

# FIRE PROTECTION SYSTEM

FIRE EXTINGUISHER, HOSE REEL AND FIRE HYDRANT



2023

# **FIRE PROTECTION SYSTEM**

FIRE EXTINGUISHER, HOSE REEL AND FIRE HYDRANT

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## **AUTHORS**

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POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH  
2023

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## **FIRE PROTECTION SYSTEM**

### **FIRE EXTINGUISHER, HOSE REEL AND FIRE HYDRANT**

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# PREFACE

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This eBook aims to develop students' ability to relate basic knowledge in the topic of active fire protection systems, including portable fire extinguishers, hose reel systems and fire hydrant systems. It explains the application and calculation methods of fire-fighting equipment, incorporating the Uniform Building By Law 1984 and related codes of practice. Each chapter concludes with self-learning exercises to reinforce students' knowledge and understanding. For the development of deeper knowledge, suggestions for improvement are welcome.

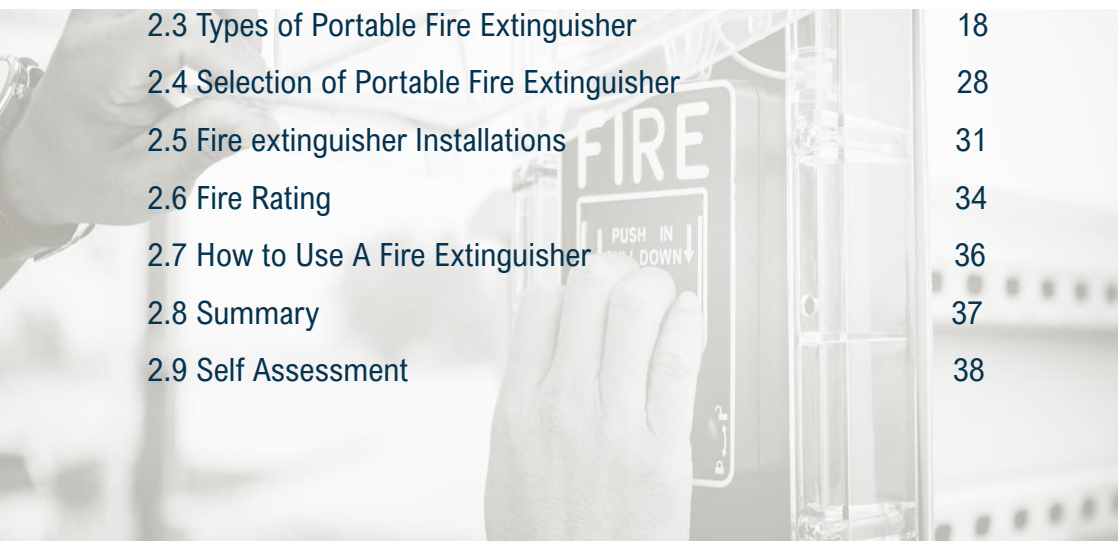
Rohaza binti Majid

Amir bin Abdullah

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**FIRE**

## **CHAPTER 1.0 INTRODUCTION**

### **1.1 ACTIVE FIRE PROTECTION SYSTEM**

Active Fire Protection Systems are integral components of building fire protection systems, designed to combat fires through both manual and automatic means. Manual operation involves utilizing various equipment such as portable fire extinguishers and hose reel systems enable individuals to take immediate action in extinguishing small or large fires. On the other hand, automatic operation entails the use of sophisticated systems like automatic fire sprinkler systems and automatic carbon dioxide systems. These systems are designed to detect and suppress fires automatically without human intervention.



## 1.2 THE AIMS

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**01** **detecting** the fire earlier so that occupants were able to evacuate the building immediately.

**02** **controlling** the movement of smoke and fire from spreading to the entire of the building

**03** **breaking** the fire triangle chain by removing oxygen and heat inside the combustion element

**04** **alerting** emergency services at an early stage of the fire (give a warning of fire to occupancy)

*"Safety First is  
Safely Always "*

Charles Melville Hays

## 1.3 FIRE CLASSIFICATION

---

### CLASS A : FIRES INVOLVING SOLID MATERIALS

- A Class A fire refers to a type of fire that involves ordinary combustible materials such as wood, paper, fabric, plastic, and some types of trash.
- These fires are characterized by the presence of easily burnable materials that leave behind ash when they are burned.
- Class A fires are common in residential settings, offices, schools, and other places where these ordinary combustibles are present.
- The best way to deal with these types of fires is by cooling them or removing heat using **water** fire suppression equipment or smoldering them or removing oxygen using **dry powder/dry chemical powder**.





## CLASS B : FIRES INVOLVING LIQUIDS

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- Class B fires involve flammable liquids such as gasoline, oil, diesel, alcohol, kerosene, paint thinner, and various industrial solvents. These liquids have low flash points, which means they can easily vaporize and ignite at relatively low temperatures.
- Class B fires can spread quickly and can be extremely dangerous if not handled properly.



*"Take Fire Prevention  
Seriously, Prevention Is  
Better Than Cure"*

Activities or situations that commonly involve flammable liquids and can potentially lead to Class B fires include :

- Fuel storage and handling: Storing, transferring, or transporting flammable liquids such as gasoline, diesel, or aviation fuel.

- Vehicle accidents: Vehicle crashes or accidents involving cars, trucks, or other motorized vehicles can result in fuel spills and potential Class B fires.
- Flammable liquid containers: Mishandling, leakage, or improper storage of flammable liquid containers can lead to fire hazards.



- When dealing with a Class B fire, it is important to remember that water should not be used as an extinguishing agent, as it can spread the flammable liquid and potentially make the fire worse.
- Instead, fire extinguishers containing dry chemical agents like ABC powder, carbon dioxide (CO<sub>2</sub>), or foam are commonly used to suppress Class B fires.
- These extinguishing agents work by either smothering the fire to remove oxygen (foam and CO<sub>2</sub>) or interrupting the chemical reaction (dry chemical powders).

Preventive measures, such as using appropriate containers, maintaining equipment, and having fire safety protocols in place, are crucial to minimize the risk of Class B fires.



**Table 1. Maximum area of class B fire (deep liquid) for which extinguishers are suitable**

Extinguisher rating	Maximum area for three extinguishers (foam extinguishers only) (m <sup>2</sup> )	Maximum area for two extinguishers (m <sup>2</sup> )	Maximum area for one extinguisher (m <sup>2</sup> )
21B	0.42	0.26	0.14
34B	0.68	0.42	0.23
55B	1.10	0.69	0.37
70B	1.40	0.88	0.47
89B	1.78	1.11	0.59
113B	2.26	1.41	0.75
144B	2.88	1.80	0.96
183B	3.66	2.29	1.22
233B	4.66	2.91	1.55

## CLASS C : FIRE INVOLVING GASES

---



- A Class Flammable Gas fire refers to a type of fire involving the combustion of flammable gases.
  - These fires occur when flammable gases, such as propane, methane, butane, acetylene, or natural gas, come into contact with an ignition source, causing them to ignite and burn.
  - Flammable gas fires can spread quickly, especially in confined spaces, as the gas can disperse rapidly and ignite over a large area.
- In some cases, flammable gas fires may not have visible flames, particularly if the gas is not well-mixed with air. Instead, the flames may appear as a blue or colorless "invisible" fire.

## SAFETY TIPS FOR CLASS FLAMMABLE GAS FIRES:

- Shut off the gas supply: If it is safe to do so, shut off the gas supply to the affected area to prevent further fueling of the fire.
- Use the correct extinguisher: If you have access to dry chemical or CO2 extinguishers, use them to suppress the flames from a safe distance.
- Prevention: Practice safe handling and storage of flammable gases. Regularly inspect gas equipment, ensure proper ventilation in enclosed spaces, and follow safety guidelines.





## CLASS D : FIRE INVOLVING METALS

---

- Class D fires occur when certain reactive metals, such as magnesium, titanium, sodium, potassium, lithium, and others, undergo combustion in the presence of an ignition source, such as heat or a spark.
- Class D fires are relatively rare but can be extremely dangerous and challenging to extinguish due to the unique properties of these metals.

### CHARACTERISTICS OF CLASS D METALS FIRES:

- Fuel: The primary fuel source for Class D fires is combustible metals. These metals have high heat conductivity and can generate intense heat when they react with air or water.
- Intense heat: Class D fires can reach extremely high temperatures, leading to the potential for nearby flammable materials to ignite.
- Unique combustion properties: Some combustible metals can react violently with water, releasing hydrogen gas and exacerbating the fire.
- Specialized extinguishing agents: Class D fires require specialized knowledge and equipment for safe handling and extinguishing.



## CLASS E : FIRES INVOLVING ELECTRICAL EQUIPMENT

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- Class E fires involve energized electrical equipment, such as electrical panels, wiring, appliances, motors, and transformers, catching fire.
- These fires occur when an electrical fault or short circuit causes the release of heat and ignition of surrounding materials.
- Class E fires are unique because they involve live electrical currents.
- The most critical aspect of extinguishing Class E fires is to avoid using water or water-based extinguishers.



*"Be In Control And Stay Away From Fire"*

### EXTINGUISHING CLASS E FIRES:

- Dry chemical fire extinguishers (ABC dry powder): These extinguishers are effective for smothering the fire and interrupting the combustion process.
- Carbon dioxide (CO<sub>2</sub>) fire extinguishers: CO<sub>2</sub> extinguishers displace oxygen, suffocating the fire without leaving any residue, making them suitable for use on electrical equipment.



## CLASS F : FIRES INVOLVING FATS AND COOKING OILS

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- Class F fires typically occur in kitchens and commercial cooking areas, such as restaurants, cafeterias, and food processing facilities.
- The primary fuel source for Class F fires is cooking oils and fats, including vegetable oils, animal fats, and other greases used in cooking.

### POTENTIALLY DANGEROUS SPLATTERING :

- When water is added to a burning cooking oil fire, it can cause the oil to splatter, spreading the fire and potentially causing burn injuries to those nearby.



*"Fire Prevention Can Save Lives"*

- Kitchen fires are often classified as Class F fires because they involve fats and grease commonly found in the kitchen.

## PRECAUTIONS TO MINIMIZE THE RISK OF A KITCHEN FIRE

- 1** One of the leading causes of kitchen fires is unattended cooking. Always stay in the kitchen while cooking, frying, grilling, or broiling food. If you need to leave the kitchen, turn off the stove.
- 2** Keep flammable items such as dish towels, paper towels, oven mitts, and wooden utensils away from the stovetop. Make sure the area around the stove is clear of clutter.
- 3** Avoid distractions like phone calls, texting, or watching TV while cooking. Staying focused on cooking reduces the chances of accidents.
- 3** If a small grease fire starts in a pan, smother it by carefully sliding a lid over the pan and turning off the heat. Do not use water on a grease fire, as it can cause the fire to spread.



## 1.4 SUMMARY

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### **AVOID POTENTIAL FIRES IN BUILDINGS FOR THE SAFETY OF OCCUPANTS AND THE PROTECTION OF PROPERTY**

To avoid potential fires in buildings and ensure safety, it is essential to prioritize fire prevention measures. Regular maintenance of electrical systems and equipment, proper storage and handling of flammable materials, and the enforcement of a no-smoking policy are crucial steps. Additionally, installing and maintaining fire safety equipment, conducting fire drills, and educating occupants about fire safety protocols contribute to creating a safer environment. Developing a comprehensive fire safety plan and using fire-resistant construction materials further mitigate the risk of fires, safeguarding both occupants and property.



## 1.5 SELF ASSESSMENT

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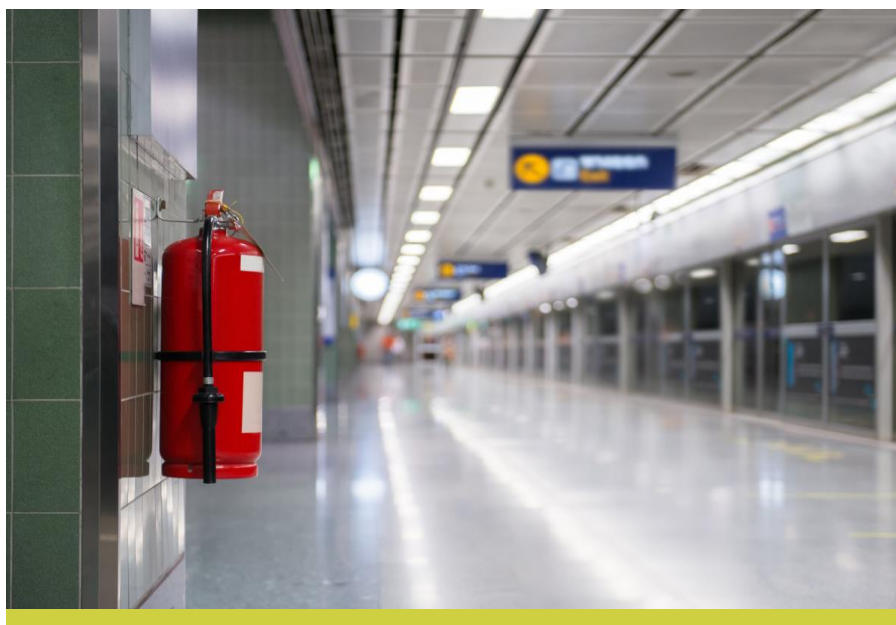
1. Class F fire classification is refer to :
  - A. Grease
  - B. Newspaper
  - C. Fabric cloth
  - D. Petrol
  
2. Choose TWO (2) types of fuel in Class A Fire Classification
  - A. Plastic and cooking oil
  - B. Grease and petrol
  - C. LPG and diesel
  - D. Fabric cloth and newspaper
  
3. "The best way to deal with these types of fires is by cooling them or removing heat using water fire suppression equipment or smoldering them or removing oxygen using dry powder/dry chemical powder (DP)"
  - A. Class A
  - B. Class B
  - C. Class C
  - D. Class D



## CHAPTER 2.0 PORTABLE FIRE EXTINGUISHER

### 2.1 INTRODUCTION

During the initial outbreak of a fire incident, portable fire extinguishers (PFEs) are elementary fire-fighting equipment intended for first-aid fire fighting to prevent escalation into a full-scale fire. PFEs contain medium extinguishing agents such as dry powder, foam, water, carbon dioxide gas, or wet chemicals and can be manually operated by building occupants to control and extinguish fires in the initial stage. These compact and easily transportable devices play a vital role in fire safety by providing a quick and accessible means of tackling fires before they escalate and become more dangerous.



## 2.2 STANDARDS AND REGULATIONS

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### UBBL 1984 CLAUSE 227

"Portable extinguisher shall be provided in accordance with the relevant codes of practice and shall be sited in prominent positions on exit routes to be visible from all direction and similar extinguishers in a building shall be of the same method of operation"

### MS1539 :PART 3 :2000

"Fire classes, fire hazard location, extinguisher distribution, extinguisher performance as well as application should be the criteria for determining the size and quantities of portable fire extinguisher."



## 2.3 TYPES OF PORTABLE FIRE EXTINGUISHER

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### ABC DRY POWDER

- Dry Powder Extinguishers are suitable for use on Class A, B C and highly effective for electrical fire hazards.
- This multi purpose extinguisher interferes with the combustion process and provides rapid fire knock down.
- Typical applications for these extinguishers include homes, commercial offices, public places, restaurants, hotels, schools, industrial units, small areas including vehicles.

- The medium inside the cylinder consist of 97% sodium bicarbonate, 1.5% magnesium stearate, 1% magnesium carbonate & 0.5% tri calcium phosphate.



The color code for dry powder fire extinguishers is blue.

---



“A Small Match Lights a  
Big Fire”

## KEY FEATURES AND CHARACTERISTICS

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- The dry powder used in this type of fire extinguisher works by interrupting the chemical reaction of the fire and smothering the flames, thereby suppressing the fire.
- Dry powder is non-conductive, making it safe to use on electrical fires. When applied to Class C fires, it does not conduct electricity and does not pose an electrical shock hazard to the user.
- Dry powder fire extinguishers typically have a squeeze-grip handle or lever for activation, and the user can quickly discharge the powder by pressing the lever.





<https://www.safelines.co.uk/fire-extinguisher-types>

## CARBON DIOXIDE FIRE EXTINGUISHER

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A carbon dioxide (CO<sub>2</sub>) fire extinguisher is a type of portable fire extinguisher that uses carbon dioxide gas as the extinguishing agent. CO<sub>2</sub> extinguishers are specifically designed to tackle Class B and Class E fires, involving flammable liquids and energized electrical equipment, respectively. They are widely used in industrial settings, laboratories, server rooms, and areas with sensitive electrical equipment.

They are known for being effective and versatile, particularly in scenarios where water or other types of extinguishing agents might cause damage.

## KEY FEATURES AND CHARACTERISTICS:

- Carbon dioxide (CO<sub>2</sub>) is a non-flammable, colorless, and odorless gas. It works by displacing oxygen around the fire, effectively smothering the flames and interrupting the combustion process.
- Carbon dioxide (CO<sub>2</sub>) is a non-conductive and non-corrosive gas. It displaces oxygen, which starves the fire of the oxygen it needs to burn. CO<sub>2</sub> is especially suitable for fires involving flammable liquids, gases, and electrical equipment.
- Carbon dioxide is effective for fires in confined spaces where oxygen can be rapidly depleted, leading to smothering the fire.
- When CO<sub>2</sub> is discharged, it leaves no residue behind. This makes it ideal for use in areas with sensitive equipment, electronics, machinery, or valuable documents where cleanup after extinguishing the fire is a concern.



The color code for wet chemical fire extinguishers is black.

---

## WET CHEMICAL FIRE EXTINGUISHER

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Wet chemical fire extinguishers are specifically designed to address the unique challenges posed by fires involving cooking oils and fats. Class F fires, also known as kitchen fires, can occur when cooking oils and fats used in deep fryers, griddles, and cooking ranges ignite. These fires can spread rapidly and can be difficult to extinguish with traditional fire extinguishing agents due to the high temperatures and re-ignition potential of the hot cooking oil.



***"Stay Alert! Never Leave Cooking Unattended"***

## KEY FEATURES AND CHARACTERISTICS

---

- The wet chemical used in these extinguishers is a specially formulated solution, typically based on potassium acetate. The chemical is mixed with water to create a foam when discharged.
- The extinguishing agent used in wet chemical fire extinguishers is a specially formulated solution containing a potassium-based solution, often combined with an alkaline substance. This solution reacts with burning cooking oils and fats to create a soap-like layer on the surface of the liquid, effectively smothering the fire and preventing re-ignition.
- When the wet chemical comes into contact with hot cooking oils or fats, it undergoes a process called saponification. Saponification turns the oil into a soapy foam, which effectively cools the oil, prevents it from splashing, and creates a barrier that extinguishes the fire by cutting off the oxygen supply.



The color code for wet chemical fire extinguishers is golden yellow.



## WATER BASED FIRE EXTINGUISHER

---

Water extinguishers are suitable for Class A fires caused by combustion of solid materials such as wood, paper, straw, textiles and coal etc. Typical applications for these extinguishers include commercial offices, public places, restaurants, hotels, schools, industrial units and many others.

## KEY FEATURES AND CHARACTERISTICS

---

- The main extinguishing agent in water-based fire extinguishers is plain water. Some water-based extinguishers may contain additives or foaming agents to enhance their firefighting capabilities.
- Water-based extinguishers should not be used on Class B fires involving flammable liquids (e.g., gasoline, oil) or Class E fires involving energized electrical equipment, as it can spread the fire or pose a risk of electric shock.



The color code for water fire extinguishers is red.

---





## FOAM FIRE EXTINGUISHER

- A foam fire extinguisher is a type of portable fire extinguisher that uses foam as the extinguishing agent.
- It is a versatile fire suppression tool designed to tackle Class A and Class B fires, making it suitable for fires involving ordinary combustible materials (like wood, paper, and cloth) and flammable liquids (such as gasoline, oil, and solvents).



*"Ensure Fire Safety, Save Life, Save Property"*

- Foam extinguishers are commonly found in commercial and industrial settings, as well as in areas with a risk of flammable liquid fires.
- Foam extinguishers work by cooling the fire and smothering the flames, making them highly effective for Class A and Class B fires.



## KEY FEATURES AND CHARACTERISTICS

---

- The extinguishing agent in foam fire extinguishers is a foam concentrate mixed with water. When the extinguisher is discharged, the foam forms a thick blanket that covers the fuel, cutting off the oxygen supply and suppressing the fire.
- Foam extinguishers should not be used on large Class F fires involving extensive electrical equipment. In such cases, it is safer to de-energize the equipment and use an appropriate extinguisher.
- The foam not only smothers the fire by cutting off its oxygen supply but also has a cooling effect, reducing the temperature of the fuel and helping prevent re-ignition.
- Foam extinguishers may leave a residue after use that requires cleaning. They can also create a temporary reduction in visibility due to the foam.



The color code for foam fire extinguishers is cream.

## 2.4 SELECTION OF PORTABLE FIRE EXTINGUISHER

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Selecting the appropriate portable fire extinguisher involves considering several factors, including the type of fire risks present, the specific fire classes that might occur, and the location of the extinguisher. The selection process should adhere to local fire safety regulations and guidelines.

### 1 IDENTIFY FIRE HAZARDS

Conduct a thorough fire risk assessment of the area or building. Identify potential fire hazards, such as flammable liquids, combustible materials, electrical equipment, and cooking areas. Consider the type and quantity of flammable materials present.





**EMERGENCY CALL**

**999**



## **2 CHOOSE SUITABLE EXTINGUISHING AGENTS**

Choose suitable extinguishing agents: based on the identified fire hazards, select extinguishing agents that are appropriate for the potential fire classes, for example:

- Dry powder extinguishers (Class A) for ordinary combustibles.
- Foam or dry chemical extinguishers (Class B) for flammable liquid fires.
- Class D or specialized extinguishers for combustible metal fires.
- Carbon dioxide (CO<sub>2</sub>) or dry powder extinguishers (Class E) for electrical fires.
- Wet chemical extinguishers (Class F) for commercial cooking settings.

### **3 EVALUATE EXTINGUISHER**

#### **SIZE AND CAPACITY**

Consider the size of the area or the potential fire risk when determining the capacity of the extinguishers. Larger areas may require more extensive and higher-capacity extinguishers.

### **4 PROPER MAINTENANCE**

Regularly inspect and maintain the extinguishers to ensure they are in good working condition. Follow recommended inspection schedules and conduct servicing as required.

### **5 COMPLIANCE WITH REGULATIONS**

Ensure that the selected extinguishers meet local fire safety regulations and standards.

It is essential to prioritize personal safety during a fire emergency.

Portable fire extinguishers are effective for small fires in their early stages, but for larger or uncontrollable fires, evacuate the area immediately and call for professional help. Fire safety is a shared responsibility, and everyone should be aware of the fire risks and the proper use of fire extinguishers in their surroundings.

## 2.5 FIRE EXTINGUISHER INSTALLATIONS

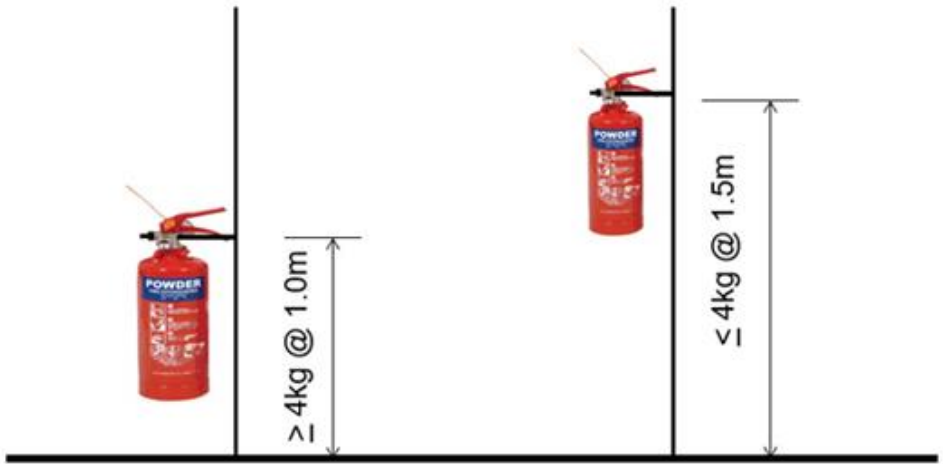
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**01** Extinguishers should be located in conspicuous positions on brackets or stands where they will be readily seen by persons following an escape route. Siting positions near to room exits and stairways, corridors and lobbies are most suitable. Extinguishers should not be located where a potential fire might prevent access to them.

**02** Small extinguishers with a total weight up to and including 4kg should be mounted so as to position the handle about 1.5m from the floor but the carrying handle of larger, heavier extinguishers should be about 1m from the floor. Care should be taken to ensure that a heavy extinguisher does not itself cause injuries by being dislodged and falling onto limbs or bodies.

- 03 Extinguishers should be available for immediate use at all times. Extinguishers should be sited in such a way that it is not necessary to travel more than 20m from the site of the fire to reach an extinguisher. Similar positions on each floor are advisable. It is inadvisable to place extinguishers in positions in rooms or corridors away from exits unless they are necessary to cover a particular hazard.



- 04 Extinguishers provided to deal with special fire risks should be sited near to the fire risk concerned, but not so near as to be inaccessible or place the operator in undue danger in case of fire.

05

The operation of extinguishers is affected by temperature and those conforming to MS 1539: Part 1 are therefore marked with the temperature range within which they will perform satisfactorily. Extinguishers should not be exposed to storage temperatures outside the range marked on the extinguisher.

06

Extinguishers, unless specially treated by the manufacturer, specially housed in purpose designed boxes, or provided with protective covers designed for the purpose, should not be located in places where they may be exposed to unduly corrosive atmospheres or to splashing by corrosive fluids.

## NOTE

If the fire risk is in a confined space, it is generally advisable to position the extinguisher immediately outside that space.





## 2.6 FIRE RATING

The fire rating of a portable fire extinguisher refers to its effectiveness in extinguishing specific types and sizes of fires. Fire extinguishers are classified based on the classes of fires they can effectively combat.

The fire rating of a portable fire extinguisher is usually represented as a combination of letters and numbers (e.g., 13A, 27A, 55B, etc.).

The fire rating is found by multiplying the floor area of storey in metre squared ( $m^2$ ) by 0.065

*The higher the number rating, the larger the fire extinguisher can handle*



### CALCULATE THE SIZE OF FIRE EXTINGUISHER

Calculating the appropriate size and type of portable fire extinguisher requires careful consideration of various factors to ensure the right extinguisher for the specific fire hazards and environment.



## EXAMPLE

Calculate the minimum aggregate class A rating for a single storey building of floor area 1600m<sup>2</sup>

## SOLUTION

Class A rating =  $0.065 \times 1600 = 104A$

This aggregate rating can be provided in one of a number of ways. For example:

if consider for 4kg@13A cylinder;

$$104A / 13A = 8 \text{ units}$$

$$8 \text{ units} \times 13A \text{ PFE} = 104A \dots 8 \times 4\text{kg}$$

DP of 13A

OR :

if consider for 9kg@27A cylinder;

$$104A / 27A = 3.85$$

$$= 4\text{units}$$

$$4 \text{ units} \times 27A \text{ PFE} = 108A$$

$$= 4 \times 9\text{kg DP of 27A}$$



MS1539 : Part 3 : 2003  
Specification For Portable Fire  
Extinguishers - Part 3

## 2.7 HOW TO USE A FIRE EXTINGUISHER ?

---

A fire extinguisher is a tool for fighting or extinguishing small accidental fires. Knowing how and when to use a fire extinguisher is a very important skill for safety. The following procedure describes how to use a fire extinguisher in the event of an emergency.

- 1** Pull the pin at the top of the extinguisher.
- 2** Aim the nozzle at approximate 1.5m to the base of the fire.
- 3** Squeeze the lever slowly to begin discharge the extinguishing agent. Release the handle will stop discharge of the extinguishing medium.
- 4** Sweep the nozzle left and right position to cover as much area as possible



## 2.8 SUMMARY

---



In conclusion, fire safety is very important to protect life and property. Fire extinguishers are valuable tools that can effectively combat small fires during their initial stages, but they have limitations and should be used with caution. Proper training and awareness regarding fire extinguisher usage are crucial for individuals to respond effectively in emergency situations.

However, personal safety should always be the top priority, and if the fire cannot be controlled or poses a significant risk, immediate evacuation is necessary. It is essential to maintain regular inspections of fire extinguishers, promote fire safety education, and have established emergency response procedures in place. By prioritizing fire safety, we can minimize the risks associated with fires and ensure the well-being of individuals and communities.

## 2.9 SELF ASSESSMENT

---

1. The most common extinguisher found in public spaces today is the \_\_\_\_\_.
  - A. Water
  - B. Foam
  - C. Carbon dioxide
  - D. Dry powder
2. ABC fire extinguishers extinguish fire by cooling it down.
  - A. True
  - B. False
3. What does PASS stand for ?
  - A. Pull Arm Shout Squeeze
  - B. Push Arm Shoot Sweep
  - C. Pull Aim Squeeze Sweep
  - D. Push Aim Shoot Shout

check your answer here :



<http://bit.ly/selfassessmentfe>





## CHAPTER 3.0 FIRE HOSE REEL SYSTEM

### 3.1 INTRODUCTION

Hose reel is a fire fighting equipment, consisting of a length of tubing fitted with a shut-off nozzle and attached to a reel, with a permanent connection to a pressurized water supply (MS 1489 : PART 1 : 1999).

The main purpose of fire hose reels is to enable occupants to take action in the initial stages of a fire before it grows out of control. They are especially useful for tackling Class A fires, involving ordinary combustible materials like wood, paper, and cloth. It consists of various elements, including a fire water tank, hose reel pumps, hose reel pipe work, valves, and a rubber hose equipped with a drum. The installation of a hose reel system in a building is determined by the building's designated purpose group, as outlined in Schedule 10 of the Uniform Building By-Law (UBBL 1984).

Fire hose reels are typically installed in commercial, industrial, and residential buildings to provide an immediate and continuous water supply for combating early-stage fires. Fire hose reels provide an immediate water supply, allowing occupants to respond quickly to a fire before it escalates, potentially saving lives and minimizing property damage.

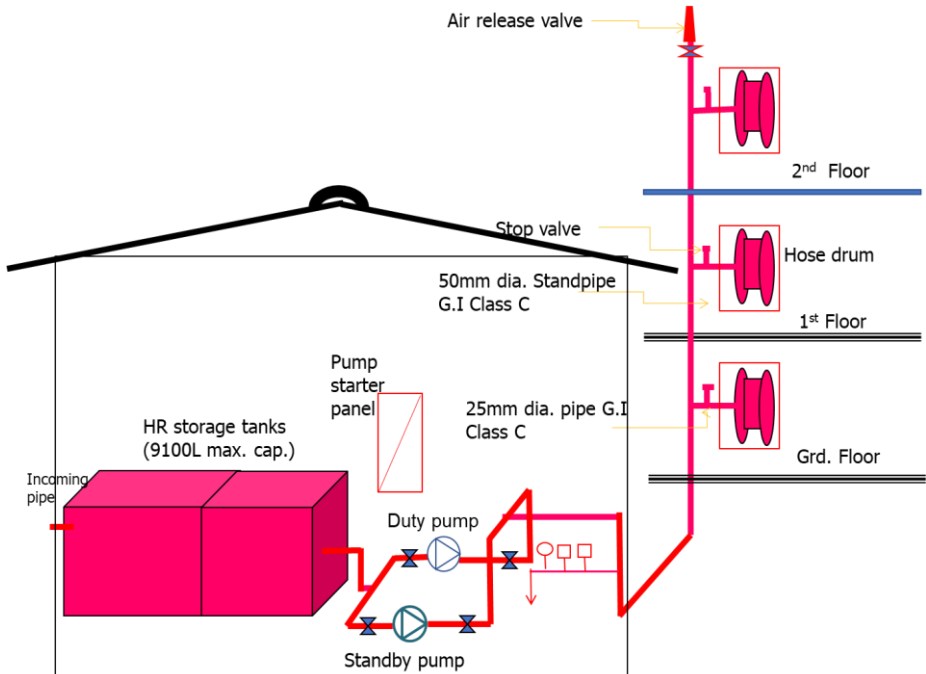
Occupancy Hazard	Extinguishing system Note 2	Fire alarm system Note 3
IV. Office		
Total gross floor area.		
1. Four storeys and below or less than 1,000 square metres.	-	-
2. Five storeys and above or of exceeding 1,000 square metres.	G	2
3. Exceeding 18 metres in height and less than 10,000 square metres.	G	1 & 2
4. 30 metres and above in height or of exceeding 10,000 square metres.	A & G	2, 4, 5 & 6



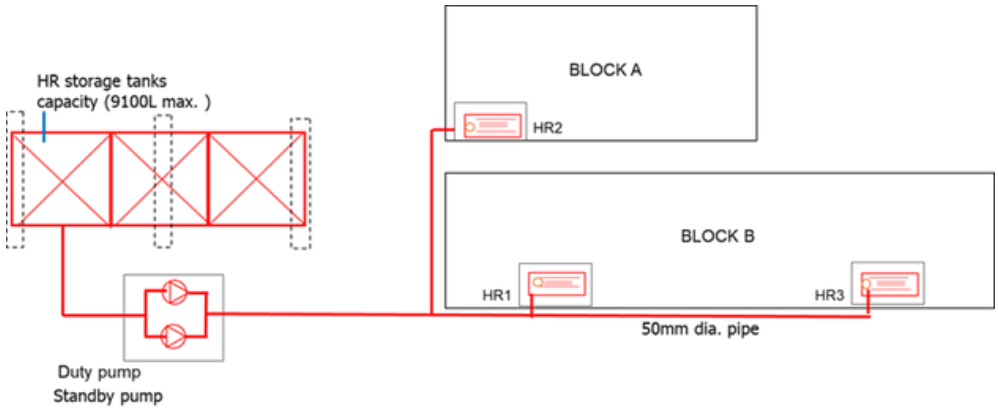
Uniform Building by Law 1984 (10th Schedule) :  
The letter 'G' refers to buildings requiring a fire hose reel system

## 3.2 DESIGN REQUIREMENTS

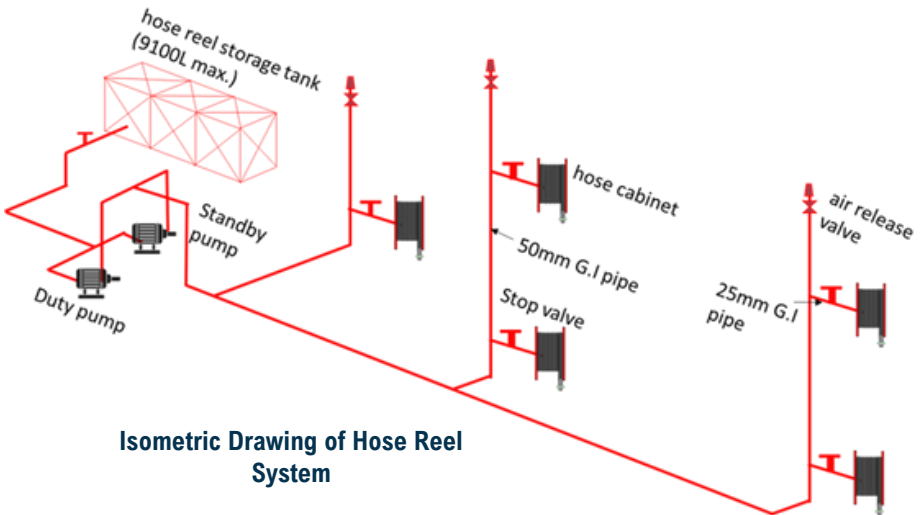
- M.S.1489 Part 1: Hydrant System, Hose Reels and Foam Inlets;
- M.S.1447 - Hose Reels with semi – rigid hose;
- M.S.1488: Semi – rigid hoses for first aid fixed installations.
- It should be complied with M.S.1447 and stated detailed under the 10th. Schedule (refer to UBBL 1984)
- Uniform Building by Law 1984 (10th Schedule)







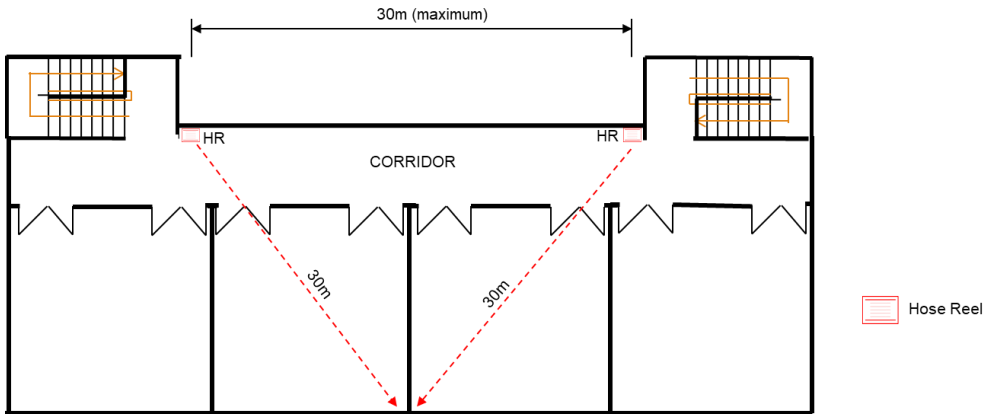
Plan View of Hose Reel System



Isometric Drawing of Hose Reel System

### 3.3 LOCATION OF HOSE REEL IN BUILDING

The location of fire hose reel in a building is critical for their effectiveness in responding to fires quickly and efficiently. Fire hose reels should be strategically placed in easily accessible and visible locations throughout the building to ensure that occupants can reach them promptly during an emergency.



#### 1 NEAR EXITS

Hose reels should be sited in prominent and accessible at each floor level adjacent to exits in corridors on exit routes, in such a way that the nozzle of the hose can be taken into every room and within 6m of each part of a room, having regard to any obstruction.

## 2 COVERAGE AREA

One hose reel unit should be provided for every 800m<sup>2</sup> of usable floor space (MS1447 : Hose Reel with Semi-Rigid Hose)

## 3 DISTANCE LIMITATIONS

The installation of each hose reel are usually to be placed where could cover 30 meters of hose coverage between the hose reels stack.

## 4 CLEAR VISIBILITY

Fire hose reels should be easily seen and identifiable. Avoid obstructing them with furniture, decorations, or other objects that may hinder their visibility.



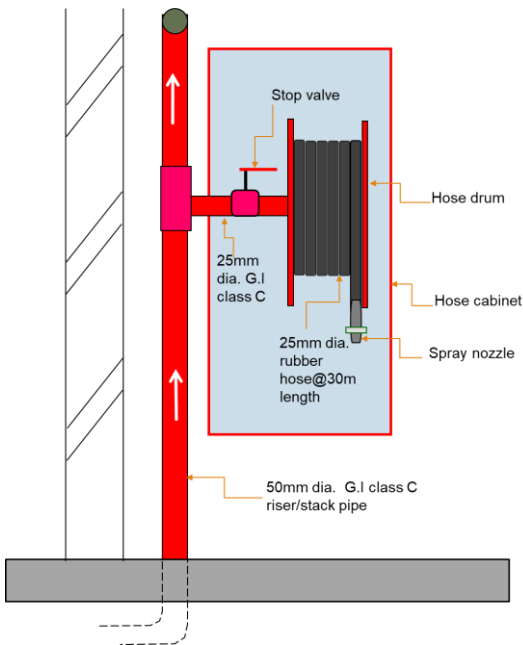
When installed on open floor areas it may be necessary to position hose reels above head height, but in these cases the nozzle retainer, the hose guide and the inlet valve should be fitted at about 900mm above floor level.

Hose reel stack installation are fixed directly above head level to consider the potential for any damage from surroundings environment.

## 3.4 COMPONENT OF HOSE REEL SYSTEM

### FIRE HOSE REEL CABINET

Fire hose reel cabinet is a housing unit designed to enclose and protect the components such as fire hose reel, nozzle, drum and rubber hose. It serves as a protective casing for the fire hose reel, keeping it secure, clean, and readily accessible during emergencies. The cabinet is an essential component of the overall fire safety system in a building, ensuring that the fire hose reel is in optimal condition for immediate use when needed.



## HOSE REEL STORAGE TANK

The hose reel system should be supply water from the storage tank having a minimum capacity of 2275L for the first hose reel and 1137.5L for each additional hose reel up to a maximum of 9100L. (Schedule 10th UBBL 1884).The tank should be automatically supplied from a town main.



***"Prevent Fires, Protect Lives"***

The hose reel tank need to be refilled with 50mm supply pipe and at the min. flow rates of 120L/min (30 lpm). The material used for the fire tank is either made from pressed steel (hot dipped galvanized and coated internally with bituminous paints for corrosion protection), Fiberglass Reinforced Plastics (FRP) or Reinforced Concrete (R.C).

Clause 247(2) : Main water storage tanks within the building, other than for hose reel systems, shall be located at ground, first or second basement levels, with fire brigade pumping inlet connection accessible to fire appliances.

## HOSE REEL PUMP



All pumps should be capable of being started and stopped manually. The standby pump should be so arranged that will operate automatically on failure for any reason of the duty pump.

The hose reel pump set consists of 1 unit of Duty Pump and 1 unit of Standby Pump. Pump flowrates 120L/min capability and operating pressure at 2 to 3 bars where 4 hose reels could be activated at one time during fire.





Standby Pump supplied with power from the emergency generator /diesel (fuel supply should be adequate for min. 1 hour of operation)

## **FIRE HOSE**

The fire hose used in the system is a high-pressure hose made of synthetic materials like rubber or synthetic fibers to withstand the water pressure during firefighting. It typically has a length of 30 meters or more to cover a considerable distance.

## **STOP VALVE**

The hose reel system includes a stop valve that controls the water supply to the fire hose. This valve is usually located near the hose reel for easy access and operation.

## REEL DRUM

The central component is the cylindrical drum itself, which is usually made of sturdy materials like steel or other metals. The drum is designed to hold the fire hose in a neat and organized manner, allowing for easy deployment when needed.

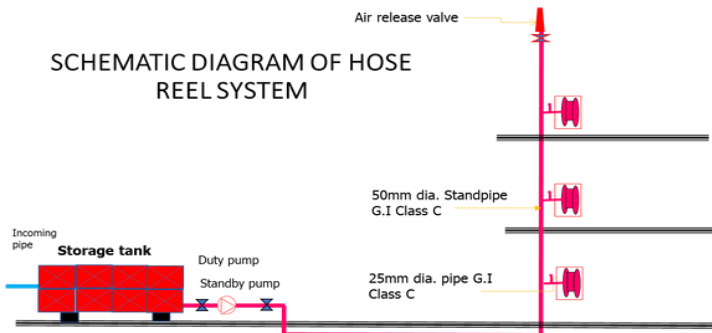


## NOZZLE

A hose nozzle is attached to the end of the fire hose. The nozzle allows the user to control the water flow, either as a straight stream or a spray pattern.

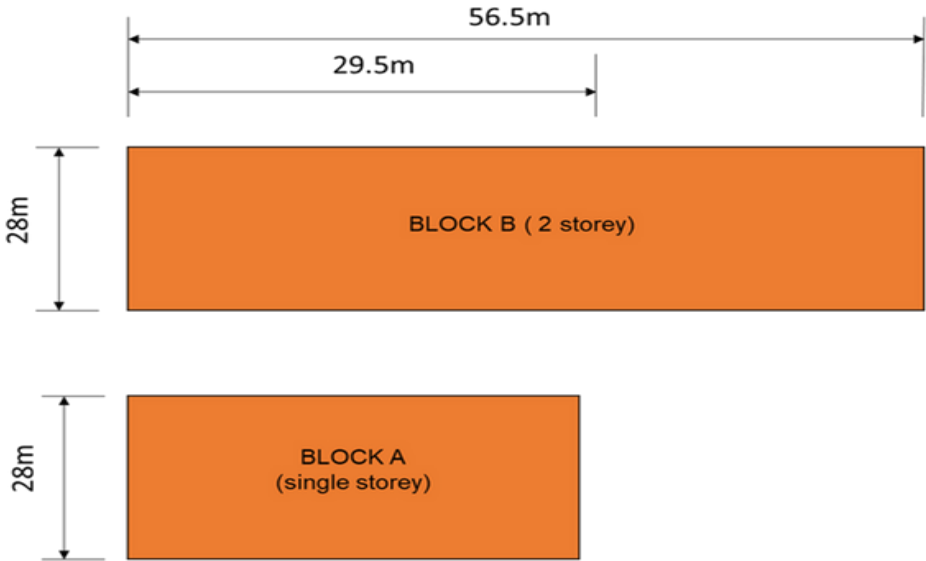
## PIPEWORK

The pipework of a fire hose reel is an important component of the fire hose reel system, responsible for delivering water from the water supply source to the hose reel for firefighting purposes. It is generally 50mm nominal diameter and the feed individual hose reel should be not less than 25mm diameter.





### 3.5 BASIC DESIGN OF HOSE REEL SYSTEM



#### EXAMPLE

The diagram shows a one-story office building (Block A) and one block of a two-story office building (Block B).

- i. Determine the number of hose reel required in both buildings block and
- ii. Calculate the size of the water storage tank

## **SOLUTION i. The number of hose reel required in both buildings**

1. Calculate total floor area :

Floor area (Block A) :  $29.5\text{m} \times 28\text{m} = 826 \text{ m}^2$

Floor area (Block B) :  $56.5\text{m} \times 28\text{m} = 1582 \text{ m}^2 \times 2 \text{ floor level}$   
 $= 3164 \text{ m}^2$

-----

**Total floor area for office building = 3990 m<sup>2</sup>**

-----

2. Refer to UBBL 1984 for the requirement of fire fighting system (Tenth Schedule : Table of requirement for the fire alarm system and fire extinguishment system)

IV. Office		
Total gross floor area.		
1. Four storeys and below or less than 1,000 square metres.	—	—
2. Five storeys and above or of exceeding 1,000 square metres.	G	2
3. Exceeding 18 metres in height and less than 10,000 square metres.	G	1 & 2
4. 30 metres and above in height or of exceeding 10,000 square metres.	A & G	2, 4, 5 & 6

The requirements of building with total floor area **3990m<sup>2</sup>**

(exceeding 1000m<sup>2</sup>) is hose reel system (G) and manual electric fire alarm system (2).

## SOLUTION

---

3. Calculate the number of hose reel

# Floor area (Block A) :  $29.5\text{m} \times 28\text{m} = 826 \text{ m}^2$

refer to MS1489 : Hose reel coverage area =  $800 \text{ m}^2$  / hose

No. of hose reel required

$$= \text{floor area} \div \text{hose reel coverage area}$$

$$= 826 \div 800$$

$$= 1.03$$

$$= \mathbf{1 \text{ unit of hose reel}}$$

Floor area (Block B – Ground Level) :  $1582 \text{ m}^2$

refer to MS1489 : Hose reel coverage area =  $800 \text{ m}^2$  / hose

No. of hose reel required

$$= \text{floor area} \div \text{hose reel coverage area}$$

$$= 1582 \div 800$$

$$= 1.9775$$

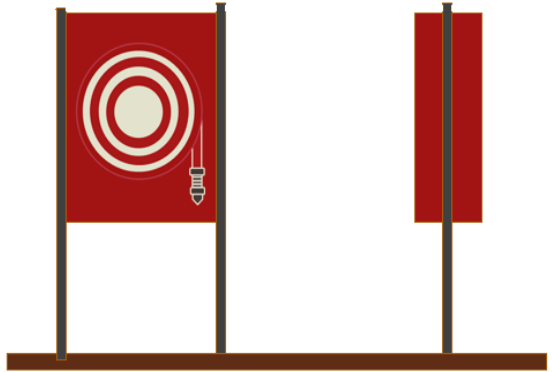
$$= \mathbf{2 \text{ unit of hose reel}}$$

*When position each hose reel, considering the distance between each hose reel is 30m maximum.*



Hence, since the Block B is a two story building, the number of hose reel should be provided is 4 unit.

**Total hose reel = 5  
unit/building**



## SOLUTION ii. Size of the water storage tank

1. Refer to UBBL 1984 ( Schedule 10th) water storage quantity for hose reel system

2	Minimum quantity of water storage required for hose reel systems only	
	Minimum storage required for the first hose reel	2275L
	For each additional hose reel	1137.5L up to maximum of 9100L

Capacity of hose reel storage tank :

Water capacity for the first hose reel (HR1)

$$= 2275L$$

Water capacity for the next hose reel (HR2, HR3, HR4 and HR5):

$$= 1137.5L \times 4$$

$$= 4550L$$

Total water storage capacity :

$$= 2275 + 4550$$

$$= 6825L$$

Hose reel storage tank can be positioned at ground floor, lower ground floor, basement or roof top level.

$$+ 10\% \text{ for HR tank size} = 682.5L$$

Hose reel tank size

$$= 6825L + 682.5L$$

$$= 7507.5L @ 7.51m^3$$

Hose reel storage tank size

(consider 1 unit of tank size is 1.22m x 1.22m x 1.22m) :

assume the width and height of tank is 1.22 m x 2.44m;

Hence,

$$\text{Length} = 7.51m^3$$

-----

$$[ 1.22m \times 2.44m ]$$

$$= 7.51m^3 / 2.98m$$

$$= 2.52m$$

1 tank dimension is 1.22m, hence

$$= 2.52m / 1.22m$$

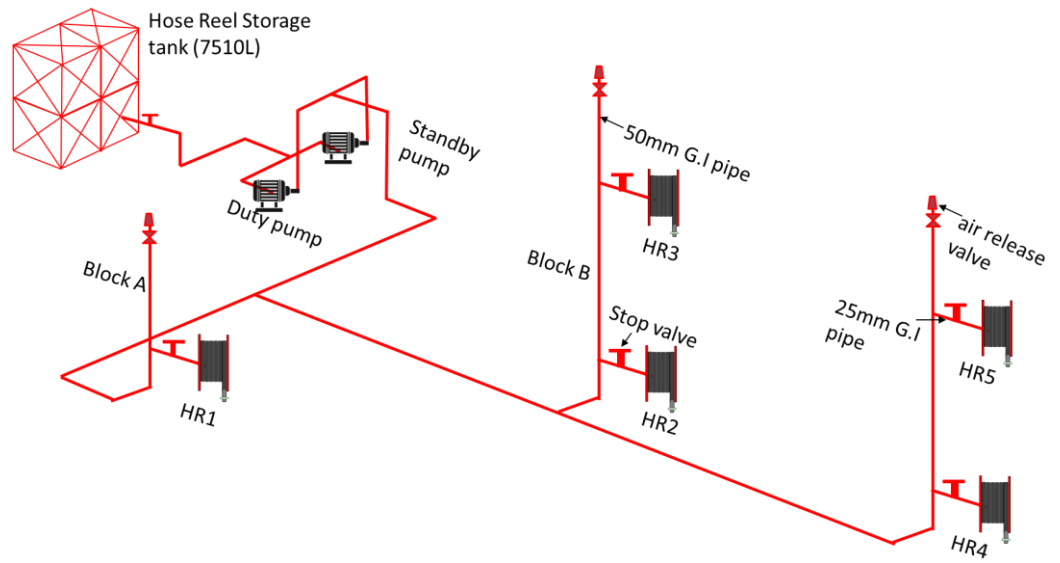
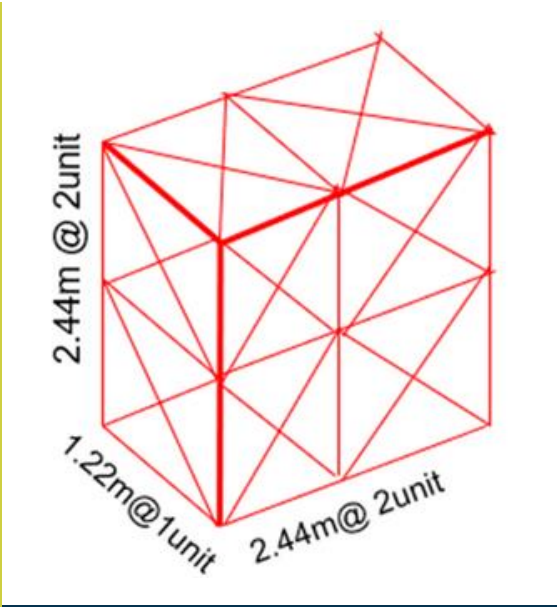
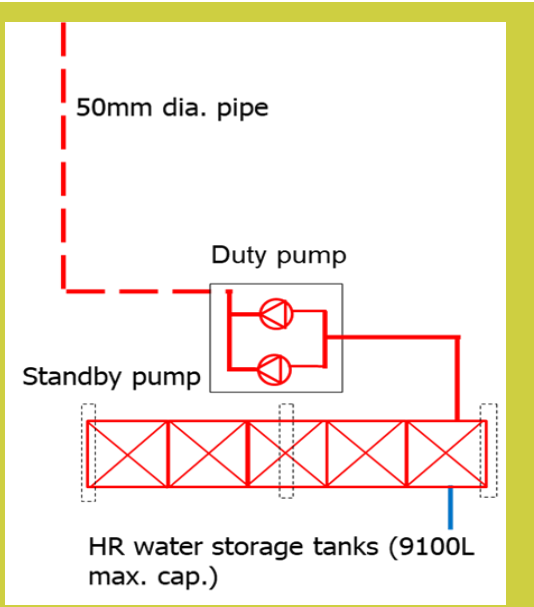
$$= 2.07 @ 2 \text{ unit}$$

Actual Length (L)

$$= 2 \text{ unit} \times 1.22m$$

$$= 2.44m @ 2 \text{ unit}$$

**Hose reel water storage tank size : 2.44m(L) x 1.22m(W) x 2.44m(H)**



**ISOMETRIC DRAWING OF HOSE REEL SYSTEM**

## 3.6 HOW TO USE A FIRE HOSE REEL ?

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Before attempting to use the fire hose reel, assess the fire situation to ensure your safety and the safety of others. If the fire is too large or spreading rapidly, it may be best to evacuate the area and call the fire department.

- 1 Open the hose cabinet
- 2 Pull out the rubber hose to a safe distance from the fire.
- 3 Turn on the stop valve to allow the water flow into the rubber hose.
- 4 Swing the nozzle to produce a water spray.
- 5 Direct the water to the base of flames.

- 6 Sweep the water spray left and right action until the fire stop.
- 7 When the fire completely stop, roll back the rubber hose and return it to the hose cabinet.



[http://bit.ly/use\\_firehose](http://bit.ly/use_firehose)

## 3.7 DAMAGE ON FIRE HOSE REEL



### CONDITION 1

The hose is not rewound neatly inside the hose drum, it can lead to various issues, including difficulty in deployment during emergencies, tangling, kinking, and potential damage to the hose



### CONDITION 2

Rust on the metal cabinet of a hose reel can occur due to exposure to moisture or environmental conditions. Rust not only affects the appearance of the hose reel but can also compromise its structural integrity over time.



### CONDITION 3

The glass door of a fire hose cabinet is broken. If the broken glass has sharp edges or poses a safety hazard, cordon off the area around the fire hose cabinet to prevent access and protect people from potential injuries.



## 3.8 SUMMARY

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Building owners and occupants should not underestimate the importance of complying with the requirements and maintenance of the hose reel system. These systems are designed to provide an important means of fire suppression and control during the initial stages of a fire. By ensuring proper installation, regular maintenance, and adherence to safety guidelines, the hose reel system contributes significantly to the overall fire safety of the building and the well-being of its occupants. Additionally, it is crucial to conduct a follow-up observation of the hose reel system after it has been used in the event of a fire. This allows for any necessary repairs or replacements to be carried out promptly to restore the system's functionality and readiness for future fire incidents.



### 3.9 SELF ASSESSMENT

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1. Identify the diameter of hose reel stack pipe :
  - A. 20mm
  - B. 30mm
  - C. 40mm
  - D. 50mm
2. Maximum hose reel water storage capacity is :
  - A. 7100L
  - B. 8100L
  - C. 9100L
  - D. 10100L
3. Below are the location of hose reel installation in buildings **EXCEPT** :
  - A. Corridor
  - B. Inside the stairway
  - C. Beside exit door
  - D. Lift lobby
4. Below are the component in hose reel cabinet **EXCEPT** :
  - A. Rubber hose
  - B. Nozzle
  - C. Stop valve
  - D. Air release valve

check your answer here :



[http://bit.ly/quiz\\_hr](http://bit.ly/quiz_hr)





## 4.0 FIRE HYDRANT SYSTEM

### 4.1 INTRODUCTION

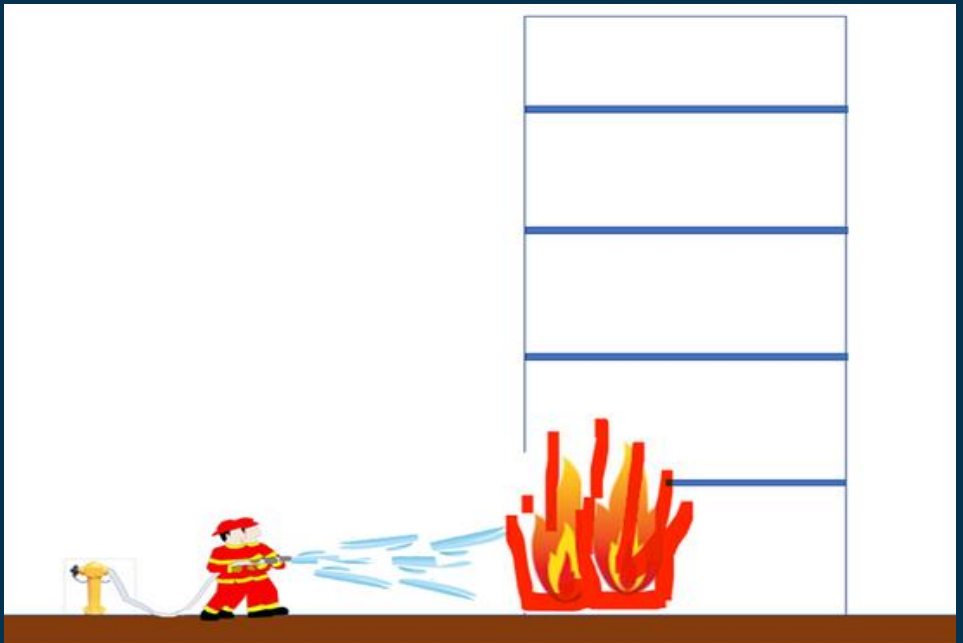
A fire hydrant system is a critical component of fire protection infrastructure found in buildings, industrial facilities, and public areas. It is a device connected to an underground water supply, typically through a water main, that allows firefighters to access a large volume of water quickly. It serves as a vital connection point between the main water source and each hydrant outlet, specifically designed for firefighting purposes. It also provides a readily available water supply to combat fires effectively. The water supply for the fire hydrant system can be sourced from either a public water supply mains, such as those provided by the local water authority or from a private water storage tank.

## 4.2 STANDARDS AND REGULATIONS

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Fire hydrant systems are designed and installed in accordance with standards and regulations as following ;

- MS 1395 : Specification for pillar hydrant
- M.S.1489 Part 1: Hydrant System, Hose Reels and Foam Inlets;
- M.S.1447 - Hose Reels with semi – rigid hose;
- M.S.1488: Semi – rigid hoses for first aid fixed installations.
- UBBL 1984 clause 225 and 10th. Schedule



## APPLICATION OF FIRE HYDRANT

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A fire hydrant system is provided for the purpose of:

- intended to provide water to each pillar hydrant for the fireman to fight a fire.
- where the water supply is not available or inadequate, the hydrant supply the water into the fire engine which it is then pumped and sprayed over the fire.



## 4.3 DESIGN REQUIREMENTS

- 1 Hydrant pillar spacing less or 91.5m in between and each location has a minimum 6m (width) that could withstand 25 tons loading.
- 2 Each hydrant pillar should be provided with 30m of 65mm dia. canvas hose, coupling and nozzle that to be placed in the special cabinets nearby.



*‘Where there is smoke,  
there is fire’*

- 3 In any special case for pressurized hydrant (used pumps) each hydrant pillars (twin outlets) need to have a water supply at the minimum flow rates of 1000 L/min and at working pressure of 4 bar (58 Psi/9m head).



- 4 Hydrant pillar system location less or 6m from the building if it is a high rise building.

## 4.4 TYPES OF FIRE HYDRANT SYSTEM



The specific fire protection requirements of the property are crucial in determining the type of fire hydrant system.

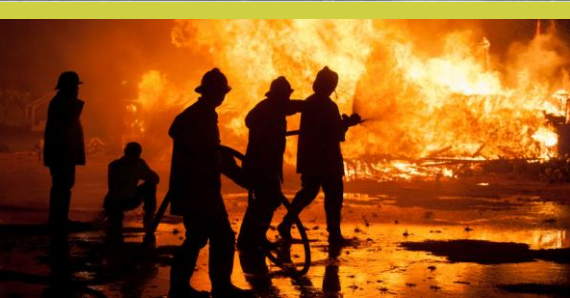
Different properties have varying fire safety needs based on factors like occupancy type, fire hazards, and the extent of potential fire incidents.

For example, buildings with higher fire protection requirements, such as large industrial facilities or high-rise buildings, may benefit from a private or pressurized fire hydrant system with additional features like water meter, fire tanks and pumps to ensure adequate water flow and pressure.

Design method could be categories into THREE types of external fire hydrant systems :

- 01 Public Fire Hydrant
- 02 Private Fire Hydrant
- 03 Pressurized Fire Hydrant

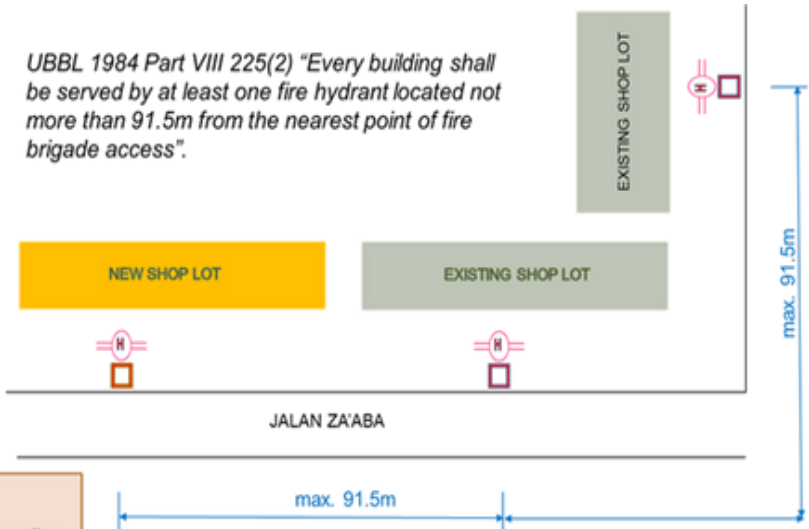
### **PUBLIC FIRE HYDRANT SYSTEM**



A public fire hydrant systems is a discharge pipe provided in a public property such as residential areas, commercial buildings, and places with a dense population. The systems are directly connected to the municipal water supply, ensuring a continuous and abundant water source. If there is a reliable municipal water supply with adequate pressure, a public system might be the most practical choice. The components of this system consist of fire hydrants, concrete chambers and sluice valves.



UBBL 1984 Part VIII 225(2) "Every building shall be served by at least one fire hydrant located not more than 91.5m from the nearest point of fire brigade access".



**LEGEND**

- Hydrant pillar
- Concrete chamber

### Public Fire Hydrant System

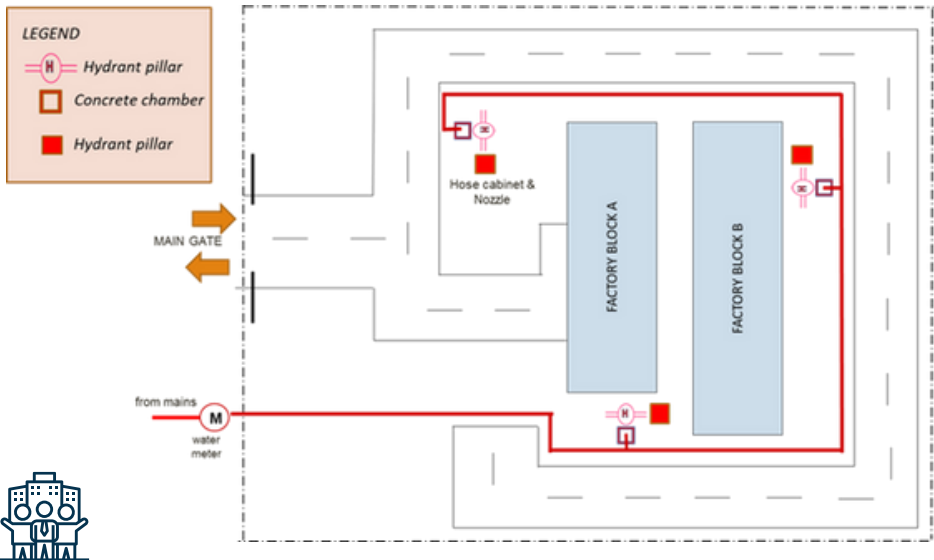


"Fire Destruction is One Man's Job,  
Fire Prevention is Everybody's Job"

## PRIVATE FIRE HYDRANT SYSTEM

Private fire hydrants are connected directly from a water supply mains to the pipe and a water meter. This system is located in private buildings such as industrial areas, shopping complexes, office areas and institutions.

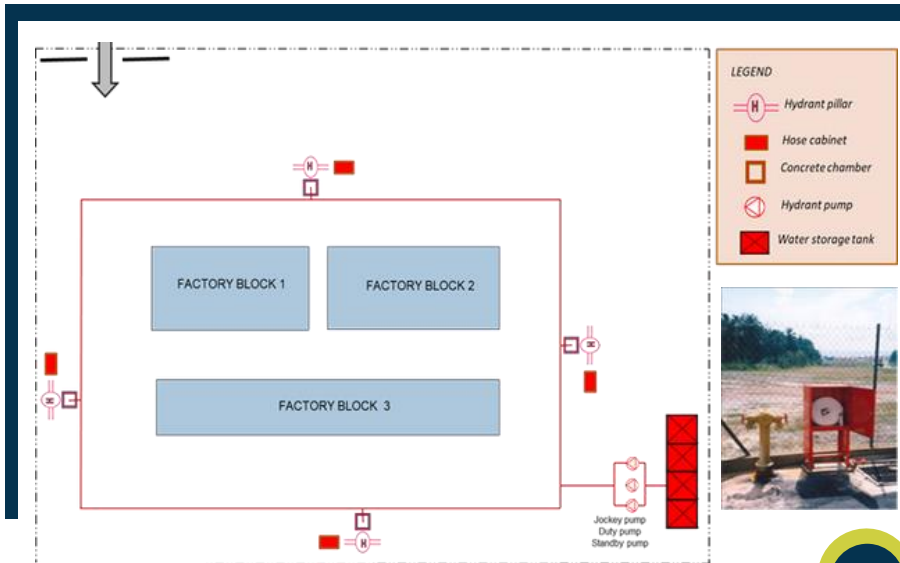
Fire hydrants set are equipped with hydrant pillar, water meter, hose cabinets containing hose lines, couplings and nozzles as well as concrete chambers and sluice valves.



# PRESSURIZED FIRE HYDRANT SYSTEM

Pressurized fire hydrant system is a system with tanks and pumps that are commonly used in larger properties, industrial facilities, commercial buildings such as sawmills, fireworks factories and rubber tire factories. This type of system ensures a continuous and pressurized water supply for firefighting purposes.

A type of pillar hydrant with twin outlets capable of supplying a flow rate of 1000L/min and a working pressure of 4 – 7 bar. The system components are equipped with pillar hydrant, concrete chamber, sluice valve, water storage tank and a set of pump such as jockey pump, duty pump and standby pump before being connected to each fire hydrant.



## 4.5 FIRE HYDRANT COMPONENTS



### HYDRANT WATER STORAGE TANK

Fire hydrant storage tank is provided with a minimum effective capacity of 135,000 liters and is equipped with a four-way breeching inlet to enable the fire brigade to help refill the storage tank cause by low water pressure. Water storage tank is made of hot dipped galvanized pressed steel, fiberglass reinforced polyester (FRP) or reinforced concrete (RC) and painted with red colour.

### HYDRANT PUMP SET

The pressurized fire hydrant system is equipped with 3 types of pumps which are jockey pump, duty pump and standby pump. The pump capacity capable of delivering 3000 L/m flowrate with a running pressure of 4 - 7 bar for the use of 3 fire hydrants simultaneously.

The power supply for the standby pump is coming from the emergency generator or diesel engine driven that is capable of operating continuously for 2 hours at full load operation.

## TYPES OF HYDRANT PILLAR

A fire hydrant pillar, also known as a fire hydrant standpipe or fire hydrant post, is a type of above-ground fire hydrant installation. It is a vertical structure designed to provide access to a water supply for firefighting purposes.

Fire hydrant pillars are installed above ground, making them easier to access and maintain. They are usually anchored securely to the ground to prevent tampering or accidental damage.



### 1 RED HYDRANT PILLAR

Red hydrant (public) means the flow of a fire hydrant installation installed to provide an unmetred water supply for the purpose of fire fighting operations.

## 2 YELLOW HYDRANT PILLAR

Yellow fire hydrant (private) means a stream of fire hydrants installed to provide a metered water supply to a premises or compound for the purpose of fire extinguishing operations.



<https://hub.unitrade.com.my/product/pillar-fire-hydrant-100mm-cw-outlet/>



## CONCRETE CHAMBER

A two-way hydrant pillar typically has two separate outlet nozzles, each with its valve and control mechanism. This design allows for two independent water supply connections, enabling firefighters to access water from two different sources simultaneously.

This feature can be advantageous in situations where the water supply from one source is insufficient or unavailable, ensuring continuous water flow during firefighting operations.



A concrete chamber is a protective enclosure that houses the valve assembly, pipelines, and other critical components of the hydrant system. It is typically constructed using reinforced concrete to provide robust protection against external damage, vandalism, and environmental factors.



2-way outlet  
pillar hydrant



concrete  
chamber

sluce valve



Hydrant key

## HYDRANT CABINET

Each private or pressurized hydrant system is provided with a hydrant hose cabinet. The hydrant hose cabinet is installed adjacent to the hydrant pillar consisting of couplings, spray nozzles and canvas hoses.

hydrant  
cabinet



Coupling

65mm dia @ 30m length  
of canvas hose

Spray nozzle



## 4.6 SUMMARY

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Fires can occur suddenly and cause injuries, death, and property damage. Fire hydrants play a crucial role in controlling fires and minimizing their impact. It is essential to keep fire hydrants in good condition and ready for use at all times. Regular maintenance, inspections, and testing are necessary to ensure their functionality.



Proper signage and accessibility are important for firefighters to quickly locate and use hydrants during emergencies. Collaboration between local authorities and property owners is crucial for implementing fire safety protocols and promoting awareness. Maintaining fire hydrants in a state of readiness enhances firefighting efforts, reduces the impact of fires, and protects lives and property.



## 4.7 SELF ASSESSMENT

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1. A set of pump for pressurized hydrant system consists of :

- A. Duty and jockey pump
- B. Duty and standby pump
- C. Standby and jockey pump
- D. Jockey, duty and standby pump

2. Hydrant pillar for public installation is painted in signal red color code.

- A. True
- B. False

3. Below are the main component of private fire hydrant :

- A. Fire storage tank, pump set and hydrant pillar
- B. Fire storage tank, pump set, hydrant pillar and hose cabinet
- C. Hydrant pillar, hose cabinet and water meter
- D. Fire storage tank, hydrant pillar, pump set, water meter

check your answer here :



[http://bit.ly/hydrant\\_quiz](http://bit.ly/hydrant_quiz)



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