

STUDY MATERIAL FOR

CONSOLIDATED EXAMINATION F-95 FOR:

F-50 SPRINKLER SYSTEMS FOR COMPACTORS

F-51 SPRINKLER SYSTEMS FOR COMPACTORS
SYSTEM-WIDE

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Consolidated Study Material F95: F50,F51.doc

This study material, in addition to any formal courses you have taken, will help you prepare for the examination for the Certificate of Fitness for the consolidated examination for Standpipe and Sprinkler systems (F-95). The study material includes information taken from the Fire Prevention Code and the Fire Prevention Directives of the Bureau of Fire Prevention, NYFD. The study material does not contain all of the information you need to know in order to perform the job as a certificate of fitness holder under this consolidated series. In addition to other requirements of the Certificates of Fitness covered under this consolidated series it is your responsibility to become familiar with all applicable rules and regulations of the City of New York, even if they are not covered in this document.

All questions on the Certificate of Fitness examination are multiple choice, with four alternative answers to each question. Only one answer is correct for each question. If you do not answer a question or mark more than one alternative your answer will be scored as incorrect. A score of 70% correct is required on the examination in order to qualify for the Certificate of Fitness. Read each question carefully before marking your answer. There is no penalty for guessing.

Sample questions

1. The minimum water pressure at the level of the highest sprinkler head should be:
 - (A) 15 psi.
 - (B) 25 psi.
 - (C) 50 psi.
 - (D) 100 psi.

The correct answer is "A". You would mark "A" on your answer sheet.

2. A supply of extra sprinkler heads:
 - (A) is not required to be kept.
 - (B) may be obtained from the Bureau of Fire Prevention.
 - (C) may be obtained from the nearest Fire Company.
 - (D) are required to be kept on the building premises.

The correct answer is "D". You would mark "D" on your answer sheet.

PROVISIONS OF THE FIRE PREVENTION CODE OF NEW YORK

All multiple dwellings, factories, office buildings, warehouses, stores and offices, theaters and music halls, and all hospitals and asylums, and all public schools and other public buildings, churches and other places where large numbers of persons are congregated for purposes of worship, instruction or amusement, and all piers, bulkheads, wharves, pier sheds, bulkhead sheds or other waterfront structures shall provide such fire hose, fire extinguishers, buckets, axes, fire hooks, fire doors and other means of preventing and extinguishing fires as the commissioner may direct.

Sprinkler systems in garment factories and factories using flammable oil for processing.

A one source automatic wet pipe sprinkler system shall be provided in every non-fireproof building in which there is a garment factory or a factory engaged in the processing of combustible fabrics with a flammable oil, and which exceeds three stories in height, and in which more than fifty persons are employed above the street floor. A flammable oil is defined as an oil which emits a flammable vapor below one hundred twenty-five degrees Fahrenheit. An automatic dry pipe sprinkler system is acceptable in place of an automatic wet pipe sprinkler system where low temperatures or other conditions would prevent the installation of a wet pipe system. The sprinkler systems shall be provided in all parts of such buildings.

Sprinkler and/or standpipe system maintenance and inspections.

1. Automatic and non-automatic sprinkler systems shall be inspected at least once a month by a competent person holding a certificate of fitness, employed by the owner, to see that all parts of the system are in perfect working order, and that the Fire Department connection or connections, if any, are ready for immediate use by the Fire Department. A detailed record of each inspection shall be kept for examination by a representative of the Fire Department.
2. A supply of at least six extra sprinkler heads shall be kept available on the premises, to replace promptly any fused or damaged sprinklers. Any head which has opened or has been damaged shall be replaced immediately with a good sprinkler head. One or more employees instructed in the maintenance of sprinkler systems.
3. At least once in five years, the Fire Department connection or connections, if any, for a sprinkler and/or standpipe system shall be subjected to a hydrostatic pressure test and the standpipe system shall also be subjected to a flow and pressure test to demonstrate its suitability for Fire Department use. The test shall be conducted by the owner's representative before a representative of the Fire Department.

Maintenance and inspections of standpipe and sprinkler pumps and accessories.

Valves, hose, tools and other accessory fire fighting appliances shall be kept readily available and in good working order. Fire pumps shall be operated at least once in thirty days in a manner which will subject the standpipe system to a hydrostatic pressure of at least fifty pounds per square inch at the top story hose outlet. The qualified operator shall maintain a suitable record of his or her compliance with this requirement for inspection by the Fire Department. The installation of fire and booster pumps shall be subject to inspection and/or test in the presence of an inspector from the bureau of fire prevention.

PROVISIONS OF BUREAU OF FIRE PREVENTION FIRE DIRECTIVE 4-82

Record keeping. The Certificate of Fitness Holder shall maintain a detailed record of all inspections. A record card with the date of each inspection, the Certificate of Fitness number, and the signature of the Certificate of Fitness holder shall be posted near the main control valve.

The detailed inspection report shall include information relative to conditions of water supply, gravity and pressure tanks and levels therein, valves, risers, piping, sprinkler heads, hose valves, hoses and nozzles, siamese connections, alarms, fire pumps, obstructions, and conditions of all other system equipment and appurtenances. All defects of violations shall be noted on the report. Records should be kept for one year and be made available to any representative of the Fire Department.

Reporting of defects or violations. The Certificate of Fitness holder must report all major defects immediately to:

1. the local Fire Company
2. the owner or manager of the building
3. the Bureau of Fire Prevention

Major defects or violations include: empty tank, break or major leak in system water piping, inoperative or shut water supply valves; or complete or partial shut down of sprinkler and/or standpipe systems for repairs or other reason, and defective siamese connections.

Other defects or violations which are minor should be reported to the owner or manager of the building. If the defects are not corrected within 30 days, the defects should be reported in writing to the Bureau of Fire Prevention.

Failure to make inspections, maintain records, and report defects or violations may be cause for revocation of the Certificate of Fitness and court enforcement proceedings.

PROVISIONS OF THE NEW YORK BUILDING CODE

Sources of water supply for sprinkler systems.

Automatic sources of water supply for sprinkler systems include a gravity tank, pressure tank, automatic fire pump, or direct connection to the public water system. Auxiliary sources of water supply for sprinkler systems include manually activated fire pumps or siamese connections. Tanks used to provide the required primary water supply to a standpipe system may also be used as a supply for a non-automatic sprinkler system. Non-automatic sources of supply for sprinkler systems shall include siamese connections. Where siamese connections are installed, metal signs shall be fastened to or above the siamese connection indicating the area protected. Where the building has two or more frontages, additional metal signs shall be installed indicating the location of the siamese connection. The installation and construction of siamese connections shall be the same as required for fire standpipe systems, except that the caps of each automatic sprinkler siamese connection shall be painted green. The entire siamese connection of a non-automatic sprinkler system shall be painted aluminum. The caps of each siamese connection used for combination standpipe and sprinkler systems shall be painted yellow and signs shall be provided.

At least one automatic source of water supply shall be provided for sprinklers installed in all occupancy groups, except that:

- (a) Two automatic sources of water supply shall be provided for sprinklers in:
 - (1) Buildings classified in occupancy group A.
 - (2) Buildings classified in occupancy group C when the area on one floor exceeds twenty thousand square feet.
 - (3) Buildings classified in occupancy group F-1 when open heads are required for stages of unlimited size.
- (b) The domestic water supply may be used to supply a sprinkler system when installed in buildings classified in occupancy groups E, G, H and J. The domestic water supply may be used to supply sprinklers if all of the following conditions are met:
 - (1) The domestic water supply line from the tank or street has the required pressure (as described below).
 - (2) An O.S. & Y. valve or an approved valve having visual indication, sealed open, is installed in the sprinkler supply branch.
 - (3) The number of heads in each fire section does not exceed twenty, and no more than ten heads are supplied from any one domestic water riser.
 - (4) The connection is made at the supply or riser side of any domestic branch control valves.

Direct connection of sprinklers to the public water system.

Direct connection of sprinklers to a city water main is acceptable as an automatic water supply provided the main is capable of maintaining a pressure of at least fifteen psig at the top of the highest sprinkler riser, with five hundred gpm of water flowing from a two and one-half inch hydrant outlet located at the street level within 250 feet of the building. The size of each connection shall be as large as that of the main riser and, except in sprinkler systems in multiple dwellings, shall be at least three inches and shall be controlled by an accessible shutoff valve.

Each service shall be equipped, under the sidewalk, with a control valve in a flush sidewalk box located within two feet of the front wall of the building or street line as required by the department of environmental protection. The location of the control valve shall be indicated by a sign placed on the structure directly opposite the sidewalk flush box, and shall have a white background with one inch red letters reading: "Automatic Sprinkler Shutoff Valve ... Feet Opposite This Sign. Brass, bronze, or other metal signs with one inch letters, raised or counter-sunk one-eighth of an inch may also be used.

Sprinkler booster pumps.

Where the pressure from the city water main is less than 15 psig as described above but is sufficient to give at least five psig at the highest line of sprinklers as determined by test, an automatic, electrically driven pump installed for the purpose of boosting or increasing the city water pressure in the sprinkler system may be accepted subject to the following requirements:

- (a) Pumps shall be of approved centrifugal type, capable of delivering at least two hundred gpm, and shall be capable of supplying twenty-five per cent of the heads, in the largest area supplied, at twenty gpm, at a pressure of at least twenty-five psig at the top of the highest sprinkler riser.
- (b) Pumps shall be maintained under approved automatic control with closed circuit supervisory attachment. The supervisory attachments shall be directly connected to an office where maintenance personnel are in attendance twenty-four hours a day; or, in lieu thereof, the supervisory attachment may be directly connected to the central station of an approved operating fire alarm company. The supervisory alarm services shall be arranged so as to provide positive indication at an approved central

office or sprinkler alarm panel board that the pump has operated or that the source of electrical supply has failed.

When sprinkler are not directly connected to the public water system and a sprinkler booster pump is not present a pressure or gravity tank shall be used.

Protection of sprinkler system.

All parts of an automatic system exposed to freezing temperatures shall be protected from freezing or in lieu thereof, an automatic drypipe system or a system filled with a nonfreezing, noncombustible solution shall be used. When a system filled with nonfreezing solution is used and the system is connected to a potable water supply, it shall be subject to the requirements of the health department and the bureau of water supply of the department of environmental protection. Sprinkler heads subject to damage shall be protected.

Inspection and tests.

- (a) **Automatic wet and dry systems.** Automatic wet and dry sprinkler systems shall be subjected to a hydrostatic pressure test for a period of one hour at a pressure of at least one hundred psig at the topmost sprinkler head and at least two hundred psig at the lowest cross connection to the siamese connections.
- (b) **Automatic dry pipe systems.** In addition to the hydrostatic test the automatic dry pipe systems shall also be tested to forty psig air pressure for a twenty-four hour period with the pressure loss not to exceed one and one-half psig.
- (c) **Non-automatic sprinkler systems.** Non-automatic sprinkler systems shall be subjected to a hydrostatic pressure test of fifty psig at the topmost sprinkler head, with the test pressure maintained for a period of at least one hour.
- (d) **Pressure tanks.** Pressure tanks shall be hydrostatically tested to a pressure of at least one and one-half times the working pressure for a period of one hour.
- (e) **Sprinkler branches and heads supplied from domestic water.** Sprinkler branches and heads shall be tested at the pressure required by this section or at the pressure of the domestic water supply, whichever is greater.

PROVISIONS OF REFERENCE STANDARD RS 17-2

Chapter 2 - Water Supplies

Pumps. In light hazard occupancies with only limited ordinary hazard areas, an automatic fire pump serving the lower 300 feet of the standpipe system may be used as the primary supply to the sprinkler system, if a secondary automatic switching power supply is available to drive the pump. In hydraulically designed sprinkler systems supplied from a gravity tank, the pressure may be increased by means of an automatic, special service fire pump. The pump shall be arranged in a bypass to permit the portion of the system so supplied to be served by the system's siamese connections. If the pump is not supplied from the street side of the building service switch, the electrical service and pump operation shall be fully supervised; provided that a secondary automatic switching power supply is available to drive the pumps.

Pressure Tanks. A pressure tank in accordance is an acceptable water supply source. The total available quantity of water in pressure tanks need not exceed 15,000 gallons when there is a secondary source of

water supply available from a gravity tank or a street connection acceptable to the Commissioner of Buildings. The maximum gross capacity of a single pressure tank shall be 9,000 gallons.

Each tank shall be kept at a maximum of 2/3 full of water and a minimum of 1/3 full of air maintained under a minimum pressure of 75 psig. The water-to-air ratio shall be so proportioned and the tank so located that a minimum pressure of 15 psig will be available on the highest line of sprinklers below the main roof when all the water is being discharged from the tank. The tanks shall be supplied with water through a fixed pipe, independent of the sprinkler piping, and at least 2 inches in size. The water supply and connection shall be capable of supplying the tank at a rate of at least 65 gpm without reducing the pressure in the tank. The tank shall have a fixed water level plate on the end of the tank opposite the gauge glass, or equivalent devices, to indicate the level of the water in the tank.

The air compressor shall be provided with automatic controls for maintaining the air pressure. The capacity of the compressor shall be sufficient to build up the tank pressure to 75 psig within 3 hours or less. Pressure tanks shall be provided with approved closed circuit high and low water and high low air alarms. Pressure tanks shall be located at or above the top level of sprinklers.

AUTOMATIC SPRINKLER SYSTEMS

Automatic sprinkler systems are designed to automatically distribute water on a fire. The sprinkler system is designed to extinguish the fire entirely, or to prevent the spread of the fire. An automatic sprinkler system consists of a series of pipes at or near the ceiling in a building. The sprinkler system is fitted with automatic devices designed to release water on a fire. These devices are called sprinkler heads. A disk or cap normally closes the sprinkler heads. This cap is held in place by a heat-sensitive releasing element. A rise in temperature to a predetermined level causes the sprinkler head to open. Water is then discharged in the form of spray. When the sprinkler heads open they are said to have fused. The sprinkler heads are fitted at standard intervals on the piping. If more than one head opens, the area sprayed by each overlaps that of the sprinkler head next to it.

Sprinkler systems are required by law in various occupancies. They also may be installed voluntarily by the owner of the building. The sprinkler systems are installed to protect the building and its occupants. The installation of sprinklers has a major effect in reducing fire losses. Statistical evidence shows that about 96% of the fires are extinguished or controlled when sprinklers are installed. The 4% failure was due to a variety of causes including burst piping, closed supply valves, frozen water lines, etc.

Automatic sprinklers are very effective for life safety. They signal the existence of a fire. At the same time they discharge water to the burning area. When sprinkler systems are installed there are rarely problems getting to the seat of the fire. They also reduce interference with visibility for fire fighting due to smoke. The downward force of the water sprayed from sprinkler heads lowers the smoke level in the room. Sprinkler systems also serve to cool the smoke. This makes it possible for persons to remain in the area much longer than they could if the room were without sprinklers.

Most standard sprinkler systems have devices that automatically give an alarm when a sprinkler head discharges water. This alarm is usually an audible signal in the building. In many cases they also give an alarm at a remote location, such as the local fire house or a central station company. The central station company monitors the entire fire protection system for water discharge and problems with the equipment. When water discharge or equipment problems are identified the local fire house is immediately notified. This allows the Fire Department to gain control of a fire as quickly as possible. Water is rarely discharged accidentally from sprinkler heads.

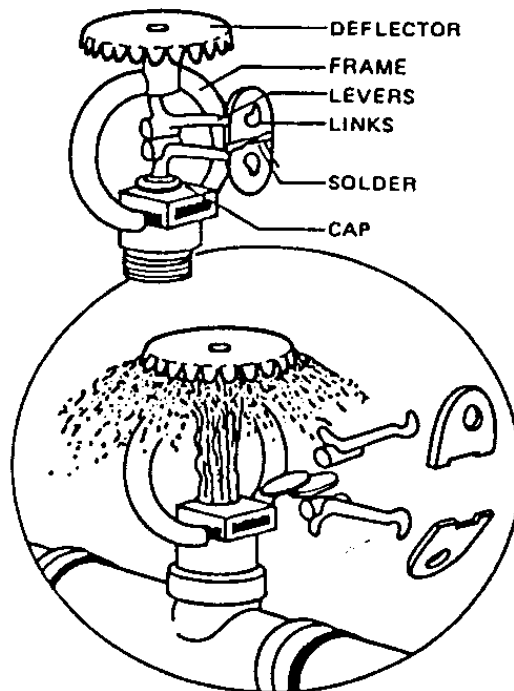
SPRINKLER HEADS

Sprinkler heads are made of metal. They are screwed into the piping at standard intervals. The water is prevented from leaving the sprinkler head by an arrangement of levers and links. The levers and links are soldered together on the sprinkler head. The solder is a metal alloy with a fixed melting point. Other types of sprinkler heads use a quartz bulb which expands and breaks under heat. Still another type uses a solid chemical held in a cylinder which is broken by heat action. The sprinkler head is designed to withstand at least 500 psi without injury or leakage. If properly installed, there is little danger of the sprinkler head breaking apart unless it is damaged.

The latest type of sprinkler head is called the "cycling sprinkler". This sprinkler cycles water on and off depending on the temperature. When the disk reaches a temperature of 165oF, the valve opens, permitting water to flow. When the disk temperature cools the valve closes to shut off the water.

Some sprinkler heads are designed to be used in special situations. Sprinkler heads exposed to corrosive conditions are often covered with a protective coat of wax, or lead. Corrosive vapors are likely to make automatic sprinklers inoperative or slow down the speed of operation. They can also seriously block the spray nozzles in the sprinkler heads. They can damage, weaken or destroy the delicate parts of the sprinkler heads. In most cases such corrosive action takes place over a long time. For this reason the sprinkler heads must be carefully watched for signs of corrosion. Care should be taken to make sure that the protective coating is not damaged when handling or replacing the heads.

A typical fusible link type sprinkler head is shown in the picture below.



A typical sprinkler head

Spray Pattern of Sprinklers. The best way to put out a fire is to spray the water from the sprinkler head downward and horizontally. The spray pattern will also prevent the spread of the fire. The force of the water against the deflector creates a heavy spray which is directed outward and downward. The shape of the

deflector determines the spray pattern of the water discharged from the sprinkler head. Usually, this is an umbrella shaped spray pattern. At a distance of 4 feet below the deflector, the spray covers a circular area having a diameter of approximately 16 feet when the sprinkler is discharging 15 gpm. The newest kinds of sprinkler heads allow the sprinklers to be placed farther apart needing lower flow rates to give coverage to an area. These new heads offer more effective fire protection and are less likely to cause water damage than the old sprinkler heads.

Systems Using Large Drop Sprinkler Heads. Large drop sprinkler heads are special sprinklers designed to discharge large drops of water from the head. These sprinkler heads are used to break through the strong updrafts of high challenge fires.

Temperature Ratings of Sprinkler Heads. Automatic sprinkler heads have various temperature ratings which state the temperatures at which they will fuse. The temperature rating of all solder type automatic sprinklers is stamped on the soldered link. For other heat sensitive units, the temperature rating is stamped on one of the releasing parts. The temperature ratings of sprinkler heads are also indicated by a color coding system. See color codes below.

<u>Temperature Ratings</u>	<u>Color Code</u>
135° to 170°	Uncolored
175° to 225°	White
230° to 300°	Blue

In places where the temperature is normally high (e.g. boilers, ovens and drying rooms) a sprinkler head with a higher temperature rating must be used. This is to make sure that the sprinkler head does not discharge water at the wrong time. If heads with a high temperature rating are used in ordinary room (e.g., an office, an apartment, and store) the value of the sprinkler protection is greatly reduced. This is because the temperature will have to increase much higher for the sprinkler head to open.

Sprinkler systems are excellent for controlling fires. However, they can cause water damage if they are not shut down soon after the fire has been extinguished. No control valve on the system should be closed except on the order of the fire officer in charge. Sometimes the Fire Department has a difficult time finding the control valve to shut down the system. This problem can be prevented by keeping a small sketch of the sprinkler system and the position of the control valves. This sketch should always be readily available. This sketch is very helpful to the fire fighters when they have to work with the sprinkler system.

Build up of Foreign Material on Sprinkler Heads. Sometimes conditions exist which cause a build-up of foreign material on sprinkler heads. This may prevent the sprinkler head from working properly. This build-up is commonly called loading. The build-up of foreign material insulates the sprinkler head. This insulation prevents the sprinkler head from opening at the temperature it is designed to.

If the build-up is hard, it may prevent the sprinkler head from opening. The best practice is to replace loaded sprinklers with new sprinklers rather than to attempt to clean them. If the deposits are hard, attempts to clean the heads are likely to damage them. This damage may make prevent the sprinkler heads from working properly. The damage may also cause the sprinkler heads to leak.

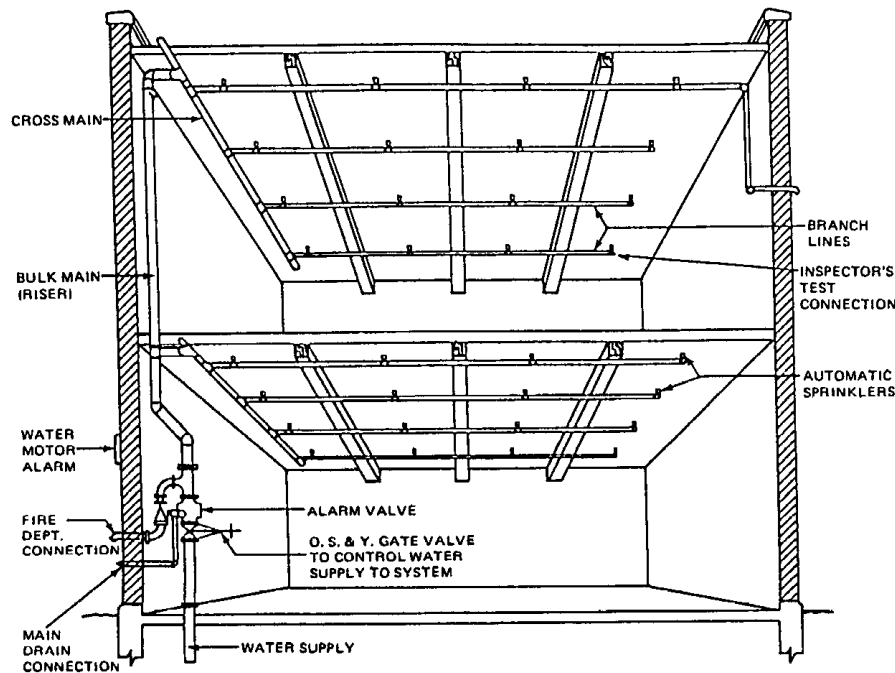
Deposits of light dust are less serious than hard deposits. Dust build up may delay the operation of sprinkler heads. However, it will not prevent the eventual discharge of water. Dust deposits can be blown or brushed off. If a brush is used, it should be soft to avoid possible injury to sprinkler parts. Scouring or acidic liquids are likely to damage the sprinkler heads and should not be used for cleaning. Hot solutions of any kind should never be used to clean the sprinkler heads.

Sometimes sprinklers heads need to be protected when ceilings or piping are being painted. Usually a small lightweight paper bag or a sheet of lightweight paper is placed over the heads until the painting is completed. The bag or the sheet of paper should be secured with a rubber band. The bags are likely to delay the operation of the sprinkler heads and should be removed immediately after the painting is completed. There is no known method to safely remove paint from under the water cap or on the fusible link. Sprinkler heads that have been painted other than by the manufacturer must be replaced with new units.

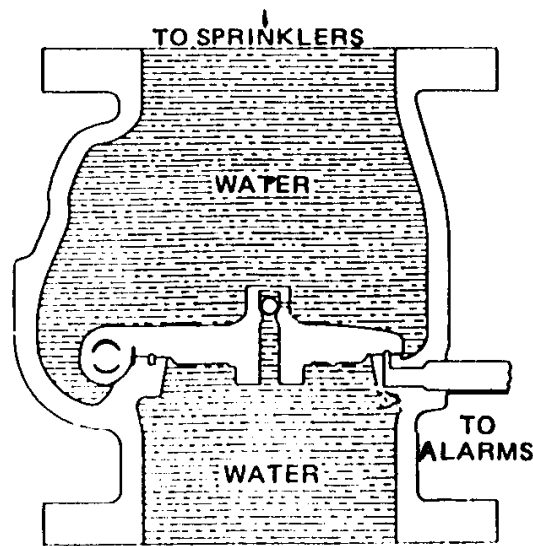
A supply of at least six extra sprinklers with the appropriate wrench should always be kept in a sprinkler cabinet. This extra supply should be used to promptly replace any sprinklers that have opened or have been damaged. The extra supply of sprinkler heads should be exactly the same as the sprinkler heads already installed in the system. It is very important that the replacement sprinkler heads have the same temperature rating as those installed in the system.

WET PIPE SPRINKLER SYSTEMS

Wet pipe systems have water in the piping at all times. This type of system is used where there is no danger of the water supply freezing. A picture of a typical wet pipe system is shown in the picture below. A typical wet pipe sprinkler valve is shown on the following page.



A typical wet pipe system



A typical wet pipe sprinkler valve

Where temperatures drop below freezing the ordinary wet pipe system cannot be used. There are two methods for using automatic sprinkler systems in places exposed to freezing temperatures. One method is to design a system where water enters the sprinkler piping only after a control valve is opened. These are dry pipe systems, deluge systems, or preaction systems. The other method adds an antifreeze solution to the water in the wet pipe system. The antifreeze solution is a mixture of chemicals designed to prevent the water from freezing.

Antifreeze Solutions. Antifreeze is added to the water in piping exposed to freezing temperatures. When the sprinkler heads fuse the system works in the same way as a wet pipe system does. Antifreeze solutions are costly and may be difficult to maintain. Antifreeze is usually used for small unheated areas. Antifreeze solutions may be used only in accordance with applicable local health regulations.

Cold Weather Valves. An automatic sprinkler system should not be shut off and drained to avoid freezing during cold weather. However, parts of the sprinkler system may be shut down. Permission must be obtained from the local fire house. Permission may be given to shut off a maximum of 10 sprinklers on a wet pipe system. These shutoff valves are commonly referred to as cold weather valves.

WATER SUPPLY SOURCES FOR SPRINKLER AND STANDPIPE SYSTEMS

The sources used to supply water to sprinkler systems are the same as those for standpipe systems. Sprinklers and standpipe systems may be supplied from one or a combination of sources. For example, they may be supplied by public mains, gravity tanks, pressure tanks, reservoirs, rivers, or lakes. A single water supply would appear to be all that is needed to supply a sprinkler or a standpipe fire protection system. This assumes that there is enough water at an acceptable pressure. However, there are a few reasons why it is good to have a second water supply source. These reasons include: 1) a single supply source may be out of service (for maintenance or repair) during a fire emergency; 2) a single supply source may be disabled during fire or before the fire is fully extinguished; 3) the water supply source may fall below normal pressure or volume during an emergency.

In some cases it is required by law to have a second water supply source. Whether a second source is needed depends on several factors. These factors include the strength and reliability of the primary supply, the value of the property, the height, area and design of the building.

When a sprinkler or a standpipe system is supplied from a public water main, the entire system may be closed down by closing a control valve. This valve is located between the building and the water main in a box that is recessed into the sidewalk. The location of the box is found by reading a sign on a building or post nearby. For example, the sign might read **"Shut-off for Sprinkler System Located 6 Feet From This Sign"**, or it will have similar instructions. A special key may be required to operate this valve.

The control valve for the building may also be attached to an upright post, known as a post indicator valve (PIV). The building or section of the building controlled by the valve is usually marked on the post. The position of this valve (open or closed) is shown through a telltale opening in the post. On some posts, a padlock must first be opened or forced to release the operating wrench. On others, an iron strap must first be released by cutting a riveted leather section.

The main water supply for sprinkler and/or standpipe systems may also be controlled an OS&Y valve (Outside Screw and Yolk valve). The OS&Y valves are found just inside the building wall on the main riser, or outside in protected pits. It is easy to tell at a glance if the valve is open or shut. When the stem is all the way out the valve is open. When the stem is all the way in the valve is closed. Some OS&Y valves may be used to control the water supply for individual floors in a building. The OS&Y valves are also installed to shut off certain sections of an individual floor. Being able to shut off parts of a building allows the Fire Department to have greater control over the fire protection system. When a fire is under control in an area the OS&Y valve can be closed to prevent any further water damage.

Sometimes repairs must be made to the sprinkler or standpipe system. When this happens the OS&Y valves are used to close the water supply to only those sections being repaired. This is good because the rest of the sprinkler or standpipe system does not have to be shut down.

A building may have both a standpipe and a sprinkler system installed. Each system may have its own water supply source. For example, the standpipe system may be supplied by a gravity tank and the sprinkler system supplied by a pressure tank.

It is quite common for the two systems to share the same water supply source. For example, both systems may use the same gravity tank as a water supply source. The gravity tank is a limited water supply. The amount of water that is allocated to each system is regulated by local building laws.

Acceptable water supplies for the sprinkler or standpipe systems include connection to public or private water mains, connection to fire pumps, pressure tanks, and gravity tanks. These sources may be also used in combination to supply a standpipe and/or a sprinkler system. At least one of the water sources should be able to supply the standpipe or sprinkler system automatically. This supply must have the needed water volume and water pressure for the entire system. The public water works system is the most commonly used water supply source. In tall buildings the connection to the public water system may not have enough water pressure to supply the upper floors. In this situation a second supply source is often required to increase the water pressure. For example, a fire pump may be installed in a building that is more than ten stories high. The higher the building the greater the water pressure needed to supply the standpipe and/or sprinkler system.

Connections to Public Water Works System. While a connection to a reliable public water works system is the preferred primary water supply for standpipe and automatic sprinkler systems, a check valve must be

installed next to the interior connection to the standpipe or sprinkler system. This valve makes sure that the system does not backflow into the public water supply.

Fire Pumps. The fire pump is designed to draw water from a supply source. The water is then pumped into the fire protection system under high pressure. A fire pump with both a reliable source of power and a reliable suction water supply is a desirable piece of equipment. A suction water supply is simply a source of water that the pump can draw water from. With a good water supply a fire pump can pump water into a sprinkler or standpipe system for a long time. Sometimes more than one fire pump is installed in high rise buildings. The extra fire pumps are needed to maintain the desired water pressure levels at the top floors of the buildings.

Manually started pumps may be used as a secondary supply source if the primary water supply will last long enough to allow the pump to be started. This kind of system must give an automatic waterflow signal to the Certificate of Fitness holder when the pump must be started.

Automatic fire pumps are usually installed where a high water demand may occur immediately. This demand may occur in a deluge system. An automatic fire pump is also used when someone is not always available to activate the manual pump. Automatic fire pumps must have their suction **“under a positive head”** to avoid delays in drawing water from the supply source. Under positive head means that the water supplying the pump must be fed into the fire pump under pressure. This can be achieved by connecting the fire pump to a suction tank. Water is forced into the pump by gravity. Automatic fire pumps are activated as soon as a drop of air or water pressure is noticed in the fire protection system. The drop in pressure occurs when a hoseline is opened or a sprinkler head has fused.

Gravity Tanks. Gravity tanks of adequate capacity and elevation make a good primary supply and may be acceptable as a single supply. A gravity tank may be located on the top of a building or on a tall tower. The water in the tank is distributed throughout the sprinkler or standpipe system because of the pull of gravity.

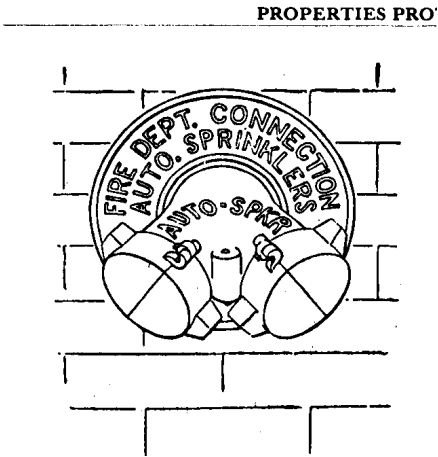
Pressure Tanks. Pressure tanks have several possible uses in automatic sprinkler or standpipe systems. Pressure tanks are often used where there is enough water from a supply source but the water pressure is too low. Pressure tanks may also be used in tall buildings that need the extra water pressure to supply the highest line of sprinklers or the highest line of hoses.

The tank is normally kept two-thirds full of water and one third full of air. The air pressure in the tank should be maintained above 75 psi. The air for pressure tanks is supplied by air compressors. Because the water is always under pressure it can be forcefully distributed throughout the sprinkler or standpipe system. An important limitation is the small amount of water that can be stored in such tanks. Where a small pressure tank is accepted as the water supply, the system is called a Limited Supply System.

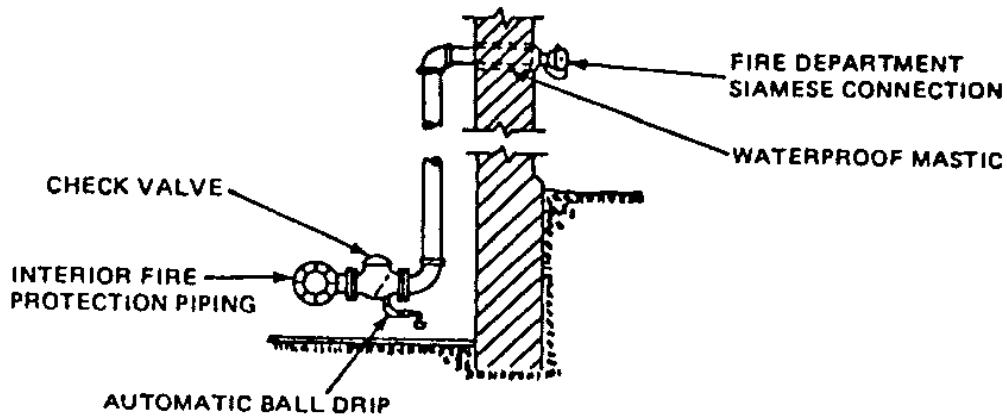
The pressure tank gives a strong starting pressure for the first sprinkler heads or standpipe hoses that open. The flow from the tank may be used while the automatic fire pumps begin to increase the water supply pressure. The pressure tank supplies these sprinkler heads and/or standpipe hoses until the Fire Department begins pumping water into the system

Siamese Connections for Fire Department Use. Normally a sprinkler or a standpipe system is connected to an automatic water supply source. Other sources of water are supplied through Fire Department siamese connections at the building. Siamese connections are a standard part of all sprinkler and standpipe systems. At least one siamese connection must be installed in all sprinkler and standpipe systems. When responding to an alarm most fire departments supply water to the standpipe system first. The standpipe system supplies water to the fire hoses in the building. Water is then supplied to the sprinkler system through its own siamese connection. Care should be taken that standpipe and the sprinkler connections are properly marked

because the connections look the same. The exact purpose of each siamese connection should be shown nearby or on the siamese connection itself. The New York Building Code requires siamese connections to be color coded. The siamese connection to an automatic sprinkler system should be painted green. The siamese connection to non-automatic sprinkler system should be painted aluminum. The siamese connection to a standpipe should be painted red. Two examples of typical siamese connections are shown below.



Fire Department connections must always be accessible. Each connection should be fitted with a lower check valve. The check valve prevents the backflow of the private water supply into the public water supply. The figure below shows the main features of a Fire Department siamese connection.



Fire department connection

The automatic drip ball device between the lower check valve and the outside hose coupling prevents water from building up in the piping. This ball drip device makes sure that the Fire Department connection is not blocked by water that has frozen in the piping. If water freezes in the piping, the Fire Department will not be able to pump water into the system. Under normal conditions the automatic ball drip should be dry. A wet ball drip device indicates that the lower check valve may be defective. If the check valve is defective it should be replaced immediately. Many standpipe and sprinkler systems use the Fire Department siamese connection as a secondary water supply source.

WATERFLOW ALARMS IN SPRINKLER AND STANDPIPE SYSTEMS SUPERVISION

Sprinkler and standpipe systems should have devices and equipment for signaling when water flows through risers or mains supplying the systems. The flow may be due to fire, leakage, or accidental rupture of the piping. It is important that prompt action is taken when waterflow is noticed or signaled by these devices.

Functions of Alarms and Supervisory Signals. Sprinkler and standpipe systems with a waterflow alarm serve two functions. (1) It is an effective fire extinguishing system. (2) It is an automatic fire alarm. An alarm is signaled as soon as a sprinkler head has fused or a hose has been activated. Waterflow alarms and fire alarms give warning of the actual occurrence of a fire. They also signal when water flows through the system due to broken pipes. Alarms alert occupants and summon the Fire Department. Any signal, whether waterflow or supervisory, may be used to give an audible alarm. It may also send a signal to an approved central station company. The central station company will then contact the local fire house.

Supervisory devices are often connected to a central station company which monitors the sprinkler and/or standpipe systems for problems with equipment and when sprinkler heads are opened or standpipe hoses have been activated. The central station company should be notified when any control valves are closed for maintenance or repair. This reduces the number of false alarms.

Automatic sprinkler systems are required to have an approved water motor gong or an electric bell, horn, or siren on the outside of the building. An electric bell or other audible signal device may also be located inside the building. Water operated devices must be located near the alarm valve, dry pipe valve, or other water control valves in order to avoid long runs of connecting pipe.

Devices and Equipment Supervised. Sprinkler and/or standpipe system supervision is commonly provided for several purposes. These purposes include the detection of: (1) low water level in water supply tanks, (2) low temperature in water supply tanks or ground level reservoirs, (3) high or low water level in pressure tanks, (4) high or low air pressure in pressure tanks, (5) high or low air pressure in dry pipe sprinkler or standpipe systems, (6) failure of electric power supply to fire pumps, and (8) automatic operation of electric fire pumps.

Waterflow Alarm Valves. The basic design of most waterflow alarm valves is that of a check valve which lifts from its seat when water flows into a sprinkler system. This alarm then starts an audible signal to alert the occupants in the building that the sprinkler or standpipe system has been activated.

Alarm Retarding Devices. An alarm check valve that is exposed to changing water supply pressure needs an alarm retarding device. This is required to prevent false alarms when the check valve clapper is lifted from its seat by a temporary pressure surge.

Gate Valves. Gate valves of the non-indicating type are provided in water distribution systems. Gate valves allow parts of the sprinkler or standpipe system to be shut off for repairs or maintenance. This is done without reducing protection over a wide area. Such valves are normally a non-rising stem type. They are operated using a special key wrench. A valve box is located over the valve to keep dirt from the valve. The valve box also provides a convenient access point for the valve wrench to the valve nut. A complete record should be made for each valve in the system. This record should include the exact location, the date it was installed, the make, the direction of opening, number of turns to open, and any maintenance that was performed.

GARBAGE COMPACTOR SPRINKLER SYSTEMS

Waste compactors are usually found in tall multiple dwelling complexes such as apartment buildings. They are used to reduce the trash build-up in a building. They consist of a tall chute that has an opening at each floor. Each opening is used for trash disposal. Occupants of the buildings take their trash and throw it through the opening and down the chute. The trash piles up in the chute. At the bottom of the chute there is a device that regularly crushes the trash into smaller blocks of trash. The blocks of trash are then removed and taken to a garbage dump. The compactor may be located indoors or outdoors.

The build-up of trash in the compactor chute is a fire hazard. Fires have been started in several ways, for example, by a smoldering cigarette thrown into the compactor chute. Sprinkler systems must be installed to put out fires that may start in the compactor chute. Any of the standard water supply sources may be used to supply the compactor sprinkler system. For example, gravity tanks, fire pumps and pressure tanks are all used as water supply sources. Fire doors must be installed in the chute to allow firefighter access to burning trash.

The Certificate of Fitness holder must know the location of all sprinkler heads, control valves, supply lines and compactor rooms. A sketch of the entire compactor sprinkler system should be drawn by the Certificate of Fitness holder. This sketch should be posted in the compactor room in a frame under glass. The sketch should be made available to official representative representatives of the Fire Department. The Certificate of Fitness holder may be questioned about this sketch by inspectors from the Fire Department during routine inspections. A sign indicating the location of all control valves should be kept in the compactor room. This sign should be displayed with the sketch in the compactor room. All control valves in the sprinkler system must be labeled. The label should show the purpose of the valve. The labels should be attached to the yoke of the valves. All indicating valves in the compactor sprinkler system must be sealed open.

A minimum of 6 extra sprinkler heads with the appropriate wrench must be available to replace any opened or damaged sprinkler heads. Opened or damaged sprinkler heads must be replaced immediately. A garden hose connected to a water supply must be kept in the compactor room. This hose may be used to put out small fires or smoldering material in the compactor room.

The Certificate of Fitness holder must conduct an inspection of the entire sprinkler system at least once a month. Special attention should be given to the condition of the sprinkler heads in the compactor chute and the compactor room. Any defects or violations must be recorded in a detailed inspection report. All inspections are recorded on a card kept near the main control valve. The Certificate of Fitness holder should sign and date the card each time an inspection is made. If any minor defects in the system are discovered they must be reported to the owner of the building. If repairs are not made within 30 days the Certificate of Fitness Holder must notify the Bureau of Fire Prevention. If any major defects are discovered they must be reported to the local fire company, the owner of the building, and the Bureau of Fire Prevention. Major defects must be repaired immediately.

When a fire is discovered in the compactor the Certificate of Fitness holder should notify the local fire house immediately. He should not attempt to enter the compactor chute to put out the fire.

**STUDY MATERIAL FOR THE
CERTIFICATE OF FITNESS FOR
CONSOLIDATED EXAM FOR:**

**STANDPIPE SYSTEMS WITH PRESSURE TANKS,
SPRINKLER SYSTEMS WITH PRESSURE TANKS, AND
SPRINKLER SYSTEMS WITH PRESSURE TANKS COMPLEX-WIDE**

F-96

**ALSO INCLUDED IN THIS BOOKLET YOU WILL
FIND THE FOLLOWING:**

1. NOTICE OF EXAMINATION (NOE)

REVISED 9/02/99

NOTICE OF EXAMINATION FOR

Title: Consolidated Examination for Certificate of Fitness for: Standpipe Systems with Pressure Tank, Sprinkler Systems with Pressure Tank, and Sprinkler Systems with Pressure Tank Complex-wide (F-96)

Date of Test: Written tests are conducted Monday to Friday (except legal holidays)
9:00 AM to 2:30 PM.

QUALIFICATION REQUIREMENTS

1. Applicants must be at least 18 years of age.
2. Applicants must have a reasonable understanding of the English language.
3. Applicants must present a letter of recommendation from his/her employer. The letter must be on official letterhead and must state the applicant's full name, character, physical condition, experience, and address of premises where applicant will be employed.
4. Applicants must present two (2) forms of satisfactory identification i.e., driver's license and passport picture ID.
5. Applicants must present a sketch or plan of the system they are applying for.

APPLICATION INFORMATION

Application Fees: \$25.00 for originals and \$15.00 for renewals. The fee may be paid in cash, money order, or personal check payable to New York City Fire Department. The \$25.00 fee must be payable by all applicants prior to taking the Certificate of Fitness test. Application forms are available at the Public Certification Unit, 1st floor, 9 MetroTech Center, Brooklyn, NY 11201.

TEST INFORMATION

Test: The test will be of the written, multiple choice type. A passing score of at least 70% is required in order to secure a Certificate of Fitness. Individuals with a license as a Master Fire Suppression Pipe Contractor (Dept. of Buildings) Class A or B; or as a Master Plumber (Dept. of Buildings); or a certification as a Fire Protection Engineering Technician-Automatic Sprinkler System Layout Levels II or III (NICET) or Fire Protection Engineering Technician-Special Hazards Systems Layout III or IV (NICET) may have the written test waived. This procedure is the **Alternative Issuance Policy**. Call (718) 999-1986 for additional information and forms.

This study material, in addition to any formal courses you have taken, will help you prepare for the examination for the Certificate of Fitness for the consolidated examination for Standpipe and Sprinkler systems F-96. The study material includes information taken from the Fire Prevention Code and the Fire Prevention Directives of the Bureau of Fire Prevention, NYFD. The study material does not contain all of the information you need to know in order to perform the job as a certificate of fitness holder under this consolidated series. In addition to other requirements of the Certificates of Fitness covered under this consolidated series it is your responsibility to become familiar with all applicable rules and regulations of the City of New York, even if they are not covered in this document.

All questions on the Certificate of Fitness examination are multiple choice, with four alternative answers to each question. Only one answer is correct for each question. If you do not answer a question or mark more than one alternative your answer will be scored as incorrect. A score of 70% correct is required on the examination in order to qualify for the Certificate of Fitness. Read each question carefully before marking your answer. There is no penalty for guessing.

Sample Questions

- _____1. The minimum water pressure at the level of the highest sprinkler head should be:
- (A) 15 psi.
 - (B) 25 psi.
 - (C) 50 psi.
 - (D) 100 psi.

The correct answer is "A". You would mark "A" on your answer sheet.

- _____2. When a gravity tank is required in a yard system the tank should be:
- (A) underground.
 - (B) on the ground level.
 - (C) elevated above ground level.
 - (D) filled with compressed foam.

The correct answer is "C". You would mark "C" on your answer sheet.

PROVISIONS OF THE FIRE PREVENTION CODE OF NEW YORK

All multiple dwellings, factories, office buildings, warehouses, stores and offices, theaters and music halls, and all hospitals and asylums, and all public schools and other public buildings, churches and other places where large numbers of persons are congregated for purposes of worship, instruction or amusement, and all piers, bulkheads, wharves, pier sheds, bulkhead sheds or other waterfront structures shall provide such fire hose, fire extinguishers, buckets, axes, fire hooks, fire doors and other means of preventing and extinguishing fires as the commissioner may direct.

Sprinkler systems in garment factories and factories using flammable oil for processing.

A one source automatic wet pipe sprinkler system shall be provided in every non-fireproof building in which there is a garment factory or a factory engaged in the processing of combustible fabrics with a flammable oil, and which exceeds three stories in height, and in which more than fifty persons are employed above the street floor. A flammable oil is defined as an oil which emits a flammable vapor below one hundred twenty-five degrees Fahrenheit. An automatic dry pipe sprinkler system is acceptable in place of an automatic wet pipe sprinkler system where low temperatures or other conditions would prevent the installation of a wet pipe system. The sprinkler systems shall be provided in all parts of such buildings.

Sprinkler and/or standpipe system maintenance and inspections.

1. Automatic and non-automatic sprinkler systems shall be inspected at least once a month by a competent person holding a certificate of fitness, employed by the owner, to see that all parts of the system are in perfect working order, and that the Fire Department connection or connections, if any, are ready for immediate use by the Fire Department. A detailed record of each inspection shall be kept by the Certificate of Fitness Holder for examination by a representative of the Fire Department.
2. A supply of at least six extra sprinkler heads with the appropriate wrench shall be kept available on the premises, to replace promptly any fused or damaged sprinklers. Any head which has opened or has been damaged shall be replaced immediately with an appropriate sprinkler head. One or more employees shall be instructed in the maintenance of sprinkler systems.
3. At least once in five years, the Fire Department connection or connections, if any, for a sprinkler and/or standpipe system shall be subjected to a hydrostatic pressure test and the standpipe system shall also be subjected to a flow and pressure test to demonstrate its suitability for Fire Department use. The test shall be conducted by the owner's representative before a representative of the Fire Department.

Maintenance and inspections of standpipe and sprinkler pumps and accessories.

Valves, hose, tools and other accessory fire fighting appliances shall be kept readily available and in good working order. Fire pumps shall be operated at least once in thirty days in a manner which will subject the standpipe system to a hydrostatic pressure of at least fifty pounds per square inch at the top story hose outlet. The qualified operator shall maintain a suitable record of his or her compliance with this requirement for inspection by the Fire Department. The installation of fire and booster pumps shall be subject to inspection and/or test in the presence of an inspector from the Bureau of Fire Prevention.

PROVISIONS OF BUREAU OF FIRE PREVENTION FIRE DIRECTIVE 4-82

Record keeping. The Certificate of Fitness Holder shall maintain a detailed record of all inspections. A record card with the date of each inspection, the Certificate of Fitness number, and the signature of the Certificate of Fitness holder shall be posted near the main control valve.

The detailed inspection report shall include information relative to conditions of water supply, gravity and pressure tanks and levels therein, valves, risers, piping, sprinkler heads, hose valves, hoses and nozzles, siamese connections, alarms, fire pumps, obstructions, and conditions of all other system equipment and appurtenances. All defects or violations shall be noted on the report. Records should be kept for one year and be made available to any representative of the Fire Department.

Reporting of defects or violations. The Certificate of Fitness holder must report all major defects immediately to:

1. the local Fire house
2. the owner or manager of the building
3. the Bureau of Fire Prevention

Major defects or violations include: empty tank, break or major leak in system water piping, inoperative or shut water supply valves; or complete or partial shut down of sprinkler and/or standpipe systems for repairs or other reason, and defective siamese connections.

Other defects or violations which are minor should be reported to the owner or manager of the building. If the defects are not corrected within 30 days, the defects should be reported in writing to the Bureau of Fire Prevention.

Failure to make inspections, maintain records, and report defects or violations may be cause for revocation of the Certificate of Fitness and court enforcement proceedings.

PROVISIONS OF THE NEW YORK BUILDING CODE

Sources of water supply for sprinkler systems.

Automatic sources of water supply for sprinkler systems include a gravity tank, pressure tank, automatic fire pump, or direct connection to the public water system. Auxiliary sources of water supply for sprinkler systems include manually activated fire pumps or siamese connections. Tanks used to provide the required primary water supply to a standpipe system may also be used as a supply for an automatic sprinkler system. Non-automatic sources of supply for sprinkler systems shall include siamese connections. Where siamese connections are installed, metal signs shall be fastened to or above the siamese connection indicating the area protected. Where the building has two or more frontages, additional metal signs shall be installed indicating the location of the siamese connection. The installation and construction of siamese connections shall be the same as required for fire standpipe systems, except that the caps of each automatic sprinkler siamese connection shall be painted green. The entire siamese connection of a non-automatic sprinkler system shall be painted aluminum. The caps of each siamese connection used for combination standpipe and sprinkler systems shall be painted yellow and signs shall be provided.

At least one automatic source of water supply shall be provided for sprinklers installed in all occupancy groups, except that:

- (a) Two automatic sources of water supply shall be provided for sprinklers in:
 - (1) Buildings classified in occupancy group A.
 - (2) Buildings classified in occupancy group C when the area on one floor exceeds twenty thousand square feet.
 - (3) Buildings classified in occupancy group F-1 when open heads are required for stages of unlimited size.

- (b) The domestic water supply may be used to supply a sprinkler system when installed in buildings classified in occupancy groups E, G, H and J. The domestic water supply may be used to supply sprinklers if all of the following conditions are met:
- (1) The domestic water supply line from the tank or street has the required pressure (as described below).
 - (2) An O.S. & Y. valve or an approved valve having visual indication, sealed open, is installed in the sprinkler supply branch.
 - (3) The number of heads in each fire section does not exceed twenty, and no more than ten heads are supplied from any one domestic water riser.
 - (4) The connection is made at the supply or riser side of any domestic branch control valves.

Direct connection of sprinklers to the public water system.

Direct connection of sprinklers to a city water main is acceptable as an automatic water supply provided the main is capable of maintaining a pressure of at least fifteen psig at the top of the highest sprinkler riser, with five hundred gpm of water flowing from a two and one-half inch hydrant outlet located at the street level within 250 feet of the building. The size of each connection shall be as large as that of the main riser and, except in sprinkler systems in multiple dwellings, shall be at least three inches and shall be controlled by an accessible shutoff valve.

Each service shall be equipped, under the sidewalk, with a control valve in a flush sidewalk box located within two feet of the front wall of the building or street line as required by the department of environmental protection. The location of the control valve shall be indicated by a sign placed on the structure directly opposite the sidewalk flush box, and shall have a white background with one inch red letters reading: "Automatic Sprinkler Shutoff Valve ... Feet Opposite This Sign". Brass, bronze, or other metal signs with one-inch letters, raised or counter-sunk one-eighth of an inch may also be used.

Sprinkler booster pumps.

Where the pressure from the city water main is less than 15 psig as described above but is sufficient to give at least five psig at the highest line of sprinklers as determined by test, an automatic, electrically driven pump installed for the purpose of boosting or increasing the city water pressure in the sprinkler system may be accepted subject to the following requirements:

- (a) Pumps shall be of approved centrifugal type, capable of delivering at least two hundred gpm, and shall be capable of supplying twenty-five per cent of the heads, in the largest area supplied, at twenty gpm, at a pressure of at least twenty-five psig at the top of the highest sprinkler riser.
- (b) Pumps shall be maintained under approved automatic control with closed circuit supervisory attachment. The supervisory attachments shall be directly connected to an office where maintenance personnel are in attendance twenty-four hours a day; or, in lieu thereof, the supervisory attachment may be directly connected to the central station of an approved operating fire alarm company. The supervisory alarm services shall be arranged so as to provide positive indication at an approved central office or sprinkler alarm panel board that the pump has operated or that the source of electrical supply has failed.

When sprinklers are not directly connected to the public water system and a sprinkler booster pump is not present a pressure or gravity tank shall be used.

Protection of sprinkler system.

All parts of an automatic system exposed to freezing temperatures shall be protected from freezing or in lieu thereof, an automatic drypipe system or a system filled with a nonfreezing, noncombustible solution shall be used. When a system filled with nonfreezing solution is used and the system is connected to a potable water supply, it shall be subject to the requirements of the Health Department and the Bureau of Water Supply of the Department of Environmental Protection. Sprinkler heads subject to damage shall be protected.

Inspection and tests.

(a) **Automatic wet and dry systems.** Automatic wet and dry sprinkler systems shall be subjected to a hydrostatic pressure test for a period of one hour at a pressure of at least one hundred psig at the topmost sprinkler head and at least two hundred psig at the lowest cross connection to the siamese connections.

(b) **Automatic dry pipe systems.** In addition to the hydrostatic test the automatic dry pipe systems shall also be tested to forty psig air pressure for a twenty-four hour period with the pressure loss not to exceed one and one-half psig.

(c) **Non-automatic sprinkler systems.** Non-automatic sprinkler systems shall be subjected to a hydrostatic pressure test of fifty psig at the topmost sprinkler head, with the test pressure maintained for a period of at least one hour.

(d) **Pressure tanks.** Pressure tanks shall be hydrostatically tested to a pressure of at least one and one-half times the working pressure for a period of one hour.

(e) **Sprinkler branches and heads supplied from domestic water.** Sprinkler branches and heads shall be tested at the pressure required by this section or at the pressure of the domestic water supply, whichever is greater.

PROVISIONS OF REFERENCE STANDARD RS 17-2

Chapter 2 - Water Supplies

Pumps. In light hazard occupancies with only limited ordinary hazard areas, an automatic fire pump serving the lower 300 feet of the standpipe system may be used as the primary supply to the sprinkler system, if a secondary automatic switching power supply is available to drive the pump. In hydraulically designed sprinkler systems supplied from a gravity tank, the pressure may be increased by means of an automatic, special service fire pump. The pump shall be arranged in a bypass to permit the portion of the system so supplied to be served by the system's siamese connections. If the pump is not supplied from the street side of the building service switch, the electrical service and pump operation shall be fully supervised; provided that a secondary automatic switching power supply is available to drive the pumps.

Pressure Tanks. A pressure tank in accordance with Fire Department's requirements is an acceptable water supply source. The total available quantity of water in pressure tanks need not exceed 15,000 gallons when there is a secondary source of water supply available from a gravity tank or a street connection acceptable to the Commissioner of Buildings. The maximum gross capacity of a single pressure tank shall be 9,000 gallons.

Each tank shall be kept at a maximum of 2/3 full of water and a minimum of 1/3 full of air maintained under a minimum pressure of 75 psig. The water-to-air ratio shall be so proportioned and the tank so located that a minimum pressure of 15 psig will be available on the highest line of sprinklers below the main roof when all

the water is being discharged from the tank. The tanks shall be supplied with water through a fixed pipe, independent of the sprinkler piping, and at least 2 inches in size. The water supply and connection shall be capable of supplying the tank at a rate of at least 65 gpm without reducing the pressure in the tank. The tank shall have a fixed water level plate on the end of the tank opposite the gauge glass, or equivalent devices, to indicate the level of the water in the tank.

The air compressor shall be provided with automatic controls for maintaining the air pressure. The capacity of the compressor shall be sufficient to build up the tank pressure to 75 psig within 3 hours or less. Pressure tanks shall be provided with approved closed circuit high and low water and high low air alarms. Pressure tanks shall be located at or above the top level of sprinklers.

AUTOMATIC SPRINKLER SYSTEMS

Automatic sprinkler systems are designed to automatically distribute water on a fire. The sprinkler system is designed to extinguish the fire entirely, or to prevent the spread of the fire. An automatic sprinkler system consists of a series of pipes at or near the ceiling in a building. The sprinkler system is fitted with automatic devices designed to release water on a fire. These devices are called sprinkler heads. The sprinkler heads are normally closed by a disk or cap. This cap is held in place by a heat sensitive releasing element. A rise in temperature to a predetermined heat causes the sprinkler head to open. Water is then discharged in the form of spray. When the sprinkler heads open they are said to have fused. The sprinkler heads are fitted at standard intervals on the piping. If more than one head opens, the area sprayed by each overlaps that of the sprinkler head next to it.

Sprinkler systems are required by law in various occupancies. They also may be installed voluntarily by the owner of the building. Sprinkler systems are installed to protect the building and its occupants. The installation of sprinklers has a major effect in reducing fire losses. Statistical evidence shows that about 96% of the fires are extinguished or controlled when sprinklers are installed. The 4% failure was due to a variety of causes including burst piping, closed supply valves, frozen water lines, etc.

Automatic sprinklers are very effective for life safety. They signal the existence of a fire. At the same time they discharge water to the burning area. When sprinklers are installed there are rarely problems getting to the seat of the fire. They also reduce interference with visibility for fire fighting due to smoke. The downward force of the water sprayed from sprinkler heads lowers the smoke level in the room. Sprinkler systems also serve to cool the smoke. This makes it possible for persons to remain in the area much longer than they could if the room were without sprinklers.

Most standard sprinkler systems have devices that automatically give an alarm when a sprinkler head discharges water. This alarm is usually an audible signal in the building. In many cases they also give an alarm at a remote location, such as the local fire house or a central station company. The central station company monitors the entire fire protection system for water discharge and problems with the equipment. When water discharge or equipment problems are identified the local fire house is immediately notified. This allows the Fire Department to gain control of a fire as quickly as possible. Water is rarely discharged accidentally from sprinkler heads.

SPRINKLER HEADS

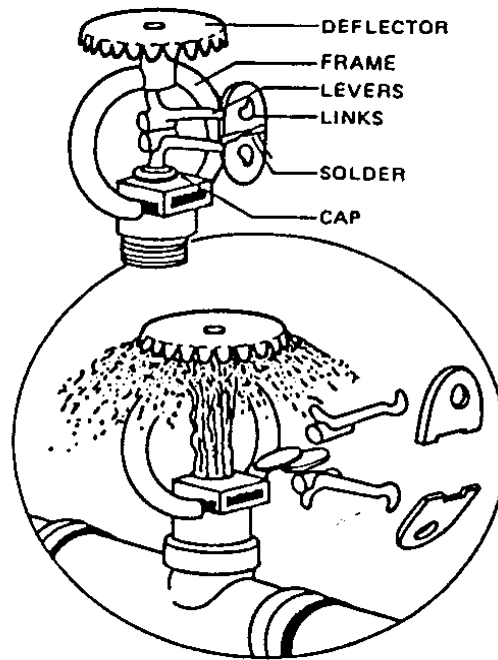
Sprinkler heads are made of metal. They are screwed into the piping at standard intervals. The water is prevented from leaving the sprinkler head by an arrangement of levers and links. The levers and links are soldered together on the sprinkler head. The solder is a metal alloy with a fixed melting point. Other types of sprinkler heads use a quartz bulb which expands and breaks under heat. Still another type uses a solid chemical held in a cylinder which is broken by heat action. The sprinkler head is designed to withstand at

least 500 psi without injury or leakage. If properly installed, there is little danger of the sprinkler head breaking apart unless it is damaged.

The latest type of sprinkler head is called the "cycling sprinkler". This sprinkler head cycles water on and off depending on the temperature. When the disk reaches a temperature of 165°F, the valve opens, permitting water to flow. When the disk temperature cools the valve closes to shut off the water.

Some sprinkler heads are designed to be used in special situations. Sprinkler heads exposed to corrosive conditions are often covered with a protective coat of wax or lead. Corrosive vapors are likely to make automatic sprinklers inoperative or slow down the speed of operation. They can also seriously block the spray nozzles in the sprinkler heads. They can damage, weaken or destroy the delicate parts of the sprinkler heads. In most cases such corrosive action takes place over a long time. For this reason the sprinkler heads must be carefully watched for signs of corrosion. Care must be taken to make sure that the protective coating is not damaged when handling or replacing the heads.

A typical fusible link type sprinkler head is shown in the picture below.



A typical sprinkler head

Spray Pattern of Sprinklers. The best way to put out a fire is to spray the water from the sprinkler head downward and horizontally. The spray pattern will also prevent the spread of the fire. The force of the water against the deflector creates a heavy spray which is directed outward and downward. The shape of the deflector determines the spray pattern of the water discharged from the sprinkler head. Usually, this is an umbrella-shaped spray pattern. At a distance of 4 feet below the deflector, the spray covers a circular area having a diameter of approximately 16 feet when the sprinkler is discharging 15 gpm. The newest kinds of sprinkler heads allow the sprinklers to be placed farther apart needing lower flow rates to give coverage to an area. These new heads offer more effective fire protection and are less likely to cause water damage than the old sprinkler heads.

Systems Using Large Drop Sprinklers Heads. Large drop sprinkler heads are special sprinklers designed to discharge large drops of water from the head. These sprinkler heads are used to break through the strong updrafts of high challenge fires.

Temperature Ratings of Sprinkler Heads. Automatic sprinkler heads have various temperature ratings which state the temperatures at which they will fuse. The temperature rating of all solder type automatic sprinklers is stamped on the soldered link. For other heat sensitive units, the temperature rating is stamped on one of the releasing parts. The temperature ratings of sprinkler are also indicated by a color coding system. See color codes below.

<u>Temperature Ratings</u>	<u>Color Code</u>
135° to 170°	Uncolored
175° to 225°	White
230° to 300°	Blue

In places where the temperature is normally high (e.g. boilers, ovens and drying rooms) a sprinkler head with a higher temperature rating must be used. This is to make sure that the sprinkler head does not discharge water at the wrong time. If heads with a high temperature rating are used in ordinary rooms (e.g., an office, an apartment, or a store) the value of the sprinkler protection is greatly reduced. This is because the temperature will have to increase much higher for the sprinkler head to open.

Sprinkler systems are excellent for controlling fires. However, they can cause water damage if they are not shut down soon after the fire has been extinguished. No control valve on the system should be closed except on the order of the fire officer in charge. Sometimes the Fire Department has a difficult time finding the control valve to shut down the system. This problem can be prevented by keeping a small sketch of the sprinkler system and the position of the control valves. This sketch should always be readily available. This sketch is very helpful to the fire fighters when they have to work with the sprinkler system.

Build up of Foreign Material on Sprinklers Heads. Sometimes conditions exist which cause a build-up of foreign material on sprinkler heads. This may prevent the sprinkler head from working properly. This build-up is commonly called loading. The build-up of foreign material insulates the sprinkler head. This insulation prevents the sprinkler head from opening at the temperature it is designed to.

If the build-up is hard, it may prevent the sprinkler head from opening. The best practice is to replace loaded sprinkler heads with new sprinkler heads rather than to attempt to clean them. If the deposits are hard, attempts to clean the heads are likely to damage them. This damage may prevent the sprinkler heads from working properly. The damage may also cause the sprinkler heads to leak.

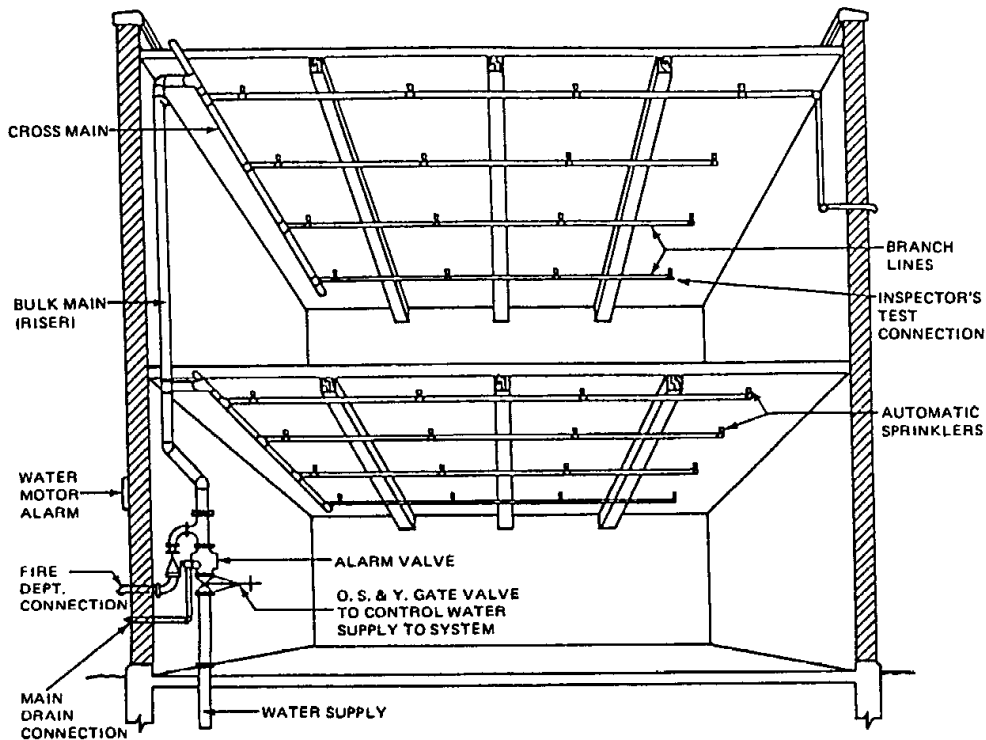
Deposits of light dust are less serious than hard deposits. Dust build-up may delay the operation of sprinkler heads. However, it will not prevent the eventual discharge of water. Dust deposits can be blown or brushed off. If a brush is used, it should be soft to avoid possible injury to sprinkler parts. Scouring or acidic liquids are likely to damage the sprinklers heads and should not be used for cleaning. Hot solutions of any kind should never be used to clean the sprinkler heads.

Sometimes sprinklers need to be protected when ceilings or piping are being painted. Usually a small lightweight paper bag or a sheet of lightweight paper is placed over the heads until the painting is completed. The bag or the sheet of paper should be secured with a rubber band. The bags are likely to delay the operation of the sprinkler heads and should be removed immediately after the painting is completed. There is no known method to safely remove paint from under the water cap or on the fusible link. Sprinkler heads that have been painted other than by the manufacturer must be replaced with new units.

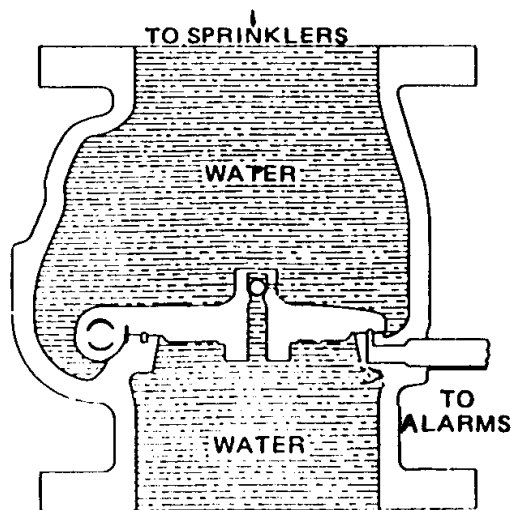
A supply of at least six extra sprinkler heads with the appropriate wrench should always be kept in a sprinkler cabinet. This extra supply should be used to promptly replace any sprinkler heads that have opened or have been damaged. The extra supply of sprinkler heads should be exactly the same as the sprinkler heads already installed in the system. It is very important that the replacement sprinkler heads have the same temperature rating as those installed in the system.

WET PIPE SPRINKLER SYSTEMS

Wet pipe sprinkler systems have water in the piping at all times. This type of system is used where there is no danger of the water supply freezing. A typical wet pipe system is shown in the picture below. A typical wet pipe sprinkler valve is shown on the following page.



A typical wet pipe system



A typical wet pipe sprinkler valve

Where temperatures drop below freezing the ordinary wet pipe system cannot be used. There are two methods for using automatic sprinkler systems in places exposed to freezing temperatures. One method is to design a system where water enters the sprinkler piping only after a control valve is opened. These are dry pipe systems, deluge systems, or preaction systems. The other method adds an antifreeze solution to the water in the wet pipe system. The antifreeze solution is a mixture of chemicals designed to prevent the water from freezing.

Antifreeze Solutions. Antifreeze is added to the water in piping exposed to freezing temperatures. When the sprinkler heads fuse the system works in the same way a wet pipe system. Antifreeze solutions are costly and may be difficult to maintain. Antifreeze is usually used for small unheated areas. Antifreeze solutions may be used only in accordance with applicable local health regulations.

Cold Weather Valves. An automatic sprinkler system should not be shut off and drained to avoid freezing during cold weather. However, parts of the sprinkler system may be shut down. Permission must be obtained from the local fire house. Permission may be given to shut off a maximum of 10 sprinklers on a wet pipe system. These shutoff valves are commonly referred to as cold weather valves.

WATER SUPPLY SOURCES FOR SPRINKLER AND STANDPIPE SYSTEMS

The sources used to supply water to sprinkler systems are the same as those for standpipe systems. Sprinkler and standpipe systems may be supplied from one or a combination of sources. For example, they may be supplied by public mains, gravity tanks, pressure tanks, reservoirs, rivers, or lakes. A single water supply would appear to be all that is needed to supply a sprinkler or a standpipe fire protection system. This assumes that there is enough water at an acceptable pressure. However, there are a few reasons why it is good to have a second water supply source. These reasons include: 1) a single supply source may be out of service (for maintenance or repair) during a fire emergency; 2) a single supply source may be disabled during fire or before the fire is fully extinguished; 3) the water supply source may fall below normal pressure or volume during an emergency.

In some cases it is required by law to have a second water supply source. Whether a second supply source is needed depends on several factors. These factors include the strength and reliability of the primary supply, the value of the property, the height, area and design of the building.

When a sprinkler or a standpipe system is supplied from a public water main, the entire system may be closed down by closing a control valve. This valve is located between the building and the water main in a box that is recessed into the sidewalk. The location of the box is found by reading a sign on a building or post nearby. For example, the sign might read "**Shutoff for Sprinkler System Located 6 Feet from This Sign,**" or it will have similar instructions. A special key may be required to operate this valve.

The control valve for the building may also be attached to an upright post, known as a post indicator valve (PIV). The building or section of the building controlled by the valve is usually marked on the post. The position of this valve (open or closed) is shown through a telltale opening in the post. On some posts, a padlock must first be opened or forced to release the operating wrench. On others, an iron strap must first be released by cutting a riveted leather section.

The main water supply for sprinkler and/or standpipe systems may also be controlled by an OS&Y valve (Outside Screw and Yolk valve). The OS&Y valves are found just inside the building wall on the main riser, or outside in protected pits. It is easy to tell at a glance if the valve is open or shut. When the stem is all the way out the valve is open. When the stem is all the way in the valve is closed. Some OS&Y valves may be used to control the water supply for individual floors in a building. The OS&Y valves are also installed to shut off certain sections of an individual floor. Being able to shut off parts of a building allows the Fire Department to have greater control over the fire protection system. When a fire is under control in an area the OS&Y valve can be closed to prevent any further water damage.

Sometimes repairs must be made to the sprinkler or standpipe system. When this happens the OS&Y valves are used to close the water supply to only those sections being repaired. This is good because the rest of the sprinkler system does not have to be shut down.

A building may have both a standpipe and a sprinkler system installed. Each system may have its own water supply source. For example, the standpipe system may be supplied by a gravity tank and the sprinkler system supplied by a pressure tank.

It is quite common for the two systems to share the same water supply source. For example, both systems may use the same gravity tank as a water supply source. The gravity tank is a limited water supply. The amount of water that is allocated to each system is regulated by local building laws.

Acceptable water supplies for the sprinkler or standpipe systems include connection to public or private water mains, connection to fire pumps, pressure tanks, and gravity tanks. These sources may be also used in combination to supply a standpipe and/or a sprinkler system. At least one of the water sources should be able to supply the standpipe or sprinkler system automatically. This supply must have the needed water volume and water pressure for the entire system. The public water works system is the most commonly used water supply source. In tall buildings the connection to the public water system may not have enough water pressure to supply the upper floors. In this situation a second supply source is often required to increase the water pressure. For example, a fire pump may be installed in a building that is more than ten stories high. The higher the building the greater the water pressure needed to supply the standpipe and/or sprinkler system.

Connections to Public Water Works System. While a connection to a reliable public water works system is the preferred primary water supply for standpipe and automatic sprinkler systems, a check valve must be

installed next to the interior connection to the standpipe or sprinkler system. This valve makes sure that the standpipe system does not backflow into the public water supply.

Fire Pumps. The fire pump is designed to draw water from a supply source. The water is then pumped into the fire protection system under high pressure. A fire pump with both a reliable source of power and a reliable suction water supply is a desirable piece of equipment. A suction water supply is simply a source of water that the pump can draw water from. With a good water supply a fire pump can pump water into a sprinkler or standpipe system for a long time. Sometimes more than one fire pump is installed in high rise buildings. The extra fire pumps are needed to maintain the desired water pressure levels at the top floors of the buildings.

Manually started pumps may be used as a secondary supply source if the primary water supply will last long enough to allow the pump to be started. This kind of system must give an automatic water-flow signal to the Certificate of Fitness holder when the pump must be started.

Automatic fire pumps are usually installed where a high water demand may occur immediately. This demand may occur in a deluge system. An automatic fire pump is also used when someone is not always available to activate the manual pump. Automatic fire pumps must have their suction “under a positive head” to avoid delays in drawing water from the supply source. **Under positive head** means that the water supplying the pump must be fed into the fire pump under pressure. This can be achieved by connecting the fire pump to a suction tank. Water is forced into the pump by gravity. Automatic fire pumps are activated as soon as a drop of air or water pressure is noticed in the fire protection system. The drop in pressure occurs when a hoseline is opened or a sprinkler head has fused.

Gravity Tanks. Gravity tanks of adequate capacity and elevation make a good primary supply and may be acceptable as a single supply. A gravity tank may be located on the top of a building or on a tall tower. The water in the tank is distributed throughout the sprinkler or standpipe system because of the pull of gravity.

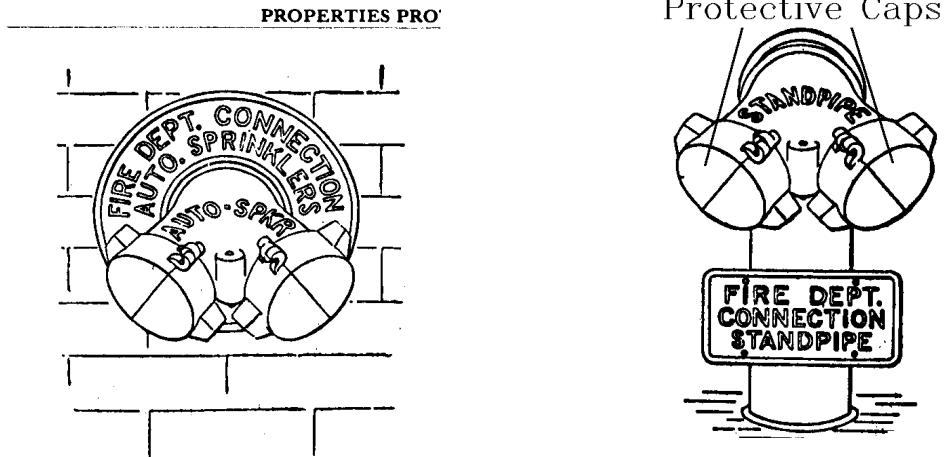
Pressure Tanks. Pressure tanks have several possible uses in automatic sprinkler or standpipe systems. Pressure tanks are often used where there is enough water from a supply source but the water pressure is too low. Pressure tanks may also be used in tall buildings that need the extra water pressure to supply the highest line of sprinklers or the highest line of hoses.

The tank is normally kept two-thirds full of water and one third full of air. The air pressure in the tank should be maintained above 75 psi. The air for pressure tanks is supplied by air compressors. Because the water is always under pressure it can be forcefully distributed throughout the sprinkler or standpipe system. An important limitation is the small amount of water that can be stored in such tanks. Where a small pressure tank is accepted as the water supply, the system is called a Limited Supply System.

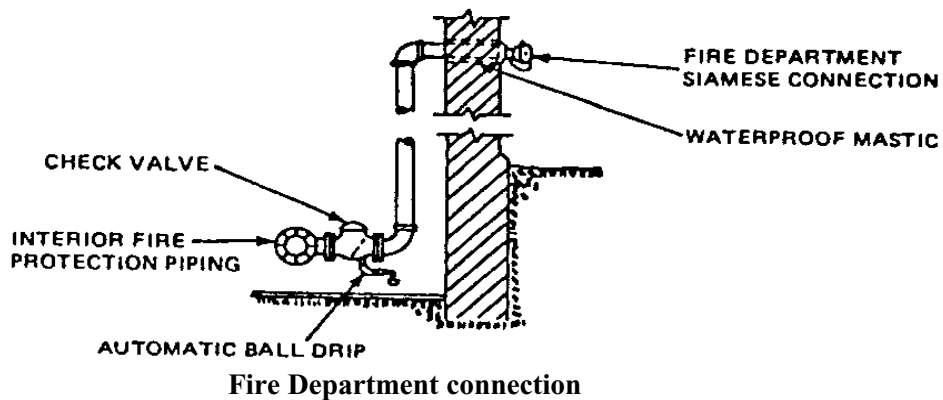
The pressure tank gives a strong starting pressure for the first sprinklers or hoses that open. The flow from the tank may be used while the automatic fire pumps begin to increase the water supply pressure. The pressure tank supplies these sprinklers and/or hoses until the Fire Department begins pumping water into the system

Siamese Connections for Fire Department Use. Normally a sprinkler or a standpipe system is connected to an automatic water supply source. Other sources of water are supplied through Fire Department siamese connections at the building. Siamese connections are a standard part of all sprinkler and standpipe systems. At least one siamese connection must be installed in all sprinkler and all standpipe systems. When responding to an alarm most fire departments supply water to the standpipe system first. The standpipe system supplies water to the fire hoses in the building. Water is then supplied to the sprinkler system through its own siamese connection. Care should be taken that standpipe and the sprinkler connections are

properly marked because the connections look the same. The exact purpose of each siamese connection should be shown nearby or on the siamese connection itself. The New York Building Code requires siamese connections to be color coded. The siamese connection to an automatic sprinkler system should be painted green. The siamese connection to non-automatic sprinkler system should be painted aluminum. The siamese connection to a standpipe should be painted red. Two examples of typical siamese connections are shown below.



Fire Department connections must always be accessible. Each connection should be fitted with a lower check valve. The check valve prevents the backflow of the private water supply into the public water supply. The figure below shows the main features of a Fire Department siamese connection.



The automatic drip device between the lower check valve and the outside hose coupling prevents water from building up in the piping. The ball drip device makes sure that the Fire Department connection is not blocked by water that has frozen in the piping. If water freezes in the piping, the Fire Department will not be able to pump water into the system. Under normal conditions the automatic ball drip should be dry. A wet ball drip device indicates that the lower check valve may be defective. If the lower check valve is defective it should be replaced immediately. Many standpipe and sprinkler systems use the Fire Department siamese connection as the secondary water supply source.

WATER-FLOW ALARMS IN SPRINKLER AND STANDPIPE SYSTEMS SUPERVISION

Sprinkler and standpipe systems should have devices and equipment for signaling when water flows through risers or mains supplying the systems. The flow may be due to fire, leakage, or accidental rupture of the piping. It is important that prompt action is taken when water-flow is noticed or signaled by these devices.

Functions of Alarms and Supervisory Signals. Sprinkler and standpipe systems with a water-flow alarm serve two functions. (1) It is an effective fire extinguishing system. (2) It is an automatic fire alarm. An alarm is signaled as soon as a sprinkler head has fused or a hose has been activated. Water-flow alarms and fire alarms give warning of the actual occurrence of a fire. They also signal when water flows through the system due to broken pipes. Alarms alert occupants and summon the Fire Department. Any signal, whether water-flow or supervisory, may be used to give an audible alarm. It may also send a signal to a central station company. The central station company will then contact the local fire house.

Supervisory devices are often connected to a central station company which monitors the sprinkler and/or standpipe systems for problems with equipment and when sprinkler heads are opened or standpipe hoses have been activated. The central station company should be notified when any control valves are closed for maintenance or repair. This reduces the number of false alarms.

Automatic sprinkler systems are required to have an approved water motor gong or an electric bell, horn, or siren on the outside of the building. An electric bell or other audible signal device may also be located inside the building. Water operated devices must be located near the alarm valve, dry pipe valve, or other water control valves in order to avoid long runs of connecting pipe.

Devices and Equipment Supervised. Sprinkler and/or standpipe system supervision is commonly provided for several purposes. These purposes include the detection of: (1) low water level in water supply tanks, (2) low temperature in water supply tanks or ground level reservoirs, (3) high or low water level in pressure tanks, (4) high or low air pressure in pressure tanks, (5) high or low air pressure in dry pipe sprinkler or standpipe systems, (6) failure of electric power supply to fire pumps, and (8) automatic operation of electric fire pumps.

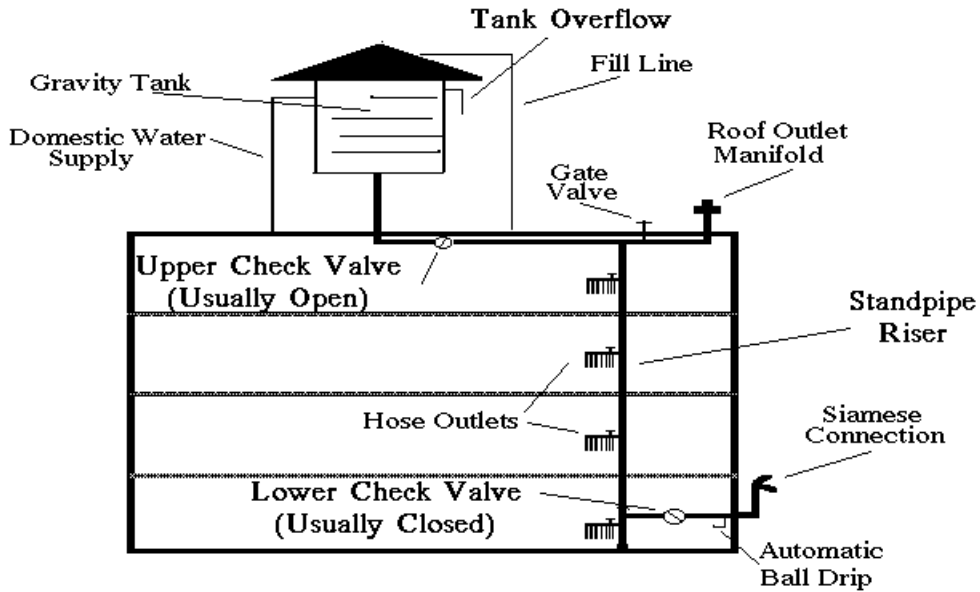
Water-flow Alarm Valves. The basic design of most water-flow alarm valves is that of a check valve which lifts from its seat when water flows into a sprinkler or standpipe system. This alarm then starts an audible signal to alert the occupants in the building that the sprinkler or standpipe system has been activated.

Alarm Retarding Devices. An alarm check valve that is exposed to changing water supply pressure needs an alarm retarding device. This is required to prevent false alarms when the check valve clapper is lifted from its seat by a temporary pressure surge.

Gate Valves. Gate valves of the non-indicating type are provided in water distribution systems. Gate valves allow parts of the sprinkler or standpipe system to be shut off for repairs or maintenance. This is done without reducing protection over a wide area. Such valves are normally a non-rising stem type. They are operated using a special key wrench. A valve box is located over the valve to keep dirt from the valve. The valve box also provides a convenient access point for the valve wrench to the valve nut. A complete record should be made for each valve in the system. This record should include the exact location, the date it was installed, the make, the direction of opening, number of turns to open, and any maintenance that was performed.

INTRODUCTION AND OVERVIEW OF STANDPIPE SYSTEMS

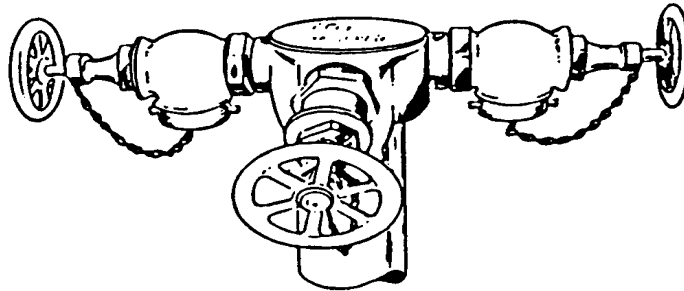
Standpipe systems are an important part of the fire protection system in a building. The standpipe system provides water that fire fighters can manually discharge through hoses onto a fire. Water is fed into a piping system. The piping runs vertically (up and down) and horizontally (side to side) throughout the building. The piping running vertically are usually called risers. The risers are usually located in the staircase enclosures or in the hallways in the building. This piping system supplies water to every floor in the building. When a standpipe system is installed and properly maintained it is a very effective means for extinguishing fires. A typical standpipe system is shown below in the illustration below.



A Typical Standpipe System

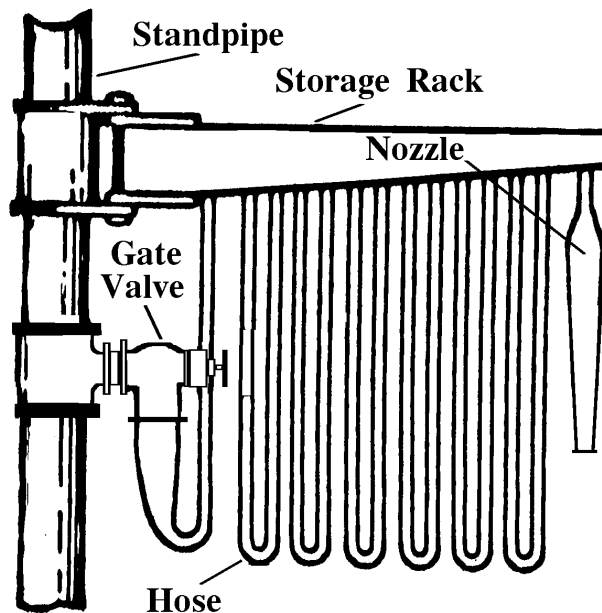
STANDPIPE DESIGN

Standpipe systems are used in buildings where it may be difficult for the Fire Department to pump water on the fire. For example, standpipe systems are required in buildings that are over six stories 75 feet in height. A standpipe system may be combined with an automatic fire protection system. For example, a standpipe system and a sprinkler system may be installed in the same building. The standpipe and the sprinkler systems may even share the same water supply and riser piping. The top of the standpipe riser extends up onto the roof. Three hose connections are attached to the top of the standpipe riser. These three connections make up the roof manifold. The roof manifold is used when extinguishing fires on the roof. It is also used when testing the water flow in the standpipe. An example of a typical roof manifold is shown in the picture on the following page.



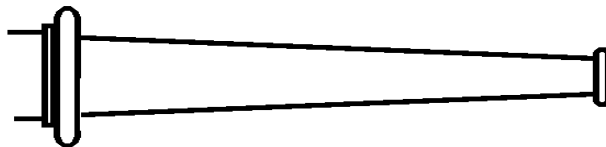
A Typical Roof Manifold

At selected locations in the building the piping is connected to a hose. These connections are controlled by gate valves. No water is allowed into the hose until the valve is opened. The gate valve must be manually opened by the fire fighter. The hose is usually stored on a quick release rack. An example of a typical quick release rack is shown below.



A Typical Fire Hose Outlet and Release Rack

A nozzle is attached at the end of the hose. The nozzle is used to direct the stream of water from the hose. An example of a typical nozzle is shown in the picture below.

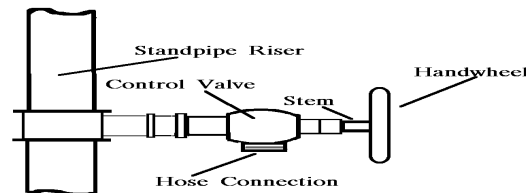


A Typical Nozzle

The hose and nozzle must be easy to reach at all times. The hose outlets are located so that every part of the building may be reached with a hose stream. The maximum length of a single hoseline is 125 feet. Sometimes the hoses are installed in cabinets. If the hoses are installed in cabinets each cabinet should be labeled "FIRE HOSE". When the hose outlets are not easy to see, signs should be posted telling where the hose outlets are located.

A pressure reducing device should be installed in the piping at each hose outlet. An occupant of the building may be injured if a hose is used when the pressure reducing device is not installed. The pressure reducing device may be adjusted or removed by Fire Department personnel during an emergency.

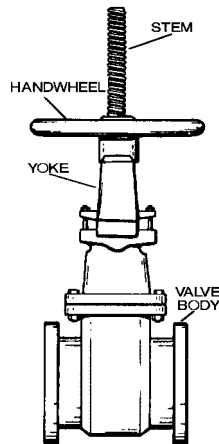
Another kind of connection to the standpipe is found in some systems. A short length of piping is welded to the riser. At the end of this pipe is a control valve and a 2 1/2 inch hose connection. No hose is installed to this connection. The Fire Department attaches its own hose to this connection when fighting a fire. An example of this kind of connection is shown in the picture below.



Fire Department Connection to a Standpipe Riser

Each standpipe system is also fitted with a drain valve. The drain valve is located at the lowest point on the standpipe system. The drain valve is used when the standpipe system is being tested or repaired. The drain valve is usually sealed in the closed position.

OS&Y (Outside Screw and Yoke) gate valves are installed at several places in the system. The OS&Y valves can be used to shut down just a part of the standpipe system. Sections may be shut down when fighting a fire. Sections are also shut down for testing, repairs or maintenance. It is easy to tell if the OS&Y valve is in the open or closed position. If the stem is raised above the control wheel the valve is open. If the stem is flush with the control wheel the valve is closed. A typical OS&Y gate valve is shown below. The valve in the picture is open.



Typical OS&Y valve

TYPES OF STANDPIPE SYSTEMS

Wet Standpipe: This system always has water in the piping. The water in the system is always under pressure. In some cases a fire pump may be used to increase the water pressure. The wetpipe system is the most commonly used standpipe system. It is used in heated buildings where there is no danger of the water in the piping freezing. Any part of the standpipe system that is exposed to freezing temperatures should be insulated. It is very important that the water in the piping does not freeze. Frozen water may prevent the standpipe system from working.

Dry Standpipe with an Automatic Dry Pipe Valve. This system is usually supplied by a public water main. Under normal conditions there is no water in the piping. Instead, there is air under pressure in the piping. A dry pipe valve is installed to prevent water from entering the standpipe system. The dry pipe valve is designed to open when there is drop of air pressure in the standpipe. When a hose is opened it causes a drop in air pressure in the standpipe system. Then the dry pipe valve automatically lets water flow into the standpipe. A control valve is installed at the automatic water supply connection. This valve should be kept open at all times to supply the standpipe system. This system is usually installed in a building that is not heated.

Dry Standpipe with a Manual Control Valve. This system is supplied by a public water main. Under normal conditions this system has no water in the piping. The water is not allowed into the standpipe until a control valve is manually operated. The control valve remains closed until a fire occurs. This system is usually used in a building that is not heated.

Dry Standpipe with No Permanent Water Supply. Under normal conditions this system has no water in the piping. Water is pumped into the standpipe system by the Fire Department. The water is pumped in through the siamese connection. This system cannot be used unless water is supplied by the Fire Department. A sign must be attached to each of the hose outlets. It should read "**Dry Standpipe for Fire Department Use Only**". This system is usually used in a building that is not heated.

CLASSES OF STANDPIPES SYSTEMS

Standpipe systems are classified depending on who is expected to use the system. The three classes are briefly described on the following page.

Class I: This system is designed to be used by professional fire fighters. For example, the system is used by Fire Department and Fire Brigade personnel. The fire hoses in these systems are 2 1/2 inches in diameter. The large hose diameter makes it difficult to control the stream of water from the hose.

Class II: This system is designed to be used by the occupants of a building. The hose and nozzle are connected to the standpipe. They are ready to be used by occupants in case of a fire. The hose is 1 1/2 inches in diameter. The hose stream is easier to control than the Class I hose.

Class III: This system may be used by either professional fire fighters or by occupants of the building. The hosing may be adjusted to either 1 1/2 or 2 1/2 inches in diameter. This is done by attaching special reducing valves to the hose line.

INSPECTION AND MAINTENANCE

The standpipe system must be regularly inspected by the Certificate of Fitness holder. This is to make sure that the system is working properly at all times. All parts of the standpipe system should be visually checked monthly. This visual inspection should make sure that the system is free from corrosion. The inspection should also make sure that there is no physical damage to the system. Special attention should be paid to any evidence of tampering with the standpipe system. Any part of the system that is damaged or missing should be repaired or replaced immediately.

All valves and connections to the automatic water supply sources should be inspected weekly. The valves should be checked to make sure that they are in the correct position. The valves should also be labeled to show their correct position and purpose. The hose outlets should be checked to make sure that the pressure reducing devices are present. The Fire Department should be notified when any part of the system is shut down for maintenance or repairs. A sign should be posted indicating that the section is shut down. All Fire Department connections must be tested at least once every 5 years.

All major defects in the system should be immediately reported to the local fire house. The owner of the building and the Bureau of Fire Prevention should also be notified. Major defects include: an empty tank, a break or a leak in the system's piping, an inoperative or shut water supply valve, and a defective siamese connection. The defects should be corrected as soon as possible. A complete or partial shutdown of the standpipe system for repairs or any other reason must also be reported.

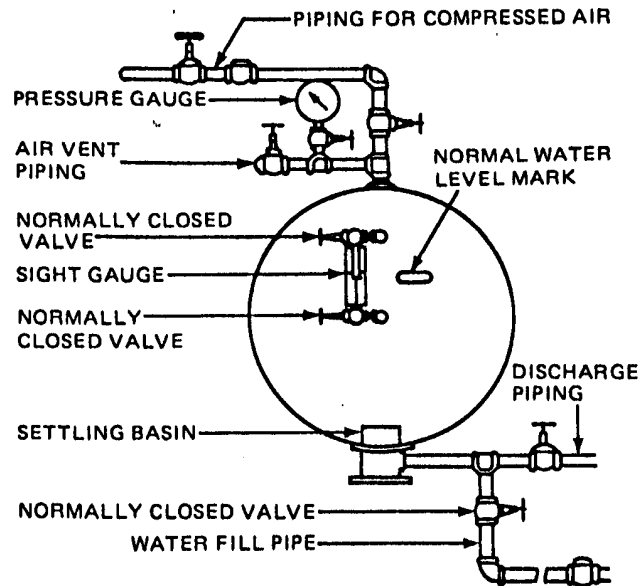
Minor defects should be reported to the owner of the building. The defects should be repaired within 30 days. If the defects are not corrected within 30 days, they must be reported to the Bureau of Fire Prevention.

The date of all inspections, maintenance and repairs made on the system must be recorded on the inspection record card. The record should also include the Certificate of Fitness number and the signature of the Certificate of Fitness holder. This record must be posted near the main control valve. All records must be kept for a period of at least one year. They should be made available to any representative of the Fire Department.

PRESSURE TANKS

Pressure tanks are enclosed water tanks of limited size. Air pressure in the tank permits forceful discharge of water in the tank into the standpipe or sprinkler system. A pressure tank may be used as a primary or secondary water supply for a standpipe or a sprinkler system. A pressure tank is usually housed in an enclosed structure. The temperature in the enclosure is kept at 40° Fahrenheit or above. The heated structure may be located anywhere in the building or even outside the building.

Pressure tanks are usually kept approximately two-thirds full of water and one-third full of pressurized air. The minimum acceptable air pressure inside the tank is 75 psi (pounds per square inch). The air pressure in the tank is automatically maintained by an air compressor. The maximum capacity of pressure tanks is typically 9,000 gallons. Some standpipe and/or sprinkler systems require more than 9,000 gallons of water. If necessary several pressure tanks can be used in combination to supply the system. A sectional view of a standard pressure tank is shown in the diagram below.



A Standard Pressure Tank

Pressure Tank Alarms

All pressure tanks used to provide the required primary water supply of a standpipe or sprinkler system should be equipped with two high and low alarm systems. One system monitors the high and low air pressure. The other system monitors the high and low water levels. The alarm system automatically controls the air-to-water ratio which should always be 1 (air) to 2 (water). An alarm signals the Certificate of Fitness holder when the water level or the air pressure falls too low. When this happens the pressure tank should be adjusted or repaired immediately.

Supervision of the Pressure Tank.

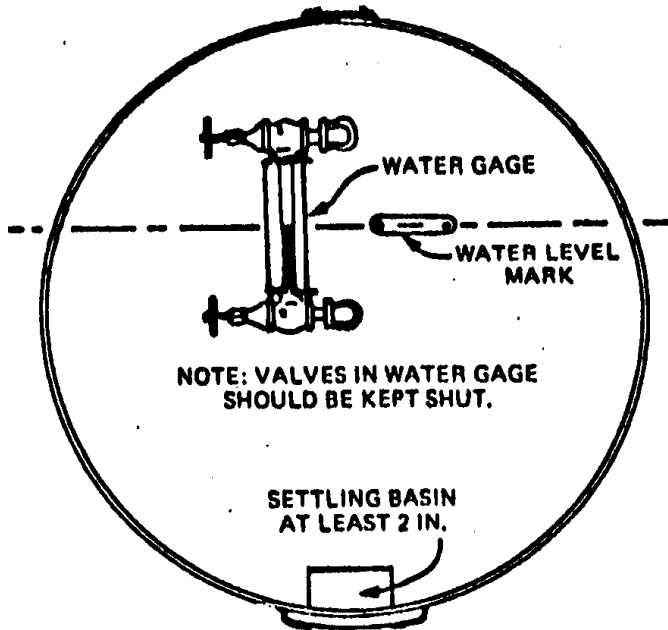
The pressure tank may also be supervised by an approved central station company which monitors the entire standpipe or sprinkler system. Supervisory devices are installed in the pressure tank. These devices alert the central station company when there is a problem with the tank's water level, air pressure, or water temperature. The devices also alert the central station company when water has been discharged from the tank. When water has been discharged through a hose outlet or a sprinkler head the local fire house must be notified.

The central station company notifies the Certificate of Fitness holder when a problem is caused by equipment failure. Repairs and adjustments should be made promptly. It is important that the pressure tank is returned to good working order as soon as possible.

Inspection and Maintenance of Pressure Tanks

The water level and air pressure in pressure tanks should be inspected monthly. The water level and air pressure must provide an adequate water supply to the standpipe or sprinkler system.

The water gauge valve must be opened to examine the water level as shown in the sectional diagram below.



When the valve is opened the water will flow into the gage. This allows the Certificate of Fitness holder to compare the water level in the tank to the desired water level mark. Adjustments to the water level should be made as needed. After visually inspecting the water gauge valve, the valve should be closed. When the valve is closed, the water and air in the tank are isolated from the sight glass. If the gauge glass breaks the volume of water and the air pressure are not affected.

The inside of pressure tanks should be inspected carefully every three years. Rusting in the tank may require repainting or other repairs. The inside of the tank should be thoroughly scraped, wire brushed and repainted. No foreign materials should be allowed to fall into the standpipe system.

The temperature inside the structure housing the pressure tank should be checked daily during cold weather to make sure that the temperature is at least 40° Fahrenheit at all times.

**STUDY MATERIAL FOR THE
CERTIFICATE OF FITNESS FOR
CONSOLIDATED EXAM FOR:**

F-97

**STANDPIPE SYSTEMS WITH FIRE PUMPS AND
GRAVITY TANKS**

STANDPIPE SYSTEMS WITH FIRE PUMPS

SPRINKLER SYSTEMS WITH FIRE PUMPS

**SPRINKLER SYSTEMS WITH FIRE PUMPS
COMPLEX WIDE**

**ALSO INCLUDED IN THIS BOOKLET YOU WILL
FIND THE FOLLOWING:**

1. NOTICE OF EXAMINATION (NOE) (R-10/20/99)

NOTICE OF EXAMINATION FOR

Title: Consolidated Examination for Certificate of Fitness for F-97: Standpipe Systems with Fire Pumps and Gravity Tanks (F-12), Standpipe Systems with Fire Pumps (F-14), Sprinkler Systems with Fire Pumps (F-21), and Sprinkler Systems with Fire Pumps Complex-wide (F-49)

Date of Test: Written tests are conducted Monday to Friday (except legal holidays)
9:00 AM to 2:30 PM.

QUALIFICATION REQUIREMENTS

1. Applicants must be at least 18 years of age.
2. Applicants must have a reasonable understanding of the English language.
3. Applicants must present a letter of recommendation from his/her employer. The letter must be on official letterhead and must state the applicant's full name, character, physical condition, experience, and address of premises where applicant will be employed.
4. Applicants must present two (2) forms of satisfactory identification i.e., driver's license and passport picture ID.
5. Applicants must present a sketch or plan of the systems they are applying for.

APPLICATION INFORMATION

Application Fees: \$25.00 for originals and \$5.00 for renewals. The fee may be paid in cash, money order, or personal check payable to New York City Fire Department. The \$25.00 fee must be payable by all applicants prior to taking the Certificate of Fitness test. Application forms are available at the Public Certification Unit, 1st floor, 9 MetroTech Center, Brooklyn, NY 11201.

TEST INFORMATION

Test: The test will be of the written, multiple choice type. A passing score of at least 70% is required in order to secure a Certificate of Fitness. Individuals with a license as a Master Fire Suppression Pipe Contractor (Dept. of Buildings) Class A or B; or as a Master Plumber (Dept. of Buildings); or a certification as a Fire Protection Engineering Technician-Automatic Sprinkler System Layout Levels II or III (NICET) or Fire Protection Engineering Technician-Special Hazards Systems Layout III or IV (NICET); or a license as a Professional Engineer (PE) or Registered Architect (RA) issued by the NYS Dept. of Education plus one year of fire protection or fire safety experience may have the written test waived. This procedure is the **Alternative Issuance Policy**. Call (718) 999-1993 for additional information and forms.

This study material contains some of the information you will need to prepare for the Consolidated Examination for the Certificate of Fitness for Standpipe/Sprinkler Systems (F-97). The study material includes information taken from relevant sections of the Fire Prevention Code, the Fire Prevention Directives of the Bureau of Fire Prevention, FDNY and the Building Code of New York. The Study Material does not contain all the information you need to know in order to perform the job as a certificate of fitness holder under this consolidated series. In addition to other requirements of the Certificates of Fitness covered under this consolidated series it is your responsibility to become familiar with all applicable rules and regulations of the City of New York, even if they are not covered in this document.

All questions on the Certificate of Fitness examination are multiple choice, with four alternative answers to each question. Only one answer is correct for each question. If you do not answer a question, or if you mark more than one alternative your answer will be scored as incorrect. A score of 70% correct is required on the examination in order to qualify for the Certificate of Fitness. Read each question carefully before marking your answer. There is no penalty for guessing.

Sample questions

- _____ 1. A standpipe system is primarily used for:
- (A) draining water from low level areas.
 - (B) fire fighting operations.
 - (C) washing down the floors in a building.
 - (D) draining water from kitchen areas in the building.

The correct answer is "B". You would press "B" on your touch screen terminal.

- _____ 2. **When a gravity tank is required in a yard system the tank should be:**
- (A) underground.
 - (B) on the ground level.
 - (C) elevated above ground level.
 - (D) filled with compressed foam.

The correct answer is "C". You would mark "C" on your touch screen terminal.

PROVISIONS OF THE FIRE PREVENTION CODE OF NEW YORK

All multiple dwellings, factories, office buildings, warehouses, stores and offices, theaters and music halls, and all hospitals and asylums, and all public schools and other public buildings, churches and other places where large numbers of persons are congregated for purposes of worship, instruction or amusement, and all piers, bulkheads, wharves, pier sheds, bulkhead sheds or other waterfront structures shall provide such fire hose, fire extinguishers, buckets, axes, fire hooks, fire doors and other means of preventing and extinguishing fires as the commissioner may direct.

Sprinkler systems in garment factories and factories using flammable oil for processing.

A one source automatic wet pipe sprinkler system shall be provided in every non-fireproof building in which there is a garment factory or a factory engaged in the processing of combustible fabrics with a flammable oil, and which exceeds three stories in height, and in which more than fifty persons are employed above the street floor. A flammable oil is defined as an oil that emits a flammable vapor below one hundred twenty-five degrees Fahrenheit. An automatic dry pipe sprinkler system is acceptable in place of an automatic wet pipe sprinkler system where low temperatures or other conditions would prevent the installation of a wet pipe system. The sprinkler systems shall be provided in all parts of such buildings.

Sprinkler and/or standpipe system maintenance and inspections.

1. Automatic and non-automatic sprinkler systems shall be inspected at least once a month by a competent person holding a certificate of fitness, employed by the owner, to see that all parts of the system are in perfect working order, and that the Fire Department connection or connections, if any, are ready for immediate use by the Fire Department. A detailed record of each inspection shall be kept by the Certificate of Fitness Holder for examination by a representative of the Fire Department.
2. A supply of at least six extra sprinkler heads with the appropriate wrench shall be kept available on the premises, to replace promptly any fused or damaged sprinklers. Any head that has opened or has been damaged shall be replaced immediately with an appropriate sprinkler head. One or more employees shall be instructed in the maintenance of sprinkler systems.
3. At least once in five years, the Fire Department connection or connections, if any, for a sprinkler and/or standpipe system shall be subjected to a hydrostatic pressure test and the standpipe system shall also be subjected to a flow and pressure test to demonstrate its suitability for Fire Department use. The test shall be conducted by the owner's representative before a representative of the Fire Department.

Maintenance and inspections of standpipe and sprinkler pumps and accessories.

Valves, hose, tools and other accessory fire fighting appliances shall be kept readily available and in good working order. Fire pumps shall be operated at least once in thirty days in a manner that will subject the standpipe system to a hydrostatic pressure of at least fifty pounds per square inch at the top story hose outlet. The qualified operator shall maintain a suitable record of his or her compliance with this requirement for inspection by the Fire Department. The installation of fire and booster pumps shall be subject to inspection and/or test in the presence of an inspector from the Bureau of Fire Prevention.

PROVISIONS OF BUREAU OF FIRE PREVENTION FIRE DIRECTIVE 4-82

Record keeping. The Certificate of Fitness Holder shall maintain a detailed record of all inspections. A record card with the date of each inspection, the Certificate of Fitness number, and the signature of the Certificate of Fitness holder shall be posted near the main control valve.

The detailed inspection report shall include information relative to conditions of water supply, gravity and pressure tanks and levels therein, valves, risers, piping, sprinkler heads, hose valves, hoses and nozzles, siamese connections, alarms, fire pumps, obstructions, and conditions of all other system equipment and appurtenances. All defects or violations shall be noted on the report. Records should be kept for one year and be made available to any representative of the Fire Department.

Reporting of defects or violations. The Certificate of Fitness holder must report all major defects immediately to:

1. the local Fire house
2. the owner or manager of the building
3. the Bureau of Fire Prevention

Major defects or violations include: empty tank, break or major leak in system water piping, inoperative or shut water supply valves; or complete or partial shut down of sprinkler and/or standpipe systems for repairs or other reason, and defective siamese connections.

Other defects or violations that are minor should be reported to the owner or manager of the building. If the defects are not corrected within 30 days, the defects should be reported in writing to the Bureau of Fire Prevention.

Failure to make inspections, maintain records, and report defects or violations may be cause for revocation of the Certificate of Fitness and court enforcement proceedings.

PROVISIONS OF THE NEW YORK BUILDING CODE

Sources of water supply for sprinkler systems.

Automatic sources of water supply for sprinkler systems include a gravity tank, pressure tank, automatic fire pump, or direct connection to the public water system. Auxiliary sources of water supply for sprinkler systems include manually activated fire pumps or siamese connections. Tanks used to provide the required primary water supply to a standpipe system may also be used as a supply for an automatic sprinkler system. Non-automatic sources of supply for sprinkler systems shall include siamese connections. Where siamese connections are installed, metal signs shall be fastened to or above the siamese connection indicating the area protected. Where the building has two or more frontages, additional metal signs shall be installed indicating the location of the siamese connection. The installation and construction of siamese connections shall be the same as required for fire standpipe systems, except that the caps of each automatic sprinkler siamese connection shall be painted green. The entire siamese connection of a non-automatic sprinkler system shall be painted aluminum. The caps of each siamese connection used for combination standpipe and sprinkler systems shall be painted yellow and signs shall be provided.

At least one automatic source of water supply shall be provided for sprinklers installed in all occupancy groups, except that:

- (a) Two automatic sources of water supply shall be provided for sprinklers in:
 - (1) Buildings classified in occupancy group A.
 - (2) Buildings classified in occupancy group C when the area on one floor exceeds twenty thousand square feet.
 - (3) Buildings classified in occupancy group F-1 when open heads are required for stages of unlimited size.
- (b) The domestic water supply may be used to supply a sprinkler system when installed in buildings classified in occupancy groups E, G, H and J. The domestic water supply may be used to supply sprinklers if all of the following conditions are met:
 - (1) The domestic water supply line from the tank or street has the required pressure (as described below).
 - (2) An O.S. & Y. valve or an approved valve having visual indication, sealed open, is installed in the sprinkler supply branch.
 - (3) The number of heads in each fire section does not exceed twenty, and no more than ten heads are supplied from any one domestic water riser.
 - (4) The connection is made at the supply or riser side of any domestic branch control valves.

Direct connection of sprinklers to the public water system.

Direct connection of sprinklers to a city water main is acceptable as an automatic water supply provided the main is capable of maintaining a pressure of at least fifteen psig at the top of the highest sprinkler riser, with five hundred gpm of water flowing from a two and one-half inch hydrant outlet located at the street level within 250 feet of the building. The size of each connection shall be as large as that of the main riser and, except in sprinkler systems in multiple dwellings, shall be at least three inches and shall be controlled by an accessible shutoff valve.

Each service shall be equipped, under the sidewalk, with a control valve in a flush sidewalk box located within two feet of the front wall of the building or street line as required by the department of environmental protection. The location of the control valve shall be indicated by a sign placed on the structure directly opposite the sidewalk flush box, and shall have a white background with one inch red letters reading: "Automatic Sprinkler Shutoff Valve ... Feet Opposite This Sign". Brass, bronze, or other metal signs with one-inch letters, raised or counter-sunk one-eighth of an inch may also be used.

Sprinkler booster pumps.

Where the pressure from the city water main is less than 15 psig as described above but is sufficient to give at least five psig at the highest line of sprinklers as determined by test, an automatic, electrically driven pump installed for the purpose of boosting or increasing the city water pressure in the sprinkler system may be accepted subject to the following requirements:

- (a) Pumps shall be of approved centrifugal type, capable of delivering at least two hundred gpm, and shall be capable of supplying twenty-five per cent of the heads, in the largest area supplied, at twenty gpm, at a pressure of at least twenty-five psig at the top of the highest sprinkler riser.
- (b) Pumps shall be maintained under approved automatic control with closed circuit supervisory attachment. The supervisory attachments shall be directly connected to an office where maintenance personnel are in attendance twenty-four hours a day; or, in lieu thereof, the supervisory attachment may be directly connected to the central station of an approved operating fire alarm company. The supervisory alarm services shall be arranged so as to provide positive indication at an approved

central office or sprinkler alarm panel board that the pump has operated or that the source of electrical supply has failed.

When sprinklers are not directly connected to the public water system and a sprinkler booster pump is not present a pressure or gravity tank shall be used.

Protection of sprinkler system.

All parts of an automatic system exposed to freezing temperatures shall be protected from freezing or in lieu thereof, an automatic drypipe system or a system filled with a nonfreezing, noncombustible solution shall be used. When a system filled with nonfreezing solution is used and the system is connected to a potable water supply, it shall be subject to the requirements of the Health Department and the Bureau of Water Supply of the Department of Environmental Protection. Sprinkler heads subject to damage shall be protected.

Inspection and tests.

(a) **Automatic wet and dry systems.** Automatic wet and dry sprinkler systems shall be subjected to a hydrostatic pressure test for a period of one hour at a pressure of at least one hundred psig at the topmost sprinkler head and at least two hundred psig at the lowest cross connection to the siamese connections.

(b) **Automatic dry pipe systems.** In addition to the hydrostatic test the automatic dry pipe systems shall also be tested to forty psig air pressure for a twenty-four hour period with the pressure loss not to exceed one and one-half psig.

(c) **Non-automatic sprinkler systems.** Non-automatic sprinkler systems shall be subjected to a hydrostatic pressure test of fifty psig at the topmost sprinkler head, with the test pressure maintained for a period of at least one hour.

(d) **Pressure tanks.** Pressure tanks shall be hydrostatically tested to a pressure of at least one and one-half times the working pressure for a period of one hour.

(e) **Sprinkler branches and heads supplied from domestic water.** Sprinkler branches and heads shall be tested at the pressure required by this section or at the pressure of the domestic water supply, whichever is greater.

PROVISIONS OF REFERENCE STANDARD RS 17-2

Chapter 2 - Water Supplies

Pumps. In light hazard occupancies with only limited ordinary hazard areas, an automatic fire pump serving the lower 300 feet of the standpipe system may be used as the primary supply to the sprinkler system, if a secondary automatic switching power supply is available to drive the pump. In hydraulically designed sprinkler systems supplied from a gravity tank, the pressure may be increased by means of an automatic, special service fire pump. The pump shall be arranged in a bypass to permit the portion of the system so supplied to be served by the system's siamese connections. If the pump is not supplied from the street side of the building service switch, the electrical service and pump operation shall be fully supervised; provided that a secondary automatic switching power supply is available to drive the pumps.

Pressure Tanks. A pressure tank in accordance with Fire Department's requirements is an acceptable water supply source. The total available quantity of water in pressure tanks need not exceed 15,000 gallons when

there is a secondary source of water supply available from a gravity tank or a street connection acceptable to the Commissioner of Buildings. The maximum gross capacity of a single pressure tank shall be 9,000 gallons.

Each tank shall be kept at a maximum of 2/3 full of water and a minimum of 1/3 full of air maintained under a minimum pressure of 75 psig. The water-to-air ratio shall be so proportioned and the tank so located that a minimum pressure of 15 psig will be available on the highest line of sprinklers below the main roof when all the water is being discharged from the tank. The tanks shall be supplied with water through a fixed pipe, independent of the sprinkler piping, and at least 2 inches in size. The water supply and connection shall be capable of supplying the tank at a rate of at least 65 gpm without reducing the pressure in the tank. The tank shall have a fixed water level plate on the end of the tank opposite the gauge glass, or equivalent devices, to indicate the level of the water in the tank.

The air compressor shall be provided with automatic controls for maintaining the air pressure. The capacity of the compressor shall be sufficient to build up the tank pressure to 75 psig within 3 hours or less. Pressure tanks shall be provided with approved closed circuit high and low water and high low air alarms. Pressure tanks shall be located at or above the top level of sprinklers.

AUTOMATIC SPRINKLER SYSTEMS

Automatic sprinkler systems are designed to automatically distribute water on a fire. The sprinkler system is designed to extinguish the fire entirely, or to prevent the spread of the fire. An automatic sprinkler system consists of a series of pipes at or near the ceiling in a building. The sprinkler system is fitted with automatic devices designed to release water on a fire. These devices are called sprinkler heads. The sprinkler heads are normally closed by a disk or cap. This cap is held in place by a heat sensitive releasing element. A rise in temperature to a predetermined heat causes the sprinkler head to open. Water is then discharged in the form of spray. When the sprinkler heads open they are said to have fused. The sprinkler heads are fitted at standard intervals on the piping. If more than one head opens, the area sprayed by each overlaps that of the sprinkler head next to it.

Sprinkler systems are required by law in various occupancies. They also may be installed voluntarily by the owner of the building. The sprinklers are installed to protect the building and its residents. The installation of sprinklers has a major effect in reducing fire losses. Statistical evidence shows that about 96% of the fires are extinguished or controlled when sprinklers are installed. The 4% failure was due to a variety of causes including burst piping, closed supply valves, frozen water lines, etc.

Automatic sprinklers are very effective for life safety. They signal the existence of a fire. At the same time they discharge water to the burning area. When sprinklers are installed there are rarely problems getting to the seat of the fire. They also reduce interference with visibility for fire fighting due to smoke. The downward force of the water sprayed from sprinklers lowers the smoke level in the room. The sprinklers also serve to cool the smoke. This makes it possible for persons to remain in the area much longer than they could if the room were without sprinklers.

Most standard sprinkler systems have devices that automatically give an alarm when a sprinkler head discharges water. This alarm is usually an audible signal in the building. In many cases they also give an alarm at a remote location, such as the local fire house or a central station company. The central station company monitors the entire fire protection system for water discharge and problems with the equipment. When water discharge or equipment problems are identified the local fire house is immediately notified. This allows the Fire Department to gain control of a fire as quickly as possible. Water is rarely discharged accidentally from sprinkler heads.

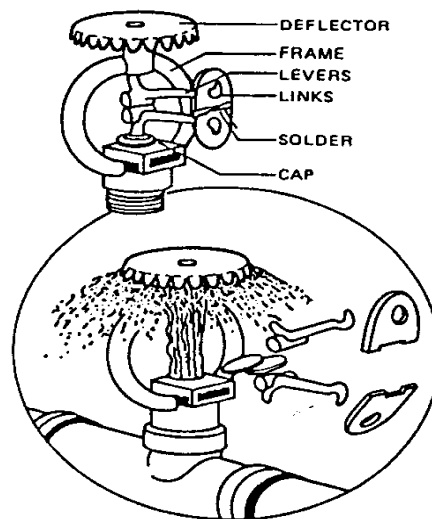
SPRINKLER HEADS

Sprinkler heads are made of metal. They are screwed into the piping at standard intervals. The water is prevented from leaving the sprinkler head by an arrangement of levers and links. The levers and links are soldered together on the sprinkler head. The solder is a metal alloy with a fixed melting point. Other types of sprinkler heads use a quartz bulb that expands and breaks under heat. Still another type uses a solid chemical held in a cylinder that is broken by heat action. The sprinkler head is designed to withstand at least 500 psi without injury or leakage. If properly installed, there is little danger of the sprinkler breaking apart unless it is damaged.

The latest type of sprinkler head is called the "cycling sprinkler". This sprinkler head cycles water on and off depending on the temperature. When the disk reaches a temperature of 165°F, the valve opens, permitting water to flow. When the disk temperature cools the valve closes to shut off the water.

Some sprinkler heads are designed to be used in special situations. Sprinkler heads exposed to corrosive conditions are often covered with a protective coat of wax, or lead. Corrosive vapors are likely to make automatic sprinklers inoperative or slow down the speed of operation. They can also seriously block the spray nozzles in the sprinkler heads. They can damage, weaken or destroy the delicate parts of the sprinkler heads. In most cases such corrosive action takes place over a long time. For this reason the sprinkler heads must be carefully watched for signs of corrosion. Care must be taken to make sure that the protective coating is not damaged when handling or replacing the heads.

A typical fusible link type sprinkler head is shown in the picture below.



A typical sprinkler head

Spray Pattern of Sprinklers: The best way to put out a fire is to spray the water from the sprinkler head downward and horizontally. The spray pattern will also prevent the spread of the fire. The force of the water against the deflector creates a heavy spray that is directed outward and downward. The shape of the deflector determines the spray pattern of the water discharged from the sprinkler head. Usually, this is an umbrella shaped spray pattern. At a distance of 4 feet below the deflector, the spray covers a circular area having a diameter of approximately 16 feet when the sprinkler is discharging 15 gpm. The newest kinds of sprinkler heads allow the sprinklers to be placed farther apart need lower flow rates to give coverage to an

area. These new heads offer more effective fire protection and are less likely to cause water damage than the old sprinkler heads.

Systems Using Large Drop Sprinklers Heads: Large drop sprinkler heads are special sprinklers designed to discharge large drops of water from the head. These sprinkler heads are used to break through the strong updrafts of high challenge fires.

Temperature Ratings of Sprinkler Heads: Automatic sprinkler heads have various temperature ratings that state the temperatures at which they will fuse. The temperature rating of all solder type automatic sprinklers is stamped on the soldered link. For other heat sensitive units, the temperature rating is stamped on one of the releasing parts. The temperature ratings of sprinkler are also indicated by a color coding system. See color codes below.

<u>Temperature Ratings</u>	<u>Color Code</u>
135° to 170°	Uncolored
175° to 225°	White
230° to 300°	Blue

In places where the temperature is normally high (e.g. boilers, ovens and drying rooms) a sprinkler head with a higher temperature rating must be used. This is to make sure that the sprinkler head does not discharge water at the wrong time. If heads with a high temperature rating are used in ordinary room (e.g., an office, an apartment, or a store) the value of the sprinkler protection is greatly reduced. This is because the temperature will have to increase much higher for the sprinkler head to open.

Sprinkler systems are excellent for controlling fires. However, they can cause water damage if they are not shut down soon after the fire has been extinguished. No control valve on the system should be closed except on the order of the fire officer in charge. Sometimes the Fire Department has a difficult time finding the control valve to shut down the system. This problem can be prevented by keeping a small sketch of the sprinkler system and the position of the control valves. This sketch should always be readily available. This sketch is very helpful to the fire fighters when they have to work with the sprinkler system.

Build up of Foreign Material on Sprinklers. Sometimes conditions exist which cause a build up of foreign material on sprinkler heads. This may prevent the sprinkler head from working properly. This build up is commonly called loading. The build of foreign material insulates the sprinkler head. This insulation prevents the sprinkler from opening at the temperature it is designed to.

If the build up is hard, it may prevent the sprinkler head from opening. The best practice is to replace loaded sprinkler heads with new sprinkler heads rather than to attempt to clean them. If the deposits are hard, attempts to clean the heads are likely to damage them. This damage may prevent the sprinkler from working properly. The damage may also cause the sprinkler head to leak.

Deposits of light dust are less serious than hard deposits. Dust build up may delay the operation of sprinkler heads. However, it will not prevent the eventual discharge of water. Dust deposits can be blown or brushed off. If a brush is used, it should be soft to avoid possible injury to sprinkler parts. Scouring or acidic liquids are likely to damage the sprinklers heads and should not be used for cleaning. Hot solutions of any kind should never be used to clean the sprinkler heads.

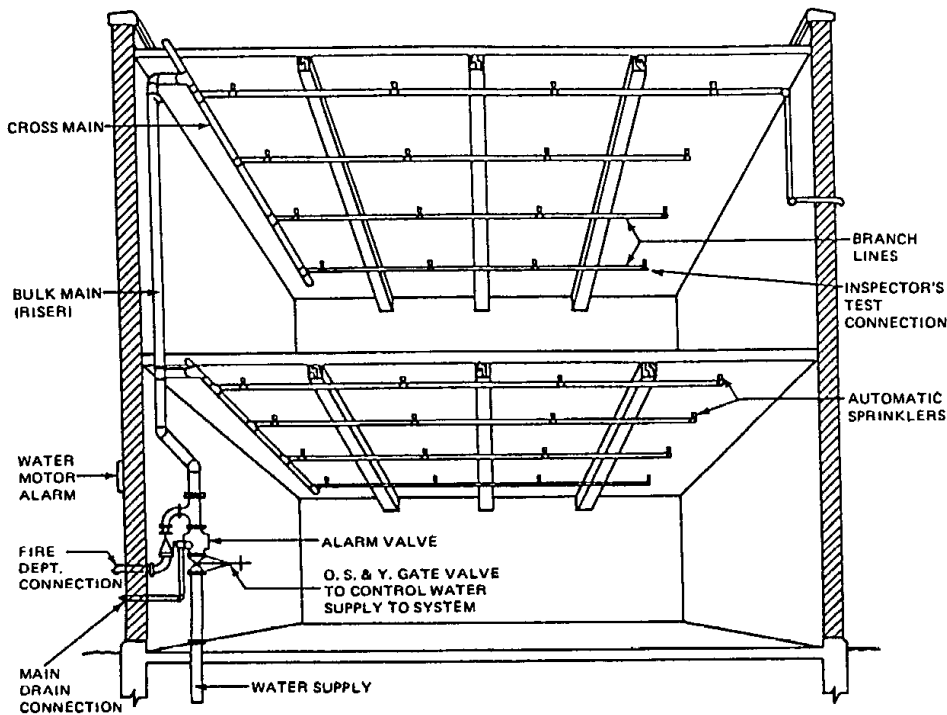
Sometimes sprinklers need to be protected when ceilings or piping are being painted. Usually a small lightweight paper bag or a sheet of lightweight paper is placed over the heads until the painting is completed. The bag or the sheet of paper should be secured with a rubber band. The bags are likely to delay the operation of the sprinklers and should be removed immediately after the painting is completed. There is no

known method to safely remove paint from under the water cap or on the fusible link. Sprinklers that have been painted other than by the manufacturer must be replaced with new units.

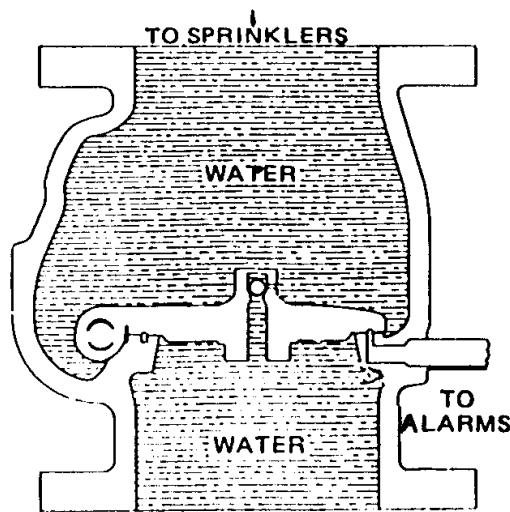
A supply of at least six extra sprinkler heads with the appropriate wrench should always be kept in a sprinkler cabinet. This extra supply should be used to promptly replace any sprinkler heads that have opened or have been damaged. The extra supply of sprinkler heads should be exactly the same as the sprinkler heads already installed in the system. It is very important that the replacement sprinkler heads have the same temperature rating as those installed in the system.

WET PIPE SPRINKLER SYSTEMS

Wet pipe systems have water in the piping at all times. This type of system is used where there is no danger of the water supply freezing. A typical wet pipe system and a typical wet pipe sprinkler valve are shown in the picture below.



A typical wet pipe system



A typical wet pipe sprinkler valve

Where temperatures drop below freezing the ordinary wet pipe system cannot be used. There are two methods for using automatic sprinkler systems in places exposed to freezing temperatures. One method is to design a system where water enters the sprinkler piping only after a control valve is opened. These are dry pipe systems, deluge systems, or preaction systems. The other method adds an antifreeze solution to the water in the wet pipe system. The antifreeze solution is a mixture of chemicals designed to prevent the water from freezing.

Antifreeze Solutions: Antifreeze is added to the water in piping exposed to freezing temperatures. When the sprinkler heads fuse the system works in the same way a wet pipe system. Antifreeze solutions are costly and may be difficult to maintain. Antifreeze is usually used for small unheated areas. Antifreeze solutions may be used only in accordance with applicable local health regulations.

Cold Weather Valves: An automatic sprinkler system should not be shut off and drained to avoid freezing during cold weather. However, parts of the sprinkler system may be shut down. Permission must be obtained from the local fire house. Permission may be given to shut off a maximum of 10 sprinklers on a wet pipe system. These shutoff valves are commonly referred to as cold weather valves.

WATER SUPPLY SOURCES FOR SPRINKLER AND STANDPIPE SYSTEMS

The sources used to supply water to sprinkler systems are the same as those for standpipe systems. Sprinkler and standpipe systems may be supplied from one or a combination of sources. For example, they may be supplied by public mains, gravity tanks, pressure tanks, reservoirs, rivers, or lakes. A single water supply would appear to be all that is needed to supply a sprinkler fire protection system. This assumes that there is enough water at an acceptable pressure. However, there are a few reasons why it is good to have a second water supply source. These reasons include: 1) a single supply source may be out of service (for maintenance or repair) during a fire emergency; 2) a single supply source may be disabled during fire or before the fire is fully extinguished; 3) the water supply source may fall below normal pressure or volume during an emergency.

In some cases it is required by law to have a second water supply source. Whether a second supply source is needed depends on several factors. These factors include the strength and reliability of the primary supply, the value of the property, the height, area and design of the building.

When a sprinkler or a standpipe system is supplied from a public water main, the entire system may be closed down by closing a control valve. This valve is located between the building and the water main in a box that is recessed into the sidewalk. The location of the box is found by reading a sign on a building or post nearby. The sign should read "**Shutoff for Sprinkler System Located 6 Feet from This Sign,**" or it will have similar instructions. A special key may be required to operate this valve.

The control valve for the building may also be attached to an upright post, known as a post indicator valve (PIV). The building or section of the building controlled by the valve is usually marked on the post. The position of this valve (open or closed) is shown through a telltale opening in the post. On some posts, a padlock must first be opened or forced to release the operating wrench. On others, an iron strap must first be released by cutting a riveted leather section.

The main water supply for sprinkler and/or standpipe systems may also be controlled by an OS&Y valve (Outside Screw and Yolk valve). The OS&Y valves are found just inside the building wall on the main riser, or outside in protected pits. It is easy to tell at a glance if the valve is open or shut. When the stem is all the way out the valve is open. When the stem is all the way in the valve is closed. Some OS&Y valves may be used to control the water supply for individual floors in a building. The OS&Y valves are also installed to shut off certain sections of an individual floor. Being able to shutoff parts of a building allows the Fire Department to have greater control over the fire protection system. When a fire is under control in an area the OS&Y valve can be closed to prevent any further water damage.

Sometimes repairs must be made to the sprinkler or standpipe system. When this happens the OS&Y valves are used to close the water supply to only those sections being repaired. This is good because the rest of the sprinkler system does not have to be shut down.

A building may have both a standpipe and a sprinkler system installed. Each system may have its own water supply source. For example, the standpipe system may be supplied by a gravity tank and the sprinkler system supplied by a pressure tank.

It is quite common for the two systems to share the same water supply source. For example, both systems may use the same gravity tank as a water supply source. The gravity tank is a limited water supply. The amount of water that is allocated to each system is regulated by local building laws.

Acceptable water supplies for the sprinkler include connection to public or private water mains, connection to fire pumps, pressure tanks, and gravity tanks. These sources may be also used in combination to supply a standpipe system. At least one of the water sources should be able to supply the standpipe or sprinkler system automatically. This supply must have the needed water volume and water pressure for the entire system. The public water works system is the most commonly used water supply source. In tall buildings the connection to the public water system may not have enough water pressure to supply the upper floors. In this situation a second supply source is often required to increase the water pressure. For example, a fire pump may be installed in a building that is more than ten stories high. The higher the building the greater the water pressure needed to supply the standpipe and/or sprinkler system.

Connections to Public Water Works System. While a connection to a reliable public water works system is the preferred primary water supply for standpipe and automatic sprinkler systems, a check valve must be installed next to the interior connection to the standpipe system. This valve makes sure that the standpipe system does not backflow into the public water supply.

Fire Pumps. The fire pump is designed to draw water from a supply source. The water is then pumped into the fire protection system under high pressure. A fire pump with both a reliable source of power and a reliable suction water supply is a desirable piece of equipment. A suction water supply is simply a source of water that the pump can draw water from. With a good water supply a fire pump can pump water into a sprinkler or standpipe system for a long time. Sometimes more than one fire pump is installed in high rise buildings. The extra fire pumps are needed to maintain the desired water pressure levels at the top floors of the buildings.

Manually started pumps may be used as a secondary supply source if the primary water supply will last long enough to allow the pump to be started. This kind of system must give an automatic waterflow signal to the Certificate of Fitness holder when the pump must be started.

Automatic fire pumps are usually installed where a high water demand may occur immediately. This demand may occur in a deluge system. An automatic fire pump is also used when someone is not always available to activate the manual pump. Automatic fire pumps must have their suction “under a positive head” to avoid delays in drawing water from the supply source. **Under positive head** means that the water supplying the pump must be fed into the fire pump under pressure. This can be achieved by connecting the fire pump to a suction tank. Water is forced into the pump by gravity. Automatic fire pumps are activated as soon as a drop of air or water pressure is noticed in the fire protection system. The drop in pressure occurs when a hoseline is opened or a sprinkler head has fused.

Gravity Tanks. Gravity tanks of adequate capacity and elevation make a good primary supply and may be acceptable as a single supply. A gravity tank may be located on the top of a building or on a tall tower. The water in the tank is distributed throughout the sprinkler or standpipe system because of the pull of gravity.

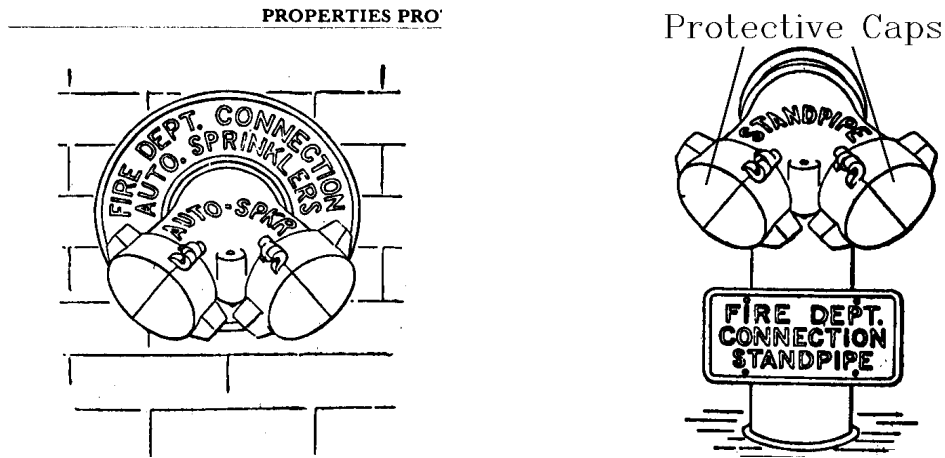
Pressure Tanks. Pressure tanks have several possible uses in automatic sprinkler or standpipe protection. Pressure tanks are often used where there is enough water from a supply source but the water pressure is too low. Pressure tanks may also be used in tall buildings that need the extra water pressure to supply the highest line of sprinklers or the highest line of hoses.

The tank is normally kept two-thirds full of water and one third full of air. The air pressure in the tank should be maintained above 75 psi. The air for pressure tanks is supplied by air compressors. Because the water is always under pressure it can be forcefully distributed throughout the sprinkler or standpipe system. An important limitation is the small amount of water that can be stored in such tanks. Where a small pressure tank is accepted as the water supply, the system is called a Limited Supply System.

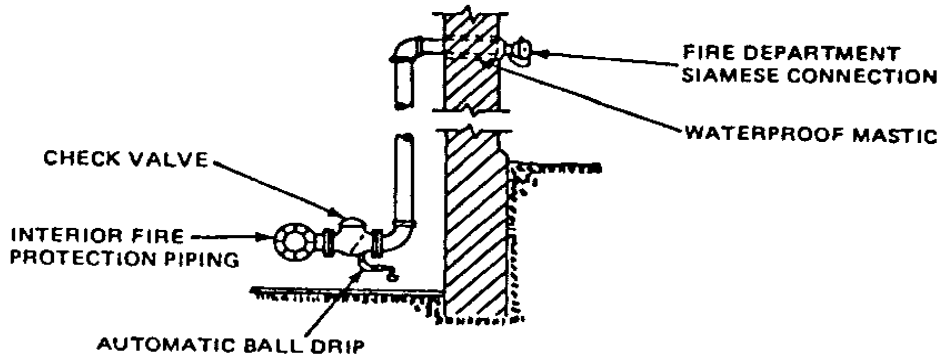
The pressure tank gives a strong starting pressure for the first sprinklers that open. The flow from the tank may be used while the automatic fire pumps begin to increase the water supply pressure. The pressure tank supplies these sprinklers until the Fire Department begins pumping water into the system

Siamese Connections for Fire Department Use. Normally a sprinkler or standpipe system is connected to an automatic water supply source. Other sources of water are supplied through Fire Department siamese connections at the building. Siamese connections are a standard part of all sprinkler and standpipe systems. At least one siamese connection must be installed in all standpipe systems. When responding to an alarm most Fire Departments supply water to the standpipe system first. The standpipe system supplies water to the fire hoses in the building. Water is then supplied to the sprinkler system through its own siamese connection. Care should be taken that standpipe and the sprinkler connections are properly marked because the connections look the same. The exact purpose of each siamese connection should be shown nearby or on the siamese connection itself. The New York Building Code requires siamese connections to be color coded. The siamese connection to an automatic sprinkler system should be painted green. The siamese connection

to non-automatic sprinkler system should be painted aluminum. The siamese connection to a standpipe should be painted red. Two examples of typical siamese connections are shown below.



Fire Department connections must always be accessible. Each connection should be fitted with a check valve, but not with a gate valve. The check valve prevents the backflow of the private water supply into the public water supply. The figure below shows the main features of a Fire Department siamese connection.



Fire Department connection

The automatic drip device between the check valve and the outside hose coupling prevents water from building up in the piping. This drip device makes sure that the Fire Department connection is not blocked by water that has frozen in the piping. If water freezes in the piping, the Fire Department will not be able to pump water into the system. Under normal conditions the automatic drip should be dry. A wet drip device indicates that the check valve may be defective. If the check valve is defective it should be replaced immediately. Many standpipe systems use the Fire Department siamese connection as the secondary water supply source.

WATERFLOW ALARMS IN SPRINKLER AND STANDPIPE SYSTEMS SUPERVISION

Sprinkler and standpipe systems should have devices and equipment for signaling when water flows through risers or mains supplying the systems. The flow may be due to fire, leakage, or accidental rupture of the piping. It is important that prompt action is taken when waterflow is noticed or signaled by these devices.

Functions of Alarms and Supervisory Signals. Sprinkler and standpipe systems with a waterflow alarm serve two functions. (1) It is an effective fire extinguishing system. (2) It is an automatic fire alarm. An alarm is signaled as soon as a sprinkler head has fused or a hose has been activated. Waterflow alarms and fire alarms give warning of the actual occurrence of a fire. They also signal when water flows through the system due to broken pipes. Alarms alert occupants and summon the Fire Department. Any signal, whether waterflow or supervisory, may be used to give an audible alarm. It may also send a signal to the central station company. The central station company will then contact the local fire house.

Supervisory devices are often connected to a central station company which monitors the sprinkler and/or standpipe systems for problems with equipment and when sprinkler heads are opened or standpipe hoses have been activated. The central station company should be notified when any control valves are closed for maintenance or repair. This reduces the number of false alarms.

Sprinkler systems are required to have an approved water motor gong or an electric bell, horn, or siren on the outside of the building. An electric bell or other audible signal device may also be located inside the building. Water operated devices must be located near the alarm valve, dry pipe valve, or other water control valves in order to avoid long runs of connecting pipe.

Devices and Equipment Supervised. Sprinkler and/or standpipe system supervision is commonly provided for several purposes. These purposes include the detection of: (1) low water level in water supply tanks, (2) low temperature in water supply tanks or ground level reservoirs, (3) high or low water level in pressure tanks, (4) high or low air pressure in pressure tanks, (5) high or low air pressure in dry pipe sprinkler systems, (6) failure of electric power supply to fire pumps, and (8) automatic operation of electric fire pumps.

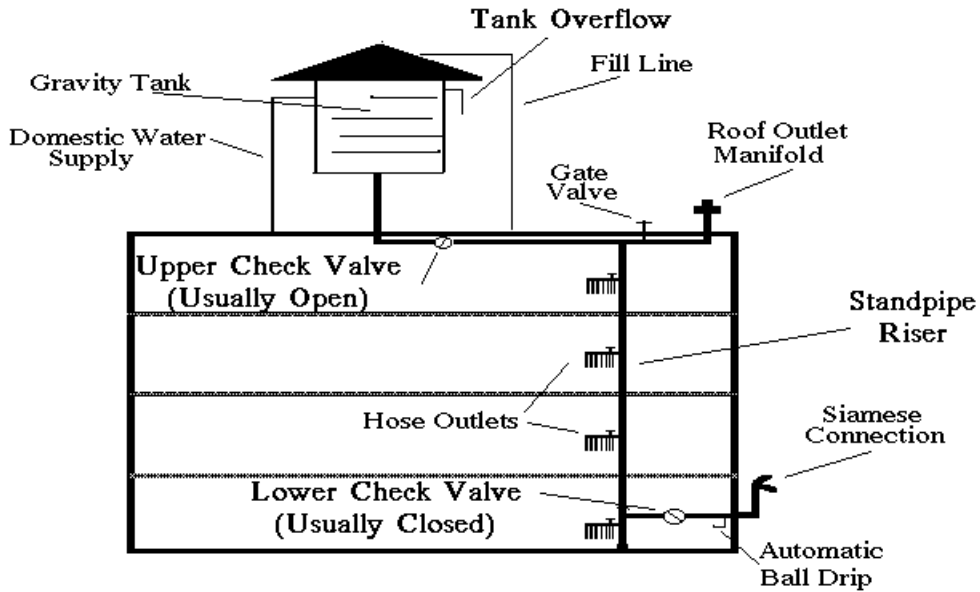
Waterflow Alarm Valves. The basic design of most waterflow alarm valves is that of a check valve which lifts from its seat when water flows into a sprinkler system. This alarm then starts an audible signal to alert the people in the building that the sprinkler system has been activated.

Alarm Retarding Devices. An alarm check valve that is exposed to changing water supply pressure needs an alarm retarding device. This is required to prevent false alarms when the check valve clapper is lifted from its seat by a temporary pressure surge.

Gate Valves. Gate valves of the non-indicating type are provided in water distribution systems. Gate valves allow parts of the sprinkler or standpipe system to be shut off for repairs or maintenance. This is done without reducing protection over a wide area. Such valves are normally a non-rising stem type. They are operated using a special key wrench. A valve box is located over the valve to keep dirt from the valve. The valve box also provides a convenient access point for the valve wrench to the valve nut. A complete record should be made for each valve in the system. This record should include the exact location, the date it was installed, the make, the direction of opening, number of turns to open, and any maintenance that was performed.

INTRODUCTION AND OVERVIEW OF STANDPIPE SYSTEMS

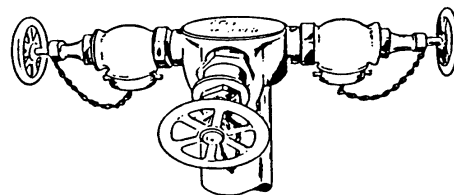
Standpipe systems are an important part of the fire protection system in a building. The standpipe system provides water that fire fighters can manually discharge through hoses onto a fire. Water is fed into a piping system. The piping runs vertically (up and down) and horizontally (side to side) throughout the building. The piping running vertically are usually called risers. The risers are usually located in the staircase enclosures or in the hallways in the building. This piping system supplies water to every floor in the building. When a standpipe system is installed and properly maintained it is a very effective means for extinguishing fires. A typical standpipe system is shown below in the illustration below.



A Typical Standpipe System

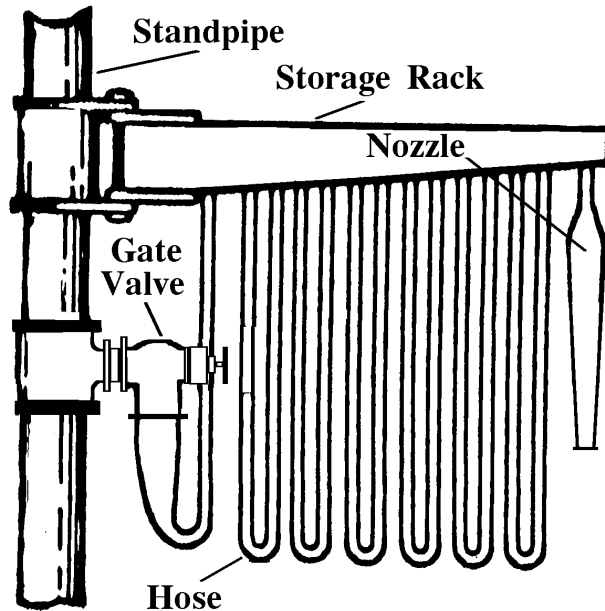
STANDPIPE DESIGN

Standpipe systems are used in buildings where it may be difficult for the Fire Department to pump water on the fire. For example, standpipe systems are required in buildings that are over six stories 75 feet in height. A standpipe system may be combined with an automatic fire protection system. For example, a standpipe system and a sprinkler system may be installed in the same building. The standpipe and the sprinkler systems may even share the same water supply and riser piping. The top of the standpipe riser extends up onto the roof. Three hose connections are attached to the top of the standpipe riser. These three connections make up the roof manifold. The roof manifold is used when extinguishing fires on the roof. It is also used when testing the water flow in the standpipe. An example of a typical roof manifold is shown in the picture below.



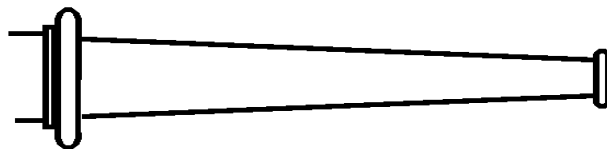
A Typical Roof Manifold

At selected locations in the building the piping is connected to a hose. These connections are controlled by gate valves. No water is allowed into the hose until the valve is opened. The gate valve must be manually opened by the fire fighter. The hose is usually stored on a quick release rack. An example of a typical quick release rack is shown below.



A Typical Fire Hose Outlet and Release Rack

A nozzle is attached at the end of the hose. The nozzle is used to direct the stream of water from the hose. An example of a typical nozzle is shown in the picture below.

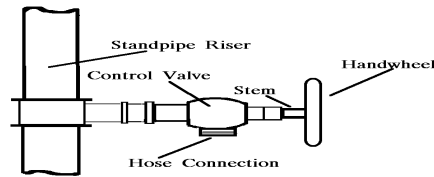


A Typical Nozzle

The hose and nozzle must be easy to reach at all times. The hose outlets are located so that every part of the building may be reached with a hose stream. The maximum length of a single hoseline is 125 feet. Sometimes the hoses are installed in cabinets. If the hoses are installed in cabinets each cabinet should be labeled "FIRE HOSE". When the hose outlets are not easy to see, signs should be posted telling where the hose outlets are located.

A pressure reducing device should be installed in the piping at each hose outlet. An occupant of the building may be injured if a hose is used when the pressure reducing device is not installed. The pressure reducing device may be adjusted or removed by Fire Department personnel during an emergency.

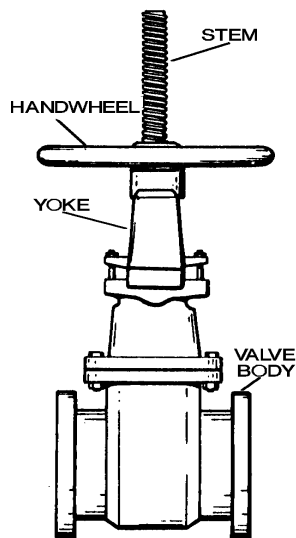
Another kind of connection to the standpipe is found in some systems. A short length of piping is welded to the riser. At the end of this pipe is a control valve and a 2 1/2 inch hose connection. No hose is installed to this connection. The Fire Department attaches its own hose to this connection when fighting a fire. An example of this kind of connection is shown below.



Fire Department Connection to a Standpipe Riser

Each standpipe system is also fitted with a drain valve. The drain valve is located at the lowest point on the standpipe system. The drain valve is used when the standpipe system is being tested or repaired. The drain valve is usually sealed in the closed position.

OS&Y (Outside Screw and Yoke) gate valves are installed at several places in the system. The OS&Y valves can be used to shut down just a part of the standpipe system. Sections may be shut down when fighting a fire. Sections are also shut down for testing, repairs or maintenance. It is easy to tell if the OS&Y valve is in the open or closed position. If the stem is raised above the control wheel the valve is open. If the stem is flush with the control wheel the valve is closed. A typical OS&Y gate valve is shown below. The valve in the picture is open.



Typical OS&Y valve

TYPES OF STANDPIPE SYSTEMS

Wet Standpipe. This system always has water in the standpipe. The water in the system is always under pressure. In some cases a fire pump may be used to increase the water pressure. The wetpipe system is the most commonly used standpipe system. It is used in heated buildings where there is no danger of the water in the piping freezing. Any part of the standpipe system that is exposed to freezing temperatures should be insulated. It is very important that the water in the piping does not freeze. Frozen water may prevent the standpipe system from working.

Dry Standpipe with an Automatic Dry Pipe Valve. This system is usually supplied by a public water main. Under normal conditions there is no water in the standpipe. Instead, there is air under pressure in the standpipe. A dry pipe valve is installed to prevent water from entering the standpipe. The dry pipe valve is designed to open when there is drop of air pressure in the standpipe. When a hose is opened it causes a drop in air pressure in the standpipe system. Then the dry pipe valve automatically lets water flow into the standpipe. A control valve is installed at the automatic water supply connection. This valve should be kept open at all times to supply the standpipe system. This system is usually installed in a building that is not heated.

Dry Standpipe with a Manual Control Valve. This system is supplied by a public water main. Under normal conditions this system has no water in the piping. The water is not allowed into the standpipe until a control valve is manually operated. The control valve remains closed until a fire occurs. This system is usually used in a building that is not heated.

Dry Standpipe with No Permanent Water Supply. Under normal conditions this system has no water in the standpipe. Water is pumped into the standpipe system by the Fire Department. The water is pumped in through the siamese connection. This system cannot be used unless water is supplied by the Fire Department. A sign must be attached to each of the hose outlets. It should read "**Dry Standpipe for Fire Department Use Only**". This system is usually used in a building that is not heated.

CLASSES OF STANDPIPES SYSTEMS

Standpipe systems are classified depending on who is expected to use the system. The three classes are briefly described below.

Class I: This system is designed to be used by professional fire fighters. For example, the system is used by Fire Department and Fire Brigade personnel. The fire hoses in these systems are 2 1/2 inches in diameter. The large hose diameter makes it difficult to control the stream of water from the hose.

Class II: This system is designed to be used by the occupants of a building. The hose and nozzle are connected to the standpipe. They are ready to be used by occupants in case of a fire. The hose is 1 1/2 inches in diameter. The hose stream is easier to control than the Class I hose.

Class III: This system may be used by either professional fire fighters or by occupants of the building. The hosing may be adjusted to either 1 1/2 or 2 1/2 inches in diameter. This is done by attaching special reducing valves to the hose line.

INSPECTION AND MAINTENANCE

The standpipe system must be regularly inspected by the Certificate of Fitness holder. This is to make sure that the system is working properly at all times. All parts of the standpipe system should be visually checked

monthly. This visual inspection should make sure that the system is free from corrosion. The inspection should also make sure that there is no physical damage to the system. Special attention should be paid to any evidence of tampering with the standpipe system. Any part of the system that is damaged or missing should be repaired or replaced immediately.

All valves and connections to the automatic water supply sources should be inspected weekly. The valves should be checked to make sure that they are in the correct position. The valves should also be labeled to show their correct position and purpose. The hose outlets should be checked to make sure that the pressure reducing devices are present. The Fire Department should be notified when any part of the system is shut down for maintenance or repairs. A sign should be posted indicating that the section is shut down. All Fire Department connections must be tested at least once every 5 years.

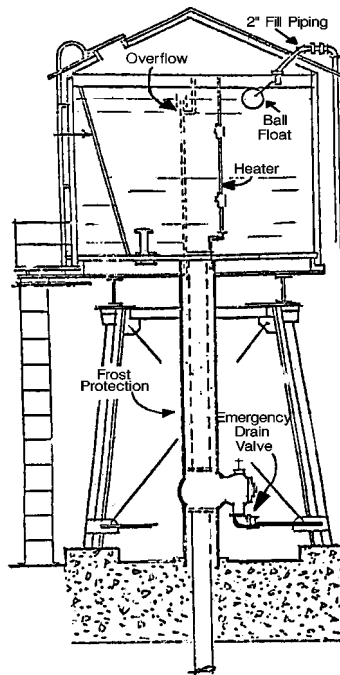
All major defects in the system should be immediately reported to the local fire house. The owner of the building and the Bureau of Fire Prevention should also be notified. Major defects include: an empty tank, a break or a leak in the system water piping, an inoperative or shut water supply valve, and a defective siamese connection. The defects should be corrected as soon as possible. A complete or partial shutdown of the standpipe system for repairs or any other reason must also be reported.

Minor defects should be reported to the owner of the building. The defects should be repaired within 30 days. If the defects are not corrected within 30 days, they must be reported to the Bureau of Fire Prevention.

The date of all inspections, maintenance and repairs made on the system must be recorded on the inspection record card. The record should also include the Certificate of Fitness number and the signature of the Certificate of Fitness holder. This record must be posted near the main control valve. All records must be kept for a period of at least one year. They should be made available to any representative of the Fire Department.

GRAVITY TANKS

Gravity tanks are used for water storage. They are made of wood, steel or concrete. Gravity tanks are used as a primary or secondary water supply source for standpipe systems. A gravity tank system delivers water from the tank through the standpipe system without the use of pumping equipment. A gravity tank should be at least 25 feet above the highest standpipe hose outlet that it supplies. Tanks may be located on the tops of buildings or raised on tall supporting towers. An example of a typical gravity tank is shown on the following page.



A Typical Gravity Tank

The water pressure in a gravity tank system depends on the elevation of the tank. This is its main advantage over other kinds of systems. Every 1 foot the tank is above the discharge outlet generates 0.434 psi (pounds per square inch) of water pressure. So in other words the higher the tank is elevated the greater the water pressure. The gravity tank is extremely reliable. It does not depend on the operation of mechanical equipment to supply the standpipe or sprinkler system.

Automatic fill pumps supply the water to most gravity tanks. The pumps fill the tank at a rate of 65 gpm (gallons per minute) or more. Two floats control the amount of water in the tank. The floats turn on the fill pump when the water in the tank is too low. The floats shut off the pump when the desired water level is reached. The floats make sure the gravity tank always has the right amount of water to supply the standpipe or sprinkler system. All gravity tanks have an overflow pipe that drains off too much water in the tank. This happens if the floats do not turn off the fill pump. A fill pump is not necessary if the water pressure in the city water main is able to keep the tank filled with the right amount of water.

Gravity tanks are exposed to very low temperatures. All parts of the gravity tank must be insulated or heated to keep the water from freezing. Several methods are used to heat the tank and the pipe that supplies the water. (1) Hot water is circulated by gravity. (2) Steam is discharged directly into tank. (3) Steam coils are placed inside the tanks. (4) Heat from the sun is used. The Certificate of Fitness holder can find out the temperature of the water by looking at a thermometer. The thermometer is located near the heating device. The tank can be severely damaged if the water inside freezes. During freezing weather, the temperature of the water inside the tank and the riser must be checked daily. The temperature of the water should always be at least 40° Fahrenheit.

Ice should not be allowed to build up on the gravity tank. The extra weight of the ice might weaken the supports of the tank and cause the tank to collapse. Falling icicles may also cause damage or injury. It is essential to be sure that the tank is properly heated, insulated and carefully maintained. The water level in the gravity tank should be inspected each month. The gravity tank should always have a full supply of water. A full tank of water is needed to be sure the standpipe system works properly during a

fire. Keeping the tank full of water also prevents wooden tanks from shrinking. A full tank of water helps keep steel tanks from rusting.

Gravity Tank Supervision

The gravity tank must be constantly monitored to be sure that the tank and its parts are working. Electrical supervision devices monitor the water temperature and the water level in the gravity tank. These devices send signals to a central station company about the water level and water temperature. The central station company notifies the Certificate of Fitness holder when a problem with the gravity tank is detected. The Certificate of Fitness holder should correct the problem as soon as possible. The supervisory devices are sometimes called high and low alarms since they also send audible signals to alert the Certificate of Fitness holder when there is a problem.

Failure of a standpipe or sprinkler system supplied by a gravity tank during a fire is usually caused by not enough water in the tank. The standpipe or sprinkler system cannot be supplied if there is not enough water in the tank. Too much water in the tank can also cause the fire protection system to fail. Too much water in the tank may cause damage due to the weight of the extra water. This could cause the gravity tank to collapse.

Inspection and Maintenance of the Gravity Tank

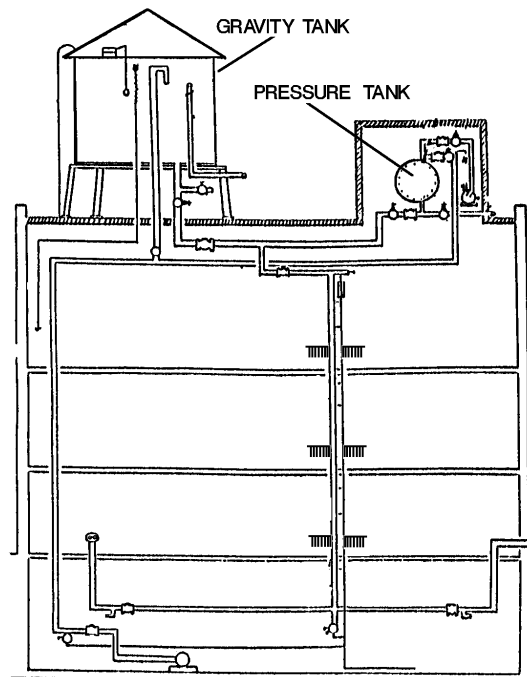
The gravity tank should be regularly inspected and maintained. Maintenance is needed to be sure that the tank functions correctly. For example, the tank may need to be painted regularly to prevent rusting. Before the inside of a gravity tank is repainted the surface should be thoroughly dried. All loose paint, rust, scale, and other surface contamination should be removed. The outside of the gravity tank will require local patching. A complete finish coat of paint is needed when the paint has weathered thin. A new coat of paint also improves the appearance of the tank after it has been patched.

Painters must be careful that scrapings or other foreign materials do not fall down the outlet into the riser piping. The discharge outlet may be covered for protection during repairs. Only a few sheets of paper or a paper bag tied over the end of the settling basin stub should be used. The paper bag should be removed immediately after the job is finished.

It is best if gravity tanks are used only for fire protection and for no other purpose. Tanks used for other purposes need to be refilled more often. The tanks become settling basins for sediment mixed in with the water. This sediment is then drawn into the piping. This may cause the standpipe system to become clogged and not work properly. The local fire house should always be notified when a tank cannot be used for any reason.

Combination Gravity Tank and Pressure Tank Installation

Pressure tanks may be used in combination with gravity tanks to supply a standpipe or sprinkler system. Both tanks may be used to make sure that an adequate water supply is available. The pressure tanks also provide added water pressure to the fire protection system. An example of a combined installation is shown on the following page.



Combination Gravity Tank and Pressure Tank Installation

FIRE PUMPS

A fire pump can be used as a primary water supply source for a standpipe or sprinkler system. They may also be used in combination with gravity tanks and pressure tanks to supply a sprinkler system. Water tanks and the Fire Department siamese connection may also be connected to the fire pump to supply water to a standpipe system. The fire pump is usually connected to the public water main for most of its water supply. Fire pumps are designed to take the water from a supply source and then discharge the water into the standpipe or sprinkler system under pressure. The pressure with which the water is discharged from the pump is called the ***total head***. The total head is usually measured in pounds per square inch (psi). The higher the psi rating of the pump the greater the pressure with which the water can be discharged. Acceptable fire pumps must deliver a minimum of at least 25 psi at the highest line of sprinkler heads or the highest line of hoses in a standpipe system.

The Centrifugal Pump

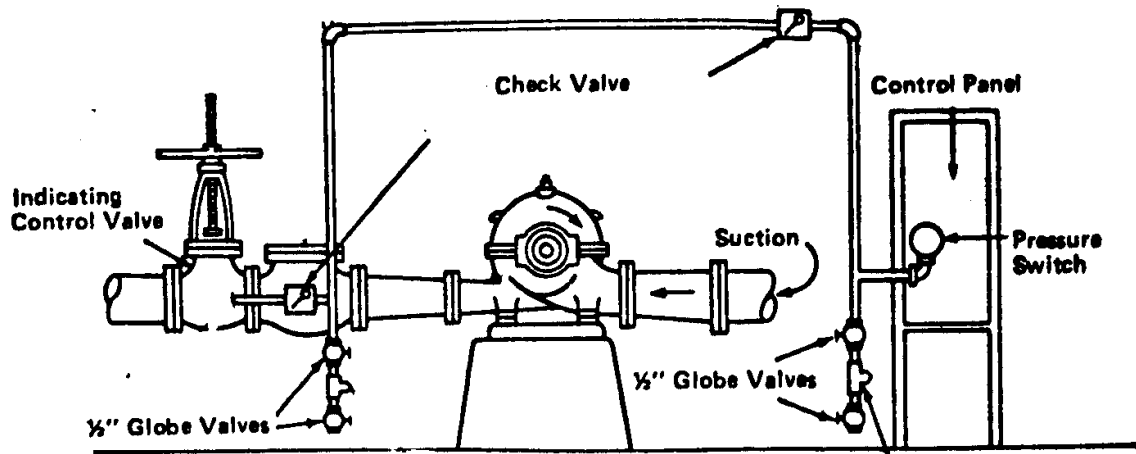
The centrifugal fire pump is the standard pump used in most fire protection systems. This is the preferred pump because it is reliable, compact, and requires little maintenance. And it can be powered by a variety of drivers including electric motors, internal combustion engines, and steam turbines.

Principles of Operation

The water available to the centrifugal pump must always be under pressure because the fire pump cannot draw water by itself from the supply source. A water tank can be used if the tank uses gravity to supply water to the pump. In other words the gravity forces the water to flow into the pump. This type of water tank is called a suction tank. The water flows from the tank through the supply inlet into the pump. As the

water passes to the center of the pump it reaches a rotating impeller. The impeller "grabs" the water on the inlet side of the pump. Then the impeller discharges the water under increased pressure into the standpipe or sprinkler system.

There are several kinds and models of centrifugal pumps. Some centrifugal pumps can discharge water from 250 gpm (gallons per minute) up to 5,000 gpm. Most centrifugal pumps have a single impeller and are therefore commonly called single stage fire pumps. A typical centrifugal pump is shown in the picture below.



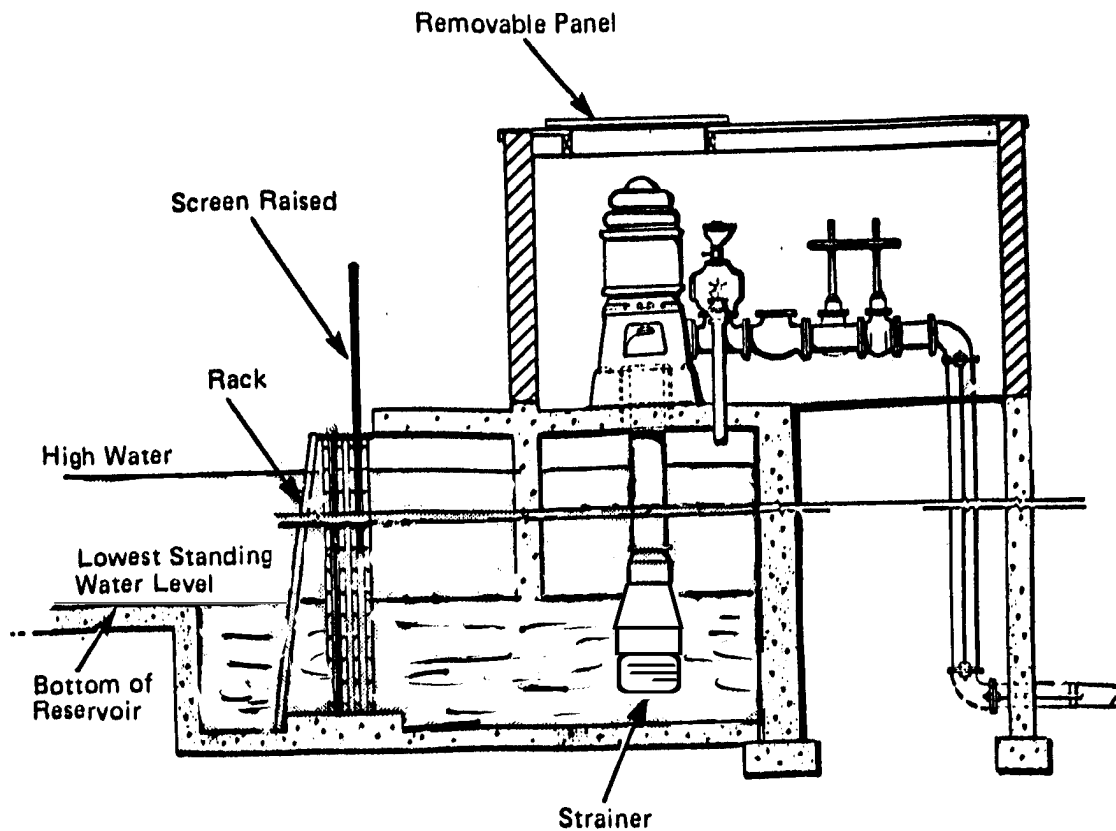
A Typical Centrifugal Pump

The Vertical Turbine Pump

The vertical turbine pump is really a modified centrifugal pump that has the capability to draw water from streams, ponds, wells etc. Unlike the standard centrifugal pump the vertical turbine pump does not need the suction supply to be under pressure for it to operate. Instead it draws the water into the pump by suction. The water is drawn into the pump. When it reaches a rotating impellers the water pressure is increased and then forcefully discharged into the fire protection system.

Although the vertical turbine pump is capable of drawing water from well it is generally not recommended to use a well as the main water supply source because it may dry up without warning. Should the well dry up it would make the fire pump useless. It is better to draw from the well and to fill a water storage tank. The fire pump should then be attached to the storage tank as it is a more reliable supply source.

It is important to inspect the water intake hose, foot valve, and the strainer regularly. Mud, gravel, leaves, or other materials could obstruct system's piping and cause damage to the pump. A vertical fire pump arrangement using a water reservoir is shown on the following page.



A Vertical Fire Pump Arrangement Using a Water Reservoir

Pump Activation

A fire pump can be started automatically or manually. The pump can be started automatically by an electric controller or an engine controller. Controllers activate the pump when there is a drop in water pressure or water flow in the fire protection system. The controllers are adjusted so that a minor drop in water pressure or minor increase in water flow due to a small leak will not activate the pumps. The controllers for the fire pumps are expensive. They require extensive maintenance and periodic testing. If an electric motor drive is used, a standby power generator is sometimes required. If an engine controller is used the appropriate fuel storage tanks should be filled and checked regularly.

When manually activated pumps are installed, they are usually used in combination with a gravity tank or a pressure tank. These tanks are designed to operate when there is a pressure drop in the fire protection system. The operation of the gravity or pressure tank and the triggering of its supervisory devices (alarms) alert the Certificate of Fitness holder that the fire pump must be activated. The Certificate of fitness holder (or another responsible individual) should then manually activate the fire pump according to manufacturer's instructions. Manually operated fire pumps are often found in industrial and manufacturing occupancies having personnel on the premises at all times.

Sometimes remote push buttons are used to activate the pump. These remote push buttons are designed to start the pump but not to stop the pump. Pumps may also have a timer installed that keeps the pump running for predetermined period of time once it is activated. This timer is designed to reduce the wear and tear on the pump and its parts due to excessive starting and stopping.

Pressure Maintenance Pumps (Jockey Pumps)

Pressure maintenance pumps, sometimes referred to as *jockey pumps*, are often found on sprinkler systems. These pumps are designed to automatically operate when there is a slight drop in pressure due to the leakage in the system or a pressure surge. The jockey pump restores the pressure in the fire protection system to the desired level. When the drop of pressure in the system is greater than the capacity of the jockey pump the fire pump is activated.

Fire Pump Location

The fire pump should be housed in a room that is fire resistant or constructed of noncombustible material. The pump room should be located as close as possible to the fire protection system. The pump room should be kept clean and accessible at all times. The fire pump, driver, and controller should be protected against possible interruption of service. The temperature inside the pump room should be maintained above 40° Fahrenheit at all times to prevent freezing of the water in the system. The pump room should only be used for fire protection functions and not for general plant operations.

Operation and Supervision

When fire pumps are activated by electric automatic controllers it is essential that they are constantly monitored to ensure the availability of the electrical power supply in case of an emergency. For this reason, supervisory devices are installed on the pumps to alert the Certificate of fitness holder and/or a central station company when there is an electrical power failure. In cases where the steam turbines or internal combustion engines are used similar supervisory devices are installed to signal when there is a problem with the controlling equipment..

Pump Inspection and Maintenance

In order to ensure the reliable operation of the pump in the case of an emergency regular inspections and maintenance should be conducted by the Certificate of Fitness holder. The pump should be activated each week according to the manufacturer's specifications to ensure that it is working properly. When the pump is in operation a small water leak is desirable and should not be considered a malfunction.

If an automatic controller operates the fire pump, the pump should be activated by reducing the water pressure in the system. This can be done by opening the test drain or initiating a large water flow from the system. By starting the fire pump this way the Certificate of fitness holder can determine if the automatic controller is working properly. Care should be taken to make sure that the pump does not overheat while conducting the test.

The centrifugal pump relies on the water supply for cooling and lubrication. The pump should never be operated without the pump being supplied with water.

A visual inspection of all parts of the pump and the controlling equipment should also be conducted each week. This inspection should include the condition and reliability of the power supply. If any problems are discovered with the equipment immediate action should be taken to correct them.

Fire pumps should be fully tested annually to make sure that the pump, driver, power supply and all other parts are working properly.

Booster Pumps

Booster pumps are sometimes used in sprinkler systems. They are small pumps with limited power and are usually located in the basement. The booster pump is used when the water pressure available at the highest sprinkler head does not quite meet the needs of the sprinkler system. This small pump increases the water pressure in the sprinkler system until it reaches acceptable levels. The Booster pump should not be confused with the fire pump or the jockey pump.

**STUDY MATERIAL FOR THE
CERTIFICATE OF FITNESS FOR
CONSOLIDATED EXAM FOR:**

F-98

**STANDPIPE SYSTEMS WITH GRAVITY TANKS
SPRINKLER SYSTEMS WITH GRAVITY TANKS
SPRINKLER SYSTEMS WITH GRAVITY TANKS
COMPLEXWIDE**

**ALSO INCLUDED IN THIS BOOKLET YOU WILL
FIND THE FOLLOWING:**

1. NOTICE OF EXAMINATION (NOE)

NOTICE OF EXAMINATION FOR

Title: Consolidated Examination for Certificate of Fitness F-98 for: Standpipe Systems with Gravity Tank (F-10), Sprinkler Systems with Gravity Tank (F-18), and Sprinkler Systems with Gravity Tank Complex-wide (F-47)

Date of Test: Written tests are conducted Monday to Friday (except legal holidays) 9:00 AM to 2:30 PM.

QUALIFICATION REQUIREMENTS

1. Applicants must be at least 18 years of age.
2. Applicants must have a reasonable understanding of the English language.
3. Applicants must present a letter of recommendation from his/her employer. The letter must be on official letterhead and must state the applicant's full name, character, physical condition, experience, and address of premises where applicant will be employed.
4. Applicants must present two (2) forms of satisfactory identification i.e., driver's license and passport picture ID.
5. Applicants must present a sketch or plan of the system they are applying for.

APPLICATION INFORMATION

Application Fees: \$25.00 for originals and \$5.00 for renewals. The fee may be paid in cash, money order, or personal check payable to New York City Fire Department. The \$25.00 fee must be payable by all applicants prior to taking the Certificate of Fitness test. Application forms are available at the Public Certification Unit, 1st floor, 9 MetroTech Center, Brooklyn, NY 11201.

TEST INFORMATION

Test: The test will be of the written, multiple choice type. A passing score of at least 70% is required in order to secure a Certificate of Fitness. Individuals with a license as a Master Fire Suppression Pipe Contractor (Dept. of Buildings) Class A or B; or as a Master Plumber (Dept. of Buildings); or a certification as a Fire Protection Engineering Technician-Automatic Sprinkler System Layout Levels II or III (NICET) or Fire Protection Engineering Technician-Special Hazards Systems Layout III or IV (NICET); or a license as a Professional Engineer (PE) or Registered Architect (RA) issued by the NYS Dept. of Education plus one year of fire protection or fire safety experience may have the written test waived. This procedure is the **Alternative Issuance Policy**. Call (718) 999-1993 for additional information and forms.

This study material, in addition to any formal courses you have taken, will help you prepare for the examination for the Certificate of Fitness for the consolidated examination for Standpipe and Sprinkler systems (F-98). The study material includes information taken from the Fire Prevention Code and the Fire Prevention Directives of the Bureau of Fire Prevention, NYFD. The study material does not contain all of the information you need to know in order to perform the job as a certificate of fitness holder under this consolidated series. In addition to other requirements of the Certificates of Fitness covered under this consolidated series it is your responsibility to become familiar with all applicable rules and regulations of the City of New York, even if they are not covered in this document.

All questions on the Certificate of Fitness examination are multiple choice, with four alternative answers to each question. Only one answer is correct for each question. If you do not answer a question or mark more than one alternative your answer will be scored as incorrect. A score of 70% correct is required on the examination in order to qualify for the Certificate of Fitness. Read each question carefully before marking your answer. There is no penalty for guessing.

Sample Questions

1. The minimum water pressure at the level of the highest sprinkler head should be:

- (A) 15 psi.
- (B) 25 psi.
- (C) 50 psi.
- (D) 100 psi.

The correct answer is "A". You would press "A" on your touch screen monitor.

2. When a gravity tank is required in a yard system the tank should be:

- (A) underground.
- (B) on the ground level.
- (C) elevated above ground level.
- (D) filled with compressed foam.

The correct answer is "C". You would press "C" on your touch screen monitor.

PROVISIONS OF THE FIRE PREVENTION CODE OF NEW YORK

All multiple dwellings, factories, office buildings, warehouses, stores and offices, theaters and music halls, and all hospitals and asylums, and all public schools and other public buildings, churches and other places where large numbers of persons are congregated for purposes of worship, instruction or amusement, and all piers, bulkheads, wharves, pier sheds, bulkhead sheds or other waterfront structures shall provide such fire hose, fire extinguishers, buckets, axes, fire hooks, fire doors and other means of preventing and extinguishing fires as the commissioner may direct.

Sprinkler systems in garment factories and factories using flammable oil for processing.

A one source automatic wet pipe sprinkler system shall be provided in every non-fireproof building in which there is a garment factory or a factory engaged in the processing of combustible fabrics with a flammable oil, and which exceeds three stories in height, and in which more than fifty persons are employed above the street floor. A flammable oil is defined as an oil that emits a flammable vapor below one hundred twenty-five degrees Fahrenheit. An automatic dry pipe sprinkler system is acceptable in place of an automatic wet pipe sprinkler system where low temperatures or other conditions would prevent the installation of a wet pipe system. The sprinkler systems shall be provided in all parts of such buildings.

Sprinkler and/or standpipe system maintenance and inspections.

1. Automatic and non-automatic sprinkler systems shall be inspected at least once a month by a competent person holding a certificate of fitness, employed by the owner, to see that all parts of the system are in perfect working order, and that the Fire Department connection or connections, if any, are ready for immediate use by the Fire Department. A detailed record of each inspection shall be kept by the Certificate of fitness holder for examination by a representative of the Fire Department.
2. A supply of at least six extra sprinkler heads with the appropriate wrench shall be kept available on the premises, to replace promptly any fused or damaged sprinklers. Any head which has opened or has been damaged shall be replaced immediately with an appropriate sprinkler head. One or more employees shall be instructed in the maintenance of sprinkler systems.
3. At least once in five years, the Fire Department connection or connections, if any, for a sprinkler and/or standpipe system shall be subjected to a hydrostatic pressure test and the standpipe system shall also be subjected to a flow and pressure test to demonstrate its suitability for Fire Department use. The test shall be conducted by the owner's representative before a representative of the Fire Department.

Maintenance and inspections of standpipe and sprinkler pumps and accessories.

Valves, hose, tools and other accessory fire fighting appliances shall be kept readily available and in good working order. Fire pumps shall be operated at least once in thirty days in a manner which will subject the standpipe system to a hydrostatic pressure of at least fifty pounds per square inch at the top story hose outlet. The qualified operator shall maintain a suitable record of his or her compliance with this requirement for inspection by the Fire Department. The installation of fire and booster pumps shall be subject to inspection and/or test in the presence of an inspector from the Bureau of Fire Prevention.

PROVISIONS OF BUREAU OF FIRE PREVENTION FIRE DIRECTIVE 4-82

Record keeping. The Certificate of fitness holder shall maintain a detailed record of all inspections. A record card with the date of each inspection, the Certificate of Fitness number, and the signature of the Certificate of fitness holder shall be posted near the main control valve.

The detailed inspection report shall include information relative to conditions of water supply, gravity and pressure tanks and levels therein, valves, risers, piping, sprinkler heads, hose valves, hoses and nozzles, siamese connections, alarms, fire pumps, obstructions, and conditions of all other system equipment and appurtenances. All defects of violations shall be noted on the report. Records should be kept for one year and be made available to any representative of the Fire Department.

Reporting of defects or violations. The Certificate of fitness holder must report all major defects immediately to:

1. the local Fire house
2. the owner or manager of the building
3. the Bureau of Fire Prevention

Major defects or violations include: empty tank, break or major leak in system water piping, inoperative or shut water supply valves; or complete or partial shut down of sprinkler and/or standpipe systems for repairs or other reason, and defective siamese connections.

Other defects or violations which are minor should be reported to the owner or manager of the building. If the defects are not corrected within 30 days, the defects should be reported in writing to the Bureau of Fire Prevention.

Failure to make inspections, maintain records, and report defects or violations may be cause for revocation of the Certificate of Fitness and court enforcement proceedings.

PROVISIONS OF THE NEW YORK BUILDING CODE

Sources of water supply for sprinkler systems.

Automatic sources of water supply for sprinkler systems include a gravity tank, pressure tank, automatic fire pump, or direct connection to the public water system. Auxiliary sources of water supply for sprinkler systems include manually activated fire pumps or siamese connections. Tanks used to provide the required primary water supply to a standpipe system may also be used as a supply for an automatic sprinkler system. Non-automatic sources of supply for sprinkler systems shall include siamese connections. Where siamese connections are installed, metal signs shall be fastened to or above the siamese connection indicating the area protected. Where the building has two or more frontages, additional metal signs shall be installed indicating the location of the siamese connection. The installation and construction of siamese connections shall be the same as required for fire standpipe systems, except that the caps of each automatic sprinkler siamese connection shall be painted green. The entire siamese connection of a non-automatic sprinkler system shall be painted aluminum. The caps of each siamese connection used for combination standpipe and sprinkler systems shall be painted yellow and signs shall be provided.

At least one automatic source of water supply shall be provided for sprinklers installed in all occupancy groups, except that:

- (a) Two automatic sources of water supply shall be provided for sprinklers in:
 - (1) Buildings classified in occupancy group A.
 - (2) Buildings classified in occupancy group C when the area on one floor exceeds twenty thousand square feet.
 - (3) Buildings classified in occupancy group F-1 when open heads are required for stages of unlimited size.
- (b) The domestic water supply may be used to supply a sprinkler system when installed in buildings classified in occupancy groups E, G, H and J. The domestic water supply may be used to supply sprinklers if all of the following conditions are met:
 - (1) The domestic water supply line from the tank or street has the required pressure (as described below).
 - (2) An O.S. & Y. valve or an approved valve having visual indication, sealed open, is installed in the sprinkler supply branch.
 - (3) The number of heads in each fire section does not exceed twenty, and no more than ten heads are supplied from any one domestic water riser.
 - (4) The connection is made at the supply or riser side of any domestic branch control valves.

Direct connection of sprinklers to the public water system.

Direct connection of sprinklers to a city water main is acceptable as an automatic water supply provided the main is capable of maintaining a pressure of at least fifteen psig at the top of the highest sprinkler riser, with five hundred gpm of water flowing from a two and one-half inch hydrant outlet located at the street level within 250 feet of the building. The size of each connection shall be as large as that of the main riser and, except in sprinkler systems in multiple dwellings, shall be at least three inches and shall be controlled by an accessible shutoff valve.

Each service shall be equipped, under the sidewalk, with a control valve in a flush sidewalk box located within two feet of the front wall of the building or street line as required by the department of environmental protection. The location of the control valve shall be indicated by a sign placed on the structure directly opposite the sidewalk flush box, and shall have a white background with one inch red letters reading: "Automatic Sprinkler Shutoff Valve ... Feet Opposite This Sign". Brass, bronze, or other metal signs with one-inch letters, raised or counter-sunk one-eighth of an inch may also be used.

Sprinkler booster pumps.

Where the pressure from the city water main is less than 15 psig as described above but is sufficient to give at least five psig at the highest line of sprinklers as determined by test, an automatic, electrically driven pump installed for the purpose of boosting or increasing the city water pressure in the sprinkler system may be accepted subject to the following requirements:

- (a) Pumps shall be of approved centrifugal type, capable of delivering at least two hundred gpm, and shall be capable of supplying twenty-five per cent of the heads, in the largest area supplied, at twenty gpm, at a pressure of at least twenty-five psig at the top of the highest sprinkler riser.
- (b) Pumps shall be maintained under approved automatic control with closed circuit supervisory attachment. The supervisory attachments shall be directly connected to an office where maintenance personnel are in attendance twenty-four hours a day; or, in lieu thereof, the supervisory attachment may be directly connected to the central station of an approved operating fire alarm company. The supervisory alarm services shall be arranged so as to provide positive indication at an approved

central office or sprinkler alarm panel board that the pump has operated or that the source of electrical supply has failed.

When sprinklers are not directly connected to the public water system and a sprinkler booster pump is not present a pressure or gravity tank shall be used.

Protection of sprinkler system.

All parts of an automatic system exposed to freezing temperatures shall be protected from freezing or in lieu thereof, an automatic drypipe system or a system filled with a nonfreezing, noncombustible solution shall be used. When a system filled with nonfreezing solution is used and the system is connected to a potable water supply, it shall be subject to the requirements of the Health Department and the Bureau of Water Supply of the Department of Environmental Protection. Sprinkler heads subject to damage shall be protected.

Inspection and tests.

(a) **Automatic wet and dry systems.** Automatic wet and dry sprinkler systems shall be subjected to a hydrostatic pressure test for a period of one hour at a pressure of at least one hundred psig at the topmost sprinkler head and at least two hundred psig at the lowest cross connection to the siamese connections.

(b) **Automatic dry pipe systems.** In addition to the hydrostatic test the automatic dry pipe systems shall also be tested to forty psig air pressure for a twenty-four hour period with the pressure loss not to exceed one and one-half psig.

(c) **Non-automatic sprinkler systems.** Non-automatic sprinkler systems shall be subjected to a hydrostatic pressure test of fifty psig at the topmost sprinkler head, with the test pressure maintained for a period of at least one hour.

(d) **Pressure tanks.** Pressure tanks shall be hydrostatically tested to a pressure of at least one and one-half times the working pressure for a period of one hour.

(e) **Sprinkler branches and heads supplied from domestic water.** Sprinkler branches and heads shall be tested at the pressure required by this section or at the pressure of the domestic water supply, whichever is greater.

PROVISIONS OF REFERENCE STANDARD RS 17-2

Chapter 2 - Water Supplies

Pumps. In light hazard occupancies with only limited ordinary hazard areas, an automatic fire pump serving the lower 300 feet of the standpipe system may be used as the primary supply to the sprinkler system, if a secondary automatic switching power supply is available to drive the pump. In hydraulically designed sprinkler systems supplied from a gravity tank, the pressure may be increased by means of an automatic, special service fire pump. The pump shall be arranged in a bypass to permit the portion of the system so supplied to be served by the system's siamese connections. If the pump is not supplied from the street side of the building service switch, the electrical service and pump operation shall be fully supervised; provided that a secondary automatic switching power supply is available to drive the pumps.

Pressure Tanks. A pressure tank in accordance with Fire Department's requirements is an acceptable water supply source. The total available quantity of water in pressure tanks need not exceed 15,000 gallons when

there is a secondary source of water supply available from a gravity tank or a street connection acceptable to the Commissioner of Buildings. The maximum gross capacity of a single pressure tank shall be 9,000 gallons.

Each tank shall be kept at a maximum of 2/3 full of water and a minimum of 1/3 full of air maintained under a minimum pressure of 75 psig. The water-to-air ratio shall be so proportioned and the tank so located that a minimum pressure of 15 psig will be available on the highest line of sprinklers below the main roof when all the water is being discharged from the tank. The tanks shall be supplied with water through a fixed pipe, independent of the sprinkler piping, and at least 2 inches in size. The water supply and connection shall be capable of supplying the tank at a rate of at least 65 gpm without reducing the pressure in the tank. The tank shall have a fixed water level plate on the end of the tank opposite the gauge glass, or equivalent devices, to indicate the level of the water in the tank.

The air compressor shall be provided with automatic controls for maintaining the air pressure. The capacity of the compressor shall be sufficient to build up the tank pressure to 75 psig within 3 hours or less. Pressure tanks shall be provided with approved closed circuit high and low water and high low air alarms. Pressure tanks shall be located at or above the top level of sprinklers.

AUTOMATIC SPRINKLER SYSTEMS

Automatic sprinkler systems are designed to automatically distribute water on a fire. The sprinkler system is designed to extinguish the fire entirely, or to prevent the spread of the fire. An automatic sprinkler system consists of a series of pipes at or near the ceiling in a building. The sprinkler system is fitted with automatic devices designed to release water on a fire. These devices are called sprinkler heads. The sprinkler heads are normally closed by a disk or cap. This cap is held in place by a heat sensitive releasing element. A rise in temperature to a predetermined heat causes the sprinkler head to open. Water is then discharged in the form of spray. When the sprinkler heads open they are said to have fused. The sprinkler heads are fitted at standard intervals on the piping. If more than one head opens, the area sprayed by each overlaps that of the sprinkler head next to it.

Sprinkler systems are required by law in various occupancies. They also may be installed voluntarily by the owner of the building. The sprinklers are installed to protect the building and its residents. The installation of sprinklers has a major effect in reducing fire losses. Statistical evidence shows that about 96% of the fires are extinguished or controlled when sprinklers are installed. The 4% failure was due to a variety of causes including burst piping, closed supply valves, frozen water lines, etc.

Automatic sprinklers are very effective for life safety. They signal the existence of a fire. At the same time they discharge water to the burning area. When sprinklers are installed there are rarely problems getting to the seat of the fire. They also reduce interference with visibility for fire fighting due to smoke. The downward force of the water sprayed from sprinklers lowers the smoke level in the room. The sprinklers also serve to cool the smoke. This makes it possible for persons to remain in the area much longer than they could if the room were without sprinklers.

Most standard sprinkler systems have devices that automatically give an alarm when a sprinkler head discharges water. This alarm is usually an audible signal in the building. In many cases they also give an alarm at a remote location, such as the local fire house or a central station company. The central station company monitors the entire fire protection system for water discharge and problems with the equipment. When water discharge or equipment problems are identified the local fire house is immediately notified. This allows the Fire Department to gain control of a fire as quickly as possible. Water is rarely discharged accidentally from sprinkler heads.

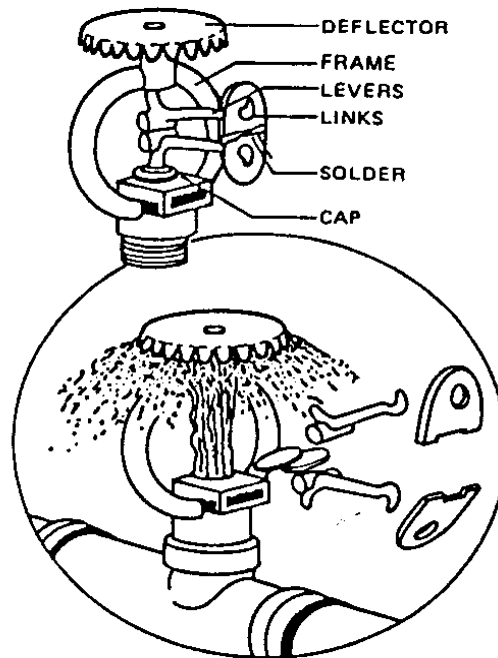
SPRINKLER HEADS

Sprinkler heads are made of metal. They are screwed into the piping at standard intervals. The water is prevented from leaving the sprinkler head by an arrangement of levers and links. The levers and links are soldered together on the sprinkler head. The solder is a metal alloy with a fixed melting point. Other types of sprinkler heads use a quartz bulb which expands and breaks under heat. Still another type uses a solid chemical held in a cylinder which is broken by heat action. The sprinkler head is designed to withstand at least 500 psi without injury or leakage. If properly installed, there is little danger of the sprinkler breaking apart unless it is damaged.

The latest type of sprinkler head is called the "cycling sprinkler". This sprinkler head cycles water on and off depending on the temperature. When the disk reaches a temperature of 165°F, the valve opens, permitting water to flow. When the disk temperature cools the valve closes to shut off the water.

Some sprinkler heads are designed to be used in special situations. Sprinkler heads exposed to corrosive conditions are often covered with a protective coat of wax, or lead. Corrosive vapors are likely to make automatic sprinklers inoperative or slow down the speed of operation. They can also seriously block the spray nozzles in the sprinkler heads. They can damage, weaken or destroy the delicate parts of the sprinkler heads. In most cases such corrosive action takes place over a long time. For this reason the sprinkler heads must be carefully watched for signs of corrosion. Care must be taken to make sure that the protective coating is not damaged when handling or replacing the heads.

A typical fusible link type sprinkler head is shown in the picture below.



A typical sprinkler head

Spray Pattern of Sprinklers: The best way to put out a fire is to spray the water from the sprinkler head downward and horizontally. The spray pattern will also prevent the spread of the fire. The force of the water against the deflector creates a heavy spray which is directed outward and downward. The shape of the

deflector determines the spray pattern of the water discharged from the sprinkler head. Usually, this is an umbrella shaped spray pattern. At a distance of 4 feet below the deflector, the spray covers a circular area having a diameter of approximately 16 feet when the sprinkler is discharging 15 gpm. The newest kinds of sprinkler heads allow the sprinklers to be placed farther apart need lower flow rates to give coverage to an area. These new heads offer more effective fire protection and are less likely to cause water damage than the old sprinkler heads.

Systems Using Large Drop Sprinklers Heads: Large drop sprinkler heads are special sprinklers designed to discharge large drops of water from the head. These sprinkler heads are used to break through the strong updrafts of high challenge fires.

Temperature Ratings of Sprinkler Heads: Automatic sprinkler heads have various temperature ratings which state the temperatures at which they will fuse. The temperature rating of all solder type automatic sprinklers is stamped on the soldered link. For other heat sensitive units, the temperature rating is stamped on one of the releasing parts. The temperature ratings of sprinkler are also indicated by a color coding system. See color codes below.

<u>Temperature Ratings</u>	<u>Color Code</u>
135° to 170°	Uncolored
175° to 225°	White
230° to 300°	Blue

In places where the temperature is normally high (e.g. boilers, ovens and drying rooms) a sprinkler head with a higher temperature rating must be used. This is to make sure that the sprinkler head does not discharge water at the wrong time. If heads with a high temperature rating are used in ordinary room (e.g., an office, an apartment, or a store) the value of the sprinkler protection is greatly reduced. This is because the temperature will have to increase much higher for the sprinkler head to open.

Sprinkler systems are excellent for controlling fires. However, they can cause water damage if they are not shut down soon after the fire has been extinguished. No control valve on the system should be closed except on the order of the fire officer in charge. Sometimes the Fire Department has a difficult time finding the control valve to shut down the system. This problem can be prevented by keeping a small sketch of the sprinkler system and the position of the control valves. This sketch should always be readily available. This sketch is very helpful to the fire fighters when they have to work with the sprinkler system.

Build up of Foreign Material on Sprinklers. Sometimes conditions exist which cause a build up of foreign material on sprinkler heads. This may prevent the sprinkler head from working properly. This build up is commonly called loading. The build of foreign material insulates the sprinkler head. This insulation prevents the sprinkler from opening at the temperature it is designed to.

If the build up is hard, it may prevent the sprinkler head from opening. The best practice is to replace loaded sprinkler heads with new sprinkler heads rather than to attempt to clean them. If the deposits are hard, attempts to clean the heads are likely to damage them. This damage may prevent the sprinkler from working properly. The damage may also cause the sprinkler head to leak.

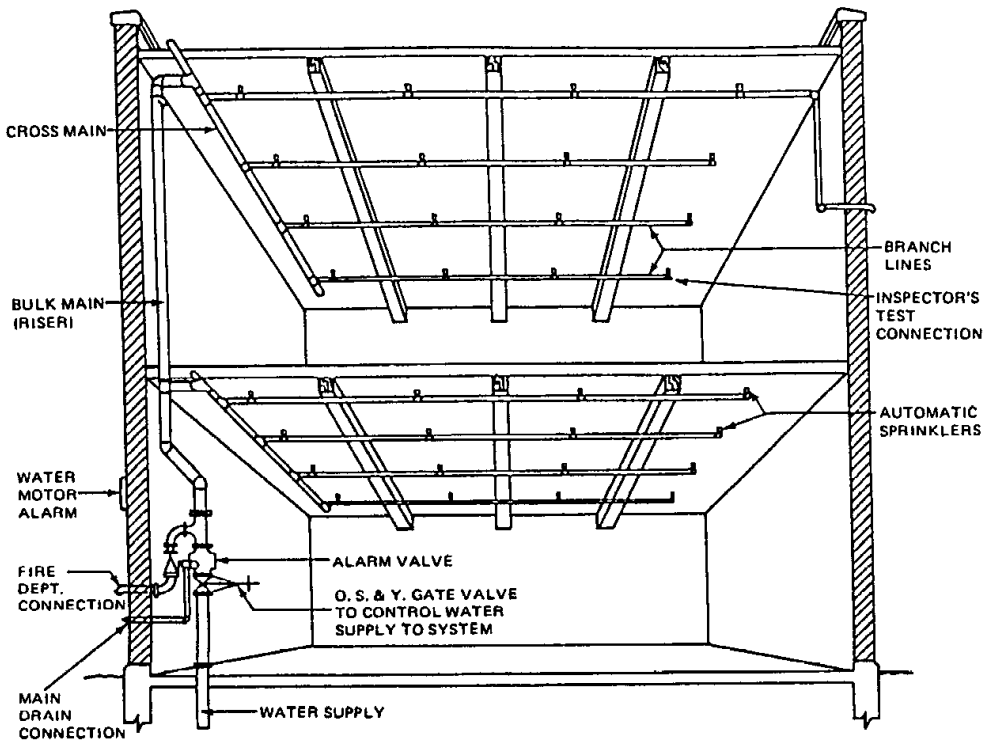
Deposits of light dust are less serious than hard deposits. Dust build up may delay the operation of sprinkler heads. However, it will not prevent the eventual discharge of water. Dust deposits can be blown or brushed off. If a brush is used, it should be soft to avoid possible injury to sprinkler parts. Scouring or acidic liquids are likely to damage the sprinklers heads and should not be used for cleaning. Hot solutions of any kind should never be used to clean the sprinkler heads.

Sometimes sprinklers need to be protected when ceilings or piping are being painted. Usually a small lightweight paper bag or a sheet of lightweight paper is placed over the heads until the painting is completed. The bag or the sheet of paper should be secured with a rubber band. The bags are likely to delay the operation of the sprinklers and should be removed immediately after the painting is completed. There is no known method to safely remove paint from under the water cap or on the fusible link. Sprinklers that have been painted other than by the manufacturer must be replaced with new units.

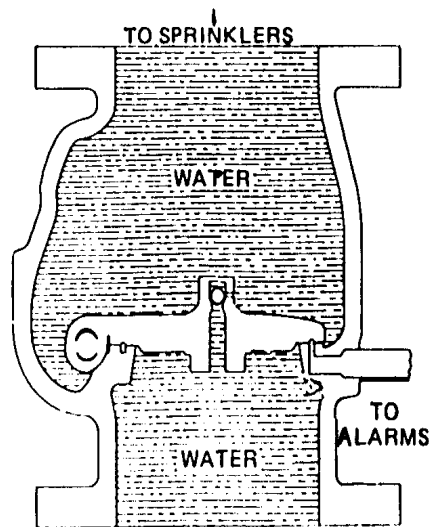
A supply of at least six extra sprinkler heads with the appropriate wrench should always be kept in a sprinkler cabinet. This extra supply should be used to promptly replace any sprinkler heads that have opened or have been damaged. The extra supply of sprinkler heads should be exactly the same as the sprinkler heads already installed in the system. It is very important that the replacement sprinkler heads have the same temperature rating as those installed in the system.

WET PIPE SPRINKLER SYSTEMS

Wet pipe systems have water in the piping at all times. This type of system is used where there is no danger of the water supply freezing. A typical wet pipe system in the picture below. A typical wet pipe sprinkler valve is shown on the following page.



A typical wet pipe system



A typical wet pipe sprinkler valve

Where temperatures drop below freezing the ordinary wet pipe system cannot be used. There are two methods for using automatic sprinkler systems in places exposed to freezing temperatures. One method is to design a system where water enters the sprinkler piping only after a control valve is opened. These are dry pipe systems, deluge systems, or preaction systems. The other method adds an antifreeze solution to the water in the wet pipe system. The antifreeze solution is a mixture of chemicals designed to prevent the water from freezing.

Antifreeze Solutions. Antifreeze is added to the water in piping exposed to freezing temperatures. When the sprinkler heads fuse the system works in the same way a wet pipe system. Antifreeze solutions are costly and may be difficult to maintain. Antifreeze is usually used for small unheated areas. Antifreeze solutions may be used only in accordance with applicable local health regulations.

Cold Weather Valves. An automatic sprinkler system should not be shut off and drained to avoid freezing during cold weather. However, parts of the sprinkler system may be shut down. Permission must be obtained from the local fire house. Permission may be given to shut off a maximum of 10 sprinklers on a wet pipe system. These shutoff valves are commonly referred to as cold weather valves.

WATER SUPPLY SOURCES FOR SPRINKLER AND STANDPIPE SYSTEMS

The sources used to supply water to sprinkler systems are the same as those for standpipe systems. Sprinkler and standpipe systems may be supplied from one or a combination of sources. For example, they may be supplied by public mains, gravity tanks, pressure tanks, reservoirs, rivers, or lakes. A single water supply would appear to be all that is needed to supply a sprinkler or a standpipe fire protection system. This assumes that there is enough water at an acceptable pressure. However, there are a few reasons why it is good to have a second water supply source. These reasons include: 1) a single supply source may be out of service (for maintenance or repair) during a fire emergency; 2) a single supply source may be disabled during a fire or before the fire is fully extinguished; 3) the water supply source may fall below normal pressure or volume during an emergency.

In some cases it is required by law to have a second water supply source. Whether a second supply source is needed depends on several factors. These factors include the strength and reliability of the primary supply, the value of the property, the height, area and design of the building.

When a sprinkler or a standpipe system is supplied from a public water main, the entire system may be closed down by closing a control valve. This valve is located between the building and the water main in a box that is recessed into the sidewalk. The location of the box is found by reading a sign on a building or post nearby. The sign should read **"Shutoff for Sprinkler System Located 6 Feet from This Sign,"** or it will have similar instructions. A special key may be required to operate this valve.

The control valve for the building may also be attached to an upright post, known as a post indicator valve (PIV). The building or section of the building controlled by the valve is usually marked on the post. The position of this valve (open or closed) is shown through a telltale opening in the post. On some posts, a padlock must first be opened or forced to release the operating wrench. On others, an iron strap must first be released by cutting a riveted leather section.

The main water supply for sprinkler and/or standpipe systems may also be controlled by an OS&Y valve (Outside Screw and Yolk valve). The OS&Y valves are found just inside the building wall on the main riser, or outside in protected pits. It is easy to tell at a glance if the valve is open or shut. When the stem is all the way out the valve is open. When the stem is all the way in the valve is closed. Some OS&Y valves may be used to control the water supply for individual floors in a building. The OS&Y valves are also installed to shut off certain sections of an individual floor. Being able to shutoff parts of a building allows the Fire Department to have greater control over the fire protection system. When a fire is under control in an area the OS&Y valve can be closed to prevent any further water damage.

Sometimes repairs must be made to the sprinkler or standpipe system. When this happens the OS&Y valves are used to close the water supply to only those sections being repaired. This is good because the rest of the sprinkler or standpipe system does not have to be shut down.

A building may have both a standpipe and a sprinkler system installed. Each system may have its own water supply source. For example, the standpipe system may be supplied by a gravity tank and the sprinkler system supplied by a pressure tank.

It is quite common for the two systems to share the same water supply source. For example, both systems may use the same gravity tank as a water supply source. The gravity tank is a limited water supply. The amount of water that is allocated to each system is regulated by local building laws.

Acceptable water supplies for the sprinkler and standpipe systems include connection to public or private water mains, connection to fire pumps, pressure tanks, and gravity tanks. These sources may be also used in combination to supply a standpipe or a sprinkler system. At least one of the water sources should be able to supply the standpipe or sprinkler system automatically. This supply must have the needed water volume and water pressure for the entire system. The public water works system is the most commonly used water supply source. In tall buildings the connection to the public water system may not have enough water pressure to supply the upper floors. In this situation a second supply source is often required to increase the water pressure. For example, a fire pump may be installed in a building that is more than ten stories high. The higher the building the greater the water pressure needed to supply the standpipe and/or sprinkler system.

Connections to Public Water Works System. While a connection to a reliable public water works system is the preferred primary water supply for standpipe and automatic sprinkler systems, a check valve must be

installed next to the interior connection to the standpipe system. This valve makes sure that the standpipe system does not backflow into the public water supply.

Fire Pumps. The fire pump is designed to draw water from a supply source. The water is then pumped into the fire protection system under high pressure. A fire pump with both a reliable source of power and a reliable suction water supply is a desirable piece of equipment. A suction water supply is simply a source of water that the pump can draw water from. With a good water supply a fire pump can pump water into a sprinkler or standpipe system for a long time. Sometimes more than one fire pump is installed in high rise buildings. The extra fire pumps are needed to maintain the desired water pressure levels at the top floors of the buildings.

Manually started pumps may be used as a secondary supply source if the primary water supply will last long enough to allow the pump to be started. This kind of system must give an automatic waterflow signal to the Certificate of fitness holder when the pump must be started.

Automatic fire pumps are usually installed where a high water demand may occur immediately. This demand may occur in a deluge system. An automatic fire pump is also used when someone is not always available to activate the manual pump. Automatic fire pumps must have their suction “under a positive head” to avoid delays in drawing water from the supply source. Under positive head means that the water supplying the pump must be fed into the fire pump under pressure. This can be achieved by connecting the fire pump to a suction tank. Water is forced into the pump by gravity. Automatic fire pumps are activated as soon as a drop of air or water pressure is noticed in the fire protection system. The drop in pressure occurs when a hoseline is opened or a sprinkler head has fused.

Gravity Tanks. Gravity tanks of adequate capacity and elevation make a good primary supply and may be acceptable as a single supply. A gravity tank may be located on the top of a building or on a tall tower. The water in the tank is distributed throughout the sprinkler or standpipe system because of the pull of gravity.

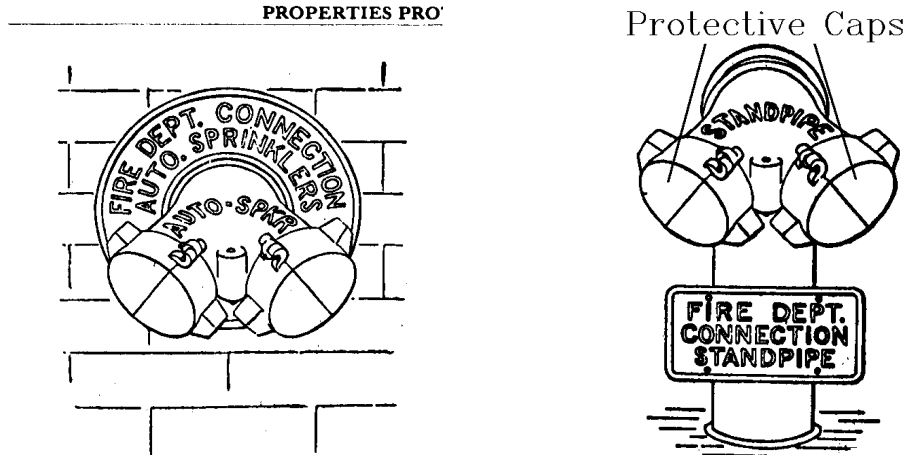
Pressure Tanks: Pressure tanks have several possible uses in automatic sprinkler or standpipe protection. Pressure tanks are often used where there is enough water from a supply source but the water pressure is too low. Pressure tanks may also be used in tall buildings that need the extra water pressure to supply the highest line of sprinklers or the highest line of hoses.

The tank is normally kept two-thirds full of water and one third full of air. The air pressure in the tank should be maintained above 75 psi. The air for pressure tanks is supplied by air compressors. Because the water is always under pressure it can be forcefully distributed throughout the sprinkler or standpipe system. An important limitation is the small amount of water that can be stored in such tanks. Where a small pressure tank is accepted as the water supply, the system is called a Limited Supply System.

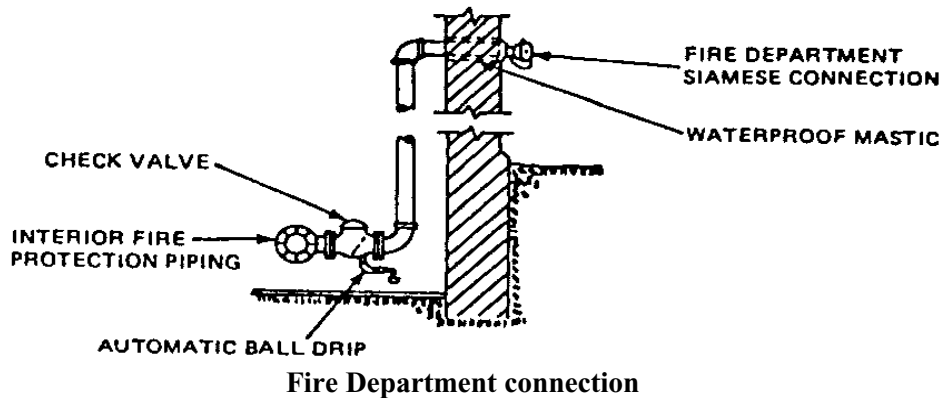
The pressure tank gives a strong starting pressure for the first sprinklers that open. The flow from the tank may be used while the automatic fire pumps begin to increase the water supply pressure. The pressure tank supplies these sprinklers until the Fire Department begins pumping water into the system

Siamese Connections for Fire Department Use. Normally a sprinkler or standpipe system is connected to an automatic water supply source. Other sources of water are supplied through Fire Department siamese connections at the building. Siamese connections are a standard part of all sprinkler and standpipe systems. At least one siamese connection must be installed in all standpipe systems. When responding to an alarm most Fire Departments supply water to the standpipe system first. The standpipe system supplies water to the fire hoses in the building. Water is then supplied to the sprinkler system through its own siamese connection. Care should be taken that standpipe and the sprinkler connections are properly marked because the connections look the same. The exact purpose of each siamese connection should be shown nearby or on

the siamese connection itself. The New York Building Code requires siamese connections to be color coded. The siamese connection to an automatic sprinkler system should be painted green. The siamese connection to non-automatic sprinkler system should be painted aluminum. The siamese connection to a standpipe should be painted red. Two examples of typical siamese connections are shown below.



Fire Department connections must always be accessible. Each connection should be fitted with a check valve, but not with a gate valve. The check valve prevents the backflow of the private water supply into the public water supply. The figure below shows the main features of a Fire Department siamese connection.



The automatic drip device between the check valve and the outside hose coupling prevents water from building up in the piping. This drip device makes sure that the Fire Department connection is not blocked by water that has frozen in the piping. If water freezes in the piping, the Fire Department will not be able to pump water into the system. Under normal conditions the automatic drip should be dry. A wet drip device indicates that the check valve may be defective. If the check valve is defective it should be replaced immediately. Many standpipe systems use the Fire Department siamese connection as the secondary water supply source.

WATERFLOW ALARMS IN SPRINKLER AND STANDPIPE SYSTEMS SUPERVISION

Sprinkler and standpipe systems should have devices and equipment for signaling when water flows through risers or mains supplying the systems. The flow may be due to fire, leakage, or accidental rupture of the piping. It is important that prompt action is taken when waterflow is noticed or signaled by these devices.

Functions of Alarms and Supervisory Signals. Sprinkler and standpipe systems with a waterflow alarm serve two functions. (1) It is an effective fire extinguishing system. (2) It is an automatic fire alarm. An alarm is signaled as soon as a sprinkler head has fused or a hose has been activated. Waterflow alarms and fire alarms give warning of the actual occurrence of a fire. They also signal when water flows through the system due to broken pipes. Alarms alert occupants and summon the Fire Department. Any signal, whether waterflow or supervisory, may be used to give an audible alarm. It may also send a signal to the central station company. The central station company will then contact the local fire house.

Supervisory devices are often connected to a central station company which monitors the sprinkler and/or standpipe systems for problems with equipment and when sprinkler heads are opened or standpipe hoses have been activated. The central station company should be notified when any control valves are closed for maintenance or repair. This reduces the number of false alarms.

Automatic sprinkler systems are required to have an approved water motor gong or an electric bell, horn, or siren on the outside of the building. An electric bell or other audible signal device may also be located inside the building. Water operated devices must be located near the alarm valve, dry pipe valve, or other water control valves in order to avoid long runs of connecting pipe.

Devices and Equipment Supervised. Sprinkler and/or standpipe system supervision is commonly provided for several purposes. These purposes include the detection of: (1) low water level in water supply tanks, (2) low temperature in water supply tanks or ground level reservoirs, (3) high or low water level in pressure tanks, (4) high or low air pressure in pressure tanks, (5) high or low air pressure in dry pipe sprinkler systems, (6) failure of electric power supply to fire pumps, and (8) automatic operation of electric fire pumps.

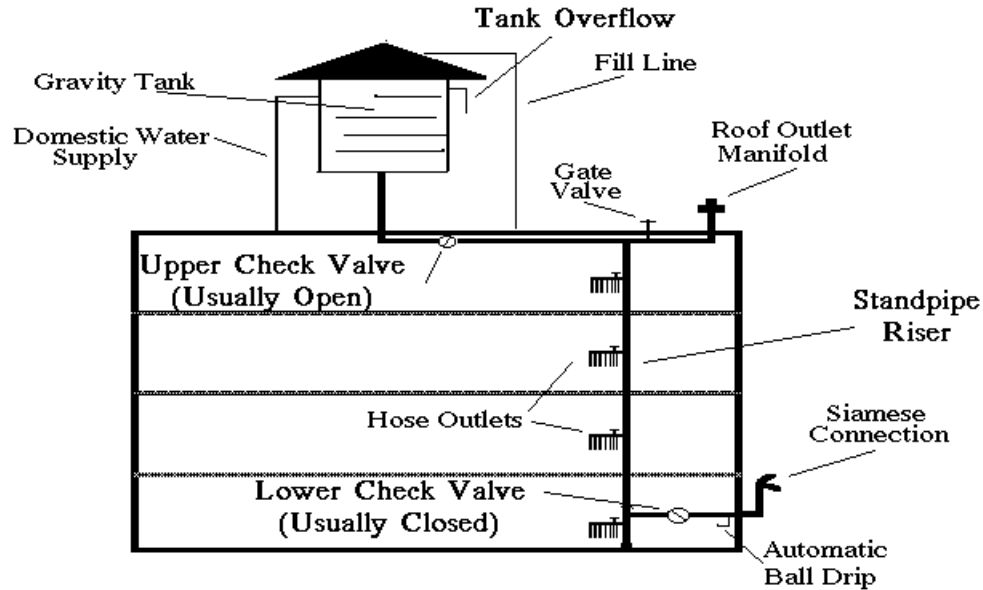
Waterflow Alarm Valves. The basic design of most waterflow alarm valves is that of a check valve which lifts from its seat when water flows into a sprinkler system. This alarm then starts an audible signal to alert the people in the building that the sprinkler system has been activated.

Alarm Retarding Devices. An alarm check valve that is exposed to changing water supply pressure needs an alarm retarding device. This is required to prevent false alarms when the check valve clapper is lifted from its seat by a temporary pressure surge.

Gate Valves. Gate valves of the non-indicating type are provided in water distribution systems. Gate valves allow parts of the sprinkler or standpipe system to be shut off for repairs or maintenance. This is done without reducing protection over a wide area. Such valves are normally a non-rising stem type. They are operated using a special key wrench. A valve box is located over the valve to keep dirt from the valve. The valve box also provides a convenient access point for the valve wrench to the valve nut. A complete record should be made for each valve in the system. This record should include the exact location, the date it was installed, the make, the direction of opening, number of turns to open, and any maintenance that was performed.

INTRODUCTION AND OVERVIEW OF STANDPIPE SYSTEMS

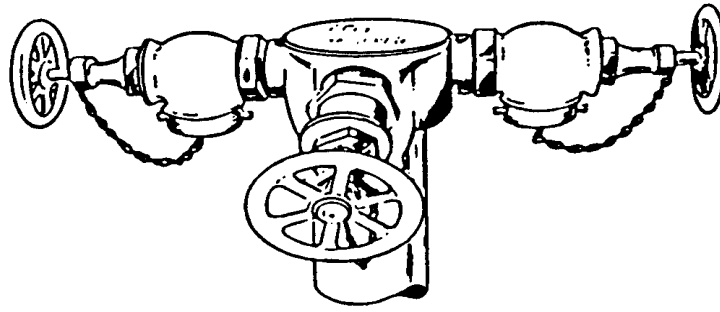
Standpipe systems are an important part of the fire protection system in a building. The standpipe system provides water that fire fighters can manually discharge through hoses onto a fire. Water is fed into a piping system. The piping runs vertically (up and down) and horizontally (side to side) throughout the building. The piping running vertically are usually called risers. The risers are usually located in the staircase enclosures or in the hallways in the building. This piping system supplies water to every floor in the building. When a standpipe system is installed and properly maintained it is a very effective means for extinguishing fires. A typical standpipe system is shown below in the illustration below.



A Typical Standpipe System

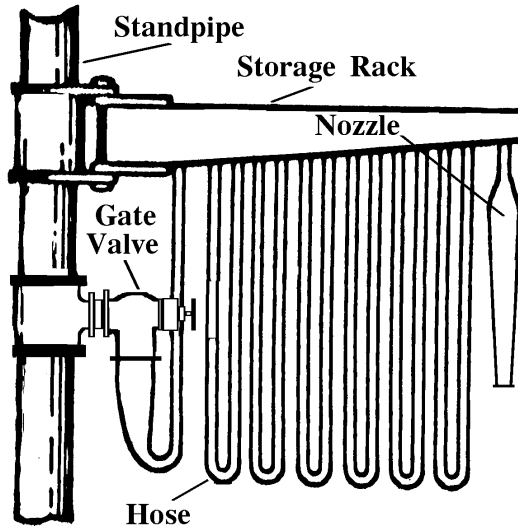
STANDPIPE DESIGN

Standpipe systems are used in buildings where it may be difficult for the Fire Department to pump water on the fire. For example, standpipe systems are required in buildings that are over six stories 75 feet in height. A standpipe system may be combined with an automatic fire protection system. For example, a standpipe system and a sprinkler system may be installed in the same building. The standpipe and the sprinkler systems may even share the same water supply and riser piping. The top of the standpipe riser extends up onto the roof. Three hose connections are attached to the top of the standpipe riser. These three connections make up the roof manifold. The roof manifold is used when extinguishing fires on the roof. It is also used when testing the water flow in the standpipe. An example of a typical roof manifold is shown in the picture on the following page.



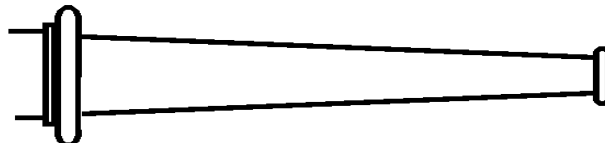
A Typical Roof Manifold

At selected locations in the building the piping is connected to a hose. These connections are controlled by gate valves. No water is allowed into the hose until the valve is opened. The gate valve must be manually opened by the fire fighter. The hose is usually stored on a quick release rack. An example of a typical quick release rack is shown below.



A Typical Fire Hose Outlet and Release Rack

A nozzle is attached at the end of the hose. The nozzle is used to direct the stream of water from the hose. An example of a typical nozzle is shown in the picture below.

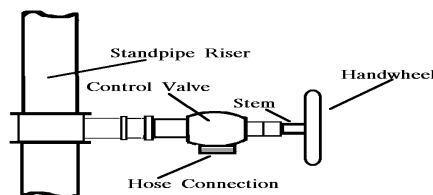


A Typical Nozzle

The hose and nozzle must be easy to reach at all times. The hose outlets are located so that every part of the building may be reached with a hose stream. The maximum length of a single hoseline is 125 feet. Sometimes the hoses are installed in cabinets. If the hoses are installed in cabinets each cabinet should be labeled "FIRE HOSE". When the hose outlets are not easy to see, signs should be posted telling where the hose outlets are located.

A pressure reducing device should be installed in the piping at each hose outlet. An occupant of the building may be injured if a hose is used when the pressure reducing device is not installed. The pressure reducing device may be adjusted or removed by Fire Department personnel during an emergency.

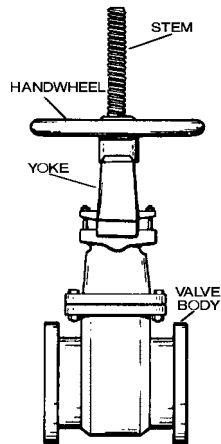
Another kind of connection to the standpipe is found in some systems. A short length of piping is welded to the riser. At the end of this pipe is a control valve and a 2 1/2 inch hose connection. No hose is installed to this connection. The Fire Department attaches its own hose to this connection when fighting a fire. An example of this kind of connection is shown in the picture below.



Fire Department Connection to a Standpipe Riser

Each standpipe system is also fitted with a drain valve. The drain valve is located at the lowest point on the standpipe system. The drain valve is used when the standpipe system is being tested or repaired. The drain valve is usually sealed in the closed position.

OS&Y (Outside Screw and Yoke) gate valves are installed at several places in the system. The OS&Y valves can be used to shut down just a part of the standpipe system. Sections may be shut down when fighting a fire. Sections are also shut down for testing, repairs or maintenance. It is easy to tell if the OS&Y valve is in the open or closed position. If the stem is raised above the control wheel the valve is open. If the stem is flush with the control wheel the valve is closed. A typical OS&Y gate valve is shown on the following page. The valve in the picture is open.



Typical OS&Y valve

TYPES OF STANDPIPE SYSTEMS

Wet Standpipe. This system always has water in the standpipe. The water in the system is always under pressure. In some cases a fire pump may be used to increase the water pressure. The wetpipe system is the most commonly used standpipe system. It is used in heated buildings where there is no danger of the water in the piping freezing. Any part of the standpipe system that is exposed to freezing temperatures should be insulated. It is very important that the water in the piping does not freeze. Frozen water may prevent the standpipe system from working.

Dry Standpipe with an Automatic Dry Pipe Valve. This system is usually supplied by a public water main. Under normal conditions there is no water in the standpipe. Instead, there is air under pressure in the standpipe. A dry pipe valve is installed to prevent water from entering the standpipe. The dry pipe valve is designed to open when there is drop of air pressure in the standpipe. When a hose is opened it causes a drop in air pressure in the standpipe system. Then the dry pipe valve automatically lets water flow into the standpipe. A control valve is installed at the automatic water supply connection. This valve should be kept open at all times to supply the standpipe system. This system is usually installed in a building that is not heated.

Dry Standpipe with a Manual Control Valve. This system is supplied by a public water main. Under normal conditions this system has no water in the piping. The water is not allowed into the standpipe until a control valve is manually operated. The control valve remains closed until a fire occurs. This system is usually used in a building that is not heated.

Dry Standpipe with No Permanent Water Supply. Under normal conditions this system has no water in the standpipe. Water is pumped into the standpipe system by the Fire Department. The water is pumped in through the siamese connection. This system cannot be used unless water is supplied by the Fire Department. A sign must be attached to each of the hose outlets. It should read "**Dry Standpipe for Fire Department Use Only**". This system is usually used in a building that is not heated.

CLASSES OF STANDPIPES SYSTEMS

Standpipe systems are classified depending on who is expected to use the system. The three classes are briefly described on the following page.

Class I: This system is designed to be used by professional fire fighters. For example, the system is used by Fire Department and Fire Brigade personnel. The fire hoses in these systems are 2 1/2 inches in diameter. The large hose diameter makes it difficult to control the stream of water from the hose.

Class II: This system is designed to be used by the occupants of a building. The hose and nozzle are connected to the standpipe. They are ready to be used by occupants in case of a fire. The hose is 1 1/2 inches in diameter. The hose stream is easier to control than the Class I hose.

Class III: This system may be used by either professional fire fighters or by occupants of the building. The hosing may be adjusted to either 1 1/2 or 2 1/2 inches in diameter. This is done by attaching special reducing valves to the hose line.

INSPECTION AND MAINTENANCE

The standpipe system must be regularly inspected by the Certificate of fitness holder. This is to make sure that the system is working properly at all times. All parts of the standpipe system should be visually checked monthly. This visual inspection should make sure that the system is free from corrosion. The inspection should also make sure that there is no physical damage to the system. Special attention should be paid to any evidence of tampering with the standpipe system. Any part of the system that is damaged or missing should be repaired or replaced immediately.

All valves and connections to the automatic water supply sources should be inspected weekly. The valves should be checked to make sure that they are in the correct position. The valves should also be labeled to show their correct position and purpose. The hose outlets should be checked to make sure that the pressure reducing devices are present. The Fire Department should be notified when any part of the system is shut down for maintenance or repairs. A sign should be posted indicating that the section is shut down. All Fire Department connections must be tested at least once every 5 years.

All major defects in the system should be immediately reported to the local fire house. The owner of the building and the Bureau of Fire Prevention should also be notified. Major defects include: an empty tank, a break or a leak in the system water piping, an inoperative or shut water supply valve, and a defective siamese connection. The defects should be corrected as soon as possible. A complete or partial shutdown of the standpipe system for repairs or any other reason must also be reported.

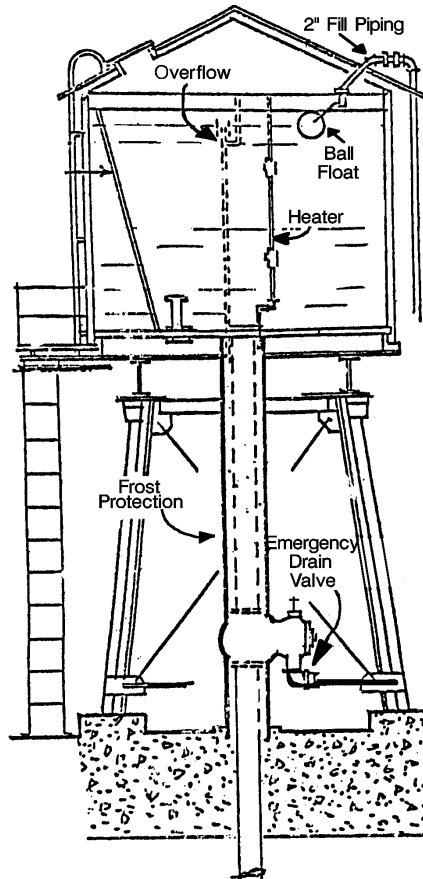
Minor defects should be reported to the owner of the building. The defects should be repaired within 30 days. If the defects are not corrected within 30 days, they must be reported to the Bureau of Fire Prevention.

The date of all inspections, maintenance and repairs made on the system must be recorded on the inspection record card. The record should also include the Certificate of Fitness number and the signature of the Certificate of fitness holder. This record must be posted near the main control valve. All records must be kept for a period of at least one year. They should be made available to any representative of the Fire Department.

GRAVITY TANKS

Gravity tanks are used for water storage. They are made of wood, steel or concrete. Gravity tanks are used as a primary or secondary water supply source for standpipe or sprinkler systems. A gravity tank system delivers water from the tank through the standpipe system without the use of pumping equipment.

A gravity tank should be at least 25 feet above the highest standpipe hose outlet or sprinkler head that it supplies. Tanks may be located on the tops of buildings or raised on tall supporting towers. An example of a typical gravity tank is shown below.



A typical Gravity Tank

The water pressure in a gravity tank system depends on the elevation of the tank. This is the main advantage over other kinds of systems. Every 1 foot the tank is above the discharge outlet generates 0.434 psi (pounds per square inch) of water pressure. In other words, the higher the tank is elevated the greater the water pressure. The gravity tank is extremely reliable. It does not depend on the operation of mechanical equipment to supply the standpipe or sprinkler system.

Automatic fill pumps supply the water to most gravity tanks. The pumps fill the tank at a rate of 65 gpm (gallons per minute) or more. Two floats control the amount of water in the tank. The floats turn on the fill pump when the water in the tank is too low. The floats shut off the pump when the desired water level is reached. The floats make sure the gravity tank always has the right amount of water to supply the standpipe or sprinkler system. All gravity tanks have an overflow pipe that drains off excess water in the tank. This

happens if the floats do not turn off the fill pump. A fill pump is not necessary if the water pressure in the city water main is able to keep the tank filled with the right amount of water.

Gravity tanks are exposed to very low temperatures. All parts of the gravity tank must be insulated or heated to keep the water from freezing. Several methods are used to heat the tank and the pipe that supplies the water. (1) Hot water is circulated by gravity. (2) Steam is discharged directly into tank. (3) Steam coils are placed inside the tanks. (4) Heat from the sun is used. The certificate of fitness holder can find out the temperature of the water by looking at a thermometer. The thermometer is located near the heating device. Severe damage can happen to the piping and the tank if the water inside freezes. During freezing weather, the temperature of the water inside the tank and the riser must be checked daily. The temperature of the water should always be at least 40° Fahrenheit.

Ice should not be allowed to build up on the gravity tank. The extra weight of the ice might weaken the supports of the tank and cause the tank to collapse. Falling icicles may also cause damage or injury. It is essential to be sure that the tank is properly heated, insulated and carefully maintained.

The water level in the gravity tank should be inspected each month. The gravity tank should always have a full supply of water. A full tank of water is needed to be sure the standpipe or sprinkler system works properly during a fire. Keeping the tank full of water also prevents wooden tanks from shrinking. A full tank of water helps keep steel tanks from rusting.

Gravity Tank Supervision

The gravity tank must be constantly monitored to be sure that the tank and its parts are working. Electrical supervision devices monitor the water temperature and the water level in the gravity tank. These devices send signals to a central station company about the water level and water temperature. The central station company notifies the certificate of fitness holder when a problem with the gravity tank is detected. The certificate of fitness holder should correct the problem as soon as possible. The supervisory devices are sometimes called high and low alarms since they also send audible signals to alert the certificate of fitness holder when there is a problem.

More often than not, failure of a standpipe or sprinkler system supplied by a gravity tank during a fire is usually caused by not enough water in the tank. The standpipe or sprinkler system cannot be supplied if there is not enough water in the tank. Too much water in the tank can also cause the system to fail. Too much water in the tank may cause damage due to the weight of the extra water. This could cause the gravity tank to collapse.

Inspection and Maintenance of the Gravity Tank

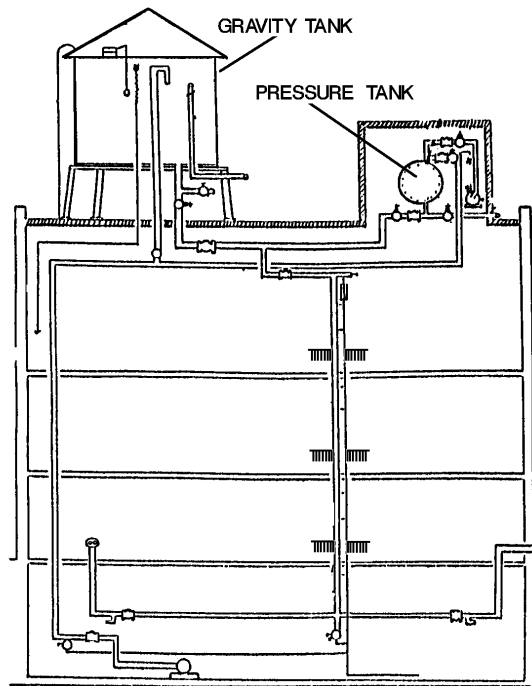
The gravity tank should be regularly inspected and maintained. Maintenance is needed to be sure that the tank functions correctly. For example, the tank may need to be painted regularly to prevent rusting. Before the inside of a gravity tank is repainted the surface should be thoroughly dried. All loose paint, rust, scale, and other surface contamination should be removed. The outside of the gravity tank will require local patching. A complete finish coat of paint is needed when the paint has weathered thin. A new coat of paint also improves the appearance of the tank after it has been patched.

Painters must be careful that scrapings or other foreign materials do not fall down the outlet into the riser or sprinkler system's piping. The discharge outlet may be covered for protection during repairs. Only a few sheets of paper or a paper bag tied over the end of the settling basin stub should be used. The paper should be removed immediately after the job is finished.

It is best if gravity tanks are used only for fire protection and for no other purpose. Tanks used for other purposes need to be refilled more often. The tanks become settling basins for sediment mixed in with the water. This sediment is then drawn into the piping. This may cause the standpipe or sprinkler system to become clogged and not work properly. The local fire house should always be notified when a tank cannot be used for any reason.

Combination Gravity Tank and Pressure Tank Installation

Pressure tanks may be used in combination with gravity tanks to supply a sprinkler or standpipe system. Both a gravity tank and a pressure tank may be used to make sure that an adequate water supply is available. Pressure tanks also provide added water pressure to the standpipe or sprinkler system. An example of a combined gravity tank/pressure tank installation for a standpipe system is shown in the picture below.



Combination Gravity Tank and Pressure Tank Installation

**STUDY MATERIAL FOR THE
CERTIFICATE OF FITNESS FOR
CONSOLIDATED EXAM FOR:**

F-99

DRY STANDPIPE SYSTEMS

STANDPIPE SYSTEMS WITH CITY MAINS

YARD HYDRANT SYSTEM

SPRINKLER SYSTEMS WITH CITY MAINS

AUTODRY SPRINKLER SYSTEMS

**SPRINKLER SYSTEMS WITH CITY MAINS
COMPLEX-WIDE**

**ALSO INCLUDED IN THIS BOOKLET YOU WILL
FIND THE FOLLOWING:**

1. NOTICE OF EXAMINATION (NOE)

NOTICE OF EXAMINATION FOR

Title: Consolidated Examination for Certificate of Fitness F-99 for: **Dry Standpipe Systems (F-09), Standpipe Systems with City Mains (F-11), Yard Hydrant Systems (F-16), Sprinkler Systems with City Mains (F-17), Autodry Sprinkler Systems (F-20), and Sprinkler Systems with City Mains Complex-wide (F-46)**

Date of Test: Written tests are conducted Monday to Friday (except legal holidays)
9:00 AM to 2:30 PM.

QUALIFICATION REQUIREMENTS

1. Applicants must be at least 18 years of age.
2. Applicants must have a reasonable understanding of the English language.
3. Applicants must present a letter of recommendation from his/her employer. The letter must be on official letterhead and must state the applicant's full name, character, physical condition, experience, and address of premises where applicant will be employed.
4. Applicants must present two (2) forms of satisfactory identification i.e., driver's license and passport picture ID.
5. Applicants must present a sketch or plan of the system they are applying for.

APPLICATION INFORMATION

Application Fees: \$25.00 for originals and \$5.00 for renewals. The fee may be paid in cash, money order, or personal check payable to New York City Fire Department. The \$25.00 fee must be payable by all applicants prior to taking the Certificate of Fitness test. Application forms are available at the Public Certification Unit, 1st floor, 9 MetroTech Center, Brooklyn, NY 11201.

TEST INFORMATION

Test: The test will be of the written, multiple choice type. A passing score of at least 70% is required in order to secure a Certificate of Fitness. Individuals with a license as a Master Fire Suppression Pipe Contractor (Dept. of Buildings) Class A or B; or as a Master Plumber (Dept. of Buildings); or a certification as a Fire Protection Engineering Technician-Automatic Sprinkler System Layout Levels II or III (NICET) or Fire Protection Engineering Technician-Special Hazards Systems Layout III or IV (NICET); or a license as a Professional Engineer (PE) or Registered Architect (RA) issued by the NYS Dept. of Education plus one year of fire protection or fire safety experience may have the written test waived. This procedure is the **Alternative Issuance Policy**. Call (718) 999-1993 for additional information and forms.

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Consolidated F-99:F09,F11,F16,F17,F20,F46 NOE.doc

This study material, in addition to any formal courses you have taken, will help you prepare for the examination for the Certificate of Fitness for the consolidated examination for Standpipe and Sprinkler systems (F-99). The study material includes information taken from the Fire Prevention Code and the Fire Prevention Directives of the Bureau of Fire Prevention, NYFD. The study material does not contain all of the information you need to know in order to perform the job as a certificate of fitness holder under this consolidated series. In addition to other requirements of the Certificates of Fitness covered under this consolidated series it is your responsibility to become familiar with all applicable rules and regulations of the City of New York, even if they are not covered in this document.

All questions on the Certificate of Fitness examination are multiple choice, with four alternative answers to each question. Only one answer is correct for each question. If you do not answer a question or mark more than one alternative your answer will be scored as incorrect. A score of 70% correct is required on the examination in order to qualify for the Certificate of Fitness. Read each question carefully before marking your answer. There is no penalty for guessing.

Sample Questions

1. The minimum water pressure at the level of the highest sprinkler head should be:

- (A) 15 psi.
- (B) 25 psi.
- (C) 50 psi.
- (D) 100 psi.

The correct answer is "A". You would press "A" on your touch screen monitor.

2. When a gravity tank is required in a yard system the tank should be:

- (A) underground.
- (B) on the ground level.
- (C) elevated above ground level.
- (D) filled with compressed foam.

The correct answer is "C". You would press "C" on your touch screen monitor.

PROVISIONS OF THE FIRE PREVENTION CODE OF NEW YORK

All multiple dwellings, factories, office buildings, warehouses, stores and offices, theaters and music halls, and all hospitals and asylums, and all public schools and other public buildings, churches and other places where large numbers of persons are congregated for purposes of worship, instruction or amusement, and all piers, bulkheads, wharves, pier sheds, bulkhead sheds or other waterfront structures shall provide such fire hose, fire extinguishers, buckets, axes, fire hooks, fire doors and other means of preventing and extinguishing fires as the commissioner may direct.

Sprinkler systems in garment factories and factories using flammable oil for processing.

A one source automatic wet pipe sprinkler system shall be provided in every non-fireproof building in which there is a garment factory or a factory engaged in the processing of combustible fabrics with a flammable oil, and which exceeds three stories in height, and in which more than fifty persons are employed above the street floor. A flammable oil is defined as an oil that emits a flammable vapor below one hundred twenty-five degrees Fahrenheit. An automatic dry pipe sprinkler system is acceptable in place of an automatic wet pipe sprinkler system where low temperatures or other conditions would prevent the installation of a wet pipe system. The sprinkler systems shall be provided in all parts of such buildings.

Sprinkler and/or standpipe system maintenance and inspections.

1. Automatic and non-automatic sprinkler systems shall be inspected at least once a month by a competent person holding a certificate of fitness, employed by the owner, to see that all parts of the system are in perfect working order, and that the Fire Department connection or connections, if any, are ready for immediate use by the Fire Department. A detailed record of each inspection shall be kept by the Certificate of Fitness Holder for examination by a representative of the Fire Department.
2. A supply of at least six extra sprinkler heads with the appropriate wrench shall be kept available on the premises, to replace promptly any fused or damaged sprinklers. Any head, which has opened or has been damaged shall be replaced immediately with an appropriate sprinkler head. One or more employees shall be instructed in the maintenance of sprinkler systems.
3. At least once in five years, the Fire Department connection or connections, if any, for a sprinkler and/or standpipe system shall be subjected to a hydrostatic pressure test and the standpipe system shall also be subjected to a flow and pressure test to demonstrate its suitability for Fire Department use. The test shall be conducted by the owner's representative before a representative of the Fire Department.

Maintenance and inspections of standpipe and sprinkler pumps and accessories.

Valves, hoses, tools and other accessory fire fighting appliances shall be kept readily available and in good working order. Fire pumps shall be operated at least once in thirty days in a manner that will subject the standpipe system to a hydrostatic pressure of at least fifty pounds per square inch at the top story hose outlet. The qualified operator shall maintain a suitable record of his or her compliance with this requirement for inspection by the Fire Department. The installation of fire and booster pumps shall be subject to inspection and/or test in the presence of an inspector from the Bureau of Fire Prevention.

PROVISIONS OF BUREAU OF FIRE PREVENTION FIRE DIRECTIVE 4-82

Record keeping. The Certificate of Fitness Holder shall maintain a detailed record of all inspections. A record card with the date of each inspection, the Certificate of Fitness number, and the signature of the Certificate of Fitness holder shall be posted near the main control valve.

The detailed inspection report shall include information relative to conditions of water supply, gravity and pressure tanks and levels therein, valves, risers, piping, sprinkler heads, hose valves, hoses and nozzles, siamese connections, alarms, fire pumps, obstructions, and conditions of all other system equipment and appurtenances. All defects or violations shall be noted on the report. Records should be kept for one year and be made available to any representative of the Fire Department.

Reporting of defects or violations. The Certificate of Fitness holder must report all major defects immediately to:

1. the local Fire house
2. the owner or manager of the building
3. the Bureau of Fire Prevention

Major defects or violations include: empty tank, break or major leak in system water piping, inoperative or shut water supply valves; or complete or partial shut down of sprinkler and/or standpipe systems for repairs or other reason, and defective siamese connections.

Other defects or violations, which are minor, should be reported to the owner or manager of the building. If the defects are not corrected within 30 days, the defects should be reported in writing to the Bureau of Fire Prevention.

Failure to make inspections, maintain records, and report defects or violations may be cause for revocation of the Certificate of Fitness and court enforcement proceedings.

PROVISIONS OF THE NEW YORK BUILDING CODE

Sources of water supply for sprinkler systems.

Automatic sources of water supply for sprinkler systems include a gravity tank, pressure tank, automatic fire pump, or direct connection to the public water system. Auxiliary sources of water supply for sprinkler systems include manually activated fire pumps or siamese connections. Tanks used to provide the required primary water supply to a standpipe system may also be used as a supply for an automatic sprinkler system. Non-automatic sources of supply for sprinkler systems shall include siamese connections. Where siamese connections are installed, metal signs shall be fastened to or above the siamese connection indicating the area protected. Where the building has two or more frontages, additional metal signs shall be installed indicating the location of the siamese connection. The installation and construction of siamese connections shall be the same as required for fire standpipe systems, except that the caps of each automatic sprinkler siamese connection shall be painted green. The entire siamese connection of a non-automatic sprinkler system shall be painted aluminum. The caps of each siamese connection used for combination standpipe and sprinkler systems shall be painted yellow and signs shall be provided.

At least one automatic source of water supply shall be provided for sprinklers installed in all occupancy groups, except that:

- (a) Two automatic sources of water supply shall be provided for sprinklers in:
 - (1) Buildings classified in occupancy group A.
 - (2) Buildings classified in occupancy group C when the area on one floor exceeds twenty thousand square feet.
 - (3) Buildings classified in occupancy group F-1 when open heads are required for stages of unlimited size.

- (b) The domestic water supply may be used to supply a sprinkler system when installed in buildings classified in occupancy groups E, G, H and J. The domestic water supply may be used to supply sprinklers if all of the following conditions are met:
 - (1) The domestic water supply line from the tank or street has the required pressure (as described below).
 - (2) An O.S. & Y. valve or an approved valve having visual indication, sealed open, is installed in the sprinkler supply branch.
 - (3) The number of heads in each fire section does not exceed twenty, and no more than ten heads are supplied from any one domestic water riser.
 - (4) The connection is made at the supply or riser side of any domestic branch control valves.

Direct connection of sprinklers to the public water system.

Direct connection of sprinklers to a city water main is acceptable as an automatic water supply provided the main is capable of maintaining a pressure of at least fifteen psig at the top of the highest sprinkler riser, with five hundred gpm of water flowing from a two and one-half inch hydrant outlet located at the street level within 250 feet of the building. The size of each connection shall be as large as that of the main riser and, except in sprinkler systems in multiple dwellings, shall be at least three inches and shall be controlled by an accessible shut-off valve.

Each service shall be equipped, under the sidewalk, with a control valve in a flush sidewalk box located within two feet of the front wall of the building or street line as required by the department of environmental protection. The location of the control valve shall be indicated by a sign placed on the structure directly opposite the sidewalk flush box, and shall have a white background with one inch red letters reading: "Automatic Sprinkler Shut-off Valve ... Feet Opposite This Sign". Brass, bronze, or other metal signs with one-inch letters, raised or counter-sunk one-eighth of an inch may also be used.

Sprinkler booster pumps.

Where the pressure from the city water main is less than 15 psig as described above but is sufficient to give at least five psig at the highest line of sprinklers as determined by test, an automatic, electrically driven pump installed for the purpose of boosting or increasing the city water pressure in the sprinkler system may be accepted subject to the following requirements:

- (a) Pumps shall be of approved centrifugal type, capable of delivering at least two hundred gpm, and shall be capable of supplying twenty-five per cent of the heads, in the largest area supplied, at twenty gpm, at a pressure of at least twenty-five psig at the top of the highest sprinkler riser.

- (b) Pumps shall be maintained under approved automatic control with closed circuit supervisory attachment. The supervisory attachments shall be directly connected to an office where maintenance personnel are in attendance twenty-four hours a day; or, in lieu thereof, the supervisory attachment may be directly connected to the central station of an approved operating fire alarm company. The supervisory alarm services shall be arranged so as to provide positive indication at

an approved central office or sprinkler alarm panel board that the pump has operated or that the source of electrical supply has failed.

When sprinklers are not directly connected to the public water system and a sprinkler booster pump is not present a pressure or gravity tank shall be used.

Protection of sprinkler system.

All parts of an automatic system exposed to freezing temperatures shall be protected from freezing or in lieu thereof, an automatic drypipe system or a system filled with a nonfreezing, noncombustible solution shall be used. When a system filled with nonfreezing solution is used and the system is connected to a potable water supply, it shall be subject to the requirements of the Health Department and the Bureau of Water Supply of the Department of Environmental Protection. Sprinkler heads subject to damage shall be protected.

Inspection and tests.

(a) **Automatic wet and dry systems.** Automatic wet and dry sprinkler systems shall be subjected to a hydrostatic pressure test for a period of one hour at a pressure of at least one hundred psig at the topmost sprinkler head and at least two hundred psig at the lowest cross connection to the siamese connections.

(b) **Automatic dry pipe systems.** In addition to the hydrostatic test the automatic dry pipe systems shall also be tested to forty psig air pressure for a twenty-four hour period with the pressure loss not to exceed one and one-half psig.

(c) **Non-automatic sprinkler systems.** Non-automatic sprinkler systems shall be subjected to a hydrostatic pressure test of fifty psig at the topmost sprinkler head, with the test pressure maintained for a period of at least one hour.

(d) **Pressure tanks.** Pressure tanks shall be hydrostatically tested to a pressure of at least one and one-half times the working pressure for a period of one hour.

(e) **Sprinkler branches and heads supplied from domestic water.** Sprinkler branches and heads shall be tested at the pressure required by this section or at the pressure of the domestic water supply, whichever is greater.

PROVISIONS OF REFERENCE STANDARD RS 17-2

Chapter 2 - Water Supplies

Pumps. In light hazard occupancies with only limited ordinary hazard areas, an automatic fire pump serving the lower 300 feet of the standpipe system may be used as the primary supply to the sprinkler system, if a secondary automatic switching power supply is available to drive the pump. In hydraulically designed sprinkler systems supplied from a gravity tank, the pressure may be increased by means of an automatic, special service fire pump. The pump shall be arranged in a bypass to permit the portion of the system so supplied to be served by the system's siamese connections. If the pump is not supplied from the street side of the building service switch, the electrical service and pump operation shall be fully supervised; provided that a secondary automatic switching power supply is available to drive the pumps.

Pressure Tanks. A pressure tank in accordance with Fire Department's requirements is an acceptable water supply source. The total available quantity of water in pressure tanks need not exceed 15,000 gallons when

there is a secondary source of water supply available from a gravity tank or a street connection acceptable to the Commissioner of Buildings. The maximum gross capacity of a single pressure tank shall be 9,000 gallons.

Each tank shall be kept at a maximum of 2/3 full of water and a minimum of 1/3 full of air maintained under a minimum pressure of 75 psig. The water-to-air ratio shall be so proportioned and the tank so located that a minimum pressure of 15 psig will be available on the highest line of sprinklers below the main roof when all the water is being discharged from the tank. The tanks shall be supplied with water through a fixed pipe, independent of the sprinkler piping, and at least 2 inches in size. The water supply and connection shall be capable of supplying the tank at a rate of at least 65 gpm without reducing the pressure in the tank. The tank shall have a fixed water level plate on the end of the tank opposite the gauge glass, or equivalent devices, to indicate the level of the water in the tank.

The air compressor shall be provided with automatic controls for maintaining the air pressure. The capacity of the compressor shall be sufficient to build-up the tank pressure to 75 psig within 3 hours or less. Pressure tanks shall be provided with approved closed circuit high and low water and high low air alarms. Pressure tanks shall be located at or above the top level of sprinklers.

AUTOMATIC SPRINKLER SYSTEMS

Automatic sprinkler systems are designed to automatically distribute water on a fire. The sprinkler system is designed to extinguish the fire entirely, or to prevent the spread of the fire. An automatic sprinkler system consists of a series of pipes at or near the ceiling in a building. The sprinkler system is fitted with automatic devices designed to release water on a fire. These devices are called sprinkler heads. The sprinkler heads are normally closed by a disk or cap. This cap is held in place by a heat-sensitive releasing element. A rise in temperature to a predetermined level causes the sprinkler head to open. Water is then discharged in the form of spray. When the sprinkler heads open they are said to have fused. The sprinkler heads are fitted at standard intervals on the piping. If more than one head opens, the area sprayed by each overlaps that of the sprinkler head next to it.

Sprinkler systems are required by law in various occupancies. They also may be installed voluntarily by the owner of the building. Sprinkler systems are installed to protect the building and its occupants. The installation of sprinkler systems has a major effect in reducing fire losses. Statistical evidence shows that about 96% of the fires are extinguished or controlled when sprinklers are installed. The 4% failure was due to a variety of causes including burst piping, closed supply valves, frozen water lines, etc.

Automatic sprinkler systems are very effective for life safety. They signal the existence of a fire. At the same time they deliver water to the burning area. When sprinkler systems are installed there are rarely problems getting to the seat of the fire. They also reduce interference with visibility for fire fighting due to smoke. The downward force of the water sprayed from sprinkler heads lowers the smoke level in the room. Sprinkler systems also serve to cool the smoke. This makes it possible for persons to remain in the area much longer than they could if the room were without sprinklers.

Most standard sprinkler systems have devices that automatically give an alarm when a sprinkler head discharges water. This alarm is usually an audible signal in the building. In many cases they also give an alarm at a remote location, such as the local fire house or a central station company. The central station company monitors the entire fire protection system for water discharge and problems with the equipment. When water discharge or equipment problems are identified the local fire house is immediately notified. This allows the Fire Department to gain control of a fire as quickly as possible. Water is rarely discharged accidentally from sprinkler heads.

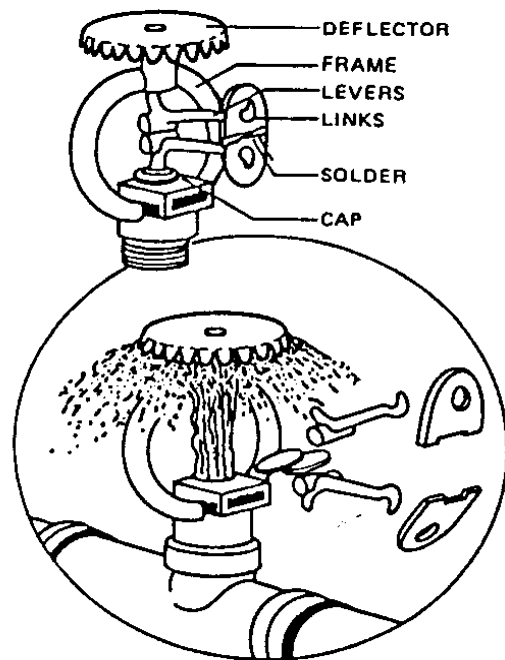
SPRINKLER HEADS

Sprinkler heads are made of metal. They are screwed into the piping at standard intervals. The water is prevented from leaving the sprinkler head by an arrangement of levers and links. The levers and links are soldered together on the sprinkler head. The solder is a metal alloy with a fixed melting point. Other types of sprinkler heads use a quartz bulb which expands and breaks under heat. Still another type uses a solid chemical held in a cylinder which is broken by heat action. The sprinkler head is designed to withstand at least 500 psi without injury or leakage. If properly installed, there is little danger of the sprinkler head breaking apart unless it is damaged.

The latest type of sprinkler head is called the "cycling sprinkler". This sprinkler head cycles water on and off depending on the temperature. When the disk reaches a temperature of 165°F, the valve opens, permitting water to flow. When the disk temperature cools the valve closes to shut off the water.

Some sprinkler heads are designed to be used in special situations. Sprinkler heads exposed to corrosive conditions are often covered with a protective coat of wax, or lead. Corrosive vapors are likely to make automatic sprinklers inoperative or slow down the speed of operation. They can also seriously block the spray nozzles in the sprinkler heads. They can damage, weaken or destroy the delicate parts of the sprinkler heads. In most cases such corrosive action takes place over a long time. For this reason the sprinkler heads must be carefully watched for signs of corrosion. Care must be taken to make sure that the protective coating is not damaged when handling or replacing the heads.

A typical fusible link type sprinkler head is shown in the picture below.



A typical sprinkler head

Spray Pattern of Sprinklers. The best way to put out a fire is to spray the water from the sprinkler head downward and horizontally. The spray pattern will also prevent the spread of the fire. The force of the water against the deflector creates a heavy spray which is directed outward and downward. The shape of the

deflector determines the spray pattern of the water discharged from the sprinkler head. Usually, this is an umbrella-shaped spray pattern. At a distance of 4 feet below the deflector, the spray covers a circular area having a diameter of approximately 16 feet when the sprinkler is discharging 15 gpm. The newest kinds of sprinkler heads allow the sprinklers to be placed farther apart needing lower flow rates to give coverage to an area. These new heads offer more effective fire protection and are less likely to cause water damage than the old sprinkler heads.

Systems Using Large Drop Sprinklers Heads. Large drop sprinkler heads are special sprinklers designed to discharge large drops of water from the head. These sprinkler heads are used to break through the strong updrafts of high challenge fires.

Temperature Ratings of Sprinkler Heads. Automatic sprinkler heads have various temperature ratings which state the temperatures at which they will fuse. The temperature rating of all solder type automatic sprinklers is stamped on the soldered link. For other heat sensitive units, the temperature rating is stamped on one of the releasing parts. The temperature ratings of sprinkler heads are also indicated by a color coding system. See color codes below.

<u>Temperature Ratings</u>	<u>Color Code</u>
135° to 170°	Uncolored
175° to 225°	White
230° to 300°	Blue

In places where the temperature is normally high (e.g. boilers, ovens and drying rooms) a sprinkler head with a higher temperature rating must be used. This is to make sure that the sprinkler head does not discharge water at the wrong time. If heads with a high temperature rating are used in ordinary rooms (e.g., an office, an apartment, or a store) the value of the sprinkler protection is greatly reduced. This is because the temperature will have to increase much higher for the sprinkler head to open.

Sprinkler systems are excellent for controlling fires. However, they can cause water damage if they are not shut down soon after the fire has been extinguished. No control valve on the system should be closed except on the order of the fire officer in charge. Sometimes the Fire Department has a difficult time finding the control valve to shut down the system. This problem can be prevented by keeping a small sketch of the sprinkler system and the position of the control valves. This sketch should always be readily available. This sketch is very helpful to the fire fighters when they have to work with the sprinkler system.

Build-up of Foreign Material on Sprinkler Heads. Sometimes conditions exist which cause a build-up of foreign material on sprinkler heads. This may prevent the sprinkler heads from working properly. This build-up is commonly called loading. The build-up of foreign material insulates the sprinkler head. This insulation prevents the sprinkler head from opening at the temperature it is designed to.

If the build-up is hard, it may prevent the sprinkler head from opening. The best practice is to replace loaded sprinkler heads with new sprinkler heads rather than to attempt to clean them. If the deposits are hard, attempts to clean the heads are likely to damage them. This damage may prevent the sprinkler heads from working properly. The damage may also cause the sprinkler heads to leak.

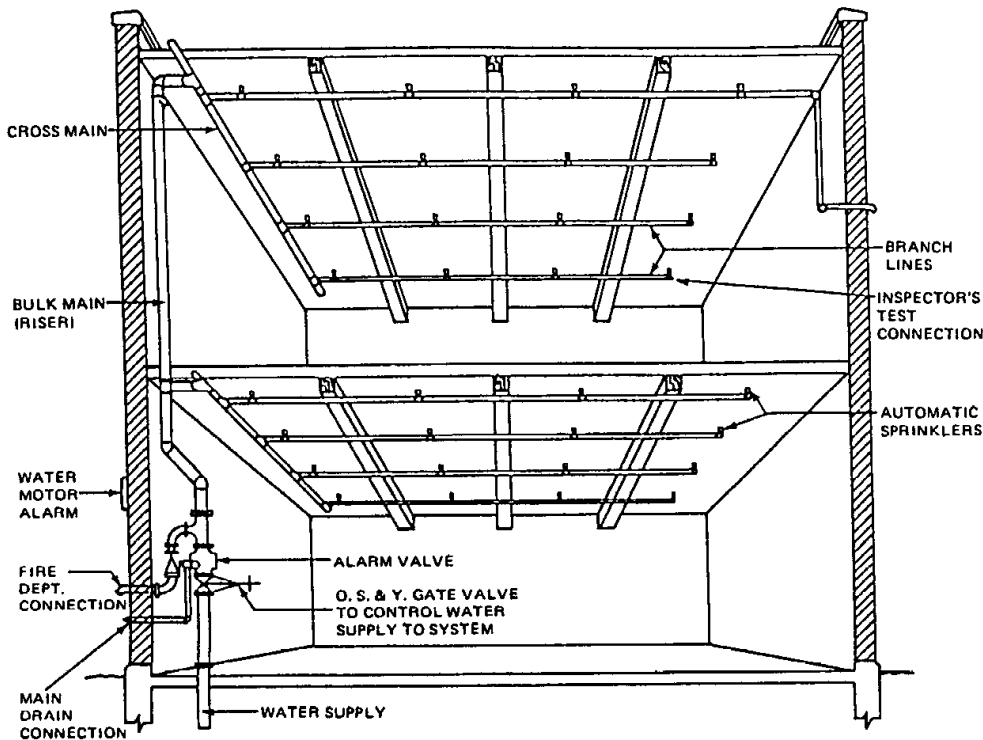
Deposits of light dust are less serious than hard deposits. Dust build-up may delay the operation of sprinkler heads. However, it will not prevent the eventual discharge of water. Dust deposits can be blown or brushed off. If a brush is used, it should be soft to avoid possible injury to sprinkler parts. Scouring or acidic liquids are likely to damage the sprinklers heads and should not be used for cleaning. Hot solutions of any kind should never be used to clean the sprinkler heads.

Sometimes sprinkler heads need to be protected when ceilings or piping are being painted. Usually a small lightweight paper bag or a sheet of lightweight paper is placed over the heads until the painting is completed. The bag or the sheet of paper should be secured with a rubber band. The bags are likely to delay the operation of the sprinkler heads and should be removed immediately after the painting is completed. There is no known method to safely remove paint from under the water cap or on the fusible link. Sprinkler heads that have been painted other than by the manufacturer must be replaced with new units.

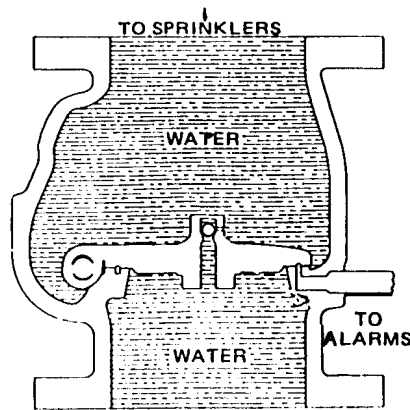
A supply of at least six extra sprinkler heads with the appropriate wrench should always be kept in a sprinkler cabinet. This extra supply should be used to promptly replace any sprinkler heads that have opened or have been damaged. The extra supply of sprinkler heads should be exactly the same as the sprinkler heads already installed in the system. It is very important that the replacement sprinkler heads have the same temperature rating as those installed in the system.

WET PIPE SPRINKLER SYSTEMS

Wet pipe sprinkler systems have water in the piping at all times. This type of system is used where there is no danger of the water supply freezing. A typical wet pipe system is shown below. A typical wet pipe sprinkler valve is shown on the following page.



A typical wet pipe system



A typical wet pipe sprinkler valve

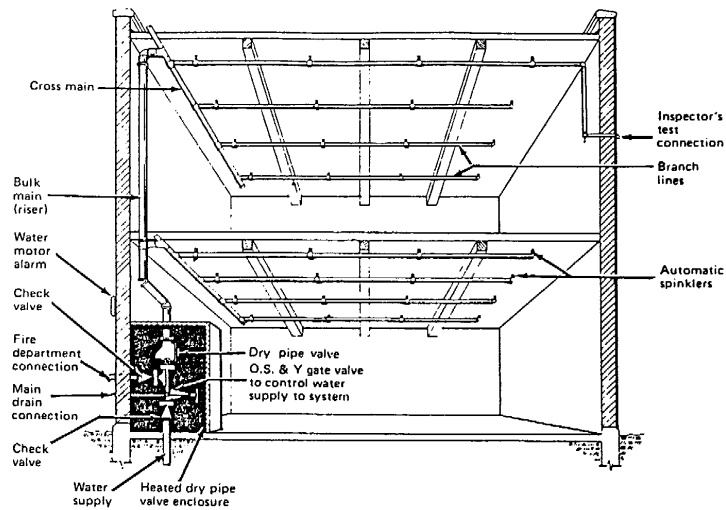
Where temperatures drop below freezing the ordinary wet pipe system cannot be used. There are two methods for using automatic sprinkler systems in places exposed to freezing temperatures. One method is to design a system where water enters the sprinkler piping only after a control valve is opened. These are dry pipe systems, deluge systems, or preaction systems. The other method adds an antifreeze solution to the water in the wet pipe system. The antifreeze solution is a mixture of chemicals designed to prevent the water from freezing.

Antifreeze Solutions. Antifreeze is added to the water in piping exposed to freezing temperatures. When the sprinkler heads fuse the system works in the same way as a wet pipe system does. Antifreeze solutions are costly and may be difficult to maintain. Antifreeze is usually used for small unheated areas. Antifreeze solutions may be used only in accordance with applicable local health regulations.

Cold Weather Valves. An automatic sprinkler system should not be shut off and drained to avoid freezing during cold weather. However, parts of the sprinkler system may be shut down. Permission must be obtained from the local fire house. Permission may be given to shut off a maximum of 10 sprinklers on a wet pipe system. These shut-off valves are commonly referred to as cold weather valves.

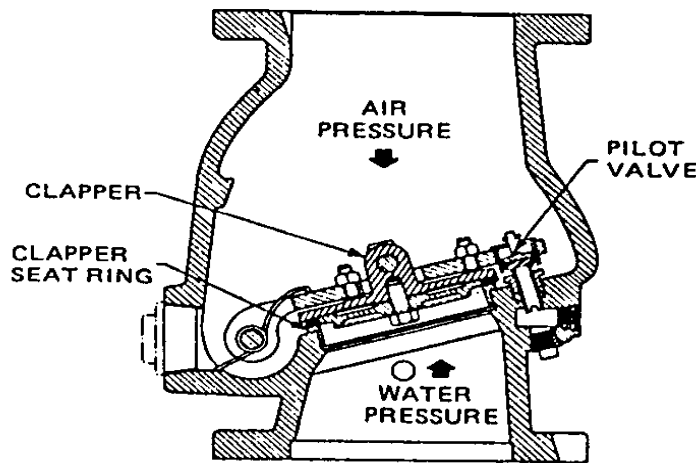
AUTO-DRY SPRINKLER AND DRY STANDPIPE SYSTEMS

Dry pipe sprinkler or dry standpipe systems are installed where wet pipe systems cannot be heated to prevent freezing. Under normal conditions there is no water in the piping. Instead the piping in the system is filled with air under pressure. The air pressure in the system is controlled automatically by an air maintenance device. The system use standard sprinkler heads or hoses and nozzles. When a sprinkler head is opened by the heat from a fire or a nozzle is manually opened, the air pressure is reduced in the piping. The drop in air pressure causes a special dry pipe valve to open. A supervisory device signals when the valve is opened. Then water flows into the piping and out of the opened sprinkler heads or out of the hoses. This water flow also sounds a local alarm to alert the occupants in the building. The alarm may also be transmitted to a central station company. The central station company will then notify the Fire Department that there is a fire. In buildings where life hazard is very high (e.g., schools, hospitals) the alarm is transmitted directly to the Fire Department. Sometimes a combination of a wet pipe and a dry pipe system may be used when part of the building cannot be heated. A typical dry pipe sprinkler system is shown on the following page.



Typical Dry Pipe System

Dry Pipe Valve Designs. These valves prevent water from flowing into the piping until a sprinkler head or a nozzle has opened. This is accomplished by installing a clapper in the dry pipe. The air pressure in the system keeps the clapper closed. When the sprinkler head or the nozzle opens it causes a drop of pressure in the piping. This causes the valve to open and allows water into system. Most dry pipe valves are designed so that a moderate air pressure in a dry pipe system will hold back a much greater water pressure. When the clapper has opened the valve is said to have tripped. A picture of a typical dry pipe valve is shown below.



A Typical Clapper Type Dry Valve

Higher than normal water pressure or a water hammer may cause the dry valve to trip by accident. Water hammer is caused by a sudden flow of water or a sudden change of water pressure in the system. To reduce this danger, air pressure is usually kept well above the normal trip point. The air pressure is usually set at 15 to 20 psi (pounds per square inch) above the normal trip level. Some valves are specially designed for low pressures. In this case the manufacturer's instructions regarding pressures should be followed.

Quick Opening Devices. In a dry pipe system there is a delay between the opening of a sprinkler head or a standpipe nozzle and the discharge of water. This delay may allow the fire to spread and more sprinkler heads or nozzles to open. The delay is due to the time required for the air to leave the system's piping. This difficulty may be partly overcome by the installation of quick opening devices.

Two devices are used to reduce the time needed to open the clapper and allow water into the system. These devices are an accelerator and an exhaustor. They are both automatically activated when a drop of 2 psi in air pressure is noticed in the system. They quickly change the water and air pressure balance in the system. This change trips the dry pipe valve allowing the water to force its way through the sprinkler piping in less time. The failure of an accelerator or exhaustor to operate does not prevent normal tripping of a dry pipe valve.

Special care must be taken when using a dry standpipe system. The nozzle must never be pointed at the fire until all of the air has been drained from the system. Otherwise, pressurized air would be discharged onto the fire. This would cause the fire to burn more intensely.

The following sprinkler systems are similar to the basic design of the dry pipe sprinkler system. These are called Preaction, Deluge and Non-automatic sprinkler systems. Unlike the dry pipe system they do not have pressurized air in the piping.

PREACTION SPRINKLER SYSTEMS

Preaction systems are designed for situations where there is danger of serious water damage. Water damage is usually caused by damaged sprinklers or broken piping. There is no water in the piping under normal conditions. The air in the piping is not under pressure. A preaction valve prevents the water from entering the system. The valve is automatically opened when a fire detection system discovers that there is a fire. This valve is tripped by the fire detection system before any of the sprinkler heads open. A supervisory device signals when the valve is opened. The preaction valve can also be operated manually.

The preaction system has several advantages over a dry pipe system. The preaction valve opens sooner because the fire detectors react to heat changes faster than sprinkler heads. Fire and water damage is decreased because water is sprayed on the fire more quickly and the alarm is given as soon as the preaction valve is opened. Because the sprinkler piping is normally dry, preaction systems are nonfreezing.

Heat responsive devices are commonly used to trip preaction valves. These devices are also used to activate alarm and supervisory systems. There are three main devices used to trip preaction valves: (1) devices designed to operate at a fixed temperature; (2) devices designed to operate when the temperature in the room increases a set amount in a given time period (rate-of-rise), and (3) devices combining fixed temperature and rate of rise devices. Other ways to activate a preaction valve are smoke detectors, gas detecting systems and automatic signals from other safety systems.

Alarms are standard accessory equipment on water control valves. They provide an audible signal in the building if the valve operates for any reason. An alarm is also sent out if a problem is discovered with the equipment. The alarms send a signal to a central station company or a public fire alarm system. Often the signal is sent to both the central station company and the public alarm.

Preaction System with a Recycling Feature. A special kind of preaction system is a recycling system for controlling sprinklers. This system shuts off the water when the fire has been put out or the heat drops. If the fire rekindles or the heat rises sharply, water is discharged again. The system continues cycling on and off as long as the fire persists.

Combined Dry Pipe and Preaction Systems. These systems have the basic features of both types of systems. The piping system contains air under pressure. A heat detecting device opens the water control valve and a quick opening device. The system then fills with water and operates as a wet pipe system. If the heat detecting system fails, the system will operate as a standard dry pipe system.

DELUGE SPRINKLER SYSTEMS

A deluge sprinkler system is designed to wet down an entire area in the case of a fire. This system is needed when there is danger of a fire rapidly spreading throughout the building. The deluge system will slow down the spread of the fire. Deluge systems are suitable for hazardous occupancies. This includes buildings in which flammable liquids or other hazardous materials are handled or stored.

The sprinkler heads in the deluge system are open at all times. Under normal conditions there is no water in the piping. The air in the piping is not under pressure. A closed control valve prevents water from flowing into the system. A fire detection device automatically opens the control valve when a fire is identified. A supervisory device signals when the valve is opened. When the valve is opened water flows into the system. The water is then sprayed out all of the sprinkler heads. The water control valve may also be opened manually.

Open and closed sprinkler heads may be used together in a single system. This is usually done where deluge protection is not needed over the entire area.

NON-AUTOMATIC SPRINKLER SYSTEMS

In this type of system all pipes are normally dry. Water is supplied when needed by pumping water into the system through the siamese connection. Some of these systems are supplied by manual operation of a water control valve.

There are several non-automatic systems. (1) Perforated pipe systems. These have a single line of piping drilled at intervals for water discharge. These systems are usually found in basements or other areas difficult to reach in fire fighting operations. (2) Open fixed spray nozzles for transformer vaults or other hazardous areas. (3) Exterior exposure sprinklers (or window sprinklers) use open sprinkler heads to form an external water curtain on the walls of a building. (4) Foam supply systems are used for the protection of special hazardous occupancies.

WATER SUPPLY SOURCES FOR SPRINKLER AND STANDPIPE SYSTEMS

The sources used to supply water to sprinkler systems are the same as those for standpipe systems. Sprinkler and standpipe systems may be supplied from one or a combination of sources. For example, they may be supplied by public mains, gravity tanks, pressure tanks, reservoirs, rivers, or lakes. A single water supply would appear to be all that is needed to supply a sprinkler or a standpipe fire protection system. This assumes that there is enough water at an acceptable pressure. However, there are a few reasons why it is good to have a second water supply source. These reasons include: 1) a single supply source may be out of service (for repair or maintenance) during a fire emergency; 2) a single supply source may be disabled during a fire or before the fire is fully extinguished; 3) the water supply source may fall below normal pressure or volume during an emergency.

In some cases it is required by law to have a second water supply source. Whether a second supply source is needed depends on several factors. These factors include the strength and reliability of the primary supply, the value of the property, the height, area and design of the building.

When a sprinkler or a standpipe system is supplied from a public water main, the entire system may be closed down by closing a control valve. This valve is located between the building and the water main in a box that is recessed into the sidewalk. The location of the box is found by reading a sign on a building or post nearby. For example, the sign might read "**Shut-off for Sprinkler System Located 6 Feet from This Sign,**" or it may have similar instructions. A special key may be required to operate this valve.

The control valve for the building may also be attached to an upright post, known as a post indicator valve (PIV). The building or section of the building controlled by the valve is usually marked on the post. The position of this valve (open or closed) is shown through a telltale opening in the post. On some posts, a padlock must first be opened or forced to release the operating wrench. On others, an iron strap must first be released by cutting a riveted leather section.

The main water supply for sprinkler and/or standpipe systems may also be controlled by an OS&Y valve (Outside Screw and Yolk valve). The OS&Y valves are found just inside the building wall on the main riser, or outside in protected pits. It is easy to tell at a glance if the valve is open or shut. When the stem is all the way out the valve is open. When the stem is all the way in the valve is closed. Some OS&Y valves may be used to control the water supply for individual floors in a building. The OS&Y valves are also installed to shut off certain sections of an individual floor. Being able to shut off parts of a building allows the Fire Department to have greater control over the fire protection system. When a fire is under control in an area the OS&Y valve can be closed to prevent any further water damage.

Sometimes repairs must be made to the sprinkler or standpipe system. When this happens the OS&Y valves are used to close the water supply to only those sections being repaired. This is good because the rest of the sprinkler or standpipe system does not have to be shut down.

A building may have both a standpipe and a sprinkler system installed. Each system may have its own water supply source. For example, the standpipe system may be supplied by a gravity tank and the sprinkler system supplied by a pressure tank.

It is quite common for the two systems to share the same water supply source. For example, both systems may use the same gravity tank as a water supply source. The gravity tank is a limited water supply. The amount of water that is allocated to each system is regulated by local building laws.

Acceptable water supplies for the sprinkler or standpipe systems include connection to public or private water mains, connection to fire pumps, pressure tanks, and gravity tanks. These sources may be also used in combination to supply a standpipe and/or a sprinkler system. At least one of the water sources should be able to supply the standpipe or sprinkler system automatically. This supply must have the needed water volume and water pressure for the entire system. The public water works system is the most commonly used water supply source. In tall buildings the connection to the public water system may not have enough water pressure to supply the upper floors. In this situation a second supply source is often required to increase the water pressure. For example, a fire pump may be installed in a building that is more than ten stories high. The higher the building the greater the water pressure needed to supply the standpipe and/or sprinkler system.

Connections to Public Water Works System. While a connection to a reliable public water works system is the preferred primary water supply for standpipe and automatic sprinkler systems, a check valve must be

installed next to the interior connection to the standpipe or sprinkler system. This valve makes sure that the system does not backflow into the public water supply.

Fire Pumps. The fire pump is designed to draw water from a supply source. The water is then pumped into the fire protection system under high pressure. A fire pump with both a reliable source of power and a reliable suction water supply is a desirable piece of equipment. A suction water supply is simply a source of water that the pump can draw water from. With a good water supply a fire pump can pump water into a sprinkler or standpipe system for a long time. Sometimes more than one fire pump is installed in high rise buildings. The extra fire pumps are needed to maintain the desired water pressure levels at the top floors of the buildings.

Manually started pumps may be used as a secondary supply source if the primary water supply will last long enough to allow the pump to be started. This kind of system must give an automatic waterflow signal to the Certificate of Fitness holder when the pump must be started.

Automatic fire pumps are usually installed where a high water demand may occur immediately. This demand may occur in a deluge system. An automatic fire pump is also used when someone is not always available to activate the manual pump. Automatic fire pumps must have their suction “**under a positive head**” to avoid delays in drawing water from the supply source. Under positive head means that the water supplying the pump must be fed into the fire pump under pressure. This can be achieved by connecting the fire pump to a suction tank. Water is forced into the pump by gravity. Automatic fire pumps are activated as soon as a drop of air or water pressure is noticed in the fire protection system. The drop in pressure occurs when a hoseline is opened or a sprinkler head has fused.

Gravity Tanks. Gravity tanks of adequate capacity and elevation make a good primary supply and may be acceptable as a single supply. A gravity tank may be located on the top of a building or on a tall tower. The water in the tank is distributed throughout the sprinkler or standpipe system because of the pull of gravity.

Pressure Tanks. Pressure tanks have several possible uses in automatic sprinkler or standpipe systems. Pressure tanks are often used where there is enough water from a supply source but the water pressure is too low. Pressure tanks may also be used in tall buildings that need the extra water pressure to supply the highest line of sprinklers or the highest line of hoses.

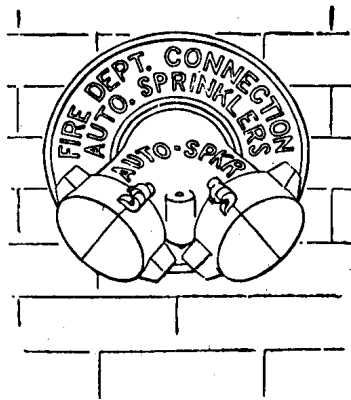
The tank is normally kept two-thirds full of water and one third full of air. The air pressure in the tank should be maintained above 75 psi. The air for pressure tanks is supplied by air compressors. Because the water is always under pressure it can be forcefully distributed throughout the sprinkler or standpipe system. An important limitation is the small amount of water that can be stored in such tanks. Where a small pressure tank is accepted as the water supply, the system is called a Limited Supply System.

The pressure tank gives a strong starting pressure for the first sprinkler heads or standpipe hoses that open. The flow from the tank may be used while the automatic fire pumps begin to increase the water supply pressure. The pressure tank supplies these sprinkler heads and/or standpipe hoses until the Fire Department begins pumping water into the system

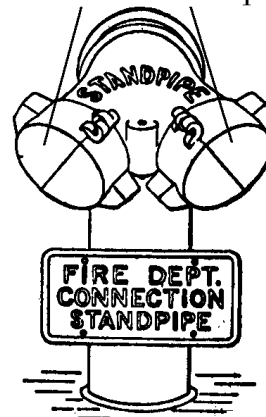
Siamese Connections for Fire Department Use. Normally a sprinkler or standpipe system is connected to an automatic water supply source. Other sources of water are supplied through Fire Department siamese connections at the building. Siamese connections are a standard part of all sprinkler and standpipe systems. At least one siamese connection must be installed in all sprinkler and standpipe systems. When responding to an alarm most fire departments supply water to the standpipe system first. The standpipe system supplies water to the fire hoses in the building. Water is then supplied to the sprinkler system through its own siamese connection. Care should be taken that the standpipe and the sprinkler connections are properly

marked because the connections look the same. The exact purpose of each siamese connection should be shown nearby or on the siamese connection itself. The New York Building Code requires siamese connections to be color coded. The siamese connection to an automatic sprinkler system should be painted green. The siamese connection to non-automatic sprinkler system should be painted aluminum. The siamese connection to a standpipe should be painted red. Two examples of typical siamese connections are shown below.

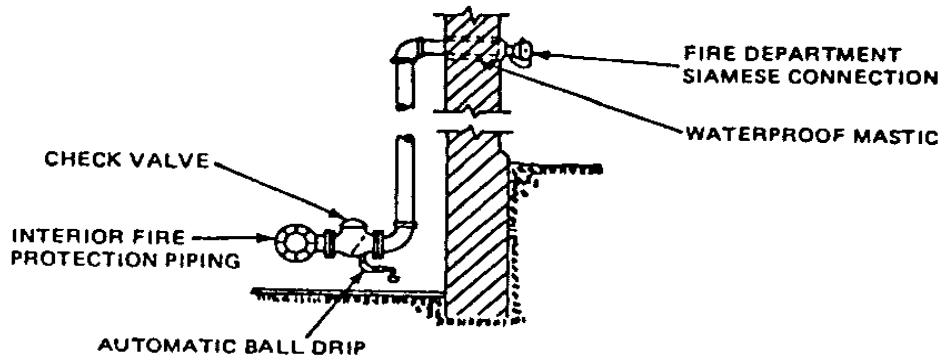
PROPERTIES PRO'



Protective Caps



Fire Department connections must always be accessible. Each connection should be fitted with a lower check valve. The check valve prevents the backflow of the private water supply into the public water supply. The figure below shows the main features of a Fire Department siamese connection.



Fire Department connection

The automatic ball drip device between the lower check valve and the outside hose coupling prevents water from building up in the piping. The ball drip device makes sure that the Fire Department connection is not blocked by water that has frozen in the piping. If water freezes in the piping, the Fire Department will not be able to pump water into the system. Under normal conditions the automatic ball drip should be dry. A wet ball drip device indicates that the lower check valve may be defective. If the check valve is defective it should be replaced immediately. Many standpipe and sprinkler systems use the Fire Department siamese connection as the secondary water supply source.

WATERFLOW ALARMS IN SPRINKLER AND STANDPIPE SYSTEMS SUPERVISION

Sprinkler and standpipe systems should have devices and equipment for signaling when water flows through risers or mains supplying the systems. The flow may be due to fire, leakage, or accidental rupture of the piping. It is important that prompt action is taken when waterflow is noticed or signaled by these devices.

Functions of Alarms and Supervisory Signals. Sprinkler and standpipe systems with a waterflow alarm serve two functions. (1) It is an effective fire extinguishing system. (2) It is an automatic fire alarm. An alarm is signaled as soon as a sprinkler head has fused or a hose has been activated. Waterflow alarms and fire alarms give warning of the actual occurrence of a fire. They also signal when water flows through the system due to broken pipes. Alarms alert occupants and summon the Fire Department. Any signal, whether waterflow or supervisory, may be used to give an audible alarm. It may also send a signal to an approved central station company. The central station company will then contact the local fire house.

Supervisory devices are often connected to a central station company which monitors the sprinkler and/or standpipe systems for problems with equipment and when sprinkler heads are opened or standpipe hoses have been activated. The central station company should be notified when any control valves are closed for maintenance or repair. This reduces the number of false alarms.

Automatic sprinkler systems are required to have an approved water motor gong or an electric bell, horn, or siren on the outside of the building. An electric bell or other audible signal device may also be located inside the building. Water operated devices must be located near the alarm valve, dry pipe valve, or other water control valves in order to avoid long runs of connecting pipe.

Devices and Equipment Supervised. Sprinkler and/or standpipe system supervision is commonly provided for several purposes. These purposes include the detection of: (1) low water level in water supply tanks, (2) low temperature in water supply tanks or ground level reservoirs, (3) high or low water level in pressure tanks, (4) high or low air pressure in pressure tanks, (5) high or low air pressure in dry pipe sprinkler or standpipe systems, (6) failure of electric power supply to fire pumps, and (8) automatic operation of electric fire pumps.

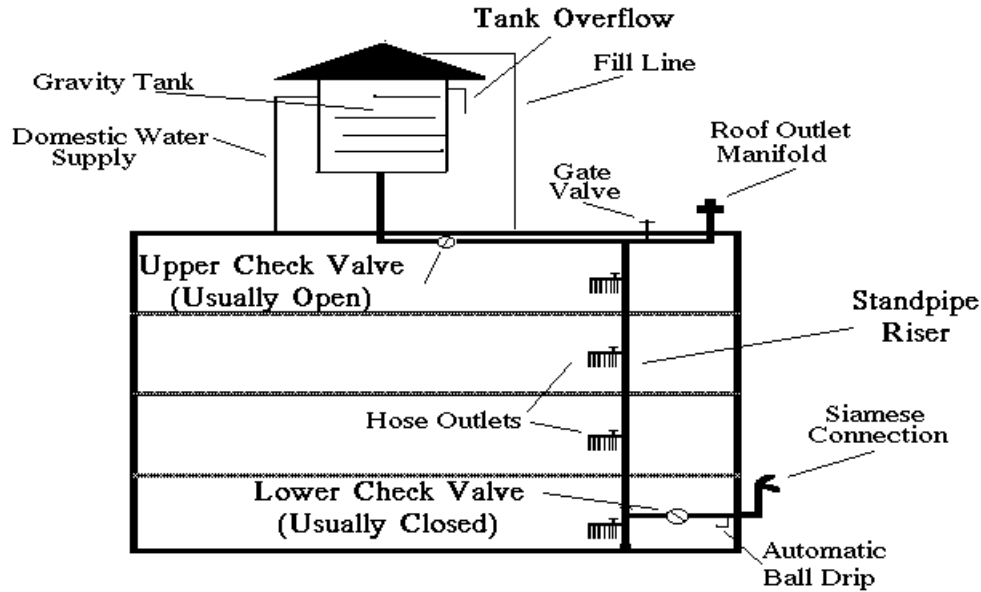
Waterflow Alarm Valves. The basic design of most waterflow alarm valves is that of a check valve which lifts from its seat when water flows into a sprinkler system. This alarm then starts an audible signal to alert the occupants in the building that the sprinkler or standpipe system has been activated.

Alarm Retarding Devices. An alarm check valve that is exposed to changing water supply pressure needs an alarm retarding device. This is required to prevent false alarms when the check valve clapper is lifted from its seat by a temporary pressure surge.

Gate Valves. Gate valves of the non-indicating type are provided in water distribution systems. Gate valves allow parts of the sprinkler or standpipe system to be shut off for repairs or maintenance. This is done without reducing protection over a wide area. Such valves are normally a non-rising stem type. They are operated using a special key wrench. A valve box is located over the valve to keep dirt from the valve. The valve box also provides a convenient access point for the valve wrench to the valve nut. A complete record should be made for each valve in the system. This record should include the exact location, the date it was installed, the make, the direction of opening, number of turns to open, and any maintenance that was performed.

INTRODUCTION AND OVERVIEW OF STANDPIPE SYSTEMS

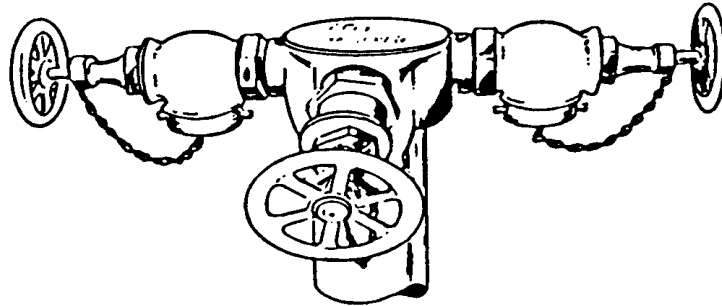
Standpipe systems are an important part of the fire protection system in a building. The standpipe system provides water that fire fighters can manually discharge through hoses onto a fire. Water is fed into a piping system. The piping runs vertically (up and down) and horizontally (side to side) throughout the building. The piping running vertically are usually called risers. The risers are usually located in the staircase enclosures or in the hallways in the building. This piping system supplies water to every floor in the building. When a standpipe system is installed and properly maintained it is a very effective means for extinguishing fires. A typical standpipe system is shown below in the illustration below.



A Typical Standpipe System

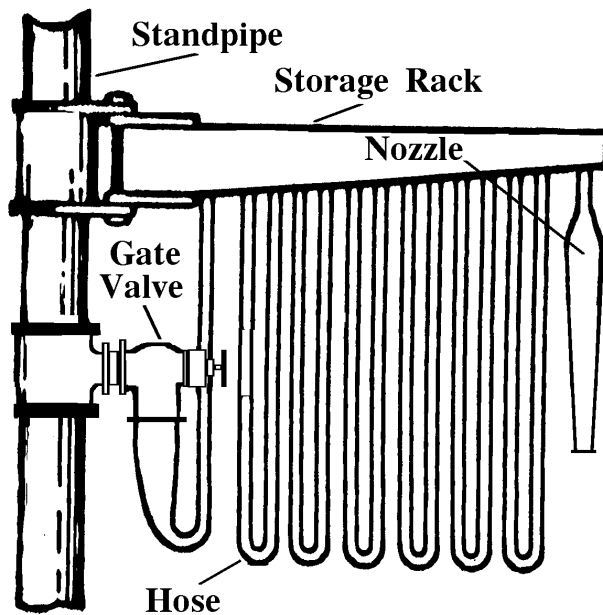
STANDPIPE DESIGN

Standpipe systems are used in buildings where it may be difficult for the Fire Department to pump water on the fire. For example, standpipe systems are required in buildings that are over six stories 75 feet in height. A standpipe system may be combined with an automatic fire protection system. For example, a standpipe system and a sprinkler system may be installed in the same building. The standpipe and the sprinkler systems may even share the same water supply and riser piping. The top of the standpipe riser extends up onto the roof. Three hose connections are attached to the top of the standpipe riser. These three connections make up the roof manifold. The roof manifold is used when extinguishing fires on the roof. It is also used when testing the water flow in the standpipe. An example of a typical roof manifold is shown in the picture on the following page.



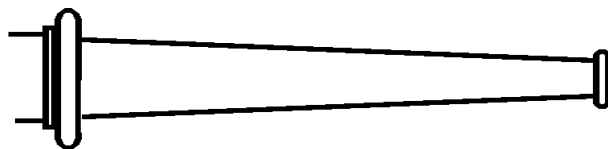
A Typical Roof Manifold

At selected locations in the building the piping is connected to a hose. These connections are controlled by gate valves. No water is allowed into the hose until the valve is opened. The gate valve must be manually opened by a fire fighter. The hose is usually stored on a quick release rack. An example of a typical quick release rack is shown below.



A Typical Fire Hose Outlet and Release Rack

A nozzle is attached at the end of the hose. The nozzle is used to direct the stream of water from the hose. An example of a typical nozzle is shown in the picture below.

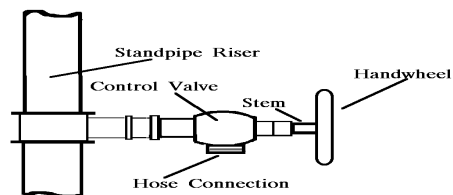


A Typical Nozzle

The hose and nozzle must be easy to reach at all times. The hose outlets are located so that every part of the building may be reached with a hose stream. The maximum length of a single hoseline is 125 feet. Sometimes the hoses are installed in cabinets. If the hoses are installed in cabinets each cabinet should be labeled "FIRE HOSE". When the hose outlets are not easy to see, signs should be posted telling where the hose outlets are located.

A pressure reducing device should be installed in the piping at each hose outlet. An occupant of the building may be injured if a hose is used when the pressure reducing device is not installed. The pressure reducing device may be adjusted or removed by Fire Department personnel during an emergency.

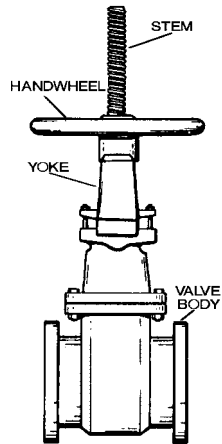
Another kind of connection to the standpipe is found in some systems. A short length of piping is welded to the riser. At the end of this pipe is a control valve and a 2 1/2 inch hose connection. No hose is installed to this connection. The Fire Department attaches its own hose to this connection when fighting a fire. An example of this kind of connection is shown in the picture below.



Fire Department Connection to a Standpipe Riser

Each standpipe system is also fitted with a drain valve. The drain valve is located at the lowest point on the standpipe system. The drain valve is used when the standpipe system is being tested or repaired. The drain valve is usually sealed in the closed position.

OS&Y (Outside Screw and Yoke) gate valves are installed at several places in the system. The OS&Y valves can be used to shut down just a part of the standpipe system. Sections may be shut down when fighting a fire. Sections are also shut down for testing, repairs or maintenance. It is easy to tell if the OS&Y valve is in the open or closed position. If the stem is raised above the control wheel the valve is open. If the stem is flush with the control wheel the valve is closed. A typical OS&Y gate valve is shown on the following page. The valve in the picture is open.



Typical OS&Y valve

TYPES OF STANDPIPE SYSTEMS

Wet Standpipe. This system always has water in the piping. The water in the system is always under pressure. In some cases a fire pump may be used to increase the water pressure. The wetpipe system is the most commonly used standpipe system. It is used in heated buildings where there is no danger of the water in the piping freezing. Any part of the standpipe system that is exposed to freezing temperatures should be insulated. It is very important that the water in the piping does not freeze. Frozen water may prevent the standpipe system from working.

Dry Standpipe with an Automatic Dry Pipe Valve. This system is usually supplied by a public water main. Under normal conditions there is no water in the piping. Instead, there is air under pressure in the piping. A dry pipe valve is installed to prevent water from entering the standpipe system. The dry pipe valve is designed to open when there is drop of air pressure in the standpipe. When a hose is opened it causes a drop in air pressure in the standpipe system. Then the dry pipe valve automatically lets water flow into the standpipe. A control valve is installed at the automatic water supply connection. This valve should be kept open at all times to supply the standpipe system. This system is usually installed in a building that is not heated.

Dry Standpipe with a Manual Control Valve. This system is supplied by a public water main. Under normal conditions this system has no water in the piping. The water is not allowed into the standpipe until a control valve is manually operated. The control valve remains closed until a fire occurs. This system is usually used in a building that is not heated.

Dry Standpipe with No Permanent Water Supply. Under normal conditions this system has no water in the piping. Water is pumped into the standpipe system by the Fire Department. The water is pumped in through the siamese connection. This system cannot be used unless water is supplied by the Fire Department. A sign must be attached to each of the hose outlets. It should read "**Dry Standpipe for Fire Department Use Only**". This system is usually used in a building that is not heated.

CLASSES OF STANDPIPES SYSTEMS

Standpipe systems are classified depending on who is expected to use the system. The three classes are briefly described on the following page.

Class I: This system is designed to be used by professional fire fighters. For example, the system is used by Fire Department and Fire Brigade personnel. The fire hoses in these systems are 2 1/2 inches in diameter. The large hose diameter makes it difficult to control the stream of water from the hose.

Class II: This system is designed to be used by the occupants of a building. The hose and nozzle are connected to the standpipe. They are ready to be used by occupants in case of a fire. The hose is 1 1/2 inches in diameter. The hose stream is easier to control than the Class I hose.

Class III: This system may be used by either professional fire fighters or by occupants of the building. The hosing may be adjusted to either 1 1/2 or 2 1/2 inches in diameter. This is done by attaching special reducing valves to the hose line.

INSPECTION AND MAINTENANCE

The standpipe system must be regularly inspected by the Certificate of Fitness holder. This is to make sure that the system is working properly at all times. All parts of the standpipe system should be visually checked monthly. This visual inspection should make sure that the system is free from corrosion. The inspection should also make sure that there is no physical damage to the system. Special attention should be paid to any evidence of tampering with the standpipe system. Any part of the system that is damaged or missing should be repaired or replaced immediately.

All valves and connections to the automatic water supply sources should be inspected weekly. The valves should be checked to make sure that they are in the correct position. The valves should also be labeled to show their correct position and purpose. The hose outlets should be checked to make sure that the pressure reducing devices are present. The Fire Department should be notified when any part of the system is shut down for maintenance or repairs. A sign should be posted indicating that the section is shut down. All Fire Department connections must be tested at least once every 5 years.

All major defects in the system should be immediately reported to the local fire house. The owner of the building and the Bureau of Fire Prevention should also be notified. Major defects include: an empty tank, a break or a leak in the system's piping, an inoperative or shut water supply valve, and a defective siamese connection. The defects should be corrected as soon as possible. A complete or partial shutdown of the standpipe system for repairs or any other reason must also be reported.

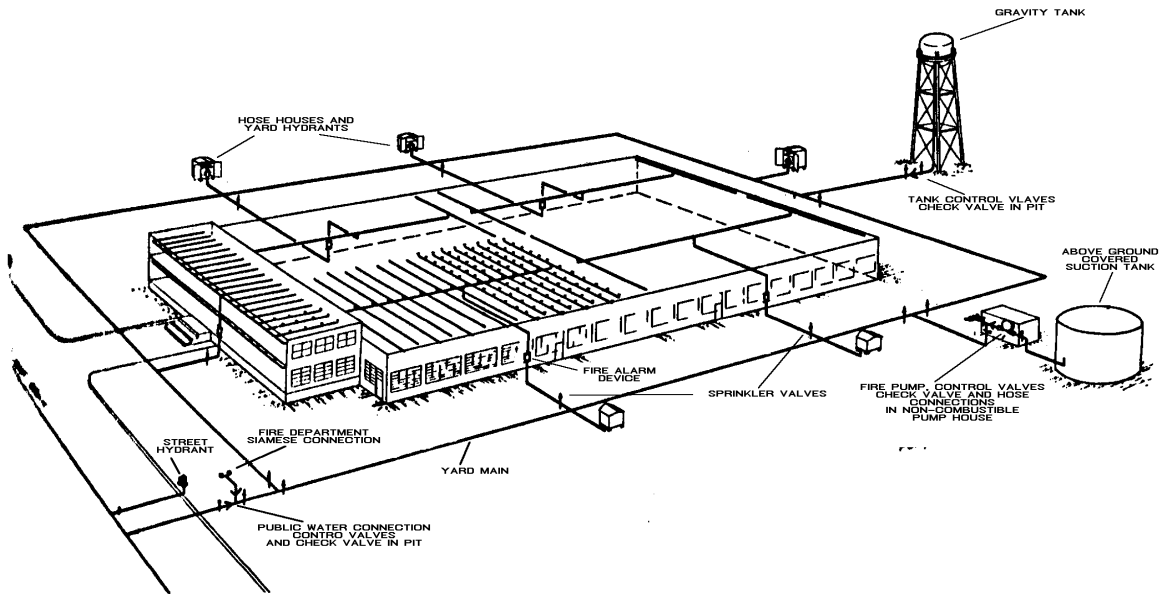
Minor defects should be reported to the owner of the building. The defects should be repaired within 30 days. If the defects are not corrected within 30 days, they must be reported to the Bureau of Fire Prevention.

The date of all inspections, maintenance and repairs made on the system must be recorded on the inspection record card. The record should also include the Certificate of Fitness number and the signature of the certificate of fitness holder. This record must be posted near the main control valve. All records must be kept for a period of at least one year. They should be made available to any representative of the Fire Department.

YARD SYSTEMS

A yard hydrant system is most often used in large private manufacturing plants or storage buildings. The yard system is often needed because the public water supply does not meet the needs of the fire protection system. The yard system usually has several private water sources supplying the total fire protection system. The total system may have a sprinkler system, hydrants, and a standpipe and hose system installed.

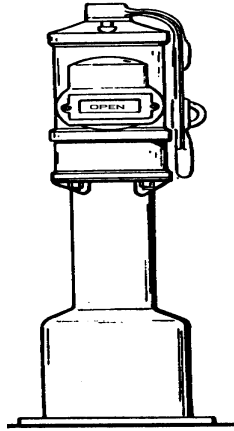
The water supply sources are all connected together in the yard system. This allows the water to be directly supplied to any part of the system when needed. Water can be supplied even when one of the supply sources is not working. The combined sources of water keep the water pressure in the system at a high level. The picture below shows a detailed yard fire protection system.



A Typical Yard Fire Protection System

The water supply sources are all connected to a main water supply grid. This supply grid surrounds the entire building. Control valves are installed at various locations on the system. These valves are called post indicator valves (PIV). As the name suggests they indicate the position of the valve. The valves are manually operated. Each valve has two positions, opened and closed. Under normal conditions the PIV valves are sealed open. The PIV valves allow the Fire Department to shut down only part of the system. The PIV valves are also used to shut down parts of the system when conducting repairs and maintenance. A typical PIV valve is shown on the following page.

The water in the yard system is not allowed to flow into the public water system. It is prevented from doing so by a check valve.



Typical PIV Valve

Several supervisory and alarm devices are usually installed in the yard system. They indicate when there is a problem with the equipment. They also indicate when water flows through the yard system. These devices are needed to make sure that the system will work properly in case of a fire. The supervisory devices may be connected to a central station company. The central station company is automatically notified when there is any problem with the yard system. It will then notify the local fire house.

Several different water supply sources may be used in a yard system.

Gravity tank. The gravity tank supplies water using the force of gravity.

Fire Pump. The fire pump draws water from a suction tank and pumps it into the system when needed.

Public Waterworks Connection. The street main supplies water using the water pressure in the public water works system. Sometimes a street main may not be connected to the system if it is located too far away from the building.

Hose Houses. Hose houses may be installed on the system. The hose house must be painted red. The house is usually located outside the main water supply grid. The house must be accessible at all times. Hoses, nozzles and other fire protection tools are kept in the hose house. Standpipe connections are located in the hose house. These connections allow the fire fighters to connect directly into the yard system. They are very helpful when the street mains are located too far away from the building. The connections save a lot of time when fighting a fire.

Pressure Tank. This tank may supply water to the yard system under pressure. The tank is filled with water and air. The air forces the water out under pressure when part of the fire protection system is activated.

Fire Department Siamese Connection. A siamese connection is always installed on the system. The siamese connection is used by the fire department to pump water into the system.

Hydrants. Hydrants may be installed in some systems. They allow the fire department to run hoses from the public water mains. The location of the hydrants will depend on the layout of the public water supply system

INSPECTION AND MAINTENANCE OF YARD SYSTEMS

The certificate of fitness holder should conduct regular inspections of the entire yard system. A record of all inspections should be made. The certificate of fitness of holder should sign and date all records. These records should be kept for at least one year. They should be made available to any representative of the Fire Department.

The certificate of fitness holder should make sure that the hose houses are in good working order. All equipment inside should be inspected. The hose house should be accessible at all times. The hose house should be painted red. Care should be taken to make sure that the area inside the house is kept clean and dry. All valves should be checked to make sure that they are in the correct position.

Any problems with the equipment in the yard system should be noted. Major defects should be reported to the Fire Department and the owner of the building immediately. Minor defects should be reported to the owner. In all cases the defects in the system should be repaired immediately.