Fighting fire where it starts

How the Verisk Sprinkler Assessment Report helps underwriters understand, evaluate, and reduce the risk of insuring properties protected by sprinklers

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Sprinklers: The most effective way to fight fire before it spreads

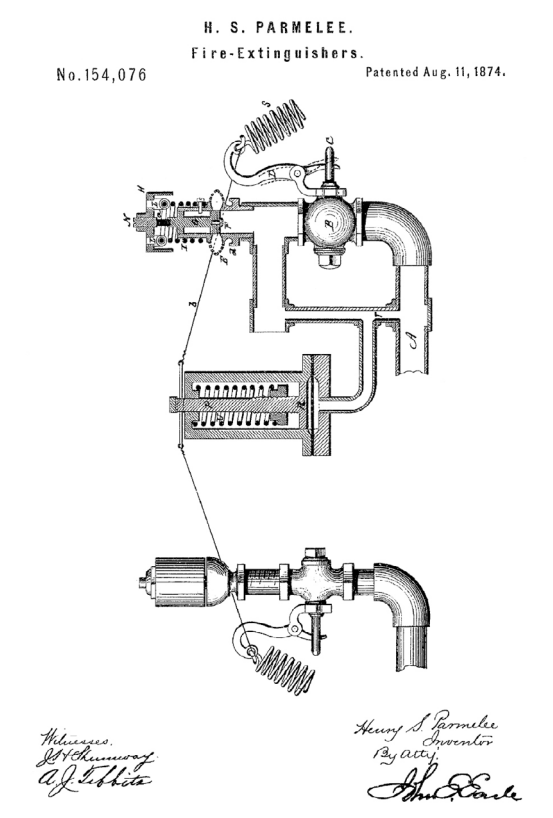
Fire has been one of the greatest perils to people and property through the ages— from the destruction of the Library of Alexandria two millennia ago, to the Triangle Shirtwaist Factory fire in the last century, to The Station nightclub blaze of 2003 and the Notre-Dame Cathedral conflagration of 2019.[1–3] All of these fires share a tragic commonality—they were sparked in buildings that lacked a sprinkler system that might have controlled the flames and changed the outcome.

While the idea of fighting fire with water delivered by a system of pipes and sprinklers was far in the future when Julius Caesar set the Library of Alexandria alight, the know-how and technology was already available and in use by the end of the 19th century. American inventors Phillip H. Pratt and Henry S. Parmelee received patents in the 1870s for devices similar to modern sprinkler systems.[4]

The average property loss per fire is reduced by one-half to two-thirds when a sprinkler system is present.

A centuries-old idea

- Renaissance painter and inventor Leonardo da Vinci is widely credited with building the world's first sprinkler system in a noble patron's kitchen during the 15th century. Legend tells that da Vinci's system was inauspiciously activated when a fire erupted, drenching the food being prepared for a special feast.
- British chemist Ambrose Godfrey, best known as the inventor of the fire extinguisher, used gunpowder to trigger the release of water in his 1723 sprinkler system.
- Architect William Congreve is credited for installing a sprinkler array resembling modern systems in the Theatre Royal, Drury Lane, in London in 1812.
- In the 1870s, American inventors Phillip H. Pratt and Henry S. Parmelee received patents for systems that started to closely resemble modern sprinkler systems with heads that activated when exposed to heat.



Source: United States Patent and Trademark Office, <www.uspto.gov>.

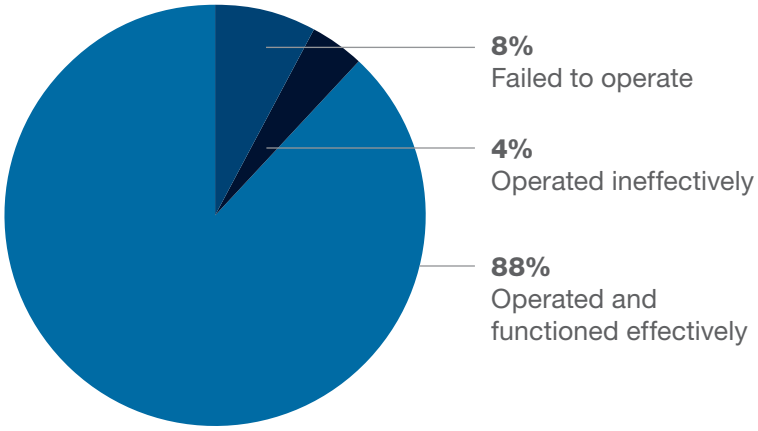
Today, automatic sprinkler systems are a cornerstone of fire protection in commercial and public buildings and, increasingly, in residential occupancies, including single-family homes. They save lives and prevent extensive damage by controlling or suppressing a fire at its source before it spreads out of control. The National Fire Protection Association (NFPA) reports that the loss of life in a fire is 87 percent lower when a building is protected by sprinklers compared with those with no automatic extinguishing systems.[5]

Automatic sprinkler systems that are appropriately designed, properly installed, well-maintained, and provided with a sufficient water supply are the most reliable and proven way to reduce the risk of loss of life and property in a fire.

The average property loss per fire is reduced by one-half to two-thirds when a sprinkler system is in place compared with fires in buildings where sprinklers are absent. Insurers generally give premium discounts when properties are protected by automatic sprinkler systems.

But savvy underwriters know that having a sprinkler system installed in a building is not enough—you need to be confident that it will work as intended if a fire breaks out. NFPA data reveals that in fires large enough to trigger a sprinkler system, sprinklers operated effectively 88 percent of the time. Research also shows that when sprinklers are present, fire is confined to the room where it originates 96 percent of the time, preventing widespread destruction of a building and its contents and, subsequently, loss of life.

Sprinker Operation and Effectiveness



Source: U.S. Experience with Sprinklers, National Fire Protection Association report, 2017.

Sprinkler facts

- A fire sprinkler system includes a network of pipes and valves that carry water from a supply source such as a tank or city water system to a series of fire sprinklers positioned throughout a building.

- Sprinklers are designed to operate automatically with a heat-activated element, either a solder link or a glass bulb, that breaks when the temperature rating of the thermal element is reached. When that occurs, the sprinkler opens to release water.

- Despite what's on the silver screen in movies such as *The Matrix*, which shows a fire sprinkler system gushing indiscriminately throughout a building, individual sprinkler heads are designed to operate independently and only activate directly above or in close proximity to the source of a fire, limiting water damage while effectively controlling or suppressing a fire when it is relatively small and easily contained.

The volume of water discharged from fire sprinklers to control or suppress a fire is much less than that of fire hoses used during firefighting operations. Less water means less water damage associated with fighting a fire. Moreover, sprinklers operate immediately in the area of fire origin on smaller fires compared to the time it takes for the fire department to arrive and deploy equipment and connect hose lines to fight larger fires. It can routinely take 10 or more minutes for firefighters to reach a fire and begin applying water to put it out.

The key question for insurers: *Can I rely on a sprinkler system to reduce risk?*

Fire requires three elements: Heat, oxygen, and fuel. Take away one and you eliminate the fire. Water is a cost-effective and efficient way to cool and remove the heat component, which is why sprinklers are highly effective fire-protection tools. *But sometimes a sprinkler system may fail to perform as expected for a variety of reasons, including such factors as:*

- ✔ **Gaps in inspection, testing, and maintenance (ITM)—**Sprinkler systems have routine ITM covering valves, drains, sprinklers, and other components. Inspections and tests can identify weaknesses that can lead to malfunctions or ineffective sprinkler system performance, increasing the potential for injury, property damage, and business interruption.
- ✔ **Change in occupancy—**Sprinkler systems should be designed for the hazard they are protecting. When a new tenant moves into a building, it's important to ensure that the sprinkler system's design is appropriate for the new function, for example when a restaurant replaces an optician's office. When an occupancy changes, the system design should be modified as necessary to remain effective.
- ✔ **Water supply—**While a water source may have been adequate at the time of a sprinkler system's installation, shifts in the surrounding community, such as increased development, could alter the available supply to existing fire sprinkler systems.
- ✔ **Human error—**Painted sprinklers that don't register the heat of a fire, stacked boxes that obstruct the spray of water, and a valve closed by accident are among the reasons why human error is to blame two-thirds of the time when a sprinkler system fails to operate as intended.[6]

The far left photo shows a painted sprinkler, which may not respond effectively in the event of a fire. The near left photo shows a main valve that is shut, so no water will flow. These errors are a concern because the policies covering these properties may have been priced based on having a functioning sprinkler system present.

On-the-ground expertise produces the Verisk SAR

It takes technical expertise to understand and evaluate a sprinkler system's effectiveness. Few insurers have the resources or training to do this task themselves. The **Verisk Sprinkler Assessment Report** (SAR) is an analytical tool that can quantify whether a sprinkler system will be effective in mitigating loss for a building in the event of a fire, making it an important resource for underwriting.

A team of about 400 specially trained field representatives perform on-the-ground surveys in commercial properties located throughout the United States. Using ISO's Specific Commercial Property Evaluation Schedule (SCOPES), which additionally references NFPA standards, the ISO field representatives evaluate sprinkler systems. Using a consistent methodology that identifies key performance indicators and deficiencies, the field representatives produce the Verisk SAR, which helps insurers assess whether a property is a good risk for issuing insurance coverage. The Verisk SAR is part of the ProMetrix® suite of underwriting products.

Types of sprinkler systems

- **Wet pipe systems** contain water in the piping at all times. The simplest, most common, and most reliable type of sprinkler system, wet pipe systems are suitable for any installation with stable temperatures above 40 degrees F.

- **Dry pipe systems** feature pipes filled with pressurized air or nitrogen. When a sprinkler is activated, this pneumatic pressure is lowered, allowing water to flow into the piping system to the area of the fire. Following activation, dry pipe systems must be drained and reset. More expensive and time-consuming to maintain, dry pipe systems require a heated valve room. They are suitable for parking garages, warehouses, and other facilities where temperatures fall below 40 degrees F, unless freeze protection is determined not to be required by NFPA 13.

- **Deluge systems** are designed for use in higher risk areas where rapid fire development is expected, such as airplane hangars. All deluge sprinklers are "open"; that is, they do not contain a thermal operating element. Upon system activation, water flows from all sprinklers.

- **Pre-action systems** are designed to avoid accidental operation in properties highly vulnerable to water damage, such as museums. The pipes are dry until activation.

Understanding the Sprinkler Assessment Report

The SAR is designed to be easy-to-read for insurance underwriters and agents who rely on its data to make informed decisions about coverage and premiums. Understanding the SAR can help insurers optimally price policies as well as avoid turning away potential customers whose sprinkler system deficiencies can be easily remediated.

EXECUTIVE SUMMARY

Building Sprinkler Credit:	**Sprinkler Credit Received**
Sprinkler Design Standard:	**NFPA 13 Design**
Sprinkler Grade:	**48** (out of 100) 0 – 100
Percent of Building Sprinklered:	**100%**
Sprinkler Demand Met:	**62%**
Hose Stream Demand Met:	**0%**

Automatic Sprinkler Grade Components	Deficiency Points
Water Supply	43
Sprinkler Components	9
Sprinkler Testing	0
Non-Sprinklered Areas	0
Rack Storage Obstructions	0
Building Conditions	0
Total Deficiency Points (Maximum of 100)	52
Automatic Sprinkler Grade (Range 0-100, 100 being best)	48

The SAR includes a building's address, the date of its most recent on-site survey by ISO field representatives, and the NFPA standard used for the design of the risk's sprinkler system. The most common standard used for sprinkler design is NFPA 13, *Standard for the Installation of Sprinkler Systems,* which requires the most comprehensive coverage for the entire building, including protection of unoccupied areas such as attics, closets, and similar spaces. The scope of NFPA 13 includes property protection for the building structure and its contents.

The second most prevalent design is from NFPA 13R, *Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies,* which is established to protect residential occupancies up to and including four stories in height that are located in buildings not exceeding 60 feet in height above the grade plane. This sprinkler standard is focused not on protecting the building, but to provide time for occupants to evacuate. NFPA 13R allows for the omission of sprinkler protection from attics, bathrooms, closets, and other concealed spaces under certain conditions. These systems are often employed in hotels, residential townhouses, and apartment complexes.

The SAR includes an executive summary that indicates whether a property is eligible to receive an insurance rating credit for having a sprinkler system based on a grading scale from zero to 100. Scores of 10 or above are eligible for full credit. Systems with a sprinkler score of less than 10 may be eligible for partial credit, or no credit.

It's important for insurers to understand that a lower score might not be as dire as it first appears. While some deficiencies are expensive or difficult to ameliorate—such as a city water supply that no longer meets the demands of the building—others are easily fixed. Painted or missing sprinklers are replaceable, for instance. Failing to test the system annually as required may be an oversight that can be easily rectified.

Take an example of a sprinkler system receiving a grade of 57. At first glance, the building might seem a poor risk, but a closer examination of the SAR reveals that 20 points were lost for failing to conduct a yearly test, while another 10 points were lost for faulty components, and three points were taken off for building conditions. A further 10 points were lost because the building lacked a secondary source of water. To improve this grade, the owner of the property could schedule the missing test, replace faulty components, and amend building conditions without undue hardship, bringing a disappointing score of 57 up to 90 without incurring significant expense or inconvenience. In turn, the property owner would benefit not only from lower premiums but increased safety of the building and its contents.

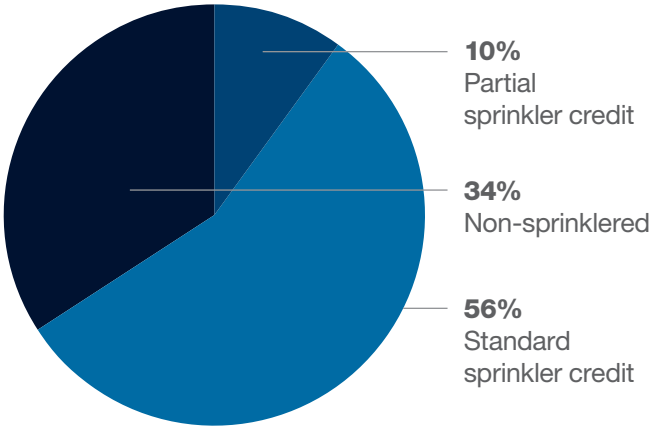
Verisk's team of 400 field representatives perform on-the-ground inspections in commercial properties located throughout the United States.

In a second example, a sprinkler system receives a score of 57, but in this case 35 points were lost to poor water supply and eight points were lost for areas not protected by the sprinkler system. That property's deficiencies would be expensive and perhaps impractical to fix.

Getting maximum credit

- ✔ The easiest way for a property owner to ensure a sprinkler system receives full credit is to perform the required annual inspections and tests. Each year a system isn't checked, there's a reduction in credit. After four years without an inspection and testing, the building is considered non-sprinklered for purposes of insurance coverage.
- ✔ Providing access to inspectors and keeping accurate records of annual tests is necessary to receive full sprinkler credit.
- ✔ Complying with regulations, such as displaying a placard with the system hydraulic design in a visible location, will help ensure full credit.

Sprinkler Credit in ProMetrix



Among commercial properties in the ProMetrix database that have sprinkler systems installed, two-thirds receive full or partial credit.

- ✔ Maintenance is critical, including replacing faulty sprinklers, inspecting whether any sprinklers are obstructed by building contents, and ensuring all valves are in their correct operating positions.
- ✔ Be aware of human error—in 59 percent of incidents in which sprinklers failed to operate, the system had been shut off. If an inspection reveals the system is turned off, no credit will be received.

Human error is to blame two-thirds of the time when a sprinkler system fails to operate as intended.

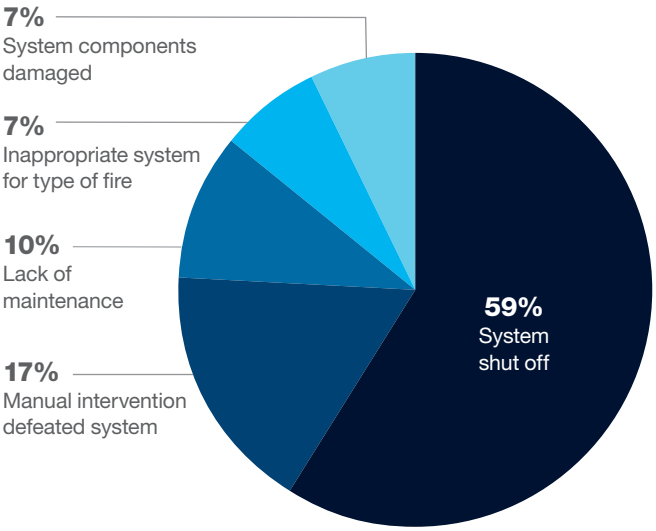
Water, water, everywhere?

The SAR evaluates whether there's an adequate water supply to meet the demand of the sprinkler system based on how the building is constructed (building construction class) as well as its use (building sprinkler occupancy class). The construction class ranges from Class 1 for frame buildings to Class 6 for fire-resistive buildings. The occupancy classes range from severe risk, such as a sawmill, to light risk, such as a motel.

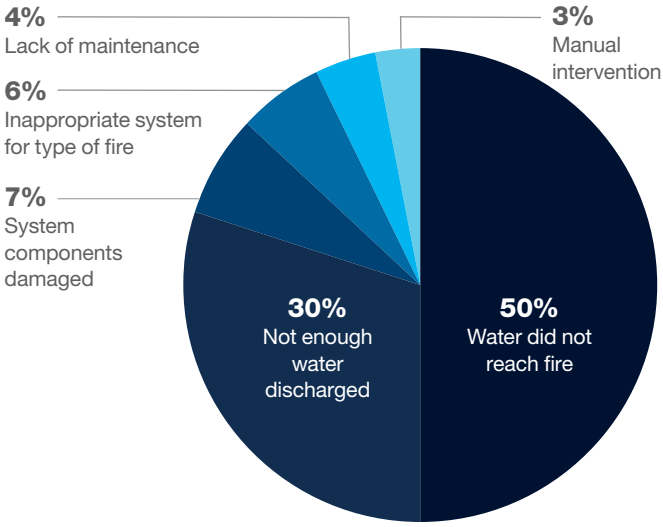
Changes in the occupancy of a building can significantly change the requirements of the water supply and sprinkler system design overall. It's the responsibility of the building owner to ensure the sprinkler system remains adequately designed and meets its ITM requirements.

The SAR also shows whether the hose stream demand for the fire department can be met by the water supply and whether the water supply can meet the demand flow duration anticipated if a fire breaks out.

Reasons for Sprinkler Failures



Reasons for Sprinkler Ineffectiveness



Source for graphs above: U.S. Experience with Sprinklers, National Fire Protection Association report, 2017.

Verisk fights the freeze

Water is ideal for putting out fires quickly, but there's one major complication: Water freezes at 32 degrees F. In balmy climates and in heated facilities, this isn't a problem for wet pipe sprinkler systems. And in locations where temperatures regularly fall below freezing—such as parking garages and unheated warehouses in the Northeast, for example—the solution is to employ a dry pipe system paired with a heated valve room. But what about in geographies where freezing is unlikely most of the time? Is it really necessary to install an expensive and complicated dry pipe sprinkler system? The answer used to be yes. Today, there's a new approach used by Verisk field representatives with the Verisk Freeze Analysis Program.

Freezing is a major concern in any sprinkler system where there is a risk of ice rendering the system inoperative. The NFPA 13 benchmark mandates freeze protection any time the temperature can fall below 40 degrees F. That means that in places where freezing is rarely documented but temperatures have been recorded in the mid-30s—such as parts of Florida, California, Arizona, and Texas—the conservative approach has been to install a dry pipe sprinkler system.

Verisk is implementing a new strategy that incorporates a risk-based model that employs seven decades of climate data, engineering principles, and heat-transfer analysis to evaluate the risk of ice plugging a wet pipe system. The Freeze Analysis Program allows the 400 field representatives who evaluate sprinkler systems to determine whether a wet sprinkler system will be effective in temperatures below 40 degrees F, thereby helping customers reduce risk and expense.

Tax breaks for sprinklers

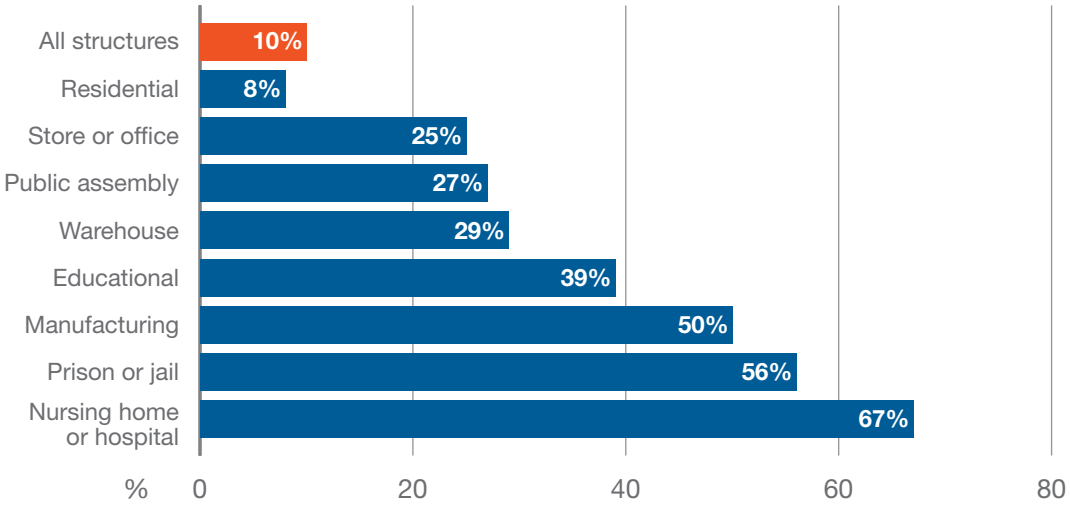
Businesses have historically been able to deduct the cost of installing a sprinkler system as a depreciation allowance with a recovery period of 39 years.[7] New tax laws have accelerated the ability to write off sprinkler system costs following lobbying by the National Fire Sprinkler Association (NFSA) and the efforts of lawmakers such as U.S. Rep. Jim Langevin of Rhode Island, whose district includes West Warwick, where the tragic Station nightclub fire claimed the lives of 100 people and injured 230 when pyrotechnics sparked flames in a venue that lacked sprinklers.[8]

The 2017 Tax Cut and Jobs Act allows business owners to recover the costs of investing in a sprinkler system and to upgrade existing systems. The law allows business owners to deduct up to $1.04 million of the cost of investing in a commercial fire sprinkler system, including upgrading an existing system, according to the NFSA.[9] The provision was expanded in 2020 with the passage of the Coronavirus Aid, Relief, and Economic Security (CARES) Act to allow for deducting the higher sums necessary to retrofit commercial high rises, where fighting fire is difficult. In order to be eligible for the full deduction, the equipment must be in use after September 2017 and installed before January 2, 2023. After that, the bonus depreciation percentage will be reduced.

Embracing sprinklers

Insurance companies have been pivotal in encouraging installations of automatic sprinkler systems since the technology emerged in the 1800s. Discounts on premiums often pay for themselves in lower payouts for losses in fires. And likewise, property owners that install and upgrade sprinkler systems find the investment can pay for itself through lower premiums as long as the system is maintained. Property owners that maintain their building's sprinkler systems and provide records and access to Verisk field representatives can be attractive customers for insurance companies, which can be confident their exposure has been accurately assessed. Sprinklers can prevent deaths, injury, and property damage, as well as costly interruptions of business operations and potential litigation in the aftermath of a fire, but only when they're in working order. A change in occupancy resulting in an inadequate sprinkler system relative to the premises, sloppy maintenance, or an inadequate water supply are risks that can be identified with a professional inspection. The Verisk SAR is a powerful tool for ensuring a sprinkler system will be effective when it's needed to fight a fire.

Presence of Sprinklers Not Universal

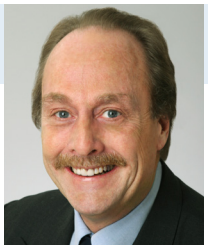


Some type of sprinkler was present in 10 percent of reported U.S. structure fires during 2010–2014, but sprinkler presence varies widely by occupancy.

Source: U.S. Experience with Sprinklers, National Fire Protection Association report, 2017.

Learn more about automatic sprinkler systems and Verisk's products and services relating to fire protection.

Contributors



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Notes

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