were present compared to fires in homes with no AES.

The rate of firefighter injuries per home fire in which sprinklers were present was 78 percent lower than in homes with no AES.

In reported home fires in which sprinklers were present, the fire was confined to the object or room of origin 97 percent of the time compared to 74 percent in homes with no AES.

[i] The term *home* includes one- and two-family homes, including manufactured housing and apartments or other multifamily homes.

INTRODUCTION

This report provides a statistical overview of sprinkler presence and performance in reported fires. This information is essential for understanding the prevalence, impact, reliability, and effectiveness of these systems and increasing their positive impact. Because the majority of fire deaths are caused by home fires, additional details are provided on sprinklers in fires in these properties.

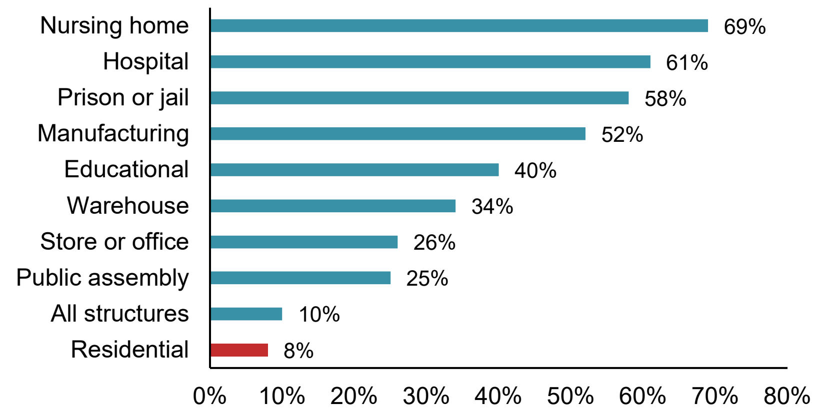
Estimates were derived from the details collected by the US Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and NFPA's annual fire department experience survey. Unless otherwise specified, estimates and rates in this report exclude fires in properties under construction. In addition, the casualty and loss estimates can be heavily influenced by the inclusion or exclusion of one unusually serious fire.

More detailed information is available in the supporting tables.

Sprinkler Presence and Type

Some type of sprinkler was present in an estimated average of 51,000 (10 percent) of the reported structure fires during 2015–2019. Sprinkler presence varied widely by occupancy. Figure 1 shows the percentage of fires by occupancy in which any type of sprinkler was present. Sprinklers were most likely to be found in institutional occupancies, such as nursing homes, hospitals, and prisons or jails. Although the majority of the structure fires and associated civilian fire deaths, injuries, and direct property damage occurred in residential properties, particularly homes, only 8 percent of the reported residential fires occurred in properties with sprinklers. High-rise buildings are more tightly regulated and much more likely to have sprinklers than shorter structures.[1]

Figure 1. Presence of sprinklers in US structure fires by occupancy: 2015–2019



Some properties have both sprinkler and non-sprinkler AES. This is particularly likely in commercial kitchens. In such cases, only the AES type in the fire area would be recorded. This could result in underestimates of the presence of sprinklers in some occupancies.

Table A summarizes information about the various types of automatic extinguishing systems (AES) present in all the reported structure fires *except those in buildings under construction*. Figure 2 shows that wet pipe systems were in use at almost nine out of every 10 reported fires in which sprinklers were present.

Figure 2. Types of sprinklers present at US structure fires: 2015–2019

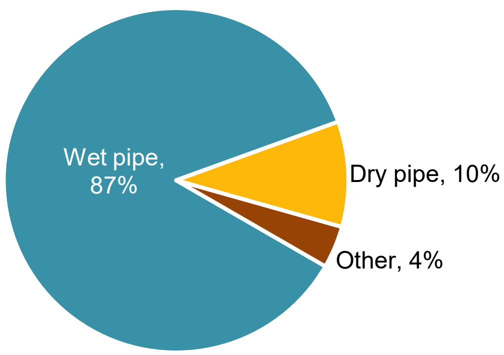
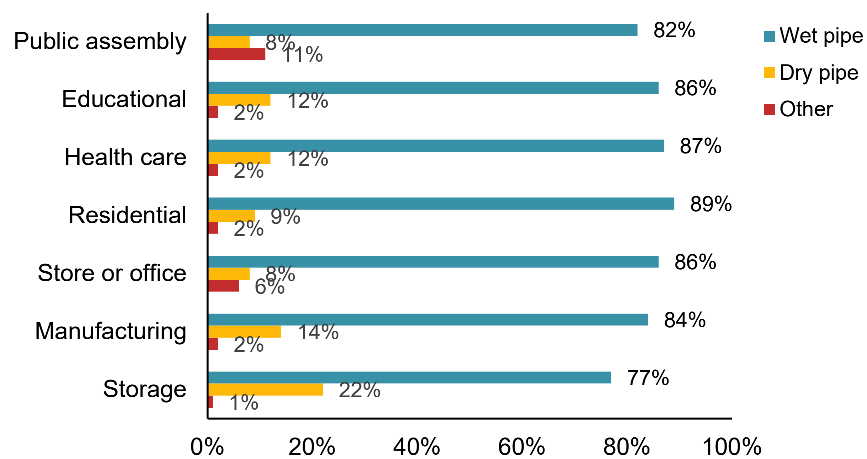


Table A. Summary of AES presence and type in reported structure fires: 2015–2019 annual averages

AES Presence and Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
AES present	**61,100**	**(13%)**	**37**	**(1%)**	**1,130**	**(9%)**	**$1,086**	**(10%)**
Sprinkler system present	51,000	(10%)	36	(1%)	1,020	(8%)	$1,008	(9%)
Wet pipe sprinkler system	*44,200*	*(9%)*	*33*	*(1%)*	*919*	*(7%)*	*$908*	*(9%)*
Dry pipe sprinkler system	*5,000*	*(1%)*	*2*	*(0%)*	*87*	*(1%)*	*$88*	*(1%)*
Other type of sprinkler system	*1,800*	*(0%)*	*1*	*(0%)*	*14*	*(0%)*	*$12*	*(0%)*
Non-sprinkler AES present	10,100	(2%)	1	(0%)	111	(1%)	$78	(1%)
Partial AES system of any type present	**2,500**	**(1%)**	**6**	**(0%)**	**54**	**(0%)**	**$109**	**(1%)**
AES of any type not in fire area and did not operate	**1,700**	**(0%)**	**2**	**(0%)**	**55**	**(0%)**	**$56**	**(1%)**
No AES present	**423,200**	**(87%)**	**2,816**	**(98%)**	**11,609**	**(90%)**	**$9,387**	**(88%)**
Total	**488,500**	**(100%)**	**2,862**	**(100%)**	**12,848**	**(100%)**	**$10,637**	**(100%)**

Figure 3 shows that dry pipe sprinkler systems were more common in storage occupancies. Table 2 in the supporting tables shows that other types of sprinkler systems were seen most frequently in eating and drinking establishments and grocery or convenience stores. It is possible that some of these other types were miscodes of systems designed specifically for cooking equipment.

Figure 3. Sprinkler system type by occupancy: 2015–2019



Fires in Properties with Sprinklers vs. with No AES

Figure 4 shows that the death rate per 1,000 reported fires was 89 percent lower in properties with sprinklers than in properties with no AES. These rates are based strictly on the reported presence or absence of this equipment; whether or not the system operated was not considered. Civilian deaths in sprinklered properties are discussed in greater detail later in this report.

Figure 4. Civilian death rates per 1,000 reported fires in properties with sprinklers and with no AES 2015–2019

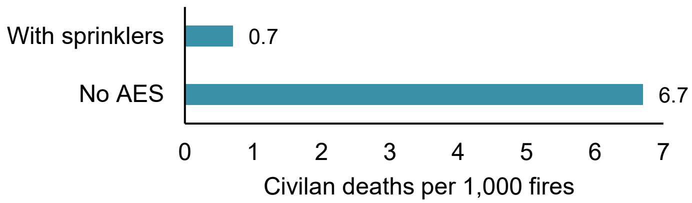


Figure 5 shows that the civilian injury rate per 1,000 reported fires was 27 percent lower in properties with sprinklers than in properties with no AES. Many of the injuries occurred in fires that were too small to activate the sprinklers. In others, someone was injured while trying to fight the fire in the initial moments before the sprinklers operated.

Figure 5. Civilian injury rates per 1,000 reported fires in properties with sprinklers vs. with no AES: 2015–2019

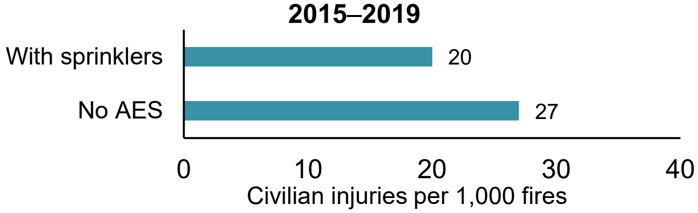
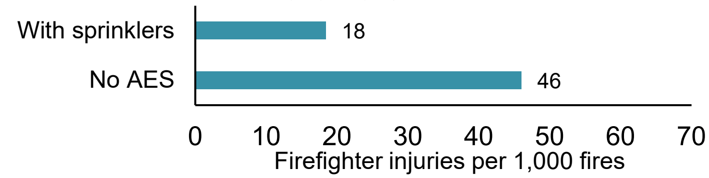


Figure 6 shows that the rate of firefighter injuries per 1,000 fires was 60 percent lower in structure fires with sprinklers compared to fires in properties without AES protection. Sprinklers begin to control a fire when they activate, making the situation less dangerous for responding firefighters.

Figure 6. Firefighter injury rates per 1,000 fires in properties with sprinklers vs. with no AES: 2015–2019

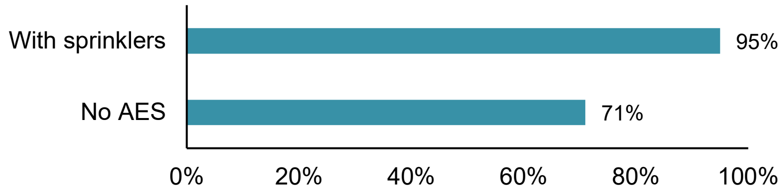


Reductions in the average dollar loss per fire when sprinklers were present varied greatly by occupancy. Table 4 in the supporting tables shows that compared to properties with no AES, the average overall loss was 11 percent lower in fires where sprinklers were present. The percentage reductions were highest in health care occupancies (73 percent), stores or offices (70 percent), public assembly occupancies (63 percent), and homes (62 percent).

The average loss per fire was higher in sprinklered warehouses and manufacturing properties than in those with no AES. Warehouse contents or expensive machinery may be rendered worthless by smoke alone. A very small fire can damage expensive manufacturing equipment. In the rare cases in which a sprinkler system fails to operate or operates ineffectively, the monetary loss can be exceedingly high, increasing the average loss for the occupancy type. For example, the average loss in sprinklered manufacturing properties was inflated by a $1.1 billion loss caused by a November 2019 Texas petrochemical plant explosion and the resulting multi-day fire and additional explosions.[2] The plant's wet pipe sprinkler system did not operate.

Sprinklers limit fire spread. Figure 7 shows a 24 percent increase in fires that were confined to the object or room of origin when sprinklers were present compared to fires with no AES.

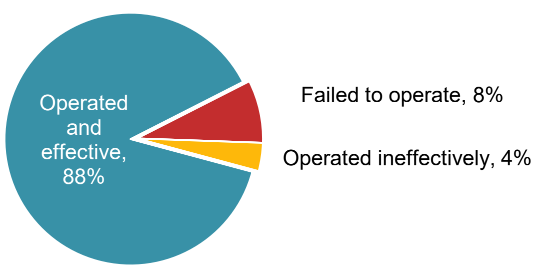
Figure 7. Percent of fires confined to object or room of origin in properties with sprinklers vs. with no AES: 2015–2019



Sprinkler Operation, Effectiveness, and Issues

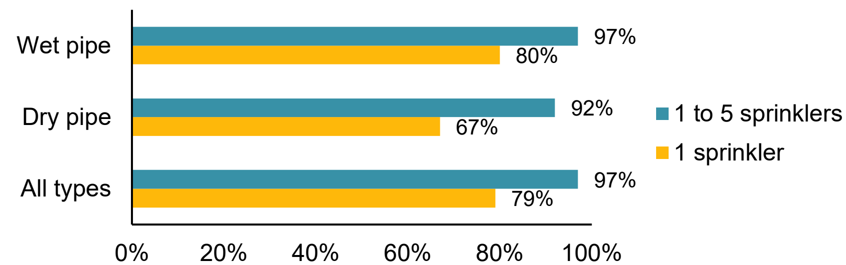
From 2015 to 2019, sprinklers operated in 92 percent of the fires in which they were present and the fire was considered large enough to activate them.[i] They were effective at controlling the fire in 96 percent of the fires in which they operated. Taken together, sprinklers operated effectively in 88 percent of the fires large enough to trigger them. (See Figure 8.) Details on sprinkler operation and effectiveness in different occupancies and for wet and dry pipe systems are provided in Table 6 of the supporting tables.

Figure 8. Sprinkler operation and effectiveness: 2015–2019



Sprinkler systems are designed to operate only where fire is present. Just one sprinkler activated in more than three-quarters (77 percent) of the fires in which sprinklers of any type operated and four out of five (80 percent) fires with operating wet pipe sprinkler systems. Figure 9 shows that in 97 percent of the fires in which sprinklers operated, five or fewer were activated. This was true for 92 percent of the dry pipe sprinkler systems.[ii] In 99 percent of the fires with operating sprinklers of any type, 10 or fewer sprinklers operated.

Figure 9. When sprinklers operated, percentage of fires in which one or one to five sprinklers operated by type of sprinkler system: 2015–2019



The following incident descriptions illustrate the effectiveness of sprinklers:

- Around 2:30 a.m., an alarm monitoring company alerted the local fire department to a system activation at a department store in a North Dakota mall. [3] Arriving firefighters initially saw no signs of fire or operating sprinklers. A store representative led them to a separate area where water was coming from under a closed office door. An electronic device left to charge overnight had overheated and started a small fire on the desk that spread to a chair. A single sprinkler extinguished the fire.

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[i] These calculations exclude fires with confined structure fire incident types (NFIRS incident types 113–118). Among confined fires in which sprinklers were present, the fire was too small to activate the sprinklers 71 percent of the time, the sprinklers operated and were effective 14 percent of the time, and the sprinklers failed to operate 4 percent of the time. Since these fires are, by definition, confined, it is likely that a substantial share of the fires in which the sprinklers were said to fail, were, in fact, too small to cause the sprinkler to operate. The 41 percent of non-confined fires (NFIRS incident types 110–123, except for 113–118) that were too small to activate the sprinklers and the less than 1 percent of the non-confined structure fires in which sprinkler operation was unclassified were also excluded.

[ii] Fires with NFIRS confined fire incident types were included in these calculations.

- An intentional fire set along an exterior wall of a California nonprofit organization's storage facility spread inside.[4] The fire department was notified around 4:20 a.m. Two sprinklers controlled the inside fire and firefighters completed extinguishment. In the report, the investigator noted that the building would likely have been a total loss without the working sprinklers.
- A sprinkler at an Illinois fitness center controlled a dryer fire. [5] Responding firefighters used a pump can to extinguish the remaining fire inside the dryer. The maintenance worker who discovered the fire had attempted to put the fire out with an extinguisher. He was transported to the hospital for treatment of moderate smoke inhalation.

In 98 percent of the fires in which one sprinkler operated, it was effective. Figure 10 shows that sprinklers were somewhat less likely to have operated effectively when more sprinklers operated.

Figure 10. Percentage of fires in which sprinklers were effective by number that operated: 2015–2019

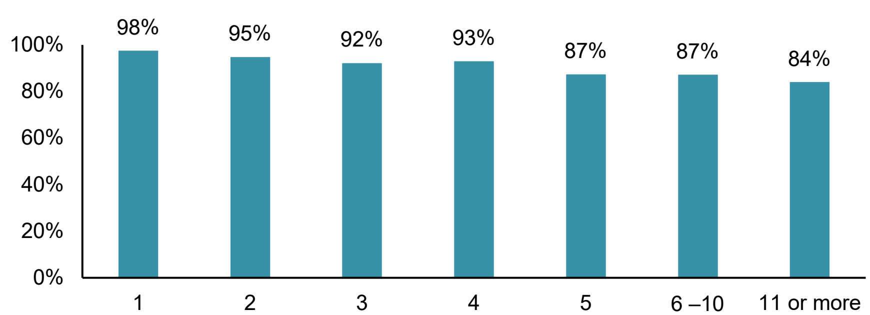


Figure 11 shows that in nearly three out of every five incidents in which sprinklers failed to operate, the system had been shut off.

- An October 2018 West Virginia warehouse fire in which the sprinklers had been shut off caused $10 million in property damage.[6] The warehouse contained plastic goods and recycled plastic.

Figure 11. Reasons for sprinkler failure: 2015–2019

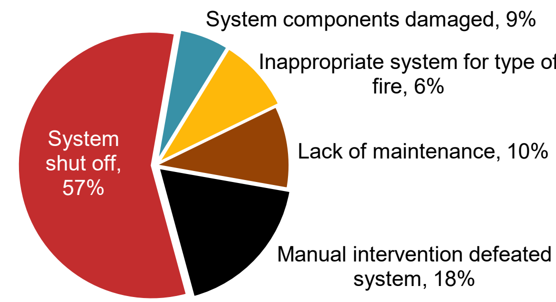
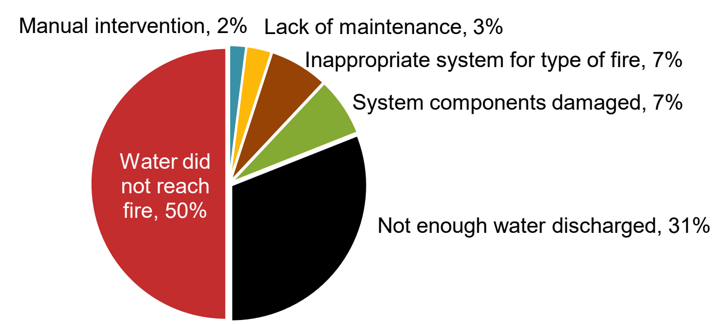


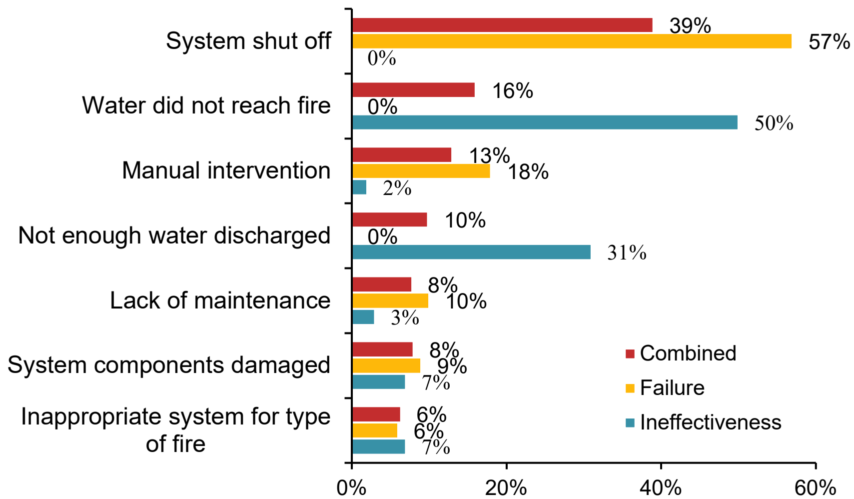
Figure 12 shows that in eight out of every 10 fires in which sprinkler systems operated ineffectively, the problem involved getting water to the fire. In half of the fires in which sprinklers were ineffective, the water did not reach the fire. In nearly one-third of the fires, not enough water was discharged.

Figure 12. Reasons for sprinkler ineffectiveness: 2015–2019



In 2015–2019, reported sprinkler failures (750 per year) were more than twice as common as reported fires in which sprinklers were ineffective (340 per year). Figure 13 shows the breakdown of each cause of failure or ineffectiveness individually and combined. For example, manual intervention was blamed for 13 percent of the total situations in which sprinklers were either ineffective or failed to operate at all. As noted earlier, manual intervention was blamed for 18 percent of the fires in which sprinklers failed to operate and 2 percent of the fires in which they were ineffective.

Figure 13. Reasons for combined sprinkler failure and ineffectiveness: 2015–2019



The categories in Figures 11–13 are based on NFIRS and sometimes overlap.

Long, Wu, and Blum explored the root causes of unsatisfactory sprinkler performance, dividing them into the following broad categories:[7]

- "Failure to maintain operational status of the system." Regular inspection, testing, and maintenance are essential to ensure sprinkler operability. Water being shut off before or during a fire is included in this category.
- "Failure to assure adequacy of the system and/or for the complete coverage of current hazard." Problems with the initial plans, installation errors, and changes to the structure or its contents could be captured here.
- "Defects affecting, but not involving, the sprinkler system." This includes water supply problems and building construction issues.
- "Inadequate performance by the sprinkler itself." Sprinkler systems have numerous components. A failure of one component can impact the larger system.
- All other situations, including fires that started on the structure's exterior, delays in notifying the fire department, etc.

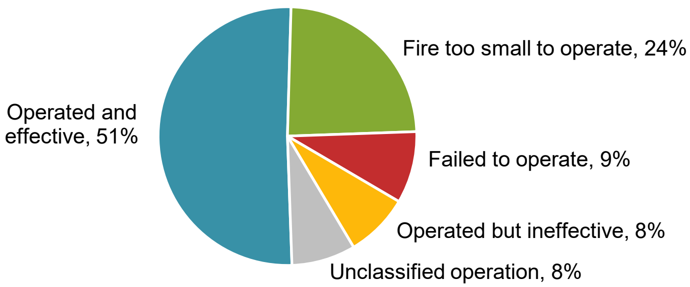
Civilian Deaths in Sprinklered Properties

While sprinklers were present in 10 percent of all the properties in which fires occurred in 2015–2019, only 1 percent of all the fire deaths occurred in these properties. Fires in sprinklered properties killed an average of 36 people per year in 2015–2019. Fires in properties that were not under construction and had no automatic extinguishing systems caused an average of 2,816 civilian deaths per year.

In fires that were large enough to activate sprinklers, 21, or 87 percent, of the fatalities per year resulted from fires in which the sprinklers operated. Of those who died in fires with operating sprinklers, 18, or 86 percent, died in fires in which the sprinklers operated effectively. Taken together, 18, or three-quarters (75 percent), of the 24 victims of fires large enough to activate sprinklers per year were fatally injured in fires in which the sprinklers operated and were effective.

Figure 14 shows that nine, or one-quarter, of the 36 victims per year of fires in sprinklered properties were fatally injured in fires that never became large enough to activate the sprinklers. In other cases, the sprinklers extinguished the fire. Victims in fires with sprinklers were typically fatally injured before the sprinklers activated. In both situations, the victims were usually intimate with the ignition. In some cases, the victim had been smoking in bed or while using medical oxygen. The victim's clothing may have caught fire while the victim was cooking or smoking.

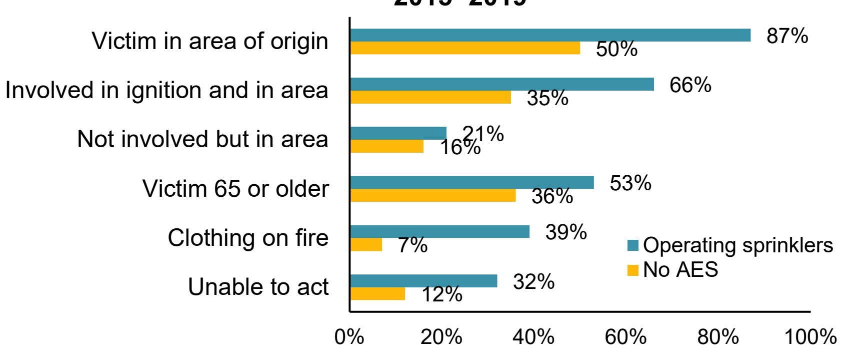
Figure 14. Civilian fire deaths by sprinkler performance: 2015–2019



- In 2015, a resident of a 7-story North Carolina apartment building was fatally injured when he lit a cigarette while using medical oxygen. The living room sprinkler extinguished his burning clothes and chair.[8]

Compared to victims of fires in which no AES was present, people who died in fires in which sprinklers operated were more likely to have been in the area of origin, been at least 65 or older, been wearing clothing that caught fire, or been unable to act, and even more likely to have been involved in the ignition and in the area. Figure 15 shows this contrast. Note that many of these differences are also evident among victims of fires with and without working smoke alarms.[9]

Figure 15. Victim characteristics in fires with operating sprinklers vs. with no AES: 2015–2019



There are limits to even the best fire protection. When someone is directly involved in the ignition of a fire or their clothing is burning, they may be fatally injured before the sprinkler system operates. If someone is physically incapable of getting themself to safety, even a fire controlled by sprinklers can still cause harm.

Three-quarters (76 percent) of the fire deaths in sprinklered properties resulted from fires that were confined to the object or room of origin. This was true for only 18 percent of the deaths from fires in which no AES was present. When present, sprinklers keep the fire from spreading and threatening those in other areas. A fire that is confined to the room of origin is much less dangerous to those outside the room.

Multiple death fires are rare when sprinklers are present. However, as mentioned earlier, exterior fires can challenge sprinkler protection. In addition, explosions can damage a sprinkler system, rendering it ineffective or non-functional.

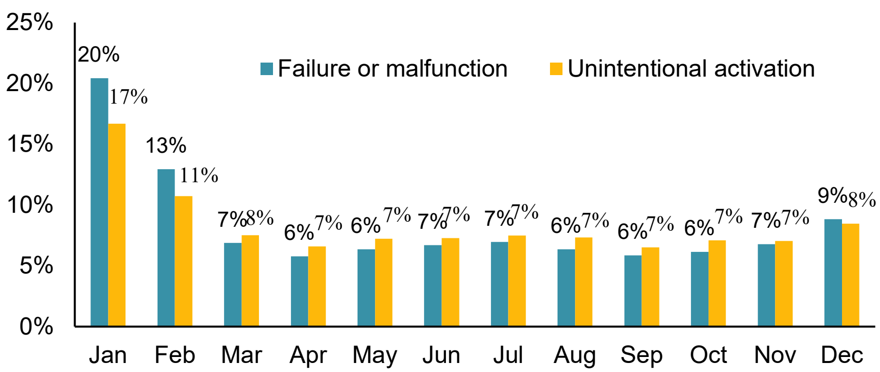
Two fires in 2015–2019 in which sprinklers were present resulted in four deaths each.

- Around 2:00 a.m. one morning in March 2017, a fire department was alerted to a fire at a Maryland assisted living facility of unprotected wood-frame construction.[10] One employee and six adult residents were in the structure at the time of the fire. All the residents required assistance to evacuate. A discarded cigarette had ignited leaves and grass outside the building. The flames spread to the exterior wall, porch, and into the confined ceiling space. Both detection and activation of the residential wet pipe sprinkler system were delayed because the fire was in the concealed space. Once activated, the sprinkler system controlled the fire. In addition to the four fatalities, three civilians were also injured.
- Around 9:30 p.m. on a May 2019 evening, an Illinois fire department was notified of an explosion and fire at a silicone manufacturing plant.[11] The plant was operating at the time. The explosion damaged both the detection and sprinkler systems, so they did not operate.

Unwanted Activations

Fire departments responded to an estimated average of 26,000 sprinkler activations caused by a system failure or malfunction per year and 29,700 unintentional sprinkler activations per year in 2015–2019. According to the *NFIRS 5.0 Complete Reference Guide,*[12] false alarms due to sprinkler failures or malfunctions include "any failure of sprinkler equipment that leads to sprinkler activation with no fire present." This category "excludes unintentional operating caused by damage to the sprinkler system." Unintentional activations also include "testing the sprinkler system without fire department notification." The winter months of December, January, and February account for only one-quarter of the year yet Figure 16 shows that 42 percent of the sprinkler system failures or malfunctions occurred in these three months, as did 36 percent of the unintentional activations. This suggests that cold weather and frozen pipes played a role.

Figure 16. Unwanted sprinkler activations by type and month: 2015–2019



Not all activations result in water flow outside the system. For example, water may flow in the pipes of a dry pipe system. This could alert a monitoring company and trigger a fire department response.

In their 2012 article on investigating inadvertent fire sprinkler discharges,[13] Blum, Long, and Dillon referred to Russ Fleming's 2000 description of the six primary reasons for non-fire discharges from sprinklers: overheating, freezing, mechanical damage, corrosion, deliberate sabotage, and mechanical defects.

Overheating can be caused by nearby equipment that may have been added after a sprinkler system was installed. While overheating typically affects the sprinkler and not the piping, freezing can impact the pipes. Mechanical damage can occur when a sprinkler is bumped by something such as a ladder, forklift, or tossed objects. Deliberate sabotage includes vandalism and disabling sprinklers to increase fire damage. While rare, manufacturing defects can also occur.

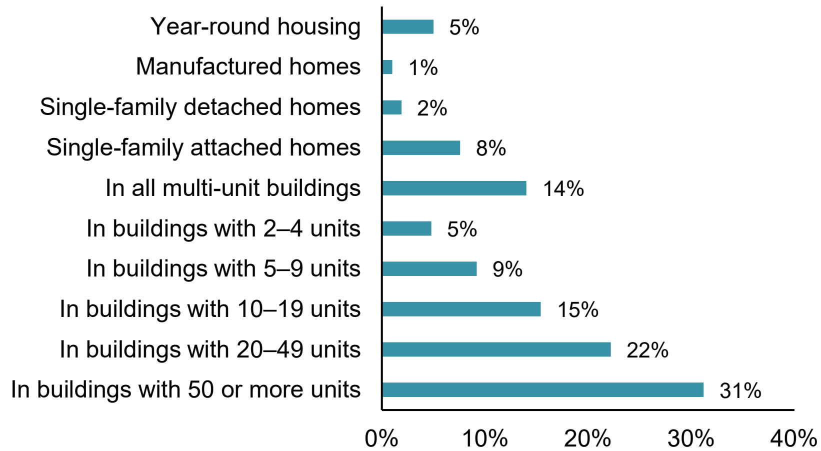
In a 2017 article, Huet, Martorano, and Ames described experiments involving intentional damage simulating random microscopic flaws to more than 100 glass bulb sprinklers. These were then exposed to a constant load in a test frame.[14] Forty-four of the sprinklers failed within 36 days, while the remaining 58 lasted more than two years. They concluded that unwanted activations due to damaged sprinkler bulbs tended to occur within days or weeks of the damage. Such damage, if undetected, could explain unwanted activations with no identifiable cause.

Sprinklers in Home Fires

Sprinkler Presence and Type

During 2015–2019, some type of fire sprinkler was present in an estimated average of 23,600 reported home structure fires (7 percent) per year. Properties under construction were excluded from these estimates. Table B summarizes information about automatic extinguishing systems (AES), including sprinklers, in all reported home structure fires except those under construction. According to the 2011 American Housing Survey, buildings with more housing units were more likely to have sprinklers. Figure 17 shows that 5 percent of housing units that are occupied year-round had sprinklers, ranging from a low of 1 percent in manufactured homes to a high of 31 percent in buildings with at least 50 units.[15]

Figure 17. Percentage of occupied units with sprinklers per the 2011 American Housing Survey



Source: American Housing Survey

Figure 18 shows that wet pipe sprinkler systems were present in nine out of every 10 reported home fires with sprinklers.

Figure 18. Types of sprinkler systems present at home structure fires: 2015–2019

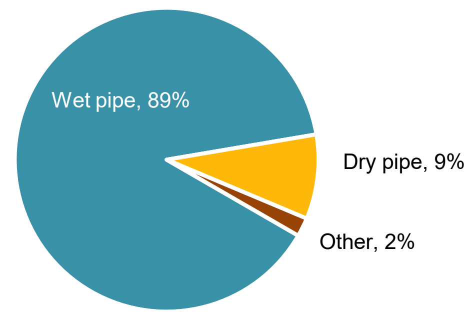


Table B. Summary of AES presence and type in reported home structure fires, excluding properties under construction: 2015–2019 annual averages

AES Presence and Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
AES present	**25,000**	**(7%)**	**24**	**(1%)**	**593**	**(5%)**	**$197**	**(3%)**
Sprinklers present	23,600	(7%)	23	(1%)	555	(5%)	$194	(3%)
Wet pipe sprinkler system	*21,000*	*(6%)*	*22*	*(1%)*	*477*	*(4%)*	*$185*	*(3%)*
Dry pipe sprinkler system	*2,100*	*(1%)*	*1*	*(0%)*	*69*	*(1%)*	*$8*	*(0%)*
Other type of sprinkler system	*500*	*(0%)*	*0*	*(0%)*	*9*	*(0%)*	*$1*	*(0%)*
Non-sprinkler AES present	1,400	(0%)	1	(0%)	38	(0%)	$3	(0%)
Partial system AES present	900	(0%)	5	(0%)	40	(0%)	$25	(0%)
AES not in fire area and did not operate	500	(0%)	0	(0%)	28	(0%)	$24	(0%)
None present	**318,500**	**(92%)**	**2,587**	**(99%)**	**10,408**	**(94%)**	**$6,907**	**(97%)**
Total	**344,900**	**(100%)**	**2,616**	**(100%)**	**11,036**	**(100%)**	**$7,153**	**(100%)**

Fires in Homes with Sprinklers vs. with No AES

Figure 19 shows that the civilian death rate per 1,000 reported fires was 88 percent lower in homes with sprinklers than in homes with no AES during 2015–2019. These rates are based only on the reported presence or absence of an AES; operation was not considered.

Figure 19. Civilian death rates per 1,000 fires in homes with sprinklers vs. with no AES: 2015–2019

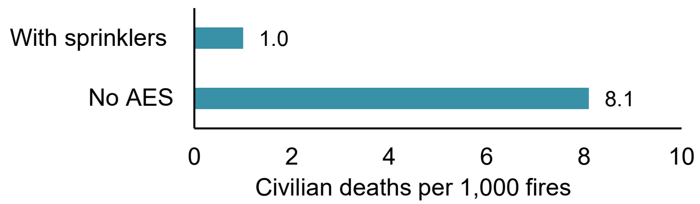


Figure 20 shows that the civilian injury rate per 1,000 reported fires was 28 percent lower in homes with sprinklers than in homes with no AES. In many cases, the injuries occurred in fires that were too small to activate the sprinkler system. In others, someone was injured while trying to fight the fire in the initial moments before the sprinklers operated. A 2012 Fire Protection Research Foundation study found that sprinkler presence was associated with a 53 percent reduction in the medical cost of civilian injuries per 100 home fires.[16]

Figure 20. Civilian injury rates per 1,000 fires in homes with sprinklers vs. with no AES: 2015–2019

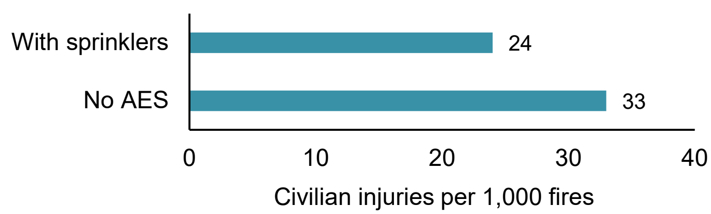
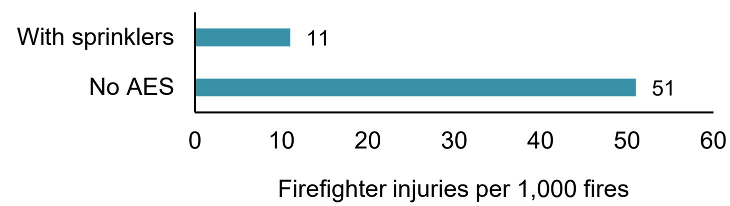


Figure 21 shows that the average firefighter fireground injury rate per 1,000 reported home fires was 78 percent lower when sprinklers were present than in fires with no AES.

Figure 21. Firefighter injury rates per 1,000 fires in homes with sprinklers vs. with no AES: 2015–2019



When sprinklers were present in reported home fires, the average property loss per fire was 62 percent lower than the average in homes with no AES. See Figure 22.

Figure 22. Average loss per fire in homes with sprinklers vs. with no AES: 2015–2019

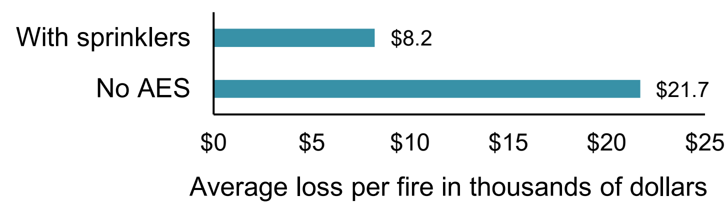
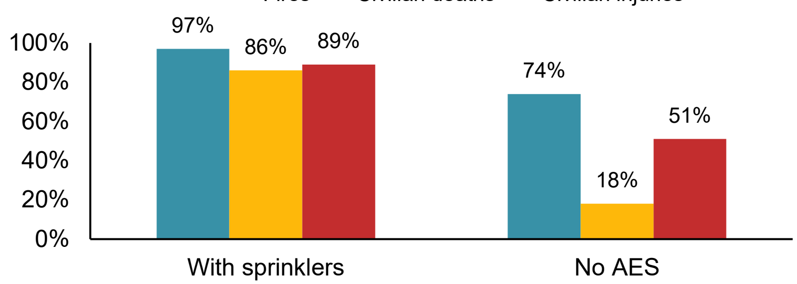


Figure 23 shows that when sprinklers were present, almost all of the fires were confined to the object or room of origin. The majority of civilian deaths and injuries resulting from fires in homes with sprinklers were caused by these fires. In home fires that lacked AES, only three-quarters of the fires were confined to the object or room of origin. Only one in five deaths and half of the injuries in home fires with no AES present resulted from such fires.

Figure 23. Percent of home fires, injuries, and casualties resulting from fires confined to object or room of origin: 2015–2019



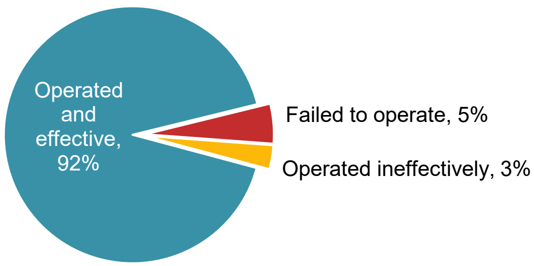
In rare cases, sprinklers may contain or even extinguish fires that cause fatal injuries. These injuries can occur *before* the fire's heat reaches a sprinkler. In some situations, the victim might be unable to move out of harm's way.

- An alarm monitoring company notified a fire department of a fire in a 12-story New York apartment building. By the time firefighters arrived, a wet pipe sprinkler system had operated and extinguished most of the fire in a third-floor apartment. A bed in the living room had been ignited by smoking materials. A male resident with a mobility impairment was severely burned and died at the hospital.[17]

Sprinkler Operation, Effectiveness, and Issues in Home Fires

Figure 24 shows that sprinklers operated in 95 percent of the home fires in which sprinklers were present and the fires were considered large enough to activate them.[i] They were effective at controlling the fire in 97 percent of the fires in which they operated. Taken together, sprinklers operated effectively in 92 percent of the fires large enough to trigger them.

Figure 24. Sprinkler operation and effectiveness in home fires: 2015–2019



Sprinklers protect occupants and property in many circumstances. Sometimes, no one is home or everyone has safely evacuated. Operating sprinklers can also protect a building and its occupants from incendiary fires. Fires that start on the exterior of a building can be particularly challenging, as they can enter into concealed spaces and spread before smoke alarms sound to alert occupants. Sprinkler protection for balconies can limit the damage from these fires. The following are several examples of such scenarios:

- One sprinkler operated to extinguish a grease fire that spread to the overhead cabinets in the kitchen of a second-floor Arizona apartment. The resident had gone outside while cooking and learned of the fire when an outdoor sprinkler alarm sounded. Another building resident called 911 to report the sprinkler activation and burning odor.[18]
- A dry pipe sprinkler system extinguished a fire in a second-floor unit in a three-story university apartment building in Colorado. A candle had been left burning unattended when the occupant left the unit. A

[i] These calculations exclude fires with confined structure fire incident types (NFIRS incident types 113–118). Among confined fires in which sprinklers were present, the fire was too small to activate the sprinklers 69 percent of the time, the sprinklers operated and were effective in 27 percent of total fires with sprinklers (and in 99 percent of the fires in which sprinklers operated), and the sprinklers failed to operate 3 percent of the time. Since these fires are, by definition, confined, it is likely that a substantial share of the fires in which the sprinklers were said to fail, were, in fact, too small to cause the sprinkler to operate. The 34 percent of non-confined fires (NFIRS incident types 110–123, except for 113–118) that were too small to activate the sprinklers and the 1 percent of non-confined structure fires in which sprinkler operation was unclassified were also excluded.

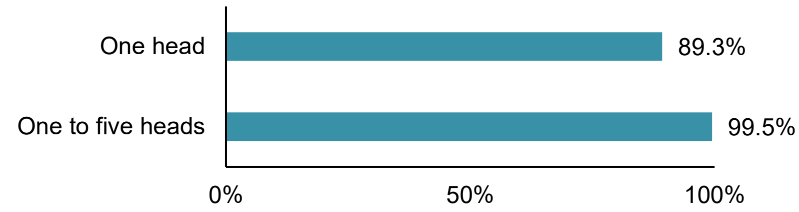
drape on an open window ignited when it was blown over the candle. The fire spread to the window blinds and papers on the desk before it was extinguished.[19]

- While firefighters were responding to a late afternoon fire alarm with smoke reported on the second floor of a four-story Oregon apartment building, they were informed that residents on the second and fourth floors had mobility impairments and would need help to evacuate. After they arrived, they found that the sprinkler system had extinguished an incendiary fire in a second-floor laundry room.[20]
- A 24-unit Texas apartment building was protected by a wet pipe sprinkler system installed under the provisions of NFPA 13R, *Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies*. Discarded smoking materials ignited a plastic container on a third-floor balcony. The fire spread to an outdoor couch and upward and sideways on the balcony until a sidewall sprinkler activated and contained the fire. Firefighters completed extinguishment when they arrived. The exterior fire did not activate smoke alarms inside the building.[21]

As in structure fires overall, when home sprinklers failed to operate, it was usually because the system had been shut off. This was true in a 2015 California single-family home fire that killed a young woman. The property's sprinkler system, installed to the requirements of NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, had been shut off at some point before the fire.[22]

Figure 25 shows that in nearly all the home fires in which operating sprinklers were present, five or fewer individual sprinklers operated.

Figure 25. Percent of home fires with operating sprinklers in which one or one to five operated: 2015–2019



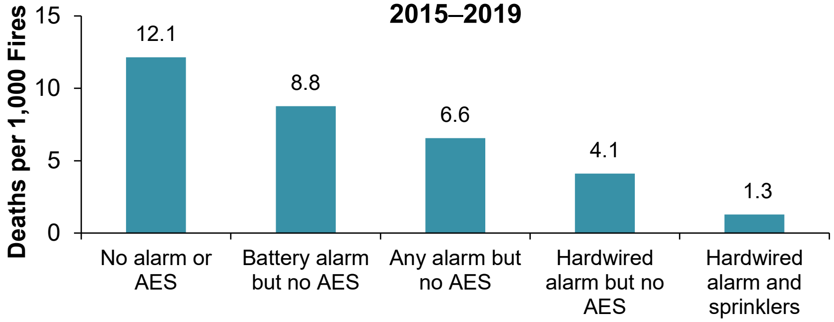
Impact of Smoke Alarm and Sprinkler Presence on Death Rates per 1,000 Home Fires

The lowest home fire death rate per 1,000 reported fires was found in homes with sprinkler systems and hardwired smoke alarms.[i] Figure 26 shows that compared to reported home fires (*including* properties under construction) in which no smoke alarms or AES was present, the death rate per 1,000 reported fires was:

- 28 percent lower when battery-powered smoke alarms were present, but AES protection was not
- 46 percent lower when smoke alarms with any power source were present but AES protection was not
- 66 percent lower when hardwired smoke alarms were present but AES protection was not
- 89 percent lower when sprinklers and hardwired smoke alarms were present

[i] In this analysis, the term *smoke alarm* also includes smoke detectors that are part of a system.

Figure 26. Average fire death rate per 1,000 reported home structure fires by presence of smoke alarms and AES: 2015–2019



Note that these rates are based on the *presence* of various types of fire protection; operation was not considered. Minor fires in homes with monitored smoke alarms are more likely to result in a fire department response than comparable fires in homes with unmonitored smoke alarms. Smoke alarms in monitored systems are generally hardwired.

Unwanted Activations

Fire departments responded to an estimated average of 4,700 non-fire activations of home fire sprinklers per year caused by a system failure or malfunction and 5,400 unintentional sprinkler activations per year in 2015–2019. According to the *NFIRS 5.0 Complete Reference Guide*[23], sprinkler failures or malfunctions include "any failure of sprinkler equipment that leads to sprinkler activation with no fire present." The category "excludes unintentional operating caused by damage to the sprinkler system," which should be considered unintentional activations. Unintentional activations include "testing the sprinkler system without fire department notification."

Forty-eight percent of the home sprinkler activations resulting from system failures or malfunctions and 38 percent of the unintentional home sprinkler activations occurred in the winter months of December, January, and February.

Conclusions and Further Reading

Sprinklers are a very reliable and effective part of fire protection. Their impact is most visible in the reduction of civilian fire deaths per 1,000 reported fires when sprinklers are present compared to fires without AES. Notable reductions can also be seen in the injury rates, in most occupancies, in the average loss per fire. Increasing the use of sprinklers can reduce loss of life and property damage caused by fire.

NFPA standards provide essential guidance on the installation, inspection, testing, maintenance, and integration of sprinklers with other systems, as well as for evaluating needs when an occupancy changes use or contents. See the following standards for more information:

- NFPA 13, *Standard for the Installation of Sprinkler Systems*
- NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*
- NFPA 13R, *Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies*
- NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*. See NFPA 25 for minimum inspection, testing, and maintenance requirements for sprinkler systems.
- NFPA 4, *Standard for the Integrated Fire Protection and Life Safety Systems Testing*. See NFPA 4 for test protocols to ensure that the fire protection and life safety systems will function correctly together.
- NFPA 1, *Fire Code*. NFPA 1 includes evaluation requirements for assessing the adequacy of existing sprinkler systems if the use or contents of a space have changed.

Resources to help reduce the home fire death toll by increasing the number of new one- and two-family homes protected by sprinklers are available from the NFPA Fire Sprinkler Initiative.

Methodology

The statistics in this analysis are estimates derived from the US Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association (NFPA) annual survey of US fire departments. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates. Unless otherwise specified, properties under construction were excluded from the analysis.

The NFPA fire department experience survey provides estimates of the big picture. NFIRS is a voluntary system through which participating fire departments report detailed factors about the fires to which they respond.

To compensate for fires reported to local fire departments but not captured in NFIRS, scaling ratios are calculated and then applied to the NFIRS database using the formula below:

$$\frac{\text{NFPA's fire experience survey projections}}{\text{NFIRS totals}}$$

NFPA also allocates unknown data proportionally to compensate for fires for which information was undetermined or not reported.

Fires in which partial sprinkler systems were present and fires in which sprinklers were present but failed to operate because they were not in the fire area were excluded from the estimates of presence and operation. Fires with one of the six NFIRS confined fire incident types were included in estimates of sprinkler presence, fire spread, and sprinklers operating, but not of operation or effectiveness in general. Information on methodology is provided in more detail at the end of this report.

Confined structure fires in NFIRS include confined cooking fires, confined chimney or flue fires, confined trash fires, confined fuel burner or boiler fires, confined commercial compactor fires, and confined incinerator fires (NFIRS incident types 113–118). Losses are generally minimal in these fires, which, by definition, are assumed to have been limited to the object of origin. Although detailed data about detection is not required for these fires, it is sometimes available.

Raw NFIRS data for 2015–2019, excluding properties under construction, contained a total of 7,737 confined structure fires (1 percent of total confined fires) in which some type of AES was present and 34,919 confined structure fires (4 percent of total confined fires) in which none was present. AES presence was undetermined or left blank for 95 percent of the confined structure fires. A total of 4,355 confined fires with AES present indicated wet pipe, dry pipe, or other sprinklers were present. The AES type was undermined or not reported in 2,338 confined fires with AES present. Sprinkler operation when present was known in a total of 92 percent (3,793) of the confined fires in which sprinklers were present . Sprinkler operation for confined fires was used to calculate the number of sprinklers that operated in fires in which sprinklers operated but not for overall estimates of operation or effectiveness.

The raw NFIRS data for 2015–2019 contained a total of 53,859 non-confined structure fires (NFIRS incident type 110–123, excluding incident types 113–118) in which AES presence was known. A total of 103 civilian deaths; 2,137 civilian injuries; and $3.8 billion in direct property damage were associated with these fires. AES presence was known for 97 percent of the non-confined fires, 90 percent of the deaths, 95 percent of the injuries, and 99 percent of the direct property damage. The AES type was known in 67 percent of the non-confined fires, 80 percent of the deaths, 81 percent of the injuries, and 84 percent of the associated property loss when AES was present.

When sprinklers were present in non-confined structure fires, sprinkler operation was known for a five-year raw total of 27,151 fires associated with 57 deaths; 1,426 injuries; and $2.6 billion in direct property damage. When present, sprinkler operation was known for 84 percent of the non-confined fires, 72 percent of the deaths, 89 percent of the injuries, and 89 percent of the direct property damage. ("Operation of AES, other" was considered unknown.).

When AES was coded as present, but failed to operate, and the reason given was "fire not in the area protected," NFPA recoded the AES presence to

"Not in fire area; did not operate." These incidents and incidents coded to indicate the presence of partial systems were excluded from further analysis.

Property damage has not been adjusted for inflation. In most cases, fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest million dollars. Less rounding is used when the numbers are smaller.

For more information on the methodology used for this report see, *How NFPA's National Estimates Are Calculated for Home Structure Fires.*

Acknowledgments

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that makes this analysis possible. Their contributions allow us to estimate the size of the fire problem.

We are also grateful to the US Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

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[1] M. Ahrens. *High-Rise Building Fires*. (Quincy, MA: National Fire Protection Association, 2016), 8. nfpa.org/news-and-research/fire-statistics-and-reports/fire-statistics/fires-by-property-type/high-rise-building-fires
[2] S. Badger, "Large-Loss Fires and Explosions in the United States in 2019," *NFPA Journal,* November/December 2020. nfpa.org/News-and-Research/Publications-and-media/NFPA-Journal/2020/November-December-2020/Features/LL-Report
[3] R. Campbell, "Firewatch: Sprinkler Extinguishes Overnight Fire in Department Store, North Dakota," *NFPA Journal*, November/December 2019.
[4] R. Campbell, "Firewatch: Sprinkler Credited with Preventing Large Loss in Arson Fire, California," *NFPA Journal*, January/February 2020.
[5] R. Campbell, "Firewatch: Sprinkler Extinguishes Fire that Starts in Fitness Club Dryer, Illinois," *NFPA Journal*, March/April 2020.
[6] S. Badger, "Large-Loss Fires for 2017," *NFPA Journal*, November/December 2018.
[7] R. Long, Jr., N. Wu, and A. Blum, "Lessons Learned from Unsatisfactory Sprinkler Performance," *Fire Protection Engineering*, 2010, Quarter 4 issue. jonochshorn.com/scholarship/writings/rand-100percent-DD/Long-lessons-learned-2010.pdf.
[8] NFPA's Fire Incident Data Organization (FIDO) report.
[9] M. Ahrens. *Smoke Alarms in US Home Fires*. (Quincy, MA: National Fire Protection Association, 2021). nfpa.org//-/media/Files/News-and-Research/Fire-statistics-and-reports/Detection-and-signaling/ossmokealarms.pdf
[10] S. Badger. *Catastrophic Multiple-Death Fires in 2017*. (Quincy, MA: National Fire Protection Association, 2018).
[11] S. Badger, "Catastrophic Multiple-Death Fires and Explosions by Type in 2019," *NFPA Journal,* September 2020. nfpa.org/News-and-Research/Publications-and-media/NFPA-Journal/2020/September-October-2020/Features/Catastrophic/Sidebar
[12] *National Fire Incident Reporting System Complete Reference Guide* (US Fire Administration, National Fire Data Center, 2015) 3-27/3-28.
[13] A. Blum, R. Long, Jr., and S. Dillon. *Investigating Inadvertent Automatic Fire Sprinkler System Discharges*. *Forensic Engineering*, 2012. doi.org/10.1061/9780784412640.056
[14] R. Huet, et al. *Delayed Fracture of Glass Bulbs Used in Fire Sprinklers*. *Fire Technology* 53, 629–647 (2017). doi.org/10.1007/s10694-016-0584-4
[15] "2011 National Health and Safety Characteristics — All Occupied Units, Variable 1, Units by Structure Type," US Census Bureau, American Housing Survey Table Creator, accessed July 23, 2021. census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html?s_areas=00000&s_year=2011&s_tablename=TABLES01&s_bygroup1=3&s_bygroup2=1&s_filtergroup1=1&s_filtergroup2=1
[16] J. Hall, Jr., M. Ahrens, and B. Evarts. *Sprinkler Impact on Fire Injury*. (Quincy, MA: Fire Protection Research Association, 2012), 6, 19.
[17] Richard Campbell, "Firewatch: Resident Dies when Smoking Materials Ignite Bedding," *NFPA Journal*, March/April 2017.

[18] Richard Campbell, "Firewatch: Sprinkler Extinguishes Kitchen Fire at Apartment Complex," *NFPA Journal*, January/February 2017.
[19] Richard Campbell, "Firewatch: Sprinkler Extinguishes Candle Fire in University Apartment Building, CO," *NFPA Journal*, November/December 2017.
[20] Richard Campbell, "Firewatch: Sprinkler System Extinguishes Arson Fire in Apartment Building, Oregon," *NFPA Journal*, January/February 2019.
[21] Richard Campbell, "Firewatch: Sprinklers Limit Fire Damage at Apartment Complex, Texas," *NFPA Journal*, September/October 2018.
[22] NFPA's Fire Incident Data Organization (FIDO) report.
[23] *National Fire Incident Reporting System Complete Reference Guide* (US Fire Administration, National Fire Data Center, 2015) 3-27/3-28.

RESEARCH

US Experience with Sprinklers

Supporting Tables

October 2021

Marty Ahrens

US Experience with Sprinklers: Supporting Tables

The tables in this document are a companion to the report of the same name. The table topics are listed below.

Most of the national estimates of fires and losses in this analysis are presented as 2015–2019 annual averages. Estimates were derived from the US Fire Administration's National Fire Incident Reporting System (NFIRS) and NFPA's annual fire department experience survey and include proportional shares of unknown or missing data. Fires are rounded to the nearest 10, deaths and injuries to the nearest one, and property loss to the nearest million dollars. Property loss was not adjusted for inflation. Percentages were calculated on unrounded estimates. Sums may not equal totals due to rounding errors. Estimates include proportional shares of fires with unknown data. For more information on how these estimates were calculated, please see the full report and *How NFPA's National Estimates Are Calculated for Fires.*

Acknowledgments

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that makes this analysis possible. Their contributions allow us to estimate the size of the fire problem.

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Table 1. Presence of Sprinklers in Structure Fires by Property Use (Excluding Properties Under Construction)

Property Use	Number of Structure Fires with Equipment Present and Percentage of Total Structure Fires by Property Use — Any Automatic Extinguishing System (AES) 1980–1984		1994–1998		2015–2019		Any Sprinkler 2015–2019	
All public assembly	4,280	(13%)	4,380	(26%)	7,900	(49%)	4,120	(25%)
Variable-use amusement place	120	(8%)	140	(16%)	240	(21%)	210	(19%)
Place of worship or funeral property	50	(2%)	90	(5%)	330	(19%)	290	(16%)
Library or museum	80	(14%)	110	(28%)	190	(30%)	180	(28%)
Eating or drinking establishment	3,310	(16%)	3,240	(29%)	5,740	(62%)	2,300	(25%)
Passenger terminal	70	(20%)	60	(35%)	300	(40%)	250	(33%)
Educational property	1,620	(13%)	1,820	(24%)	2,000	(43%)	1,860	(40%)
Health care property*	6,920	(47%)	4,400	(68%)	3,820	(65%)	3,420	(58%)
Nursing home	2,250	(61%)	2,060	(76%)	2,170	(76%)	1,980	(69%)
Hospital	3,370	(47%)	1,650	(74%)	830	(80%)	640	(61%)
Prison or jail	370	(10%)	430	(19%)	300	(61%)	280	(58%)
All residential	7,090	(1%)	11,110	(3%)	32,370	(9%)	30,390	(8%)
Home (including apartment)	5,120	(1%)	8,440	(2%)	24,970	(7%)	23,570	(7%)
Hotel or motel	1,590	(15%)	1,690	(35%)	2,190	(56%)	2,090	(54%)
Dormitory or barracks	430	(16%)	620	(29%)	2,300	(60%)	2,130	(56%)
Rooming or boarding home	70	(4%)	230	(17%)	900	(31%)	860	(29%)
Residential board and care home or assisted living facility	Not available		Not available		860	(46%)	820	(43%)
Store or office	5,510	(13%)	5,230	(21%)	6,500	(34%)	4,940	(26%)
Grocery or convenience store	1,160	(15%)	1,190	(27%)	2,360	(53%)	1,250	(28%)
Laundry, dry cleaning, or other professional service	330	(8%)	310	(13%)	330	(19%)	330	(18%)
Department store	1,340	(44%)	1,100	(52%)	580	(51%)	520	(47%)
Office	1,240	(12%)	1,470	(25%)	1,000	(32%)	940	(30%)
Manufacturing facility	11,910	(44%)	6,400	(50%)	3,050	(58%)	2,720	(52%)
All storage	1,430	(2%)	1,090	(3%)	830	(4%)	810	(4%)
Warehouse (excluding cold storage)	1,060	(13%)	740	(22%)	500	(35%)	500	(34%)
All structures**	38,620	(4%)	37,100	(7%)	61,40	(13%)	51,000	(10%)

* Health care property includes other facilities not listed separately. In 1980–1984 and 1994–1998, this category excludes doctors' offices and elder care facilities without nursing staff (which are assumed to be residential board and care facilities). In 2015–2019, health care property includes nursing homes, hospitals, clinics, doctor's offices, substance abuse recovery centers or developmental disability facilities.
** Includes properties not listed separately above.

Note: Post-1998 estimates are based only on fires reported in Version 5.0 of NFIRS and include fires reported as confined fires. After 1998, buildings under construction are excluded. Sprinkler statistics exclude partial systems and installations with no sprinklers in the fire area.

Table 2. Type of Sprinkler System Reported in Structure Fires Where Equipment Was Present in Fire Area by Property Use (Excluding Properties Under Construction): 2015–2019 Annual Averages

Property Use	Fires per year with any type of sprinkler	Wet pipe sprinklers		Dry pipe sprinklers		Other sprinklers*	
All public assembly	4,120	3,330	(82%)	330	(8%)	470	(11%)
Variable-use amusement place	210	180	(85%)	30	(14%)	0	(1%)
Place of worship or funeral property	290	220	(75%)	50	(16%)	20	(9%)
Library or museum	180	170	(97%)	0	(2%)	0	(1%)
Eating or drinking establishment	2,300	1,740	(76%)	160	(7%)	400	(17%)
Passenger terminal	250	240	(98%)	0	(1%)	0	(0%)
Educational property	1,860	1,590	(86%)	230	(12%)	30	(2%)
Health care property**	3,420	2,960	(87%)	390	(12%)	70	(2%)
Nursing home	1,980	1,730	(88%)	210	(11%)	40	(2%)
Hospital	640	570	(89%)	60	(9%)	10	(1%)
Prison or jail	280	250	(91%)	20	(8%)	0	(1%)
All residential	30,390	27,030	(89%)	2,770	(9%)	590	(2%)
Home (including apartment)	23,570	20,960	(89%)	2,130	(9%)	480	(2%)
Dormitory or barracks	2,130	1,830	(86%)	260	(12%)	30	(2%)
Hotel or motel	2,090	1,850	(88%)	190	(9%)	50	(2%)
Rooming or boarding house	860	800	(94%)	50	(6%)	0	(0%)
Residential board and care or assisted living facility	820	730	(89%)	70	(9%)	20	(2%)
Store or office	4,940	4,270	(86%)	380	(8%)	290	(6%)
Grocery or convenience store	1,250	980	(78%)	100	(8%)	180	(14%)
Laundry, dry cleaning, or other professional service	330	300	(91%)	20	(5%)	10	(4%)
Department store	520	460	(88%)	50	(10%)	10	(2%)
Office	940	820	(87%)	80	(8%)	40	(5%)
Manufacturing facility	2,720	2,290	(84%)	370	(14%)	60	(2%)
All storage	810	620	(77%)	180	(22%)	10	(1%)
Warehouse (excluding cold storage)	500	410	(81%)	90	(18%)	0	(1%)
All structures ***	51,000	44,160	(87%)	5,040	(10%)	1,810	(4%)

* Includes deluge and pre-action sprinkler systems and may include sprinklers of an unknown or unreported type.
** Nursing homes, hospitals, clinics, doctor's offices, substance abuse recovery centers or developmental disability facilities.
*** Includes properties not listed separately above.

Note: Row totals are shown in the left-most column of percentages and sums may not equal totals due to rounding errors. In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. This field was not required if the fire did not begin within the designed range of the system. Buildings under construction and partial systems were excluded.

Source: NFIRS and NFPA fire experience survey.

Table 3. Estimated Reduction in Civilian Deaths per Thousand Fires Associated with All Types of and Wet Pipe Sprinklers by Property Use (Excluding Properties Under Construction): 2015–2019 Annual Averages

Property Use	Without AES	With sprinklers of any type	Percent reduction from no AES	With wet pipe sprinklers	Percent reduction from no AES
All public assembly	1.9	0.1	97%	0.1	96%
Health care*	1.2	0.8	33%	0.5	58%
Residential	8.0	0.9	89%	1.0	88%
Home (including apartment)	8.1	1.0	88%	1.0	87%
Dormitory or barracks	1.0	0.2	84%	0.2	81%
Hotel or motel	8.6	0.2	98%	0.2	98%
Rooming or boarding house	6.5	3.3	49%	3.5	46%
Residential board and care or assisted living facility	3.2	1.4	57%	1.5	52%
Store or office	1.2	0.5	57%	0.4	64%
Manufacturing facility	1.0	0.6	34%	0.7	22%
Warehouse (excluding cold storage)	2.1	0.0	100%	0.0	100%
All structures**	6.7	0.7	89%	0.7	89%

* Includes nursing homes, hospitals, clinics, doctor's offices, substance abuse recovery centers or developmental disability facilities.
** Includes properties not listed separately above.

Note: These are national estimates of structure fires reported to US municipal fire departments based on fires reported in NFIRS and so exclude fires reported only to federal or state agencies or industrial fire brigades.

Source: NFIRS and NFPA fire experience survey.

Table 4. Estimated Reduction in Average Direct Property Loss per Fire Associated with Any Type of and Wet Pipe Sprinklers by Property Use (Excluding Properties Under Construction): 2015–2019 Annual Averages

Property Use	Loss without AES	Loss with sprinklers of any type	Percent reduction	Loss with wet pipe sprinkler system	Percent reduction from no AES
All public assembly	$31,500	$11,600	63%	$12,000	62%
Health care*	$13,900	$3,800	73%	$4,000	71%
Residential	$21,200	$8,500	60%	$9,000	57%
Home (including apartment)	$21,700	$8,200	62%	$8,800	59%
Dormitory or barracks	$3,700	$1,500	58%	$1,700	53%
Hotel or motel	$29,800	$22,400	28%	$22,700	24%
Rooming or boarding house	$7,700	$3,600	52%	$3,700	51%
Residential board and care or assisted living facility	$4,600	$6,700	-44%	$7,300	-58%
Store or office	$59,400	$17,600	70%	$17,900	70%
Manufacturing facility	$141,000	$170,300	No reduction	$192,100	No reduction
Warehouse (excluding cold storage)	$112,300	$144,000	No reduction	$149,400	No reduction
All structures	$22,200	$19,800	11%	$20,600	7%

* Includes nursing homes, hospitals, clinics, doctor's offices, substance abuse recovery centers or developmental disability facilities.
** Includes properties not listed separately above.

Note: These are national estimates of structure fires reported to US municipal fire departments based on fires reported in NFIRS and so exclude fires reported only to federal or state agencies or industrial fire brigades.

Source: NFIRS and NFPA fire experience survey.

Table 5. Percentage of Fires with Fire Spread Confined to Room of Origin in Fires with Sprinklers Present vs. No Automatic Extinguishing System: 2015–2019 Annual Averages

Property Use	Percentage of fires confined to room of origin excluding structures under construction and sprinklers not in fire area With no AES	With sprinklers of any type	Difference (in percentage points)
Public assembly	77%	93%	16%
Religious property	73%	94%	22%
Library or museum	83%	96%	13%
Eating or drinking establishment	72%	91%	19%
Educational	89%	97%	8%
Health care property*	92%	98%	6%
Residential	74%	97%	23%
Home (including apartment)	74%	97%	23%
Dormitory or barracks	97%	99%	3%
Hotel or motel	84%	96%	13%
Store or office	67%	92%	24%
Grocery or convenience store	72%	94%	22%
Department store	65%	90%	25%
Office building	75%	93%	19%
Manufacturing facility	64%	84%	21%
Storage	25%	80%	55%
Warehouse (excluding cold storage)	52%	79%	27%
All structures**	71%	95%	24%

* Includes nursing homes, hospitals, clinics, doctor's offices, substance abuse recovery centers or developmental disability facilities.
** Includes properties not listed separately above.

Note: All fires with one of the six NFIRS confined structure fire incident types were considered confined to the object of origin by definition. Fires that were confined to the room of origin include fires confined to the object of origin. In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. This field is not required if the fire did not begin within the designed range of the system.

Source: NFIRS and NFPA fire experience survey.

Table 6. Sprinkler Reliability and Effectiveness When Fire Was Coded as Not Confined, Was Large Enough to Activate Sprinkler, and Sprinkler Was Present in Area of Fire by Property Use: 2015–2019 Annual Averages

A. All Sprinklers

Property Use	Number of fires per year where sprinklers were present	Non-confined fires too small to activate or unclassified operation	Fires coded as confined fires	Number of qualifying fires per year	Percent where equipment operated (A)	Percent effective of those that operated (B)	Percent where equipment operated effectively (A x B)
All public assembly	4,120	720	2,580	820	89%	92%	82%
Eating or drinking establishment	2,300	410	1,360	530	88%	91%	80%
Educational property	1,860	420	1,220	220	84%	97%	82%
Health care property*	3,420	650	2,390	380	86%	98%	84%
All residential	30,390	2,600	23,310	4,480	94%	97%	91%
Home (including apartment)	23,570	1,890	18,030	3,650	95%	97%	92%
Hotel or motel	2,090	400	1,280	410	91%	97%	88%
Store or office	4,940	1,150	2,450	1,340	90%	96%	86%
Grocery or convenience store	1,250	280	730	240	85%	94%	80%
Department store	520	180	220	120	89%	97%	86%
Office	940	210	510	220	88%	97%	85%
Manufacturing facility	2,720	650	900	1,170	91%	94%	86%
All storage	810	140	280	380	86%	95%	84%
Warehouse (excluding cold storage)	500	90	160	250	88%	95%	84%
All structures**	51,000	6,780	34,830	9,390	92%	96%	88%

* Includes nursing homes, hospitals, clinics, doctor's offices, substance abuse recovery centers or developmental disability facilities.
** Includes properties not listed separately above.

Note: In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. This field is not required if the fire did not begin within the designed range of the system.

Source: NFIRS and NFPA fire experience survey.

Table 6. Sprinkler Reliability and Effectiveness When Fire Was Coded as Not Confined, Was Large Enough to Activate Sprinkler, and Sprinkler Was Present in Area of Fire by Property Use: 2015–2019 Annual Averages, (Continued)

B. Wet Pipe Sprinkler Systems Only

Property Use	Number of fires per year where sprinklers were present	Non-confined fires too small to activate or unclassified operation	Fires coded as confined fires	Number of qualifying fires per year	Percent where equipment operated (A)	Percent effective of those that operated (B)	Percent where equipment operated effectively (A x B)
All public assembly	3,330	600	2,030	700	90%	94%	85%
Eating or drinking establishment	1,740	330	980	430	90%	93%	84%
Educational property	1,590	370	1,020	200	85%	97%	83%
Health care property*	2,960	570	2,050	330	88%	97%	85%
All residential	27,030	2,330	20,560	4,150	95%	97%	92%
Home (including apartment)	20,960	1,690	15,870	3,390	95%	97%	92%
Hotel or motel	1,850	350	1,130	370	92%	97%	90%
Store or office	4,270	1,030	2,030	1,210	91%	97%	88%
Grocery or convenience store	980	250	520	210	87%	95%	83%
Department store	460	160	190	110	88%	98%	86%
Office	820	190	440	180	89%	97%	86%
Manufacturing facility	2,290	540	770	980	92%	94%	87%
All storage	620	110	220	300	91%	95%	87%
Warehouse (excluding cold storage)	410	80	120	210	90%	96%	86%
All Structures**	44,160	5,920	29,870	8,370	92%	96%	89%

* Includes nursing homes, hospitals, clinics, doctor's offices, substance abuse recovery centers or developmental disability facilities.
** Includes properties not listed separately above.

Note: In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. This field is not required if the fire did not begin within the designed range of the system.

Source: NFIRS and NFPA fire experience survey.

Table 6. Sprinkler Reliability and Effectiveness When Fire Was Coded as Not Confined, Was Large Enough to Activate Sprinkler, and Sprinkler Was Present in Area of Fire by Property Use: 2015–2019 Annual Averages, (Continued)

C. Dry Pipe Sprinkler Systems Only

Property Use	Number of fires per year where sprinklers were present	Non-confined fires too small to activate or unclassified operation	Fires coded as confined fires	Number of qualifying fires per year	Percent where equipment operated (A)	Percent effective of those that operated (B)	Percent where equipment operated effectively (A x B)
All residential	2,770	230	2,280	260	91%	97%	89%
Homes	2,130	160	1,770	190	92%	98%	90%
Store or office	380	100	190	90	83%	94%	78%
Manufacturing facility	370	100	110	160	89%	93%	83%
All storage	180	30	70	80	79%	94%	74%
All structures*	5,040	690	3,540	800	87%	94%	82%

* Includes properties not listed separately above.

Note: These are percentages of fires reported to US municipal fire departments and so exclude fires reported only to federal or state agencies or industrial fire brigades. In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction were excluded. Percentages are based on estimated total fires reported in NFIRS with the indicated type of automatic extinguishing system and system performance not coded as fire too small to activate systems. Fires were excluded if the reason for failure or ineffectiveness was “system not present in area of fire.” Fires were recoded from “operated but ineffective” to “failed to operate” if the reason for failure or ineffectiveness was “system shut off.” Fires were recoded from “failed to operate” to “operated but ineffective” if the reason for failure or ineffectiveness was “not enough agent” or “agent did not reach fire.”

Source: NFIRS and NFPA fire experience survey.

Table 7. Number of Sprinklers That Operated in Structure Fires by Type of Sprinkler System (Excluding Properties Under Construction): 2015–2019 Annual Averages

Number of Sprinklers Operating	Percentage of structure fires where that many sprinklers operated		
	Wet Pipe	Dry Pipe	All Sprinklers (Including "other")
1	80%	47%	77%
1 or 2	91%	63%	89%
1 to 3	94%	71%	92%
1 to 4	96%	83%	95%
1 to 5	97%	90%	97%
1 to 10	99%	99%	99%

Note: Percentages are based on structure fires reported in NFIRS to US municipal fire departments and so exclude fires reported only to federal or state agencies or industrial fire brigades. Percentages are based on fires where sprinklers were reported as present and operating and there was reported information on the number of sprinklers that operated. Fires were excluded if the reason for failure or ineffectiveness was coded as "system not present in area of fire." Fires were recoded from "operated but ineffective" to "failed to operate" if the reason for failure or ineffectiveness was "system shut off." Fires were recoded from "failed to operate" to "operated but ineffective" if the reason for failure or ineffectiveness was "not enough agent" or "agent did not reach fire." In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. Buildings under construction were excluded, as were partial systems and fires reported as confined fires.

Source: NFIRS and NFPA fire experience survey.

Table 8. Reasons for Sprinkler Failure or Ineffectiveness in Structure Fires Large Enough to Activate Sprinkler Present in Fire Area (Excluding Fires with Confined Structure Fire Incident Types and Fires in Properties Under Construction): 2015–2019 Annual Averages

A. Reason Sprinkler Failed to Operate

Reason	All sprinklers		Wet pipe		Dry pipe	
System shut off	430	(57%)	340	(56%)	70	(64%)
Manual intervention defeated system	130	(18%)	120	(20%)	10	(8%)
Lack of maintenance	70	(10%)	60	(9%)	10	(12%)
System components damaged	70	(9%)	50	(9%)	10	(12%)
Inappropriate system for type of fire	40	(6%)	40	(6%)	0	(4%)
Total	750	(100%)	610	(100%)	100	(100%)

B. Reason Operating Sprinkler Was Ineffective

Reason	All sprinklers		Wet pipe		Dry pipe	
Water did not reach the fire	170	(50%)	140	(53%)	10	(36%)
Not enough water released	100	(31%)	70	(27%)	20	(50%)
Inappropriate system for type of fire	20	(7%)	20	(8%)	0	(3%)
System components damaged	20	(7%)	20	(8%)	0	(3%)
Lack of maintenance	10	(3%)	0	(1%)	0	(7%)
Manual intervention defeated system	10	(2%)	10	(3%)	0	(0%)
Total	340	(100%)	270	(100%)	40	(100%)

C. Reasons for Sprinkler Failure or Ineffectiveness Combined

Reason	All sprinklers		Wet pipe		Dry pipe	
System shut off	430	(39%)	340	(39%)	70	(47%)
Water did not reach the fire	170	(16%)	140	(16%)	10	(10%)
Manual intervention defeated system	140	(13%)	130	(15%)	10	(6%)
Not enough water released	100	(10%)	70	(8%)	20	(14%)
System components damaged	90	(8%)	80	(9%)	10	(10%)
Lack of maintenance	80	(8%)	60	(7%)	20	(11%)
Inappropriate system for type of fire	70	(6%)	60	(7%)	10	(4%)
Total	1,080	(100%)	880	(100%)	140	(100%)

Note: Buildings under construction were excluded, as were partial systems and fires reported as confined fires. Fires reported with unclassified reasons for failure were treated as cases of unknown reasons for failure.

Source: NFIRS and NFPA fire experience survey.

Table 9. Characteristics of Fatal Victims in Fires with Sprinklers vs. No Automatic Extinguishing Equipment: 2015–2019 Annual Averages

A. Number of Victims by Sprinkler Presence and Performance

Sprinkler/AES Status	**Deaths when sprinklers present**		**Deaths when no AES present**	
Total civilian deaths	36	(100%)	2,816	(100%)
Operated and effective	*18*	*(51%)*		
Operated but ineffective	*3*	*(8%)*		
Fire too small to operate	*9*	*(24%)*		
Failed to operate	*3*	*(9%)*		
Unclassified operation	*3*	*(8%)*		

B. Characteristics in Fires with Operating Sprinklers vs. No AES

Fire or Victim Characteristic	**Deaths when sprinklers present**		**Deaths when no AES present**	
With operating sprinklers	21	(100%)	2,816	(100%)
Victim in area of origin	18	(87%)	1,319	(50%)
Involved in ignition	*14*	*(66%)*	*976*	*(35%)*
Not involved in ignition	*4*	*(21%)*	*446*	*(16%)*
Victim 65 or older	11	(53%)	1,001	(36%)
Clothing on fire	8	(39%)	193	(7%)
Unable to act	7	(32%)	331	(12%)

Note: Here is an example of how to read this table: Almost nine out of every 10 people (87 percent) who died in fires despite the presence of operating sprinklers were located in the area of fire origin. Being closer to the fire makes it harder to escape. In comparison, only half of the fatal victims (50 percent) in fires in which no automatic extinguishing equipment was present were located in the area of fire origin.

Source: NFIRS and NFPA fire experience survey.

Fire Loss in the United States During 2020

Marty Ahrens and Ben Evarts

September 2021

Key Findings

In 2020, local fire departments responded to an estimated 1.4 million fires in the United States. These fires caused 3,500 civilian fire deaths and 15,200 reported civilian fire injuries. Property damage was estimated at $21.9 billion.

On average, a fire department responded to a fire somewhere in the US every 23 seconds in 2020. A home structure fire was reported every 89 seconds, a home fire death occurred every three hours and 24 minutes, and a home fire injury occurred every 46 minutes.

More than one-third of the fires (490,500 — or 35 percent) occurred in or on structures. Most fire losses were caused by these fires, including 2,730 civilian fire deaths (78 percent); 13,000 civilian fire injuries (86 percent); and $12.1 billion in direct property damage (55 percent). Major fires in the California wildland/urban interface (WUI) caused $4.2 billion in direct property damage (19 percent). Unfortunately, losses from these fires were not broken out by incident type. A substantial portion of the loss was undoubtedly due to structure fires.

Only one-quarter of the fires (26 percent) occurred in home properties, including one- or two-family homes and apartments or other multifamily housing, yet these fires caused three-quarters of the civilian fire deaths (74 percent) and injuries (76 percent).

One of every five fires (19 percent) occurred in one- or two-family homes, yet these fires caused nearly two-thirds of the civilian fire deaths (64 percent) and nearly three-fifths of the civilian fire injuries (57 percent). The 6 percent of fires that occurred in apartments caused 10 percent of the civilian fire deaths and 19 percent of the injuries.

Vehicle fires accounted for 15 percent of the fires, 18 percent of the civilian deaths, and 11 percent of the civilian injuries.

Neither structures nor vehicles were involved in half of the fires reported in 2020. These fires included brush, grass, or wildland fires — excluding crops, timber, and other properties of value (20 percent); outside rubbish fires (16 percent); outside fires involving property of value (6 percent); and other fires (7 percent).

The 2020 estimates of the number of fires were 40–64 percent lower than in 1980 for most of the major incident type categories. However, property loss, adjusted for inflation, was 10 percent higher in 2020 than in 1980. This was partially due to the previously mentioned California WUI fires and a $3 billion Navy ship fire.

The 2020 estimate of total fire deaths was 46 percent lower than in 1980, home fire deaths were 50 percent lower, deaths in one- or two-family home fires were 47 percent lower, and apartment fire deaths were 66 percent lower.

Because the US population has grown since 1980, population-based rates have dropped even more than the estimates have.

Less progress has been made in preventing deaths and injuries associated with reported fires. For overall home fires, the 2020 rate of 7.2 deaths per 1,000 reported home fires was almost identical to the rate of 7.1 in 1980. The rate for one- or two-family home fires was 16 percent higher than in 1980, while the rate for apartment fires was 43 percent lower.

Most of the reduction in reported fires and fire losses occurred more than a decade ago. There is still more work to do, particularly around home fires.

Introduction

In many ways, 2020 was an anomaly. With the COVID-19 pandemic, many businesses were shuttered. Some people worked remotely, some continued normal work, and still others lost their jobs. Overall, people spent more time at home.

An Acosta report released in September 2020 noted that 55 percent of shoppers were eating at home more often during the pandemic than before it began.[1] The Outdoor Foundation reported that 53 percent of Americans at least six years of age engaged in outdoor recreation at least once during 2020.[2] This was the highest outdoor recreational participation rate ever recorded. These are examples of how people's behaviors and routines changed during the pandemic. While we do not yet have national data on the causes of fires in 2020, increases and decreases in various activities were likely associated with the corresponding changes in related fires.

In 2020, local fire departments, including departments protecting towns, townships, cities, and counties, responded to an estimated 1,388,500 fires in the US. These fires caused an estimated 3,500 civilian deaths; 15,200 civilian injuries; and $21.9 billion in direct property damage. This report provides a breakdown of these fires. Firefighter fatalities and injuries are discussed in separate NFPA reports and are not included here.

On average, a fire department responded to a fire somewhere in the US every 23 seconds in 2020. A civilian was fatally injured in a fire every two hours and 31 minutes. Every 35 minutes, a civilian suffered a non-fatal fire injury.

The fire and fire loss estimates in this analysis are derived from NFPA's 2020 fire department experience survey (FES). Only fires reported to local fire departments are included. State fire agencies were also surveyed about large loss and catastrophic multiple-death fires. Such major incidents were added to the results from the FES. For more information on how these estimates were calculated, see *Methodology Used in Calculating National Estimates from NFPA's Fire Experience Survey*.

Trends

While some year-to-year fluctuation is normal, from 2019 to 2020, the total number of fires rose 8 percent, civilian deaths fell 6 percent, and civilian injuries fell 8 percent. The increase in total fires was statistically significant. Meanwhile, direct property damage was 1.5 times as high in 2020 as it was in 2019. The 2020 fire property damage included losses of $4.2 billion from California fires in the WUI and a California blaze that destroyed a naval ship ($3 billion). The WUI fires included a wide variety of incidents and property types; these could not be broken down further.

The estimate of total fires was 54 percent lower in 2020 than in 1980, while fire death and injury estimates were 46 percent and 50 percent lower, respectively, over the same period. Property loss, adjusted for inflation, was 10 percent higher than in 1980. See Figures 1–3.

US Census data shows that the resident population of the US grew 46 percent from 1980 to 2020. The resulting rate of 4.2 fires per 1,000 population in 2020 was 68 percent lower than the 13.1 rate in 1980 and 7 percent higher than the 2019 rate of 3.9.

The 10.6 civilian fire deaths per million population in 2020 was 63 percent lower than the 28.6 rate in 1980 and 6 percent lower than the rate of 11.3 in 2019. (See Figures 4 and 5.)

Figure 1. Reported fires by year

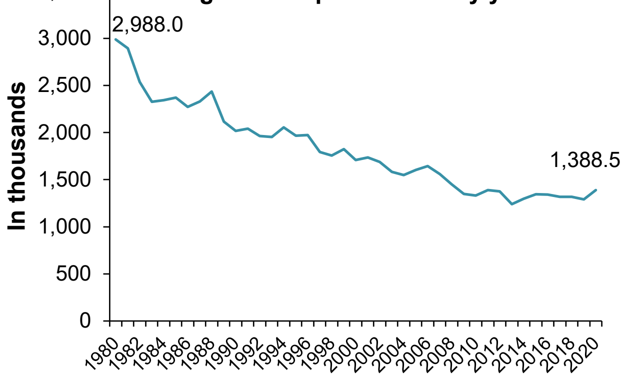


Figure 2. Civilian fire deaths by year

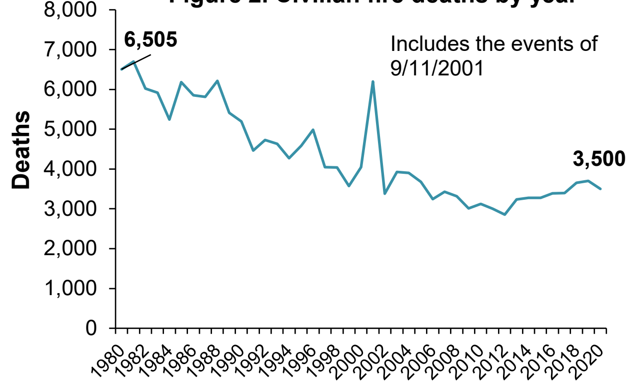


Figure 3. Estimated fire property loss by year*

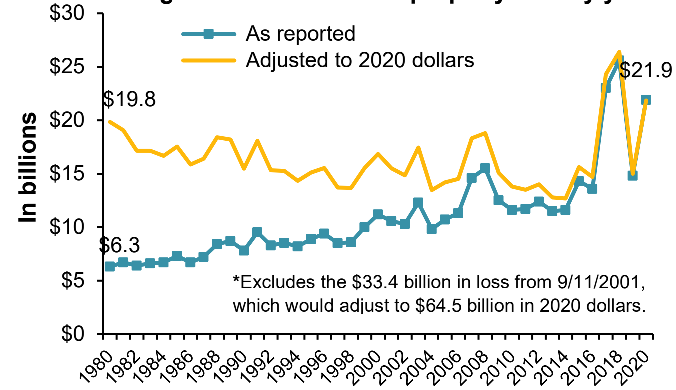
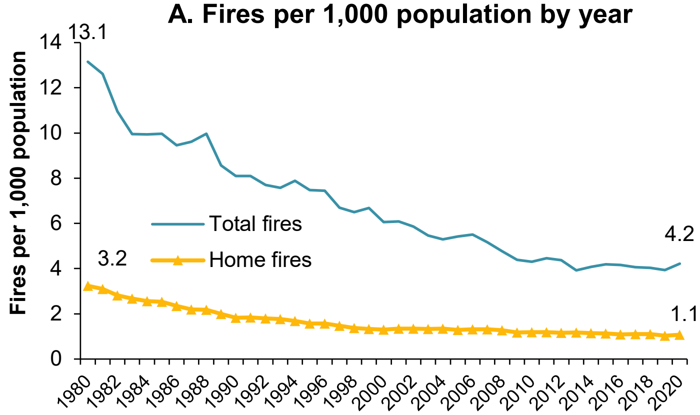
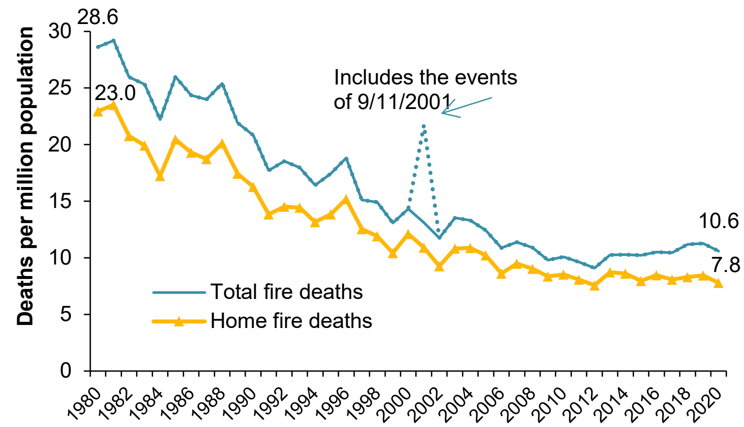


Figure 4. Population-based fire and civilian fire death rates: 1980–2020

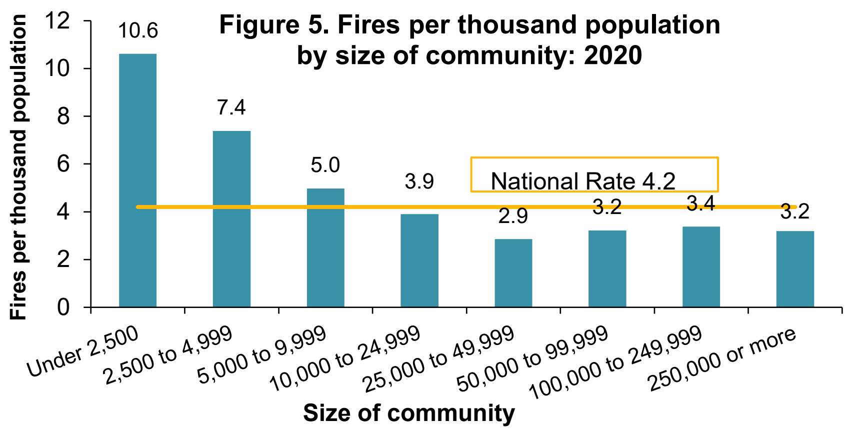
A. Fires per 1,000 population by year



B. Civilian fire deaths per million population



While smaller communities have fewer fires than larger communities, the 10.6 fires per 1,000 population for fire departments protecting communities with fewer than 2,500 people is 2.5 times the overall national rate. Fire departments in smaller communities are less likely to conduct fire prevention or code enforcement activities.[3] Open burning to get rid of debris might also be more common in these communities. Figure 5 shows that the rate of fires generally decreases as the population protected increases from very small to midsize, with the lowest population-based rate of fires found in departments protecting populations of at least 25,000.



The fire rates tell only part of the story. To really understand the US fire problem, the areas of progress, and the remaining challenges, we need to know more about where fires occur, the causes of these fires, and whether fires and casualties are increasing or decreasing in actual number and population-based rates. For information about specific fire causes or fires in specific occupancies, see nfpa.org/News-and-Research.

Table 1 provides a summary of fires, civilian casualties, and direct property loss by type of fire for 2020.

Definitions

Civilian: Anyone other than a firefighter.

Structure fire: In general, any fire in or on a structure is considered a structure fire, even if the structure itself is not damaged.

Homes: One- or two-family homes, including manufactured homes, and apartments, or other multifamily housing.

Non-home or other residential: Hotels, motels, dormitories, rooming houses, residential board and care, and unclassified residential.

Residential: Homes plus non-home or other residential.

Non-residential: Public assembly, educational (excluding dorms), institutional, stores or offices, industrial, utility, manufacturing or processing, storage, and bridges, tents, poles, and other special properties.

Highway vehicle: Vehicle intended for use on roadways, such as cars, trucks, motorcycles, buses, recreational vehicles in transit, etc. A vehicle burning inside a garage is considered a vehicle fire if the fire did not spread to the structure or other items.

Structure Fires

In 2020, the estimated 490,500 structure fires (35 percent of the reported fires) caused 2,730 civilian fire deaths (78 percent of total civilian fire deaths); 13,000 civilian injuries (86 percent); and $12.1 billion in direct property damage (55 percent). While structure fires probably dominated the $4.2 billion in property loss from California wildfires, it is not possible to disaggregate these fires by incident type or occupancy.

Table 1. Reported Fires in 2020 by Incident Type

Incident Type	Fires		Civilian Deaths		Civilian Injuries		Property Loss (In Millions)[1]	
Fires in California Wildland-Urban Interface (WUI)							**$4,200**	**(19%)**
Structure Fire	**490,500**	**(35%)**	**2,730**	**(78%)**	**13,000**	**(86%)**	**$12,107**	**(55%)**
Residential structure fire	**379,500**	**(27%)**	**2,630**	**(75%)**	**11,900**	**(78%)**	**$8,703**	**(40%)**
Home structure fire	356,500	(26%)	2,580	(74%)	11,500	(76%)	$8,400	(38%)
One- and two-family home, including manufactured homes	*270,500*	*(19%)*	*2,230*	*(64%)*	*8,600*	*(57%)*	*$6,771*	*(31%)*
Apartment or other multifamily housing	*86,000*	*(6%)*	*350*	*(10%)*	*2,900*	*(19%)*	*$1,629*	*(7%)*
Other residential structure fire	*23,000*	(2%)	50	(1%)	400	(3%)	$303	(1%)
Non-residential structure fire	111,000	(8%)	100	(3%)	1,100	(7%)	$3,404	(16%)
Vehicle Fire	**209,500**	**(15%)**	**630**	**(18%)**	**1,700**	**(11%)**	**$5,170**	**(24%)**
Highway vehicle fire	173,000	(12%)	580	(17%)	1,500	(10%)	$1,615	(7%)
Other vehicle fire*	36,500	(3%)	50	(1%)	200	(1%)	$3,555*	(16%)
Outside and Other Fire**	**688,500**	**(50%)**	**140**	**(4%)**	**500**	**(3%)**	**$389**	**(2%)**
Fire outside but no vehicle (outside storage, crops, timber, etc.)	84,000	(6%)	**	**	**	**	$210	(1%)
Fires in brush, grass, or wildland (excluding crops and timber) with no dollar loss	277,000	(20%)	**	**	**	**	**	**
Outside rubbish fire	225,000	(16%)	**	**	**	**	**	**
All other fires	102,500	(7%)	**	**	**	**	$179	(1%)
Total	**1,388,500**	**(100%)**	**3,500**	**(100%)**	**15,200**	**(100%)**	**$21,866**	**(100%)**

* Includes a $3 billion naval ship fire in California.
** Casualty data is not reported for subcategories of outside and other fires. Property damage is not captured for brush, grass, or wildland with no loss or outside rubbish fires.
Note: Sums may not equal totals due to rounding errors.
Source: NFPA's 2020 survey of fire departments for US fire experience and surveys of state fire authorities for large loss and catastrophic multiple-death fires.

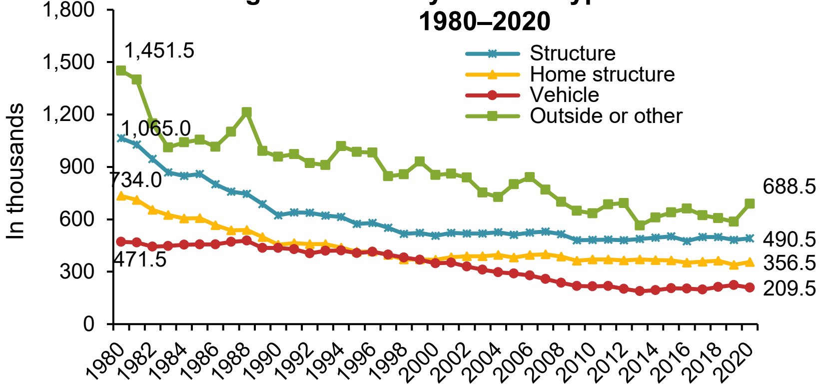


Figure 6. Fires by incident type in the US: 1980–2020

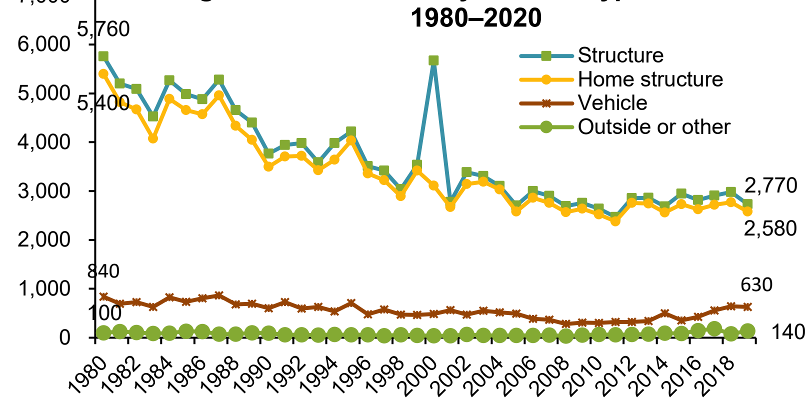


Figure 7. Fire deaths by incident type in the US: 1980–2020

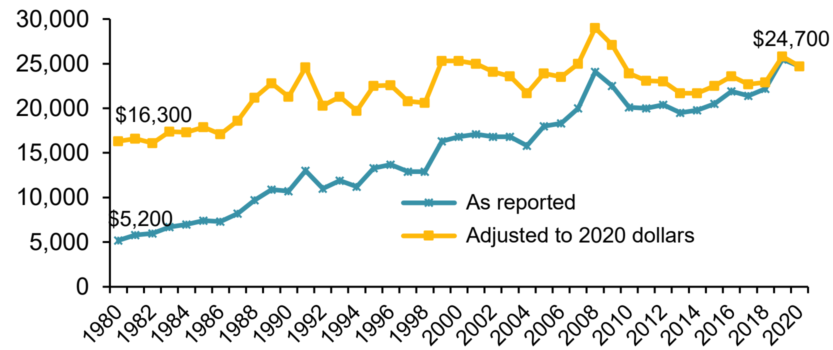
In 2020, on average, fire departments responded to a structure fire every 64 seconds, a structure fire death occurred every three hours and 13 minutes, and a structure fire injury occurred every 41 minutes.

From 2019 to 2020, the number of structure fires rose 2 percent, while associated civilian deaths fell 8 percent, civilian injuries fell 6 percent, and property damage fell 1 percent. The estimate of the total number of structure fires was 54 percent lower in 2020 than in 1980, while structure fire death and injury estimates were 52 percent and 47 percent lower, respectively, over the same period. Although somewhat lower in 2020, structure fires cause 80–90 percent of the civilian fire deaths and injuries in most years, with the events of September 11, 2001, contributing to a high of 92 percent in 2001. See Figures 6 and 7.

Figure 8 shows that the average loss per structure fire, adjusted for inflation, was 1.5 times as high in 2020 ($24,700) as in 1980 ($16,300).

In 2020, an estimated 379,500 total residential structure fires (27 percent) caused 2,630 civilian deaths (75 percent); 11,900 civilian injuries (78 percent); and $8.7 billion in direct property damage (40 percent). From 2019 to 2020, residential structure fires rose 5 percent, associated civilian deaths fell 8 percent, civilian injuries fell 6 percent, and residential fire property damage rose 9 percent. The increase in residential fires was statistically significant.

Figure 8. Average loss per structure fire: 1980–2020



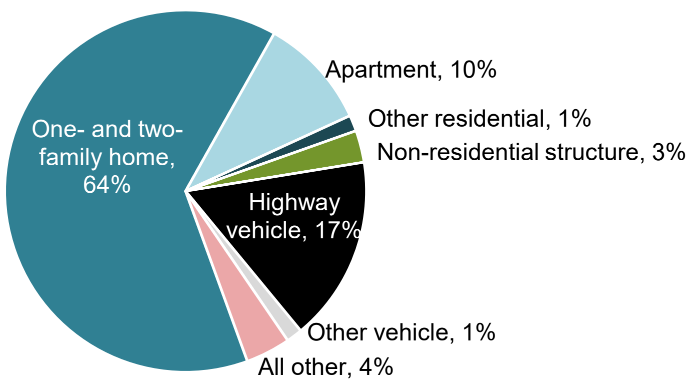
Excludes the $33.4 billion loss from 9/11/2001, which would adjust to $64.4 billion in 2020 dollars.

The estimate of 379,500 residential structure fires reported in 2020 was 50 percent lower than the 757,500 in 1980. Residential structure fire deaths fell 52 percent from 5,446 in 1980 to 2,630 in 2020.

The 2020 estimate of 11,900 residential fire injuries was 44 percent lower than the 21,100 in 1980.

See Figure 9 for a breakdown of 2020 fire deaths by type of fire.

Figure 9. Civilian fire deaths by incident type and occupancy: 2020



Home Structure Fires

The 356,500 home structure fires in 2020 (26 percent) caused 2,580 civilian fire deaths (74 percent); 11,500 civilian injuries (76 percent), and $8.4 billion in direct property damage (38 percent). On average, a home structure fire was reported every 89 seconds, a home fire death occurred every three hours and 24 minutes, and a home fire injury occurred every 46 minutes.

From 2019 to 2020, the number of home structure fires rose 5 percent, associated civilian deaths fell 7 percent, civilian injuries fell 6 percent, and home fire property damage rose 8 percent. With the COVID-19 pandemic, more people spent more time at home during 2020. This meant more cooking; more use of heating, air conditioning, and other equipment; and other activities that can contribute to home fires, which could account for the increase.

However, more people at home also means more people are available to assist in the event of a fire. This could have contributed to the reduction in fire deaths. Sesseng, Storesund, and Steen-Hansen found that being alone at the time of a fire was one of the common factors in fatal fires in Norway.[4]

With homes accounting for 94 percent of residential structure fires, it is not surprising that the pattern for home fires resembles that of residential structure fires. The estimated number of home structure fires was 51 percent lower in 2020 than in 1980, while estimates for home fire deaths and injuries were 50 percent and 42 percent lower, respectively.

Figure 4 shows that the population-based rates of home fires and home deaths were both 66 percent lower in 2020 than in 1980. The rate of reported home fires fell from 3.2 per thousand population in 1980 to 1.1 in 2020, while the home fire death rate dropped from 23.0 per million population to 7.8 per million population over the same period. The trend lines for the home fire death rate and total fire death rate are very similar.

For information on the causes and circumstances of home fires, see NFPA's report, *Home Structure Fires.* For information about deaths and injuries caused by home fires, see NFPA's report, *Home Fire Victims by Age and Gender.*

In 2020, the 270,500 one- or two-family home structure fires (19 percent) caused 2,230 civilian fire deaths (64 percent); 8,600 civilian fire injuries (57 percent); and $6.8 billion in direct property damage (31 percent). From 2019 to 2020, fires in one- or two-family homes rose 2 percent, while deaths fell 7 percent, injuries fell 2 percent, and property damage rose 5 percent. The estimated number of structure fires in one- or two-family homes was 54 percent lower in 2020 than in 1980, while estimated deaths and injuries were both 47 percent lower.

The 86,000 apartment or other multifamily housing fires in 2020 (6 percent) caused 350 civilian fire deaths (10 percent); 2,900 civilian fire injuries (19 percent), and $1.6 billion in direct property damage (7 percent). From 2019 to 2020, the number of reported apartment fires jumped 15 percent, a statistically significant increase, returning to roughly the 2018 level after a steep decline from 2018 to 2019. From 2019 to 2020, apartment fire deaths fell 8 percent, injuries fell 15 percent, and property damage jumped 22 percent, returning to 2017–2018 levels.

The estimated number of apartment structure fires was 40 percent lower in 2020 than in 1980, while apartment fire deaths and apartment fire injuries were 66 percent and 19 percent lower, respectively. The 2020 apartment injury estimate is the lowest seen since the survey began.

Less progress has been made in reducing deaths and injuries in reported home fires. In 1980, there were 7.1 deaths per 1,000 reported home fires overall. This was also true for one- or two-family homes and apartments. In 2020, the 7.2 deaths per 1,000 reported home fires was actually 2 percent higher than in 1980. In comparison, the death rate per 1,000 reported apartment fires dropped 43 percent to 4.1.

Apartment buildings, particularly high-rise apartments, are more regulated than one- or two-family homes where the 2020 rate of 8.2 deaths per 1,000 reported fires was 16 percent higher than in 1980.

While the rates fluctuated, 1984 was the only one year in which the death rate (6.5) per 1,000 one- or two-family home fires was lower than it was in 1980. Apartment fire-based death rates have had a fairly consistent downward trend. In many years, the death rate per 1,000 total home fires was higher than in 1980 because there are more reported fires in one- or two-family than there are in apartments. See Figure 10.

Figure 11 shows that the 2020 rate of 34 civilian injuries per 1,000 apartment fires was 34 percent higher than the 1980 rate of 25. For one- or two-family home fires, the 2020 rate of 32 injuries per 1,000 fires was 17 percent higher than the 1980 rate of 27. The 32 injuries per 1,000 reported home fires overall in 2020 was 20 percent higher than the rate of 27 in 1980.

Caution should be used when interpreting these results. Occupants who are alerted by smoke alarms may handle a small fire without fire department assistance, resulting in fewer small fires being reported. In addition, many apartment buildings have monitored fire detection that can result in a fire department response even when the system is triggered by a minor fire.

Figure 10. Deaths per 1,000 reported home fires by year and occupancy: 1980–2020

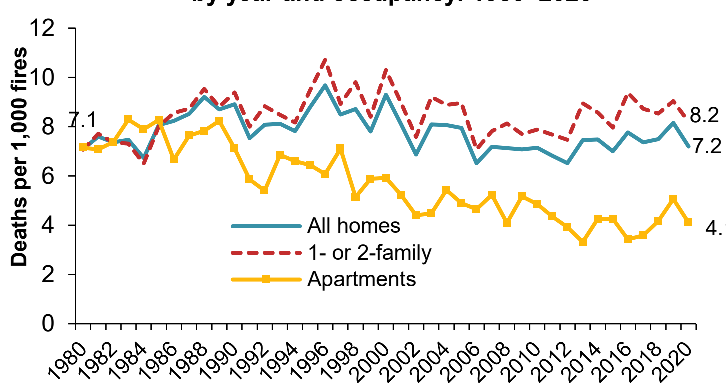
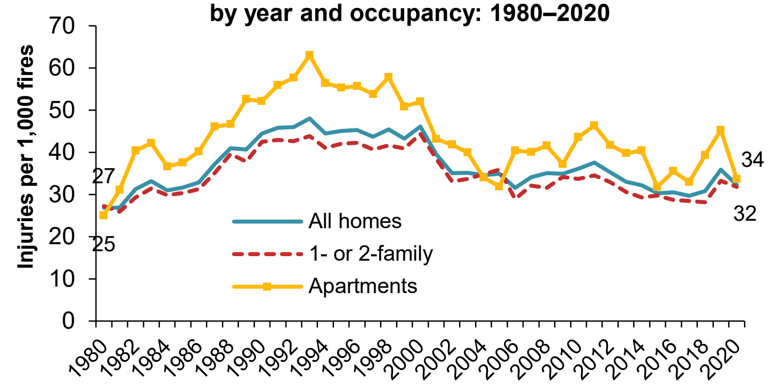


Figure 11. Injuries per 1,000 reported home fires by year and occupancy: 1980–2020



Non-Home Structure Fires

Non-home occupancies, including other residential properties such as dormitories, hotels and motels, rooming houses, and residential board and care occupancies, and non-residential properties, such as public assembly, educational, institutional, retail, office, manufacturing, and industrial or utility occupancies, are more regulated than home properties.

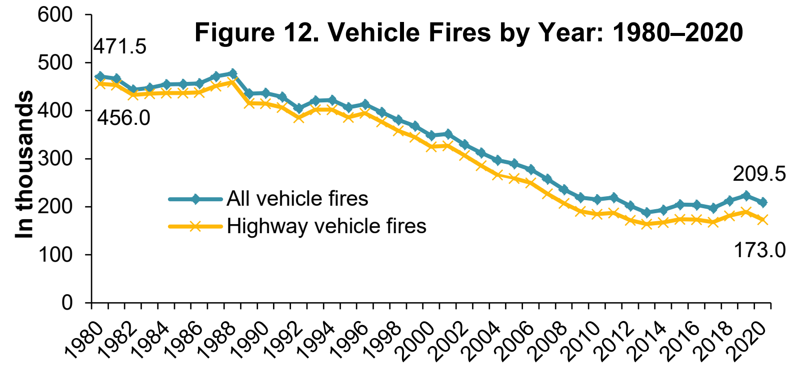
In 2020, the estimated 23,000 structure fires in other residential properties (2 percent) — including unclassified residential structures — caused 50 civilian fire deaths (1 percent), 400 civilian fire injuries (3 percent), and $303 million in direct property damage (1 percent). From 2019 to 2020, other residential structure fires rose 5 percent, deaths fell 50 percent, and injuries fell 20 percent. Direct property damage climbed 45 percent. The 2020 estimated number of other residential structure fires was 2 percent lower than in 1980; 2020 estimates of civilian fire deaths and injuries were 80 and 71 percent lower, respectively.

In 2020, the 111,000 non-residential structure fires (8 percent) caused an estimated 100 civilian fire deaths (3 percent); 1,100 civilian injures (7 percent); and $3.4 billion in direct property damage (16 percent). From 2019 to 2020, non-residential structure fires fell 8 percent, deaths fell 9 percent, injuries fell 8 percent, and direct property damage fell 21 percent. The 2020 estimate of non-residential structure fires was 64 percent lower than the 1980 estimate, while the estimates for civilian deaths and injuries were 56 and 70 percent lower, respectively.

NFPA has reports on the causes and circumstances of fires in many of these occupancies. For the latest annual averages of fires, civilian casualties, and property damage by occupancy or property use (currently 2015–2019), see *Fires by Occupancy or Property Type.*

Vehicle Fires in 2020

Vehicle fires are an often-overlooked part of the fire problem, yet in 2020, an estimated 209,500 vehicle fires (15 percent) caused 630 civilian fire deaths (18 percent); 1,700 civilian fire injuries (11 percent); and $5.2 billion in direct property damage (24 percent). More than half of the vehicle property loss resulted from a July 2020 naval ship fire in California that resulted in an estimated loss of $3 billion.



From 2019 to 2020, vehicle fires overall fell 6 percent, while vehicle fire deaths fell 2 percent, vehicle fire injuries fell 15 percent, and property damage more than doubled. The estimated number of vehicle fires was 56 percent lower in 2020 than in 1980. Estimates of deaths and injuries were 15 and 58 percent lower, respectively.

Eighty-three percent of the vehicle fires, 92 percent of the associated deaths, and 88 percent of the associated injuries resulted from fires involving highway vehicles. The 173,000 highway vehicle fires (12 percent of total fires) in 2020 caused an estimated 580 civilian fire deaths (17 percent); 1,500 civilian fire injuries (10 percent); and $1.6 billion in direct property damage (7 percent). Fire departments responded to an average of one highway vehicle fire every 3 minutes and 3 seconds.

The 9 percent decline in highway vehicle fires from 2019 to 2020 was statistically significant. In addition, highway vehicle fire deaths rose 5 percent, injuries fell 12 percent, and property damage fell 2 percent. The estimated number of highway vehicle fires in 2020 was 62 percent lower than the 1980 estimate, while the associated fire death estimate was only 11 percent lower, and the injury estimate was 47 percent lower.

For more information on the causes and circumstances of highway vehicle fires, see NFPA's 2020 report *Vehicle Fires*. Vehicles that burn inside a garage or other structure but do not damage the structure or spread to other contents are counted as vehicle fires and are the exception to the structure fire definition discussed earlier.

Other non-highway vehicles, such as boats or ships; aircraft; trains; and agricultural, garden, or industrial vehicles, were involved in an estimated 36,500 fires (3 percent) in 2020. These fires caused 50 civilian deaths (1 percent), 200 civilian injuries (1 percent), and $3.6 billion in direct property damage (16 percent). From 2019 to 2020, other vehicle fires rose 9 percent, while deaths fell 47 percent, injuries fell 33 percent, and property damage rose to six times the previous estimate.

The 2020 estimate of other non-highway vehicle fires was more than twice the 1980 estimate. It is possible that more such vehicles, including boats, planes, construction vehicles, and garden vehicles, are in use today. Despite this large increase in fires, the estimated number of deaths was 44 percent lower, and the number of injuries was 84 percent lower.

Outside and Other Fires in 2020

Half of the reported fires in 2020 (50 percent) were non-structural, non-vehicle fires or "other fires" that did not fit into any of the standard categories. The estimated 688,500 outside and other fires caused 140 civilian fire deaths (4 percent), 500 civilian fire injuries (3 percent), and $389 million in direct property damage (2 percent). Casualties were grouped together in this broad category and not subdivided further. A fire in an outside or unclassified property was reported every 46 seconds.

The 84,000 outside fires involving property of value (6 percent), such as outside storage, crops, timber, etc., caused $210 million in direct property damage (1 percent). Outside and other fires also included 277,000 brush, grass, and wildland fires, excluding crops and timber, (20 percent) and 225,000 outside rubbish fires (16 percent). Property damage information was not collected for these two incident types in NFPA's survey. The remaining 102,500 other non-structural, non-vehicle fires (7 percent) caused $179 million in direct property damage (1 percent).

From 2019 to 2020, outside and other fires of all types combined rose 17 percent, while associated deaths jumped 75 percent, injuries fell 29 percent, and direct property damage climbed 28 percent (excluding the major WUI fires in 2020). The estimated number of outside fires involving property of value, such as outside storage, crops, or timber — but not structures or vehicles — rose 19 percent, while property damage from these incidents rose 2 percent. Brush, grass, or wildland fires with no value or loss involved rose 13 percent. Outside rubbish fires rose 27 percent. Other fires rose 8 percent. Direct property damage from these other fires jumped 83 percent.

The increases in outside rubbish fires; outside fires involving property of value; and brush, grass, or wildland fires were statistically significant. Amidst the pandemic, the Centers for Disease Control and Prevention advised that outdoor activities carried less risk of exposure to COVID-19 than socializing indoors.[5] Increased outdoor time may have contributed to the increased prevalence of these fires.

The estimated number of outside and other non-structural, non-vehicular fires was 53 percent lower in 2020 than it was in 1980. The death estimate from these fires was 56 percent higher, while the estimated number of injuries was 64 percent lower. The estimated number of outside fires involving property of value was 3 percent lower in 2020 than in 1980. Figure 13 shows that the biggest decreases in this category were in the estimated number of brush, grass, or wildland fires with no value or loss (61 percent), other fires (59 percent), and outside rubbish fires (43 percent).

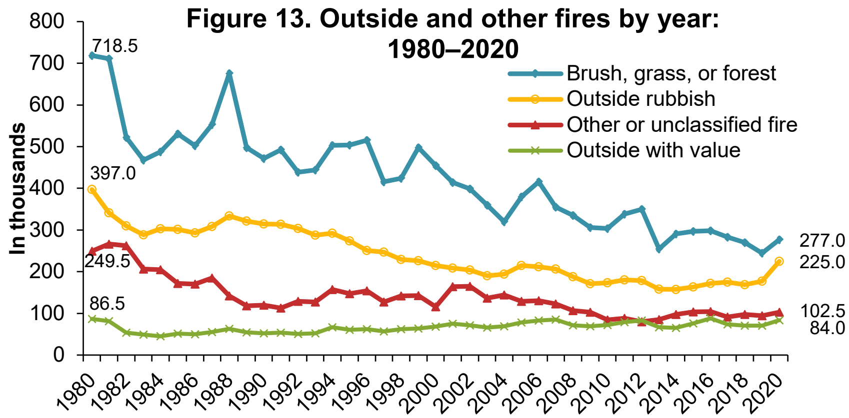


Figure 13. Outside and other fires by year: 1980–2020

Acknowledgments

NFPA is grateful to the many fire departments that responded to the 2020 fire experience survey for their continuing efforts to provide the data necessary to make national projections. The authors would also like to thank the members of the NFPA staff who worked on this year's survey, including Steve Belski, Frank Deely, and Jay Petrillo, for editing the survey forms and making follow-up calls to fire departments.

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[1] "New Acosta Report Details How COVID-19 Is Reinventing How America Eats," Acosta, September 2020. https://www.acosta.com/news/new-acosta-report-details-how-covid-19-is-reinventing-how-america-eats. Accessed August 5, 2021.

[2] *2021 Outdoor Participation Trends Report*. Outdoor Foundation. https://outdoorindustry.org/wp-content/uploads/2015/03/2021-Outdoor-Participation-Trends-Report.pdf. Accessed August 5, 2021.

[3] Hylton Haynes. *Fourth Needs Assessment of the US Fire Service*. Quincy, MA: NFPA, 2016.

[4] Sesseng, Christian; Storesund, Karolina; and Steen-Hansen, Anne, "Analysis of fatal fires in Norway in the 2005–2014 period." RISE Fire Research, Report A17 20176:2, 2017. https://www.researchgate.net/profile/Karolina_Storesund/publication/325869441_Analysis_of_fatal_fires_in_Norway_in_the_2005-2014_period/links/5b29f4c04585150c633fb32d/Analysis-of-fatal-fires-in-Norway-in-the-2005-2014-period.pdf. Accessed August 23, 2021.

[5] "Outdoor and Indoor Activities," Centers for Disease Control and Prevention. Updated August 19, 2021. https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/outdoor-activities.html. Accessed September 15, 2021.

RESEARCH

Fire Loss in the United States:
Trend Tables

September 2021

NFPA Applied Research

Fire Losses in the United States — List of Trend Tables: 1980–2020

Acknowledgements

NFPA is grateful to the many fire departments that responded to the 2020 fire experience survey for their continuing efforts to provide the data necessary to make national projections. The authors would also like to thank the members of the NFPA staff who worked on this year's survey, including Steve Belski, Frank Deely, and Jay Petrillo, for editing the survey forms and making follow-up calls to fire departments.

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NFPA Index No. 3118

All Fires in the United States

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey (FES). The FES uses definitions from the US Fire Administration's National Fire Incident Reporting System (NFIRS

In some years, large conflagrations, such as the events of September 11, 2001, or fires in the wildland/urban interface (WUI), caused large losses that were not broken out by incident type. Such losses are part of the US fire problem but are not included in the tables about specific types of fires.

Fires that were reported to federal or state firefighting organizations, handled by industrial fire brigades, or not reported at all are not captured here. Estimates can be skewed by the inclusion or omission of one very serious fire. Anyone who is not a firefighter is considered a civilian.

For details about fires resulting in unusually large numbers of fire deaths or exceptionally large property losses, see NFPA's *Large-Loss Fires in the United States* and *Catastrophic Multiple-Death Fires* reports and the associated tables on the costliest and deadliest fires over time.

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] As Reported	In 2020 Dollars
1980	2,988,000	6,505	30,200	$6.3	$19.8
1981	2,893,500	6,700	30,450	$6.7	$19.1
1982	2,538,000	6,020	30,525	$6.4	$17.2
1983	2,326,500	5,920	31,275	$6.6	$17.1
1984	2,343,000	5,240	28,125	$6.7	$16.7
1985	2,371,000	6,185	28,425	$7.3	$17.6
1986	2,271,500	5,850	26,825	$6.7	$15.8
1987	2,330,000	5,810	28,215	$7.2	$16.4
1988	2,436,500	6,215	30,800	$8.4	$18.4
1989	2,115,000	5,410	28,250	$8.7	$18.2
1990	2,019,000	5,195	28,600	$7.8	$15.5
1991	2,041,500	4,465	29,375	$9.5	$18.1
1992	1,964,500	4,730	28,700	$8.3	$15.3
1993	1,952,500	4,635	30,475	$8.5	$15.2
1994	2,054,500	4,275	27,250	$8.2	$14.3
1995	1,965,500	4,585	25,775	$8.9	$15.1
1996	1,975,000	4,990	25,550	$9.4	$15.5
1997	1,795,000	4,050	23,750	$8.5	$13.7
1998	1,755,500	4,035	23,100	$8.6	$13.7
1999	1,823,000	3,570	21,875	$10.0	$15.5
2000	1,708,000	4,045	22,350	$11.2	$16.9
2001[2]	1,734,500	6,196	21,100	$44.0	$64.5
2002	1,687,500	3,380	18,425	$10.3	$14.8
2003	1,584,500	3,925	18,125	$12.3	$17.3
2004	1,550,500	3,900	17,875	$9.8	$13.5
2005	1,602,000	3,675	17,925	$10.7	$14.2

All Fires in the United States (Continued)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] As Reported	In 2020 Dollars
2006	1,642,500	3,245	16,400	$11.3	$14.5
2007	1,557,500	3,430	17,675	$14.6	$18.2
2008	1,451,500	3,320	16,705	$15.5	$18.7
2009	1,348,500	3,010	17,050	$12.5	$15.1
2010	1,331,500	3,120	17,720	$11.6	$13.8
2011	1,389,500	3,005	17,500	$11.7	$13.5
2012	1,375,000	2,855	16,500	$12.4	$14.0
2013	1,240,000	3,240	15,925	$11.5	$12.8
2014	1,298,000	3,275	15,775	$11.6	$12.7
2015	1,345,500	3,280	15,700	$14.3	$15.6
2016	1,342,000	3,390	14,650	$13.6	$14.7
2017	1,319,500	3,400	14,670	$23.0	$24.3
2018	1,318,500	3,655	15,200	$25.6	$26.4
2019	1,291,500	3,704	16,600	$14.8	$15.0
2020	1,388,500	3,500	15,200	$21.9	$21.9

[1]Individual incidents with large losses can affect the total for a given year.
[2]Estimates include 2,451 civilian deaths; 800 civilian injuries; and $33.44 billion in property loss resulting from the events of 9/11/01.

Note: Direct property damage figures do not include indirect losses, like business interruption.
Inflation adjustment to 2020 dollars was done using the Consumer Price Index Purchasing Power of the Dollar.

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

Structure Fire Problem in the United States

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey (FES). The FES uses definitions from the US Fire Administration's National Fire Incident Reporting System (NFIRS). In general, any fire that occurs in or on a structure is considered a structure fire, even if no damage was done to the structure itself. (Since the inception of Version 5.0 of NFIRS, a vehicle that burns inside a structure but does not damage the structure is considered a vehicle fire.)

In some years, large conflagrations, such as the events of September 11, 2001, or fires in the wildland/urban interface (WUI) or other areas, caused large losses that were not broken out by incident type. Such losses are part of the US fire problem but are not included in the tables about specific types of fires.

Fires that were reported to federal or state firefighting organizations, handled by industrial fire brigades, or not reported at all are not captured here. Estimates can be skewed by the inclusion or omission of one very serious fire. Anyone who is not a firefighter is considered a civilian.

For details about fires resulting in unusually large numbers of fire deaths or exceptionally large property losses, see NFPA's *Large-Loss Fires in the United States* and *Catastrophic Multiple-Death Fires* reports and the associated tables on the costliest and deadliest fires over time.

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] As Reported	In 2020 Dollars
1980	1,065,000	5,675	24,725	$5.5	$17.3
1981	1,027,500	5,760	25,700	$6.0	$17.1
1982	946,500	5,200	25,575	$5.7	$15.3
1983	868,500	5,090	26,150	$5.8	$15.1
1984	848,000	4,525	23,025	$5.9	$14.7
1985	859,500	5,265	23,350	$6.4	$15.4
1986	800,000	4,985	22,750	$5.8	$13.7
1987	758,000	4,880	23,815	$6.2	$14.1
1988	745,000	5,280	26,275	$7.2	$15.8
1989	688,000	4,655	24,025	$7.5	$15.7
1990	624,000	4,400	24,075	$6.7	$13.3
1991	640,500	3,765	24,975	$8.3	$15.8
1992	637,500	3,940	24,325	$7.0	$12.9
1993	621,500	3,980	26,550	$7.4	$13.3
1994	614,000	3,590	23,125	$6.9	$12.1
1995	573,500	3,985	21,725	$7.6	$12.9
1996	578,500	4,220	21,875	$7.9	$13.1
1997	552,000	3,510	20,375	$7.1	$11.5
1998	517,500	3,420	19,425	$6.7	$10.7
1999	523,000	3,040	18,525	$8.5	$13.2
2000	505,500	3,535	19,600	$8.5	$12.8
2001[2]	521,500	3,220	17,225	$8.9	$13.0
2002	519,000	2,775	15,600	$8.7	$12.5
2003	519,500	3,385	15,600	$8.7	$12.3
2004	526,000	3,305	15,525	$8.3	$11.4
2005	511,000	3,105	15,325	$9.2	$12.2

Structure Fire Problem in the United States (Continued)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] As Reported	In 2020 Dollars
2006	524,000	2,705	14,350	$9.6	$12.3
2007	530,500	3,000	15,350	$10.6	$13.2
2008	515,000	2,900	14,960	$12.4	$14.9
2009	480,500	2,695	14,740	$10.8	$13.0
2010	482,000	2,755	15,420	$9.7	$11.5
2011	484,500	2,640	15,635	$9.7	$11.2
2012	480,500	2,470	14,700	$9.8	$11.1
2013	487,500	2,855	14,075	$9.5	$10.6
2014	494,000	2,860	13,425	$9.8	$10.7
2015	501,500	2,685	13,000	$10.3	$11.3
2016	475,500	2,950	12,775	$10.4	$11.2
2017	499,000	2,815	12,160	$10.7	$11.3
2018	499,000	2,910	12,700	$11.1	$11.4
2019	481,500	2,980	13,900	$12.3	$12.5
2020	490,500	2,730	13,000	$12.1	$12.1

[1]Individual incidents with large losses can affect the total for a given year.
[2]Does not include the events of 9/11/01, which caused 2,451 civilian deaths; 800 civilian injuries; and $33.44 billion in property loss.

Note: Direct property damage figures do not include indirect losses, like business interruption.
Inflation adjustment to 2020 dollars was done using the Consumer Price Index Purchasing Power of the Dollar.

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

Home Structure Fire Problem in the United States

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey (FES). The FES uses definitions from the US Fire Administration's National Fire Incident Reporting System (NFIRS). In general, any fire that occurs in or on a structure is considered a structure fire, even if no damage was done to the structure itself. (Since the inception of Version 5.0 of NFIRS, a vehicle that burns inside a structure but does not damage the structure is considered a vehicle fire.) The term *home* encompasses one- and two-family homes, including manufactured homes, apartments, or other multifamily homes.

In some years, large conflagrations, such as the events of September 11, 2001, or fires in the wildland/urban interface (WUI) or other areas, caused large losses that were not broken out by incident type. Such losses are part of the US fire problem but are not included in the tables about specific types of fires.

Fires that were reported to federal or state firefighting organizations or not reported at all are not captured here. Estimates can be skewed by the inclusion or omission of one very serious fire. Anyone who is not a firefighter is considered a civilian.

For details about fires resulting in unusually large numbers of fire deaths or exceptionally large property losses, see NFPA's *Large-Loss Fires in the United States* and *Catastrophic Multiple-Death Fires* reports and the associated tables on the costliest and deadliest fires over time. For more information about home structure fires, see the NFPA report *Home Structure Fires* and the accompanying supporting tables.

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)[1] As Reported	In 2020 Dollars
1980	734,000	5,200	19,700	$2,848	$8,965
1981	711,000	5,400	19,125	$3,128	$8,898
1982	654,500	4,820	20,450	$3,147	$8,438
1983	625,500	4,670	20,750	$3,205	$8,328
1984	605,500	4,075	18,750	$3,362	$8,370
1985	606,000	4,885	19,175	$3,693	$8,879
1986	565,500	4,655	18,575	$3,464	$8,193
1987	536,500	4,570	19,965	$3,599	$8,205
1988	538,500	4,955	22,075	$3,897	$8,541
1989	498,500	4,335	20,275	$3,876	$8,103
1990	454,500	4,050	20,225	$4,157	$8,249
1991	464,500	3,500	21,275	$5,463	$10,388
1992	459,000	3,705	21,100	$3,775	$6,973
1993	458,000	3,720	22,000	$4,764	$8,541
1994	438,000	3,425	19,475	$4,215	$7,371
1995	414,000	3,640	18,650	$4,264	$7,247
1996	417,000	4,035	18,875	$4,869	$8,048
1997	395,500	3,360	17,300	$4,453	$7,187
1998	369,500	3,220	16,800	$4,273	$6,797
1999	371,000	2,895	16,050	$4,965	$7,718
2000	368,000	3,420	16,975	$5,525	$8,316
2001	383,500	3,110	15,200	$5,516	$8,074
2002	389,000	2,670	13,650	$5,931	$8,543
2003	388,500	3,145	13,650	$5,949	$8,384
2004	395,500	3,190	13,700	$5,833	$8,009
2005	381,000	3,030	13,300	$6,729	$8,926

Home Structure Fire Problem in the United States (Continued)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)[1] As Reported	In 2020 Dollars
2006	396,000	2,580	12,500	$6,832	$8,779
2007	399,000	2,865	13,600	$7,389	$9,227
2008	386,500	2,755	13,160	$8,243	$9,930
2009	362,500	2,565	12,650	$7,616	$9,194
2010	369,500	2,640	13,350	$6,928	$8,238
2011	370,000	2,520	13,910	$6,914	$7,971
2012	365,000	2,380	12,875	$7,010	$7,918
2013	369,500	2,755	12,200	$6,792	$7,549
2014	367,500	2,745	11,825	$6,826	$7,367
2015	365,500	2,560	11,075	$6,960	$7,512
2016	352,000	2,735	10,750	$7,231	$7,712
2017	357,000	2,630	10,600	$7,741	$8,078
2018	363,000	2,720	11,200	$8,022	$8,166
2019	339,500	2,770	12,200	$7,767	$7,767
2020	356,500	2,580	11,500	$8,400	$8,400

[1]Individual incidents with large losses can affect the total for a given year.

Note: Direct property damage figures do not include indirect losses, like business interruption.
Inflation adjustment to 2020 dollars was done using the Consumer Price Index Purchasing Power of the Dollar.

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

One- and Two-Family Home Structure Fires[1] in the United States

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey (FES). The FES uses definitions from the US Fire Administration's National Fire Incident Reporting System (NFIRS). In general, any fire that occurs in or on a structure is considered a structure fire, even if no damage was done to the structure itself. (Since the inception of Version 5.0 of NFIRS, a vehicle that burns inside a structure but does not damage the structure is considered a vehicle fire.) Manufactured homes are considered one- or two-family homes.

In some years, large conflagrations, such as the events of September 11, 2001, or fires in the wildland/urban interface (WUI) or other areas, caused large losses that were not broken out by incident type. Such losses are part of the US fire problem but are not included in the tables about specific types of fires.

Fires that were reported to federal or state firefighting organizations or not reported at all are not captured here. Estimates can be skewed by the inclusion or omission of one very serious fire. Anyone who is not a firefighter is considered a civilian.

For details about fires resulting in unusually large numbers of fire deaths or exceptionally large property losses, see NFPA's *Large-Loss Fires in the United States* and *Catastrophic Multiple-Death Fires* reports and the associated tables on the costliest and deadliest fires over time. For more information about home structure fires, see the NFPA report *Home Structure Fires* and the accompanying supporting tables.

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)[2] As Reported	In 2020 Dollars
1980	590,500	4,175	16,100	$2,447	$7,702
1981	574,000	4,430	14,875	$2,713	$7,717
1982	538,000	3,960	15,750	$2,794	$7,492
1983	523,500	3,825	16,450	$2,792	$7,255
1984	506,000	3,290	15,100	$2,945	$7,332
1985	501,500	4,020	15,250	$3,217	$7,734
1986	468,000	4,005	14,650	$2,992	$7,077
1987	433,000	3,780	15,200	$3,078	$7,017
1988	432,500	4,125	17,125	$3,349	$7,340
1989	402,500	3,545	15,225	$3,335	$6,972
1990	359,000	3,370	15,250	$3,534	$7,013
1991	363,000	2,905	15,600	$3,354	$6,378
1992	358,000	3,160	15,275	$3,178	$5,870
1993	358,000	3,035	15,700	$4,111	$7,370
1994	341,000	2,785	14,000	$3,537	$6,185
1995	320,000	3,035	13,450	$3,615	$6,144
1996	324,000	3,470	13,700	$4,121	$6,811
1997	302,500	2,700	12,300	$3,735	$6,028
1998	283,000	2,775	11,800	$3,642	$5,793
1999	282,500	2,375	11,550	$4,123	$6,409
2000	283,500	2,920	12,575	$4,639	$6,983
2001	295,500	2,650	11,400	$4,652	$6,809
2002	300,500	2,280	9,950	$5,005	$7,209
2003	297,000	2,735	10,000	$5,052	$7,120
2004	301,500	2,680	10,500	$4,948	$6,794
2005	287,000	2,570	10,300	$5,781	$7,668

One- and Two-Family Home Structure Fires[1] in the United States (Continued)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)[2] As Reported	In 2020 Dollars
2006	304,500	2,155	8,800	$5,936	$7,628
2007	300,500	2,350	9,650	$6,225	$7,773
2008	291,000	2,365	9,185	$6,892	$8,303
2009	272,500	2,100	9,300	$6,391	$7,716
2010	279,000	2,200	9,400	$5,895	$7,010
2011	274,500	2,105	9,485	$5,746	$6,624
2012	268,000	2000	8,825	$5,818	$6,572
2013	271,500	2,430	8,300	$5,626	$6,253
2014	273,500	2,345	8,025	$5,844	$6,389
2015	270,500	2,155	8,050	$5,799	$6,340
2016	257,000	2,410	7,375	$6,142	$6,635
2017	262,500	2,290	7,470	$6,141	$6,491
2018	276,500	2,360	7,800	$6,493	$6,695
2019	264,500	2,390	8,800	$6,428	$6,511
2020	270,500	2,230	8,600	$6,771	$6,771

[1]Includes manufactured homes.
[2]Individual incidents with large losses can affect the total for a given year.

Note: Direct property damage figures do not include indirect losses, like business interruption.
Inflation adjustment to 2020 dollars was done using the Consumer Price Index Purchasing Power of the Dollar.

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

Apartment or Multifamily Housing Structure Fires in the United States

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey (FES). The FES uses definitions from the US Fire Administration's National Fire Incident Reporting System (NFIRS). In general, any fire that occurs in or on a structure is considered a structure fire, even if no damage was done to the structure itself. (Since the inception of Version 5.0 of NFIRS, a vehicle that burns inside a structure but does not damage the structure is considered a vehicle fire.) In NFIRS 5.0, row houses and townhouses are considered apartments. Apartments in two-family homes or duplexes are not included here.

In some years, large conflagrations, such as the events of September 11, 2001, or fires in the wildland/urban interface (WUI) or other areas, caused large losses that were not broken out by incident type. Such losses are part of the US fire problem but are not included in the tables about specific types of fires.

Fires that were reported to federal or state firefighting organizations or not reported at all are not captured here. Estimates can be skewed by the inclusion or omission of one very serious fire. Anyone who is not a firefighter is considered a civilian.

For details about fires resulting in unusually large numbers of fire deaths or exceptionally large property losses, see NFPA's *Large-Loss Fires in the United States* and *Catastrophic Multiple-Death Fires* reports and the associated tables on the costliest and deadliest fires over time. For more information about home structure fires, see the NFPA report *Home Structure Fires* and the accompanying supporting tables.

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)[1] As Reported	In 2020 Dollars
1980	143,500	1,025	3,600	$401	$1,262
1981	137,000	970	4,250	$415	$1,180
1982	116,500	860	4,700	$353	$947
1983	102,000	845	4,300	$413	$1,073
1984	99,500	785	3,650	$417	$1,038
1985	104,500	865	3,925	$476	$1,144
1986	97,500	650	3,925	$472	$1,116
1987	103,500	790	4,765	$521	$1,188
1988	106,000	830	4,950	$548	$1,201
1989	96,000	790	5,050	$541	$1,131
1990	95,500	680	4,975	$623	$1,236
1991	101,500	595	5,675	$609	$1,158
1992	101,000	545	5,825	$597	$1,103
1993	100,000	685	6,300	$653	$1,171
1994	97,000	640	5,475	$678	$1,186
1995	94,000	605	5,200	$649	$1,103
1996	93,000	565	5,175	$748	$1,236
1997	93,000	660	5,000	$718	$1,159
1998	86,500	445	5,000	$631	$1,004
1999	88,500	520	4,500	$842	$1,309
2000	84,500	500	4,400	$886	$1,334
2001	88,000	460	3,800	$864	$1,265
2002	88,500	390	3,700	$926	$1,334
2003	91,500	410	3,650	$897	$1,264
2004	94,000	510	3,200	$885	$1,215
2005	94,000	460	3,000	$948	$1,257

Apartment or Multifamily Housing Structure Fires in United States (Continued)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)[1] As Reported	In 2020 Dollars
2006	91,500	425	3,700	$896	$1,151
2007	98,500	515	3,950	$1,164	$1,453
2008	95,500	390	3,975	$1,351	$1,628
2009	90,000	465	3,350	$1,225	$1,479
2010	90,500	440	3,950	$1,033	$1,228
2011	95,500	415	4,425	$1,168	$1,347
2012	97,000	380	4,050	$1,192	$1,346
2013	98,000	325	3,900	$1,166	$1,296
2014	94,000	400	3,800	$982	$1,074
2015	95,000	405	3,025	$1,161	$1,269
2016	95,000	325	3,375	$1,089	$1,176
2017	95,000	340	3,130	$1,600	$1,691
2018	86,500	360	3,400	$1,529	$1,577
2019	75,000	380	3,400	$1,339	$1,356
2020	86,000	350	2,900	$1,629	$1,629

[1]Individual incidents with large losses can affect the total for a given year.

Note: Direct property damage figures do not include indirect losses, like business interruption.
Inflation adjustment to 2020 dollars was done using the Consumer Price Index Purchasing Power of the Dollar.

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

Residential Structure Fire Problem in the United States

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey (FES). The FES uses definitions from the US Fire Administration's National Fire Incident Reporting System (NFIRS). In general, any fire that occurs in or on a structure is considered a structure fire, even if no damage was done to the structure itself. (Since the inception of Version 5.0 of NFIRS, a vehicle that burns inside a structure but does not damage the structure is considered a vehicle fire.) Residential structures include homes, hotels and motels, dormitories and related properties, rooming houses, unclassified residential properties, and, since NFIRS 5.0, residential board and care properties.

In some years, large conflagrations, such as the events of September 11, 2001, or fires in the wildland/urban interface (WUI) or other areas, caused large losses that were not broken out by incident type. Such losses are part of the US fire problem but are not included in the tables about specific types of fires.

Fires that were reported to federal or state firefighting organizations or not reported at all are not captured here. Estimates can be skewed by the inclusion or omission of one very serious fire. Anyone who is not a firefighter is considered a civilian.

For details about fires resulting in unusually large numbers of fire deaths or exceptionally large property losses, see NFPA's *Large-Loss Fires in the United States* and *Catastrophic Multiple-Death Fires* reports and the associated tables on the costliest and deadliest fires over time. To find annual averages of fires and losses by property use and broad incident type, use the NFPA Fires by Occupancy or Property Type tool.

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] As Reported	In 2020 Dollars
1980	757,500	5,446	21,100	$3.0	$9.4
1981	733,000	5,540	20,375	$3.3	$9.4
1982	676,500	4,940	21,100	$3.3	$8.8
1983	641,500	4,820	21,450	$3.3	$8.6
1984	623,000	4,240	19,275	$3.4	$8.5
1985	622,000	5,025	19,825	$3.8	$9.1
1986	581,500	4,770	19,025	$3.6	$8.5
1987	551,500	4,660	20,440	$3.7	$8.4
1988	552,500	5,065	22,600	$4.0	$8.8
1989	513,500	4,435	20,750	$4.0	$8.4
1990	467,000	4,115	20,650	$4.3	$8.5
1991	478,000	3,575	21,850	$5.6[1]	$10.7
1992	472,000	3,765	21,600	$3.9	$7.2
1993	470,000	3,825	22,600	$4.8[2]	$8.6
1994	451,000	3,465	20,025	$4.3	$7.5
1995	425,500	3,695	19,125	$4.4	$7.5
1996	428,000	4,080	19,300	$5.0	$8.3
1997	406,500	3,390	17,775	$4.6	$7.4
1998	381,500	3,250	17,175	$4.4	$7.0
1999	383,000	2,920	16,425	$5.1	$7.9
2000	379,500	3,445	17,400	$5.7	$8.6
2001	396,500	3,140	15,575	$5.6	$8.2
2002	401,000	2,695	14,050	$6.1	$8.8
2003	402,000	3,165	14,075	$6.1	$8.6
2004	410,500	3,225	14,175	$5.9	$8.1
2005	396,000	3,055	13,825	$6.9	$9.2

Residential Structure Fires in the United States (Continued)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] As Reported	In 2020 Dollars
2006	412,500	2,620	12,925	$7.0	$9.0
2007	414,000	2,895	14,000	$7.5	$9.4
2008	403,000	2,780	13,560	$8.6	$10.4
2009	377,000	2,590	13,050	$7.8	$9.4
2010	384,000	2,665	13,800	$7.1	$8.4
2011	386,000	2,550	14,360	$7.1	$8.2
2012	381,000	2,405	13,125	$7.2	$8.1
2013	387,000	2,785	12,575	$7.0	$7.8
2014	386,500	2,795	12,175	$7.0	$7.7
2015	388,000	2,605	11,575	$7.2	$7.9
2016	371,500	2,800	11,125	$7.4	$8.0
2017	379,000	2,710	10,910	$7.9	$8.4
2018	387,000	2,820	11,600	$8.3	$8.6
2019	361,500	2,870	12,700	$8.0	$8.1
2020	379,500	2,630	11,900	$8.7	$8.7

[1]Individual incidents with large losses can affect the total for a given year.

Note: Direct property damage figures do not include indirect losses, like business interruption.
Inflation adjustment to 2020 dollars was done using the Consumer Price Index Purchasing Power of the Dollar.

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

Non-Home Structure Fires in the United States

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey (FES). The FES uses definitions from the US Fire Administration's National Fire Incident Reporting System (NFIRS). In general, any fire that occurs in or on a structure is considered a structure fire, even if no damage was done to the structure itself. (Since the inception of Version 5.0 of NFIRS, a vehicle that burns inside a structure but does not damage the structure is considered a vehicle fire.) Non-home properties exclude one- or two-family homes and apartments but *include* other residential properties such as hotels and motels, dormitories and related properties, rooming houses, unclassified residential properties, and, since NFIRS 5.0, residential board and care properties.

In some years, large conflagrations, such as the events of September 11, 2001, or fires in the wildland/urban interface (WUI) or other areas, caused large losses that were not broken out by incident type. Such losses are part of the US fire problem but are not included in the tables about specific types of fires.

Fires that were reported to federal or state firefighting organizations or not reported at all are not captured here. Estimates can be skewed by the inclusion or omission of one very serious fire. Anyone who is not a firefighter is considered a civilian.

For details about fires resulting in unusually large numbers of fire deaths or exceptionally large property losses, see NFPA's *Large-Loss Fires in the United States* and *Catastrophic Multiple-Death Fires* reports and the associated tables on the costliest and deadliest fires over time. To find annual averages of fires and losses by property use and broad incident type, use the NFPA Fires by Occupancy or Property Type tool.

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] as Reported	in 2020 Dollars
1980	331,000	475	5,025	$2.6	$8.2
1981	316,500	360	6,575	$2.8	$8.0
1982	292,000	380	5,125	$2.6	$7.0
1983	243,000	420	5,400	$2.6	$6.8
1984	242,500	450	4,275	$2.5	$6.2
1985	253,500	380	4,175	$2.7	$6.5
1986	234,500	330	4,175	$2.4	$5.7
1987	221,500	310	3,850	$2.6	$5.9
1988	206,500	325	4,200	$3.3[3]	$7.2
1989	189,500	320	3,750	$3.6[4]	$7.5
1990	169,500	350	3,850	$2.6	$5.2
1991	176,000	265	3,700	$2.9	$5.5
1992	178,500	235	3,225	$3.2	$5.9
1993	163,500	260	4,550	$2.6	$4.7
1994	176,000	165	3,650	$2.7	$4.7
1995	159,500	345	3,075	$3.4	$5.8
1996	161,500	185	3,000	$3.1	$5.1
1997	156,500	150	3,075	$2.6	$4.2
1998	148,000	200	2,625	$2.4	$3.8
1999	152,000	145	2,475	$3.5	$5.4
2000	137,500	115	2,625	$3.0	$4.5
2001[2]	138,000	110	2,025	$3.4	$5.0
2002	130,000	105	1,950	$2.8	$4.0
2003	131,000	240	1,950	$2.7	$3.8
2004	130,500	115	1,825	$2.5	$3.4
2005	130,000	75	2,025	$2.5	$3.3

Non-Home Structure Fires in the United States Problem (Continued)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] as Reported	in 2020 Dollars
2006	128,000	125	1,850	$2.8	$3.6
2007	131,500	135	1,750	$3.2	$4.0
2008	128,500	145	1,800	$4.1	$4.9
2009	118,000	130	2,090	$3.2	$3.9
2010	112,500	115	2,070	$2.8	$3.3
2011	114,500	120	1,725	$2.8	$3.2
2012	115,500	90	1,825	$2.8	$3.2
2013	118,000	100	1,875	$2.7	$3.0
2014	126,500	115	1,600	$3.0	$3.3
2015	136,000	125	1,925	$3.3	$3.6
2016	123,500	215	2,025	$3.2	$3.5
2017	142,000	185	1,560	$3.0	$3.2
2018	136,000	190	1,500	$3.0	$3.1
2019	142,000	210	1,700	$4.5	$4.6
2020	134,000	150	1,500	$3.7	$3.7

[1]Individual incidents with large losses can affect the total for a given year.

[2]Does not include the events of 9/11/01, which caused 2,451 civilian deaths; 800 civilian injuries; and $33.44 billion in property loss.

Note: Direct property damage figures do not include indirect losses, like business interruption.
Inflation adjustment to 2020 dollars was done using the Consumer Price Index Purchasing Power of the Dollar.

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

Non-Residential Structure Fires in the United States

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey (FES). The FES uses definitions from the US Fire Administration's National Fire Incident Reporting System (NFIRS). In general, any fire that occurs in or on a structure is considered a structure fire, even if no damage was done to the structure itself. (Since the inception of Version 5.0 of NFIRS, a vehicle that burns inside a structure but does not damage the structure is considered a vehicle fire.) Non-residential properties exclude one- or two-family homes and apartments, hotels and motels, dormitories and related properties, rooming houses, unclassified residential properties, and, since NFIRS 5.0, residential board and care properties.

In some years, large conflagrations, such as the events of September 11, 2001, or fires in the wildland/urban interface (WUI) or other areas, caused large losses that were not broken out by incident type. Such losses are part of the US fire problem but are not included in the tables about specific types of fires.

Fires that were reported to federal or state firefighting organizations, handled by industrial fire brigades, or not reported at all are not captured here. Estimates can be skewed by the inclusion or omission of one very serious fire. Anyone who is not a firefighter is considered a civilian.

For details about fires resulting in unusually large numbers of fire deaths or exceptionally large property losses, see NFPA's *Large-Loss Fires in the United States* and *Catastrophic Multiple-Death Fires* reports and the associated tables on the costliest and deadliest fires over time. To find annual averages of fires and losses by property use and broad incident type, use the NFPA Fires by Occupancy or Property Type tool.

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] as Reported	in 2020 Dollars
1980	307,500	229	3,625	$2.4	$7.6
1981	294,500	220	5,325	$2.7	$7.7
1982	270,000	260	4,475	$2.5	$6.7
1983	227,000	270	4,700	$2.5	$6.5
1984	225,000	285	3,750	$2.5	$6.2
1985	237,500	240	3,525	$2.7	$6.5
1986	218,500	215	3,725	$2.3	$5.4
1987	206,500	220	3,375	$2.5	$5.7
1988	192,500	215	3,675	$3.2	$7.0
1989	174,500	220	3,275	$3.5	$7.3
1990	157,000	285	3,425	$2.5	$5.0
1991	162,500	190	3,125	$2.8	$5.3
1992	165,500	175	2,725	$3.1	$5.7
1993	151,500	155	3,950	$2.6	$4.7
1994	163,000	125	3,100	$2.6	$4.5
1995	148,000	290	2,600	$3.3	$5.6
1996	150,500	140	2,575	$3.0	$5.0
1997	145,500	120	2,600	$2.5	$4.0
1998	136,000	170	2,250	$2.3	$3.7
1999	140,000	120	2,100	$3.4	$5.3
2000	126,000	90	2,200	$2.8	$4.2
2001[2]	125,000	80	1,650	$3.2	$4.7
2002	118,000	80	1,550	$2.7	$3.9
2003	117,500	220	1,525	$2.6	$3.7
2004	115,500	80	1,350	$2.4	$3.3
2005	115,000	50	1,500	$2.3	$3.1
2006	111,500	85	1,425	$2.6	$3.3
2007	116,500	105	1,350	$3.1	$3.3
2008	112,000	120	1,400	$3.8	$3.9
2009	103,500	105	1,690	$3.0	$4.6
2010	98,000	90	1,620	$2.6	$3.6

Non-Residential Structure Fires in the United States (Continued)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] as Reported	in 2020 Dollars
2011	98,500	90	1,275	$2.6	$3.1
2012	99,500	65	1,525	$2.6	$3.0
2013	100,500	70	1,500	$2.6	$2.9
2014	107,500	65	1,250	$2.9	$2.9
2015	113,500	80	1,425	$3.1	$3.2
2016	104,000	150	1,650	$3.0	$3.4
2017	120,000	105	1,250	$2.8	$3.2
2018	112,000	90	1,100	$2.8	$3.0
2019	120,000	110	1,200	$4.4	$2.9
2020	111,000	100	1,100	$3.4	$4.5

[1]Individual incidents with large losses can affect the total for a given year.

[2]Does not include the events of 9/11/01, which caused 2,451 civilian deaths; 800 civilian injuries; and $33.44 billion in property loss.

Note: Direct property damage figures do not include indirect losses, like business interruption.
Inflation adjustment to 2020 dollars was done using the Consumer Price Index Purchasing Power of the Dollar.

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

Highway Vehicle Fires in the United States

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey (FES). The FES uses definitions from the US Fire Administration's National Fire Incident Reporting System (NFIRS.) Since the inception of Version 5.0 of NFIRS, a vehicle that burns inside a structure but does not damage the structure is considered a vehicle fire. Highway vehicles include cars, trucks, motorcycles, buses, recreational vehicles in transit, and other vehicles intended for roadway use. The term *highway* describes the type of vehicle, not the location of the fire. See the NFPA report *Vehicle Fires* for more information on the causes and circumstances of these incidents.

In some years, large conflagrations, such as the events of September 11, 2001, or fires in the wildland/urban interface (WUI) or other areas, caused large losses that were not broken out by incident type. Such losses are part of the US fire problem but are not included in the tables about specific types of fires.

Fires that were reported to federal or state firefighting organizations or not reported at all are not captured here. Estimates can be skewed by the inclusion or omission of one very serious fire. Anyone who is not a firefighter is considered a civilian.

For details about fires resulting in unusually large numbers of fire deaths or exceptionally large property losses, see NFPA's *Large-Loss Fires in the United States* and *Catastrophic Multiple-Death Fires* reports and the associated tables on the costliest and deadliest fires over time. To find annual averages of fires and losses by property use and broad incident type, use the NFPA Fires by Occupancy or Property Type tool.

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] as Reported	Direct Property Damage (in Billions)[1] in 2020 Dollars
1980	456,000	650	2,850	$0.5	$1.6
1981	453,000	770	2,900	$0.5	$1.4
1982	433,000	575	3,250	$0.5	$1.3
1983	435,500	670	3,400	$0.6	$1.6
1984	437,000	530	3,250	$0.6	$1.5
1985	437,000	770	3,250	$0.7	$1.7
1986	438,000	665	2,850	$0.7	$1.7
1987	451,000	755	2,900	$0.7	$1.6
1988	459,000	800	2,750	$0.8	$1.8
1989	415,500	560	2,750	$0.8	$1.7
1990	415,000	645	3,025	$0.8	$1.6
1991	406,500	530	2,675	$0.8	$1.5
1992	385,500	665	2,750	$0.8	$1.5
1993	402,000	540	2,400	$0.9	$1.6
1994	402,000	555	2,325	$1.0	$1.7
1995	386,000	490	2,275	$1.0	$1.7
1996	395,000	550	2,075	$1.1	$1.8
1997	377,000	450	1,950	$1.1	$1.8
1998	358,500	545	2,050	$1.1	$1.7
1999	345,000	450	1,600	$1.1	$1.7
2000	325,000	450	1,325	$1.2	$1.8
2001	327,000	470	1,750	$1.3	$1.9
2002	307,000	540	1,700	$1.2	$1.7
2003	286,000	455	1,400	$1.1	$1.6
2004	266,500	520	1,300	$1.0	$1.4
2005	259,000	500	1,450	$1.0	$1.3

Highway Vehicle Fires in the United States, (Continued)

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Billions)[1] as Reported	in 2020 Dollars
2006	250,000	445	1,075	$1.0	$1.3
2007	227,500	365	1,500	$1.1	$1.4
2008	207,000	350	850	$1.2	$1.4
2009	190,500	260	1,455	$1.0	$1.2
2010	184,500	285	1,440	$1.0	$1.2
2011	187,500	270	1,020	$1.0	$1.2
2012	172,500	300	800	$1.3	$1.5
2013	164,000	300	925	$1.1	$1.2
2014	167,500	310	1,275	$1.1	$1.2
2015	174,000	445	1,550	$1.2	$1.3
2016	173,000	280	1,075	$1.3	$1.4
2017	168,000	400	1,370	$1.5	$1.6
2018	181,500	490	1,300	$1.4	$1.4
2019	189,500	550	1,700	$1.6	$1.6
2020	173,000	580	1,500	$1.6	$1.6

[1]Individual incidents with large losses can affect the total for a given year.

Note: Direct property damage figures do not include indirect losses, like business interruption.
Inflation adjustment to 2020 dollars was done using the Consumer Price Index Purchasing Power of the Dollar.

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

Number of Fires by Type of Fire

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey. Fires that were reported to federal or state firefighting organizations, handled by industrial fire brigades, or not reported at all are not captured here. The term *highway vehicle* refers to vehicles intended for roadway use, such as cars, trucks, buses, motorcycles, recreational vehicles in transit, etc.

Year	Total	Structures	Outside of Structures with Value but No Vehicle (outside storage, crops, timber, etc.)	Highway Vehicles	Other Vehicles (Trains, Boats, Ships, Aircraft, Farm Vehicles, and Construction Vehicles)	Brush, Grass, and Wildland (excluding crops and timber) with No Value or Loss Involved	Rubbish Including Dumpsters (outside of structures), with No Value or Loss Involved	All Other Fires
1980	2,988,000	1,065,000	86,500	456,000	15,500	718,500	397,000	249,500
1981	2,893,500	1,027,500	81,000	453,000	13,500	711,000	341,000	266,500
1982	2,538,000	946,500	54,000	433,000	10,000	522,500	309,500	262,500
1983	2,326,500	868,500	49,500	435,500	11,500	467,500	288,000	206,000
1984	2,343,000	848,000	45,000	437,000	17,500	487,500	303,000	205,000
1985	2,371,000	859,500	51,500	437,000	18,500	531,000	301,500	172,000
1986	2,271,500	800,000	50,000	438,000	18,500	502,000	293,000	170,000
1987	2,330,000	758,000	55,000	451,000	20,000	553,000	308,500	184,500
1988	2,436,500	745,000	63,000	459,000	18,500	675,500	333,500	142,000
1989	2,115,000	688,000	54,500	415,500	20,000	498,000	321,000	118,000
1990	2,019,000	624,000	52,000	415,000	21,500	472,000	314,500	120,000
1991	2,041,500	640,500	53,500	406,500	22,000	492,000	314,000	113,000
1992	1,964,500	637,500	50,500	385,500	19,500	439,000	304,000	128,500
1993	1,952,500	621,500	52,000	402,000	18,500	444,000	287,500	127,000
1994	2,054,500	614,000	66,500	402,000	20,000	503,000	292,000	157,000
1995	1,965,500	573,500	61,000	386,000	20,500	503,500	274,000	147,000
1996	1,975,000	578,500	62,500	395,000	18,500	515,000	251,000	154,500
1997	1,795,000	552,000	56,500	377,000	20,000	415,500	247,000	127,000
1998	1,755,500	517,500	62,000	358,500	22,500	424,000	229,000	142,000
1999	1,823,000	523,000	64,000	345,000	23,500	498,000	226,500	143,000
2000	1,708,000	505,500	68,500	325,000	23,500	455,000	215,000	115,500
2001	1,734,500	521,500	75,000	327,000	24,500	414,000	208,500	164,000
2002	1,687,500	519,000	71,000	307,000	22,500	399,000	204,000	165,000
2003	1,584,500	519,500	66,000	286,000	26,000	360,000	190,500	136,500
2004	1,550,500	526,000	69,000	266,500	30,500	320,000	194,000	144,500
2005	1,602,000	511,000	78,000	259,000	31,000	379,500	215,000	128,500

Number of Fires by Type of Fire (Continued)

Year	Total	Structures	Outside of Structures with Value but No Vehicle (outside storage, crops, timber, etc.)	Highway Vehicles	Other Vehicles (Trains, Boats, Ships, Aircraft, Farm Vehicles, and Construction Vehicles)	Brush, Grass, and Wildland (excluding crops and timber), with No Value or Loss Involved	Rubbish Including Dumpsters (outside of structures), with No Value or Loss Involved	All Other Fires
2006	1,642,500	524,000	82,500	250,000	28,000	415,500	212,000	130,500
2007	1,557,500	530,500	85,000	227,500	30,500	355,000	206,500	122,500
2008	1,451,500	515,000	71,000	207,000	29,000	335,000	188,000	106,500
2009	1,348,500	480,500	69,000	190,500	28,500	306,000	171,000	103,000
2010	1,331,500	482,000	72,500	184,500	31,000	304,000	173,000	84,500
2011	1,389,500	484,000	79,000	187,500	31,500	338,000	180,500	88,500
2012	1,375,000	480,500	83,000	172,000	30,000	350,000	179,000	80,000
2013	1,240,000	487,500	67,000	164,000	24,000	254,500	158,000	85,000
2014	1,298,000	494,000	65,000	167,500	26,000	290,500	157,500	97,500
2015	1,345,500	501,500	76,000	174,000	30,000	297,000	163,000	103,500
2016	1,342,000	475,500	88,000	173,000	31,000	298,500	172,000	104,000
2017	1,319,500	499,000	74,000	168,000	29,500	283,000	174,500	91,000
2018	1,318,500	499,000	70,500	181,500	31,000	270,000	169,000	97,500
2019	1,291,500	481,500	70,500	189,500	33,500	244,500	177,500	94,500
2020	1,388,500	490,500	84,000	173,000	36,500	277,000	225,000	102,500

These estimates are based on data reported to the NFPA by fire departments that responded to the 1980–2018 fire experience survey.

Note: Direct property damage figures do not include indirect losses, like business interruption.
Inflation adjustment to 2020 dollars was done using the Consumer Price Index Purchasing Power of the Dollar.

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

Number of Civilian Fire Deaths by Type of Fire

The estimates below are based on fires reported to local (including county) fire departments and derived from the NFPA annual fire experience survey.

Anyone who is not a firefighter is considered a civilian. For details about fires resulting in unusually large numbers of fire deaths or exceptionally large property losses, see the NFPA report *Catastrophic Multiple-Death Fires* and the associated tables on the deadliest fires over time.

In general, any fire that occurs in or on a structure is considered a structure fire, even if no damage was done to the structure itself. (Since the inception of Version 5.0 of NFIRS, a vehicle that burns inside a structure but does not damage the structure is considered a vehicle fire.)

Year	Total	Structure	Home Structure	Vehicle	Outside or Other
1980	6,505	5,675	5,200	740	90
1981	6,700	5,760	5,400	840	100
1982	6,020	5,200	4,820	695	125
1983	5,920	5,090	4,670	725	105
1984	5,240	4,525	4,075	630	85
1985	6,185	5,265	4,885	825	95
1986	5,850	4,985	4,655	735	130
1987	5,810	4,880	4,570	805	125
1988	6,215	5,280	4,955	865	70
1989	5,410	4,655	4,335	685	70
1990	5,195	4,400	4,050	695	100
1991	4,465	3,765	3,500	605	95
1992	4,730	3,940	3,705	730	60
1993	4,635	3,980	3,720	595	60
1994	4,275	3,590	3,425	630	55
1995	4,585	3,985	3,640	535	65
1996	4,990	4,220	4,035	710	60
1997	4,050	3,510	3,360	480	60
1998	4,035	3,420	3,220	575	40
1999	3,570	3,040	2,895	470	60
2000	4,045	3,535	3,420	465	45
2001	6,196	5,671	3,110	485	40
2002	3,380	2,775	2,670	565	40
2003	3,925	3,385	3,145	475	65
2004	3,900	3,305	3,190	550	45
2005	3,675	3,105	3,030	520	50
2006	3,245	2,705	2,580	490	50
2007	3,430	3,000	2,865	385	45
2008	3,320	2,900	2,755	365	55
2009	3,010	2,695	2,565	280	35
2010	3,120	2,755	2,640	310	55

Number of Civilian Fire Deaths by Type of Fire (Continued)

Year	Total	Structure	Home Structure	Vehicle	Outside or Other
2011	3,005	2,640	2,520	300	65
2012	2,855	2,470	2,380	325	60
2013	3,240	2,855	2,755	320	65
2014	3,275	2,860	2,745	345	70
2015	3,280	2,685	2,560	500	95
2016	3,390	2,950	2,735	355	85
2017	3,390	2,815	2,630	430	145
2018	3,655	2,910	2,720	560	185
2019	3,704	2,980	2,770	644	80
2020	3,500	2,730	2,580	630	140

Source: *Fire Loss in the United States During 2020* and previous reports in the series.

APPENDIX D: 2021 Code Change Proposals

RB313.1-21

VRC: R313.1, R313.1.1

Proponents: Andrew Milliken (amilliken@staffordcountyva.gov)

2018 Virgina Residential Code

Revise as follows:

R313.1 Townhouse automatic fire sprinkler systems. ~~Notwithstanding the requirements of Section 103.3, where installed, an~~ An automatic residential fire sprinkler system ~~for *townhouses*~~ shall be ~~designed and installed in accordance with NFPA 13D or Section P2904.~~ installed in *townhouses.*

> **Exception:** An automatic residential fire sprinkler system shall not be required when additions or alterations are made to existing *townhouses* that do not have an automatic residential fire sprinkler system installed.

R313.1.1 Design and installation. Automatic residential fire sprinkler systems for *townhouses* shall be designed and installed in accordance with Section P2904 or NFPA 13D, 13, or 13R.

Reason Statement: This proposal is the same townhouse fire sprinkler requirement initially approved by the Board of Housing and Community Development during the 2018 Code Development Cycle. Recognizing that townhomes require homeowners to put their trust in their neighbors for fire safety, requiring fire sprinklers in townhomes provides active and built-in protection for homeowners against that risk for each townhome in the row.

Home fires are fast; sprinklers are faster. According to Underwriters Laboratories, modern home furnishing burn tests have measured the burn rates and times of older home furnishings, made up of materials using solid wood, wool and down, and compared them with today's home furnishings that contain mostly synthetic materials and electronics in addition to open-floor plans, larger homes and engineered lumber. The results? Today's home fires burn much faster, leaving less time for residents to get out of structures and posing new challenges for firefighters (www.youtube.com/watch?v=aDNPhq5ggoE).

Home fires are deadly; sprinklers save lives. According to National Fire Protection Association statistics for 2020, 74% of fire deaths occur in the home. Home fire sprinklers can save lives and property from fire. They respond quickly and effectively to fire, often extinguishing the fire before the fire department arrives. Only the sprinkler closest to the fire will activate, spraying water on the fire.

Homes need to be affordable; sprinklers are too. The national average for installing automatic fire sprinklers in new homes is $1.35 per sprinklered square foot. Putting that figure in perspective, people pay similar amounts for carpet upgrades, whirlpool baths, or granite countertops.

MYTH: "A smoke alarm provides enough protection." FACT: Smoke alarms alert occupants to the presence of danger, but do nothing to extinguish the fire. Home fire sprinklers respond quickly to reduce heat, flames, and smoke from a fire, giving residents valuable time to get out safely. Having a working smoke alarm cuts the chances of dying in a reported fire in half. However, if you have a reported fire in your home, the risk of dying decreases by about 85% when sprinklers are present.

MYTH: "Newer homes are safer homes; the fire and death problem is limited to older homes." FACT: Age of housing is a poor predictor of fire death rates. Yes, new construction codes allow for tighter construction and better draft-stopped homes, which help slow the spread of fire. However, these safeguards have not completely mitigated the home fire problem. The majority of home fires are caused by candles, smoking materials, cooking, arcing, and other occupant-based activities. These types of fires happen in old and new construction alike. Moreover, new methods of construction negatively impact occupant and firefighter life safety under fire conditions. The National Research Council of Canada (NRC) tested the performance of unprotected floor assemblies exposed to fire. The findings of the study, "The Performance of Unprotected Floor Assemblies in Basement Fire Scenarios," assert that these structures are prone to catastrophic collapse as early as six minutes from the onset of fire. The same UL study found that the synthetic construction of today's home furnishings add to the increased risk by providing a greater fuel load. Larger homes, open spaces, increased fuel loads, void spaces, and changing building materials contribute to: faster fire propagation, shorter time to flashover, rapid changes in fire dynamics, shorter escape time, shorter time to collapse

MYTH: "Home fire sprinklers are expensive and will make housing unaffordable, especially for first-time buyers moving to our area." FACT: The fact is that home fire sprinklers are affordable. In 2013, the Fire Protection Research Foundation issued its updated Home Fire Sprinkler Cost Assessment report, which revealed that the cost of installing home fire sprinklers averages $1.35 per sprinklered square foot for new construction. That's down from $1.61 per sprinklered square foot that was in the Foundation's 2008 report. To put the cost of sprinklers into perspective, many people pay similar amounts for carpet upgrades, a paving stone driveway, or a whirlpool bath. Installing home fire sprinklers can help residents significantly reduce property loss in the event of fire, cut homeowner insurance premiums, and help support local fire service efforts.

MYTH: "We don't need sprinkler requirements; they can be installed in homes voluntarily."FACT: Fire sprinklers are a U.S. model building code requirement for all new, one- and two-family homes. If a new home is lacking this safety feature, it is not adhering to national model building codes, and should therefore be considered substandard. Adopting this requirement to sprinkler new homes provides a greater overall level of safety in communities. By requiring this technology, you are ensuring that a large number of residents can enjoy the same level of safety found in many offices, schools, apartments, and public buildings. Beyond the life-saving benefits of home sprinklers, there are other incentives; cities can reduce the strain on fire service personnel, limit damage to property, and help conserve municipal water resources by reducing the amount of water needed to fight fires.

MYTH: “Home fire sprinklers often leak or activate accidentally.” FACT: Leaks from fire sprinklers are very rare. Scottsdale, Arizona, for instance, has had an ordinance for home fire sprinklers since 1986. According to *NFPA's "U.S. Experience with Sprinklers" report, a survey conducted there found that the majority of residents living in sprinklered homes had never experienced a leak or maintenance problem. The report also noted that sprinklers operated in 94 percent of home fires in which sprinklers were present and fires were considered large enough to activate them. They were effective at controlling the fire in 96 percent of fires in which they operated. In three of every five home fires in which sprinklers failed to operate, the system had been shut off.*

MYTH: "If you want your home fire sprinklers to be reliable, they will need frequent, expensive maintenance.” FACT: The standard design for home fire sprinklers is much simpler than the design for more traditional sprinklers used in commercial buildings. If you install home fire sprinklers, the only “inspection and maintenance” you need to do are simple tasks outlined by the Home Fire Sprinkler Coalition, including simple flow tests and visual inspections.

MYTH: “When a fire occurs, every sprinkler will activate and everything in the house will be ruined." FACT: In the event of a fire, typically, only the sprinkler closest to the fire will activate, spraying water directly on the fire, leaving the rest of the house dry and secure. Roughly 85 percent of the time, only one sprinkler activates during a fire.

MYTH: “The water damage caused by fire sprinklers will be more extensive than fire damage.” FACT: Home fire sprinklers can significantly reduce property loss and damage due to a fire. The sprinkler will quickly control the heat and smoke from the fire, limiting damage to other areas of the house and giving residents valuable time to get out safely. Any resulting impact from the sprinkler will be much less severe than the damage caused by water from fire-fighting hose lines. Fire departments use up to eight-and-a-half times more water to extinguish a home fire as fire sprinklers would use to extinguish the same fire.

MYTH: “Home fire sprinklers are not practical in colder climates, as the pipes will freeze and cause water damage.” FACT: With proper installation, home fire sprinklers will not freeze in cold settings. NFPA 13D, Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes, sets forth guidelines on proper insulation to avoid pipes freezing.

MYTH: “Home fire sprinklers are unattractive and will ruin the aesthetics of our residents’ homes.”FACT: New home fire sprinkler models are very unobtrusive, can be mounted flush with walls or ceilings, and can be concealed behind decorative covers.

MYTH: “Any time a smoke alarm goes off it will activate the home fire sprinklers.” FACT: Each individual sprinkler is designed and calibrated to activate only during the heat from a fire. They do not operate in response to smoke, burned toast, cooking vapors, steam, or an activating smoke alarm.

https://ul.org/new-demonstration-video-shows-you-only-have-three-minutes-escape-home-fire

https://www.nfpa.org/Public-Education/Staying-safe/Safety-equipment/Home-fire-sprinklers/Fire-Sprinkler-Initiative/Take-action/Free-downloads/Myths-vs-facts

Resiliency Impact Statement: This proposal will increase Resiliency
This proposal will increase the minimum life safety infrastructure of new residential townhouses such that they are more resilient to the impact of fire. It ensures that fire sprinkler protection is built-in with each townhome and remains for the life span of the structure.

Cost Impact: The code change proposal will increase the cost of construction
According to a 2013 study by the Fire Research Foundation, the national average cost for installing a residential sprinkler system is $1.35 per square foot or $3,375 for a 2,500-square-foot home. A copy of that report is available at https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Suppression/HomeFireSprinklerCostAssessment2013.ashx. With the average construction cost of a new home at $114 per square foot in 2019, that’s paying a little more than 1% of a home’s value for 24/7 fire protection.

Attached Files

- **Fact Sheet - water supply.pdf**
  https://va.cdpaccess.com/proposal/1134/1554/files/download/659/
- **Fact Sheet - Townhouses.pdf**
  https://va.cdpaccess.com/proposal/1134/1554/files/download/658/

FACT SHEET

Water Supplies for Home Fire Sprinkler Systems

This document has been developed to dispel myths by providing factual information about water supply requirements for home fire sprinkler systems.

MYTH: ***Home fire sprinkler systems require expensive upgrades to a new home's water supply system.***

FACTS: Home fire sprinkler systems have become so efficient that they can often be designed to use the same or even less water than a new home's plumbing system.

- Fire sprinklers typically require only 7 pounds-per-square-inch (psi) to operate, which is less than the minimum required pressure for residential plumbing fixtures.

  Plumbing systems require:
  - 8 psi minimum pressure for any plumbing fixture.[1]
  - 20 psi minimum pressure for temperature controlled shower valves (these are mandatory in new homes).[2]
  - 40 psi minimum pressure for the main supply connection (applies to all homes with indoor plumbing, even those supplied by wells).[3]
- A single fire sprinkler can use as little as 8 gallons-per-minute (gpm). With home fire sprinkler systems typically designed to accommodate two simultaneously flowing sprinklers, 16 gpm may be all that's needed to supply fire sprinklers. This is actually less than the 18 gpm minimum that would be required by the Plumbing Code to supply plumbing fixtures in a typical entry-level home with 3 bedrooms, 2 bathrooms and 2 outdoor hose connections.[4]
- Fire sprinklers will typically require more water in larger, more expensive homes, but such homes tend to have more plumbing fixtures, which require an increased water supply for plumbing as well. One or two sprinklers must flow for a minimum of 7-10 minutes, which can be provided by a well and/or a small tank when sprinklers are not supplied by a water distribution system.

MYTH: ***Home fire sprinkler systems require big, expensive water meters.***

FACTS: When a fire sprinkler system is supplied by a water distribution system, water meter size is based on the required pressure and flow, which as stated above, may actually be greater for plumbing than for fire sprinklers. Fire sprinklers won't lead to increased meter or tap fees when the sprinkler system is able to be supplied by the same size meter that serves household plumbing.

A typical 5/8-inch meter will flow up to 20 gpm, which is adequate to operate a fire sprinkler system in many homes.[5] A 3/4-inch meter, which will flow well over 30 gpm, is capable of handling just about any home fire sprinkler system. Most often, the size of underground pipe leading to a house is much more limiting than the meter itself. Upsizing the underground piping

[1] International Residential Code (IRC) Table P2903.1
[2] IRC Section P2708
[3] IRC Section P2903.3
[4] IRC Table P2903.6 [17.5 fixture units: 2 bathroom groups, 1 kitchen group, 1 laundry group and 2 hose bibs], and IRC Table P2903.6(1)
[5] IRC Table P2904.6.2(2) [This is the prescriptive allowance for any meter. When a meter of known flow characteristics flows more, the higher flow may be used.]

between the meter and the house is an easy and inexpensive way to improve pressure and flow for all plumbing, including fire sprinklers, without a larger meter.

It's important to note some meter manufacturers' literature specify lesser flow limits, focusing on the range over which a meter will accurately measure continuous flow. With respect to supplying home fire sprinklers, meter flow limits should be evaluated based on the maximum flow rate rather than continuous flow accuracy limits. Water authorities should recognize that sprinklers will always use less water than fire hoses connected to unmetered fire hydrants that would otherwise be needed to put out a fire, so there is no legitimate value in requiring accurate measurement of sprinkler flow in the event of a fire

MYTH: Fire sprinkler systems require expensive backflow preventers.

FACTS: National plumbing codes never require backflow protection for home fire sprinkler systems fabricated with materials approved for household plumbing, such as CPVC, PEX or copper.[6] Occasionally, a local plumbing authority may nevertheless request a backflow preventer, not recognizing that fire sprinkler systems can be safety connected directly to a potable water supply.

Where backflow prevention is an issue because of a local requirement, there are several options whereby additional backflow controls for fire sprinklers can be avoided.

- Fire sprinklers can be incorporated as part of a multipurpose plumbing system that feeds both sprinklers and plumbing fixtures from a home's cold water plumbing pipes.
- Fire sprinklers can be supplied by a separate water connection, with a toilet connected to the end of sprinkler piping to ensure that the piping is occasionally purged by flushing the toilet to prevent stagnant water. This arrangement is referred to as "passive purge."
- Where a yard irrigation system is installed, backflow prevention will be required because such systems are subject to backflow of non-potable water. Fire sprinklers can share the irrigation backflow preventer; thereby, eliminating the need for an additional device.

MYTH: Rural water distribution systems and wells don't have enough water to supply home fire sprinklers.

FACTS: As indicated above, if the water distribution system or well provides enough water to supply household plumbing needs, the supply may be adequate for fire sprinklers. In some cases a larger pump or tank may be needed for sprinklers, but standard, off-the-shelf pumps and tanks suitable for plumbing systems are permitted. When such upgrades are provided, they actually benefit the owner on a daily basis beyond fire protection, because the home's plumbing system will be more robust. Additional water storage can also be invaluable for emergency use in the event of a natural disaster that interrupts utilities.

It should also be noted that, were a rural water distribution system found to be inadequate to supplying 16 gpm for fire sprinklers, it would probably fall short of the minimum code-required plumbing demand, and it would surely fall far short of the 1,000+ gpm needed from fire hydrants to support a fire department extinguishing a fire in an unsprinklered home.

About IRC Fire Sprinkler Coalition
Founded in 2007, the IRC Fire Sprinkler Coalition has grown to include more than 100 international, national and regional public safety organizations, including associations representing 45 states, all of whom support the mission of promoting residential fire sprinkler systems in new home construction. More information can be found at www.IRCFireSprinkler.org.

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[6] IRC Section P2904.1

INTERNATIONAL RESIDENTIAL CODE FIRE SPRINKLER COALITION

FACT SHEET
Fire Sprinkler Systems for Townhouses

Beginning with the 2009 edition, the International Residential Code (IRC) requires fire sprinkler systems to be provided as a standard feature in all newly constructed townhouses. This document provides information to dispel myths about the background and costs associated with townhouse fire sprinkler systems.

MYTH: Fire sprinkler systems are an expensive add-on in new townhouses that will negatively impact affordability.

FACTS: The IRC provides numerous financial offsets that reduce the cost of fire sprinklers. For example, townhouse separation walls are permitted to be 1-hour fire rated, rather than 2-hour, when sprinklers are provided. This single incentive can dramatically reduce the overall construction costs, when comparing the total cost of building a sprinklered townhouse with 1-hour separation walls vs an unsprinklered townhouse with 2-hour walls.

According to a 2010 estimate provided by a national “Top 10” multifamily builder, the cost savings associated with reducing a townhouse separation wall from a 2-hour rated assembly to a 1-hour rated assembly is approximately $2.20 per square foot of separation wall. Assuming a 2-story, 1,200 square foot townhouse measuring 20-feet by 30-feet with a pitched roof and attic, the incremental cost of providing a 2-hour wall versus a 1-hour wall would be $1,567. In comparison, the sprinkler system for this building, using the most recent national average cost of $1.35 per square foot cited by the National Fire Protection Research Foundation would be $1,620. Therefore, the firewall incentive alone could reduce the net cost of sprinklers to $53 in this example.

When other factors are considered, such as reduced fire access roadway widths, reduced fire hydrant and water main requirements, and the fact that sprinkler installation costs are often less for townhouses vs. single-family homes due to economies of scale, the overall cost of constructing a sprinklered townhouse community may be less than a non-sprinklered community.

MYTH: Residential sprinkler systems in townhouses are a new and unproven technology that is not yet ready for widespread use.

FACTS: The first residential sprinkler standard was written more than 45 years ago, in 1975, and according to U.S. government statistics, millions of families now live in sprinkler-properties. With respect to townhouses, the **Maryland Building Officials Association**, one of the original proponents of the IRC sprinkler requirement for townhouses in 2008, summed up their extensive experience with fire sprinklers in townhouses in their justification statement, as follows:

> “*Since 1990, townhouses in Maryland have been sprinklered and being so has not been detrimental to the home building industry, but has been a major success to saving lives over the past 18 years. To address reasonable fire protection and affordable housing, many Maryland jurisdictions over the years have permitted townhouse separation of one hour with sprinklers installed in accordance with NFPA 13D. Therefore, based on our past success with sprinklered townhouses with one-hour separations between the townhouses, MBOA is in support of mandatory sprinklers in townhouses with one-hour dwelling unit separations.*

MYTH: The IRC requirement to install fire sprinklers in townhouses was initiated by the fire service and the fire sprinkler industry and it was forced on builders.

FACTS: The code change proposal that added the IRC fire sprinkler requirement (Proposal RB66-07/08) was actually submitted by a major multifamily builder, AvalonBay Communities, and public comments supporting this change were submitted by the Maryland Building Officials Association and the New York State Building Officials Conference. As a major builder of multifamily residential properties, AvalonBay Communities developed extensive experience in installing fire sprinkler systems in townhouses and concluded that sprinkler systems were desirable, cost-effective and should be required as a standard feature in new townhouses.

MYTH: It's best to give home buyers the right to choose whether or not to have sprinklers, as opposed to having codes mandate these systems in all townhouses.

FACTS: It is a fundamental function of building codes to ensure safe housing. Home buyers don't get to choose whether their homes are built to withstand seismic forces, wind loads or snow loads. Likewise, home buyers aren't given the choice of having or not having safe electrical, plumbing, or mechanical systems or smoke alarms. Codes provide minimum requirements for all of these aspects of safe housing in the interest of public safety.

Fire sprinkler systems are no different. Just as car safety regulations have evolved over time from only requiring seat belts to now requiring air bags and backup cameras, building codes have evolved from requiring only smoke alarms to now requiring sprinkler systems for fire safety.

In the case of townhouses, it particularly makes sense for codes to require sprinkler systems because each family's safety is reliant on their neighbors. An accident or careless behavior in one unit often impacts multiple units in non-sprinklered townhouses. Fire sprinklers are the most effective way to ensure that a fire in one townhouse will not threaten families in adjacent units.

Furthermore, townhouses are typically constructed as "spec homes," without buyer involvement during the design or construction process. Adding sprinklers after-the-fact to a finished townhouse unit would greatly increase the cost and complexity of the installation, if it were feasible at all. Likewise, it makes no sense to allow an initial buyer, or the builder in the case of a speculative home, to opt out of fire sprinklers, knowing that such a choice will deny all future owners the option of having sprinklers, given that retrofit installations are typically not feasible.

About IRC Fire Sprinkler Coalition. Founded in 2007, the IRC Fire Sprinkler Coalition has grown to include more than 100 international, national and regional public safety organizations, including associations representing 45 states, all of whom support the mission of promoting residential fire sprinkler systems in new home construction. More information can be found at www.IRCFireSprinkler.org.

RB313.1(2)-21

VRC: SECTION R313, R313.1, R313.1.1, R313.2, R313.2.1

Proponents: Glenn Dean

2018 Virgina Residential Code

SECTION R313
AUTOMATIC FIRE SPRINKLER SYSTEMS

Revise as follows:

R313.1 Townhouse automatic fire sprinkler systems. ~~Notwithstanding the requirements of Section 103.3, where installed, an~~ An automatic residential fire sprinkler ~~system for *townhouses*~~ systems shall be ~~designed and installed in accordance with NFPA 13D or Section P2904.~~ installed in *townhouses* .

> **Exception:** An automatic residential fire sprinkler system shall not be required when additions or alterations are made to existing *townhouses* that do not have an automatic residential fire sprinkler system installed.

R313.1.1 Design and installation. Automatic residential fire sprinkler systems for *townhouses* shall be designed and installed in accordance with Section P2904 or NFPA ~~13D, 13, or 13R.~~ 13D.

R313.2 One- and two-family dwellings automatic fire sprinkler systems. ~~Notwithstanding the requirements of Section 103.3, where installed, a an~~ An automatic residential fire sprinkler system shall be designed and installed in ~~accordance with Section P2904 or NFPA 13D, 13 or 13R.~~ one- and two-family dwellings.

> **Exception:** An automatic residential fire sprinkler system shall not be required for additions or alterations to existing buildings that are not already provided with an automatic residential fire sprinkler system.

R313.2.1 Design and installation. Automatic residential fire sprinkler systems shall be designed and installed in accordance with Section P2904 or NFPA ~~13D, 13 or 13R.~~ 13D.

Reason Statement: I'm submitting this to revert to model code language because the facts supporting a sprinkler requirement in NEW residential construction have not changed over the years, nor have the falsehoods against it. The facts and falsehoods need not be enumerated – again – in this supporting statement. We already know what they are and have for decades. Because of materials used, lightweight construction, density of housing and so on, newly constructed houses burn quickly making the incorporation of sprinklers more imperative. Having a residential sprinkler system provides time for occupants to vacate before untenable conditions are created as they would be without the presence of sprinklers. The fragility of the construction industry is nothing new either. It has been fragile for decades and will continue to fragile for years to come. The same with the increase of housing costs. That's not new. It's always gone up and will continue to go up. By comparison, what I can't understand is the sacrificial cost of a human life when compared to the now relatively insignificant cost of installing residential sprinklers in new construction.

Resiliency Impact Statement: This proposal will increase Resiliency
If construction resiliency means to reduce, respond, adapt or avoid a failure due to a destructive event such as a fire, then yes, this proposal will increase resiliency.

Cost Impact: The code change proposal will increase the cost of construction
This code change might increase construction cost approximately one percent - OR LESS - particularly in light of the tradeoffs available.

RB313.1(3)-21

VRC: R313.1, R313.1.1

Proponents: Jeffrey Shapiro (jeff.shapiro@intlcodeconsultants.com)

2018 Virgina Residential Code

Revise as follows:

R313.1 Townhouse automatic fire sprinkler systems. An automatic sprinkler system shall be installed in townhouses.~~Notwithstanding the requirements of Section 103.3, where installed, an automatic residential fire sprinkler system for *townhouses* shall be *townhouses* designed and installed in accordance with NFPA 13D or Section P2904.P2904.~~

~~Exception~~ Exceptions : 1. *Townhouses* containing no more than three *townhouse units.*

2. An automatic ~~residential fire~~ sprinkler system shall not be required when additions or alterations are made to existing *townhouses* that do not have an automatic ~~residential fire~~ sprinkler system installed.

R313.1.1 Design and installation. Automatic ~~residential fire~~ sprinkler systems for *townhouses* shall be designed and installed in accordance with Section P2904 or NFPA 13D, 13, or 13R.

Reason Statement: This proposal provides a reasonable approach to providing fire safety in newly constructed Virginia townhouses, by including an option for townhouses with less than four units to be built without fire sprinklers. This exception specifically responds to concerns that have previously been raised in Virginia about the feasibility and cost of providing sprinklers in smaller townhouse projects and projects built in rural areas that lack a public water supply. Although 12 of the 13 states/DC that currently adopt the IRC requirement for townhouse sprinklers do not amend in an un-sprinklered unit threshold, and all of these states include the same types of rural and remote area that have been cited as being of concern in Virginia, it is hoped that this Virginia exception will provide a path that building officials, industry, and the fire service will view as reasonable and worthy of support.

Below is a list of considerations that are commonly discussed when reviewing adoption of the IRC's townhouse sprinkler requirement.

1. **Precedence - Adopt the model code requirement:** This proposal will realign the Virginia Residential Code with the IRC by retaining the IRC requirement for fire sprinklers in new townhouses, as modified by an exclusion for less than 4 townhouse units. The IRC requirement was first published in the 2009 IRC and has been retained in the 2012, 2015, 2018, 2021, and 2024 editions of the code. Thirteen state-level code adoptions [California, District of Columbia, Hawaii, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, New York (3+ stories above grade), Oklahoma, Pennsylvania, Washington (more than 4 units), Wisconsin] and numerous other jurisdictions, include the IRC townhouse sprinkler requirement. There is no evidence of negative impacts on home affordability or other detrimental issues associated with the adoption of townhouse sprinklers in any jurisdictions where the IRC requirement is in place.
2. **Parity with the Virginia Building Code:** Section 903.2.8 of the Virginia Building Code requires all townhouses, regardless of height or area, to be sprinklered. There is no technical basis for requiring fire sprinklers to be installed under the Virginia Building Code yet exempt the same requirement under the Residential Code. It is the intent of the IRC and this proposal to provide equal protection to residents of all townhouses with four or more units, regardless of which code they are built under.
3. **Increased fire risk associated with townhouses – They are multifamily occupancies:** Unlike detached homes, where an owner has direct control over personal safety, townhouses are multifamily structures that include many unrelated individuals and families living under a single roof. Clearly, there is no “owner’s choice” argument in the case of townhouses because the fire safety of at least two other families relies on the behavior of someone else who lives under the same roof, i.e. a neighbor’s accident, carelessness, or perhaps even unlawful activities such as a drug lab will impact your safety, your family’s safety, your pets’ safety (who may be home unattended when a fire occurs) and your property. There have been many incidents where a fire in one townhouse unit had catastrophic consequences on neighbors who had nothing to do with the cause of the fire. Residential fire sprinklers prevent such tragedies by keeping fires contained to the unit of origin, either controlling the fire or extinguishing it altogether. It is also worth noting that the National Fire Incident Reporting System codes townhouses as multifamily occupancies, separate from one- and two-family dwellings and recognizing that the risk associated with a townhouse fires is that of a multifamily occupancy.
4. **Increased danger of residential fire behavior:** Research conducted by the National Institute of Standards and Technology and Underwriters Laboratories on residential fire behavior and the value of residential fire sprinklers to firefighter and occupant safety provides a technical basis for this recommendation. Research shows that the rate of fire growth in modern residential structures has increased, partly attributed to an increased heat release rate and an increased heat of combustion associated with modern synthetic materials used in household goods and furnishings. Faster fire growth in a multifamily structure means that occupants of adjacent units will be endangered more quickly than was the case with legacy furnishings
5. **Increased risk to firefighters and demand on fire service resources from townhouses:** Townhouses place significantly increased demand on fire service resources as compared to detached dwellings. Townhouses increase the complexity of rescue operations, and firefighting is hampered because fire spread into adjacent units cannot be easily followed by firefighters from unit to unit. There are no access openings in party walls allowing firefighters to pass back and forth between opposite sides when fighting a fire. Furthermore, townhouses with

four or more units, which are the focus of this proposal, tend to be large structures that create the potential for large fires. Wind-driven flames from an uncontrolled residential fire can bypass rated separations and result in fire extension to adjacent units and structures and are challenging to emergency responders, particularly in rural areas served by diminishing volunteer and equipment resources.

6. **Sustainable housing and environmental impact:** In addition to life-safety and property protection attributes of fire sprinklers, research by FM Global has also verified the value of fire sprinklers in sustainable housing and protecting the environment from pollution associated with toxic smoke and contaminated runoff from manual firefighting. Of particular interest is the conclusion that a single fire event, in addition to destroying a townhouse, can offset the cumulative value of green construction and energy saving appliances, i.e. green efforts are negated if a fire occurs and sprinklers aren't installed as an insurance policy that remains ready to control it.
7. **Financial impact of townhouse sprinklers recognized by builders and cannot be equated to one- and two-family dwellings:** Arguments often conveyed by the building industry in opposition to residential sprinklers based on possible cost implications aren't relevant to townhouses because sprinklered townhouses can actually be less expensive to build than non-sprinklered townhouses. The difference is attributed to incentives that are offered by the IRC and the International Fire Code (IFC) for sprinklered properties. Unlike single family developments, where multiple builders might not be able to directly recoup the value of infrastructure incentives, townhouses are typically built in communities where the developer is the builder, so the cost reductions are directly realized. There's no better testament to this cost comparison than the fact that the IRC's townhouse sprinkler requirement was proposed (RB66-07/08) by a major national multifamily builder, Avalon Bay Communities, not the fire service or public safety interest group. Prior to the 2009 edition, the IRC didn't include an allowance to reduce the fire rating of townhouse separation walls from 2-hours to 1-hour, which had been permitted by the IBC. Avalon Bay Communities proposed adding the IBC wall reduction to the IRC with the quid pro quo of also adding the IBC's requirement to sprinkler all townhouses. Avalon Bay Communities knew that the cost savings associated with the reduced wall rating alone may equal or exceed the cost of installing sprinklers. When combined with other incentives offered by the IFC for access roads and water supply, the company knew that they could actually save money by sprinklering townhouses.
8. **Economic impact:** Installation costs for fire sprinklers in townhouses are offset by cost savings that can be realized in other aspects of construction. Cost incentives for townhouse development/buildings may include:
   1. Reduced material and labor costs associated with reductions in the required fire rating of townhouse separation walls from 2-hours to 1-hour. This incentive has an added benefit, particularly in the current market of tight material and labor supplies, of significantly reducing the amount of drywall that must be secured to construct a project and the associated challenge of securing labor resources to apply additional drywall layers needed to achieve a 2-hour assembly rating. In addition, Code Change RB67-19 resulted in a change to the 2021 IRC that permits sprinkler piping to penetrate and be routed in townhouse common walls. This can reduce sprinkler installation costs by allowing a single water supply for multiple sprinkler systems in a townhouse building, and by allowing sidewall sprinklers to be used as a means of improved coverage and avoid the need to install pipe in attic areas that might be subject to freezing.
   2. Reductions in minimum required water supply for firefighting, allowing for smaller water mains, and typically eliminating some fire hydrants.
   3. Somewhat unique to Virginia is an allowance in R310.1, Exception 1, which eliminates the IRC requirement to provide emergency escape and rescue openings for dwellings that are equipped with a fire sprinkler system. Accordingly, there is a significant design advantage with respect to allowing builders to used fixed glazing or windows that do not meet the minimum size and operability requirements of the IRC for escape openings. In addition, for townhouses, which typically have small fenced yards that may not easily connect to a public way, the elimination of escape and rescue openings can solve site layout issues by eliminating the need for accessways from yards to a public way. Additionally, eliminating escape window or door openings for basements deletes not only additional windows for sleeping rooms, but also the associated window well, escape ladder, fall protection for the window well opening and issues with sealing below-grade wall openings from water infiltration, and associated costs.
   4. Increased portion of roof area permitted to have solar panels (R324.6), which increases available solar generating capacity.
   5. Permissible area of a mezzanine increases from 1/3 of the floor area of the room with a mezzanine to 1/2 (R325.3). This permits increased design flexibility for a top-story mezzanine vs. having a 4th story in a townhouse, which falls out of the IRC scope and forces IBC compliance.
   6. Permissible enclosure of mezzanines in rooms not exceeding 2 stories above grade plane vs requiring openness to the room with walls not exceeding 36 inches in height (R325.5).

Many of these cost offsets relate to design options that are difficult to specifically quantify because they relate to unique architectural design features, such as the inclusion of mezzanines, or on local fire code requirements that are specific to individual jurisdictions. However, the cost offsets associated with permissible reductions in townhouse separations and unfinished basement floor-ceiling assemblies can be quantified.

To quantify these values, a calculation model was created using data from the Craftsman National Construction Estimator program. For the purpose of this submittal, four sample runs were performed on a sample townhouse using two wall types (back-to-back 1-hour walls in a non-sprinklered building vs. a staggered stud 1-hour wall in a sprinklered building) and two sprinkler installation costs ($1.50/sqft and $2.00/sqft). Although the NFPA published a report "Home Fire Sprinkler Cost Assessment – 2013" (attached) estimates a national average cost of $1.35/sqft installation costs, the Virginia model runs used costs of $1.50/sqft and $2.00/sqft in an effort to be reasonably conservative, even though townhouse sprinkler systems may cost less than NFPA's estimated costs because there is an economy of scale in townhouse communities.

The sample townhouse building contains five units that are three stories tall with a pitched roof and dimensions 20ft x 30ft x 10ft floor-to-floor. Summary sheets for each run with full documentation of the wall designs and costs are available. Cumulative results for the four runs provided below. Each run includes a national average cost and four additional data point multipliers for unique communities. The value modifiers are based on cumulative average cost adjustments for labor and materials recommended by the Craftsman estimator, intended to provide a reasonable representation of costs in different areas.

It should be noted that builders often claim that reductions in the fire resistance of wall assemblies are not realistic because the 2-hour assemblies are needed for control of sound transmission. However, research on Sound Transmission Classes (STCs) of various wall designs indicates that this is not accurate. STC ratings are a measure of the effectiveness of partitions in reducing airborne sound transmission, with higher numbers having better performance in resisting sound transmission. For reference, there is no minimum in the IRC, but optional IRC Appendix K recommends a minimum of 45. The IBC requires a minimum STC of 50 by design or 45 by field test.

For the purpose of this analysis, two different types of 1-hour rated wall assemblies were evaluated and compared to a back-to-back set of 1-hour wall assemblies, sometimes used as a permissible alternate to a listed 2-hour assembly. STCs for these walls are reported as follows:

· Base level staggered stud 1-hour wall (one layer of insulation, which could be increased to 50-52 with modifications) – STC 45-48

· Base level double stud 1-hour wall (insulation in each stud channel) – STC 57

· Back-to-back 1-hour walls sometimes used as a 2-hr substitute (STC can be increased by adding additional insulating material in the space between the inner wall membranes at additional cost. Empty air space between these inner membranes actually reduces sound performance, which is why the base wall STC is not at high-performance level) – STC 45

Other wall designs with higher STC ratings can be modeled upon request if wall construction details are provided. To put the cost results into perspective of a monthly mortgage payment, a calculation was performed to evaluate the net cost of a $2,000 price increase (the highest of costs in the four model runs) to a homeowner after reductions associated with homeowners insurance (assumed at 5% based on NAHB's insurance analysis for major carriers and which is a common reduction offered by insurers in many states for NFPA 13D protection) and income tax deductions (assumed at 24% Federal marginal rate and excluding Virginia income tax). Based on a review of online interest rates, properties and sample insurance rates, a mortgage value of $400,000 was selected at an interest rate of 4.25% and an annual homeowner's insurance cost of $1,500 for a property estimated at $500,000 value. <u>Based on the highest-cost system from model runs and parameters described above, the net monthly payment for fire sprinklers is $1.23, or approximately $15/year. This is far less than even a minor fluctuation in interest rates that buyers may experience at any time.</u>

Note that permit and plan review fees and time vary from jurisdiction to jurisdiction. Some jurisdictions do not require any plan review for residential fire sprinklers, which is consistent with the "developed pipe length" methodology prescribed in IRC Section P2904. Alternately, some jurisdictions use a flow test of the installed system in lieu of design plans and plan review, which requires a single onsite inspection that can be performed by a regular building or plumbing inspector when performing other on-site inspections.

With respect to maintenance, there is no mandatory maintenance required for typical residential sprinkler systems supplied by a public or private water service, other than not interfering with the system by closing valves, painting sprinklers, etc. Homeowners may choose to perform voluntary verification test for water flow alarms (which are not required by NFPA 13D or IRC P2904).

Specific cost model documentation will be provided separately since cdpVA would not support inclusion of tables in the reason statement.

Resiliency Impact Statement: This proposal will increase Resiliency
See reason statement.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
See reason statement. It is difficult to quantify net cost or savings because these are going to vary based on individual projects and the extent to which developers/builders take advantage of savings incentives to offset costs associated with sprinkler installation.

APPENDIX E:

ADDITIONAL COMMENTS AND DOCUMENTATION

FROM STUDY GROUP MEMBERS

NOTE: *The final draft of the study group report was shared with the study group members for review and feedback. Appendix E has been added to the final report and includes the additional documentation and information received from study group members after reviewing the final draft.*

Commonwealth of Virginia

Moldovan, Florin <florin.moldovan@dhcd.virginia.gov>

Residential Study Group Report

Andrew Clark <AClark@hbav.com> Thu, Jun 2, 2022 at 11:11 AM
To: "Moldovan, Florin" <florin.moldovan@dhcd.virginia.gov>
Cc: Craig Toalson <CToalson@hbav.com>, Andrew Clark <AClark@hbav.com>

Florin – Thanks for sending this over. And good work on compiling an extremely extensive report! I've started to review now – and have several comments. I will send them over to you as I complete them, so that I'm not dumping a bunch of information on you before the deadline. Here are some of my initial thoughts.

Smoke Alarms – Page 7 of the PDF

Data from NFPA

I think it would be helpful to include some data from the National Fire Protection Association (NFPA) about the strong correlation between home fire deaths and lack of working smoke alarms/no smoke alarms. It speaks to your point that smoke alarms are proven to save lives – and that additional efforts to expand home fire safety will depend, in large part, on ensuring that residents have smoke alarms that are operational.

The following is from a 2021 NFPA Report: https://www.nfpa.org//-/media/Files/News-and-Research/Fire-statistics-and-reports/Detection-and-signaling/ossmokealarms.pdf

- Almost three out of five home fire deaths were caused by fires in properties with no smoke alarms (41 percent) or smoke alarms that failed to operate (16 percent).
- The death rate per 1,000 home structure fires is 55 percent lower in homes with working smoke alarms than in homes with no alarms or alarms that fail to operate.

Stakeholders Working to Increase Smoke Alarm Safety

I mentioned this in one of the workgroup meetings – but I think it's important to note in the report that some stakeholders are keenly aware of the importance of smoke alarms – and have been working to advance policies/regulations/programs to expand smoke alarm protection in residential structures.

During the 2022 General Assembly Session, the Home Builders Association of Virginia drafted and successfully passed SB 607, which will require home inspectors to actually test the smoke alarms in homes and report their findings in the final home inspection report. Right now, they are currently only required to inspect whether the smoke alarm is present or not. This bill will create another touch point for consumers to be educated on the status of their smoke alarms.

We also worked with Senator Jeremy McPike to introduce budget language to expand funding for the Virginia Department of Fire Programs so that they provide money to local fire departments to be used to purchase and deploy smoke alarms. The budget amendment created a Residential Structure Fire Safety Fund – it can be found here: https://budget.lis.virginia.gov/amendment/2022/1/SB30/Introduced/MR/420/1s/. Although the budget amendment didn't make it in the final budget approved by the legislature, the HBAV will continue to push for it in future Sessions.

Comment about Zero Home Fire Deaths in Localities with Sprinkler Mandates:

On page 7, there is a comment about reports from localities that require sprinkler systems suggest that no lives have been lost because of fires. Have any of the stakeholders submitted these reports for review by the workgroup? If so, they should be cited or linked in the report. I have yet to see any of these reports, but I've heard that comment made on several occasions. If the reports are not available or have not been provided by any of the stakeholders, I would suggest adding a quick comment indicating that the workgroup and the Department have not see those reports. My apologies if they have been distributed – it's possible I missed them.

--

Andrew Clark Vice President, Government Affairs

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[Quoted text hidden]

Commonwealth of Virginia

Moldovan, Florin <florin.moldovan@dhcd.virginia.gov>

Water Connection Fees

1 message

Andrew Clark <AClark@hbav.com> Tue, Jun 7, 2022 at 9:24 AM
To: "Florin Moldovan (florin.moldovan@dhcd.virginia.gov)" <florin.moldovan@dhcd.virginia.gov>
Cc: "Jeff Brown (Jeff.Brown@dhcd.virginia.gov)" <jeff.brown@dhcd.virginia.gov>

Florin – Some additional input for the sprinkler report – page 9 of the PDF under water meter size and connection fees.

Here is some additional information about the difference in water connection fees for ¾ and 1" water meters

Henrico County

Source: https://henrico.us/utility/water-sewer-connection-fees/water-and-sewer-connection-fees-2021-2022/

Water Connection Fee:

Townhome (5/8"): $4,485 per unit

Separate domestic line and fire line (5/8"): $8,970 ($4,485 *2)

Townhome (1"): $17,400

Chesterfield County

Source: https://www.chesterfield.gov/513/Rates-and-Fees

Capital Cost Recovery Charge

Townhome (5/8"): $5,725 per unit

1": $14,313

Water Service Installation Charge (Service Lines and Meters)

Service Lines:

5/8”: $1,900

1”: $2,150

Meters:

5/8”: $200

1”: $240

Hanover County

Source: https://www.hanovercounty.gov/DocumentCenter/View/1423/Capacity-Fees-PDF?bidId=

Water Capacity Fees:

5/8 and ¾” meter - $6,595

1” - $14,581

Blacksburg

Source: https://www.blacksburg.gov/home/showpublisheddocument/5224/637588345347700000

5/8” Water Meter: $3,765

1” Water Meter: $6,938

Salem

Source: https://salemva.gov/Departments/Water-Sewer-Dept/Water-and-Sewer-Connection-and-Availability-Fees

Water Connection Fees

5/8 and ¾” - $1,500

1” - $1,800

Water Availability Fee

5/8 and ¾ - $2,000

1” - $4,000

Combined Water Connection Fees

5/8 and ¾ - $3,500

1” - $5,800

Botetourt County

Source: https://www.westernvawater.org/home/showpublisheddocument/12762/637765915048130000

Water Availability Fee

5/8” - $3,000

1” - $7,500

Water Connection Fee

5/8” - $2,000

1” - $2,000

Combined Water Connection Fee

5/8” - $5,000

1” - $9,500

Roanoke County and Roanoke City

Source: https://www.westernvawater.org/home/showpublisheddocument/12766/637765915057370000

Water Availability Fee

5/8” - $3,000

1” - $7,500

Water Connection Fee

5/8” - $2,000

1” - $2,000

Total Fee

5/8” - $5,000

1” - $9,500

Franklin County

Source: https://www.westernvawater.org/home/showpublisheddocument/12764/637765915052500000

Water Availability Fee

5/8” - $3,000

1” - $7,500

Water Connection Fee

5/8” - $2,000

1” - $2,000

Total Fee

5/8” - $5,000

1” - $9,500

Winchester

Source: https://www.winchesterva.gov/utilities/availability-fees

Water Service Availability Fee

5/8 and ¾” - $5,300

1” - $8,800

Isle of Wight

Source: https://www.co.isle-of-wight.va.us/departments/public_utilities/fees_and_service_rates.php

Residential Water Installation/Connection Fees

5/8” - $4,000

1” - $10,000

James City County

Source: https://www.jamescitycountyva.gov/DocumentCenter/View/2015/Rates--Charges-PDF

Systems Facility Fee:

5/8" - $3,219

¾" - $4,829

1" - $8,048

--

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Commonwealth of Virginia

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Water Connection Fees Data and Other Cost Drivers

Andrew Clark <AClark@hbav.com>
To: "Florin Moldovan (florin.moldovan@dhcd.virginia.gov)" <florin.moldovan@dhcd.virginia.gov>
Cc: "Jeff Brown (Jeff.Brown@dhcd.virginia.gov)" <jeff.brown@dhcd.virginia.gov>

Tue, Jun 7, 2022 at 10:00 AM

Florin – Here is some additional clarifying information on our comments related to water meters, connection fees, and additional drivers of cost.

Water Connection Fees/Water Meters: Cost estimates from the Fire Protection Research Foundation do not include the cost of increasing the size of a structure's water meter from ¾" or 5/8" to 1" to accommodate the residential fire sprinkler system. Increasing the water meter size, in many localities, results in a significantly higher per-unit water connection or availability fee. The Home Builders Association of Virginia surveyed localities across the Commonwealth to determine to magnitude of the fee increase and found increases ranging from several hundred dollars to over $18,000 per unit.

Fire Services Representatives Dispute the Claim That 1" Water Meter Will Be Necessary:

Although residential sprinkler advocates in Virginia dispute this claim, the issue of water connection fees has garnered the attention of legislators in California after fire marshals across the state reported very broad and disproportionate fee schedules for residential fire sprinklers from jurisdictions. Data collected by the California Residential Water Purveyor and Fire Sprinkler Task Force (attached) in 2021 showed that localities were requiring 1" water meters for residential structures and that residential fire sprinkler hook-ups could range in cost from $3,000 per house up to over $60,000 per house. For example, the Mesa Water District in California explicitly states that they require 1" water meter: https://www.mesawater.org/customer-service/rates-and-fees. While the sprinkler study group has debated this issue at length, the issue is incredibly complex and warrants additional research prior to advancing the proposal to require fire sprinkler systems in new one- and two-family dwellings and townhomes. Fire services representatives cannot dispute the fact that 1" water meters may be required given the experience in California.

Additional Items to Factor Into Sprinkler Cost Estimates:

Additionally, cost estimates from residential sprinkler advocates often overlook two additional "tangible" costs, and one "intangible" cost.

First, in some communities where the static pressure of surrounding waterlines is insufficient, it will be necessary to install a booster pump to provide enough pressure for an effective fire suppression system. Home builders in several regions of the Commonwealth provided cost estimates of $1,260 to $2,600 for these systems.

Second, although NFPA 13D does not itself require the installation of a backflow prevention device, the National Fire Protection Association agrees that many municipal water authorities in Virginia and across the country ***require*** the devices to prevent contaminants from reaching drinking water[5], so it will be a cost borne by the consumer if these proposals are enacted. Home builders in Virginia have provided cost estimates ranging from $450 to $1,000 for these devices.

Lastly, NFPA 13D systems require the review and approval by the Authority Having Jurisdiction (AHJ), which has the potential to extend construction time and place additional burden on localities, many of which are currently struggling to employ enough plan reviewers to keep up with current construction activity levels.

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WaterPurveyorData2021.xlsx
19K

California Residential Water Purveyor/Fire Sprinkler Task Force

Water Purveyor Data

Water Purveyor Name/Location	Minimimum meter size	Wastewater Capacity Charge SFD	Reserve Water Capacity Fee	Water Service connection 5/8" meter	Water Service connection 3/4" meter	Water Service connection 1" meter	Bi-monthly 5/8" service charge	Bi-monthly 3/4" service charge	Bi-monthly 1" service charge	Bi-monthly 1" service charge w fire system
East Bay Municipal Utility District		$2,810.00		$5,543.00	$18100 -$ 40040	$30,230 - $66,870				
Contra Costa Water District				$27,743.00						
Central Contra Costa Sanitary District		$6,803.00								
Dublin San Ramon Services District		$15,906.00	$45,200.00							
Alameda County Water District				$7,358.00						
Zone 7 Water				$29,440.00		$29,440.00				
San Francisco Public Utilities Commission		$4,084 - $12,045		$1,906.00						
Antelope Valley (Palmdale/Lancaster)				~$20,000						
North Marin Water District (Novato)								$34.15	$68.30	$38.80
North Marin Water District (West Marin)								$34.15	$68.30	$38.80
Marin Municipal Water District							$39.66	$39.66		
City of Petaluma	1" for all new service or remodels						$14.40	$14.40	$14.40	
San Diego Public Utilities Department	note 2									
Cal Water	1" for all new service or remodels							28/mo	$97.00	
City of Fresno	any that will calc 3/4 - 2"									
City of Kerman	1' iron pipe size (no remodel ordinance)									
City of Clovis							$23.90	$23.90	$23.90	$23.90
Menlo Park						17,000 -27,000				
East Palo Alto Water								$13.74		148.42 for 1.5 meter
Palo Alto Park Mutual	Currently in litigation									
City of Dixon	3/4"						N/A	$37.88	$59.98	$59.98
Pittsburg Water Department							$24.29	$24.29	$53.03	$101.09
Martinez Water Department							$69.50		$120.00	$91.00
Anaheim Water Department	1"						$9.90	$9.90	$12.97	$12.97
Garden Grove	5/8"						$29.63	$29.63	$47.14	
San Clemente								$25.33	$25.33	
City of Orange				1,500 per acre for	2,290 per acre above 400'		$29.07	$29.07	$42.29	
Mesa Water District	1" ususally required with sprinklers						$27.23 Bi-monthly, $13.61 monthly	$41.14 bi-monthly, $20.57 monthly	$68.36 bi-monthly, $34.18 monthly	

Note 1: Passive purge with a combined system or backflow

Note 2: 3/4 or 1 inch service and meter upgrade to 1 inche if fire water supply requires it

Cell: C6
Comment: [Threaded comment]

Your version of Excel allows you to read this threaded comment; however, any edits to it will get removed if the file is opened in a newer version of Excel. Learn more: https://go.microsoft.com/fwlink/?linkid=870924

Comment:
Zone 1 wastewater fee per single-family unit = $6,803 (Zone 1)
Zone 2 wastewater fee per single-family unit = $6,803 (gravity fee) plus $1,585 (pumping fee) for total of $8.388 per single family unit

Cell: D7
Comment: Jessica Power:
Reserve Water Capacity Fee (the cost to buy into DSRSD's water distribution system) for 5/8" meter is $13,335 per residential unit PLUS Zone 7 Water District (which supplies the actual water) connection fee for 5/8" meter is $31,865 per unit for a total of $45,200 per unit

Cell: E8
Comment: Jessica Power:
Residential Water Meter Facilities Connection Charge = $7,358 per residential unit

Cell: A9
Comment: Jessica Power:
(The water connection fees are collected by the Building Departments of the Cities of Livermore and Pleasanton, and by the Dublin San Ramon Services District, which are agents for Zone 7. The cities also charge their own water connection facility fees.)

Cell: C10
Comment: Jessica Power:
Wastewater Connection Fee for 5/8" = $4,084 to $12,045 per unit, depending on location

Cell: K13
Comment: Jessica Power:
For all meters in Paradise Ranch Estates $51.75

Cell: H15
Comment: Jessica Power:
Monthly fee

Cell: I15
Comment: Jessica Power:
Monthly fee

Cell: J15
Comment: Jessica Power:
Monthly fee

Cell: H20
Comment: [Threaded comment]

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Comment:
Pulled from website. No information if differences for different sizes or fire sprinklers.

APPENDIX F:

GENERAL STAKEHOLDERS WORKGROUP MEETING EXCERPTS

Note: This Appendix contains excerpts from the General Stakeholders Workgroup Meeting related to the three code change proposals mandating the installation of automatic sprinkler systems in townhouses.

Code Change Proposal RB313.1-21

Excerpt from June 14, 2022, General Stakeholders Workgroup Meeting Summary

Andrew Milliken (proponent): This brings back a proposal initially approved by the BHCD, requiring sprinklers for townhouses. There is a Floor Modification to remove NFPA 13 and 13R references.

Andrew Clark [Home Builders Association of Virginia (HBAV)]: Submitted comments in cdpVA. This would add too much cost to building new homes. Meters and water connection fees, especially those requiring a 1" meter are very expensive.

Jeff Shapiro (IRC Fire Sprinkler Coalition and International Code Consultants): Sprinklers can run on water flow and a 1" meter isn't required. He clarified that there is never a case where a 1" meter is needed under the IRC. There are also incentives that could reduce costs. A typical house uses the same range for minimum water flow and pressure rate that a sprinkler system can be designed to use. Maryland and Pennsylvania can make townhouse sprinklers work more affordably when including incentives. There can actually be a cost decrease. He prefers proposal RB313.1(3), which has a more incremental approach.

Andrew Milliken: Hopes to have a compromise in the future and he's glad that the BHCD will see the Study Group report with all of the conversation around this issue.

Andrew Clark (HBAV): Asked what will be in the staff summary to the BHCD.

Jeff Brown (DHCD Staff): Everything related to a proposal is attached to it. The summary document to the BHCD will be new this cycle. There will definitely be a notation of who supported the proposals and who did not.

David Beahm (Warren County): Asked if there is a headcount of who is for and who is against each of the proposals. He also asked if the Sprinkler Study Group agreed on any proposals. He's against all of the RB313.1 code change proposals.

Jeff Brown: The summary will show who was in support and who was opposed and how the recommendation for or against came about. The Study Group didn't vote for or against any proposals.

Paula Eubank: Speaking for herself, she opposes RB313.1.

Jeff Shapiro: The IRC is a minimum standard, but requirements can be exceeded. NFPA 13 or 13R goes further than the minimum P2904 or 13D system.

William Penniman: Speaking for himself. Supports this proposal and the next 2, so that they will go forward as Non Consensus instead of Consensus for Disapproval.

Jeff Brown: Hearing no further discussion, this proposal will be marked as Non Consensus as Modified.

Code Change Proposal RB313.1(2)-21

Excerpt from June 14, 2022, General Stakeholders Workgroup Meeting Summary

Glenn Dean (proponent): On page 5 of the Residential Sprinkler Study Group report, there was a good, concise summary of smoke alarms and sprinkler systems. On page 11, it says that homes built now are safer than those built decades ago; he would like to know in what way? Because of construction materials and items placed in the houses, fires and toxicity are faster and worse than they were in the past. Smoke detectors do give an early warning, but not soon enough because of the more flammable materials. Sprinklers would help with safety. Page 12 says that there is “no demand” for sprinklers. He thinks it’s because people aren’t aware of the need. Conclusions and acknowledgements say that Virginia is in alignment with majority of states that remove the IRC requirements for sprinklers in townhouses. He thinks that won’t last and that Virginia can lead or follow.

Andrew Clark: There should be a requirement for all localities in Virginia to send fire data to the Fire Programs, so that the data can be used correctly for analysis. The Workgroup last cycle was specific to townhomes. This proposal goes beyond that scope.

Glenn Dean: Virginia Fire Incident Reporting System (VFIRS) has many data points and it’s hard to get down to more specific data. Even with all of those data points, the system itself is underutilized.

Andrew Clark: Agrees. He looked into that himself, and he had those same results. He thought there could possibly be a legislative push, or some collective effort to help the department to make that data more user friendly.

Anthony Clatterbuck (Home Builder, Culpeper Virginia): Thinks that the most beneficial reports would be developed on a state-wide basis. Each locality has different things that they report on.

Andrew Clark: Typed in the chat box:

Andrew Clark: Agreed that a state level effort is needed. Sorry if I wasnt clear - when I referred to "the Department", i was referring to Dept of Fire Programs - not local fire departments.

William Penniman: Speaking for himself. Supports this proposal to ensure that it goes forward as Non Consensus.

Steve Shapiro (Apartment and Office Building Association, Virginia Apartment Management Association): Not speaking in favor or opposition, the first sentence should say An automatic residential fire sprinkler “system” instead of “systems”.

Jeff Brown: Hearing no further discussion, this proposal will be marked as Non Consensus.

Code Change Proposal RB313.1(3)-21

Excerpt from June 14, 2022 General Stakeholders Workgroup Meeting Summary

Jeff Shapiro (proponent): This is only for townhouses, and offers a path for builders to build them without fire sprinklers required. Townhouses with less than 3 units, would not require sprinklers. It would also be an opportunity to gather Virginia data. He says that there are only 4 states listed in the Study Group report, and he listed 13 states that have adopted the IRC requirement for sprinklers in townhouses.

Andrew Clark: Land development incentives would probably make for good discussions in the future and might be what moves the needle. Especially road widths. There's nothing in the proposals that would ensure that those incentives are granted. He is in opposition to this proposal today.

Jeff Brown: There is a Floor Modification on the screen to match the RB313.1.1 with what is in the IRC. If Jeff is in agreement, the proposal will move forward with it.

Jeff Shapiro: Agrees with the modification. He is willing to work with the home builders to ensure that they get incentives.

Steve Shapiro: Asked Jeff about the exception: could there be 3 units with firewalls, then 3 more?

Jeff Shapiro: The IRC doesn't recognize fire walls like the IBC does. They would have to be separate buildings. 3 unit buildings separated from other 3 unit buildings would not require sprinklers.

William Penniman: Speaking for himself, he supports this proposal.

Dan Willham (Fairfax County): Supports this proposal.

David Beahm. He is opposed to this proposal.

Andrew Milliken: The Virginia Fire Services Board Committee approves of this proposal.

Paula Eubank: Speaking for herself, she is against this proposal.

Jeff Brown: Hearing no further discussion, this proposal will be marked as Non Consensus with the Floor Modification.