

Construction Hazard and Risk Control

Lecture Title: Fire Safety

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Date: 7th January 2026



**Undergraduate Diploma in
Occupational Health and Safety**

This lecture covers the following learning objectives:

- Describe the principles of fire initiation, classification and spread and the additional fire risks caused by construction activities in an existing workplace
- Outline the principles of fire risk assessment
- Outline the principles of fire prevention and the prevention of fire spread in construction workplaces
- Identify the appropriate fire detection and fire alarm systems and fire-fighting equipment for construction activities
- Outline the requirements for an adequate and properly maintained means of escape in the construction workplace
- Outline the factors which should be considered when implementing a successful evacuation of a construction

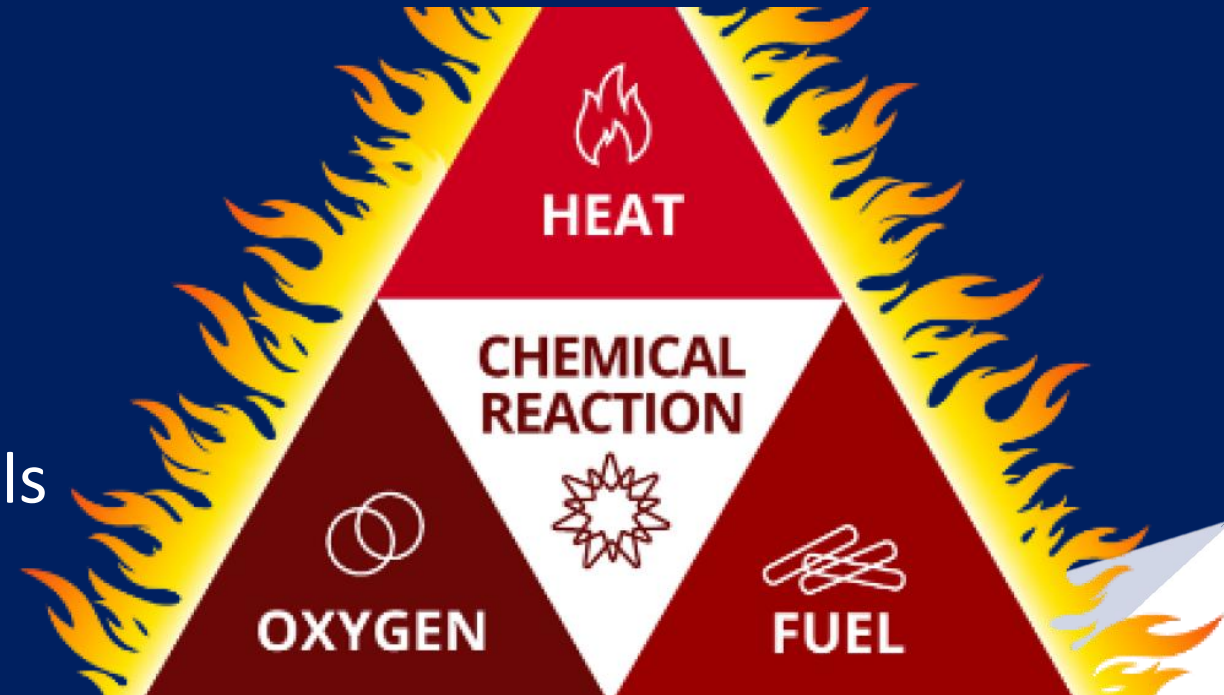


Principles of fire initiation, classification and spread and fire risks caused by construction activities:

Basic principles

The fire triangle consists of:

- Fuel – solids, liquids and gases
- Ignition source
- Oxygen – from air, oxidising materials



Classes of Fire:

- A – carboniferous solids
 - B1 – liquids soluble in water
 - B2 – liquids insoluble in water
 - C – gases
 - D – metals
 - F – high temperature cooking oils or fats.
- Electrical fires do not constitute a separate fire class.

	 Old Colour BS 5406	 New Colour BS EN3	 Class A Paper or Wood etc.	 Class B Flammable Liquids	 Class C Flammable Gas Fires	 Class D Metal Fires	 Electrical Fires
RED				Do Not Use 			Do Not Use 
RED				Do Not Use 			Do Not Use 
CREAM			Note: Multi-Purpose Foams may be used 	Note: Specialist Foams required for industrial alcohol 			Do Not Use 
BLACK				Secondary 			Primary 
BLUE				Note: Specialist DP required for Solvents & Esters 		Note: Specialist Dry Powders may be required 	
RED				Primary 	General Note – May be used in conjunction with other extinguishing agents or fire extinguishing techniques		
CANARY YELLOW				SPECIALIST HOT COOKING OIL FIRES ONLY Specifically for dealing with high temperature (360°C) cooking oils used in large industrial size catering kitchens, restaurants and takeaway establishments with deep fat frying facilities			

Sources of Ignition:

- Naked flames
- External sparks
- Internal sparking
- Hot surfaces
- Static electricity



Control of ignition sources:

- Replace a potential source with a safer alternative (e.g. radiant heaters with fixed convector heaters).
- Separate combustible materials.
- Minimise the use of portable heating appliances.
- Replace hot work with alternative methods such as cold cutting.
- Operate permit-to-work schemes for hot work processes and undertake regular checks.
- Operate a safe smoking policy.

Control of ignition sources:

- Control, inspect and monitor ignition hazards (e.g. overloading of power supplies).
- Ensure electrical, mechanical and gas equipment is installed, used, maintained and protected in accordance with the manufacturer's instructions.
- Turn off equipment when it is not attended or being used.
- Protect storage areas containing gas cylinders and other flammable materials from arson or vandalism.
- Do not permit bonfires on site

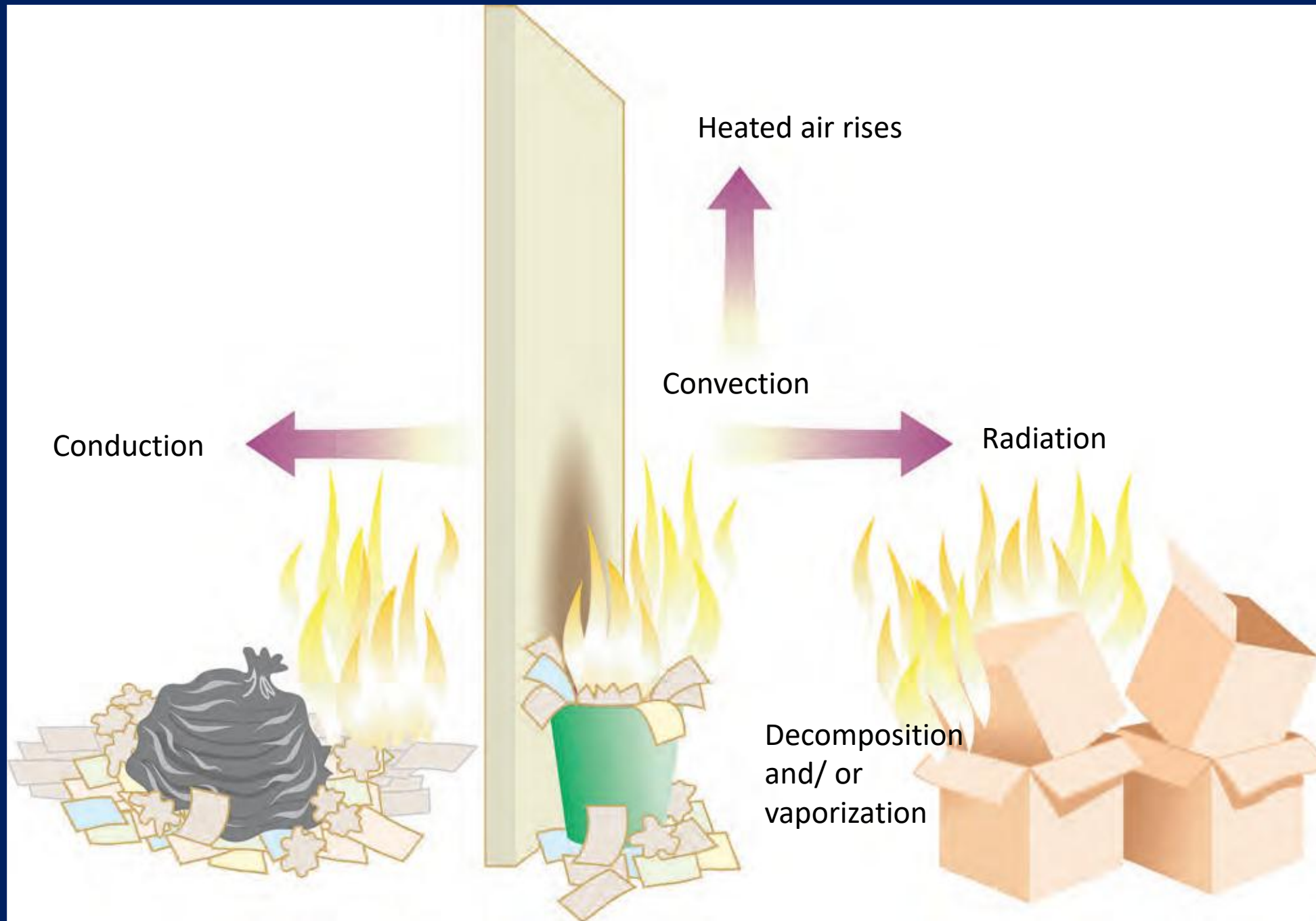


Methods of extinction:

- Cooling – reducing ignition temperature
- Smothering – limiting oxygen available
- Starving – limiting fuel supply
- Chemical reaction – interrupting the chain of combustion

Principles of heat transmission and fire spread.

- Convection – through air movements (floor to floor)
- Conduction – through conducting materials (girders)
- Radiation – emission of heat waves (bar heaters)
- Direct burning – contact with flames (rubbish catching fire)



Fire spreads:

- rubbish (particularly if burnt)
- electrical short circuits
- portable heaters
- friction causing sparks (hand grinders)
- oil heating plant
- cooking appliances
- arson (often by children)
- hot surfaces (welding)
- cigarette smoking.



Fire spreads via:

- gases/sprays
- foam plastics
- packaging
- previous spillage
- flammable dusts.

Fire spreads due to:

- delayed discovery
- alarm not raised
- fire service not informed
- lack of barriers
- fire procedures not known
- fire extinguishers unavailable, not serviced or not used
- air flow – particularly if fire doors not closed
- lack of or poor emergency lighting
- flammable materials
- flammable dusts



Additional risk of fire in construction:

- final fire protection of the building not in place;
- timber frames are more vulnerable to fire before the external finishes are in place;
- many construction work processes, such as welding, heating bitumen for roofing, cutting and grinding metals and concrete;
- enormous quantities of packaging materials; and
- sub-contractors occupying the building at the same time, some of them extremely temporary, for only a few days



Fire in construction:



Flammable materials



Flawed fire protection measures



Arson



Power sources



Cooking

Fire risk assessment:

Stages of the fire risk assessment

- Identify the fire hazards – identify sources of heat/ignition, unsafe acts (smoking) and unsafe conditions (storage of combustible materials).
- Identify all locations and persons at risk.
- Reduce the risks by the introduction of controls.
- Record the findings.
- Monitor and review

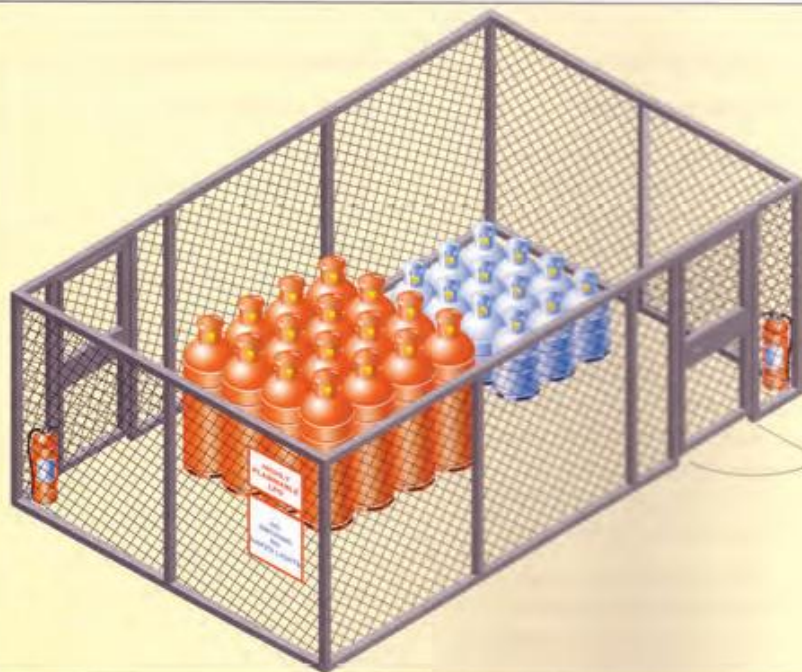
Fire Risk Assessment- Hazards:

- sources of fuel
- oxygen depletion
- flames and heat
- smoke
- gaseous combustion products
- structural failure of the building
- combustible materials on construction sites

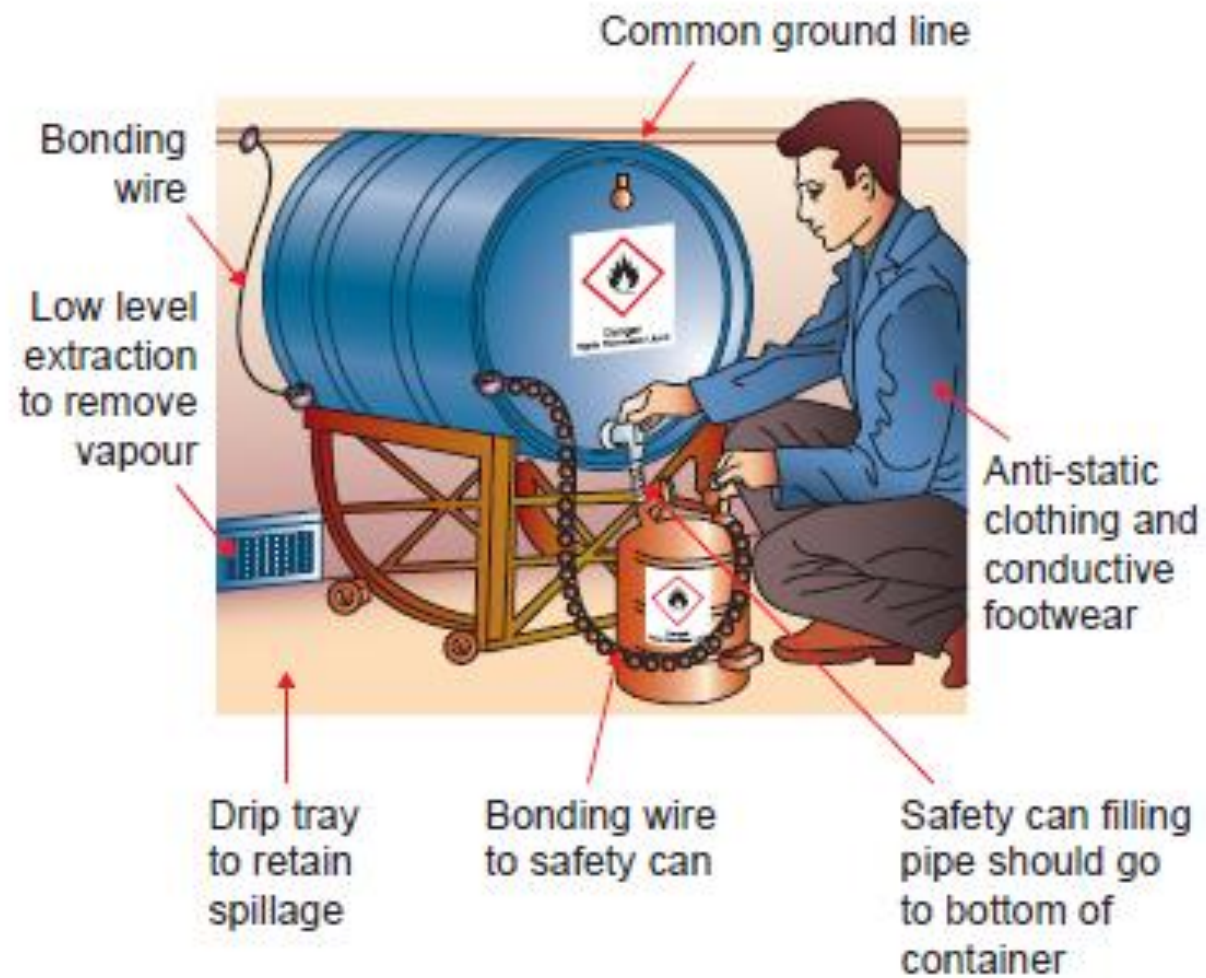




(a)



(b)



Dispensing Flammable Liquids

Sources of heat or ignition on construction sites:

- refuelling of vehicles
- dismantling fuel tank structures
- buried gas and electrical services
- bonfires
- arson

Identifying sources of fuel on construction sites:

- building materials (e.g. composite panels and timber)
- waste material
- flammable liquids and substances (e.g. paints and thinners)
- scaffold sheets and boards
- fuel for vehicles and heaters
- acetylene
- packaging materials

Other factors to consider:

- time to detect and warn
- safe egress
- adequacy of fire signs
- provision of fire-fighting equipment
- fire training – fire drills, appliance use and emergency teams
- maintenance of fire equipment
- consultation with employees.

Temporary workplace

Construction sites, temporary classrooms and buildings, exhibitions, festivals and fetes.

The requirements depend on:

- the size of the premises;
- the number of persons working or visiting the site at any one time;
- the degree of flammability of the materials used to construct the workplace or being used in the workplace;
- height above or below the ground floor and distance to a place of safety;
- the remoteness of the workplace relative to water supplies and/or fire and rescue services



Temporary workplace

Temporary accommodation units:

- erect away from the construction site;
- include in emergency planning;
- careful installation and use of heaters and cooking equipment;
- competent installation and maintenance of electrical services; and
- the installation of litter skirts

Fire prevention and prevention of fire spread

Control measures:

- elimination or reduction in the use and storage of flammable materials
- electrical safety
- control of ignition sources
- effective systems of work
- safe refuelling procedures for vehicles
- safe heating and cooking equipment and procedures
- good housekeeping
- storage facilities for small quantities (50 litres) of highly flammable or flammable liquids

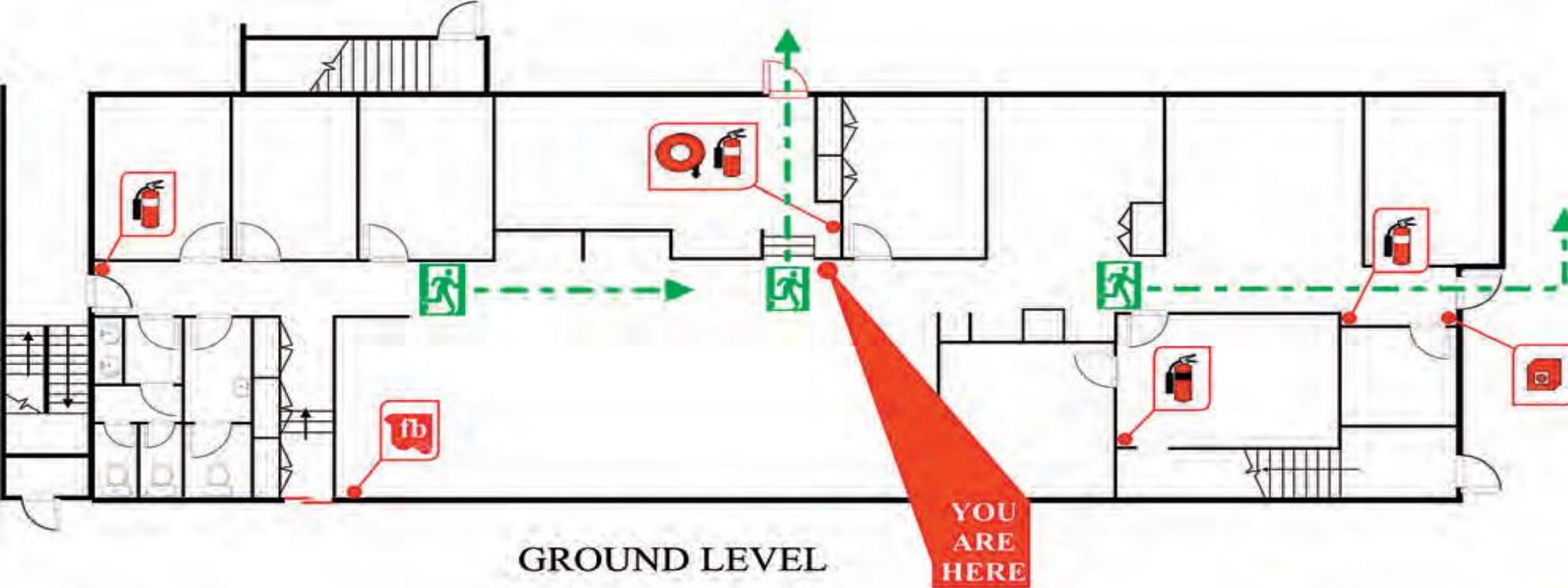


Fire detection, fire alarm and fire-fighting equipment

Fire extinguishers

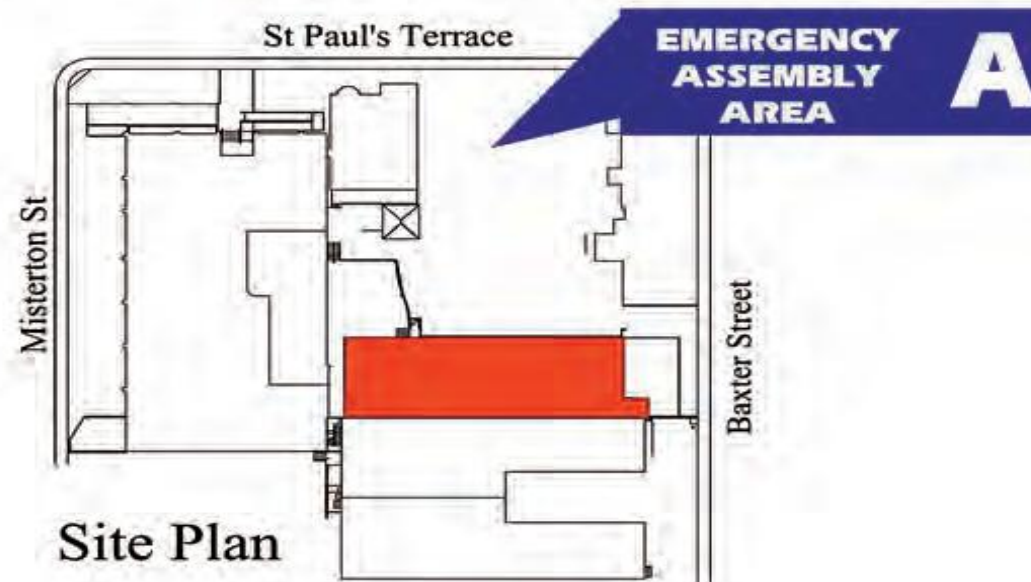
Fire extinguishers are coloured red over 95% of surface

Colour (5%)	Contents	Class/type of fire
Red	Water	A
Cream	AFFF	A (possibly B)
Cream	Foam	B and C
Black	Carbon dioxide	B and electrical
Blue	Dry powder	B, C and electrical



LEGEND

-  CO2 Fire Extinguisher
-  Dry Powder Fire Extinguisher
-  Fire Hose Reel
-  Manual Call Point
-  Fire Blanket
-  Fire Door
-  Sliding Fire Door
-  Egress Route

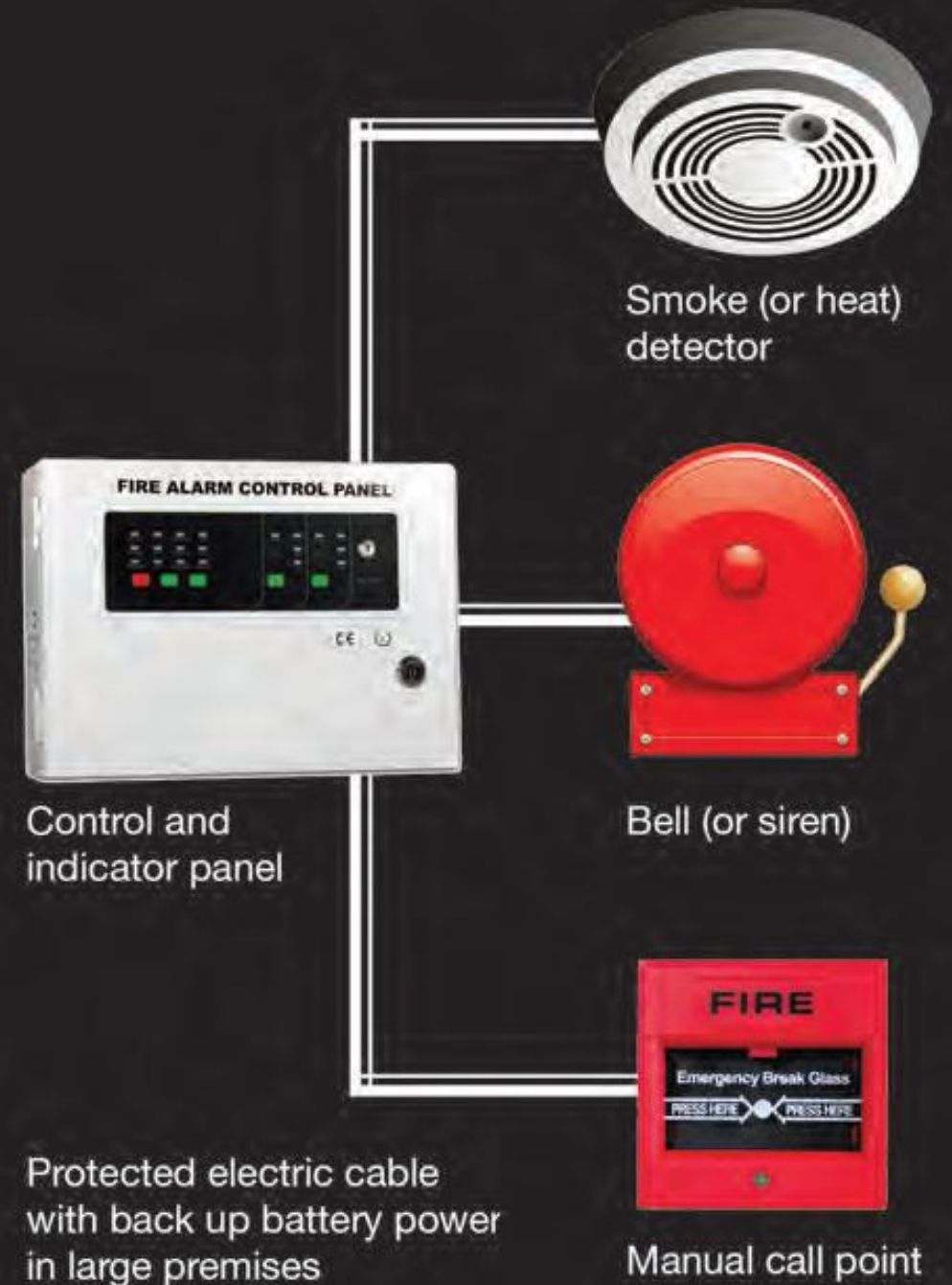


Fire-fighting equipment

- fire blankets
- hose reels
- Sprinklers

Emergency lighting

- Regular testing required



Siting, maintenance and testing of fire-fighting equipment

- sited in areas of significant risk (at least one extinguisher per 200 m² of floor space with a minimum of one per floor);
- arrangements for hot working;
- annual maintenance check of fire extinguishers; and
- weekly check of fire alarms and emergency lighting.

Fire training in the use of the equipment for all staff is essential



Fire detection and warning

- fire notices
- alarms – such as a gong, whistle or air horn and smoke/heat detectors
- audibility throughout premises
- regularly tested
- records of all tests
- vigilance of workers following training

Fire detection and warning

Automatic fire detection may be needed if:

- there are areas where people are isolated or remote and could become trapped;
- sleeping accommodation is provided;
- there are areas where a fire can develop unobserved (e.g. a warehouse)



Means of escape

- Doors – clear of obstructions and opening in direction of escape
- Escape routes (stairways and passageways) directly to a place of safety
- Lifts should not be used
- Lighting, including emergency lighting
- Directional and other signs
- Escape times
- Assembly points
- Building plans to include record of emergency escape plans.



Structural design measures

Fire loading of the building

- Surface spread of fire
- Fire resistance of structural elements
- Insulating materials
- Fire compartmentation.



Evacuation of a construction workplace

Emergency planning and training:

- evacuation procedures – fire notices
- appointment of fire marshals
- fire drills
- the location of fire points and assembly points
- roll-call
- provision for the infirm and disabled
- accident reporting and investigation
- rescue from excavations and confined spaces

Fire procedures for people with a disability

Emergency planning needs to consider the special requirements of people with physical or mental disabilities. Such issues include:

- the identification of those who may need special help to evacuate the building;
- the allocation of responsibility to specific staff to identify and assist people with a disability during emergencies;
- plan suitable escape routes;
- have a system in place that enables a person with a disability to summon help in emergencies; and
- include the arrangements for disabled persons in all staff fire training programmes



General points

1. Emergency procedures required for fire, explosions, flooding or structural collapse.
2. A hot work permit should include the need for a fire extinguisher and checks for signs of fire on completion of the work.
3. A hot work permit would be needed when cutting steel with an angle grinder and soldering pipework in a central heating system.
4. Frost around the valve on a liquid petroleum gas cylinder indicates that the valve is leaking.
5. Cylinders containing liquid petroleum gas should be stored in a locked external compound at least 3 m from any oxygen cylinders.
6. The minimum distance that oxygen cylinders should be stored away from propane, butane and other inflammable gases is 3 m.
7. Butane and propane are heavier than air and therefore represent a ground level fire hazard.





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