

JAMAICA FIRE BRIGADE

TRAINING DEPARTMENT



FIXED INSTALLATIONS

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Many large buildings have built in as part of their infrastructure, sprinklers or other fixed installations for fire fighting purposes. Fixed installation may be divided into two groups:

- 1) Those using Water
- 2) Those using other extinguishing media

1. **Automatic Sprinklers**

A most important principle of successful extinction is to attack an outbreak immediately. Any device which can detect a fire automatically and then help to extinguish it with a minimum of fire loss is of great value. Automatic Sprinkler systems using water as the extinguishing medium have been universally adopted for this purpose. This type of apparatus has been in use for over one hundred (100) years and has been installed in thousands of buildings throughout the world.

Basically, an automatic sprinkler installation comprises a system of pipes erected at or near the ceiling of each floor of a building and connected through controlling valves to one or more water supplies. At intervals in the pipework, arc scaled outlets called sprinklers or sprinkle heads, these contain a device whereby a rise in the temperature to a predetermined limit causes the sprinkler to open and water to be discharged in the form of a spray over an area of the floor. The sprinklers are so spaced that in the event of two or more heads operating simultaneously, the area sprayed by each sprinkler overlaps that which is sprayed by its neighbour, thus leaving no part of the floor unprotected.

The operation of the head leads to the opening of a valve and causes an alarm bell to ring (and in some installations a direct call to the Fire Brigade), so drawing attention to the outbreak.

Automatic sprinkler system must be provided with a suitable and acceptable water supply. The supply must be automatic, reliable and not subjected to either frost or drought conditions that would seriously affect the supply. The supply should be under the control of the occupier of the building containing the installation or where this is not practicable, the right use of the supply must be guaranteed.

The water must be free from any matter in suspension which would be liable to cause accumulations on the system's pipework. The use of salt or brackish water is not normally allowed. Acceptable water supplies are:

- i) Town mains
- ii) Elevated private reservoir
- iii) Gravity tanks

- iv) Automatic pump supply
- v) Pressure tanks

SPRINKLER HEADS

There are many different design's of sprinkler heads but they may be divided into two categories:

- i) Those in which the operating medium is fusible solder;
- ii) Those in which a bulb is ruptured by the expansion of a contained fluid.

A solder type sprinkler head has the valve retained in the closed position by a special solder which, when heated to a predetermined level, melts, allowing the parts to fly apart under pressure from the water, thus opening the valve. Common operating temperatures are 72°C, 141°C and 182°C.

In the bulb type head, a small barrel or cylinder made of special glass is used to hold the water valve in place. This bulb is hermetically (air tight) sealed and contains a quantity of liquid and a small bubble. As the temperature rises, the liquid expands and the size of the bubble decreases until it disappears. A further rise shatters the bulb, breaking it into small pieces so that it cannot obstruct the water flow and so opens the head. In spite of this ease of fracture, the strength of the bulb is such that it can withstand any pressure applied to the pipe.

The temperature rating is marked on the deflector of the sprinkler and the liquid filling the bulb is coloured, a specific colour is used for each operating temperature. The liquid employed is non-freezing and the bulb itself is not subject to corrosion.

SPRINKLER OPERATING TEMPERATURE	COLOUR OF BULB
57°C	Orange
68°C	Red
79°C	Yellow
93°C	Green
141°C	Blue
182°C	Mauve
204°C-260°C	Black

While a sprinkler system protects a building from internal fire, drenchers are placed on roofs and over windows and external openings to protect the building from damage by exposure to fire in adjacent premises. A drencher system is comprised of water heads similar to those of sprinklers; these may be sealed or unsealed but in the latter case the water is turned on manually.

2. OTHER INSTALLATIONS USING WATER

Rising mains, hose reel and private hydrants are other types of fixed installations which use water as the extinguishing medium. .

Rising Mains

A rising main consists essentially of a pipe installed vertically in a building with a fire service connection at the lower end and outlets at various levels throughout the building. There are two types of rising main:

1. Wet risers
 2. Dry risers
- i) A *Wet Risers* is a pipe kept permanently charged with water which is then immediately available for use on any floor in a building at which a hydrant (or landing valve) is provided. The riser is connected to a town main of suitable capacity with a shut off valve installed. A similar function to that of a wet riser is performed by what is technically known as a 'Down-Comer' which, like a Wet riser, is constructed of vertical piping, but which is supplied with water from a tank in the roof or at intermediate levels.
- ii) A *Dry Riser* is normally kept empty of water . It is not connected to a water supply, but is charged when required by fire service pumps. In effect it is a substitute for a line of hose, over which it has many advantages It enables an upper floor level fire to be attacked by the Fire Brigade with a line of standard hose through the building from the street. A dry riser is charged through inlets at ground level, which are usually housed in external glass fronted boxes which are clearly labelled. Occasionally, inlets may be found below pavement level in a box with a cover similar to that used for a hydrant.

An air valve is sometimes fitted at the highest point in the pipe to allow contained air to be released when the riser is charged. The air valve, if fitted, admits air to the pipe when it is drained via the drain cock after use, thus preventing the formation of a partial vacuum and water is being trapped.

The type of rising main to be installed in a building is generally determined by the height of the building. In buildings over 18m in height.. it is recommended that a dry riser is used and those above 61 m a wet riser. Booster pumps will be required and a storage tank of about 45m³ capacity will be needed with a wet riser. The reason why a wet riser must be provided above 61 m is pressure above this height.

Hose Reels

Increasing use is being made of hydraulic hose .reels. Since only the amount of tubing required needs to be pulled off the reel before the water is turned on (in some cases the water can be turned on before any tubing. is run out.) Only one person is needed to operate it. The comparative lightness and lack

of back pressure from the nozzle makes the hose reel a suitable item of equipment for any one to use. So many different type of hose reel are in use that it is impractical to describe every variation. Usually the reel is mounted

on a hollow rotating shaft to the centre of which water is fed. The tubing is connected to an outlet on this rotating shaft. Rubber tubing of 20mm or 25mm diameter is employed and a light branch with a shut off nozzle is fitted.

To operate this type of reel all that is necessary is to run out the valve and holding the branch, pull off as much tubing as necessary from the reel; the shut off nozzle is opened when the tire is reached to ensure that the tubing pays out freely without fouling or kinking, some form of guide is provided, or alternately the hose reel swings in the direction in which the tubing is being unreeled. Hose reels are protected in clearly marked, easily opened boxes on each floor of a multi storied building.

Private Hydrants

Private hydrants are usually installed in premises with extensive yards, sidings, storage areas, etc., where the nearest statutory hydrant is far from the risk or where the nature of the risk requires large quantities of water to be immediately available. These hydrants may be connected to the service main of the premises, to a separate branch from the town main, or to a ring main connected to the town main at two points.

Ring mains are also installed without any connection to town mains, being supplied from private water supplies such as tank reservoirs, lakes, canals etc.

3. INSTALLATIONS NOT USING WATER

These installations include those which use foam, carbon dioxide, vaporizing liquids, dry powder and inert gas equipment.

Foam Installations

Foam installations utilize either low expansion or high expansion foam. Some systems have the foam pre-mixed in a tank which is charged by pressurized CO₂ from a cylinder when an outbreak is detected. Others have foam concentrate stored in a tank to which water is added under pressure from a pump when required. The tank will have an inductor connected to it. The 'Venturi effect' in the inductor spreaders or pumpers.

Carbon Dioxide Installations

Carbon dioxide is not suitable for extinguishing fires involving materials which contain their own oxygen supply, e.g. nitrates, chlorates, reactive metals such as sodium, etc. The following is a list of applications where it may be used satisfactorily;

1. A wide variety of electrical apparatus and electronic equipment, e.g. electrical switch gear, transformers, electronic computers, telephone relay and repeater stations.
2. Flammable liquids, e.g. paint stores, small spray booths, solvent stores, printing ink
3. Chemical laboratories and chemical stores;
4. Libraries, archives, valuable auto stores, record stores, etc.
5. Diesel and diesel-electric locomotives, machinery in textile industry.

The installation will comprise either a battery of cylinders interconnected by a manifold and feeding into a system of high pressure distribution pipeline, or, the gas is stored in a refrigerated tank at a temperature of 180° C and at a pressure of either 20 bars, to which the pipe line, with discharge nozzle is fitted.

Either system is usually triggered by the use of a suitable automatic fire detection system. Over riding manual control is incorporated into the design of the system and should re-ignition occur, further charges can be released into the space as required.

Aisles and routes of exits should be kept clear at all times. Adequate lighting and/or emergency lighting with directional signs to ensure quick staff evacuation are necessary as well as sufficient alarms.

Vaporizing Liquid Installation

A group of halogenated hydro carbon extinguishing agents have been developed during recent years and used in fixed installations. These extinguishants have the same cleanliness in operation as carbon dioxide and are more efficient and have a more rapid flame knockdown.

They are:

- i) Bromotrifluoromethane (generally referred to as BTM. Freon 1301 or Halon 1301)
- ii) Bromochlorodifluoromethane (BCF or Halon 1211)
- iii) Chlorobromomethane (CBM)

Vaporizing liquids should not be used to extinguish fires involving chemicals containing their own oxygen supply such as cellulose, nitrate, reactive metals such as sodium, potassium magnesium, titanium, uranium, or on metal hydrides.

Halogenated hydrocarbons are gases at normal temperature and pressure. They are liquefied by compression for storage and although the vapour pressure in some cases is adequate to expel the contents of the storage containers, the pressure decreases with a fall in temperature. It is usual to pressurize the container by use of nitrogen.

Each container is equipped with suitably designed valves to retain the agent in its container and capable of discharging the liquid at the required rate. When the system operates, the liquid is fed through distribution pipes to specially designed discharge nozzles which are sited round the risk. Upon discharge the liquid immediately vaporises to form a heavy vapour which achieves very rapid extinction.

Discharge of the agent may create a light mist in the vicinity of the discharge nozzle, resulting from condensation of moisture in the air, but the mist rarely persists after discharge is completed. It is difficult to detect its presence through normal human senses; in concentrations above three percent (3 %), voice characteristics are changed due to the increased density of the agent/air mixture.

Safety Requirements

Safe guards are necessary to prevent injury or death of personnel in areas where the atmosphere may be made hazardous by the discharge of decomposition of vaporizing liquids. These may include the following:

- i) Adequate gangways and routes to the exit; these should be kept clear at all times.
- ii) Provision should be made for any necessary additional or emergency lighting and directional signs to ensure quicker, safe evacuation.
- iii) The provision of alarms within such areas; these should operate immediately upon the detection of fire.
- iv) Outward opening self dosing doors should be provided at exits from the hazardous areas.
- v) Continuous alarms or a system of colored lights should be provided at entrance to such areas to indicate that the system has operated.
- vi) Warning and instruction notices should be provided at entrances and inside such areas, to inform personnel that a vaporizing liquid system is installed. The notice should contain instructions on the action to be taken if the system operates.

- vii) Instruction and drills should be carried out to ensure the correct action is taken by personnel within or in the vicinity of such areas when the equipment operates.
- viii) Provision should be made for the prompt ventilation of such areas. Care should be taken to dissipate the hazardous atmosphere and not merely to transfer it to another area.

When responding to a fire where a total flooding system has operated in a room, the door should not be opened until the Officer in Charge is satisfied that the fire is out, unless it is necessary to perform a rescue. Equipment should be laid out, prepared and ready to deal with any fire that might occur. The room should be entered by men wearing breathing apparatus until such time as the room is well ventilated.

Dry Powder

Dry powder provides another chemical extinguishing agent suitable for use in fixed installations. They provide quick knock down and unlike vaporizing liquids they have negligible toxic effects. A major disadvantage is that they require a lot of clean up after use.

A dry powder installation consists of specifically designed pipe work and discharge nozzle covering the protected risk. The pipe work being linked to dry powder containers. The pressure is usually provided by discharging CO₂ from cylinders.

Steam and inert gases may also be employed in installations (usually aboard ships), the inert gas usually being nitrogen.

AUTOMATIC FIRE DETECTORS - GENERAL

The prime function of a fire detector is to detect one or more changes in the protected environment indicative of the development of a fire condition. Usually mounted on ceilings or in air ducts, detectors are activated in the main by smoke or radiation. These conditions can be readily identified with important stages in the development of a fire:

- i) After ignition has occurred and the invisible products of combustion are being released.
- ii) When visible smoke is being produced
- iii) When the fire is producing flame and a degree of illumination
- iv) When the temperature in the vicinity of the fire rises rapidly or reaches a predetermined figure.

These types of detectors designed to operate at one of these particular stages are as follows:

- i) Ionization Detector)
Smoke Detectors
- ii) Optical Detector.s)
- iii) Radiation Detectors
- iv) Heat Detector

The final choice of detector type has to be based on the risk to be protected and the individual circumstance of each case.

The main groups of detector system in use are those activated by smoke and those activated by heat.

Whatever detector is employed, however, it needs to be reliable robust and economical.