

Fire Protection System Water Supply Issues

A White Paper

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A key element in effective life and property protection from fire is the automatic fire sprinkler system. Data compiled by the United States Fire Administration and the National Fire Protection Association have clearly proven the life safety and property preservation benefits of fire sprinkler systems. This data shows that residential fires account for over 80% of our nation's fire deaths. People are not dying from fires in fire sprinkler protected property. A study based upon 15 years of fire loss data from Scottsdale, Arizona shows the average property loss for residential homes with fire sprinkler systems was \$2,166 compared to a \$45,019 average loss for homes without fire sprinklers. Prince George's County, Maryland, also reports a significant difference in fire losses between homes that are sprinkler protected and those that are not. Thus, there has been, and will continue to be, an increase demand for new buildings to be constructed with fire sprinklers installed including the residential home.

And key to successful fire sprinkler operation is adequate water supply. The national design and installation criteria for automatic fire sprinkler systems have been adopted by the State Fire Marshal for statewide application through statutory empowerment. The role of local government is to ensure these national fire sprinkler system design standards are met when these fire sprinkler systems are installed in new and existing buildings. Compliance with these national design standards, for the most part, are consistently applied and enforced throughout the State of Florida by fire and building departments. However, even though these national standards establish optional criteria for water supply connections, these national fire sprinkler design standards for the most part are ignored by water purveyors. These standard provide for alternative designs and often the water purveyor selects the allowable option, a decision that is intended to be decided by the owner. This inconsistency has caused horrendous cost overruns in fire protection system installations; additional and unnecessary taps; diminishing levels of life safety; significantly increased but unnecessary infrastructure costs; discriminatory fees; and a multitude of sidebar problems that, simply stated, must stop. It is the consumer who is paying outrageous fees and unnecessary material costs that is being hurt by this lack of consistent statewide application of codes and standards for water supplies for fire protection systems.

Accordingly, we strongly encourage the Florida Fire Safety Board to recommend that the CFO through its seat as a Cabinet member to recommend that the Governor and Cabinet appoint a select committee to research solutions to this growing problem and recommend needed actions to the Governor and Cabinet and, if necessary, the Florida Legislature. Because the Florida Public Service Commission, The Department of Environmental Protection, The Department of Financial Services, our Water Management Districts, and the Department of Professional and Business Regulation all have some degree of oversight with our state's water supplies it is felt the Governor and Cabinet appointed select review committee is appropriate.

DISCUSSION:

ISSUE 1. In the August 2006 edition of *Florida Trend* magazine there is an article on water conservation. This article reports that Miami-Dade County must prepare for a 100 million-gallon-per-day increase in water usage expected over the next twenty years. We must argue that many political jurisdiction have failed miserably in identifying the significant water distribution system cost savings allowed by the widespread use of automatic fire suppression systems.

Community water distribution systems are sized based upon expected growth and water supply demand. Typically a water department will provide fire protection for the community they serve by providing the required fire flow for fighting fires. The size of a water distribution system is often governed by the expected demand of the calculated fire flow for that area. This demand on the water system will increase the diameter of the piping and the amount of water that is in storage resulting in an increase in the cost of a water distribution system. A savings of 20-80% is possible on fire flow demands when sprinkler systems are installed. This reduction can save the water authorities thousands of dollars each year.

The Florida Fire Prevention Code requires that every building site have adequate water for fire fighting. The amount of water necessary to fight a fire for a particular building is based on the type of construction, building size, and fire hazard of the occupancy. The following is one of many different examples of fire flow requirements, again based upon the type of material used for construction.

Total Fire Area in Square Feet					
(Gallons per Minute Fire Flow)	Construction Type				
	I II-Fire Resistant	II one hour III one hour	IV Heavy Timber V one hour	II nonrated III nonrated	V nonrated
500	5500	3700	2600	2100	1600
750^{NT1}	7800	5000	3500	2700	2000
1000^{NT2}	11100	6800	4700	3500	2400
1250^{NT3}	15900	9300	6200	4500	2900
1500^{NT4}	22750	12700	8200	5900	3600
1750	30200	17000	10900	7900	4800
2000	38700	21800	12900	9800	6200
2250	48300	24200	17400	12600	7700
2500	59000	33200	21300	15400	9400
2750	70900	39700	25500	18400	11300
3000	83700	47100	31100	21800	13400
3250	97700	54900	35200	25900	15600
3500	112700	63400	40600	29300	18000
3750	128700	72400	46400	33500	20600

THE SIGNIFICANT ISSUE here is the fire flow demand for properties with a fire sprinkler system is much less than non-sprinkler protected buildings. Buildings that are protected by a full sprinkler system designed in accordance with national fire sprinkler design standards need only provide the required water supply for the system as designed. An example, it may take only 375 GPM to meet the fire sprinkler system design flow for a 60,000 square foot Type I Fire Resistant sprinkler protected building – if fire sprinklers were not installed then the fire flow demand is 2,750 GPM. The Florida Fire Prevention Code requires a minimum of 1,000 gallons per minute fire flow as a liberal safety factor. Thus, adding fire sprinklers can reduce the fire flow demand by 1,750 gpm in this example where a smaller diameter pipe could be used. Florida's Building and Fire Codes already require most of these larger occupancies to be protected with automatic fire sprinkler systems yet we have not done a great job in designing our water supply infrastructure, downsizing the system to meet new fire flow demands. This is particularly true when major plots of land is converted into commercial and residential property and new water distribution systems are design and installed. A recent development announcement of 4,211 acres of land into what will become a new city in Escambia County underscores the need for further investigation of water distribution systems. Starting with this vacant undeveloped land, it is possible to reduce the material costs for the water distribution system by over 50%, which then causes less demand for water meaning less reserves, which means less leakage as the pipes are smaller, which means a significant cost savings on this new community's water distribution infrastructure.

Fire fighting actually consumes a small amount of water compared to the total annual water usage. The one time fire flow demand is really what dictates the larger flow requirements. Based on the 10-year study of the fully sprinklered community of Scottsdale, AZ an average of 209 gallons of water was used by a sprinkler system as compared to an average of 3,290 gallons of water used by the fire department. Therefore, by reducing the demand needed to fight fires, the water distribution system can be smaller. A community that takes advantage of sprinkler systems installed in buildings can reduce the required fire flow and save money. While area feeder lines may still be of substantial size, branch lines clearly should be reduced when fire sprinklers have reduced the needed fire flow in new developments.

Recommendation: The focus group should discuss ways of reducing the size of water distribution system fire flow requirements where widespread use of fire sprinklers is present. Again, widespread demand for fire sprinklers already exists for many occupancy types in the current Florida Building and Fire Codes.

ISSUE 2. Cross-Connection protection is a substantial issue impacting the cost of fire sprinkler systems. While nobody disputes the liability avoidance need for cross-connection protection, the type and degree of cross-connection protection requirements imposed in Florida is very problematic.

Cross-connection protection has been greatly reviewed and reported on by many water purveyor industry related associations. Specifically, **AWWA Manual M-14, *Recommended Practice for Backflow Prevention and Cross-Connection Control*, 3rd**

Edition, 2004, has been published to provide expert guidance to the water purveyor on cross-connection or backflow protection.

Information on backflow prevention and fire protection is incorporated into Chapter 5, *Typical Hazards*, of the 3rd edition of M-14. Previous editions classified fire-suppression systems into 6 classifications based on the complexity of the system. The classification system is no longer used and the recommended protection now depends on the degree of hazard presented by the system. A low hazard (non-health hazard) is a potential cross-connection involving any substance that generally would not be a health hazard but would constitute a nuisance or be aesthetically objectionable if introduced in the potable water supply. A high hazard (health hazard) is a potential cross-connection involving any substance that could, if introduced into the potable water supply, cause death or illness, spread disease, or has a high probability of causing such effects.

The following requirements are generally for new systems.

Wet-Pipe Fire Sprinkler Systems - These systems usually have stagnated water that may not be acceptable to drinking water standards. For new systems a DCV is recommended on closed (nonflow-through) systems.

Dry-Pipe Nonpressurized Fire-Suppression Systems (Deluge)

These systems are open to the atmosphere and generally do not require backflow protection unless chemicals will be added when water flows, in which case a RPZ is suggested.

Dry-Pipe Pressurized and Preaction Fire-Suppression Systems

Dry-pipe pressurized systems typically are pressurized with air or nitrogen. Preaction systems may or may not be pressurized. A DCV is recommended unless there is a risk of a high hazard (e.g. chemicals) in which case a RPZ or air gap is recommended.

Residential, Single-Family Fire Sprinkler Systems

No backflow assemblies are required on systems that are constructed of approved potable material and are designed to flow water so it does not become stagnate.

Other Fire-Suppression Systems

Since system design can vary the level of backflow protection should be based on the type of cross-connection and the degree of hazard. The local plumbing code could regulate systems connected to private plumbing systems.

Fire Hydrants

Fire hydrants are used to supply water for fighting fires, but can also be used for other purposes such as temporary water service lines or testing and flushing water mains. Both the water purveyor and the fire authority should monitor fire hydrants. If backflow prevention is recommended it will depend on the degree of hazard presented by the use of the hydrant.

Unfortunately, we are finding demands for RPZ throughout the State of Florida when there is no indication, no high risk, and no need for cross-connection protection greater than the DCV.

Recommendation: The provisions of **AWWA Manual M-14, *Recommended Practice for Backflow Prevention and Cross-Connection Control*, 3rd Edition, 2004**, should be adopted for statewide application and the decision of which backflow device should be used is that of the owner and it shall be the burden of the water purveyor to prove high hazard conditions exist before requiring higher levels of cross-connection protection.

ISSUE 3. The size and timing of system taps is not cost effective. The most cost effective time for a tap would be when the underground piping is being installed. For the most part the location of the new building, its occupancy or hazard classification, the fire sprinkler system design criteria are already known before the water distribution system is installed in new developments. If taps could be made when the pipe is being installed then capped for future use, this would save a tremendous amount of time and money. We often have to destroy a new road or core bore under a new road when domestic and fire line taps are extended from mains on the opposite side of the road from the construction site.

And often the size of the tap is far greater than what is needed to supply the fire protection systems. The size of the tap often is decided after the construction contract has been let for the building causing much conflict and disputes over change orders to pay for the larger than needed taps. Many within the fire protection industry feel that the larger tap sizes are demanded solely for larger fees.

Recommendation: Any tap for a fire line should be of sufficient size to meet the design criteria of the fire protection systems and larger size taps should be prohibited. And water purveyors, when domestic and fire flow demands are known should allow for taps and under road extensions during the initial water distribution system installation and a reduced tap fee should be established to encourage such activity.

ISSUE 4. The conflict of meter sizes and fees is causing horrendously high fees to be imposed upon the new homeowner. If I choose to add a fire sprinkler system to my new single-family home, the cost (initial and monthly fees) of this system is a critical factor in my decision. If it is programmed that my base meter is a 5/8 inch and this meter will meet my domestic water demands then I would pay a set rate – typically a base rate computed considering the size of the meter plus consumption. But the design of my fire sprinkler system creates a water flow that is not attainable with the 5/8 inch meter and I need to upsize the meter to a 1 inch meter. If the sole reason for upgrading the meter is to meet fire sprinkler design criteria, then some jurisdictions charge a residential base rate for the 1 inch meter that is not overwhelming. But some jurisdictions demand a commercial base rate plus consumption when this commercial base rate is many times more than that required of the 5/8 inch meter.

Some water purveyors demand a separate tap for a single-family home fire line. This is unnecessary and again simply an added cost. Water purveyors should embrace automatic fire protection systems instead of creating barriers for their installation. Attached is a paper that discusses residential water supplies.

Recommendation: That a residential rate be established for a 1 inch meters that is not punitive and that this rate be made available throughout the state. That the NFPA water supply criteria be adopted as a statewide standard for water main connections for single-family homes.

There are many other issues but addressing these four will be a major start down the road of reducing conflicts that sometimes results in diminished life safety. We suspect some of the other issues will come out during the select committee's discussions.

We must, however, re-emphasize the critical issues needing resolution. First, our state's growth is expected to continue; the growth demands of our water distribution systems and its ability to provide fire flows needs to be managed; to properly manage this growth, developing fire flow guidelines and taking advantage of significantly reduced water distribution system size and capacity reductions afforded by fire sprinkler protected property must be considered; this should be a must for those large pieces of land that are being converted to commercial and residential use, land where new water distribution systems are needed, new systems that can be downsized; this should not be an overwhelming task as many new properties are already required to be sprinkler protected through the provisions of the Florida Building Code and Florida Fire Prevention Code; barriers that are adding cost and no value such as overkill on cross-connection protection, excessive meter charges, excessive taps, oversize taps should all be eliminated and controlled. This is in the best safety and economic interest of the public.



Water Purveyors Guide to Fire Sprinklers in Single Family Dwellings

Fire sprinklers have long been used in commercial buildings and large residential occupancies to provide economical life safety and property protection in those buildings. Starting in 1976, the National Fire Protection Association (NFPA) has made available a special, low cost, design and installation standard (NFPA 13D) to bring this important technology into one and two-family dwellings and manufactured homes. Every year, approximately 300,000 fires occur in homes in the United States resulting in thousands of deaths. These deaths can be prevented by the installation of a fire sprinkler system in each home.

In addition to their life safety abilities, fire sprinklers also offer the water purveyor a cost effective method of managing their water usage. During a fire in a home that does not have a fire sprinkler system, the fire department will use thousands of gallons of water to fight that fire. In a home with a fire sprinkler system, a few hundred gallons are all that the sprinkler system and the fire department will need. This efficient use of water translates into significant savings for the water purveyor.

This guide will provide a water purveyor with information on the topics that need to be addressed in preparing a jurisdiction for fire sprinklers in single-family dwellings. Although there is general information provided on all sprinkler systems this guide will concentrate on fire sprinkler system for one- and two-family dwellings, manufactured homes and townhouses. In order to save space, this guide will refer to “single family dwellings” or “homes” to make a distinction between this kind of building and a larger multi-family building like an apartment building or multi-unit condominium. In all cases, the rules that apply to single family dwellings or homes also apply to two-family dwellings, manufactured homes and townhouses that are built with sufficient separation to be considered individual homes or two-family buildings.

Model Codes

The following model codes contain requirements for fire sprinkler systems in new homes.

- The *International Building Code*, 2003 and 2006 editions, require sprinkler protection for all residential occupancies. This code is typically used for larger residential occupancies such as hotels, apartments, dormitories or condominiums, but it could also be used for single family dwellings units as well (R-3 occupancies), which would be required to be sprinklered due to this provision.

- The *International Fire Code*, 2003 and 2006 editions, also requires sprinkler protection for all residential occupancies.
- The *International Residential Code*, 2006 edition, has a residential sprinkler requirement in the appendix which allows a state or community to adopt language requiring sprinkler protection for single family dwelling units.
- NFPA 101, *Life Safety Code*, 2006 edition, now requires sprinkler protection for all new single family dwelling units.
- NFPA 5000, *Building Construction and Safety Code*, 2006 edition, now requires sprinkler protection for all new single family dwelling units.
- NFPA 1, *Uniform Fire Code*, 2006 edition, references NFPA 101 for the residential sprinkler requirement.

Sprinkler Standards

The following standards address the installation requirement for sprinklers in residential occupancies.

- NFPA 13, *Standard for the Installation of Sprinkler Systems*, can be used for sprinkler systems in any residential occupancy. It is typically used in large apartment and hotel buildings.
 - NFPA 13 uses a density/area method of determining the total flow and pressure for the sprinkler system. For example, in many residential occupancies a minimum water density of 0.1 gpm/sq ft is required over an area of 1500 sq ft. Other options exist including the use of residential sprinklers with a 4-sprinkler design.
 - Residential occupancies are typically considered Light Hazard.
 - The maximum system pressure is usually 175 psi, although some equipment is rated for higher pressure.
 - The minimum operating pressure for a sprinkler is 7 psi, or the pressure needed to obtain the minimum flow, or the pressure corresponding to the sprinkler manufacturer's listing, whichever is greater.
- NFPA 13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height*, can be used in residential occupancies up to 4 stories in height. NFPA 13R has a high level of life safety with a lesser level of property protection than NFPA 13.
 - NFPA 13R uses up to 4 flowing sprinklers to determine the flow and pressure demand of the system. For example 4 sprinklers flowing 13 gpm each would produce a total system demand of approximately 52 gpm.
 - The minimum flow for each sprinkler is determined by the manufacturer's listing, which is dependent on the area that the sprinkler is listed to cover.

At no time is the flow allowed to be less than 0.05 gpm per sq ft of coverage area.

- The domestic water demand must be added to this flow if the system is part of a combined domestic/fire protection system. Tables are provided to estimate the domestic water demand.
 - The maximum system pressure is 175 psi, although some equipment is rated for higher pressure.
 - The minimum operating pressure for a sprinkler is 7 psi, or the pressure needed to obtain the minimum flow, or the pressure corresponding to the sprinkler manufacturer's listing, whichever is greater.
- NFPA 13D, *Standard for the installation in Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, is a reasonable life safety standard for providing fire sprinkler protection in homes.
 - Wet pipe systems only
 - NFPA 13D uses up to 2 sprinklers flowing to determine the pressure and flow of the sprinkler system. For example 2 sprinklers flowing 13 gpm each would produce a total system demand of approximately 26 gpm.
 - Figure A.6.2 (a) illustrates the preferred arrangement for piping arrangement and meter location. In this case the meter would only be used on the domestic water line and therefore should not be subject to the scope of our residential fire meter project.
 - Figure A.6.2. (b) Illustrates an acceptable arrangement with 2 water lines, one for the domestic and one for the sprinkler system. Only the domestic water line is metered.
 - Figure A.6.2 (c) illustrates an acceptable arrangement with a meter on the combined domestic/fire protection water line. This should be the only illustration that would require a meter that would restrict the water to the sprinkler system.
 - The minimum flow for each sprinkler is determined by the manufacturer's listing, which is dependent on the area that the sprinkler is listed to cover. At no time is the flow allowed to be less than 0.05 gpm per sq ft of coverage area.
 - If the house is a duplex and the water supply combines the domestic/fire protection then 5 gpm must be added to the total demand.
 - The maximum system pressure is 175; unless nonmetallic pipe is used in multipurpose domestic/fire protection systems then the working pressure can be 130 psi. (See 5.2.1.2 and 5.2.1.3)
 - The minimum operating pressure for a sprinkler is 7 psi, or the pressure needed to obtain the minimum flow, or the pressure corresponding to the sprinkler manufacturer's listing, whichever is greater.
 - Plans and calculations are not required by the standard, although many local jurisdictions do require them.
 - The sprinkler contractor is required to provide the home owner with inspection, testing and maintenance information

AWWA policies and research

The following residential fire sprinkler policy statement was adopted by the AWWA Board of Directors on February 4, 1996, and was reaffirmed on June 13, 2004.

“The American Water Works Association (AWWA) recognizes the increasing use of residential fire sprinkler systems and encourages that they be designed by licensed or accredited professionals and installed by licensed fire sprinkler contractors or properly trained personnel. The design of a system requires communication with the utility so that available water pressures and flow to the residential fire system can be determined and the design can meet the utility's requirements.”

AWWA Research Foundation has published the following report: *Impact of Fire Flow on Distribution System Water Quality, Design, and Operation*. This report concludes the following:

“Water-efficient fire suppression technologies exist that use less water than conventional standards. In particular, the universal application of automatic sprinkler systems provides the most proven method for reducing loss of life and property due to fire, while at the same time providing faster response to the fire and requiring significantly less water than conventional fire-fighting techniques. It is recommended that the universal application of automatic fire sprinklers be adopted by local jurisdictions.”

Residential Fire Meters

As a general rule a fire protection water line should not have any devices in line that could restrict the flow of water (for example a meter). If this were true in all cases we would not need to develop standards for fire meters. But recognizing that combined domestic/fire protection water lines may need metering then this should be the only time such meters should be used. The scope of these efforts should not be to mandate fire service meters on dedicated fire protection lines. Meters on fire lines should have a minimal friction loss. These meters should be able to fail safely in the full flow position and an increase in sediment in the water should not affect the meter. The meter should be able to continue to flow under various failed conditions. These meters do not necessarily need to be listed for fire service, as this will increase the cost. This concept is recognized by both NFPA 13D and NFPA 13R, which allows the sprinkler system to be connected to a reliable waterworks system.

There are residential fire meters being manufactured although there is no universal standard guiding their construction. Underwriters Laboratories is in the process of releasing a document on residential fire meters (SUBJECT 327A, OUTLINE OF INVESTIGATION FOR INFERENTIAL TYPE RESIDENTIAL FLOW METERS).

The manufactures of small meters have used construction criteria for residential fire meters which is similar to that for existing fire meters over 3 inches in diameter. Some of the concerns for the use of these meters included; using dirty water under high flow conditions, endurance versus accuracy, 3rd party certification, and any increase in cost.

Although friction loss tables can be used to estimate pressure loss in average meters, actual friction loss from the manufacturer should be used because true values vary between manufacturers and sizes. The following table is taken from NFPA 13D and shows the average friction loss in psi through some common meter sizes. Note that at a flow of 26 gpm, common for many NFPA 13D systems, the friction loss in a 5/8 inch meter is prohibitive and in a 3/4 inch meter may be too high to be acceptable. Also note that in some circumstances, the two sprinkler design requirements of NFPA 13D might make flows in excess of 31 gpm mandatory, leaving little choice except a 1 inch meter.

Pressure Losses in Water Meters						
	Flow					
Meter (in)	18	23	26	31	39	52
5/8	9	14	18	26	*	*
3/4	4	8	9	13	*	*
1	2	3	3	4	6	10
1 1/2	**	1	2	2	4	7
2	**	**	**	1	2	3

*** Above Maximum rated flow of commonly available meters**
**** Less than 1 psi**

From NFPA 13D , Table 4-4.3(e)

AWWA Reference Material on Meters:

- M6, *Water Meters - Selection, Installation, Testing, and Maintenance*
- M22, *Sizing Water Service Lines and Meters*
- C703, *Fire Service Meters*, covers fire meters 3 inches and larger.

See the discussion on arrangements of systems later in this guide for a more detailed discussion of meter sizes and arrangements.

Recommended Backflow Protection

The water purveyor needs to provide safe and reliable drinking water to all customers, and therefore needs to address all types of cross-connections. In most cases the water purveyor also needs to provide water for fire fighting operations throughout the community while at the same time continuing to address future development of the community and expansion of the total system demand.

Backflow preventers should not be necessary on small residential systems with the same components as domestic systems or on small residential systems integrated with domestic systems. Research sponsored by the United States Fire Administration and conducted by Worcester Polytechnic Institute showed that water that sits for long periods of time in fire sprinkler systems is not hazardous as long as the pipe is an approved potable piping material. The following is a summary of documents that require a backflow protection device or provide guidance for their installation.

NFPA 1, *Uniform Fire Code*, requires the installation of backflow devices to protect the public water supply from contamination and they must comply with NFPA 13 or NFPA 24, *Private Fire Mains*, and the plumbing code. Backflow prevention devices must be inspected, tested, and maintained in accordance with NFPA 25, *Inspection, Testing and Maintenance of Water-Based Fire Protection Systems*.

The *Uniform Plumbing Code* recommends the following protection for fire systems as appropriate (see Section 603.4.18); Double Check Valve Assembly, Double Check Detector Assembly, Reduced Pressure Backflow Preventer or Reduced Pressure Detector Assembly. A Reduced Pressure Backflow Preventer or Detector Assembly is only required when a system is within 1700 feet of a non potable water source and a fire department connection is provided or if there is an additive in the system.

The *International Plumbing Code* (§P608.16.4) requires that the potable water supply connected to an automatic fire sprinkler or standpipe system be protected against backflow by using a double check-valve assembly or a reduced pressure principle backflow preventer as appropriate. Additives or a nonpotable water source (§P608.16.4.1) require a reduced pressure principle backflow preventer. Examples could include chemical additives, antifreeze, or connections to a nonpotable secondary water supply assuming there is a fire department connection. Backflow protection is not required when a fire protection system is part of the water distribution system and there is no fire department connection nor is backflow required on deluge, preaction or dry pipe systems.

AWWA Manual M-14, *Recommended Practice for Backflow Prevention and Cross-Connection Control*, 3rd Edition provides the following information on backflow prevention and fire protection systems. The recommended backflow protection is based on the degree of hazard presented by the system, either low hazard or high hazard. A low hazard (non-health hazard) is a potential cross-connection involving any substance that generally would not be a health hazard but would constitute a nuisance or be aesthetically objectionable if introduced in the potable water supply. A high hazard (health hazard) is

a potential cross-connection involving any substance that could, if introduced into the potable water supply, cause death or illness, spread disease, or has a high probability of causing such effects.

The following AWWA M14 requirements are generally for new systems. Existing systems usually do not require additional backflow protection if they already have some form of acceptable directional flow-control protection in place (ex: single check valve or alarm check valve) until the system is substantially altered. Requiring additional backflow prevention on existing systems can have a detrimental effect on the hydraulic capability of the system as well as the cost.

AWWA M-14 recommends two approaches for backflow protection on commercial fire sprinkler systems. The 1st approach recommends a double check valve assembly (DCV) on all systems, unless there is a risk of a high hazard cross-connection, in which case a reduced-pressure zone principal backflow prevention assembly (RPZ) is recommended. The 2nd approach is to assess each type of system individually. For this approach, M-14 provides guidance on the following types of fire-suppression systems:

Wet-Pipe Fire Sprinkler Systems usually have stagnated water that may not be acceptable to drinking water standards. For new systems a DCV is recommended on closed (nonflow-through) systems, unless there is a risk of a high hazard, in which case a PRZ or air gap is suggested. For existing systems with a low hazard of cross-connection an existing modern UL listed alarm check valve (containing no lead) can continue to be used to control the direction of flow. Existing systems that have an alarm check valve that contains lead should consider protection using a DCV. If the existing system is significantly modified then the backflow protection should also be reexamined. A fire department connection may also present a potential source of contamination based on the fire departments water supply and if additives are used.

Dry-Pipe Nonpressurized Fire-Suppression Systems (Deluge) are open to the atmosphere and generally do not require backflow protection unless chemicals will be added when water flows, in which case a RPZ is suggested.

Dry-Pipe Pressurized and Preaction Fire-Suppression Systems typically are pressurized with air or nitrogen. Preaction systems may or may not be pressurized. A DCV is recommended unless there is a risk of a high hazard (e.g. chemicals) in which case a RPZ or air gap is recommended.

Residential, Single-Family Fire Sprinkler Systems do not require backflow assemblies on systems that are constructed of approved potable material and are designed to flow water so it does not become stagnate. A DCV is suggested on other systems unless there is a risk of a high hazard cross connection in which case a RPZ or air gap is recommended

Other fire-suppression systems designs can vary and the level of backflow protection should be based on the type of cross-connection and the degree of hazard. The local plumbing code could regulate systems connected to private plumbing systems.

Antifreeze is permitted by NFPA 13, NFPA 13R and NFPA 13D for use in fire sprinkler systems. Only “Food Grade” (pure 95% grade Glycerin or Propylene Glycol) antifreeze is currently allowed to be used in fire sprinkler systems that are connected to any potable water source. When CPVC pipe is used in a fire sprinkler system, the only antifreeze that is allowed to be used is glycerin.

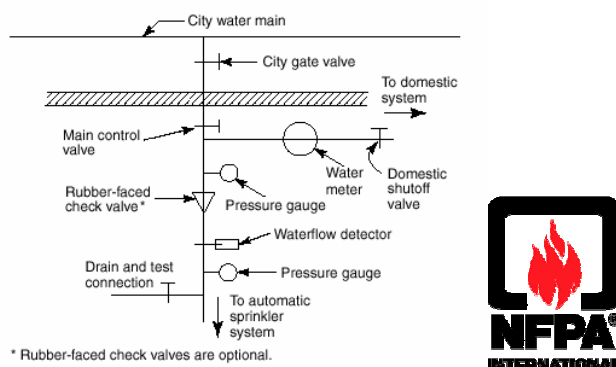
Backflow preventer approvals include the following organizations:

- The Foundation for Cross-Connection Control & Hydraulic Research at the University of Southern California
- Underwriters Laboratories - listed (classified) for friction loss and body strength
- Factory Mutual - Friction loss and body strength

NFPA13D Installation Arrangements

NFPA 13D expresses a preference for arranging the connection to a public water supply in Figure A.6.2 (shown below). The connection includes a single supply from the water main into the house. Once inside the house, the water delivery is split so that the domestic system is isolated from the fire sprinkler system. The water meter is only installed on the domestic portion, and therefore does not need to be included in the hydraulic calculations for the fire sprinkler system, and does not need to have any special requirements as far as the sprinkler system is concerned.

NFPA 13D Figure A.6.2 (a) Preferable Arrangement



The advantage to the configuration shown in Figure A.6.2(a) is that the only shut-off valve for the fire protected system also shuts off water to the domestic system. This encourages people to keep their sprinkler systems operational.

There has been significant discussion about the use of water meters on sprinklered lines. Some water purveyors want the fire sprinkler portion of the system to have a water meter, however, this practice should be discouraged on systems with waterflow alarms. Fire sprinkler systems are closed systems that do not have outlets where the homeowner can readily take water. A fire sprinkler system with a waterflow alarm will warn purveyors if an occupant of a home inappropriately attempts to take water. Given all of the problems that water meters bring to fire protection (excess friction loss, flow restriction, increased cost) it would be better to do without them. In the long run, the fire sprinkler systems

will save water purveyors money by reducing the amount of water used in fighting fires in homes. The elimination of the meter on the fire sprinkler portion of the system is a small price to pay for the life safety and water savings that the sprinkler's provide.

Figure A.6.2(b) of NFPA 13D shows another acceptable arrangement. This arrangement uses two separate supply lines from the water main into the building, one for the domestic usage and one for the fire sprinkler system. The domestic line contains a water meter while the fire sprinkler line does not. See the discussion above for justification on not putting a meter on the fire sprinkler line. This arrangement is not preferred because of the additional cost of the second supply line into the house. The homeowner should not have to pay for two separate lines.

NFPA 13D Figure A.6.2 (b) Acceptable Arrangement with Valve Supervision – Option 1

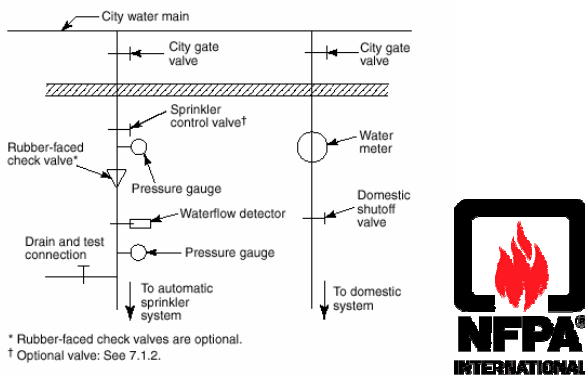
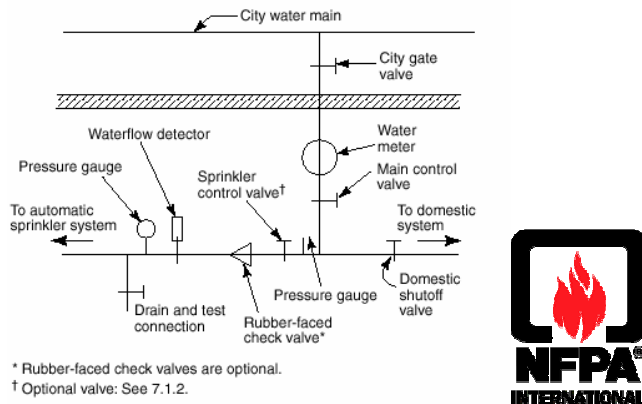
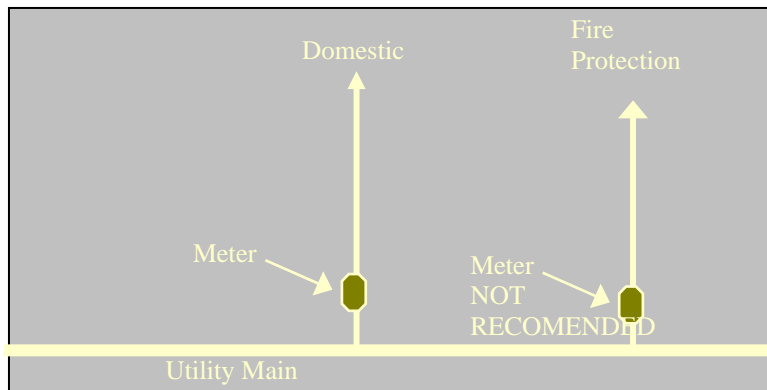


Figure A.6.2(c) of NFPA 13D shows another acceptable arrangement. This is actually similar to the preferred arrangement shown in Figure A.6.2(a), but includes a water meter on the main supply for both the fire sprinkler and the domestic water systems. While this is acceptable, the cost of the larger meter is considerable and the meter will need to be of a type that will not cause problems for the fire sprinkler system. The friction loss of the meter will need to be included in the hydraulic calculations of the fire sprinkler system.

NFPA13D Figure A.6.2(c) Acceptable Arrangement with Valve Supervision – Option 2



The following figure, showing a separate domestic service and fire protection service, each with its own meter is not referenced in NFPA 13D and is not considered acceptable for fire protection.



Hydraulic Requirements

NFPA 13D: (1-2 sprinkler design area)

- The design must include the flow and pressure for the most demanding pair of sprinklers in the same room. If all of the rooms in the home can be protected by a single sprinkler, then the design is just for a single sprinkler.
- Sprinklers are listed with a minimum flow discharge to cover a specific area. The flow is not permitted to be less than 0.05 gpm/sq ft. The flow is up to the manufacturer to declare and is different for each model of sprinkler. The manufacturer must prove that the flow from the sprinkler will control a severe fire in tests performed by independent laboratories. Examples of listed residential sprinklers are the Reliable model R3516 recessed pendent sprinkler listed to cover a 12 ft by 12 ft area at a minimum flow of 13 gpm at 7 psi and a Tyco model TY2596 concealed pendent sprinkler is listed to cover a 20 ft x 20 ft area at a minimum flow of 24 gpm and a minimum pressure of 32.7 psi.

NFPA 13R: (1-4 sprinkler design area)

- The design covers all of the sprinklers in the most demanding room up to a maximum of four sprinklers. If all of the rooms are protected with less than four sprinklers, the design will be for all of the sprinklers in the most demanding single room.
- Sprinklers are listed with a minimum flow discharge to cover a specific area. The flow is not permitted to be less than 0.05 gpm/sq ft. The flow is up to the manufacturer to declare and is different for each model of sprinkler. The manufacturer must prove that the flow from the sprinkler will control a severe fire in tests performed by independent laboratories. Examples of listed residential sprinklers are the Reliable model R3516 recessed pendent sprinkler listed to cover a 12 ft by 12 ft area at a minimum flow of 13 gpm at 7 psi and a Tyco model TY2596 concealed pendent sprinkler is listed to cover a 20 ft x 20 ft area at a minimum flow of 24 gpm and a minimum pressure of 32.7 psi.

NFPA 13: (4 sprinkler design area)

- When using residential sprinklers, the design area includes the four hydraulically most demanding sprinklers regardless of how many sprinklers are in the most demanding room. If the most demanding room does not have four sprinklers, additional sprinklers are added from adjacent rooms.
- The minimum required discharge from each sprinkler must be per the listing requirements of the sprinkler (see examples above) which are not permitted to be below 0.1 gpm/sq ft over the design area.

Rural water supply options

The majority of fire sprinkler systems use a public water main as the source of water supply. In rural and suburban areas without public mains, fire sprinklers are the most affordable and economic form of fire protection. In rural communities, where fire departments are farther away, and response times are often affected by the number of volunteers that can be assembled, a fire can destroy most of a building before the fire department ever arrives. Once the fire department arrives, water must be obtained from somewhere to fight the fire. Whenever a building is constructed, consideration needs to be given to how much water will be needed to fight a fire in that building. The water must be either available at the sight, or the fire department must be capable of delivering the water in a timely fashion. Calculating how much water will be needed is a function of the building's construction, size, use, contents and the fire protection systems installed.

In sprinklered buildings, the Required Fire Flow is generally the demand for the fire sprinkler system, which is much less than the demand of an unsprinklered building. This can save a community hundreds of thousands of dollars in construction costs and fire department operating budgets.

Rural water supply options include the following for supplying water to a fire sprinkler system when a public main is not available:

- Elevated tank
- Storage tank with a pump
- Pressure tank
- Underground well

Each of the options has advantages in certain situations. For all of these options, the two critical things to consider are:

- 1) Is the capacity of the water supply large enough to provide the demand of the sprinkler system over the required duration?
- 2) Is the method of obtaining water pressure adequate to provide the minimum necessary pressure at the highest, most remote sprinkler in the system?

There are a number of formulas and methods for determining the needed fire flow for a subdivision of homes. The Uniform Fire Code and NFPA 1142 each contain tables that provide the needed fire flow calculated by considering the most demanding building in a

subdivision. Each of these fire flow calculation methods contains significant reductions for fully sprinklered buildings and communities, which will help save the water purveyor in the development and maintenance costs of their own mains and distribution systems.

Water Department Fees

Many water purveyors require people that make connections to their water mains to pay “standby fees” in order to maintain their connections, even if they use little or no water. The justification for these fees is that the water purveyor makes the water available, and incurs some cost in doing so, making it logical that the person with the connection pay for the fact that the water was available for use. While this practice makes sense with many types of voluntary connections, it does not make sense with fire sprinkler systems.

Consider two identical homes right next door to each other; one with a fire sprinkler system, the other without. If a fire occurs in the home with a fire sprinkler system, the amount of water used to fight that fire will be tremendously less than the amount of water used to fight the fire that would occur in the unsprinklered home. Yet, if standby fees were being charged for the sprinklered home, the person spending their own money to save the water department money would be expected to pay an extra standby fee, while the person wasting the water purveyor’s money (without the fire sprinkler system) is encouraged to continue the waste by not having to pay a standby fee.

Rather than charge standby fees, water purveyors are encouraged to build a fee structure based on the Required Fire Flow necessary to fight a fire in the building. A fee structure based on the fire flow would get everyone who relies on water for fire protection to pay for it, rather than allow people without sprinkler systems to skate by without paying their fair share. At the same time, such a fee structure would recognize the fact that less water is used in sprinklered buildings by charging people with sprinklered buildings less. This would be a fair way to share the cost of fire protection in a community without penalizing building owners who install fire sprinkler systems. This fee structure could actually increase the revenue for the water purveyor.

Scottsdale, Arizona, has been a sprinklered community for more than 15 years and has more than 50 percent of the homes protected with fire sprinkler systems. According to the Scottsdale Report, there was less water used in fires in the homes with sprinklers. Sprinkler systems discharged an average of 341 gallons of water/fire as compared to 2,935 gallons of water/fire released by firefighter hoses. Many water departments and communities have recognized this savings by developing incentives for the installation of fire sprinkler systems. The following are some examples of incentives:

- California AB 2943 – Water Charges: Residential Fire Sprinkler Systems. Under existing law, local water suppliers impose charges for water service in accordance with various requirements. This bill would prohibit a local water supplier that supplies water to retail customers from imposing or increasing water charges solely due to the installation of a residential fire sprinkler system. The bill was

referred to the State Assembly Committee on Local Government on March 30, 2006.

- The City of Altamonte Springs, FL allows a 40% credit against the water connection charge for residential occupancies which have a sprinkler system installed.
- The Kentucky Public Service Commission ordered all utilities that currently access a minimum monthly bill for fire protection services to file a new rate structure and to eliminate standby fees.
- The City of Erie, PA has made a decision to provide a rate relief which would provide a 67% decrease for sprinkler standby fees and a 35% for sprinkler connections of 2 inches or less.
- M31, *Distribution System Requirements for Fire Protection*, mentions that water utilities can levy a one-time capital recovery fees or annual standby charges for fire protection systems. These charges should be based on the actual cost to provide the service.
- M1, *Principals of Water Rates, Fees, and Charges*, recognizes that sprinklers can reduce fire demands by faster, more efficient extinguishing of fires. In addition, private sprinkler connections use significantly less water than hydrants for fire fighting; as a result, they may reduce actual fire demands, because water is typically supplied only in the area of the fire. Accordingly, it is argued, there should be no additional charges for private fire service.

Maintenance

NFPA 13D, section A.4.2.1 provides information on residential sprinkler maintenance. It is the responsibility of the building owner for properly maintaining a sprinkler system. They should understand how the sprinkler system operates. A minimum monthly maintenance program should include the following:

- (1) Visual inspection of all sprinklers to ensure against obstruction of spray.
- (2) Inspection of all valves to ensure that they are open.
- (3) Testing of all waterflow devices.
- (4) Testing of the alarm system, where installed. (Note that where it appears likely that the test will result in a fire department response, notification to the fire department should be made prior to the test.)
- (5) Operation of pumps, where employed. (See NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*.)
- (6) Checking of the pressure of air used with dry systems.
- (7) Checking of water level in tanks.
- (8) Special attention to ensure that sprinklers are not painted either at the time of installation or during subsequent redecoration. When sprinkler piping or areas

next to sprinklers are being painted, the sprinklers should be protected by covering them with a bag, which should be removed immediately after painting is finished.

The most important thing that a homeowner needs to remember is what NOT to do to a sprinkler system. Do not hang objects from the sprinklers or the pipe. Do not paint, coat or obstruct the sprinklers. And do not turn off the control valve. These simple rules will ensure that the sprinkler system is functional for years to come.