# Fire Inspector

## CHAPTER NINE
## FIRE FLOW AND FIRE SUPPRESSION SYSTEMS

### Part 1

**Slide 1**

Welcome to Chapter 9 Fire Flow and Fire Suppression Systems.
In Part 1 of this chapter, we will discuss:

- the applicable Codes and NFPA standards,
- how to review construction installation plans
- water supplies
- municipal water systems
- water sources
- water distribution systems
- fire hydrants and locations
- water flow and pressure
- static and residual pressure

**Slide 2**

The suppressant most used in fire suppression systems is water. Water based suppression systems operate by delivering a specified amount of water over a fire of a predicted size. In order to determine if a system is operationally ready, the fire inspector must understand fire suppression systems, and how to determine if an adequate amount of water is available in the system. Therefore, in addition to reviewing the parts and functions of a fire suppression system, we will also review the major features of municipal water supply and distribution systems, and how to determine the adequacy of the supply system's water flow rates for firefighting.

**Slide 3**

The installation, inspecting, testing and maintenance of fire protection systems are regulated by the building and fire codes, local government bylaws, and NFPA Standards when they are adopted by the authority having jurisdiction.

In Canada, except for a limited number of municipalities who have special rights to create their own codes, construction is regulated provincially. As said in earlier Chapters in this course, the National Research Council of Canada publishes model building and fire codes, and most provinces adopt those codes as their template documents.

Building codes are considered construction codes and fire codes are considered maintenance documents. Fire codes address fire hazards within buildings and regulate the use and maintenance of buildings and building systems like fire suppression equipment.

**Slide 4**

Some of the applicable NFPA standard include:

- NFPA 12, Standard on Carbon Dioxide Extinguishing Systems
- NFPA 12A, Standard on Halon 1301 Fire Extinguishing Systems
- NFPA 12B, Standard on Halon 1211 Fire Extinguishing Systems
- NFPA 13, Standard for the Installation of Sprinkler Systems
- NFPA 13D, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes.
- NFPA 13R, Standard for the Installation of Sprinkler Systems in Low and Mid-Rise Residential Occupancies,

- NFPA 14, Standard for the Installation of Standpipes and Hose Systems
- NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection
- NFPA 16, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems

**Slide 5**

- NFPA 17, Standard for Dry Chemical Extinguishing Systems
- NFPA 17A, Standard for Wet Chemical Extinguishing Systems
- NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection
- NFPA 22, Standard for Water Tanks for Private Fire Protection
- NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- And
- NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

**Slide 6**

It is important to remember that only standards referenced in the building and fire codes are in effect. The reference documents for the building and fire codes can be found in Division B Section 1.3 of each code but you may have to check each code to find the reference. For example, NFPA 25 is not referenced in the building code, but it is in the fire code. The 2017edition of NFPA 2025 is the code in effect at the time of writing this material.

If the document is not referenced by one of the codes it is not enforceable. For example, NFPA 22 and 24 are not reference in the building or fire codes so they are not enforceable but can be used as best practices.

A copy of the refence documents tables from the BC Building and Fire Codes can be found in the additional resources section of this Chapter.

*References:*
*NBC & NFC Division B section 1.3*

**Slide 7**

The plan review stage is the first step in the review of a fire suppression system. At this stage, all relevant documents are provided by the system design professional to the authority having jurisdiction for review. The plan checker looks for code compliance, and any deficiencies are pointed out for correction.

The following information should be reviewed during the plan review stage:

- Building construction data
- System design data, including choice of, and compliance with, the appropriate NFPA sprinkler standard
- Occupancy class being protected
- Classification of any commodities being protected
- Water supply test data
- Plan of sprinkler system layout (to check for adequate sprinkler coverage, use of proper sprinkler heads, and correct pipe sizing)
- Manufacture cut sheets,

And
- Hydraulic calculations

**Slide 8**

Water is the most widely used agent for the suppression of fire. A dependable water supply is critical for manual fire suppression operations and automatic water-based fire suppression systems. Both fire engines and fire sprinkler systems require an adequate water supply to function. There are two basic types of water supplies: public and private. Some private properties and industries have their own water distribution systems. Alternately, public municipal water systems are used. The water source for both types of water systems can be either static, such as a lake, or pressurized, such as a hydrant.

Rural firefighting operations often rely on mobile water supplies delivered to site in tenders. They pickup water from a hydrant or from a static source like a stream or lake. In some cases, they use suction to draw water for dry hydrants strategically located throughout their protection area.

**Slide 9**

Most municipal water systems are owned by local government and provide water for both domestic use and for fire protection. There are also privately owned water systems. These usually serve smaller communities or single subdivisions and in many cases are operated by strata corporations or water boards. Many water districts or water boards were formed before there were local governments that provided this service. A water board may operate a number of different water systems based on where the demand for service comes from.

The three major components of a municipal water system are:
- The water source (such as a well, river, stream, lake, or human-made facility)
- The treatment plant (where impurities are removed),
  and
- The distribution system (where water from the treatment facility is delivered to the end user).

The water source needs to be large enough to meet the system demands and be able to deliver water even when the primary water source is interrupted. Therefore, reservoirs and other large storage facilities are used, and several different water sources are often used to insure an uninterrupted supply.

**Slide 10**

There are two methods by which a water distribution system delivers water through underground water mains: pump pressure, or gravity systems which use head pressure. Head pressure is static pressure caused by the weight of the water.

Water distribution systems that pump water directly into the distribution system are known as direct pumping systems. Water distribution systems that use elevated storage tanks are known as gravity systems. Most municipal water supply systems use both methods, pump pressure and gravity systems (head pressure), to supply the needed pressure.

Where gravity is used, the storage facilities are located on high ground, while end users are located on lower ground. Pumps can be used to deliver water to elevated water storage towers or to elevated reservoirs. In this manner, a failsafe is built into the system, as the elevated storage facilities can maintain the desired water pressure without the need for pumps.

The recommended minimum hydrant pressure is 20 psi (138 kPa). Generally, water pressures within the system range between 20 psi (138 kPa) and 80 psi (552 kPa).

**Slide 11**

A system of underground pipes, known as water mains, carry water from the treatment facility to the end user. Water mains are the principal pipes in the system. Large mains, know as primary feeders, carry water to large sections of towns or cities which are then carried by secondary feeders to smaller areas, and finally, by distributor pipes, which supply hydrants and users along individual streets. The size of the water main is determined by the amount of water required by the system. Obviously, the larger the main the more water it can carry.

A grid design, in which water is supplied to a hydrant from an interlocking network of water mains that provide water from several directions, is optimal. A grid allows for easier maintenance of the system and provides a more reliable water supply. A hydrant on a dead-end water main, by contrast, will have a limited water supply, and hydrants located further down a dead-end main will loose pressure to hydrants located upstream.

In some communities the water mains may not be large enough to supply the required potable water and the water required for firefighting. In this case fire departments could employ water tenders to supply the required fire flows.

**Slide 12**

Water flow within the system can be controlled with shut-off valves that are located between water mains and distribution pipes. If a grid system is used, water to a portion of the system may be controlled in case of a line break or other damage. Valves in distribution lines, like the one shown in this photo, can control the flow of water to an individual user.

**Slide 13**

Fire department access to the public or private water supply is via an upright steel barrel attached to the distribution system; otherwise known as a fire hydrant. Fire hydrants can be either wet-barrel or dry-barrel. In countries having warmer climates, the use of wet-barrel hydrants would prove beneficial, as the hydrants do not have to be drained after each use and can have separate valves for each outlet. However, as wet-barrel hydrants are subject to freezing, they are typically not used in Canada.

*References:*
*Waterhelp.org http://www.waterhelp.org/index.php/article/improper_hydrant_operation*

**Slide 14**

In climates such as ours dry-barrel hydrants are necessary. The control valve for dry-barrel hydrants is located at the hydrant base, below the frost line, in order to protect the hydrant from freezing. This valve is controlled by rotating the nut, also referred to as the stem, on the top of the hydrant. Most dry-barrel hydrants have only a single control valve and therefore require each outlet to be connected to a hose line, or have a gated coupling attached by a firefighter or be equipped with firmly attached outlet caps, when the valve is open.

Dry-barrel hydrants have a drain at the bottom that opens when the hydrant is closed. This is so the hydrant barrel stays dry when not in use. When the hydrant is fully open, the drain will close. Dry -barrel hydrants must always be either fully open or fully closed. A partially open hydrant will have a partially opened drain. A partially opened drain will allow pressurised water to flow out, eroding the ground surrounding the hydrant.

**Slide 15**

You may have noticed that fire hydrants are not all the same colour. What you are seeing is the colour assigned to each hydrant to convey how well it performs as a source of water for firefighting and other uses. When utilized,  the colour denotes how much water is available from the hydrant in GPM Gallons Per Minute. Some hydrants are all one colour, and others have caps coloured differently from the body This table shows some of the most commonly used hydrant colour code markings as identified in NFPA 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants.

Class AA – hydrants with 1500 gpm flow rate – Light blue
Class A – hydrants with flow rate between 1000-1499 gpm – Green
Class B – hydrants with flow rate between 500-999 gpm – Orange
Class C – hydrants with flow rate less than 500 gpm – Red

NFPA 291 is not referenced by the Canadian building or fire codes so it is not enforceable, but it can be used as a best practice.

*References:*
*NFPA 24*
*BCBC & BCFC 1.3 Reference Documents*

**Slide 16**

Fire hydrants are located based on local standards and recommended practices. Many communities require hydrants at each street intersection, and mid-block hydrants may need to be added where maximum distances are exceeded. Also, depending on the type and size of building, the building code may limit the travel distance to the hydrant. For example, Canadian building codes require that the unobstructed distance between a fire department connection for a standpipe or sprinkler system and the hydrant be not more than 45 meters. This may require the builders to install additional hydrants.

Private water systems are the responsibility of the owner, but fire inspectors should collect information and test results to ensure they provide adequate water supply for firefighting operations and that the systems are properly maintained.

*Reference:*
*NBC 3.2.5.15*

**Slide 17**

Fire flow is the flow rate of the water supply that is available for firefighting. Because a minimum of 20 psi residual pressure must always be maintained within a water supply system to avoid damaging the system components and keep it functioning properly, fire flow is always measured at 20 psi residual pressure. Fire flow tests include the measurement of static pressure, the pressure when no water is flowing, and residual pressure, the remaining pressure in the hydrant when water is flowing,  and formulas used to calculate the available water from these tests. Knowing the amount of water available is critical information required when preparing pre-incident plans. Test results may also highlight weak points in the water distribution system.

**Slide 18**

The amount of fire flow required to be available for non-sprinklered buildings must account for a number of different variables, including:

- the occupancy type of the building being protected,
- the type of construction,
- the size of the building,
  and
- distance from other buildings.

Within sprinklered buildings, the minimum fire flow rate required is specified by the NFPA sprinkler standard to which the system was designed. The sprinkler standards require that the amount of water flow available be sufficient to flow required number of sprinklers in the design area criteria, plus an allowance for fire fighting hose streams. The flow rates available to a system can be determined by  doing a flow test from a nearby fire hydrant.

**Slide 19**

Conducting hydrant flow tests requires a basic understanding of static pressure, residual pressure, elevation pressure, and flow pressure.

Static pressure is the pressure in the water supply system when there is no water moving. Static pressure is the potential energy in the system and is provided by gravity from an elevated storage tank, or by pump pressure. Static pressure can be measured by placing a pressure gauge on a hydrant when no water is flowing. However, be aware that, because of the large number of users of a municipal water system, water is almost always flowing; and therefore, a gauged hydrant with no open nozzles will typically still be reading the normal operating pressure of the system.

**Slide 20**

When water is flowing, some of the static pressure in the system is converted into kinetic energy, while some pressure is lost due to the friction between the pipes and the flowing water. The amount of pressure left in the system when water is flowing is know as Residual Pressure. A measure of residual energy is the best way to determine how much water is available in the system. The residual pressure within a system should not drop below 20 psi.

Elevation pressure is the amount of pressure created by gravity. Gravity, which is sometimes called head pressure, creates elevation pressure in a water system as the water flows down from a raised tank or a hilltop reservoir to the water mains below.

Flow pressure, as we already discussed, is a measure of the quantity of water flowing through an opening during a hydrant test. When a stream of water flows through an opening, 100 percent of the pressure is converted to kinetic energy.

**Slide 21**

A hydrant flow test involves the measurement of the static and residual pressures at a given hydrant. The pressure loss between the static and residual measurements can then be analyzed to calculate the available fire flow. The test results can be computed with the assistance of computer programs or graphed using specialized graph paper. By whichever method, a determination is made about the maximum water supply that is available at that location.

**Slide 22**

Obtaining static and residual pressure involves placing a gauge on the hydrant for which the information is being gathered; also know as the test hydrant. A second hydrant, that is downstream and adjacent to the test hydrant, is then opened to gain a residual pressure reading at the test hydrant. This second hydrant is referred to as the flow hydrant. The amount of water that is flowing through the system at the time of the test must be known, and this information is collected by placing a pressure gauge, known as a Pitot gauge, in the water stream flowing from the flow hydrant. The velocity pressure of the flowing water that is measured by the pitot tube and gauge is known as flow pressure.

In this photo a pitot tube is being used to measure the flow pressure from a hose stream using a smooth bore nozzle.

**Slide 23**

This video shows the calculation using a universal water flow graph.

**Slide 24**

You can also use an equation that considers the size and design of the hydrant outlet being opened, and the pressure flowing from the opening, to calculate the flow. This equation is:
$Q=29.83\ cd^2\ \sqrt{P}$

In the equation, Q is the flow in gpm, C is the coefficient of discharge (the rougher the outlet, the greater the pressure loss), d is the inside diameter of the discharge opening, and P is the pressure measured on the pitot gauge.

This may sound very complex, but the following video simplifies the mathematical equation.

**Slide 25**

Video

**Slide 26**

The coefficient of discharge refers to how smooth the transition is between the hydrant barrel and the outlet. For conducting flow tests, the 2.5” outlet is the better choice, as larger outlets entrain more air into the stream.
In some hydrants, the transition is smooth, and little pressure would be lost as the water rounds this curve and moves into the outlet. In others, there is a squared transition, which would create more pressure loss, and in others the outlet projects into the barrel, creating even more pressure loss. Depending on design, the hydrant coefficient will be either 0.9 (for smooth transitions), 0.8 for square transitions, or 0.7 for nozzles that project into the barrel.

**Slide 27**

To obtain reliable and graphable results, the residual pressure obtained at the test hydrant must be at least 25% lower than the static reading. Additional nozzles, or hydrants, must be opened until a minimum 25% pressure difference is reached. If the water mains are small and the system is weak, only one or two hydrants should be flowed, but on the other hand, if the mains are large and there is ample water it may be necessary to flow lots of hydrants.

For more information, please refer to NFPA 291 Recommended Practice for Fire Flow Testing and Marking of Hydrants.

**Slide 28**

Now that we have developed a basic understanding of fire flow, and how the water for fire flows is stored and transported, we can turn our attention to the fire suppression systems that deliver the fire flows to their intended location: over a fire.

The most common type of fire suppression system is the automatic fire sprinkler system. Automatic fire sprinkler systems have been in use since the eighteen hundreds. Until the 1940s, sprinklers were installed almost exclusively for the protection of commercial buildings, whose owners were generally able to recoup their expenses through savings on insurance costs. Over the years, building and fire codes, and municipal bylaws in some jurisdictions, have mandated the installation, testing and maintenance of automatic fire sprinkler systems in buildings based on their size and use.

**Slide 29**

Contrary to what is commonly seen on TV and in the movies, sprinkler systems are typically designed to flow one sprinkler head at a time, as each sprinkler is heated to its operating temperature. If fire sprinkler systems were actually designed as seen on TV, with every sprinkler in the system operating at the same time, unnecessary water damage would be caused, and the sprinkler system costs would skyrocket due to the cost of installing a system that could meet the water supply requirements of such a system. Sprinkler systems are designed to control fires within a building one sprinkler head at a time. As the fire grows more sprinkler heads are activated.

**Slide 30**

Fire Sprinkler systems are designed in such a way that they will be able to control a fire, even if that fire is in the most hydraulically remote area of the building. A hydraulically remote area is a location in a building where it is most challenging to deliver water. Examples of hydraulically remote areas include upper levels of a high-rise building, or where there are long pipe runs serving large floor areas.

Sprinkler systems are designed to discharge water in sufficient density to control or extinguish a fire at its incipient stage. In order to do this, the system design must consider both the occupancy hazards being protected, and the water supply requirements of the system.

**Slide 31**

When conducting a fire inspection of a building it is imperative to consider the contents as a potential fuel load. Fire protection systems must provide adequate protection for the contents and processes within the building. Sprinkler systems are required by the building code for life safety and the protection of some buildings and must be installed in conformance with NFPA 13, NFPA 13R or NFPA 13D.

NFPA 13 defines occupancies by various hazard classification including Light Hazard, Ordinary Hazard Groups 1 and 2, and Extra Hazard Groups 1 and 2. These classifications are for sprinkler design, installation, and water supply only, and are not to be confused with the occupancy classification of the building.

Light Hazard are occupancies where the quantity and combustibility of the contents are low and fire with low heat release rates can be expected.

**Slide 32**

Ordinary Hazard Group 1 occupancies are occupancies where combustibility is low, quantities of combustibles is moderate, stockpiles of combustibles do not exceed 2.4 m (8 ft.) and fires with moderate heat release rates can be expected.

Ordinary Hazard Group 2 is where the quantity of combustibles is high, but stockpiles do not exceed 12 ‘ high and fires with a moderate heat release rate can be expected.

Extra Hazard Group 1 occupancies are where the quantity and combustibility of contents are very high and dust ,lint and other materials are present introducing the probability of rapid developing fires with high heat release rates and little or no flammable or combustible liquids.

Extra Hazard Group 2 occupancies are where there is moderate to substantial quantities of flammable or combustible liquids stored or used in processing operations.

**Slide 33**

In addition to the occupancy hazard groups already identified there is also Special Occupancy Conditions that involve high piled storage of combustibles, flammable and combustible liquids , large quantities of loose combustibles, or chemicals and/or explosives that can cause excessive rapid fire spread which could cause an excessive number of sprinkler heads to open. Special Occupancy Requirements has a Chapter in NFPA 13 devoted to it. It addresses things like aerosol products and spray applications using flammable or combustible materials.

**Slide 34**

It is important to recognize that the hazard level of the contents of a building may change even though the occupancy classification, as defined by the building code, may not have changed. For example, a warehouse storing metal canoes which switches to wooden canoes may not change the building code occupancy classification, but the fuel load has greatly increased the hazard level. A sprinkler system may not be required for the building storing the metal canoes but may be required to store wooden canoes.

Any time there is a change in the occupancy classification of a building, or the commodities being stored, a review of the fire protection systems should be undertaken to make sure they are suitable for the hazard being protected. Any time there is a question about the fire protection systems suitability the design professional or installation contractor should be consulted.

**Slide 35**

During the design process the size and use of the building along with the contents are analyzed to determine the level of fire hazard and then classified accordingly. There are several NFPA hazard classifications that are based upon the occupancy characteristics. These characteristics include:

- The combustibility of contents.
- The quantity of combustibles.
- Rate of heat release from a potential fire
- The storage height of combustibles stored in the building
- The quantity of flammable and/or combustible liquids stored in the building

Buildings are classified as Light Hazard, Ordinary Hazard Group 1, Ordinary Hazard Group 2, Extra Hazard Group 1, or Extra Hazard Group 2.

**Slide 36**

**Light hazard occupancies** include things like dwelling units and offices, where the amount and combustibility of materials are low and low heat release rates are expected.

**Ordinary hazard group one** includes parking garages, mechanical rooms and storage rooms (with storage height of 8 feet or less); where combustibility is low and the quantity of materials is moderate, and where moderate heat release rates are expected.

**Ordinary hazard group two** includes occupancies such as retail stores, storage rooms and warehouses with storage heights of 12 feet or less; where the amount and combustibility of materials is moderate to high, and where moderate heat release rates can be expected.

**Extra Hazard Group one** includes sawmills, plywood/particle board manufacturing, and furniture upholstering using foam plastics; where significant quantities of highly combustible materials are present and where heat release rates could be high, but contain little to no flammable liquids.

**Slide 37**

**Extra Hazard Group Two** includes flammable liquid spraying operations and manufacturing plants where large quantities of flammable or combustible liquids are stored. These occupancies could also expect high heat release rates.

Some occupancies require the sprinkler system to be designed to take into consideration the configuration of material storage, or the combustibility of the materials being stored, because of the risk of rapid-fire spread. If not properly designed, a sprinkler system could become overwhelmed by a rapidly developing fire that opened more sprinkler heads than the system was designed for. This can easily result in failure of the water supply, rapid fire spread and total loss of the structure.

**Slide 38**

Every automatic sprinkler system requires a reliable water supply of adequate volume and pressure. The primary water supply source for an automatic sprinkler system usually comes from the public water supply system. Minimum water flow requirements are based on the type of hazard being protected, the occupancy class, and the fuel load determine the volume of water flow required.

Most sprinkler systems require the provision of a fire department connection, also referred to as the FDC, which is a fire hose connection through which a fire department can pump water into the sprinkler system via a fire department pumper. Additional water may be required if a fire grows past the design capabilities of the sprinkler system, or if there were a malfunction of the system, or disruption in the primary water supply.

**Slide 39**

The fire department connection should be located on the street side of the building and be visible and recognizable from the street or nearest point of fire department apparatus access. It should be located so the fire engine and its hose lines do not obstruct access to the building for other apparatus when connected to the FDC. The FDC must have a sign that indicates its location. If the FDC serves both a sprinkler system and a standpipe system the sign must indicate both systems, for example “Autospkr and Standpipe”.
A sign should also be provided that indicates the operating pressure required at the inlets.

The FDC must be located so that the distance from the fire department connection to a hydrant is not more than 45 m and is unobstructed.

*Reference:*
*BCBC NBC 3.2.5.15*

**Slide 40**

The concept of automatic fire sprinkler systems is simple: sprinklers are attached to an arrangement of water distribution pipes that supply water from a water source. When a fire causes a sprinkler to open, water is applied to the area below. Sprinkler systems are made up of piping of different sizes and a number of different valves, switches, and other devices are added in order to add functionality.

The system piping starts at the system check valve, or backflow prevention device, which is typically located at the system connection to the water supply piping. The check valve prevents stagnant water within the sprinkler system from re-entering the potable water supply.

**Slide 41**

Vertical sections of pipe known as risers extend from the check valve and connect the water supply mains to the main horizontal pipes called cross mains. Cross mains then connect to smaller horizontal pipes called branch lines. Sprinklers are connected to the branch line pipes by short vertical pipes known as nipple risers.

Functionality is added to fire sprinkler systems by adding check valves, main water supply control valves (including OS&Y, PIV, WPIV, and butterfly valves) sprinkler system valves (including alarm valves, dry-pipe valves and deluge valves), zone valves, smaller valves (such as drain valves and globe valves), pressure gauges, tamper switches, flow switches, and water motor gongs.

**Slide 42**

OS&Y stands for outside stem and yoke. This type of valve has a stem that moves in an out as the valve is opened or closed. When the valve is open, the stem is out. As shown in the picture.
The following video about OS&Y Valves is courtesy of the Chub Group of Insurance Companies

**Slide 43**

Video

**Slide 44**

PIV stands for post indicator valve. This type of valve is typically located outside and has a window which indicates whether the valve is open or closed. PIVs are often used with automatic sprinklers and wet standpipe systems. When the system main valve is located underground it can be difficult to tell if the valve is open or closed. A post indicator valve includes an indicator to show whether the valve is currently in an open or closed position. The handle is typically located on top of the post and is locked in either the open or closed position when not in use,

**Slide 45**

WPIV stands for wall post indicator valve. This is a form of post indicator valve that is designed to be mounted on the outside wall of a building.

The following video about Wall Post Indicator Valves is courtesy of the Chub Group of Insurance Companies

**Slide 46**

Video

**Slide 47**

To control the water supply in sprinkler systems many different valves may be incorporated. The type of sprinkler system valve needed depends on the type of sprinkler system in which they are installed. Depending on the characteristics of the building like building height, building area, and occupancy classification, the sprinkler system may be required to be divided into two or more zones in order to meet the requirements of NFPA 13, and/or the local Building Code. A zone valve enables the water from one zone to be shut off, while the remaining valves in the system remain open. Zoning means that service and maintenance works can be performed in one zone while maintaining sprinkler protection to most of the building. This is one reason that you may see multiple risers in a sprinkler room as seen in this photo, each serving a particular area or zone of the building.

Zoning also means that a signal is sent to the fire alarm system identifying the specific location of a sprinkler activation.

**Slide 48**

Properly operating sprinkler systems require the pressures to be within a set parameter, both on the supply side and on the system side of the sprinkler control valve. Pressure gauges installed in the system help to monitor, maintain, and test the sprinkler system function.

The main control valve must be locked in the OPEN position with a pad lock and chain or be fitted with a Valve Monitor or Tamper Switch that sends a signal to the fire alarm system if the valve is moved.

A waterflow switch is the interface between the sprinkler system and fire alarm system. It detects water flowing in the sprinkler system and causes the fire alarm to sound the evacuation. It only detects the water flowing in the pipes. It does not doesn't turn water on or off. It sets off the alarms by activating electrical switches.

**Slide 49**

A water motor gong operates exactly as the name implies: when water is flowing in a system, the mechanical force of the flowing water is used to rotate a hammer against a bell. This type of gong will operate when water is flowing, even if the electrical service to the building is interrupted. It uses a clapper attached to a paddle wheel to make it ring. When a sprinkler head opens, water pushes the flapper valve out of the way which covers an “alarm port.” Piping feeds water from this port to the water motor gong. As long as the sprinkler system flows water, the water motor gong will continue to operate. Paddle type water gongs can only be installed in wet sprinkler systems.

**Slide 50**

That’s the end of part one of Fire Flow and Fire Suppression Systems.
In this part we discussed:

- Relevant legislation including the building and fire codes and other standards like NFPA
- Plan review of fire protection systems
- Water supplies including municipal water distribution systems
- Water mains that carry the water to the end user
- Water supply grid systems
- Water flow control valves
- Fire hydrants and their locations
- Types of hydrants
- Colour coding of fire hydrants
- Measuring water flow rates and pressure

- Static, residual, and elevated pressure
- The coefficient of discharge refers to how smooth the transition is between the hydrant barrel and the outlet.
- Obtaining static and residual pressure readings and the use of pitot gauges
- And we started our discussion on fire sprinkler systems which we will carry on in Part 2
- Friction loss and the coefficients of hydrant discharge

**Slide 51**

We also talked about:

- Most sprinkler system heads activating one at a time as the fire grows
- The occupancy hazard classifications in NFPA 13, Light hazard, Ordinary Hazard Groups 1 & 2, Extra Hazard Groups 1 & 2, and Special Occupancy Requirements
- Water supplies for sprinkler systems
- Fire Dept. Connections or FDC
- Sprinkler system water delivery through pipes, and valves
- Indicating Vales
- Pressure and Tamper switches
- And
- Water moto gongs

Please move on to Part two.