CHAPTER 5

Fire Protection

This chapter describes the types of fire that may occur on a tanker or at a terminal and how to detect and extinguish them.

5.1 Theory of firefighting

Fires are a combination of fuel, oxygen, a source of ignition and a continuous chemical reaction, commonly known as combustion.

The main objective of firefighting is to extinguish the fire by reducing the temperature, removing the fuel, excluding the supply of air or interfering chemically with the combustion process as quickly as possible.

5.2 Types of fire and appropriate extinguishing agents

The classification of fires in table 5.1 conforms to those in the current ISO Standards and the IMO's *International Code for Fire Safety Systems (FSS Code)*.

5.3 Extinguishing agents

Extinguishing agents act by:

- Removing heat (cooling).
- Smothering (excluding the oxygen).
- Inhibiting flame (chemically interfering with the chemical chain reaction).

The extinguishing agents are applied via:

- Extinguishers, portable and wheeled – water, foam, dry or wet chemical, powder, CO_2.
- Fire hydrants and hoses with appropriate nozzle – water or foam.
- Monitors/cannons – water or foam.
- Nozzles from fixed installations – water mist, foam, CO_2, clean agent.
- Fixed deluge system – water spray and water curtain applications.

Appropriate fire extinguishers should be selected and used in line with table 5.1.

The firefighting equipment a ship must carry is determined by the regulations of the country where it is registered. These regulations are generally based on SOLAS principles.

Type	Material	Extinguishing methods	Extinguishing agents
Class A	Solid materials usually organic, e.g. wood, paper, cardboard, cloth, plastic, etc.	Cooling Smothering Flame inhibition	Water – in large quantities, continued cooling of the source of the flames and surrounding area to prevent re-ignition Foam Dry chemical
Class B	Flammable and combustible hydrocarbon liquids. Fires occur in the vapour/air mixture over the surface of flammable and combustible hydrocarbon liquids or liquefiable solids, e.g. crude oil, gasoline, petrochemicals, fuel and lubricating oils, tars, etc. An aspect to consider with liquid petroleum is the risk of re-ignition, a continuing watch should be maintained after the fire has been extinguished Class B liquids are divided into two broad categories of non-volatile and volatile	Removal of fuel source Smothering Flame inhibition	Foam – Low expansion foam, discussed in section 5.3.2.1, is an effective agent for extinguishing most hydrocarbon liquid fires CO_2 Dry chemical – Volatile liquid fires of limited size can be rapidly extinguished with dry chemical agents but are subject to re-ignition when hot surfaces are in contact with flammable vapour Water mist – Water should only be applied to oil fires as a mist. The use of a water jet may spread the burning oil by splashing or overflow
Class C	Flammable gases, e.g. propane, butane, methane and hydrogen, are volatile materials that typically have flashpoints at temperatures at or below the ambient temperature range. Flammable gases have relatively high vapour pressures, when in the liquid state, compared to flammable (volatile) liquids	Removal of fuel source Smothering	Dry chemical
Class D	Metals, e.g. magnesium, titanium, lithium, zirconium, sodium and potassium. These metals burn at high temperatures and react violently with water, air and/or other chemicals	Smothering	Specialist dry powder, extinguishing agents for Class D fires are not of a multi-purpose rating and must match the type of metal involved
Class E	Energised electrical equipment fires may be caused by a short circuit, overheating of circuits or equipment, lightning or fire spread from other areas	De-energise Smothering Flame inhibition	CO_2 Dry chemical Clean agents The immediate action is to de-energise the electrical equipment. Once de-energised, a non-conductive extinguishing agent, e.g. CO_2 should be used. Dry chemical is an effective non-conductive extinguishing agent but is difficult to clean up after use. If the equipment cannot be de-energised, it is vital that a non-conductive agent be used
Class F (or Class K)	Cooking oils and fats, generally at a temperature higher than 360°C	Smothering	Wet chemical

Table 5.1: Classification of fires

5.3.1 Cooling agents

5.3.1.1 Water

Directly applying a water jet onto a fire is effective at fighting Class A fires only. A wetting agent added to water will lower its surface tension and increase the penetration of the water, potentially reducing the amount needed to extinguish fires in tightly packed Class A materials.

For fires involving hydrocarbon liquids, water is used mainly to cool exposed surfaces and prevent the fire from escalating. Water spray and water fog may also be used to form a heat screen between the fire and firefighting personnel and equipment. If foam is not available, a water mist can extinguish fires involving shallow pools of heavy oil.

Large fires in enclosed spaces can generate enough heat to turn water to steam on contact. Take precautions to protect personnel from steam burns when using water jets.

Do not use water in any form on fires involving hot cooking oil or fat, as it may cause the fire to spread.

Do not direct concentrated water streams at fires involving liquefied gas as more liquid will be vaporised, which will increase the size of the vapour cloud size and increase the hazard. Water spray or water fog can be used on liquefied gas fires and spills as they will cool the area, control the intensity of the fire and help disperse the vapour cloud.

Do not direct water jets at energised electrical equipment as this could create a path for electricity from the equipment, which will expose firefighting personnel to the danger of electric shock.

All tankers have a water firefighting system that consists of pumps permanently connected to the sea, a fire main with hydrant points and fire hoses with couplings and jet nozzles or, preferably, jet/spray nozzles. Hydrants are located to ensure that two jets of water can reach any part of the ship. Bulkheads are sometimes fitted with permanent water spray lines.

In cold weather, prevent the fire mains and hydrants from freezing by continuously bleeding water overboard from hydrants at the extreme end of each fire main. Alternatively, all low points of the fire main may be kept drained. Flush sea water fire suppression piping systems with fresh water after use to protect the internal pipeline from oxidation.

5.3.1.2 Water mist

Water mist fire protection systems use a spray mist to absorb heat and displace oxygen. They are effective in accommodation spaces and areas within the engine room. These systems consist of a water supply connected to an atomising distribution system that can deliver a water mist through one or more nozzles.

Several types of system are currently available, including:

- Low pressure and HP systems. HP systems produce a smaller droplet size and are sometimes known as water fog systems.
- Open nozzle systems. All the system nozzles activate if a fire breaks out in the protected space.
- Closed nozzle systems. The nozzles may open locally when a fire is detected in the protected space.
- Engineered systems. These are specific to certain applications. Detailed calculations are used to determine the design parameters, e.g. nozzle size and location, water pressure and flow rates.
- Pre-engineered (packaged) systems. These have their own water supply and are suited for local applications and single installations. Some ships have systems that protect specific parts of the engine room, e.g. oil fuel treatment spaces, boiler-firing platforms, small machinery spaces and pumprooms.

For further guidance, see the latest edition of *NFPA 750: Standard on Water Mist Fire Protection Systems*.

5.3.1.3 Water curtain

Some ships have a fixed system that provides a protective water curtain between the cargo deck and the superstructure.

5.3.1.4 Foam

Foam can absorb only a limited amount of heat, so is not considered a primary cooling agent.

5.3.2 Smothering agents

Tankers may have one or more of the following smothering systems.

5.3.2.1 Foam

Foam is an aggregation of small bubbles that have a lower specific gravity than oil or water. It flows across the surface of a burning liquid and forms a consistent smothering blanket.

High expansion foam systems can fight fires in the cargo spaces, on the cargo deck, in the pumproom or in the engine spaces. Storage tanks contain foam concentrate, which is picked up in the right amount by water from the fire pumps. The foam solution then moves through permanent supply lines to off-take points, fixed foam monitors or fixed dispersal nozzles.

A good foam blanket:

- Seals against flammable vapour loss.
- Absorbs some heat and so cools the fuel surface.
- Isolates the fuel surface from the oxygen supply.
- Eliminates combustion by separating the flammable vapour layer from other ignition sources, e.g. flames or hot metal surfaces.
- Resists disruption caused by the airflow, heat or flames.
- Reseals when its surface is broken or disturbed.

Foam is an electrical conductor, so it should not be applied to energised electrical equipment. Foam applicators should be directed away from liquid petroleum fires until any water in the foam system has been flushed clear, so that the water/foam mixture will blanket the burning liquid rather than the water dispersing the burning liquid.

5.3.2.1.1 Categories of foam

Two categories of foam concentrate are currently in use.

Protein Foam (P) concentrates are used at 3–6% by volume concentration in water. They include:

- P made from hydrolysed protein materials.
- Fluoroprotein Foam (FP) with added fluorinated surface-active agents.
- Alcohol Resistant Fluoroprotein Foam (FPAR), which is resistant to break down when applied to the surface of alcohol or other solvents.

Synthetic foam concentrates are used at 1–6% by volume concentration in water. They include:

- Aqueous Film Forming Foam (AFFF), based on a mixture of hydrocarbon and fluorinated surface-active agents.
- Alcohol Resistant Aqueous Film Forming Foam (AR-AFFF) for use with alcohols and fuels blended with large amounts of alcohol.

Tankers that handle biofuel or blends containing ethyl alcohol should use alcohol resistant foams.

When buying foam concentrates, ensure that dilution rates are compatible with the equipment used by the operator and local emergency services.

Environmental concerns have been raised about perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), the fluorinated organic chemicals used in some foam concentrates. As a result, some countries have banned them. When choosing foam concentrates, operators should ensure the product meets all applicable environmental legislation. Alternative foam concentrates are now widely available.

5.3.2.1.2 Expansion ratios

Synthetic high expansion foam has expansion ratios between about 200:1 to 1,000:1. A foam generator, either fixed or mobile, sprays the foam onto a fine mesh net that has air driven through it by a fan.

High expansion foam has limited uses. It is most often used to rapidly fill an enclosed space, displacing free air and so extinguishing the fire. It is generally unsuitable for use outside as it is not easily directed onto hot, unconfined spill fires and is quickly dispersed in light wind.

Enhanced high expansion foam systems are increasingly in use on ships to protect enclosed areas such as pumprooms and engine room spaces. These systems (also known as hot foam systems) draw hot air from inside the space and have expansion ratios of 250:1 to 1,000:1. When activated, the systems release high expansion foam to flood the area, cooling the fire and displacing the air.

Medium expansion foam has an expansion ratio of 20:1 to 250:1. It can be protein or synthetic based and does not need a fan for aeration. Portable applicators can deliver a lot of foam onto spill fires, but their throw is limited and the foam can be dispersed in moderate wind.

Low expansion foam has an expansion ratio of about 3:1 to 15:1. Made from protein based or synthetic concentrates and used from fixed monitors or portable applicators, it can fight spill or tank fires. The applicators provide a good throw length and the foam is resistant to wind. It should flow evenly and progressively over a burning surface without becoming agitated or submerged. This is best achieved by directing the foam against any vertical surface next to the fire. This reduces the initial impact of the fire and builds up an unbroken smothering blanket. If there is no vertical surface, the foam should be applied in oscillating sweeps, in the direction of the wind and taking care to avoid letting the foam plunge into the liquid. Spraying foam streams and allowing them to run down the deck towards the fire is also effective but has a limited range.

5.3.2.1.3 Compatibility and storage

Different foam concentrates are generally incompatible with each other and should not be mixed in storage. However, some foams are compatible when applied to a fire in sequence or at the same time.

Most foam concentrates can be used in conventional devices that produce Ps. The systems should be thoroughly flushed out and cleaned before changing agents, as the synthetic concentrates can dislodge sediment and block the proportioning equipment.

Some foams produced from concentrates are suitable for combined use with dry chemical powder. The manufacturer's instructions should provide further guidance.

Bear in mind the compatibility of foam compounds when considering joint operations with other firefighters.

Foam concentrates may deteriorate over time, depending on how they are stored. High temperatures and exposure to the air will cause sludge and sediment to form and this may affect the extinguishing power of the expanded foam. A certified laboratory should periodically test samples of the foam concentrate.

5.3.2.2 Carbon dioxide

CO_2 is an effective smothering agent for extinguishing fires in enclosed spaces where it will not be widely diffused and personnel can be evacuated quickly, e.g. machinery spaces, pumprooms and electrical switchboard rooms. It is comparatively ineffective on open decks or jetties.

CO_2 will not damage delicate machinery or instruments. It is also non-conductive so can be used safely on or around electrical equipment, even when the equipment is switched on.

It can generate static electricity, so CO_2 should not be injected into any space that may contain an unignited flammable atmosphere.

CO_2 is asphyxiating and cannot be detected by sight or smell. All personnel should evacuate the area before CO_2 is discharged. Nobody should enter confined or partially confined spaces where the gas has been discharged unless they are supervised and are using suitable breathing apparatus and a lifeline. Any compartment flooded with CO_2 should be fully ventilated and verified as safe before anybody is permitted to enter it without a breathing apparatus.

A CO_2 system normally consists of a battery of large cylinders. The gas is piped from the cylinder manifold to diffusing nozzles. Before the CO_2 is released, an alarm should warn personnel in the compartment and give them time to evacuate.

5.3.2.3 Steam

Steam smothering systems are comparatively inefficient. They often take a long time to displace enough air from an enclosed space so that the atmosphere cannot support combustion. Steam can also generate static electricity, so it should not be injected into any space containing an unignited flammable atmosphere. However, steam can be effective when discharged from a lance-type nozzle directly at a fire around a flange or vent. It is also used to fight main engine scavenge fires and vent mast riser fires.

5.3.2.4 Sand

Sand is relatively ineffective as an extinguishing agent and is only useful for small fires on hard surfaces.

5.3.3 Flame inhibiting agents

Flame inhibitors are materials that interfere chemically with the combustion process to help extinguish flames.

5.3.3.1 Dry chemical powder

Dry chemical powder is an efficient flame inhibitor but it has a negligible cooling effect. To prevent hot metal surfaces from re-igniting the fire, the fuel should be removed and/or the area cooled using water once the fire has been extinguished.

Certain types of dry chemical can cause a foam blanket to break down. Only those labelled as foam-compatible should be used with foam. The manufacturer's instructions should provide further guidance.

Dry chemical powder can be applied as a free flowing cloud from an extinguisher, a hose reel nozzle, a fire truck monitor or a fixed system of nozzles. It is most effective when dealing with oil spill fires. It can quickly knock down a fire and can also be used in confined spaces, but personnel may need protection against inhaling the powder. It is especially useful on burning liquids escaping from leaking pipelines and joints. It is non-conductive, so can be used on electrical fires. Dry chemical powder should be directed into the flames.

Dry chemical powder can clog and become unusable if it gets damp when stored or when extinguishers are being filled. It is also prone to settling and compacting when vibrated.

Maintenance procedures should include a schedule for inverting or rolling the extinguishers to keep powder free flowing. Follow the manufacturer's maintenance procedures for agitating the powder in large capacity fixed systems.

5.3.4 Clean agent fire suppression systems

A clean agent is an electrically non-conducting gaseous firefighting compound that does not leave a residue upon evaporation. These include chemical gases (halocarbons) and blends of IGs such as argon and nitrogen, marketed under various trade names.

Clean agent systems are most effective in enclosed spaces, including:

- Computer centres.
- Storage rooms.
- Engine rooms.
- Pumprooms.
- Generator rooms.

5.3.4.1 Halon and clean agents

Halogenated hydrocarbons, known as halons, are efficient fire-extinguishing agents. However, halon gases also deplete ozone, so their production was phased out in 2000. New halon firefighting systems have been prohibited on ships since July 1992. Some systems remain in service on a small number of ships and continue to provide adequate fire protection if correctly maintained.

International restrictions on producing and using halon fire-extinguishing agents led to the development of alternative clean agents, such as halocarbon based agents or IG agents.

Clean agents are compressed gases or vaporising liquids that extinguish fires either by chemically disrupting combustion, smothering or absorbing heat, or a combination of these.

Clean agents are toxic to some degree because contact with hot surfaces and flames causes them to break down. All personnel should evacuate the area before halons or their alternatives are used. It is possible to start discharging them before evacuation is complete because the toxic concentrations when extinguishing fires are tolerable for a short time. After the fire has been extinguished, the area should be thoroughly ventilated and confirmed safe for entry. If the area needs to be entered before this, suitable breathing apparatus should be used.

For further guidance, refer to latest edition of *NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems.*

5.3.5 Inert Gas system

The purpose of an IG system is to prevent cargo tank fires or explosions. It is not a fixed firefighting system but it can be used to help to control fires and prevent explosions.

5.4 Portable fire extinguishers

Tankers and terminals have a range of portable fire extinguishers (see section 5.2 for information on the classification of fires and fire extinguishers). As well as the fire extinguishers in use, tankers are required to carry spare charges for refilling used extinguishers. Fully charged spare cylinders are carried for CO_2 extinguishers. Consider providing portable extinguishers that are suitable for use on Class A fires and can be deployed exclusively at the ship's manifold when in port.

All fire extinguishers should be maintained and available for immediate use. The system for managing safety should contain procedures for maintenance, including that done by service agents. As a minimum, all fire extinguishers should be formally checked once a year that they are in the right location, have the right charging pressure and are working properly. Guidelines for the maintenance and inspection of fire protection systems and appliances are in IMO publications, specifically the latest relevant Marine Safety Committee (MSC) Circulars.

Type of fire and fire-extinguishing mediums	Class A	Class B	Class C	Class D	Class E	Class F (OR K)
	Fires involving solid materials, usually of an organic nature, in which combustion normally takes place with the formation of glowing embers	Fires involving liquids or liquefiable solids	Fires involving gases	Fires involving metals	Fires involving energised electrical equipment, where the electrical non-conductivity of the extinguishing medium is of importance*	Fires involving cooking oils
Water/water with additives	✔					
Foam	✔	✔			*	
Dry powder/ dry chemical (standard Classes B, C)		✔	✔		✔	
Dry powder/ dry chemical (multiple or general purpose/Classes A, B, C)	✔	✔	✔		✔	
Dry powder/dry chemical (metal)				✔		
CO_2 gas		✔			✔	
Wet chemical	✔					✔
Fire blanket						✔

* *When electrical equipment is de-energised, extinguishers for Class A or B fires may be used safely.*

Table 5.2: Types of portable fire extinguisher

5.5 International shore fire connection

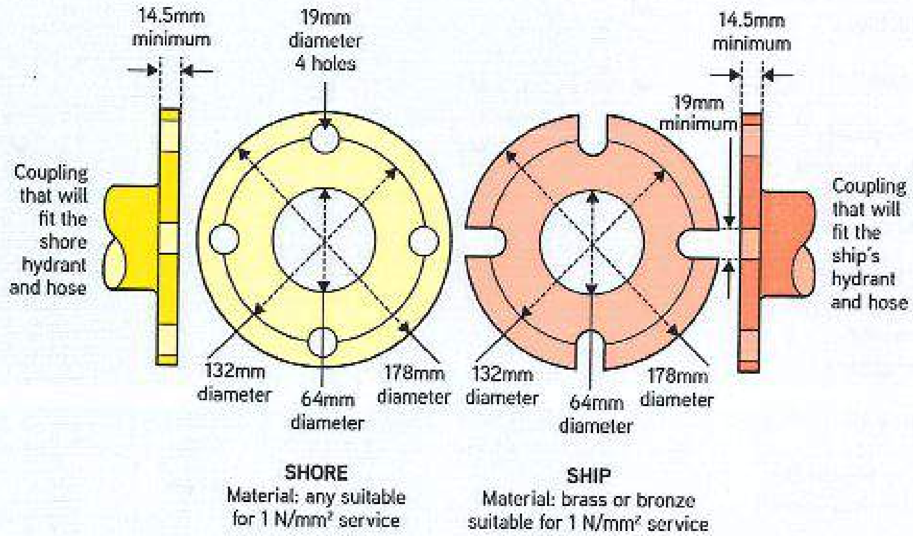
All tankers and terminals should be able to interconnect the fire mains on board and ashore so that an external water supply can be coupled to any hydrant in the ship's fire main. The international shore fire connection is a standardised way of connecting two systems that might have individual couplings or connections that do not match. This connection should be ready for immediate use (see section 19.4.3.1 and chapter 25).

The flanges on the connection should have the dimensions shown in figure 5.1. It should have a flat face on one side and a coupling on the other that will fit the hydrant or hose on the ship or shore.

If fixed on a ship, the connection should be accessible from both sides of the ship and its location clearly marked.

To interconnect the two fire mains, a fire hose with a shore connection led to its counterpart and the flange joints are bolted together.

The connection should be protected from the elements and located for immediate use. All appropriate staff should know the location and purpose of this connection. It should be discussed during the joint completion of the Ship/Shore Safety Checklist (SSSCL). Terminals should include emergency flanging of international shore fire connection in training plans.



Flange surface	Flat surface
Gasket material	Any suitable for 1 N/mm^2 service
Bolts	Four 16mm diameter/50mm long threaded to within 25mm of the bolt head
Nuts	Four to fit bolts
Washers	Eight to fit bolts

Figure 5.1: Details of the international shore fire connection

5.6 Water borne firefighting equipment

Water borne firefighting equipment, normally fire boats or firefighting tugs, can be very effective, particularly when they can manoeuvre upwind of a fire. This is often possible, especially at sea island berths.

If firefighting boats are well equipped, continuously available and can attend quickly, e.g. within 15–20 minutes of the call, this should be taken into account when assessing the firefighting equipment at a berth. If firefighting tugs cannot guarantee a response within a reasonable time, they should not be included in an assessment of a terminal's firefighting capability.

Water borne firefighting is best provided by working tugs or workboats fitted with firefighting equipment, including foam facilities. They should be capable of tackling a deck fire on the largest tanker likely to use the port.

Where firefighting tugs are part of a terminal's planned response to fires on tankers or the terminal itself, they should be made available as soon as they are needed if they are to be effective. If the tugs are helping a ship to berth or unberth at the terminal or they are working elsewhere in the harbour when a fire starts, procedures should allow them to be released as quickly as possible to help fight the fire. When idle between tasks, the tugs should have easily slipped moorings and be within reach of the terminal. They should keep a continuous radio and visual watch on the terminal.

Tugs could have varying firefighting (Fi-Fi) capabilities ranging from non-classed firefighting vessels (Fi-Fi 0) to having Class notations such as Fi-Fi I, II, III depending on Classification Society rules. Terminals should specify which level of firefighting capabilities are required for tugs included under their emergency response plans to tackle fires at the terminal.

In special circumstances, such as terminals handling a high number of tankers, or harbours with multiple terminals, a specially equipped firefighting boat should be considered.

The decision to use tugs to fight a fire on a tanker or the terminal, or to use them to unberth nearby ships, should be made by the person in overall charge of the firefighting and with the harbour authority. Firefighting tugs should have VHF/UHF radio with separate channels for towing and firefighting. When firefighting, they should be in direct contact with the person in overall charge of the firefighting.

Tugs with firefighting equipment should be inspected regularly to ensure that their equipment and foam compound stocks are in good condition. Tests of the fire pump and monitors should be carried out weekly. The foam-filling points on the tugs should be kept clear and be ready for immediate use.

As part of the terminal emergency plan, it should be decided whether trained firefighters or the crew will fight the fire. Either way, the decision should be supported with appropriate training.

5.7 Protective clothing

All fire protective clothing protects firefighters from radiant heat and burns.

Fire protective clothing is made from lightweight, fire resistant fabric with an aluminium covering. It is also called a fire proximity suit. It is not suitable for direct exposure to fire. Heavier suits, known as fire entry suits, allow personnel wearing breathing apparatus and with rescue backup to withstand direct flames for a short time.

Depending on local firefighting arrangements, the terminal should provide a minimum of two complete sets of fire proximity and fire entry suits, including helmets, SCBA, gloves and boots.

All protective clothing should be kept serviceable and dry. It should be properly fastened when worn.

Tankers should have fire protective clothing in accordance with SOLAS.

5.8 Automatic fire detection systems

5.8.1 General

Automatic fire detection and alarm systems alert personnel so they can respond promptly to a fire with the aim of saving lives and property. These systems may have one or more circuits connected to automatic fire detectors and manual activation points. They may also have one or more indicating circuits connected to alarm signals, including control panel indicator and warning lamps, outdoor flashing lights, bells and horns.

5.8.2 Types of fire detectors

Automatic detection systems consist of mechanical, electrical or electronic devices that detect environmental changes created by fire or by toxic or combustible gases. Fire detectors operate on one of three principles: sensitivity to heat, to smoke or gaseous by-products of combustion, or to flame radiation.

5.8.2.1 Heat-sensing fire detectors

Heat-sensing fire detectors fall into two general categories:

- Fixed temperature devices that trigger an alarm at a pre-determined temperature.
- Rate of rise devices that have two thermocouples; one that monitors heat rise from convection or radiation and a second that monitors the ambient temperature of the space. If the first exceeds the second, an alarm will be triggered.

Some devices combine both principles and are known as rate compensated detectors.

Generally, heat-sensing detectors are suited to detecting fires in spaces, e.g. rooms, lockers, etc., that may be subject to rapid and high heat. They may also be used directly over hazards where hot flaming fires might occur or where the speed of detection is not the prime concern.

5.8.2.2 Smoke-sensing fire detectors

Smoke-sensing fire detectors operate on various principles, including ionisation of smoke particles, photoelectric light obscuration or light scattering, electrical resistance changes in an air chamber and optically scanning a cloud chamber.

5.8.2.3 Gas-sensing fire detectors

Gas-sensing fire detectors detect one or more of the gases produced during combustion. These detectors are seldom a preferred option as tests show that smoke is detectable before gases.

5.8.2.4 Flame-sensing fire detectors

Flame-sensing fire detectors use optical sensors to spot the radiant energy emitted by fire. Flame detectors that respond to IR or ultraviolet radiation, or a combination, are available. Ultraviolet sensitive, triple IR or multi-spectrum flame detectors are generally preferred.

5.8.3 Selection of fire detectors

Fire detectors should be selected based on the types of fires that they are protecting against. The type and quantity of fuel, possible ignition sources, ranges of ambient conditions are all factors to consider. Any replacement detectors should be like for like.

Heat detectors, including fusible plugs, cost the least and have the lowest false alarm rates, but they are also the slowest to respond. Heat generated by small fires tends to dissipate rapidly, so heat detectors are best used to protect confined spaces or positioned directly over hazards where a flaming fire might occur.

Smoke detectors respond faster than heat detectors. They are best suited to confined spaces and should be installed for known air current patterns, e.g. at air conditioning return ducts, or on a grid layout.

Photoelectric smoke detectors are best used in places where smouldering or low temperature fires might be expected. Where flaming fires are expected, ionisation smoke detectors should be used.

Flame detectors give a fast response but will warn of any source of radiation in their sensitivity range. False alarm rates can be high if they are not used properly. Their sensitivity is a function of flame size and distance from the detector. They are available in explosion-proof housings, so can be used to protect areas where explosive or flammable vapours are encountered.

5.8.4 Fire detection and alarm systems in terminals

Fire detection and alarm system selection and fitting at a terminal depends on the risks of the product being handled, tanker sizes and terminal throughput.

Since heat is carried and stratified by convection currents, the location of detectors should consider natural and mechanical ventilation effects. Before installation, seek the advice of manufacturers and fire and safety experts and check that detectors comply with local regulations.