DISASTER SALVAGE TEAM
Working Towards Saving Cultural Collections

Correspondence to: the Robert McDougall Art Gallery
PO Box 2626 Christchurch
Phone (03) 3650 915 Fax (03) 3653 942

ISSN N° 1172-8949

NEWS LETTER

No 22 September 2000

Fire and Flood

- Higher installation and maintenance costs. The added complexity impacts the overall dry pipe installation cost. This complexity also increases maintenance expenditure, primarily due to added service labour costs.

- Lower design flexibility. There are strict requirements regarding the maximum permitted size (typically 750 gallons) of individual dry pipe systems. These limitations may impact the ability of an owner to make system additions.

- Increased fire response time. Up to 60 seconds may pass from the time a sprinkler opens until water is discharged onto the fire. This will delay fire extinguishing actions, which may produce increased content damage.

- Increased corrosion potential. Following operation, dry pipe sprinkler systems must be completely drained and dried. Otherwise, remaining water may cause pipe corrosion and premature failure. This is not a problem with wet pipe systems where water is constantly maintained in piping.

With the exception of unheated building spaces and freezer rooms, dry pipe systems do not offer any significant advantages over wet pipe systems and their use in heritage buildings is generally not recommended.

The third sprinkler system type, pre-action, employs the basic concept of a dry pipe system in that water is not normally contained within the pipes. The difference, however, is that water is held from piping by an electrically operated valve, known as a pre-action valve. The operation of this valve is controlled by independent flame, heat, or smoke detection. Two separate events must happen to initiate sprinkler discharge. First, the detection system must identify a developing fire and then open the pre-action valve. This allows water to flow into system piping, which effectively creates a wet pipe sprinkler system. Second, individual sprinkler heads must release to permit water flow onto the fire.

In some instances, the pre-action system may be set up with an interlock feature in which pressurised air or nitrogen is added to system piping. The purpose of this feature is twofold: first to monitor piping for leaks and second to hold water from system piping in the event of inadvertent detector operation. The most common application for this system type is in freezer warehouses.

The primary advantage of a pre-action system is the dual action required for water release: the pre-action valve must operate and sprinkler heads must fuse. This provides an added level of protection against inadvertent discharge, and for this reason, these systems are frequently employed in water sensitive environments such as archival vaults, fine art storage rooms, rare book libraries and computer centres.

There are some disadvantages to pre-action systems. These include:

- Higher installation and maintenance costs. Pre-action systems are more complex with several additional components, notably a fire detection system. This adds to the overall system cost.

- Modification difficulties. As with dry pipe systems, pre-action sprinkler systems have specific size limitations which may impact future system modifications. In addition, system modifications must incorporate changes to the fire detection and control system to ensure proper operation.

- Potential decreased reliability. The higher level of complexity associated with pre-action systems creates an increased chance that something may not work when needed. Regular maintenance is essential to ensure reliability. Therefore, if the facility's management decides to install pre-action sprinkler protection, they must remain committed to installing the highest quality equipment, and to maintaining these systems as required by manufacturer's recommendations.

Provided the application is appropriate, pre-action systems have a place in heritage buildings, especially in water sensitive spaces.

A slight variation of pre-action sprinklers is the deluge system, which is basically a pre-action system using open sprinklers. Operation of the fire detection system releases a deluge valve, which in turn produces immediate water flow through all sprinklers in a given area. Typical deluge systems applications are found in specialised industrial situations, i.e. aircraft hangers and chemical plants, where high velocity suppression is necessary to prevent fire spread. Use of deluge systems in heritage facilities is rare and typically not recommended.

Another pre-action system variation is the on/off system. This utilises the basic arrangement of a pre-action system, with the addition of a thermal detector and non-latching alarm panel. The system functions similar to any other pre-action sprinkler system, except that as the fire is extinguished, a thermal device cools to allow the control panel to shut off water flow. If the fire should re-ignite, the system will turn back on. In certain applications on/off systems can be effective. Care, however, must be exercised when selecting this equipment to ensure that it functions as desired. In most urban areas, it is likely that the fire department will arrive before the system has shut itself down, thereby defeating any actual benefits.

3.4: Sprinkler Concerns

Several common misconceptions about sprinkler systems exist. Consequently, heritage building owners and operators are often reluctant to provide this protection, especially for collections storage and other water sensitive spaces. Typical misunderstandings include:

- When one sprinkler operates, all will activate. With the exception of deluge systems (discussed later in this leaflet), only those sprinklers in direct contact with the fire's heat will react. Statistically, approximately 61% of all sprinkler controlled fires are stopped by two or less sprinklers.

- Sprinklers operate when exposed to smoke. Sprinklers function by thermal impact against their sensing elements. The presence of smoke alone will not cause activation without high heat.

- Sprinkler systems are prone to leakage or inadvertent operation. Insurance statistics indicate a failure rate of approximately 1 head failure per 16,000,000 sprinklers installed per year. Sprinkler components and systems are among the most tested systems in an average building. Failure of a proper system is very remote.

Where failures do occur, they are usually the result of improper design, installation, or maintenance. Therefore, to avoid problems, the institution should carefully select those who will be responsible for the installation and be committed to proper system maintenance.

- Sprinkler activation will cause excessive water damage to contents and structure. Water damage will occur when a sprinkler activates. This issue becomes relative, however, when compared to alternative suppression methods. The typical sprinkler will discharge approximately 25 gallons per minute (GPM) while the typical fire department hose delivers 100-250 GPM. Sprinklers are significantly less damaging than hoses. Since sprinklers usually operate before the fire becomes large, the overall water quantity required for control is lower than situations where the fire continues to increase until fire fighters arrive.

3.6: Summary:

In summary, automatic sprinklers often represent one of the most important fire protection options for most heritage applications. The successful application of sprinklers is dependent upon careful design and installation of high quality components by capable engineers and contractors. A properly selected, designed and installed system will offer unexcelled reliability. Sprinkler system

The first step toward halting a fire is to properly identify the incident, raise the occupant alarm, and then notify emergency response professionals.

Fire protection experts generally agree that automatic sprinklers represent one of the single, most significant aspects of a fire management program. Properly designed, installed, and maintained, these systems can overcome deficiencies in risk management, building construction, and emergency response. They may also provide enhanced flexibility of building design and increase the overall level of fire safety.

Fire Sprinklers

For most fires, water represents the ideal extinguishing agent. Fire sprinklers utilise water by direct application onto flames and heat, which causes cooling of the combustion process and prevents ignition of adjacent combustibles. They are most effective during the fire's initial flame growth stage, while the fire is relatively easy to control. A properly selected sprinkler will detect the fire's heat, initiate alarm, and begin suppression within moments after flames appear. In most instances sprinklers will control fire advancement within a few minutes of their activation, which will in turn result in significantly less damage than otherwise would happen without sprinklers.

Among the potential benefits of sprinklers are the following:

- Immediate identification and control of a developing fire. Sprinkler systems respond at all times, including periods of low occupancy. Control is generally instantaneous.

- Immediate alert. In conjunction with the building fire alarm system, automatic sprinkler systems will notify occupants and emergency response personnel of the developing fire.

- Reduced heat and smoke damage. Significantly less heat and smoke will be generated when the fire is extinguished at an early stage.

- Enhanced life safety. Staff, visitors and fire fighters will be subject to less danger when fire growth is checked.

- Design flexibility. Egress route and fire/smoke barrier placement becomes less restrictive since early fire control minimises demand on these systems. Many fire and building codes will permit design and operations flexibility based on the presence of a fire sprinkler system.

- Enhanced security. A sprinkler controlled fire can reduce demand on security forces by minimising intrusion and theft opportunities.

- Decreased insurance expenditure. Sprinkler controlled fires are less damaging than fires in non sprinkled buildings. Insurance underwriters may offer reduced premiums in sprinkler protected properties.

These benefits should be considered when deciding on the selection of automatic fire sprinkler protection.

3.4: System Types

There are three basic types of sprinkler systems: wet pipe, dry pipe and pre-action, with each having applicability, depending on a variety of conditions such as potential fire severity, anticipated fire growth rates, content water sensitivity, ambient conditions, and desired response. In large multifunction facilities, such as a major museum or library, two or more system types may be employed.

Wet pipe systems are the most common sprinkler system. As the name implies, a wet pipe system is one in which water is constantly maintained within the sprinkler piping. When a sprinkler activates this water is immediately discharged onto the fire.

Wet pipe system advantages include:

- System simplicity and reliability. Wet pipe sprinkler systems have the least number of components and therefore, the lowest number of items to malfunction. This produces unexcelled reliability, which is important since sprinklers may be asked to sit in waiting for many years before they are needed. This simplicity aspect also becomes important in facilities where system maintenance may not be performed with the desired frequency.

- Relative low installation and maintenance expense. Due to their overall simplicity, wet pipe sprinklers require the least amount of installation time and capital. Maintenance cost savings are also realised since less service time is generally required, compared to other system types. These savings become important when maintenance budgets are shrinking.

- Ease of modification. Heritage institutions are often dynamic with respect to exhibition and operation spaces. Wet pipe systems are advantageous since modifications involve shutting down the water supply, draining pipes, and making alterations. Following the work, the system is pressure tested and restored. Additional work for detection and special control equipment is avoided, which again saves time and expense.

- Short term down time following a fire. Wet pipe sprinkler systems require the least amount of effort to restore. In most instances sprinkler protection is reinstated by replacing the fused sprinklers and turning the water supply back on. Pre-action and dry pipe systems may require additional effort to reset control equipment.

The main disadvantage of these systems is that they are not suited for subfreezing environments. There also may be concern where piping is subject to severe impact damage, such as some warehouses.

The advantages of wet systems make them highly desirable for use in most heritage applications, and with limited exception, they represent the system of choice for museum, library and historic building protection.

The next system type, a dry pipe sprinkler system, is one in which pipes are filled with pressurised air or nitrogen, rather than water. This air holds a remote valve, known as a dry pipe valve, in a closed position. The dry pipe valve is located in a heated area and prevents water from entering the pipe until a fire causes one or more sprinklers to operate. Once this happens, the air escapes and the dry pipe valve releases. Water then enters the pipe, flowing through open sprinklers onto the fire.

The main advantage of dry pipe sprinkler systems is their ability to provide automatic protection in spaces where freezing is possible. Typical dry pipe installations include unheated warehouses and attics, outside exposed loading docks and within commercial freezers.

Many heritage managers view dry pipe sprinklers as advantageous for protection of collections and other water sensitive areas, with a perceived benefit that a physically damaged wet pipe system will leak while dry pipe systems will not. In these situations, however, dry pipe systems will generally not offer any advantage over wet pipe systems. Should impact damage happen, there will only be a mild discharge delay, i.e. 1 minute, while air in the piping is released before water flow.

Dry pipe systems have some disadvantages that must be evaluated before selecting this equipment. These include:

- Increased complexity. Dry pipe systems require additional control equipment and air pressure supply components, which increases system complexity. Without proper maintenance this equipment may be less reliable than a comparable wet pipe system.

components should be selected for compliance with the institution's objectives.

Wet pipe systems offer the greatest degree of reliability and are the most appropriate system type for most heritage fire risks. With the exception of spaces subject to freezing conditions, dry pipe systems do not offer advantages over wet pipe systems in heritage buildings. Pre-action sprinkler systems are beneficial in areas of highest water sensitivity. Their success is dependent upon selection of proper suppression and detection components and management's commitment to properly maintain systems. Water mist represents a very promising alternative to gaseous agent systems.

An abstract taken from a technical article from the North East Document Conservation Centre.
Many thanks for permission to edit.

HERE ENDS PART 1 **TO BE CONTINUED**