Understanding Cross-Connection Control for Fire Protection Systems

By Sean Cleary - April 12, 2021

With very few exceptions, almost every water-based fire protection system requires some form of backflow protection or cross-connection control. On the residential side, multi-purpose systems using domestic water piping do not require additional protection above what is required by the water purveyor or adopted plumbing code for normal domestic systems. Dry standpipe systems also require no protection since they are not normally connected to the public water system when not in use. Besides those types of exceptions, we do need to look at the installation of cross-connection control protection for fire protection systems.

The first step in any backflow assembly field test, or the installation of any backflow preventer, is to look at the system it is serving to ensure it is the correct type of the protection. To do that, there are several questions we need to answer.

These questions include:

- What is the degree of hazard the system is exposing the public water system to?
- What type of backflow is possible? Are both backpressure and backsiphonage possible?
- What type of fire protection system are we looking at?
- What are the pressure and volume requirements?
- What, if any, additives will be added to the water supplying the fire protection system?
- Does the system include fire pumps and storage tanks?
- Are there auxiliary water supplies present on site?

It is important to never simply assume that the assembly installed on a system is the correct level of protection. It is possible that changes have been made to the system or that the system was designed incorrectly. It is also possible that the installing contractor did not do the selection or installation properly. Even systems that were designed by professional engineers, installed by licensed fire protection companies, and inspected by the authority having jurisdiction are not immune from flaws. These flaws can create dangerous conditions and potential problems to the water supply, both inside the facility being served and, at times, the public water supply itself.

The potential, or actual, degree of hazard is the most important consideration when looking at the required system protection. In the U.S., we have two categories to choose from: the first are low hazard systems, which pose no health risk in the event of a backflow occurrence and will only affect the aesthetic quality of the water. The second are high hazard systems, which could cause illness or death in the event of a backflow occurrence. When we look at backflow protection in fire systems, we must look at each system as a unique installation in order to ensure that the proper protection is in place. Because of how systems are designed and installed, both backpressure and backsiphonage must be

considered possible in these installations. That itself eliminates the use of vacuum breakers on a water-based fire protection system.

Looking at water-based fire protection systems, there are several types to consider. We are examining the systems as to the required backflow protection only – the side of the system regulated by the plumbing code that ends at the backflow prevention assembly or device. Let's start with standpipe systems.

Standpipe systems are designed to provide water to fire hose connections or hose cabinets strategically installed inside a building. These systems are usually installed in large, open spaces within buildings and in multistory buildings for the purpose of manual firefighting. Standpipe systems can provide early fire suppression in these buildings, making it capable for a single individual or firefighter to offer a quick and effective response to fire. The main issue with these systems is the stagnant water that exists in them. They are considered low hazard and are normally protected with double check valve assemblies.

Automatic fire sprinkler systems consist of an arrangement of piping installed throughout a building, designed to supply a sufficient amount of water under pressure to an open sprinkler head. Most fire sprinkler heads, except sprinkler heads on a deluge system, are kept closed by a heat-sensitive operating mechanism. Typically, this operating mechanism is either a fusible link or a glass bulb. Regardless of the operating mechanism, only the sprinklers exposed to heat will open during a fire. In most cases, the piping in these systems are not rated for potable water use. The water is also in a static state and does require the installation of backflow prevention protection. There are several system types we need to look at.

Wet pipe systems are installed in areas where the ambient temperature is maintained at, or above, 40°F. When a sprinkler is activated by heat from a fire, water flows immediately from the sprinkler head. These systems have water in the piping at all times. If the system only contains water with no additives, we consider it a low hazard and double check valve assemblies are the required protection. However, In some situations where there is a need to provide sprinklers in an unheated area, such as a small loading dock, an antifreeze loop or system may exist. If that is the case, the entire system becomes a high hazard and a reduced pressure principle assembly would need to be installed.

Dry pipe systems usually are installed in large, unheated areas such as parking garages. These systems have pressurized air or nitrogen in the pipe, which keeps the main dry-pipe

valve closed. When a sprinkler activates due to heat, the air is released, allowing the dry-pipe valve to open and fill the system with water, which is discharged through the open sprinkler head. These are low hazard systems that require the installation of a double check valve assembly.

Pre-action sprinkler systems are usually installed in areas where water could cause catastrophic damage, such as in freezers, computer rooms, and areas with electronic equipment. The piping in a pre-action system contains air or nitrogen, which can be pressurized or non-pressurized. Water to the system is held back by the pre-action valve, which is connected to a fire detection system. If a fire occurs, the detection system sends a signal that opens the pre-action valve, which then allows water into the system's piping. The water is discharged through the open sprinkler. In most cases, this is also a low hazard system and would be protected with a double check valve assembly.

Deluge systems are designed so that all the sprinkler heads are open and the piping is not pressurized. These systems are usually installed in areas where the possibility of a severe fire condition is likely, such as aircraft hangars. Water to the system is held back by the deluge valve, which is connected to a fire detection system. If a fire occurs, the detection system sends a signal that opens the deluge valve, which then allows water to discharge from all of the sprinklers on the system. This is also a low hazard system and would be protected with a double check valve assembly, installed upstream of the deluge valve.

The adopted plumbing code addresses the required protection.

The Uniform Plumbing Code®, in Section 603.5.14 Protection from Fire Systems, states:

Except as provided under Section 603.5.14.1 and Section 603.5.14.2, potable water supplies to fire protection systems that are normally under pressure, including but not limited to standpipes and automatic sprinkler systems, except in one- or two-family or townhouse residential sprinkler systems, piped in materials approved for potable water distribution systems shall be protected from backpressure and backsiphonage by one of the following testable devices:

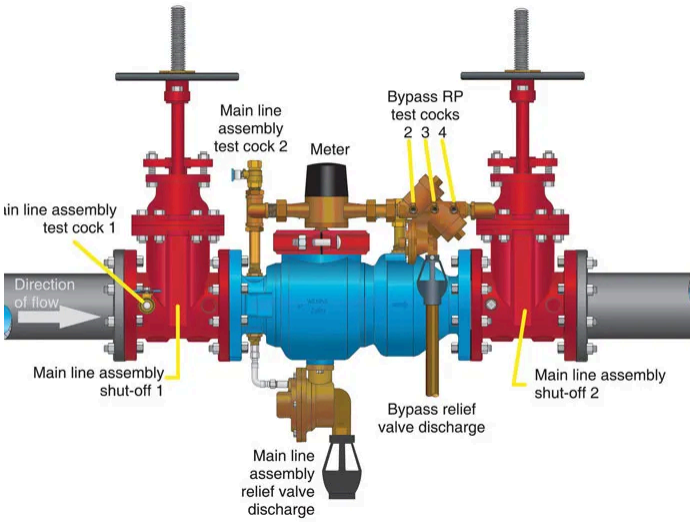
1. *Double check valve backflow prevention assembly (DCVA)*
2. *Double check detector fire protection backflow prevention assembly (DCDA)*
3. *Reduced pressure principle backflow prevention assembly (RP)*
4. *Reduced pressure detector fire protection backflow prevention assembly (RPDA)*

The code also addresses the addition of system additives. The Uniform Plumbing Code, in Section 603.5.14.2 Chemicals, states:

Where antifreeze, corrosion inhibitors, or other chemicals are added to a fire protection system supplied from a potable water supply, the potable water system shall be protected by one of the following:

1. *Reduced pressure principle backflow prevention assembly (RP)*
2. *Reduced pressure detector fire protection backflow prevention assembly*

The code requirements do allow for detector assemblies – double check detector assemblies in low hazard situations and reduced pressure detector assemblies in high hazard situations. Detector assemblies are assemblies that contain a water meter, or flow indicator, in a bypass arrangement within the larger assembly. The water meter, or flow indicator, is installed in fire systems that do not contain a large water service meter on the fire main. The bypass arrangement, which also contains the required backflow prevention, is designed to identify unauthorized water use or leakage by detecting flows of up to two gallons a minute through the bypass piping.



The code also looks at how the installation of backflow protection on existing fire protection systems can affect the system design. The Uniform Plumbing Code, in Section 603.5.14.3 Hydraulic Design, states:

Where a backflow device is installed in the potable water supply to a fire protection system, the hydraulic design of the system shall account for the pressure drop through the backflow device. Where such devices are retrofitted for an existing fire protection system, the hydraulics of the sprinkler system

design shall be checked to verify that there will be sufficient water pressure available for satisfactory operation of the fire sprinklers.

It is also important to understand that shutoff valves on backflow assemblies must be both indicating and supervised valves. All backflow prevention assembly valves on fire systems are considered control valves. Control valves must have components that visually indicate whether the valve is open or closed. For a fire sprinkler system to operate, the control valve, or valves, must remain open and the system must be continuously monitored. Therefore, there is a device on each control valve that either prevents the valve from being closed or sends an alarm when it is closed. This device can be as simple as a locked chain through the control valve that prevents that valve from opening, or an alarm system that notifies the fire department when the valve is closed. Some systems utilize both methods.

Fire department connections on fire systems can also be a concern. The existence of the fire department connection does not necessarily mean that the degree of hazard is increased, but it is a consideration when looking at the system. The Uniform Plumbing Code does address this. In Section 603.5.14.1 Fire Department Connection, it states:

Where fire protection systems supplied from a potable water system include a fire department connection that is located less than 1700 feet (518.2 m) from a nonpotable water source that is capable of being used by the fire department as a secondary water supply, the potable water supply shall be protected by one of the following:

1. *Reduced pressure principle backflow prevention assembly*
2. *Reduced pressure detector fire protection backflow prevention assembly*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The actual field test procedure steps used in testing backflow assemblies on fire protection systems is unchanged from the testing done on similar type domestic water system backflow assemblies. However, the preparations and actions before and after the backflow testing are not the same. Flow testing is necessary whenever valves are closed on fire systems and may include main drain or forward flow testing. Individuals who test backflow prevention assemblies on fire systems must have a working knowledge of these systems to safely work on any component, including the backflow prevention assemblies. Dry valves, flow switches, and alarm panels are just a few of the things that certified testers of fire protection backflow prevention assemblies must be familiar with.

Fire systems are designed to protect specific facilities. They are life safety and property protection systems. There is no one-size-fits-all solution when it comes to system type selection – it is based on many factors. An aircraft hanger is very different than an apartment or office building, and the systems protecting each will be very different. The same goes for the necessary backflow protection – it needs to meet the hazard and system requirements. We need to ensure proper pressure, volume, and protection to protect the property, people, and public water system. As with every part of what we do, training and education remain vital parts of any program.

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