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FIRE

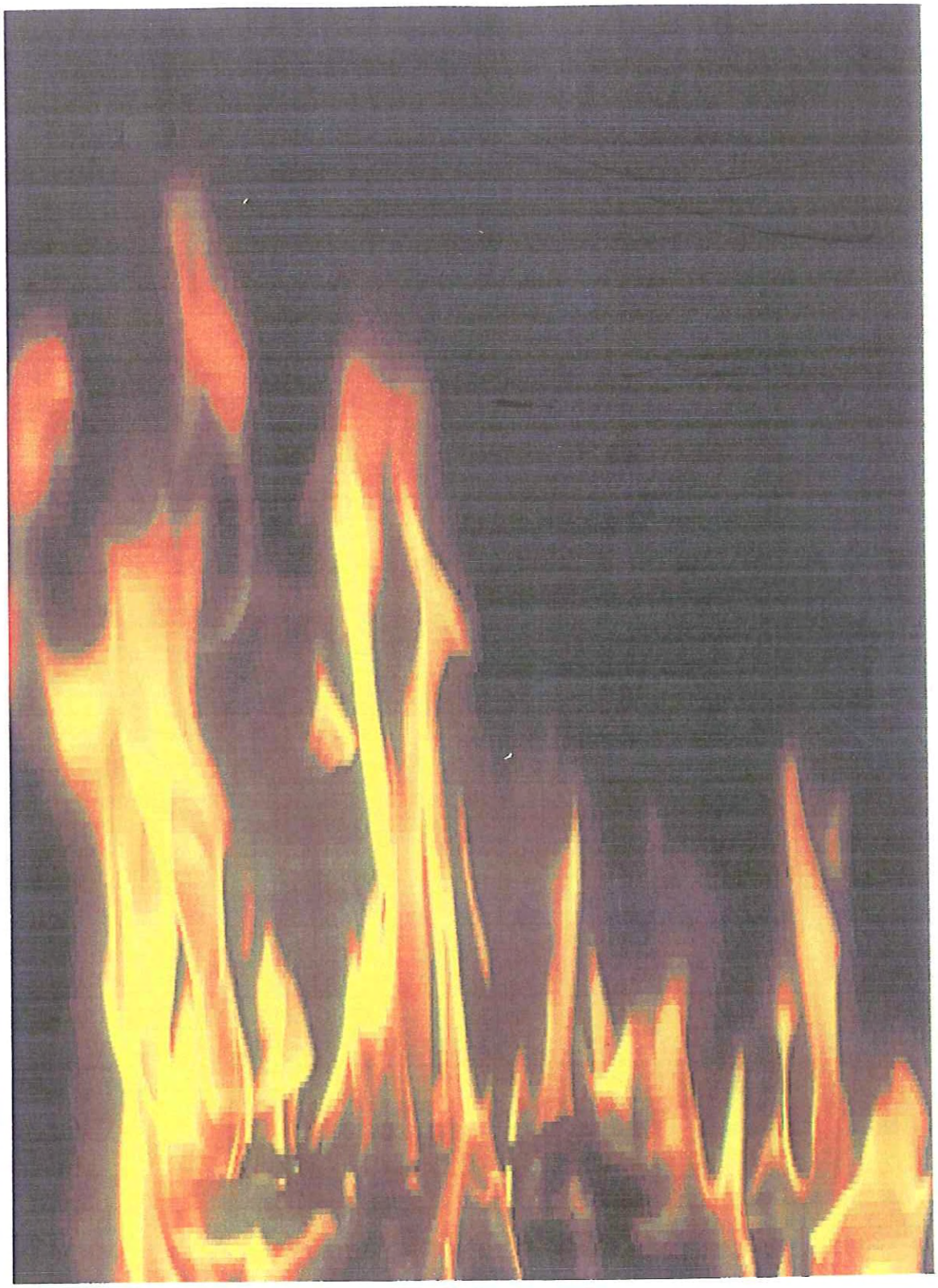
SAFETY

OPERATIONS

BOOKLET

To meet the requirements of

SOLAS Ch.II-2 Part E, Reg.16.2



		From	To
THE PERSON RESPONSIBLE FOR THE MAINTENANCE OF THIS BOOKLET IS:			
THE PERSON RESPONSIBLE FOR THE MAINTENANCE AND READY-USE CONDITION OF ALL PORTABLE FIRE FIGHTING EQUIPMENT IS:-			
THE PERSON RESPONSIBLE FOR THE MAINTENANCE AND READY-USE CONDITION OF ALL FIXED FIRE FIGHTING SYSTEMS IS:-			

INTRODUCTION

The ship's Fire Fighting Training Manual is designed to identify and explain the dangers associated with smoking, electrical hazards, flammable liquids and other common shipboard hazards.

General instruction on fire-fighting activities and fire-fighting procedures including those for notification of a fire and the use of manually operated call points is detailed. The meaning of the ship's alarms, the operation and use of fire safety systems and appliances and, where fitted, the operation and use of fire doors is explained. Similarly the operation and use of smoke dampers is referred to together with escape systems and appliances.

Regulation 16.2.1 of the revised Chapter II of SOLAS requires a fire safety operational booklet containing the necessary information and instructions for the safe operation of the ship and cargo handling operations in relation to fire safety. The purpose of this booklet is to address the requirements of regulation 16.2.1.

For the purpose of convenience to members of the crew, the information applicable for such fire safety operational guidance is contained within this booklet. Further information may be found in the Code of Safe Working Practices for Merchant Seamen. The key lesson to be learned is, if you work to ensure that fire is avoided you will not have to fight it.

It cannot be stressed too much that every member of the ship's crew has a personal responsibility to be competent is identifying the presence of fire, of knowing the correct actions to take in raising an alarm, in taking actions to ensure the safety of passengers and in taking the necessary actions to prevent fire spread whilst ensuring the utmost precautions for personal safety.

FIRE CONTROL PLANS

ID Number	Location	

MEANINGS OF THE SHIP'S ALARMS

Emergency	Signal	Location of Primary Alarm	Location of Secondary Alarm	Additional Information
General Emergency				
Man Overboard				
Abandon Vessel				
Abandon Engine Room				
Abandon Cargo Spaces				
Fire Alarm Call Point Activated				
One Fire Detector Activated				
Two Fire Detectors Activated				

Meanings of the Ship's Alarms (continued)

Emergency	Signal	Location of Primary Alarm	Location of Secondary Alarm	Additional Information
Main Machinery Space Gas Flooding System Activated				
Space. ..... Gas Flooding System Activated				
Space. ..... Gas Flooding System Activated				
Space. ..... Gas Flooding System Activated				
Space. ..... Sprinkler System Activated				
Space. ..... Sprinkler System Activated				
Space. ..... Sprinkler System Activated				
Space. ..... Sprinkler System Activated				
Space. ..... Extraction Smoke Detection				
Space. ..... Extraction Smoke Detection				
Space. ..... Extraction Smoke Detection				
Space. ..... Extraction Smoke Detection				

RAISING THE ALARM

Taking the correct initial actions in the early stages of a fire, whilst it is still small, will maximise the chances of successfully extinguishing it. Remember, even the biggest fires started as a single flame. Large fires will probably have once been small, but grew because they were not tackled, or were not tackled correctly, in the early stages.

No person on board should be in any doubt about the following:

- **Action to be taken on discovering a fire.**
- **Action to taken on hearing the alarm.**
- **Knowing where fire fighting equipment is kept.**
- **Knowing how to use it effectively.**
- **Awareness of your own and others' safety during fire fighting.**

Very often it is the actions of the person discovering a fire that can make the difference between a small blaze quickly extinguished and a catastrophic fire which could lead to the loss of the ship, or even to loss of life.

"Fires always happen to others, never to me", is a very common misconception.

The first reaction when discovering a fire is usually one of shock or disbelief. Without training this can lead to actions which are instinctive and often incorrect.

Common instinctive actions are to:

- run away leaving doors open,

- run into the compartment without fire fighting equipment and attempt to stamp out the burning material.

If the discoverer becomes a casualty, effectively no-one has discovered the fire, which will continue to grow and spread unchecked until someone else responds in a correct manner.

You may discover a fire anywhere by seeing, smelling or hearing it. If you do find a fire:

1. ***think about the correct procedure for raising the alarm.***
2. ***stay calm.***

Panic will affect your ability to act effectively and may frighten others unnecessarily.

RAISING THE ALARM

- Shout "FIRE, FIRE, FIRE", and give its location.
- Bang on doors in case people are asleep, but do not open them as this may allow smoke in unnecessarily.
- Operate a near-by Fire Alarm Call Point.
- If available use an internal telephone to inform the bridge or other control centre.

When informing the control centre state:

- the fire location
- the type of fire
- the size of fire
- details of casualties
- what actions, if any, are being taken

Do not attempt to fight the fire until others have been informed

When another person appears one should carry on raising the alarm whilst the other, providing it is safe to do so, commences first-aid fire fighting.

IF THE FIRE IS BEHIND CLOSED DOORS

If smoke is seen coming from behind a closed door there is no indication of the size or type of fire.

- ***DO NOT OPEN THE DOOR.***
- Raise the alarm in the way previously described.
- ***DO NOT TACKLE THE FIRE.***
- Prepare fire fighting equipment.
- When the Fire Attack Party arrives advise the leader of what you have observed and what you know about the situation.

IF THE DOOR OF THE COMPARTMENT ON FIRE IS OPEN

- Raise the alarm as described above.
- If you are fully clothed, and it is safe to do so, attack the fire using appropriate first- aid appliances.
    - Keep low.
    - Do not let the fire or smoke get between you and your way of escape.
- If you are beaten back **CLOSE THE DOOR.**
- Start preparing fire fighting equipment, ready for the Fire Attack Party.
- Move casualties to a place of safety.
- Consider ways of preventing the fire from spreading. E.g.
    - Boundary cooling..
    - Removing flammable items from the path of the fire..
    - Isolate local ventilation.

Switch off local electrical circuits.

Stay in the vicinity of the fire, but at a safe distance, to brief whoever is in charge. The information required is:

- Where the fire is situated,
- What is burning,
- Any hazardous substances,
- Number and position of casualties,
- What has already happened. (e.g. hoses prepared),
- Details of ventilation and electrical circuits already isolated.

Any training must ensure that all personnel know the location of the nearest extinguisher to their place of work and their accommodation. They must also know how to use the extinguisher and be aware of any limitations that it might have. Remember, the correct type of extinguisher should have been sited with regard to the type of risk in any particular area of the vessel.

Familiarity with all fire fighting equipment, and its effective and safe use in a real emergency will save vital minutes and seconds, which can make the difference between an incident and a tragedy.

SUMMARY

F - Find

I - Inform

R - Restrict

E - Extinguish

or

F - Find

I - Inform

R - Restrict

E - Escape

FIRE MUSTER DUTIES

The action to be taken on hearing Emergency Sound Signals requiring attendance at Assembly Stations are:

1. PROCEED TO ASSEMBLY STATIONS AS QUICKLY AS POSSIBLE
2. ALL PERSONNEL MUST FAMILIARISE THEMSELVES WITH THE RECOMMENDED ESCAPE ROUTES TO ASSEMBLY STATIONS. THERE MAY BE A NEED FOR ALTERNATIVE ESCAPE ROUTES AND IT IS THE RESPONSIBILITY OF ALL PERSONNEL TO BE AWARE OF ALTERNATIVE ROUTINGS
3. PERSONNEL SHOULD PROCEED TO ASSEMBLY STATIONS IN AN ORDERLY MANNER. Avoid going through accommodation spaces to reach Assembly Stations. Wherever possible use outside ladders and alleyways.
4. WHERE SPECIFIC DUTIES ARE ALLOCATED, THE DESIGNATED PERSONS SHOULD PREPARE EQUIPMENT AS DETAILED IN THE MUSTER LIST

FIRE MUSTER DUTIES

Enter here details of the actions required on hearing the fire alarm, muster positions and fire fighting parties and duties.

FIRE SAFETY OBJECTIVES

In marine terms fire safety objectives are to:

1. **Prevent the occurrence of fire and explosion.**

2. **Reduce the risk to life caused by fire.**

3. **Reduce the risk of damage caused by fire to the ship, its cargo and the environment.**

4. **Contain, control and suppress fire and explosion in the compartment of origin.**

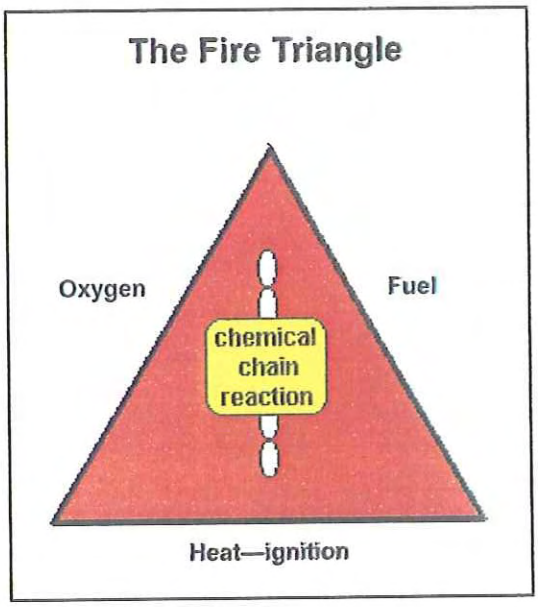
5. **Provide adequate and readily accessible means of escape for passengers and crew.**

The importance of good **CONTINGENCY PLANNING** cannot be over-emphasised.

THE NATURE OF FIRE

Fire is a chemical reaction known as combustion which occurs when **fuel** and **oxygen** are brought together with sufficient **heat** to cause ignition.

This is simply represented by the ***Fire Triangle***. A fire cannot start, or continue, if one side of the fuel – oxygen – heat triangle is absent, or if there is an interruption in the chemical chain reaction that sustains burning.



FUEL

This can be a solid, liquid or gas, which when heated gives off flammable vapours. Examples include paper, wood, cardboard, paint, oils, acetylene, etc.

OXYGEN

Oxygen is normally present in the air in sufficient quantity to sustain a fire.

HEAT

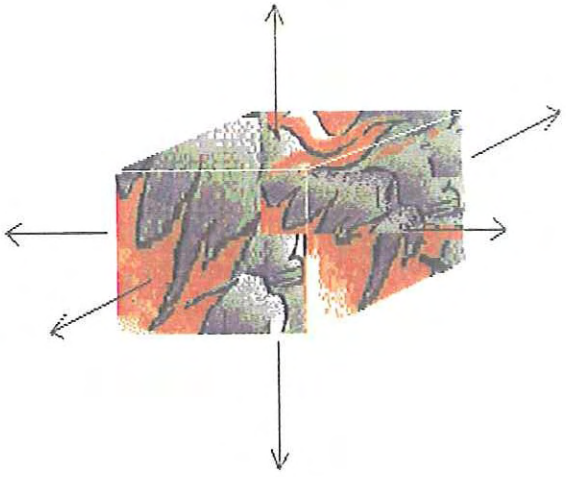
A critical temperature must be reached for ignition to occur, but once a fire has started it will normally maintain its own heat supply. Heat may be applied deliberately, or it may be accidental. For example, heaters being placed too close to furniture, curtains or paper; power points being overloaded; and personal computers being covered with office papers.

FIRE SPREAD

Heat – and fire – may spread in four different ways.

1. **Conduction**. This refers to direct heat transfer. E.g. heat travelling along or through unprotected steelwork. (girders, deck plating, bulkheads, etc.)
2. **Convection.** The spread of heat via gases, liquids or hot air circulating through stair wells, lift shaft, ventilation trucking, etc.
3. **Radiation.** Materials may be ignited when placed too close to a source of radiated heat such as an electric heater or other heating appliance.
4. **Direct Burning.** Where combustible materials give off sufficient vapour to encourage combustion to continue when coming into contact with a naked flame. E.g. a mattress being exposed to a lighted cigarette.

Fire in any one compartment may spread by one or more of the methods listed, and may spread in one or more of six directions unless inhibited by boundary cooling or some other method. Fire may also be spread via air-conditioning and heating ducts, ceiling voids, and conduits.



FIRE PREVENTION

Fire fighting on board can be extremely difficult and potentially dangerous. Good fire prevention practices greatly minimise the possibility of fire occurring. Fire prevention discipline should be a part of the every-day attitude of all personnel.

Some main areas of concern

- Bottom of lift shafts
- Stores
- Near incinerators
- Laundries and drying rooms
- Oil spills and leakage
- Lines and systems carrying oil under pressure; Fuel, Lube Oil, Hydraulic Oil and Liquid, Flammable Cargoes
- Wastepaper baskets not emptied
- Galley exhaust ducts
- Combustible material near heat sources
- Clothes hanging over cookers or heaters.

Good housekeeping

- Control of rubbish
- Tidy storerooms
- Steel bins, with lids, for collecting oily waste, emptied frequently.
- Store and use items such as cleaning fluids, paints, solvents aerosols and other highly flammable material as directed by the manufacturer. At the end of the working day secure them in the designated stowage
- All spillages are to be wiped up immediately and dirty rags disposed of safely.

- Close doors of empty compartments and switch off unnecessary lighting and other electrical equipment

Electrical

- Inspection of personal equipment (e.g. radios) by a competent person
- Take faulty equipment out of service
- Regular inspection of electrical appliances
- Disconnect equipment not in use including radios and videos
- Allow irons and soldering irons to cool before stowing. Do not leave unattended when in use.
- Renew electrical leads at the first sign of wear in the outer covering
- Sufficient, relevant and clear safety notices
- Do not overload power points
- Do not tamper with electrical fittings or equipment
- Do not push bare wires into electric sockets

Smoking

- Use proper ashtrays and disposal facilities
- Never smoke in bed
- Adhere to the designated smoking and no-smoking areas.
- Extinguish matches and cigarettes before discarding them
- Do not flick cigarette or pipe ash
- Do not smoke when moving around the ship
- Use only safety matches
- Do not stow cigarette lighter fuel with personal belongings

Machinery

- Regularly inspect and maintain all items, including those outside of the machinery spaces.
- Safety equipment such as fuel shut-offs, baffle plates, overflow alarms, heat sensors, etc. must be kept in good order
- Adhere to safe working practices

Hotwork

- Use a "Permit to Work" scheme as proposed in the Code of Safe Working Practices
- Do not use the equipment unless you have been trained and authorised to do so.
- Check that any oxy-acetylene hoses are – not leaking, securely attached and not twisted.
- Keep the working area free of sharp objects
- Do not restrict your access to the work area and move around carefully
- Make sure someone knows where you are as indicated on the Permit to Work
- Check there are no combustible materials below or adjacent to the area of work.
- Do not commence work in areas where there are surfaces covered with grease, oil, or other flammable material
- Port holes and openings through which sparks may fall should be closed
- The far side of a bulkhead or deck should be checked for materials and substances which may ignite, and for cables and other services which may be affected by the heat
- Gas Free certificates must be issued if appropriate
- Suitable fire extinguishers should be kept to hand during the operation
- A person with a suitable extinguisher should keep watch on areas which may be affected but are not visible to the welder

- Frequent checks should be made for at least two hours after the work has stopped.

Hazards

- Identify hazards to all concerned, and know the safety and emergency procedures associated with them

All personnel on board must be observant and report suspicious smells, leaks from pipes or tanks, any electrical machinery that appears to be overheating and any wrongly stowed flammables. Check for items wrongly stowed in places such as mast houses, funnel uptakes, small machinery compartments and other 'convenient' places. Report any fire fighting or safety equipment that is missing.

FIRE PRECAUTIONS WHEN HANDLING CARGO

The risk of a fire breaking out in the ship's hold during cargo work and after the ship has sailed and the consequent hazard to the ship, cargo and personnel should be obvious to all members of the crew. This section is designed to give some general guidance as to fire precautions that may be taken when handling general cargo, however the specific cargo loaded may determine the precise fire precautions to be taken.

Wherever cargo is being handled, such as in open hatchways and holds, fire precautions should be applied, including the following. No smoking or naked lights should be allowed; no hot work such as welding should be undertaken in the area; the use of damaged or faulty electrical equipment must not be permitted etc. Dependent on the cargo being loaded it may be appropriate to have fire extinguishers on hand and have fire hoses laid out ready for use.

Crew members should be aware that there are some goods, if loaded when wet, that are capable of spontaneous combustion. Consequently, there may be a increase in the risk of fire during a voyage if such kind of goods are loaded during or after rain. Some bulk cargo may be liable to hot spots, caused by extreme insect infestation, which may be cause of fire. Refrigerated cargo, such as some fruits, may be at risk of combustion if the refrigeration plant should break down during a voyage.

Care should be taken on the vehicle decks of Ro-Ro vessels to ensure that smoking restrictions are rigorously applied since the risk of fire resulting from possible spillages from the fuel tanks of vehicles carried is ever present.

It is important that all precautions are taken to ensure that cargo is safely stowed and that procedures are put in place to monitor cargo that may be at risk of combustion during the voyage.

SPECIAL PRECAUTIONS WHEN CARRYING AND HANDLING CRUDE OR PRODUCT OIL CARGOES

The main Fire Protection for the majority of hydrocarbon based oil cargoes is, without doubt, the provision of an adequate blanket of high quality Inert Gas above the cargo. Ensure that the Inert Gas Plant is always maintained in first class condition. If there is an Inert Gas failure during cargo operations, Company policy must be to stop operations until the problem is rectified.

The integrity of the cargo pipeline systems, valves, pumping machinery and measuring systems is of major importance. Consequently, Planned Maintenance to ensure this integrity must be paramount.

In Ballast, the cargo tanks should be inerted.

When purging/gas freeing the ventilation system gauzes should be intact and in good condition.

Pressure/Vacuum valves for thermal changes and Hi-Velocity Venting valves should be programmed for maintenance and certification.

When loading, if there is not a vapour return system, the vent system gauzes should be intact and in good condition.

Void spaces must be monitored for gas ingress, preferably automatically, on a continuous basis.

SPECIAL PRECAUTIONS WHEN CARRYING AND HANDLING SOLID BULK CARGOES

Prior to and during loading, transport and discharge of solid bulk cargoes, all necessary safety precautions, including any national regulations or requirements, should be observed. Reference should be made to the Code of Safe Practice for Solid Bulk Cargoes (IBC Code).

Certain bulk materials can be liable to oxidation, which process may result in hazards including oxygen reduction, emission of toxic fumes and self-heating. In such cases, particular attention should be paid to personal protection and the requirements for special precautions and any measures that might have to be taken prior to loading and after discharge.

If a bulk cargo is being carried which is liable to emit a flammable or toxic gas, an appropriate instrument for measuring the concentration of gas should be provided. It should be noted that a flammable gas detector is only suitable for testing the explosive nature of gas mixtures.

Dust created by certain cargoes may form an explosion hazard, especially during loading, discharging or cleaning. The risk should be minimised by ensuring that sufficient ventilation is provided to prevent the formation of a dust-laden atmosphere and by hosing down instead of sweeping.

Some cargoes may generate flammable gases is such quantities that a fire or explosion hazard is a possibility and if this is the case the cargo spaces and adjacent enclosed spaces should be properly ventilated at all times. It may also be necessary to monitor the atmosphere is these spaces using combustible-gas indicators.

SPECIAL PROVISIONS IN THE EVENT OF AN INCIDENT AND FIRE PRECAUTIONS INVOLVING DANGEROUS GOODS

The following information is extracted from the International Maritime Dangerous Goods Code. Reference should also be made to the Code of Safe Working Practice for Solid Bulk Cargoes, the International Bulk Chemical Code and the International Gas Carrier Code, as appropriate.

Specific information on the handling of dangerous cargo should be obtained from the Safety Data Sheets required to be provided with such cargo.

1. General

- In the event of an incident involving dangerous goods detailed recommendations are contained in *Emergency Procedures for Ships Carrying Dangerous Goods (EmS).*
- In the event of personnel exposure during an incident involving dangerous goods, detailed recommendations are contained in *Medical First Aid Guide for Use in Accidents involving Dangerous Goods (MFAG).*

2. General provisions in the event of incidents

2.1 Recommendations on emergency action may differ depending on whether or not the goods are stowed *on deck* or *under deck* or whether a substance is gaseous, liquid or solid. When dealing with incidents involving flammable gases, or flammable liquids with a flashpoint of 61° C closed cup (c.c.) or below, all sources of ignition such as naked lights, unprotected light bulbs, electric handtools) should be avoided.

2.2 In general, the recommendation is to wash spillages *on deck* overboard with copious quantities of water and, where there is likely to be a dangerous reaction with water, from as far away as practicable. Disposal of spilt dangerous goods overboard is a matter for judgement by the master, bearing in mind that the safety of the crew has priority over pollution of the sea. If it is safe to do so, spillages and leakages of substances, articles and materials identified in the International Maritime Dangerous Goods Code as MARINE POLLUTANT should be collected for safe disposal. Inert absorbent material should be used liquids.

2.3 Toxic, corrosive and/or flammable vapours in *under deck* cargo spaces should, where possible, be dispersed before undertaking any emergency action. Where a mechanical ventilation system is used, care will be necessary to ensure that flammable vapours are not ignited.

2.4 If there is any reason to suspect leakage of these substances, entry into a hold or cargo space should not be permitted until the master or responsible officer has taken all safety considerations into account and is satisfied that it is safe to do so.

2.5 Emergency entry into the hold under other circumstances should only be undertaken by trained crew wearing self-contained breathing apparatus and other protective clothing.

2.6 A careful inspection for structural damage should be carried out after dealing with spillages of substances corrosive to steel and cryogenic liquids.

3. Special Provisions for incidents involving infectious substances

3.1 If any person responsible for the transport or opening of packages containing infectious substances becomes aware of damage to or leakage from such packages, he should;

.1 avoid handling the package or keep handling to a minimum

.2 inspect adjacent packages for contamination and put aside any that have been contaminated

.3 inform the appropriate public health authority or veterinary authority, and provide information on any other countries of transit where persons may have been exposed to danger; and

.4 notify the consignor and/or the consignee.

4. Special provisions for incidents involving radioactive material

4.1 If it is evident that a package is damaged or leaking, or if it is suspected that the package may have leaked or been damaged, access to the package should be restricted and a qualified person should, as soon as possible, assess the extent of contamination and the resultant radiation level of the package. The scope of the assessment should include the package, the conveyance, the adjacent loading and unloading areas, and, if necessary, all other material which has been transported in the conveyance. When necessary, additional steps for the

protection of persons, property and the environment, in accordance with provisions established by the relevant competent authority, should be taken to overcome and minimize the consequences of such leakage or damage.

4.2 Packages damaged or leaking radioactive contents in excess of allowable limits for normal conditions of transport may be removed to an acceptable interim location under supervision, but should not be forwarded until repaired or reconditioned and decontaminated.

4.3 In the event of accidents or incidents during the transport of radioactive material, emergency provisions, as established by relevant national and/or international organisations, should be observed to protect persons, property and the environment. Appropriate guidelines for such provisions are contained in the International Atomic Agency's document "Emergency Response Planning and Preparedness for Transport Accidents Involving Radioactive Material", Safety Series No. 87.

4.4 Attention is drawn to the latest versions of both the *Emergency Procedures for Ships Carrying Dangerous Goods (EmS)* and *Medical First Aid Guide for Use in Accidents involving Dangerous Goods (MFAG).*

4.5 Emergency procedures should take into account the formation of other dangerous substances that may result from the reaction between the contents of a consignment and the environment in the event of an accident.

4.6 In the event of a package containing radioactive material suffering from a breakage or leakage while the ship is in port, the port authorities should be informed and advice obtained from them or from the competent authority *(see Chapter 7.9 of the IMDG Code and the IAEA list of national competent authorities responsible for approval and authorisations in respect of the transport of radioactive material. The list is updated annually)*. Procedures have been drawn up in many countries for summoning radiological assistance in any such emergency.

5. General fire precautions

5.1 The prevention of fire in a cargo of dangerous goods is achieved by practising good seamanship, observing in particular the following precautions:

.1 keep combustible material away from ignition sources;

.2 protect a flammable substance by adequate packing;

.3 reject damaged or leaking packages;

.4 stow packages protected from accidental damage or heating;

.5 segregate packages from substance liable to start or spread fire;

.6 where appropriate and practicable, stow dangerous goods in an accessible position so that packages in the vicinity of a fire may be protected;

.7 enforce prohibition of smoking in dangerous areas and display clearly recognisable "NO SMOKING" notices or signs; and

.8 the dangers from short-circuits, earth leakages or sparking will be apparent. Lighting and power cables, and fittings should be maintained in good condition. Cables or equipment found to be unsafe should be disconnected. Where a bulkhead is required to be suitable for segregation purposes, cables and conduit penetrations of the decks and bulkheads should be sealed against the passage of gas and vapours. When stowing dangerous goods on deck, the position and design of auxiliary machinery, electrical equipment and cable runs should be considered in order to avoid sources of ignition.

5.2 Fire precautions applying to individual classes, and where necessary to individual substances, are recommended part 2 above and parts 5 to 8 and in the Dangerous Goods List.

6. Special fire precautions for Class 1

6.1 .1 The greatest risk in the handling and transport of goods of class 1 is that of fire from a source external to the goods, and it is vital that any fire should be detected and extinguished before it can reach such goods. Consequently, it is essential that fire precautions, fire-fighting measures and equipment should be of a high standard and ready for immediate application and use.

.2 Compartments containing goods of class 1 and adjacent cargo spaces should be provided with a fire-detection system. If such spaces are not protected by a fixed fire-extinguishing system, they should be accessible for fire-fighting operations.

.3 No repair work should be carried out in a compartment containing goods of class 1. Special care should be exercised in carrying out repairs in any adjacent space. No welding burning, cutting, or riveting operations involving the use of fire, flame, spark, or arc-producing equipment should be carried out in any space other than machinery spaces and workshops where fire-extinguishing arrangements are available, except in an emergency and, if in port, with prior authorisation of the port authority.

7. Special fire precautions for class 2

7.1 Effective ventilation should be provided to remove any leakage of gas from within the cargo space or spaces, bearing in mind that some gases are heavier than air and may accumulate in dangerous concentrations in the lower part of the ship.

7.2 Measures should be taken to prevent leaking gases from penetrating into any other part of the ship.

7.3 .1 If there is any reason to suspect leakage of a gas, entry into cargo spaces or other enclosed spaces should not be permitted until the master or responsible officer has taken all safety considerations into account and is satisfied that it is safe to do so. Emergency entry under other circumstances should only be undertaken by trained crew wearing self-contained breathing apparatus and protective clothing when recommended, and always under the supervision of a responsible officer.

.2 Leakage from receptacles containing flammable gases may give rise to explosive mixtures with air. Such mixtures, if ignited, may result in explosion or fire.

8. Special precautions for class 3

8.1 Flammable liquids give off flammable vapours which, especially in an enclosed space, form explosive mixtures with air. Such vapours, if ignited, may cause a "flashback" to the place in which the substances are stowed. Due regard should be paid to the provision of adequate ventilation to prevent accumulation of vapours.

9. Special fire precautions and fire fighting for class 7

9.1 The radioactive contents of Excepted, Industrial, and Type A packages are so restricted that, in the event of an accident and damage to the package, there is a high probability that any material released, or shielding efficiency lost, would not give rise to such radiological hazard as to hamper fire-fighting or rescue operations.

9.2 Type B(U) packages, Type B(M) packages and Type C packages are designed to be strong enough to withstand severe fire without significant loss of contents or dangerous loss of radiation shielding.

FIRE TRAINING MANUAL

Complying with IMO Resolution MSC.99 (73)
SOLAS amendment to Chapter II Reg. 15

Intended for use by ALL Personnel onboard

Details concerning specific Fire Fighting equipment and systems onboard this vessel are entered in the last section of this Manual

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Section E **Organisation & Techniques**

Section F **Ship Specific Details**

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FIRE DOORS

In order to restrict the spread of fire the bulkheads and decks of a vessel are constructed to a particular standard. Various standards apply depending on the type of vessel and the nature of the space surrounded. Generally the fire resistance of a bulkhead is expressed as A, B or C followed by a number indicating the time that the division will prevent a specified temperature rise.

Class "A" - A division constructed of steel or equivalent material and capable of preventing the passage of smoke or flame for one hour (according to a standard test). Class "A" division bulkheads should be insulated with non-combustible materials so that on the side opposite to a fire the average temperature will not rise more than 139°C above the original temperature, nor more than 180°C at any one point.

Class "A-60" - must prevent the stated temperature rises for at least 60 minutes.
Class "A-30" - must prevent the stated temperature rises for at least 30 minutes.
Class "A-15" - must prevent the stated temperature rises for at least 15 minutes.
Class "A-0" - must prevent the stated temperature rises for at least 0 minutes.

Class "B" - A division capable of preventing the passage of flame for the first half an hour of the standard test. The insulation should be such that on the side opposite to a fire the average temperature will not rise more 139°C above the original temperature, nor more than 225°C at any one point.

Class "B-15" - must prevent the stated temperature rises for at least 15 minutes.
Class "B-0" - must prevent the stated temperature rises for at least 0 minutes.

A Class "B" division must be constructed of approved non-combustible materials except that combustible materials may be permitted provided they meet certain other requirements.

Class "C" - These divisions are constructed of approved non-combustible materials. They do not

need to meet the requirements for limiting the passage of smoke and flame nor limitations relative to temperature rise. Combustible veneers are permitted provided they meet other requirements.

Fire resistance of doors and doorframes fitted to bulkheads and decks is to be, as far as is practicable, at least equivalent to the bulkhead or deck in which they are fitted. Watertight doors need not be insulated.

All Ships' Accommodation Doors

Doors in Class "A" bulkheads

Each door must be capable of being opened and closed from both sides by one person only.

Fire doors in main vertical zone bulkheads, galley boundaries and stairway enclosures (provided they are not power-operated watertight doors and those which are normally locked) must comply with the following conditions:

- Self- closing (up to 3.5 angle of inclination opposing the closure)
- Close in not more than 40 seconds and not less than 10 seconds
- If a sliding door the closing rate shall be between 0.1 and 0.2m/sec.
- When held open able to be remotely released from a manned central control position.
- Able to be released from its hold back position on both sides of the door
- The release switches must incorporate a system that prevents automatic resetting of the system
- Hold back devices not controllable from the central station are not permitted
- If closed from the central control station it must be possible to re-open the door from both sides locally. After such opening the door must automatically close again.
- Have an indication at the central control as to whether it is closed or open
- Automatically close in the event of a power failure to the hold back system
- In the event of a power failure power operated doors must be operable at least ten times using local power accumulators
- When released from a remote station a sliding or power operated door must have an alarm that sounds for between 5 and 10 seconds before the door begins to move and

continuers sounding until the door is completely closed. Doors to certain special category compartments do not require alarms.

All Ships' Accommodation Doors

Doors in Class "B" bulkheads

- Ventilation openings may be allowed in the lower part of the door
- Cabin doors are to be self-closing without any hold back device

Cargo Ships

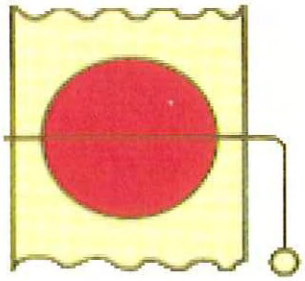
Doors in Fire- Resisting Divisions

- In "A" class divisions must be constructed of steel and doors in "B" class divisions must be non-combustible
- In boundaries of category A machinery spaces are to be self-closing and reasonably gas-tight
- Self-closing doors are not to be fitted with any hold back device, unless it is capable of remote release and of the fail safe type
- Ventilation is permitted through the lower part or beneath a door that leads between a corridor and a public space or cabin
- Watertight doors are not required to be insulated

FIRE DAMPERS

Fire dampers are provided in ventilation ducts and air intakes in order that in the event of a fire sections may be sealed and isolated and so prohibit the passage of heat and smoke.

In its simplest form the damper will consist of a solid metal (steel) plate located inside an air duct. In its open position the damper allows the free flow of air through a duct and in its closed position it completely prevents the passage of air, smoke and heat through the duct.



All dampers are required to be manually operated by means of a handle connected directly to the damper blade. Remote control is not permitted as there is no guarantee that a remote button or switch would operate correctly.

However, automatic closure is permitted and in some cases is a requirement. Automatic operation is usually by means of a fusible link which is activated at temperatures between 68° and 70°, except that in exhaust ducts serving spaces with high ambient temperatures (such as galleys or drying rooms) the temperature at which the fusible link (or other system) activates may be increased. But it may not be increased to more than 30° above the maximum deckhead temperature. Any automatic system used in controlling the fire dampers must *close* the damper in the event of a failure in any part of the system. Automatic damper closing systems must be capable of being manually overridden.

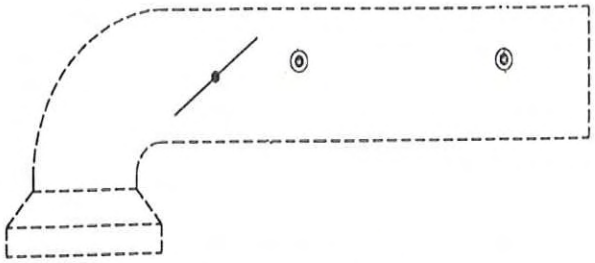
When using a fusible link it is incorporated into a wire that secures the damper in the open position. At a pre-determined temperature the link opens thus releasing the wire and allowing the damper to close under its own weight.

Each damper must have a visible indication to show if it is open or closed. The indicator, which is to

be connected directly to the damper blade, may not be reliant on an electrical or pneumatic system. The manually operated handle connected directly to the damper blade is often used as the open / closed indicator. There are to be clear and permanent 'open' and 'closed' indications so that the position of the damper may be readily determined.

The position from which any damper is operated must be readily accessible and marked in a red 'luminous' colour. If any damper is located behind a deckhead panel or other lining the access through the deckhead or lining must be marked 'FIRE DAMPER.' There should also be a notation by which the particular damper may be identified.

In a passenger vessel, where a ventilation duct passes through a main fire zone division a fire damper is to be fitted in the duct adjacent to the division. It must be capable of being manually controlled from each side of the division. In all vessels fail-safe automatic closing fire dampers are required for ducts that penetrate the boundaries of category A machinery spaces, galleys, etc.



Galley exhaust ducting showing the position of the damper and two gas extinguishing discharge nozzles

MEANS OF ESCAPE

The design of a vessel should allow for passengers and crew to quickly and safely evacuate any compartment and access the survival craft embarkation deck in the event of a fire or other emergency. Escape routes are both routes for escape and access.

There are general rules regarding the escape from all passenger and crew spaces and from spaces in which the crew is normally employed. Stairways and ladders are to be not less than specifically stated widths; there are limitations on the extent of a continuous stair run, and regulations concerning the dimensions of stairs. Ladders of rope or flexible chain or wire are not permitted to form part of an escape route. Corridors and doorways giving access to and from stairways or open decks must be wide enough to prevent congestion. Handrails at a height of 1m above the deck are fitted to both sides of a corridor, except that only one rail is required in narrow corridors.

The main escape routes from an area should be widely separated.

In older ships dead-end corridors are only permitted up to 7m length in cargo and small passenger vessels and up to 13m length in larger passenger vessels. In larger passenger vessels constructed after October 1994 dead-end corridors are not permitted. Where a dead-end corridor leads to a crew communal space there must be a suitable alternative emergency escape from that space. In newer vessels a corridor or lobby from which there is only one escape route is not permitted.

Lifts are never to be regarded a means of escape, but escalators may be considered as a normal stairway.

In passenger ships public rooms with subdued lighting must have their exits clearly marked, and doors which do not give safe escape must be signed 'NO EXIT.'

Some spaces, such as the Radio Office, may have no second means of escape: in such cases a fully opening porthole or window may be accepted. Where an escape window is not at deck level on the outside steel ladder rungs must be provided which lead to an open deck with access to the survival craft.

Hatches - Hatches may provide the second means of escape from some crew accommodation or working spaces such as a Pump Room or Steering Flat. Escape hatches must be operable from both sides, not able to be locked, and accessed by a fixed steel ladder. For ease of opening escape hatches should be provided with a counter balance.

Escape Panels - These are to arranged so that they may be easily kicked out, and only one escape panel is permitted in any escape route. Escape Panels must not permitted in escape routes taking passengers to survival craft embarkation stations, nor are they permitted in Class "A" bulkheads or doors.

Inner bedrooms - Where a crew cabin or suite incorporates a bedroom, or other inner room, that is accessed through a dayroom, and there is no direct access to the inner room from the corridor, there should be an escape panel or window to allow emergency evacuation of the inner room. However, if the dayroom is fitted with a smoke detector that is part of the ship's fixed fire detection system the inner room does not require a second means of escape.

Doors: - doors should normally open with the flow (i.e. in the direction of escape) except cabin doors which will normally open into the cabin. Doors in vertical emergency escape trunks will normally open out of the truck. In crew accommodation doors will normally be hinged, although sliding doors may be permitted in some circumstances. Within escape routes the surveyor may allow doors (in crew accommodation) to be locked for reasons of security provided the use of the route for escape purposes is not impaired.

Special Category Spaces in passenger ships - Stairways forming the means of escape are to be spaced one at each end of the space and one at mid length. Each of these escape routes is to give continuous fire shelter to the evacuation positions or to a higher deck.

Ro-Ro Spaces - are to have at least a stairway giving continuous fire shelter to the evacuation embarkation decks or to a higher deck and a ladder or stairway giving access via an escape hatch to the deck above; and from that deck to embarkation decks. These two means of escape are to be at each end of the ro-ro space. Large ro-ro spaces are required to have additional escape routes. Ro-Ro passenger vessels are to display in public spaces and cabins diagrammatic plans of escape routes.

Vertical ladders - are not permitted in any escape route providing passengers access to the evacuation embarkation positions.

Machinery Spaces - There shall be two means of escape from each machinery space, one of which shall provide continuous fire shelter. Ladders are to be secured with insulated fixing points so that heat from a fire cannot be transferred to the ladder. A control room within a machinery space must have a means of escape which does not necessitate entering the machinery space.

Small passenger 'open deck' vessels - for the protection of passengers these types of vessels may be fitted with flexible tie-down screens. Such screens must be capable of being quickly released and not secured with lacing.

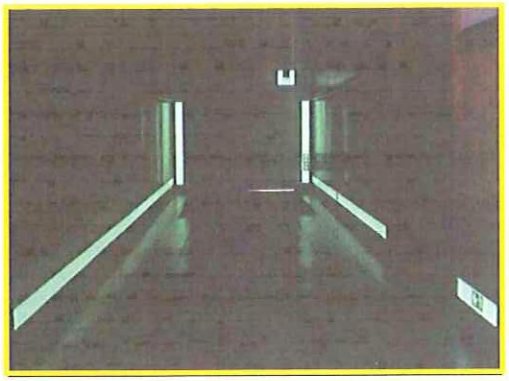
Spaces with gas cylinders - These are to be entered from the open deck, even if the space is in the tweendeck. Vertical ladders and hatches are not permitted. Access doors must open outwards

Cargo Ships and Tankers -

Accommodation : two means of escape between main bulkheads, one giving direct access to the embarkation deck or higher deck. Doors may be locked provided escape and access is not hindered and provide that they can be opened from both sides.

Tower blocks with no outside decks: all levels are to be connected to each other by an external sloping ladder with at least one access door at each level. All levels must also be connected by an internal enclosed stairway.

Low Level Lighting - Vessels carrying more than 36 passengers are required to provide low level lighting at all points of the escape route, including angles and intersections, stairways and exits. Low Level escape route marking is in addition to the required emergency lighting and may be either electrically powered or photoluminescent. Strip indicators are placed not more than 300 mm above the deck. The markings must enable passengers to identify all routes of escape and escape exits.



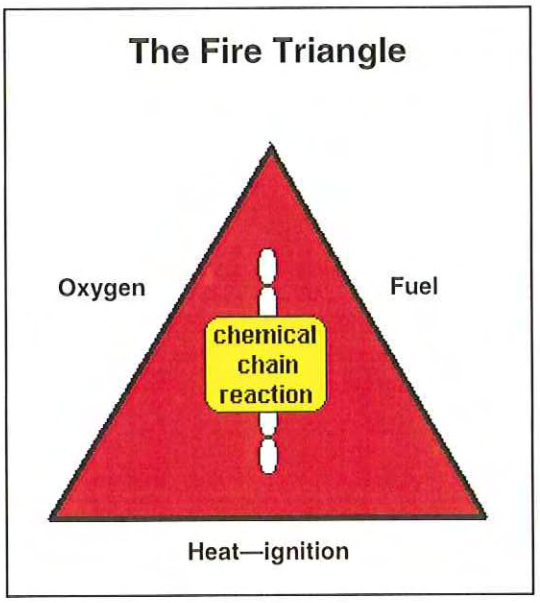
Low Level photoluminescent strips show the route of the corridor, and highlight the exit and door handle.

At frequent intervals the low level escape route lighting incorporates an indication of the direction of escape.

THE NATURE OF FIRE

Fire is a chemical reaction known as combustion which occurs when **fuel** and **oxygen** are brought together with sufficient **heat** to cause ignition.

This is simply represented by the ***Fire Triangle***. A fire cannot start, or continue, if one side of the fuel – oxygen – heat triangle is absent, or if there is an interruption in the chemical chain reaction that sustains burning.



FUEL

This can be a solid, liquid or gas, which when heated gives off flammable vapours. Examples include paper, wood, cardboard, paint, oils, acetylene, etc.

OXYGEN

Oxygen is normally present in the air in sufficient quantity to sustain a fire.

HEAT

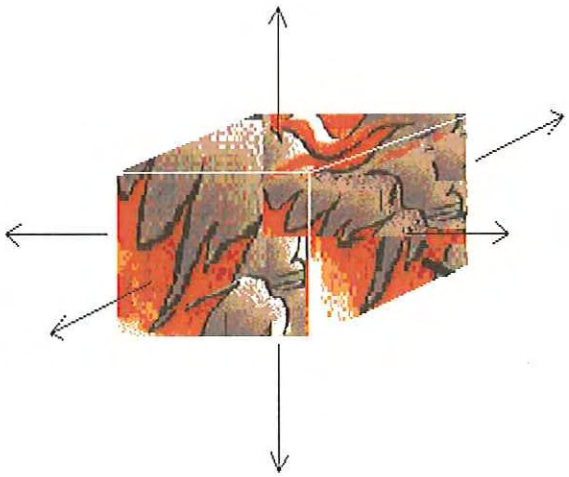
A critical temperature must be reached for ignition to occur, but once a fire has started it will normally maintain its own heat supply. Heat may be applied deliberately, or it may be accidental. For example, heaters being placed too close to furniture, curtains or paper; power points being overloaded; and personal computers being covered with office papers.

FIRE SPREAD

Heat – and fire – may spread in four different ways.

1. **Conduction**. This refers to direct heat transfer. E.g. heat travelling along or through unprotected steelwork. (girders, deck plating, bulkheads, etc.)
2. **Convection.** The spread of heat via gases, liquids or hot air circulating through stair wells, lift shaft, ventilation trucking, etc.
3. **Radiation.** Materials may be ignited when placed too close to a source of radiated heat such as an electric heater or other heating appliance.
4. **Direct Burning.** Where combustible materials give off sufficient vapour to encourage combustion to continue when coming into contact with a naked flame. E.g. a mattress being exposed to a lighted cigarette.

Fire in any one compartment may spread by one or more of the methods listed, and may spread in one or more of six directions unless inhibited by boundary cooling or some other method. Fire may also be spread via air-conditioning and heating ducts, ceiling voids, and conduits.



TYPES OF FIRE

When dealing with a fire it is important to recognise its type as the correct treatment of one type of fire may only increase the danger if applied to another type.

CLASS A Fires involving solid materials usually of an organic nature.

E.g. cloth, wood, paper, furniture, plastics, rope, etc.

CLASS B Fires involving liquids or liquifiable solids.

E.g. petrol, oils, paraffin, paint, solvent, cooking fats, waxes, etc.

CLASS C Fires involving gases or liquefied gases.

E.g. methane, propane, butane, acetylene, etc.

CLASS D Fires involving burning metals.

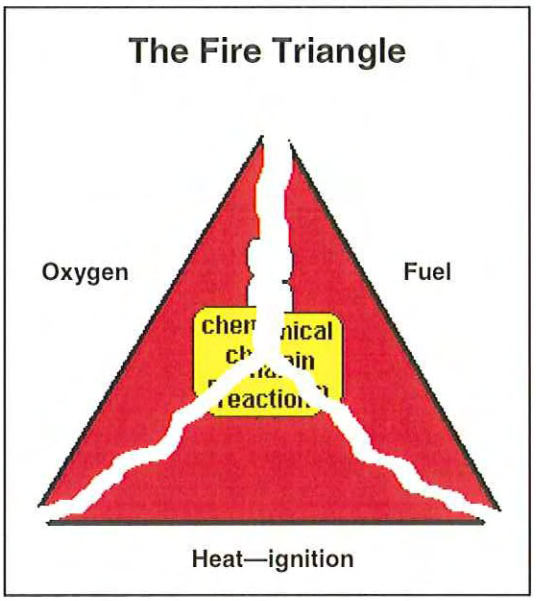
E.g. aluminium, magnesium, sodium, etc.

Note: none of the extinguishing agents referred to in this publication will deal effectively with Class D fires. This type of fire is dealt with using special extinguishants

ELECTRICAL FIRE: Electricity itself does not burn. Any fire which is referred to as an electrical fire would actually be a Class A, B C or D fire as described above, but with the additional hazard of live electrical circuits. Once the appropriate electrical circuits have been isolated the fire is treated as normal for its class.

PRINCIPLES OF FIRE EXTINGUISHING

A fire cannot start, or continue, if one side of the **fuel – oxygen – heat** triangle is absent, or if there is an interruption in the chemical chain reaction that sustains burning.



If one of these four elements can be removed the "triangle" is broken and any fire will cease to burn.

STARVATION

By removing the fuel from a fire it is unable to sustain combustion.

- remove fuel (wood, paper, etc.) from area
- close fuel valves
- manoeuvre vessel to carry heat and flames away.

SMOTHERING

This is achieved by reducing the oxygen (air) surrounding the fire. CO_2, Halon, Foam, Sand, Blankets, Steam, etc. will all have this effect.

COOLING

To reduce the temperature of the burning substance below its ignition temperature – usually this is achieved by using water as the extinguishant

INTERFERENCE

This is an anticatalytic effect that breaks the chemical chain reaction that sustains a fire. Halons and some dry powders extinguish in this way

EXTINGUISHING MEDIA

1. WATER.

Principally a cooling agent, with the added advantage that where sufficient quantities of steam are evolved the oxygen is displaced. Water is the ideal agent for cooling many fuels.

Advantages:

readily available at sea

large capacity to absorb heat

versatile - jet for penetration

- spray for cooling large areas or boundary cooling

Disadvantages:

the possible effect on stability

liquid fires may be spread through use of water

not suitable for fires involving electrics or if live cables are adjacent.

reacts with certain substances to produce toxic fumes

causes some cargoes to swell

2. CARBON DIOXIDE (CO_2)

A medium that 'smothers' the fire, thus displacing the air (with its oxygen content).

Advantages:

inert

relatively cheap

does not harm cargo

does not form toxic or explosive gases when in contact with most substances

Disadvantages:

only a limited supply will be available

no cooling effect

danger of asphyxiation

3. FOAM

Foam smothers a fire by forming an airtight seal. Foam also has the property of preventing vapours escaping through the blanket, thus inhibiting a fire igniting above the foam blanket. Foam has some cooling effect, but it must not be used on electrical equipment. There are different types of foam details of which are given in section B.8.

4. DRY POWDER

Commonly dry powder is Sodium Bicarbonate with various additives to improve flow, foam compatibility, water resistance, and shelf life. Other powders include Monoammonium phosphate, Potassium bicarbonate, Potassium chloride, etc. Modern dry powder extinguishes fire mainly by interference although with some there is also a smothering effect. Dry powder gives fast flame knock-down but no cooling effect.

5. HALONS

The extinguishing anticatalytic effect of halon to break the chemical chain reaction without which a fire cannot be sustained.

Advantages

- only a relatively small quantity required
- very fast flame knock-down
- forms a homogeneous atmosphere when used in gas flooding systems
- a 'searching' gas reaching all areas of a compartment

Disadvantages

- only a limited supply available
- relatively expensive
- no cooling effect
- possible toxic by-products if used in extremely hot temperatures

not effective on deep seated fires (e.g. mattresses, bales of wool, etc.)

a 'searching' gas which will 'escape' if used to flood a compartment not fully sealed.

Portable extinguishers using Halon are generally of the Halon 1211 (BCF) type. This is because BCF is expelled as a liquid and is thus more ably directed than Halon 1301 (BTM) which is expelled as a gas. As a liquid BCF has some cooling effect, whereas BTM as a gas quickly forms a homogeneous atmosphere throughout a large compartment. Portable halon extinguishers should not be released in a confined space where the vapours may be inhaled.

It is no longer permitted to supply halon, so once an extinguisher has been discharged it should be replaced with another type suitable for the risk.

6. HALON SUBSTITUTES

The prohibition on the supply of new halon fire extinguishers and systems has led manufacturers to try various alternatives. They fall into three broad categories:

HALOCARBONS (e.g. FM 200 and FE 13.)

Like halon these are clean, non-conductive gases which extinguish through the anticatalytic effect of breaking the chemical chain reaction which sustains a fire. Required concentrations are low, although not as low as halon 1301, and extinguishing is swift. Storage capacity required to protect a given volume is nearly twice that of halon 1301.

INERT GASES (e.g. Argon)

Argon and inert argon compound gases require a storage volume ten times that of halon 1301 and about sixty per cent that of CO_2. The extinguishing time for a total flood system is in excess of one minute.

The chapter on Fixed Gas Extinguishing Systems in Section C of this Manual includes a chart giving

comparisons between various extinguishant gases.

WATER MIST

These systems are similar to water spray systems but are engineered to produce very fine water droplets which extinguish fires because of their capacity to absorb large quantities of heat. Section C of this Manual gives outline details about water mist systems and the manner in which they extinguish fire.

FIRE PREVENTION

Fire fighting on board can be extremely difficult and possibly fatal. Good fire prevention practices greatly minimise the possibility of fire occurring. Fire prevention discipline should be a part of the every-day attitude of all personnel.

Some main areas of concern

- Bottom of lift shafts
- Stores
- Near incinerators
- Laundries and drying rooms
- Oil spills
- Wastepaper baskets not emptied
- Galley exhaust ducts
- Combustible material near heat sources
- Clothes hanging over cookers or heaters.

Good housekeeping

- Control of rubbish
- Tidy storerooms
- Steel bins, with lids, for collecting oily waste, emptied frequently.
- Store and use items such as cleaning fluids, paints, solvents aerosols and other highly flammable material as directed by the manufacturer. At the end of the working day secure them in the designated stowage
- All spillages are to be wiped up immediately and dirty rags disposed of safely.

- Close doors of empty compartments and switch off unnecessary lighting and other electrical equipment

Electrical

- Earth test and inspect wiring normally out of sight
- Inspection of personal equipment (e.g. radios) by a competent person
- Take faulty equipment out of service
- Regular inspection of electrical appliances
- Disconnect equipment not in use including radios and videos
- Allow irons and soldering irons to cool before stowing. Do not leave unattended when in use.
- Renew electrical leads at the first sign of wear in the outer covering
- Sufficient, relevant and clear safety notices
- Do not overload power points
- Do not tamper with electrical fittings or equipment
- Do not push bare wires into electric sockets

Smoking

- Use proper ashtrays and disposal facilities
- Never smoke in bed
- Adhere to the designated smoking and no-smoking areas.
- Extinguish matches and cigarettes before discarding them
- Do not flick cigarette or pipe ash
- Do not smoke when moving around the ship
- Use only safety matches.
- Do not use cigarette lighters or stow lighter fuel with personal belongings

Machinery

- Regularly inspect and maintain all items, including those outside of the machinery spaces.
- Safety equipment such as fuel shut-offs, baffle plates, overflow alarms, heat sensors, etc. must be kept in good order
- Adhere to safe working practices

Hotwork

- Use a "Safe to Work" scheme as proposed in the Code of Safe Working Practices
- Do not use the equipment unless you have been trained and authorised to do so.
- Check that any oxy-acetylene hoses are – not leaking, securely attached and not twisted.
- Keep the working area free of sharp objects
- Do not restrict your access to the work area and move around carefully
- Make sure someone knows where you are
- Check there are no combustible materials below or adjacent to the area of work.
- Do not commence work in areas where there are surfaces covered with grease, oil, or other flammable material
- Port holes and openings through which sparks may fall should be closed
- The far side of a bulkhead or deck should be checked for materials and substances which may ignite, and for cables and other services which may be affected by the heat
- Gas Free certificates must be issued if appropriate
- Suitable fire extinguishers should be kept to hand during the operation
- A person with a suitable extinguisher should keep watch on areas which may be

affected but are not visible to the welder

- Frequent checks should be made for at least two hours after the work has stopped.

Hazards

- Identify hazards to all concerned, and know the safety and emergency procedures associated with them

- The duty officer or other person when carrying out rounds must be observant and report suspicious smells, leaks from pipes or tanks, any electrical machinery that appears to be overheating and any wrongly stowed flammables. Check for items wrongly stowed in places such as mast houses, funnel uptakes, small machinery compartments and other 'convenient' places. Report any fire fighting or safety equipment that is missing.

RAISING THE ALARM

Taking the correct initial actions in the early stages of a fire, whilst it is still small, will maximise the chances of successfully extinguishing it. Remember, even the biggest fires started as a single flame. Large fires will probably have once been small, but grew because they were not tackled, or were not tackled correctly, in the early stages.

No person on board should be in any doubt about the following:

- **Action to be taken on discovering a fire.**
- **Action to taken on hearing the alarm.**
- **Knowing where fire fighting equipment is kept.**
- **Knowing how to use it effectively.**
- **Awareness of your own and others' safety during fire fighting.**

Very often it is the actions of the person discovering a fire that can make the difference between a small blaze quickly extinguished and a catastrophic fire which could lead to the loss of the ship, or even to loss of life.

"Fires always happen to others, never to me", is a very common misconception.

The first reaction when discovering a fire is usually one of shock or disbelief. Without training this can lead to actions which are instinctive and often incorrect.

Common instinctive actions are to:

- run away leaving doors open,

- run into the compartment without fire fighting equipment and attempt to stamp out the burning material.

If the discoverer becomes a casualty, effectively no-one has discovered the fire, which will continue to grow and spread unchecked until someone else responds in a correct manner.

You may discover a fire anywhere by seeing, smelling or hearing it. If you do find a fire:

1. ***think about the correct procedure for raising the alarm.***
2. ***stay calm.***

Panic will affect your ability to act effectively and may frighten others unnecessarily.

RAISING THE ALARM

- Shout "FIRE, FIRE, FIRE", and give its location.
- Bang on doors in case people are asleep, but do not open them as this may allow smoke in unnecessarily.
- Operate a near-by Fire Alarm Call Point.
- If available use an internal telephone to inform the bridge or other control centre.

When informing the control centre state:

- the fire location
- the type of fire
- the size of fire
- details of casualties
- what actions, if any, are being taken

Do not attempt to fight the fire until others have been informed

When another person appears one should carry on raising the alarm whilst the other, providing it is safe to do so, commences first-aid fire fighting.

IF THE FIRE IS BEHIND CLOSED DOORS

If smoke is seen coming from behind a closed door there is no indication of the size or type of fire.

- ***DO NOT OPEN THE DOOR.***
- Raise the alarm in the way previously described.
- ***DO NOT TACKLE THE FIRE.***
- Prepare fire fighting equipment.
- When the Fire Attack Party arrives advise the leader of what you have observed and what you know about the situation.

IF THE DOOR OF THE COMPARTMENT ON FIRE IS OPEN

- Raise the alarm as described above.
- If you are fully clothed, and it is safe to do so, attack the fire using appropriate first- aid appliances.
    - Keep low.
    - Do not let the fire or smoke get between you and your way of escape.
- If you are beaten back **CLOSE THE DOOR.**
- Start preparing fire fighting equipment, ready for the Fire Attack Party.
- Move casualties to a place of safety.
- Consider ways of preventing the fire from spreading. E.g.
    - Boundary cooling..
    - Removing flammable items from the path of the fire..
    - Isolate local ventilation.
- Switch off local electrical circuits.

Stay in the vicinity of the fire, but at a safe distance, to brief whoever is in charge. The information required is:

- Where the fire is situated,
- What is burning,
- Any hazardous substances,
- Number and position of casualties,
- What has already happened. (e.g. hoses prepared),
- Details of ventilation and electrical circuits already isolated.

Any training must ensure that all personnel know the location of the nearest extinguisher to their place of work and their accommodation. They must also know how to use the extinguisher and be aware of any limitations that it might have. Remember, the correct type of extinguisher should have been sited with regard to the type of risk in any particular area of the vessel.

Familiarity with all fire fighting equipment, and its effective and safe use in a real emergency will save vital minutes and seconds, which can make the difference between an incident and a tragedy.

SUMMARY

F - Find
I - Inform
R - Restrict
E - Extinguish

or

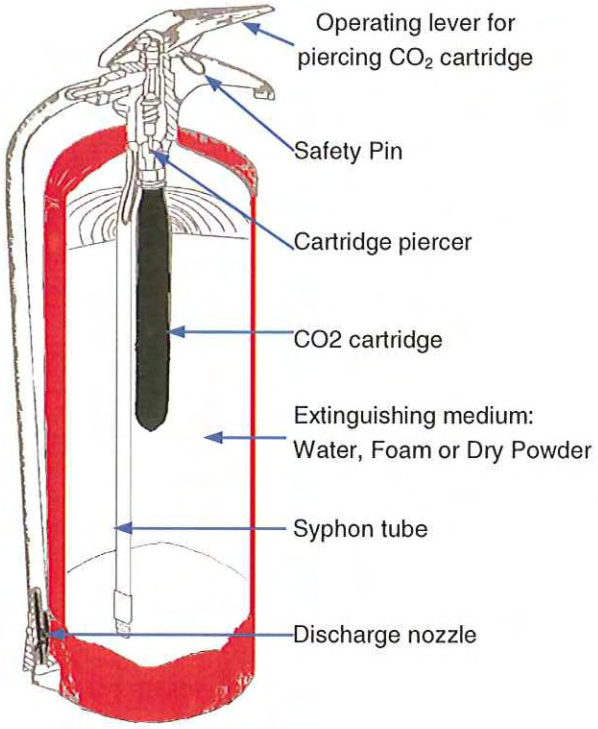
F - Find
I - Inform
R - Restrict
E - Escape

EXTINGUISHERS (PORTABLE)

A fire extinguisher is a pressurised vessel designed to attack a fire in the early stage. Pressure inside the extinguisher is used to expel the extinguishant, which will either smother, cool or chemically interfere with the fire; or fight the fire by combining two or more of these effects.

WATER, FOAM & DRY POWDER

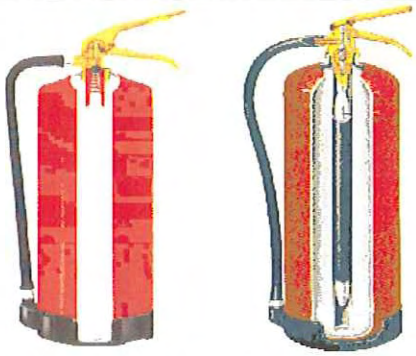
Extinguishers containing water, foam or dry powder may be similar in appearance, except that they will be clearly labelled and colour coded so that the content may be easily identified, and they all operate on the same principal. In each case the medium is stored in a welded container. When the valve is opened CO_2 gas exerts a downward pressure on the water, foam or dry powder, forcing it up a syphon tube and out through the delivery hose. The discharge will be controlled by either squeezing and releasing the operating head valve or by a control lever at the end of the discharge hose.



The content level is indicated by either a mark on the inside of the container, or a measuring cursor attached to the syphon tube

STORED PRESSURE OR CARTRIDGE OPERATED

The CO_2 used to expel the medium may either be applying permanent pressure within the extinguisher or stored in a small cartridge found inside the extinguisher and connected to the operating head. In the latter case when the operating head is depressed CO_2 from the cartridge fills the main body of the extinguisher in order to expel the medium.



Cutaway view of a Stored Pressure Extinguisher (left) where CO2 expellant permanently pressurises the extinguisher and a Cartridge Operated Extinguisher (right) where the CO2 is stored in the small cylinder in the centre.

CARBON DIOXIDE (CO_2)

Where the extinguishing medium is itself CO_2 the gas is stored as a liquid under pressure. Because of the pressures involved CO_2 extinguishers are not welded containers but solid draw. Upon discharge the liquid expands into CO^2 gas.

Gas filled (CO2 or Halon) Extinguisher.

SITING OF EXTINGUISHERS

LOCATION

Normally, extinguishers should be located in conspicuous positions on brackets or stands where they will be readily seen by persons following an escape route. The carrying handle of larger, heavier extinguishers should be about 1m from the deck but smaller extinguishers handles should be about 1.5m from the deck. Siting positions near to room exits, alleyways, stairways, lobbies and landings are most suitable. Attention should be drawn to the position by photoluminescent signs. The extinguishers, type and size, should be shown on the vessel's Fire Plan, or, in the case of smaller craft, on some other suitably arranged diagram.

ACCESSIBILITY

Extinguishers should be available for immediate use at all times. The number of extinguishers required will vary depending on the type of vessel and the risk.

Typically

on passenger vessels and ferries -

below the bulkhead deck, and in every vertical zone, there shall be at least two extinguishers available in every accommodation space, service space and control station. In enclosed accommodation spaces, service spaces and control stations above the bulkhead deck there should be at least one extinguisher on each side of the ship.

on cargo vessels and tankers –

one extinguisher should be provided in each of the spaces given above.

Additionally there will be a minimum number of extinguishers required and portable and semi-portable extinguishers are also required in machinery spaces, ro-ro spaces and ro-ro space accesses.

Where possible it is advisable to site extinguishers at similar positions on each deck. It is not advisable to place extinguishers in positions in rooms or alleyways away from exit points unless they are necessary to cover a particular hazard.

Extinguishers should not be placed in concealed positions, behind doors, in cupboards or deep recesses, unless their position is indicated by a suitable photoluminescent sign. They should not be in positions where they might cause obstruction to exit routes or be damaged by general movement around the vessel, or be close to heating appliances.

PROXIMITY TO SPECIAL FIRE RISKS

Extinguishers provided to deal with special risks should be sited near the risk concerned, but not so near as to be inaccessible or place the operator in unnecessary danger in case of fire. If the risk is in a confined space it is generally advisable to position the extinguisher immediately outside that space.

AVOIDANCE OF EXPOSURE AND CORROSION

Extinguishers should not be exposed to storage temperatures outside of the designed range. Neither should they, unless specially treated by the manufacturer or protected by a specific housing, be located in places where they may be exposed to a corrosive atmosphere or corrosive fluids. Extinguishers which stand on the deck where dampness may cause corrosion should be of a suitable type and carefully monitored as to their condition.

CHOOSING THE CORRECT EXTINGUISHER

The most appropriate extinguisher should be found near any risk, but this may not always be the case, especially where there is more than one risk in the same area. For instance, in a Control Room there may be hydraulics, computers and other electrical equipment, papers and books. If the wrong type of extinguisher is used on a fire the already serious situation may be made considerably worse. Using a water extinguisher on a chip-pan fire could result in a contained, controllable situation becoming a catastrophe as the effect of directing water into burning hot fat is to cause the fire to spread. It is important that every crew member is familiar with the advantages and limitations of each fire extinguishing medium.

WATER

Suitable for use on wood, paper, plastics and textiles (Class A fires)

DO NOT USE on fires involving liquid (oils, paints, fats, cleaning fluids, etc.)

DO NOT USE on fires where there is live electricity in the vicinity.

FOAM

Suitable for use on liquid spills and contained liquid fires of oils, paints, cleaning fluids, etc. and fires involving liquifiable solids such as fats and waxes. (Class B fires)

DO NOT USE on fires where there is live electricity in the vicinity

DRY POWDER

The type of powder known as BC Powder is suitable for use liquids and liquifiable solids as described under FOAM above (Class B fires). BC Powder may also, with the correct technique, be used to extinguish a high pressure gas flame (Class C fires). Additionally ABC Powder or Multi-Purpose Powder may be used against carbonaceous fires (Class A fires).

Dry Powder gives a fast flame knock-down, and may be used on fires involving live electrical

equipment. However, it may not be effective against a deep seated fire.

AVOID inhalation of powder.

CARBON DIOXIDE

Suitable for use on Class A & B fires and for Class C fires when in a liquid state (e.g. liquid gas leak such as methane, propane, butane, acetylene or hydrogen)

Safe for use on fires involving electricity.

May not be effective when used outside, especially in a breeze

DANGER – Hold only the insulated parts of the discharge hose and horn. With the expansion and evaporation of the CO_2 there are cooling processes and a danger of frost burn if the discharge horn is not correctly held.

DANGER – If using a CO_2 extinguisher in an explosive atmosphere stand it on the ground to ensure any electrostatic change is dissipated.

DO NOT USE without a discharge horn as the discharge will then entrain air and cause an increase in the intensity of the fire.

DANGER – Do not remain in the area after the discharge as CO_2 is asphyxiating.

FIRE EXTINGUISHER COLOUR CODING

Fire extinguishers may be colour coded to indicate the extinguishing medium they contain. Older extinguishers in UK registered vessels may have the entire body of the extinguisher appropriately coloured; more recent extinguishers will be red with a block of colour placed above the operating instructions. Some vessels may have extinguishers that are red without any colour coding: in this case it is necessary to read the instructions to determine the extinguisher contents.

Where colour coding is used it will be:

RED = Water **BLUE = Dry Powder**

CREAM = Foam **BLACK = CO_2**

In addition to fire extinguishers normally having some form of colour coding to indicate their contents, modern fire extinguishers will also bear graphic symbols to show the types of fire for which the contents are suitable. The symbol for electrical hazard will be shown on those extinguishers whose contents are safe to use on fires involving all types of electrical equipment..

INSPECTION OF FIRE EXTINGUISHERS

EXTERNAL INSPECTION

- Is the safety pin in place, and operating freely?
- Examine the exterior, including the base for signs of corrosion.
- Ensure that all instructions are legible and in appropriate languages.
- If the unit is of the stored pressure type and has a gauge, is it showing an acceptable reading?
- Examine the hose and/ or horn and their securing clips for signs of cracking or damage.
- Inspect the bracket for damage and ensure that it is securely attached
- Are the appropriate signs and instructions displayed adjacent to the extinguisher?
- Stored pressure units should be weighed and this compared against the weight stamped into the extinguisher body (solid drawn cylinders) or marked on the service label. If there has been a loss of more than 10% of the content weight the cylinder should be recharged by a competent person. Note: some manufacturers recommend that only authorised service engineers recharge their stored pressure extinguishers.
- It is not practicable to recharge CO_2 on board. If these are found to have lost more than 10% of their content weight they should be replaced and returned to an appropriate recharging facility.

INTERNAL INSPECTION (cartridge operated units)

- Discharge or empty the cylinder completely.
- Internal inspection of dry powder extinguishers must not be undertaken in a damp or moist atmosphere.
- Remove the cap slowly and carefully to vent any residual pressure.
- Empty the contents in to a clean bucket.

  Water (from Water or Foam extinguishers) should be clean and show no signs of colour through rusting

Powder must be kept dry. If there is any sign of caking, lumps, foreign matter, or the free-flow of the powder is inhibited, it should be disposed of.

- Use an inspection light to check for internal corrosion or deterioration of any protective lining.
- Remove the CO_2 cartridge and check its condition and date. If date expired it should be replaced. If in-date check the weight against the full weight as marked on the cartridge: if there has been a weight loss of more than 10% of the contents the cartridge should be replaced. Note: the weight loss of 10% refers to the contents not to the total weight.
- Check the operating mechanism.
- Ensure that hoses, syphon tubes, pressure relief ports and other orifices are not obstructed.
- Check that all washers, 'O' rings and seals are in good condition.
- Refill and reassemble the extinguisher. Lightly lubricate threads.
- Some dry powder extinguishers have a burst disc fitted in the discharge hose to prevent moisture entering and affecting the extinguisher contents.

Extinguishers must be hydraulically tested at intervals acceptable to the flag authority of the vessel. In UK this would be as follows:

CO_2 extinguishers - After ten years. Thereafter at five yearly intervals or after the extinguisher has been discharged, whichever is sooner.

Other extinguishers - Every five years.

TEST DISCHARGE

It is recommended that all extinguishers are test discharged at the intervals indicated below.

Carbon Dioxide - After ten years and subsequently after ten years. Thereafter every five years

Water, Foam & Dry Powder - Every four years.

If every year 25% of the water, foam and dry powder extinguishers and 10% of the CO_2 extinguishers are test discharged on a rotation basis, then all extinguishers will be test discharged over the required period.

EXTINGUISHERS (FIXED & WHEELED UNITS)

Machinery spaces may be provided with larger fire extinguishers. These may be fixed or wheeled of either Foam, Dry Powder or CO_2. The principal differences between these extinguishers and fully portable units is that they contain much more of the extinguishing medium but they are either fixed at one location or with a limited portability.

On the Foam (and Powder) units the pressuring CO_2 used to expel the extinguishant is contained in a cylinder mounted on outside.

Wheeled Dry Powder and Foam Extinguishers

CAPACITIES

Foam units : 45 litres or 135 litres

Powder units: 23 – 75 kg

CO^2 units: 9 – 45 kg

INSPECTION OF FOAM and POWDER UNITS

- Check the trolley or frame for damage or corrosion.
- Is the safety pin and seal in place?
- Disconnect the CO_2 cylinder - if it is corroded or more than 10% below content weight it must be changed.
- Disconnect the discharge hose and horn and carefully inspect them .
- Ensure any nozzle operates freely.
- Slowly unscrew the headcap, not more than two turns.

If any residual pressure begins to escape allow the unit to slowly depressurise before completely removing the headcap.

- Ensure any pressure relief holes in the headcap and pressure relief valve are clear .
- Examine all washers and seals. Replace if necessary.
- Use a thin smear of petroleum jelly on any threads.
- In Foam extinguishers check the level of the solution.
- In Powder extinguishers take sample scoops of powder; ensure any lumps break up immediately when lightly pressed. If the powder is caking the entire contents should be replaced
- Restore the unit to a ready-use condition.

Every five years the units should be subject to discharge test. This should be followed by a thorough inspection, including internal inspection, and recharge all according to the manufacturer's instructions.

INSPECTION OF CO_2 UNITS

- Ensure that the safety pins and seals are in place.
- Examine the hose and horn assembly.
- Remove the cylinder(s) and weigh them. If the content weight has fallen by more than 10% the cylinder must be recharged or replaced.
- Check the trolley or frame for corrosion and its general condition. Grease wheel hubs as necessary

If a CO_2 extinguisher has not been used it should be hydraulically tested not more than twenty years from the date of manufacture. If the extinguisher has been used after it is ten years old it must be hydraulically tested before refilling.

HOSES

Standard Fire Hoses are constructed from woven polyester internally lined with a synthetic rubber to give a smooth, low friction bore. This type of hose may be polyurethane coated to provide additional abrasion resistance. Other higher quality hoses comprise an all synthetic woven textile reinforcement encased in a PVC/Nitrile rubber which forms a unified lining and outer cover.

In passenger ships there should be at least one hose for each hydrant and these hoses shall be used only for fire fighting or fire fighting training. Cargo ships of over 1000 gross tonnes must have one hose for each 30m length of the vessel, plus one spare, but not less than five hoses (this number does not include any hoses that are required in the engine room or boiler room). In some cases the Authority may increase the number of hoses required.. The number of hoses required in vessels of less than 1000 gross tonnes will be determined by the Administration.

The permitted minimum length of hose is 10 metres and the maximum is ;

not more than 15 metres for machinery spaces

not more than 20 metres for other spaces & open deck

not more than 25 metres for other spaces & open deck of ships with a maximum breadth of 30 metres .

STOWAGE

Hoses may be stowed rolled, Dutch rolled (i.e. rolled from the centre with both couplings accessible, or flaked.

CARE

Hoses may chafe due to vibration, therefore they should be stowed with minimum contact with the locker interiors. Ideally their storage should be in dry, well ventilated conditions. They may also kink, especially adjacent to the hydrant. Careful leads should be made so that kinking, which reduces water flow, is avoided and the hose must be protected by being wrapped in rags or similar where it passes over sharp edges such as door sills, hatch coamings, etc. When avoidable do not drag charged hoses over rough surfaces.

Avoid subjecting hoses to sudden shock loads by opening valves and hydrants slowly. Similarly avoid sudden closure of nozzles. After contact with oils and grease and after use with foam hoses should be washed and flushed through.

Drain and wipe down before stowing. To drain the hose lay it flat along the deck and "under-run" it at shoulder height.

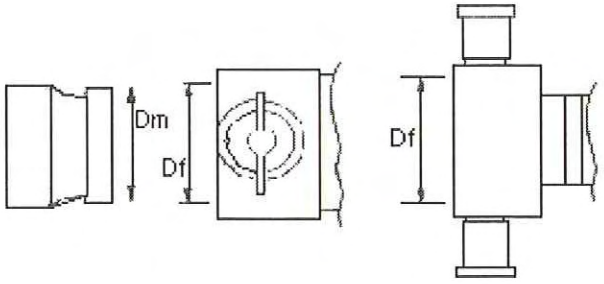
If a hose is kept flaked the position of the folds should be shifted when restowing

PRESSURE TESTING

Each hose assembly should be tested according to the manufacturers instructions. Typically this will be annually at 50% above the working pressure. Damaged and suspect hoses must be removed from service until an efficient repair can be effected.

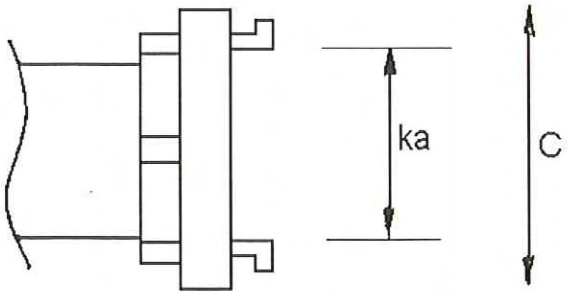
HOSE COUPLINGS

Firefighting hoses are joined together and connected to the hydrants by couplings. There are many different types of coupling all of which are incompatible unless a suitable adapter is available.



Most commonly on British vessels are found 2½ inch (65mm) *Instantaneous* couplings. Instantaneous couplings are also available in 50, 70 and 100 mm

Size	Dm	Df
38 mm	45	48
65 mm	70	75



Size	ka	C
25(D)	31	55
32	44	68
38	52	78
45	59	88
52(C)	66	98
65	81	118
75(B)	89	126

On other European vessels *Storz* couplings are mainly used. Storz 'C' is a commonly used size. Other sizes are shown in the adjacent table

Also available in Storz couplings are sizes 100, 110(A), 125, 150(3lug), and 205. But these are not used in marine fire systems.

Couplings of the same size may have different diameter tails to suit various hose sizes (e.g. a 2½ inch Instantaneous coupling may be provided with 25, 38, 45, 50 or 65 mm tails).

Instantaneous Connections
With various sizes of hose tails

Other types of coupling frequently found include Russian ROTT, Russian GOST, British Nunan and Stove, Swedish SMS, Japanese Nakajima, and Norwegian Nor couplings.

Some couplings consist of a male and female section of different but compatible designs. With this type of coupling each hose would have a male coupling at one end and a female coupling at the other. Couplings that have male and female parts that are identical are known as Hermaphrodite couplings.

Female part of a flanged
Instantaneous Connection

INSPECTION & MAINTENANCE

- After use flush with clean fresh water
- Inspect after use or at intervals of not greater than one month
- Check any release mechanism (e.g. the lugs on instantaneous couplings) for free movement.
- Inspect the sealing rings
- Use lubricants as recommended by the manufacturer. For the bolt and spring in an instantaneous connection this may be lithium grease.

Norwegian Couplings

NOZZLES

When in use the discharge end of the hose will be fitted with a nozzle so that the operator may control the manner in which water is projected at a fire. Standard nozzle sizes are 12 mm, 16 mm and 19 mm.

Spray nozzles must be capable of producing a plain jet without spread and have a throw of at least 12 m. The spray must produce a reasonably fine spray which can form a curtain, from behind which it is possible to approach a fire. The spray pattern would have a diameter of, say, 5 m at a distance of 2 m from the nozzle.

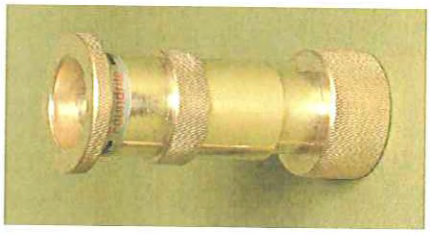
DISCHARGE RATES

When large volumes of water are used for fire fighting consideration must be given to the stability of the vessel.

Pressure Drop Bar	Discharge Rate at m^3/hour = approx. tonnes/hour		
	12 mm	16 mm	19 mm
2.1	9	14	20.5
2.5	10	15	22.5
2.7	10.5	16	23.5
3.1	11	17	25

DIFFUSER NOZZLE

A standard type of nozzle which by a twist-grip operation is able to shut off the hose discharge or deliver it as a jet or spray according to the operator's desire. Some diffuser nozzles also have a water curtain capability.



HYDROJET Firefighting Gun

DESCRIPTION

The Hydro jet Nozzle is operated by a combination of water and compressed air system. The combined built-up of air and water forces will ultimately generate a bolt of powerful water propelling more than 35 mtrs.
Works on normal fire line and working airline on-board. Supply high water volume were needed. Easy to use and transport. Training should be made during Fire drill.

Water supply

Ensure that a minimum 51mm (2.0") bore water hose is used and that all couplings are secure, leak free and in good condition.
Recommended water pressure 6 bar.

Air Supply

Ensure that a minimum 19mm (3/4") bore air hose is used and that all couplings are secure, leak free and in good condition.
Recommended air pressure 7 bar.

Hydro Jet cannon assembly

1.- Attach the Hydro jet to its tripod.
2.- Connect the water supply hose to the hydro jet cannon and the ship's water supply.
3.- Connect the air supply hose) to the hydro jet cannon and the ship's air supply.

General Information

Before operating, performing maintenance or repairing the *Hydro Jet cannon* these instructions must be read and understood by the operator, if in any doubt, ask your supervisor before using this equipment.
Safety regulations must be followed at all times. Failure to follow these instructions could result in damage to the *Hydro Jet cannon* and/or result in personal injury.

Safety

- **Do** wear Personal Protective Equipment including safety goggles, footwear, ear defenders and gloves. In some environments it will be necessary to wear facemasks or breathing apparatus.
- **Do** be aware that this tool is not electrically insulated.

- **Do** be aware that this tool can create flying debris.
- **Do** be aware of others working personnel around you.
- **Do** store this tool in a secure and dry place.
- **Always observe safe working practices and safety regulations at all times.**
- **Never** aim the *Hydro Jet cannon* at any person, this equipment produces a very powerful jet of water and can cause serious injury if misused.
- **Do not** operate the *Hydro Jet cannon*, unless it is securely fixed to its tripod or base and situated on a flat surface.
- **Do not** modify this tool in any way, as this will invalidate the warranty and could lead to serious injury.
- **Do not** drag this tool by the water or air hose.

Please note: Unrestrained air and water hoses can whip if they become detached.

Pre-Start Check

Prior to operating the tool check:

- That all fittings are secure, free from leaks and air hoses are in good condition.
- That the air pressure is correct for this tool 7 bar (100 psi).
- That the water pressure is correct for this tool 6 bar (85psi).
- Safe use of this tool requires that the operator adopt a solid stance and secure foothold.
- Gloves and personal protective equipment **must** be worn when using this tool.
- Care must be taken to avoid damaging or tripping over the air or water hose.
- Take precautions to ensure that the area to be cleaned is completely free of personnel and of any electrical equipment that is exposed or is not protected against water ingress.

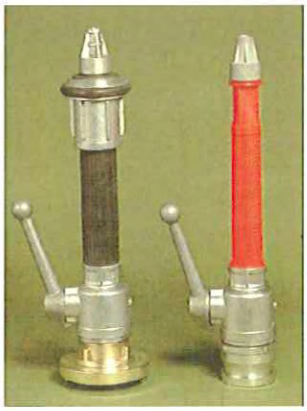
Starting Operation

With one operator securely holding and controlling the *Hydro Jet cannon*, and the water control valve on the *Hydro Jet cannon*, fully open, a second person should slowly open the water valve at the water main. It is very important that the *Hydro Jet cannon*, be held securely while the water is being turned on and while it is in use.
The air valve should now be adjusted carefully to produce a tight hard-hitting jet of water. Excessive air will cause the jet of water to break up and spread, becoming less effective.
In an emergency or once job operation has been completed, close the Cleaning Jet water valve and then the air valve.
If job has been completed, instruct the second operator to shut off the main water supply. Slowly open the *Hydro Jet cannon* water control valve again to release the water pressure in the hose.
Disconnect the air and water hose. Washing the *Hydro Jet cannon* with fresh water and store it in safe room.

EXAMPLE OF HYDRO JET CANNON

Remarks:

In case the Hydro *Jet cannon* you have on board is of a different type of above photo you may replace the photo with the correct one.



BALL VALVE NOZZLE

As the name suggests these are controlled by a lever operated ball valve.

Again, they may be with or without the water curtain facility.

TURBO NOZZLE

A Jet/Fog nozzle with spinning teeth.

The flow rate is selected by means

of a lever.

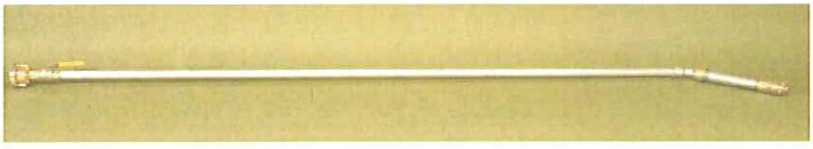
HIGH PERFORMANCE NOZZLE

A spray, jet, shut-off nozzle with 'teeth' in the discharge

end to give a good spray pattern.

FOG APPLICATOR OR LANCE NOZZLE

These are often found on vehicle carrying vessels as the long reach enables them to be used to extinguish fires beneath vehicles



CARE

Nozzles should not be dragged along the deck or subjected to knocks and blows, and they must be stowed in a manner that prevents movement . Mechanisms should be lightly greased according to the manufacturers instructions, always ensuring that the operation of the nozzle does not become impaired by a build up of old grease.

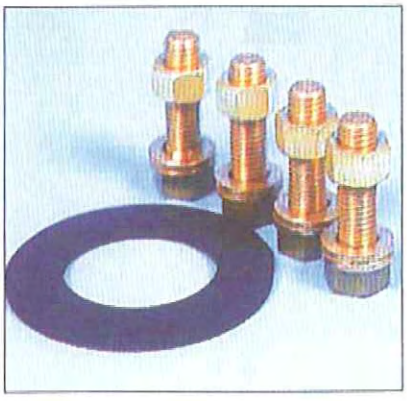
INTERNATIONAL SHORE CONNECTION

Vessels of over 500 tons must carry at least one International Shore Connection to enable water to be supplied from another vessel, or from the shore, to the fire main. It must be possible to use the connection on either side of the vessel.

International Shore Connection
With Storz coupling

The international shore connection has a flat face flange on one side, whilst the other side consists of a coupling that will fit the ship's hydrant and hose.

Description	Dimension
Outside diameter	178 mm
Inside diameter	64 mm
Bolt circle diameter	132 mm
Slots in flange	Four holes 19 mm in diameter, spaced equidistantly on a bolt circle of the above diameter, slotted to the flange periphery
Flange thickness	14.5 mm minimum
Bolts and nuts	Four. Each of 16 mm diameter, 50 mm in length with washers



A suitable gasket, four 16 mm x 50 mm long bolts, and eight washers are required to be kept with each International shore connection.

HOSES REELS

Hose reel units may be found through the accommodation alleyways and in some service spaces. They may be fixed or hinged (swinging) . Often they are recessed in to alleyway bulkhead and may be concealed behind a door. In any event their locations should be clearly identified by the appropriate signs.

The water supply to the hose may be Automatic or Manual. In the automatic version the water supply valve is opened as the hose is withdrawn from the reel and the delivery controlled by use of the nozzle.
Hoses are 19 mm or 25 mm bore and may be from 20 – 50m in length.

INSPECTION

Hose Reel units must be inspected according to the manufacturer's instructions. Typically the procedure is as follows.

1. Ensure the water supply to the hose is turned off.
2. Completely run out the hose and check its general condition.
3. Check that all couplings are tight.
4. Turn on the water and open the nozzle. Check that its operation is free. All nozzle modes (e.g. spay and jet) must be checked.
5. Close the nozzle so that the hose is subject to the full line pressure and check couplings,

pipe work and valves for leaks. Turn off the water and restow the hose.

6. For automatic hose reels turn the water on again after stowing.
7. On automatic models follow the manufacturers instructions when inspecting the automatic valve.

FOAM MAKING EQUIPMENT

FOAM

Fire fighting foam is a stable collection of small bubbles of lower density than oil or water. It has a tenacious quality enabling it to seal horizontal surfaces. Air foam is made by mixing air into a water solution containing a foam concentrate. Foam flows freely over a burning liquid surface and forms a tough, air-excluding continuous blanket to isolate volatile, combustible vapours from the air. It resists disruption due to wind and draught, or heat and flame attack, and the foam 'blanket' is capable of resealing after an incursion. Fire fighting foams retain these properties for relatively long periods.

Foams are arbitrarily divided into Low, Medium and High ranges of Expansion

Low Expansion Expansion in volume of up to 20 times the quantity of water used
Long range jet.
For tank protection, either over the top or sub-surface
High cooling effect even on vertical surfaces due to its "sticking" capability

Medium Expansion 20 –200 times
Limited range of jet
Layers up to 3m
Capable of pushing well forward and going round corners

High Expansion Expansion 200-1000 times
For rapid filling of large spaces.
Layers up to 30m
Capable of pushing well forward.
Effective vaporisation control within bounded areas

Fixed foam flooding systems for machinery spaces may use high expansion systems, but deck foam systems and portable marine systems use low expansion systems having an expansion ratio of seven or eight times the volume of the water supplied. The maximum permitted expansion ratio for a

deck marine system is twelve times.

FOAM CONCENTRATE

Foam concentrates are concentrated liquid foaming agents. In use they are diluted with water in ratios of between 1% and 6%, depending on the concentrate and risk. The solution of water and foam concentrate is then aerated and allowed to expand as required.

When using portable foam making equipment the concentrate is usually introduced to the system directly from the 25 litre storage drums.

PROTEIN FOAM

These consist primarily of protein hyrolysate, stabilising additives and inhibitors to protect against freezing, corrosion of equipment, bacterial decomposition, and to control viscosity. Some of the fire fighting properties of protein foam may be lost in storage.

FLUOROPROTEIN FOAM

Similar to protein foam but with synthetic fluoronated surfactant additives which give an improved performance and make it suitable for a wider variety of risks. It flows better than protein foam and gives a quicker flame knockdown.

AQUEOUS FILM FORMING FOAM (AFFF)

In addition to excluding air and oxygen AFFF develops a water film on the fuel surface capable of suppressing the evolution of fuel vapours. AFFF gives very rapid flame knockdown. It also has better penetration on carbonaceous (Class A) fires than the two foams mentioned above. The foam produced with AFFF concentrate is usually compatible with dry chemical extinguishants, Thus the two may usually be used together without the danger of one limiting the extinguishing effect of the

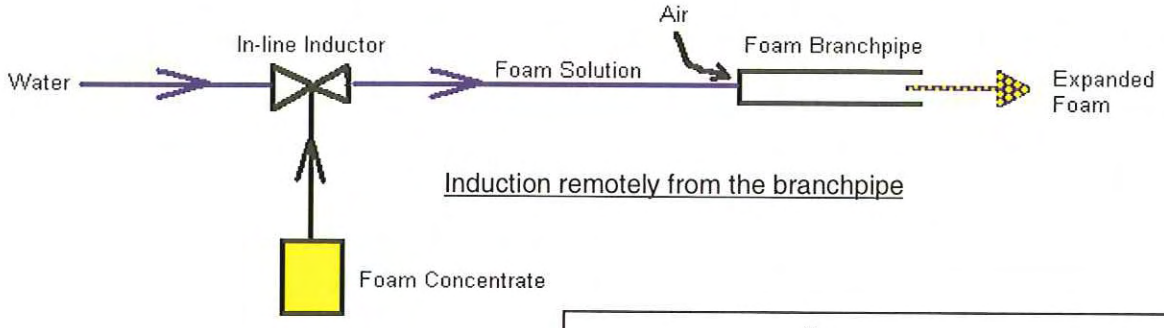
other.

ALCOHOL RESISTANT FOAM

Used on water soluble materials and other fuels destructive to regular AFFF foams. One type is based on water soluble natural polymers and an alcohol insoluble material. Another type is based on synthetic concentrates and a gelling agent which surrounds the foam bubbles and forms a protective raft on the surface of water soluble fuels

PRODUCTION OF FOAM

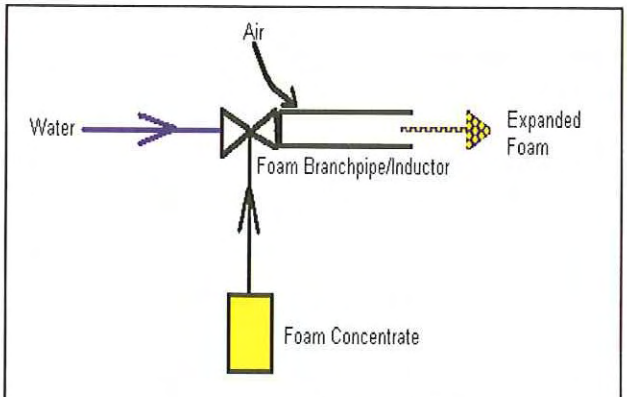
Portable foam producing appliances consist of a foam making branchpipe, an in-line inductor and a supply of foam concentrate. The inductor mixes the foam concentrate with water at the right percentage and the branchpipe mixes the resultant foam solution with air. The inductor and branchpipe may be parts of the same unit, as schematically shown in the smaller diagram below.



Induction remotely from the branchpipe

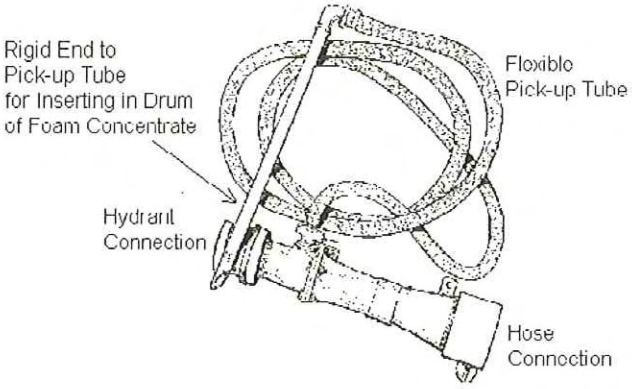
INDUCTION

The foam concentrate is introduced into the water flow via a pick-up hose and by means of Venturi suction caused by the pressure drop across the inductor. In-line inductors may be fitted with an on/off valve and a means to vary

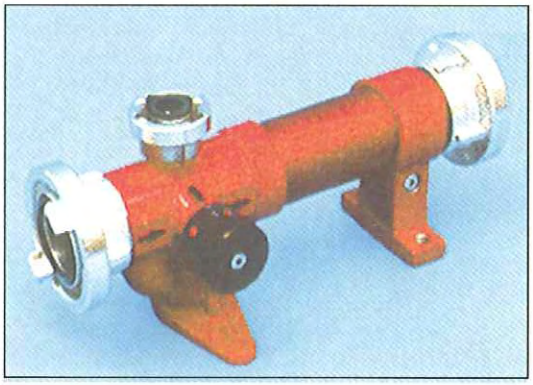


Induction at the branchpipe

the amount of concentrate that is introduced to the system: typically this will be between 1% and 6% depending on the concentrate in use.

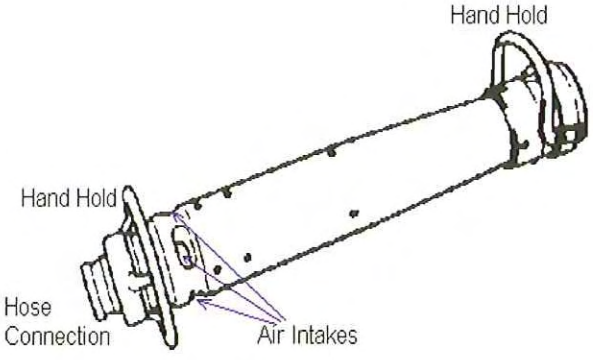


The induction may either occur directly at the branchpipe or, by use of a separate in-line inductor, at or near the fire hydrant. This latter arrangement allows the fire-fighter greater mobility as he is no longer inhibited by the foam concentrate containers and pick-up tube. Inducting foam concentrate from a drum directly into the branchpipe is especially limiting for the operator should he need to use ladders or stairs or negotiate through watertight doors.



BRANCHPIPES

The mixed water and foam concentrate is passed to the branchpipe which entrains air into the solution and delivers foam.

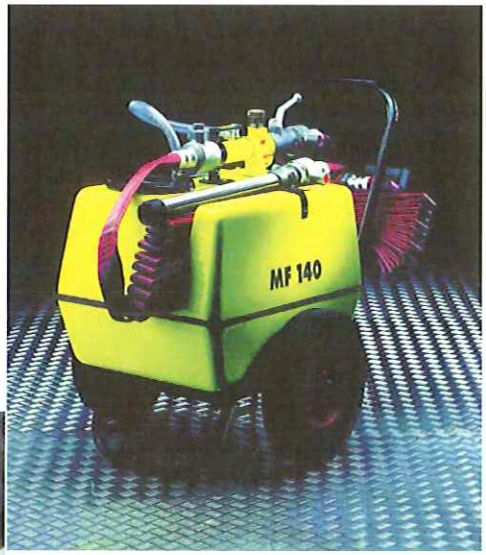


HOSES AND COUPLINGS

The hoses and couplings used for portable foam equipment will normally be of the same type as those used for the vessel's water fire fighting system, and as described previously in this section.

MOBILE FOAM UNITS

A mobile foam unit comprises a foam concentrate storage tank, usually of about 120 litres, an in-line inductor, hoses and a branchpipe, all assembled on a trolley. Operation of the unit only requires connection to a suitable pressurised water supply. If necessary the unit may be operated by one person.



FIRE BUCKETS

Where fire buckets are provided they should be painted red and clearly marked "FIRE". Fire buckets should be filled with sand or water. They should be approximately nine litre capacity, easy to handle and made of a material which is not readily flammable.

FIREMAN'S OUTFIT - PROTECTIVE CLOTHING

Fireman's protective clothing is designed to protect the skin from heat radiating from a fire, from burns and scalding by steam. They are manufactured from material which is flameproof, water resistant, and easy to clean.

Usually the suit will be a two piece (jacket and trousers) although one piece garments are sometimes found. The complete set will consist of:

- *Trousers* (with braces) – worn outside of the boots.
- *Jacket.* Elasticised at the wrists and worn over the trousers.
- Safety *helmet* with chin strap and full face *visor* and *neck curtain.* The neck curtain is to be worn outside of the jacket collar
- *Gloves* (heat resisting) - worn outside of the jacket sleeves.
- *Gloves* (rubber). Electrically non-conducting to a specified voltage.
- *Boots* (rubber). Electrically non-conducting with toe caps

The clothing should be reasonably comfortable and allow the fire-fighter freedom of movement. The wearer's ears are not covered so that he may remain partially sensitive to the ambient heat.

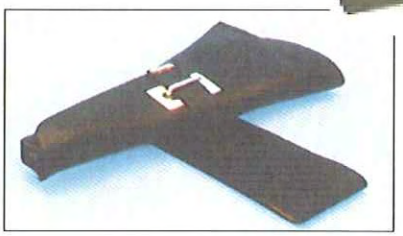
These suits are for use in *close proximity* to a fire. They are NOT Fire Entry suits.

Firemen's equipment should be stored where it is accessible but in positions which are not likely to be cut off in the event of a fire. Where more than one set of equipment is carried they should be stored in widely separated positions.

In passenger ships at least two fireman's outfits and one set of personal equipment shall be available at any one position. At least two fireman's outfits shall be stored in each main vertical zone.

FIREMAN'S OUTFIT – AXES

Fireman's axes have a short wooden or insulated handle. One side of the head has a cutting edge and the other side a spike. A belt and pouch allows a fire-fighter to carry the axe and keep both hands free.

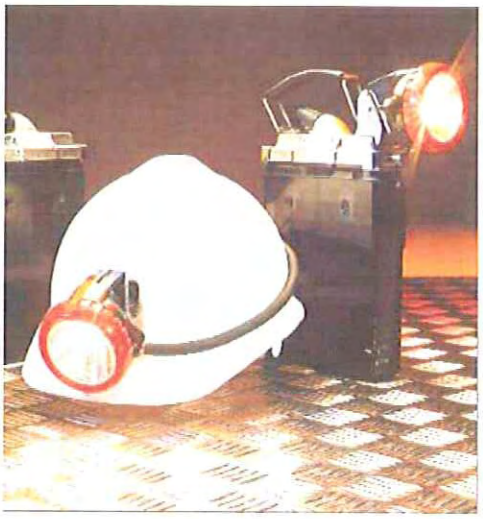


Long handled axes (felling axes) may also be provided, but are not usually a statutory requirement

FIREMAN'S OUTFIT – SAFETY LAMPS

Fireman's lamps are battery operated and must have a duration of not less than three hours. They may be either of the hand-held type or cap mounted. Hand-held lamps must have a belt clip or other suitable hands-free carrying method. The batteries should be of the re-chargeable type.

The lamps are divided into classes as described below. Class I lamps will normally be provided, except that Class II may be accepted in some older ships. Safety lamps of all Classes should be suitable for use in atmospheres where mixtures of air and flammable gases may occur.



SAFETY LAMPS	
Class I	For use in any vessel, including those where flammable gases or vapours may occur. Lamps of this class are suitable for use on oil tankers but may *not* be suitable for all flammable cargoes. Any lamp supplied to a particular vessel must be suitable for use with the cargoes carried.
Class II	For use in vessels where there is no risk of flammable gas or vapour. Lamps of Class II already accepted may remain, but no further lamps will be accepted in this class.

FIREMAN'S OUTFIT – BREATHING APPARATUS

Breathing Apparatus may be of the Smoke Helmet type or of the Self-contained type. Correct and efficient use of this apparatus requires a degree of practice and familiarity on the part of the user, so it is important that adequate training is provided. When the apparatus is used, either in training or in an emergency the recommendations of the Code of Safe Working Practices should be followed.

As with other Firemen's equipment the breathing apparatus must be stored in readily accessible positions which are not likely to be cut off in the event of fire. They should also be stowed in widely separated positions, except that in passenger vessels (UK Class I) two firemen's outfits are to be available at each storage position.

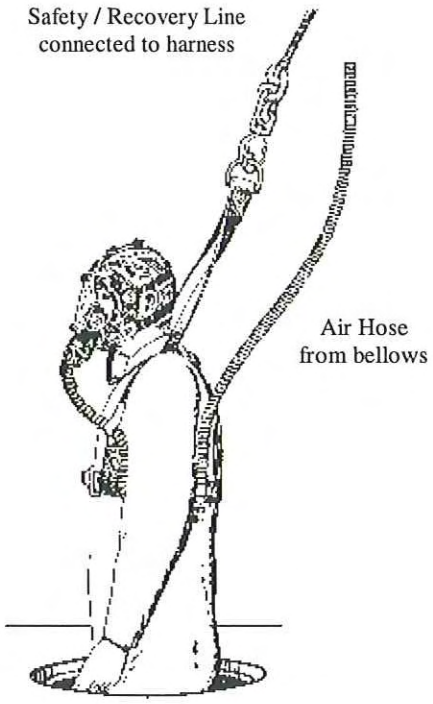
Breathing apparatus will be needed to fight a fire in an enclosed space, and in an open space when toxic or suffocating fumes are present. The equipment may also be needed to search for a missing person subsequent to a fire or other incident.

A – SMOKE HELMET.

A Smoke Helmet or Smoke Mask consists of a sealed helmet or mask, a suitable pump and a length of air hose sufficient to reach from the open deck, well removed from the hatch or doorway, to any part of the vessel. The pump (bellows) is used to manually pump air through the hose to the mask.

The complete set of equipment will consist of:

- A helmet or mask which forms an air-tight seal around the face, and which incorporates a speech diaphragm and some design feature to prevent misting.



- A flexible tube extending from the mask to the harness worn by the fire fighter.
- A safety harness incorporating attachments for the lifeline and air hose. The attachment of the lifeline must be arranged so that it may be easily removed by the wearer. Any snap hooks should be made of materials resistant to sparking on impact.
- An air hose of 19mm internal diameter with a smooth bore lining. The hose is so constructed that it does not collapse. Where lengths of hose are coupled together, and at the connections to the bellows and harness, sealing washers are used. The hose must be long enough to reach from the open deck to any part of the vessel. However, it will not normally be permitted to provided an air hose of less than 18m, nor required to provide an air hose in excess of 36m.
- A lifeline of flexible galvanised steel wire covered in plaited rope. The lifeline must be 3m longer than the air hose.
- Double action foot bellows. The double action ensures that air is supplied to the fire-fighter on both the up stoke and down stroke of the bellows. There will be a filter arrangement to prevent foreign bodies being transmitted along the air line.
- Two signal plates are provided: one screwed to the bellows and one attached to the harness. It is anticipated that communication between the wearer and the bellows operator will be by giving short, sharp pulls on the lifeline. For example:

  1 pull = More air required.

  2 pulls = Give more slack on lifeline.

  3 pulls = Help me out immediately / Come out immediately.

All members of the fire fighting parties should be thoroughly familiar with the signals.

- A safety helmet. This is often part of the fireman's protective clothing.
- The entire apparatus should be carefully stowed in a suitably sized container.

SMOKE HELMET	
ADVANTAGES	***DISADVANTAGES***
No time limit	At least two men required
Cool in use	Distance from bellows limited
Minimal training required	Air tube may be heavy to drag
Easy to maintain & test	Air tube, lifeline & hoses liable to entangle
Positive pressure providing pumping rate sufficient	Air line may get trapped or damaged

SMOKE HELMET MAINTENANCE

All equipment must be inspected at regular intervals, and always after use in practice or in an emergency. It should never be stowed when wet or dirty.

- The mask must be cleaned according to the manufacturers instructions. This will usually be with warm soapy water, and disinfected. Check that the fastenings are in good order.
- The safety harness and attachments must not be damaged or scuffed. Adjusting buckles must run freely and lock securely.
- The lifeline should be treated in the same manner as other ropes and wires. Ensure that the outer covering is in good order and that there are no signs of deformity.
- The air hose must not be crushed. Frequently connect the hose to the bellows and blow through to remove dust or insects that may have accumulated. Make sure that the seals between hose sections are in good order.

- If the bellows are made of leather a suitable lubricant must be applied every six months or when the leathers appears dry. Lightly apply and allow the lubricant to soak into the leather. If the leather is allowed to dry it will harden and crack, and may cause the pins securing the leather to shear.

B – SELF-CONTAINED BREATHING APPARATUS

The self-contained breathing apparatus comprises a facemask assembly, a frame (backplate) and harness assembly, an air cylinder and valve, a high pressure reducing valve, a warning whistle and a pressure gauge The face mask, which forms an air-tight seal around the face, has an exhalation valve, a demand valve, a voice diaphragm and some method of preventing misting. The demand valve permits the use of the equipment as a positive pressure set. This ensures that the air pressure inside the face mask is higher than atmospheric pressure and so any leaks in the seals are outwards. That is, smoke or foul air cannot be drawn into the mask. The backplate is attached to the harness and includes a method of securing the air cylinders. There may be provision to enable an alternative air supply to be connected.

Each cylinder is to contain not less than 1200 litres of fresh breathing air. The supply of air to the wearer is via an automatic regulator, but there will be a means of by-passing or over-riding the regulator to increase the volume of air available to the wearer should the need arise.

It is required that spare charged breathing air cylinders are also carried.

A pressure gauge enables the wearer to ascertain the pressure of air remaining in the cylinder at any time.

A warning whistle indicates to the wearer that the cylinder capacity is low and that he should remove himself from any unsafe atmosphere.

A lifeline of flexible galvanised steel wire covered in plaited rope is also provided. The lifeline must be at least 3m longer than is required to reach from the open deck in clean air to any part of the vessel.

The weight of the apparatus must not exceed 16kg (excluding the lifeline).

CYLINDERS

Every set of self-contained breathing apparatus must be provided with spares cylinders having a total free air capacity of 2400 litres. In practice this usually means that each set has two spare charged cylinders. There are however two exceptions:

i) in ships with five or more sets the total spare capacity (for the whole ship) need not exceed 9600 litres.

ii) if the ship is able to re-charge the air cylinders with suitable breathing air, then it is necessary to carry only 1200 litres of spare breathing air per set: however the total spare storage capacity of free air provided (for the whole ship) need not exceed 4800 litres.

Where ultra lightweight cylinders are carried there are restrictions concerning who may recharge the cylinders, the moisture content of the air used to recharge them, and the attention that must be given to the external cylinder protection and its condition.

AIR COMPRESSORS

Special air compressors intended solely for recharging compressed breathing air cylinders may be carried. They may be either portable or fixed. The air intakes must be sited so that the ingress of water or noxious fumes is avoided, even in the most adverse

circumstances. See the paragraph above concerning the restrictions placed on recharging ultra lightweight cylinders.

MAINTENANCE

Inspection and maintenance of any self-contained breathing apparatus must be carried out by a competent person and strictly in accord with the manufacturers' instructions. The detailed instructions for each set will vary with the make and model.

AFTER USE

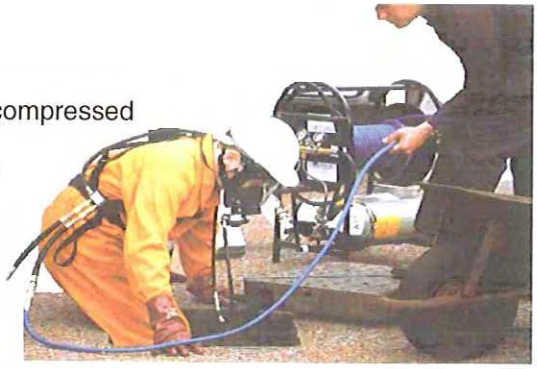
After each use of a BA set it is necessary to ensure that it is stowed in a condition whereby it is ready again for immediate use. Follow the detailed instructions given by the manufacturer; they will generally include the following:

- clean the set thoroughly
- clean the face mask and harness (this may be in warm soapy water)
- inspect the complete set for damage and any loose fittings
- fit a fully charged cylinder
- complete high pressure and low pressure tests
- disinfect the facemask
- re-stow the equipment in a ready-to-use condition and complete all use and test records.

AIR LINE BREATHING APPARATUS

Some vessels will have breathing apparatus, additional to those required by the regulation, which is supplied by air from the ship's main compressor and air line. The system requires the use of filters sited between the ship supply line and the breathing apparatus to ensure that the air delivered to the wearer is of breathable quality. It must also be

ensured that the compressor can only take in clean air.



The air line unit may be stowed on a trolley which includes compressed air cylinders. These ensure that breathing air is immediately available should there be an interruption in the supply of clean air from the ship's air main.

It is important that air filters are kept in a good clean condition, and that the purity of the delivered air is regularly checked. Air line breathing systems should not be used when there is a fire in the machinery space or in other circumstances that may affect the air supply.

DISTRESS SIGNAL UNIT

BA wearers may have clipped to the harness a Distress Signal Unit (DSU). The unit is battery operated and in its simplest form may be used by a BA wearer to indicate that immediate assistance is required.

Before entering an incident the wearer primes the unit by turning and removing a key: this key is placed at the appropriate position on the BA control board, outside of the incident. Should the wearer experience difficulty and require immediate evacuation he presses the audible alarm button on the DSU. The penetrating alarm emitted by the unit may only be silenced by inserting the key held by the BA control party. Thus once activated assistance must be rendered in order to silence the alarm

Distress signal units are also available in more elaborate forms and may include some or all of the following features

- location flashes which enhance the visibility of BA wearers to each other and to rescuers.

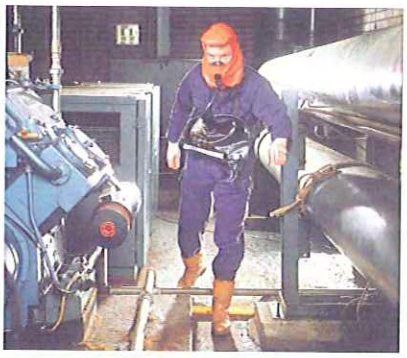
- movement or non-movement detection gives a pre-alarm, which the wearer may cancel by movement, after about thirty seconds, and a full alarm should the wearer become immobile for a longer period.
- duration timer to give a timed warning *in addition* to the BA low pressure alarm.
- evacuation whistle which is initiated from outside of the incident or by another BA wearer to command evacuation.
- low battery warning light.
- temperature sensor monitors the internal temperature of the DSU and tracks the short term exposure of DSU circuits to hotspots or long term exposure to excessive temperatures.

TRAINING

Effective and efficient use of breathing apparatus may only be achieved by frequent regular training in its use and care. It is important that any crew member designed to wear the breathing apparatus is confident and comfortable with its use.

EMERGENCY ESCAPE BREATHING DEVICES

In addition to the structure of the vessel facilitating escape from enclosed compartments as described in Section D, emergency escape breathing devices are to be provided so that, in the event of fire or other emergency, they may be readily available to aid escape.



Typically the emergency escape breathing device will be a compressed air breathing set of limited duration: say, 5 or 10 minutes. Instead of the full harness and tight fitting facemask found with a compressed air breathing set the escape set will normally be in a carrying bag that can be slung over the shoulder and include a high visibility hood which incorporates an orinasal mask and a neck seal.

Within accommodation areas all ships are to carry at least two emergency escape breathing devices. Small passenger vessels are to have at least two such devices in each main vertical zone, whilst vessels that carry more than 36 passengers must have four per vertical zone. The machinery spaces of all vessels require emergency escape breathing devices sited conspicuously and within easy reach. The quantity of emergency escape breathing devices within machinery spaces is dependant on the layout of the space and the number of persons normally working there.

As with any emergency use equipment it is important that those who might have to use the items are comfortable wearing the sets and familiar with their use.

HELI-DECK EQUIPMENT

All Ro-Ro passenger ships should have an approved helicopter pick-up area. Ro-Ro passenger ships constructed after July 1999 of over 130m in length, must have an approved helicopter landing area. Vessels are required to provide fire fighting and rescue equipment where helicopters land or conduct winching operations on an occasional or emergency basis. This equipment must be available close to the landing or winching area during helicopter operations.

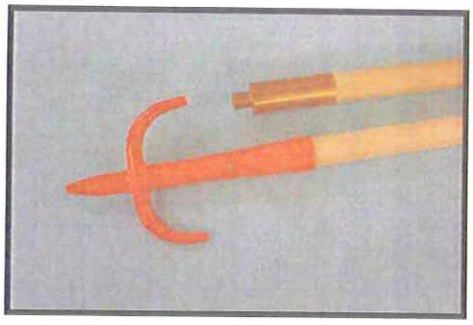
Different administrations and owners may vary in the equipment that they require, but the following minimum must be included:

- At least two dry powder extinguishers having a total capacity of not less than 45 kg.
- $C0_2$ extinguishers with a total capacity of not less than 18 kg.
- Foam monitors or foam making branchpipes capable of delivering foam to all parts of the helicopter landing area.
- At least two nozzles of an approved dual-purpose (jet/spray) type, and hoses able to reach any part of the helicopter landing area.
- Two sets of fireman's outfits (protective clothing, breathing apparatus, axe, lamp, etc)

In addition to the fire fighting appliances a range of rescue equipment is also required.

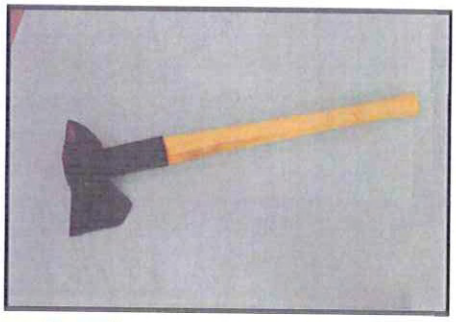
This includes:

- An adjustable wrench.
- A fire blanket.
- Bolt cutters (60 cm).
- A grab or salving hook.
- A heavy duty hacksaw and six spare blades.
- A ladder.
- A lifeline (dia 5mm x 15m).
- A pair of side cutting pliers.
- Set of screw drivers.



4.5m Grab Hook. Shown in two parts with brass screwed extension.

- A harness knife in a sheath.
- A wrecking bar.
- 2 aircraft axes of the non-wedging type.



Aircraft axe —non-wedging type

FIXED GAS FIRE EXTINGUISHING SYSTEMS

Fixed gas fire extinguishing systems are used to protect large high risk areas such as machinery spaces and cargo holds and small specific risks such as paint stores and galley exhaust ducts. Any gas used must not evolve toxic vapours. It is conveyed to the risk through fixed piping and nozzles sized and arranged to give a uniform distribution of the gas within the required discharge time. Where the extinguishing gas is stored outside of the protected space the conveying pipes are to be fitted with isolating valves clearly marked to indicate the space to which the pipe leads.

If the space protected is accessible to personnel there is to be an automatic audible warning of the imminent release of the extinguishant. In order to give time to commence evacuation there is, because of the sequence of operation, a short delay controlled by the Master between the alarm sounding and release of the extinguishing gas. Some systems incorporate a more positive time delay in the discharge sequence, although this is not permitted by all administrations.

Locally automatically operated fixed systems using Halon or Halon substitutes are permitted in

Extinguishant	Type	Extinguishing Concentration	Extinguishing Time (Seconds)	Storage Pressure (Bar)	Relative Storage Volume (Assuming Halon = 1)
Carbon Dioxide	Inert Gas	30/40%	120	52	17
FM200	Halocarbon	7%	7	25	8.7
Argon	Inert Gas	42%	75	164	10
Argonite	Inert Gas	40%	100	15	10
Inergen	Inert Gas	45/50%	60	150	10

All figures given above are approximate only
Flooding concentrations for machinery spaces and pump rooms of chemical tankers and gas carriers are in excess of those shown above

enclosed areas of high fire risk within machinery spaces (e.g a purifier room).

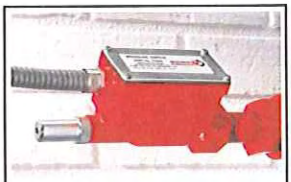
Carbon Dioxide is always stored outside of the protected space. Some other gases such as Halon 1301 and FM200 may be stored outside or inside the space.

CENTRAL BANK SYSTEMS

Where an extinguishing system comprises a number of gas cylinders located outside of the protected space they must be stored in a dedicated compartment which has direct access to the open deck. The systems typically consist of a battery of cylinders filled with liquefied CO_2 or other extinguishant, each connected to a discharge manifold. The manifold incorporates a non-return valve at each cylinder connection so that any cylinder may be disconnected without impairing the integrity of the system and so that when released extinguishing gas will not feed back into empty cylinders.

A small bank of extinguishant gas cylinders. There is a non-return valve at each manifold connection. The small cylinder contains CO_2 or nitrogen pilot gas which when released is fed through the narrow bore tubing connecting the cylinder actuators.

Other components that may be found in the system include a pressure relief valve vented to atmosphere, a pressure switch to activate audible warning of gas pressure on the manifold and shut down ventilation fans, an air line connection for checking that the lines and nozzles are clear, main compartment isolating valves (which may include an electrical connection to give audible warning and shut down fans when opened) and a release system. There will also be a means of preventing accidental or inadvertent discharge to the protected space particularly when the system is being serviced.



Manifold pressure switch used to activate audible warning of pressure on the manifold and shut down ventilation fans.

If the system is used to protect more than one space it is only necessary to

have available the quantity of gas required to flood the largest space. The smaller spaces are protected by using an appropriate proportion of the extinguishant. The disadvantage of this arrangement is that if the system is used to flood the largest space there would not be any remaining protection for the smaller spaces. If a proportion of the gas is used to extinguish a fire in one of the smaller spaces then there would be insufficient gas left for full protection of the largest space.

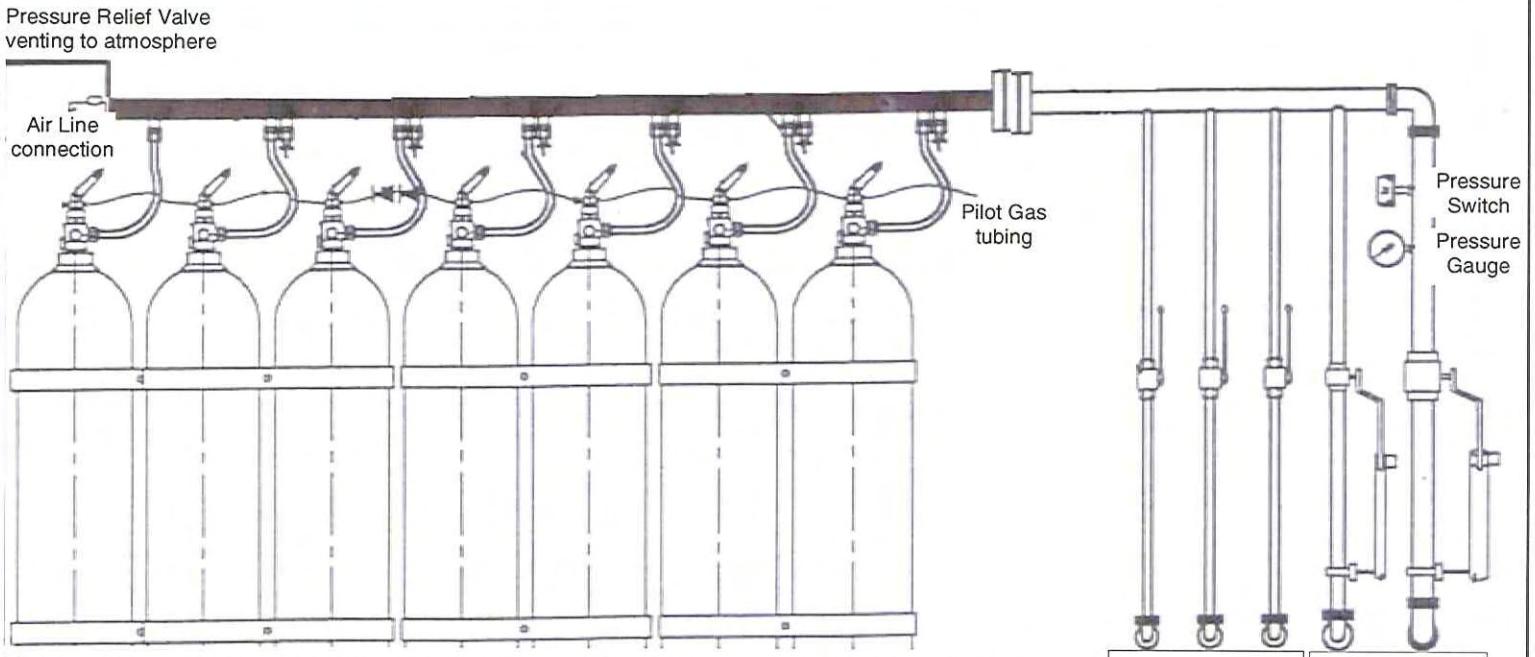
A Pilot gas cylinder fitted with a manual actuator. It may be opened either locally at the pilot cylinder or remotely by a pull cable. Alternatively the pilot cylinder could be fitted with an electrically operated actuator. When opened the pilot gas passes through small bore tubing to open the main compartment isolating valve and the extinguishant cylinders.

Release of the extinguishant to a space afire is often by use of CO_2 or nitrogen gas from small pilot cylinders. Opening the locker containing the pilot gas cylinders will active the warning alarms; release of the pilot gas will cause the main compartment isolating valve and the requisite number of cylinders to open. The system must be capable of manual operation from the cylinder stowage position in case of malfunction of the pilot gas system. There may also be a remote release position at any distance from the cylinder bank provided the pilot gas tube run s does not exceed the pilot gas volume.

Smaller systems may use a manual valve and pull-wire release as might some older systems. Larger older systems sometimes use pilot gas taken from one of the extinguishing gas (CO_2) cylinders and/ or a drop-weight and wire pull system.

SMALL SYSTEMS

Systems comprising only one or two cylinders, such as may be used for the protection of a paint store or galley exhaust duct, may not require a dedicated stowage compartment but may be located directly adjacent to the risk and operated by manual release only.



The drawing represents the arrangement of a gas fire extinguishing system comprising a total of , say, twenty or thirty cylinders, designed to protect five compartments: the Engine Room, Pump Room, Separator Room, Generator Room and Boiler Room. The quantity of extinguishing gas required is that needed for the largest space only—in this case the Engine Room. Other smaller compartments are protected by using an appropriate proportion of the extinguishant.

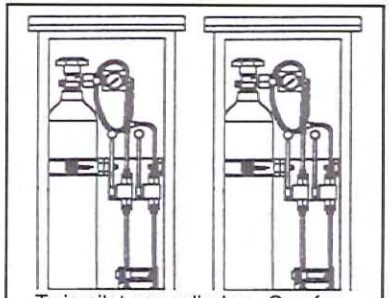
Thus, in the example, when discharging the system for the protection of the Engine Room all cylinders would be emptied. For the Pump Room only, say, five cylinders would be required, and for the Separator, Generator and Boiler Rooms just two cylinders each.

Release to the Engine Room and Pump Room is by Nitrogen or CO_2 pilot gas. Operation of the pilot gas for either of these compartments would open the appropriate isolating valve and the required number of cylinders. Release to the other spaces is by manually operating the appropriate isolating valve and, in the case of CO_2, manually opening the requisite number of cylinders. If halon, or other extinguishant requiring a fast discharge were used, then operation of two or three cylinders simulatiously would be by a pull wire system.

If the system to one of the smaller spaces were used there would not then be sufficient gas for the protection of the Engine Room. If the system to the Engine Room were used there would not be any protection remaining for the other spaces.

Manually operated isolating valves. One each for the Boiler Room, Generator Room & Separator Room

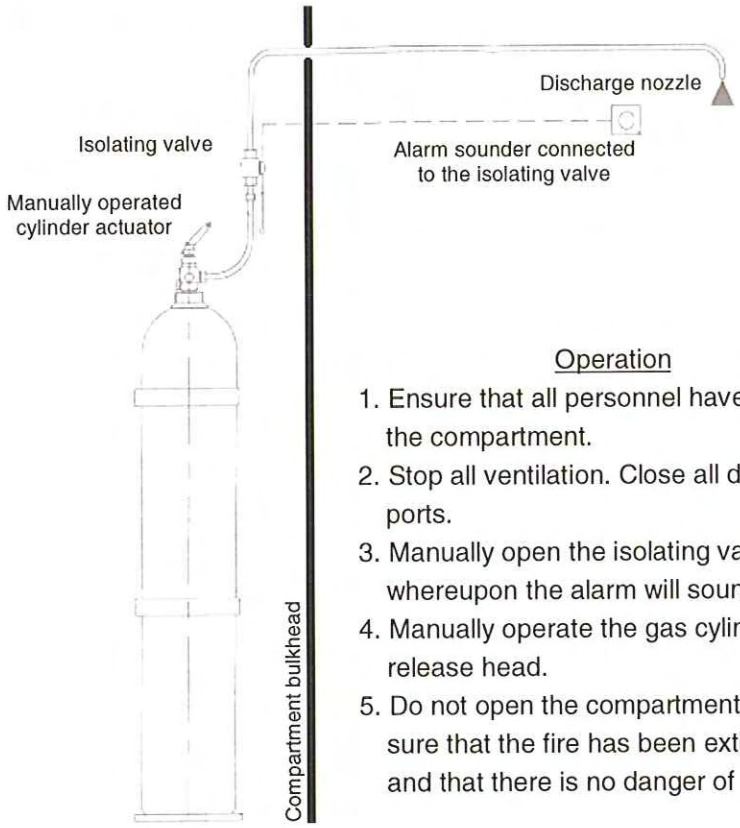
Pilot Gas operated isolating valves. One each for the Engine Room & Pump Room



Twin pilot gas cylinders. One for release of the extinguishant gas to the Engine Room and one for the Pump Room. These controls may be duplicated at a remote position

A single cylinder system

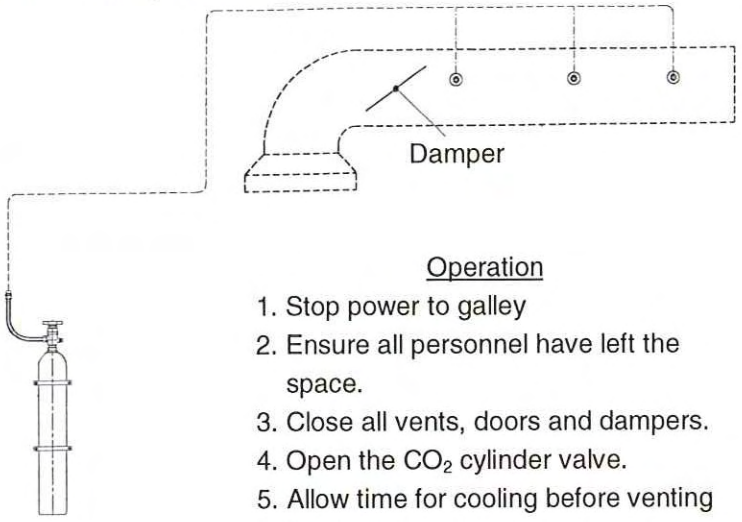
(e.g. Paint Room)



Operation

1. Ensure that all personnel have vacated the compartment.
2. Stop all ventilation. Close all doors and ports.
3. Manually open the isolating valve, whereupon the alarm will sound.
4. Manually operate the gas cylinder release head.
5. Do not open the compartment until it is sure that the fire has been extinguished and that there is no danger of re-ignition.

Galley Duct CO_2 System

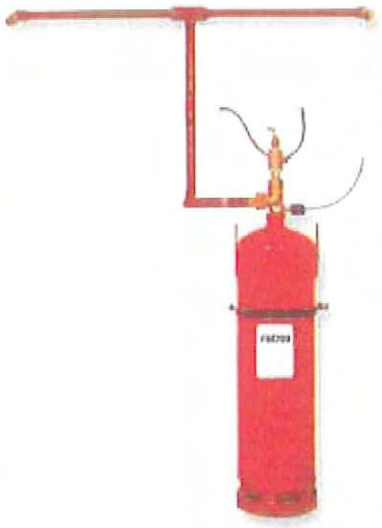


Operation

1. Stop power to galley
2. Ensure all personnel have left the space.
3. Close all vents, doors and dampers.
4. Open the CO_2 cylinder valve.
5. Allow time for cooling before venting the duct.

MODULAR SYSTEMS

Cylinders containing Halon 1301 and some halon substitutes (eg FM200) may be stored within the space protected provided they are individually distributed throughout the space. Each modular cylinder would be fitted with a short length of distribution pipe and a maximum of two discharge nozzles. An alarm system is provided to indicate if the cylinders have lost pressure due to leakage or discharge and the cylinders themselves are fitted with an over-pressure release device which, in the event of fire and the system not being operated, will discharge the extinguishant into the protected space.

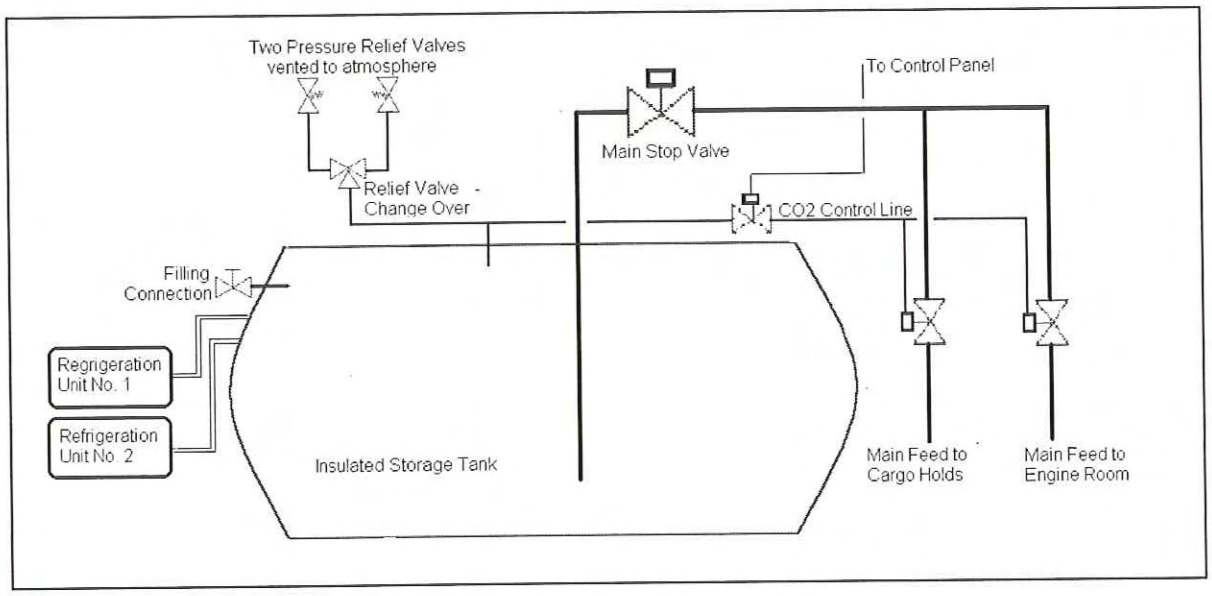


Modular cylinder with two discharge nozzles. There are two release circuits fed to the valve actuator and a connection for continuous monitoring of the cylinder pressure

Manually operated power releases (e.g. pneumatic, hydraulic or electric) with duplicate sources of power, are to be located outside of the space protected. The release systems are to be so arranged that in the event of a single point failure at least two-thirds of the extinguishant can still be released. The release systems are to be monitored for fault or loss of power and alarms provided to indicate this.

LOW PRESSURE CO_2 SYSTEMS

With this type of system the CO_2 extinguishant is contained within one or two insulated, refrigerated bulk storage tanks instead of in pressurised cylinders. Each of two refrigeration units must be able to maintain the liquid CO_2 at the appropriate operating temperature and pressure (about 20 bar). Thus, should one refrigeration unit fail the integrity of the system is not impaired. There are two relief valves with a three-way change over valve in the system so that either relief valve may be isolated for inspection and maintenance. There is a continuous readout of the contents level in the tank and a back-up system for determining the tank contents. Alarms indicate a fall of 2% in the contents of the tank.



Other components of the system include a pressure switch, main compartment isolating valves, discharge warning alarms, etc all similar to the component parts of a central bank cylinder system

STEAM SMOTHERING SYSTEMS

In general steam smothering installations are not allowed in newer buildings but may still be found in older vessels. Where some administrations still permit steam smothering to be fitted it is only to be in addition to the required fixed fire fighting system and providing that the ship's boilers can develop a specific quantity of steam within a given time.

Where such systems are found in older ships the steam is to be always immediately available and in sufficient quantities. If blank flanges are used to isolate a hold pipe (and so prevent accidental damage to cargo or if the compartment is used as a passenger space) then a 'spectacle' type flange is required so that its use may be easily seen.

In tankers the steam smothering gas is to be distributed over the surface of the cargo. In other cargo

spaces, except coal spaces, the pipe outlets shall be low down in the space.

Explosives should never be carried in a compartment fitted with steam fire smothering.

Steam smothering is not as effective as other gas extinguishants. If used the space must be kept securely closed for some considerable time to ensure that there is no flash-over when opening up.

CARGO HOLD SAMPLE SMOKE EXTRACTION

The cargo hold sample smoke extraction system is designed to give early warning of fire in a cargo hold by providing continuous air sampling at a remote location. The system is almost always linked to the CO_2 hold fire extinguishing system.

Open ended sampling pipes, terminating in a smoke accumulator, through which an extraction fan continuously draws air, are led from each hold to a cabinet usually located on the bridge. When smoke is detected in any pipe a visual and audible warning is given. On older vessels the air samples may be exhausted in the bridge in order to give a 'smell' indication of fire. In this case there will be a diverter valve so that the air sample may be to exhausted to atmosphere when smoke is present or obnoxious cargo smells are overwhelming!

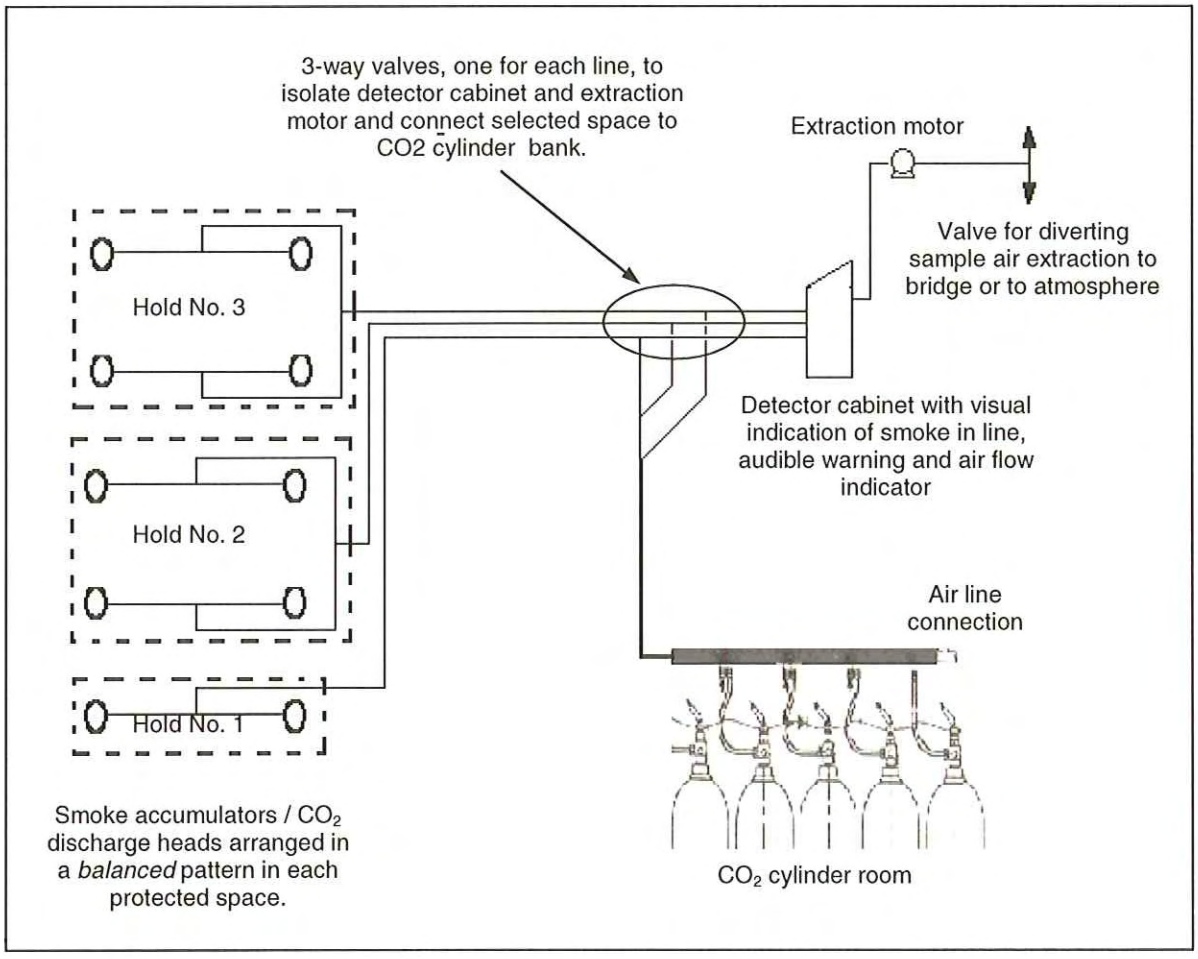
The pipe in the cabinet is clear (glass tube) and properly arranged lighting enables the viewer to see any smoke in the air sample passing through. Each glass tube also contains an impellor so by their movement it may be confirmed that air is being drawn from each protected space. When the alarm sounds or smoke is smelt observation of the glass tubes will indicate from which hold the smoke has emanated.

An alternative arrangement is to have the individual holds monitored at a remote location—say the CO_2 cylinder room—and a single pipe led to the bridge. On alarm in the bridge it is then necessary to investigate at the remote location which hold is on fire.

Although the system is required to be in operation continuously sequential scanning of holds is allowed provided the interval of scanning is acceptable: which in practice means not in excess of two minutes. The open ended sampling pipes terminate at the deckhead in the holds with a smoke accumulator. Each hold and lower hold must have a separate system. There are to be not more than

four accumulators on each line and no part of the deckhead is to be more than 12m horizontally from a smoke accumulator. When there is more than one smoke accumulator on a line they are to be *balanced,* so that the extraction from each is in equal amounts. The pipework will incorporate drains, will be protected from damage by the cargo and will include an arrangement whereby the system can be tested and purged with compressed air.

Spaces that may sometimes carry oils or refrigerated cargos as well as cargos for which smoke sampling is required will be provided with a means of isolating the appropriate sections of pipe during the carriage of oils, etc. The isolation method is usually by spectacle blank flanges.



COMBINED CO2 EXTINGUISHING

It is usual to combine an extraction smoke detection system for cargo holds with the CO_2 flooding system. When smoke has been detected and ventilators closed and the hold secured, operation of a three-way valve, found at the inspection cabinet or in the CO_2 cylinder room, isolates the smoke sampling line from the sight glass tube and the exhaust fan and connects it to the fixed CO_2 flooding system. The smoke sampling pipe now becomes the CO_2 flooding line, and the smoke accumulator a CO_2 discharge head. Release of CO_2 to cargo holds is usually by the manual release of an appropriate number of individual cylinders. A chart will show how many cylinders should initially be released to the hold on fire and the interval and number of cylinders for subsequent release.

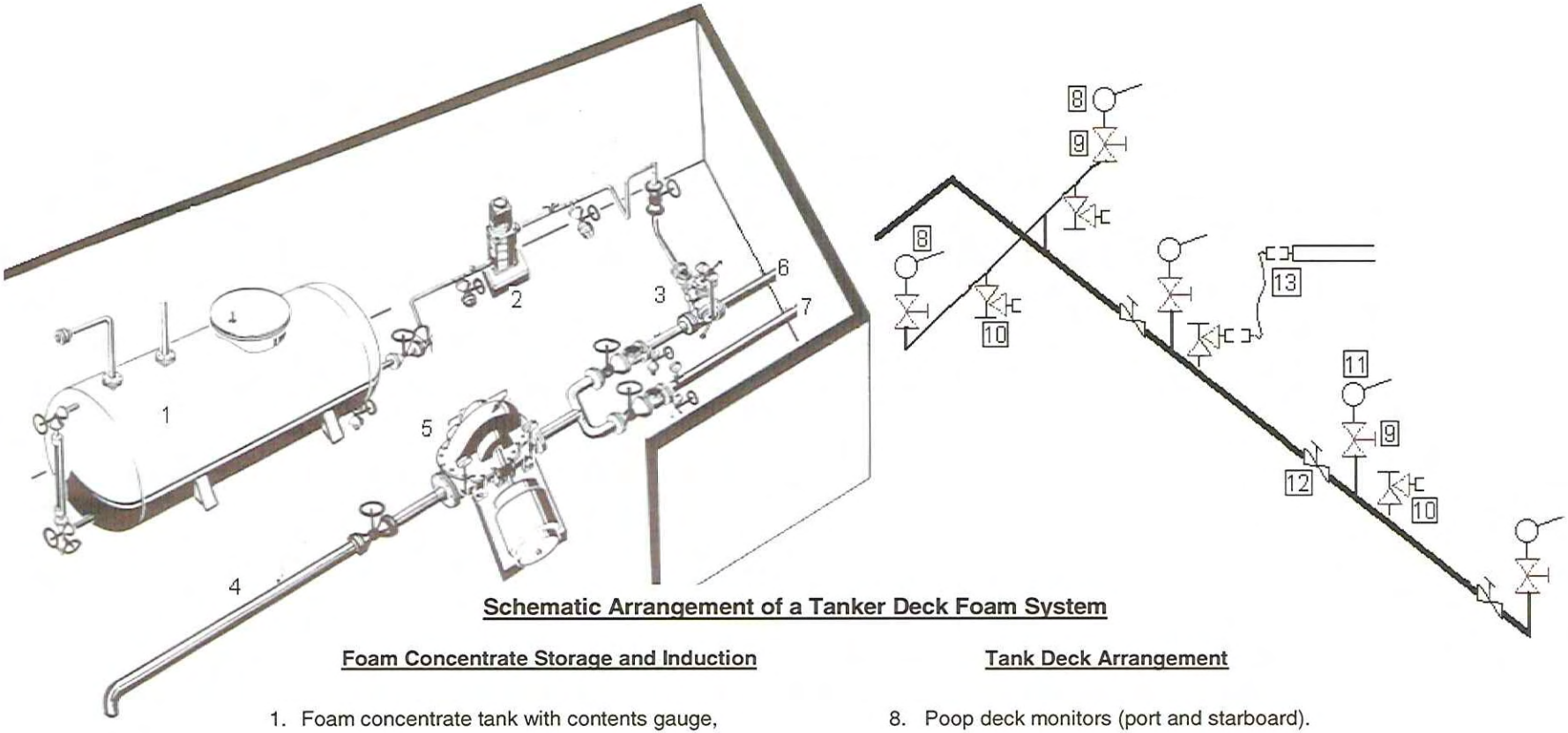
FIXED FOAM FIRE EXTINGUISHING SYSTEMS

Fixed low and high expansion foam systems are permitted in machinery spaces and fixed low expansion systems are required on cargo tank decks of tankers. A description of different types of foam and their properties is given in the chapter concerning foam making equipment in section B. of this manual.

DECK FOAM SYSTEMS FOR TANKERS

It is a requirement that tankers of over 4000 tonnes are provided with a fixed deck foam system capable of delivering foam to the entire cargo tanks deck and into any cargo tank the deck of which has been ruptured. The foam is to be applied at a specified rate per square meter of deck but at not less than 1250 litres per minute. On oil tankers there is to be sufficient foam concentrate to ensure at least twenty minutes of foam generation, and should there still be any vessels without an inert gas system then thirty minutes foam generation is required. On Chemical tankers there is to be sufficient foam for thirty minutes.

Oil Tankers	**Chemical Tankers**
The rate of supply of foam to the cargo tank deck should not be less than the greatest of the following	
0.6 litre/min. per sq. m. of cargo tanks deck area	2.0 litre/min. per sq. m. of cargo tanks deck area
6 litre/min. per sq. m. of the horizontal sectional area of the tank having the largest such area.	20 litre/min. per sq. m. of the horizontal sectional area of the tank having the largest such area.
3 litres/min per sq. m. of the (forward) area protected by the largest monitor	10 litres/min per sq. m. of the (forward) area protected by the largest monitor
1250 litres/min.	1250 litres/min.
Duration—not less than 20 minutes	Duration—not less than 30 minutes



Schematic Arrangement of a Tanker Deck Foam System

Foam Concentrate Storage and Induction

1. Foam concentrate tank with contents gauge, inspection cover, pressure/vacuum valve, overflow valve, drain valve, and filling and flushing line.
2. Foam concentrate pump.
3. Foam Proportioner.
4. Water pump suction.
5. Water pump.
6. Water/foam solution to deck monitors and hydrants or machinery space discharge nozzles.
7. Water main for fire hose system.

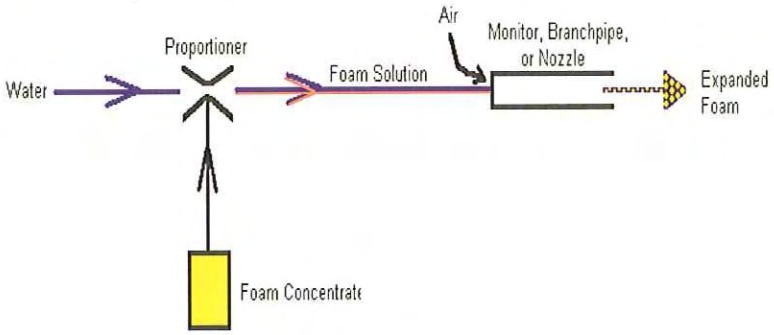
The complete system will also include flushing lines, etc.

Tank Deck Arrangement

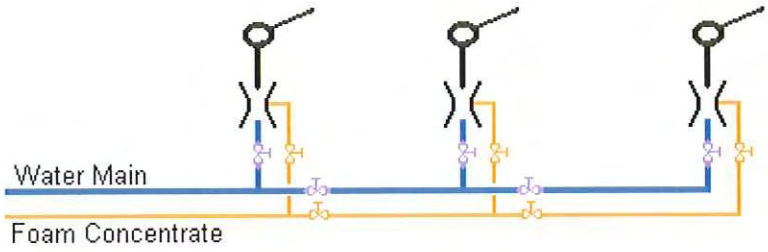
8. Poop deck monitors (port and starboard).
9. Monitor isolating valve.
10. Foam hydrant valve with hose coupling.
11. Deck monitor.
12. Deck main isolating valve.
13. Foam branchpipe and hose.

The foam concentrate is contained within a tank and usually introduced into the system by means of a foam pump and venturi proportioner. Water is pumped through the proportioner which containers a venturi restriction. The pressure drop caused by the venturi draws the correct amount of foam compound into the system. The water and foam compound is termed the *foam solution.* At the discharge monitor or branchpipe or nozzles air is entrained to expand the *solution* into foam.

Venturi Proportioner



An alternative arrangement is to provide separate foam concentrate and water lines to each monitor together with a proportioner at each monitor.



There are to be foam monitors and foam hose connections both port and starboard at the forward end of the poop or accommodation spaces facing the cargo tank decks. The rest of the cargo tank deck is normally provided with monitors situated along the centreline. Vessels with stern and bow loading / discharge arrangements are to have suitable foam protection in those areas. Each monitor will be provided with an isolating/control valve and in the foam main line immediately forward of each monitor there will be a valve to isolate damaged sections of the main. Foam monitors are normally

manually operated by lever or geared handwheel, but may be remotely controlled either electrically or hydraulically. The discharge rate may be up to 12,000 litres per minute and the expansion ratio not more than 12:1. The system will include hand held foam applicators and hoses (as described in section B. of this manual) and foam hydrants. The number of and position of these must allow for at least two applicators to direct foam at any part of the cargo tank deck area; but there must not be less than four applicators and hoses.

Foam monitor with remote control facility and *blabber mouth*. The blabber mouth allows the operator to vary the discharge from a jet to a broad arc.

Vessels of less than 4000 tonnes may be provided with a foam system that uses applicators only.

The type of foam used in the system must be effective for the type of cargo carried.

Larger monitors of up to 30,000 litres per minute are available to meet the requirements of Fire Fighter vessels. Sometimes these are arranged on telescopic masts so as to enable Fire Fighter vessels to raise their monitors above the deck level of a larger casualty vessel and to extend the range of the monitors.

Cross winds significantly affect the effective range of a foam monitor. Some tests indicate that in a crosswind of 30 knots the effective range of a deck monitor was reduced to a third of that achieved in still conditions. Other tests show that cross winds of only 10 knots greatly affect the throw of a monitor.

HIGH EXPANSION FOAM SYSTEMS FOR MACHINERY SPACES

Fixed high expansion foam systems for machinery spaces may have an expansion ration of up to 1000:1. The foam is to be delivered through fixed ducting and outlets at a rate of at least one meter depth per minute and the quantity of foam concentrate required must be sufficient to produce a volume equal to at least five times the volume of the largest space to be protected.

The high expansion foam generators are installed outside of the protected space. The foam concentrate is mixed with water by means of inductors and driven by a fan through trunking to the protected space.

High expansion foam takes a long time to clear and thus could immobilise a vessel for an extended period.

LOW EXPANSION FOAM SYSTEMS FOR MACHINERY SPACES

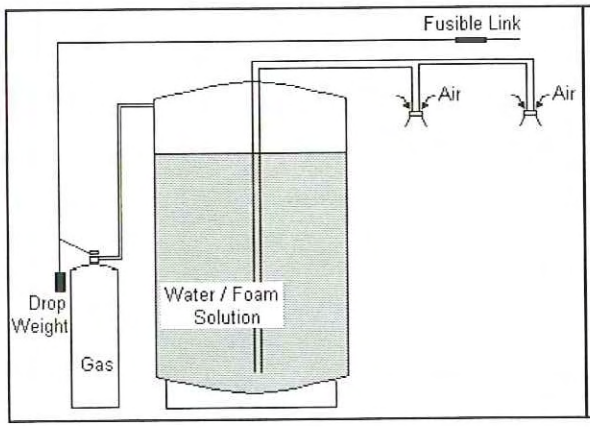
Low expansion foam systems are permitted in machinery spaces but only in addition to a fixed gas, high expansion foam, or water spray system. It is not permitted to rely solely on a low expansion foam system for the protection of a machinery space. The foam must be delivered through fixed outlets, and should cover the protected area to a depth of 150mm in five minutes.

Typically low expansion foam systems are directed at save-alls in the region of the boiler front, purifiers, diesel generators, etc,. although it is emphasised that such save-alls cannot guarantee to prevent fire spreading (e.g. oil spraying from a pipe fracture). So, in determining the quantity of foam required and nozzle distribution the area protected by the installation must include the adjacent flats and tank top.

Induction / Proportioner Systems—the application rate to the *largest single* protected area is, as stated above, 150mm in five minutes. But there must be sufficient foam compound carried to cover

all protected areas and the application rate to cover *all* protected areas is 150mm in ten minutes

Pre-mix Systems —in these systems water / foam solution is contained within a tank which, when pressurised by a gas, is distributed to be protected areas.



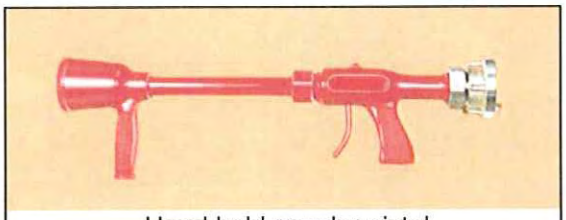
Smaller areas of risk, say a boiler front, may be protected by foam which is delivered from a pressurised tank. The system may be manually activated, and possibly also via a fusible link in the area of risk. A drop weight connected to the fusible link wire is used to open the gas (nitrogen or CO_2) cylinder. The gas is passed to the foam tank to pressurise the water/foam solution which is forced up a siphon tube to the distribution nozzles where air is entrained to expand the foam.

The initial foam charge (water/foam solution) need only be sufficient to cover the largest protected area to a depth of 150mm in five minutes. But there must be sufficient foam compound on board to cover all remaining areas to a depth of 150mm. The size of the foam solution storage tank must be that required for the protection of the largest single area or that required for the protection of all remaining areas, whichever is larger. There are to be sufficient spare gas cylinders so that the second charge (for all remaining areas) may be effected in five minutes. Recharging the system must be through permanent fittings and not take more than fifteen minutes

FIXED POWDER FIRE EXTINGUISHING SYSTEMS

Vessels carrying liquefied gases in bulk must be provided with a dry chemical powder system for the fire protection of the cargo deck area and any bow and stern loading areas. It must be possible to deliver powder to any part of the cargo deck from at least two monitors and / or hand held hose/ pistols. An inert gas, usually nitrogen, stored in pressurised cylinders located adjacent to the powder storage, is used to energise the system.

There are to be at least two independent, self-contained powder units, each with their own controls, pressurizing gas, piping, monitors and hand hoses/pistols. Vessels of under 1000 m^3 cargo capacity require only one unit.



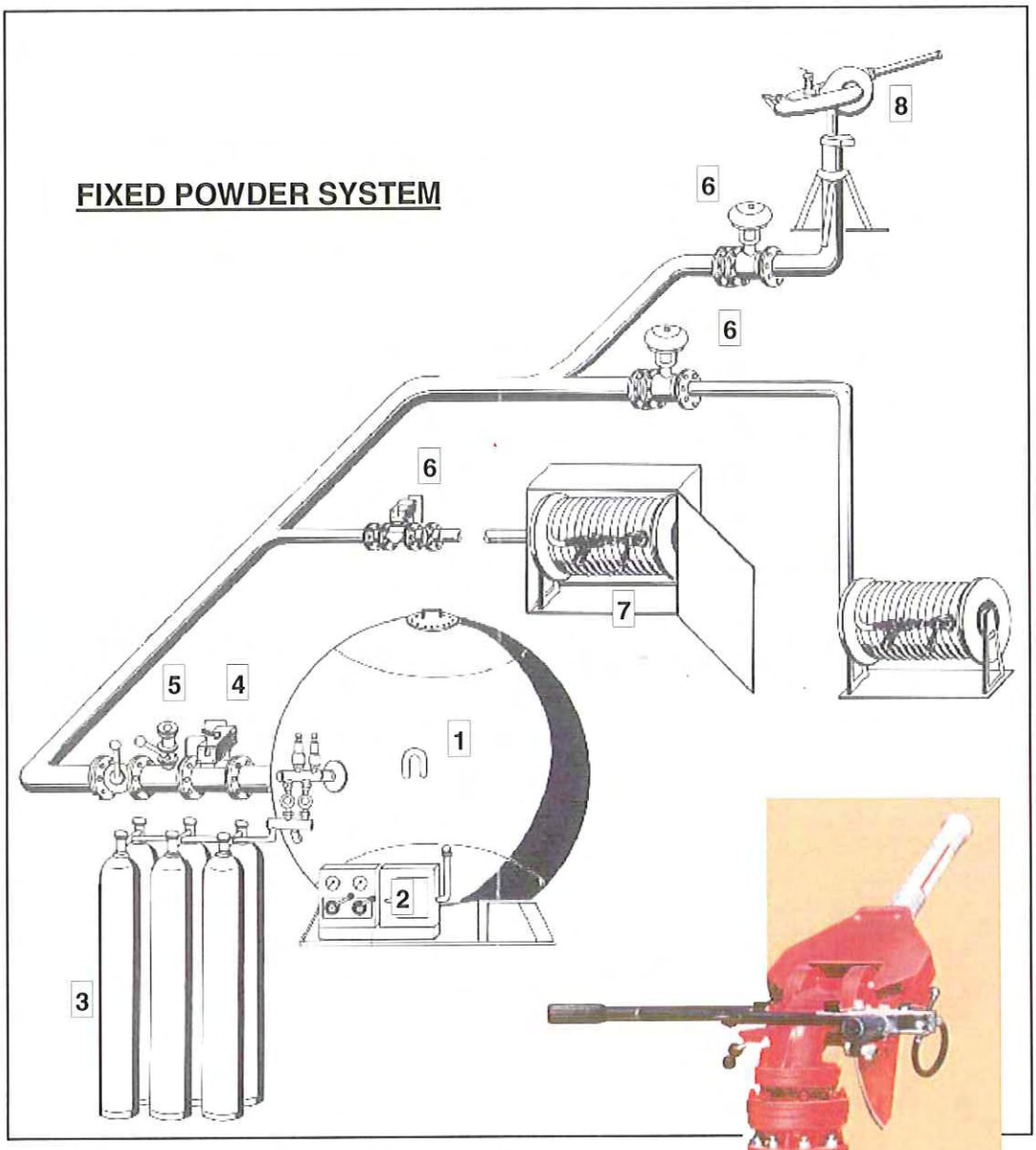
Hand held powder pistol

A monitor is required to protect the areas around the loading and discharge manifolds. It must be capable of being operated locally and remotely, although remote aiming is not required if the entire area is covered from its fixed position. At least one hand hose line and pistol or monitor should be situated at the after end of the cargo area. All hand hose lines and monitors should be capable of actuation at the hose storage reel or monitor.

The minimum permitted discharge rate for monitors is 10 kg/second and for hand hoses 3.5 kg/ second. The required capacity is increased with the distance each monitor is required to cover:

Capacity (kg/second)	10	25	45
Maximum distance of coverage (m)	10	30	40

Each container is to have sufficient powder to provide 45 seconds of discharge for all monitors and hand hoses fed by it.



1. Powder contained in pressure vessel.
2. Control panel
3. Nitrogen gas cylinders for pressurising the system.
4. Main powder valve.
5. Test connection.
6. Isolating valve.
7. Powder hose line and hand held pistol stored in cabinet
8. Powder monitor.

FIXED WATER FIRE EXTINGUISHING SYSTEMS

Water is a cheap readily available fire fighting medium that has a large capacity to absorb heat. Water systems are not usually complex, they are relatively simple to install and maintain, and are immediately available

SPRINKLER SYSTEMS

Ideally automatic sprinkler systems detect, control and extinguish a fire in its early stages. The system consists of a permanently pressurised network of water pipes terminating in several sprinkler heads. The sprinkler head which comprises a glass bulb filled with a liquid seals the end of the water pipe. When heated to a pre-determined temperature the liquid expands and so shatters the bulb. The pipe is now open-ended and thus extinguishing water is allowed to flow. A sensor detects the change in water pressure and activates the necessary alarms and pumps. The sprinkler head is fitted with a deflector plate so that the water is distributed in small droplets evenly over the fire area. The fire fighting is selective in that water will only be emitted from pipes in the fire area where the sealing bulb has shattered, and so water damage to surrounding area not affected by fire is avoided.

The temperature at which a sprinkler bulb will shatter will be dependant on the normal ambient and maximum temperatures of the compartment. Normally it will be approximately 30° C above the maximum ambient temperature. Sprinkler heads may be fitted with bulbs of various operating temperatures. So, the branch of a system protecting a drying-room would be fitted with bulb activated at a higher temperature than those fitted in accommodation alleyways. The operating temperature of the bulb is indicated by the colour of the liquid it contains.

Normally fixed automatic sprinkler systems are of the 'wet pipe' type. That is the pipes feeding each sprinkler outlet are permanently charged with water. Some small sections, e.g. where it may be

impossible to insulate against freezing, may be of the 'dry pipe' type. The system is kept continuously under pressure so as to be always ready for immediate use and must function immediately without it being necessary for a crew member to activate the system. Alarms are given whenever any sprinkler comes into operation or when there is a fault in the system. In passenger ships the alarm must also indicate the area in which the system has been activated. Sprinkler systems are arranged in zones with a maximum of 200 sprinkler heads to each zone. A isolation stop valve is provide for each zone. The system is served from a fresh water tank pressurised with air, and it must be possible to replenish the tank with fresh water and air pressure.

Bulb Colour	Burst Temperature
Orange	57° C
Red	68° C
Yellow	79° C
Green	93° C
Blue	141° C
Violet	182° C
Black	227—260° C

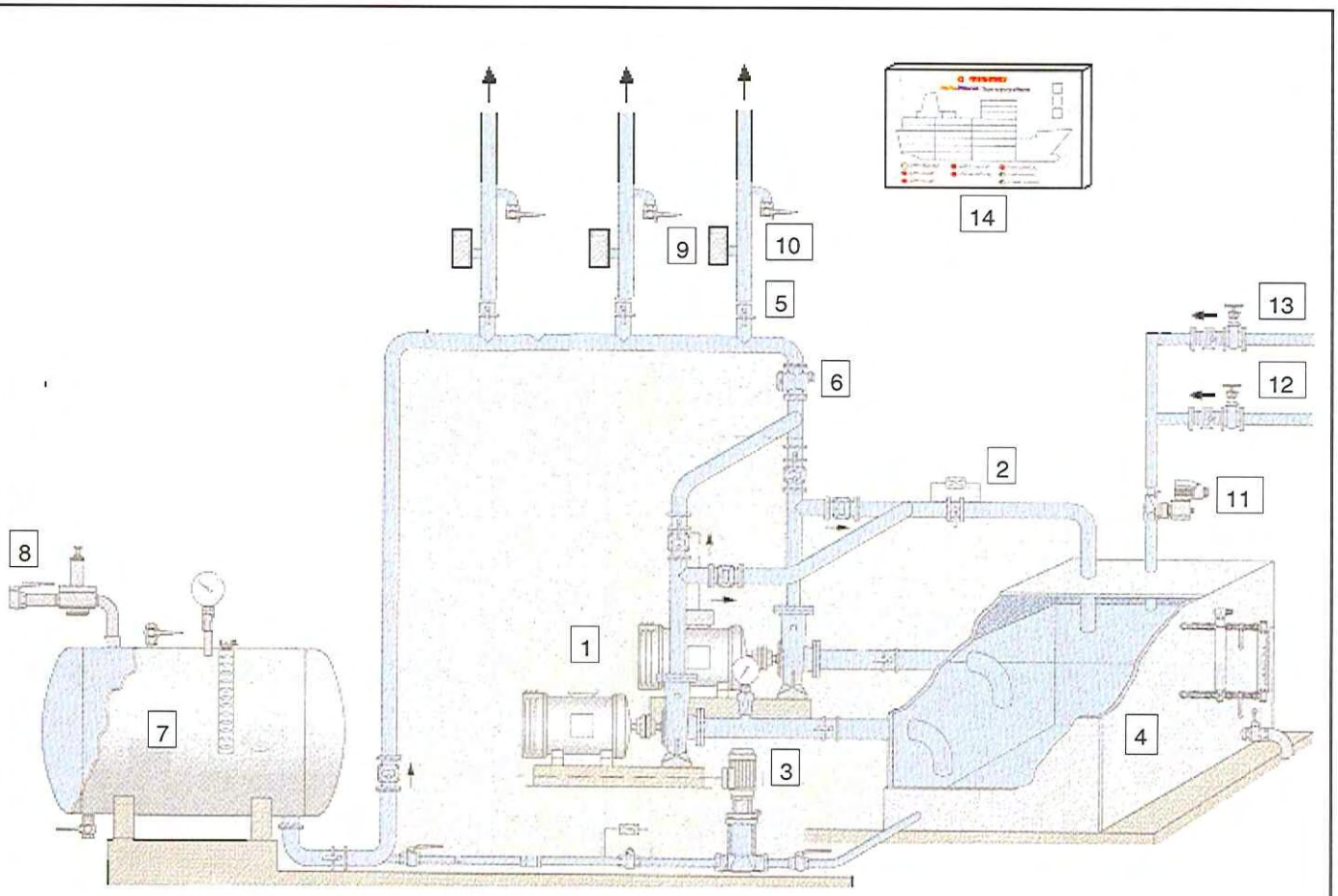
The water pumps for the sprinkler system are dedicated for use with the system and must not be used for any other purpose. It is brought into action automatically by the pressure drop in the system. It takes its supply from the sea.

The sprinkler system will have a connection to the ship's fire main which is protected by a stop valve and non-return valve, and, possibly, a coupling suitable for connecting to a shore supply.

The pressure tank containing fresh water must be twice the size of the required capacity. The minimum area that must be allowed for is 280 square meters and the discharge rate is to be at least 5 litres per square meter per minute. Therefore the minimum permitted tank size is 280 x 5 x 2 = 2800 litres.

Once a bulb has shattered pressurised water is sprayed into the area of the fire. Initially the

1	Fire pumps
2	Test line
3	Jockey pump
4	Fresh water storage tank
5	Section valve
6	Strainer
7	Pressure tank with level gauge, pressure monitoring, safety valve, etc.
8	Gas/Air pressure supply
9	Flow switch for alarms
10	Test valve
11	Control valve for automatic additional supply
12	Connection from sea suction fire pumps
13	Connection from international ship-shore connection
14	Monitoring and alarm panel



Typical arrangement of a sprinkler system

extinguishing water is expelled because of the gas pressure being maintained on the system, but immediate loss of water pressure caused by the breaking sprinkler bulb is detected by a sensor which is used start the water pump and flow switches which are used to operate the alarms. The pump delivers water from the storage tank to the sprinkler outlets. Should the fire require more water than is available from the fresh water storage tank there is an automatic change over to allow the system to take filtered sea water through a sea suction and deliver it via a strainer to the sprinkler system.

The water supply to any 'dry' section in the system is held back by an isolating valve and the pipework downstream of this is filled with compressed air. If a sprinkler shatters and opens the line the drop in air pressure is detected by a sensor which is used to open the isolating valve and so allow water to the sprinkler heads.

After use the system must be reinstated to its full protective working order.

1. Stop the pump.
2. Drain down any sea water or unclean water that has been introduced to the system. Ensure that the system is clean.
3. Replace spent sprinkler heads by new heads of the same temperature rating
4. Charge the system and fill the pressure tank to the correct level.
5. Pressurize the system.

DELUGE SYSTEMS

Deluge systems are similar to sprinkler systems except that the pipes terminate in open nozzles. In the event of a fire the nozzles distribute large quantities of water over the entire protected area, not just in a confined location as occurs when the bulb of a sprinkler systems shatters. The water application is uniformly distributed throughout the risk area.

Deluge nozzle

Areas that may be protected by deluge systems are ro-ro car decks and tank decks on gas and chemical tankers.

The deluge system is usually arranged in a manner very similar to that described above for the sprinkler system. The system is charged with clean fresh water, kept under pressure, up to the main stop valve known as the deluge valve. The pipework downstream of the deluge valve is dry. The deluge valve may be opened automatically when detectors indicate a fire or it may be opened manually. When the deluge valve is opened the fall in water pressure is detected and system pumps activated. There is a pressurised storage tank and a pump connected to a sea suction similar to the arrangement described for the sprinkler system.

On ships carrying liquefied gases in bulk a water spay system for cooling, fire prevention and crew protection is installed to cover:

- Exposed cargo tank domes and exposed parts cargo tanks
- Exposed on deck flammable or toxic product storage containers
- Cargo discharge manifolds and the area of their control valves and the area of other control valves.
- Boundaries of the following area facing the cargo area —
  superstructure and deckhouses normally manned
  cargo compressor rooms
  storerooms containing high risk fire items
  cargo control rooms

The system on ships carrying liquefied gases in bulk is to uniformly distribute water spay on horizontal surfaces at a rate of at least 10 l/m^2 per minute, and on vertical surfaces at rate of at least 4 l/m^2 per minute. The system may comprise two or more completely independent sections or it must be provided with valves for isolating damaged sections. Pumps and normally close valves are to be operated remotely from a suitable position outside of the cargo area.

WATER MIST SYSTEMS

The fire extinguishing ability of water can be enhanced by decreasing the size of the water droplets. Fine water spay systems, known as *water mist* reduce the water droplet size and the total quantity of water required When compared to standard sprinkler and deluge systems a water mist system has the following advantages:

- Small pipe sizes give ease of pipe run, minimum weight, and reduced cost.
- Pump size reduced.
- Minimal secondary damage caused by the use of water
- Less adverse effect on stability.

The superior effectiveness of a water system using finer droplets is a result of the ratio of the droplet surface area to its mass. As this ratio increases the area through which heat transfer can occur (for a given volume of water) also increases. In simpler terms, small water droplets absorb heat faster than big droplets and so the cooling effect in the fire area is greater. However if the droplets are too small they may not meet their target because they are not heavy enough to overcome the hot air currents of the fire. Water mist systems also have a suffocating effect in that they reduce the concentration of oxygen in the air. However even in enclosed spaces this effect is limited both in its duration and the area affected. The suffocation effect is greatest when the droplets are extremely fine and the fire has a high heat content, Consequently a large amount of vapour is formed in a short time. In practice water mist systems extinguish primarily through cooling.

Water Mist
Sprinkler Nozzle

Water mist systems have to be carefully designed, give even coverage of the protected area and, when protecting a specific item, arranged so as to be as close as possible to the risk. The general design is as previously described for a (wet) sprinkler system, except that it works on a higher pressure - say 40 bar - and uses specially designed nozzles to produce the required droplet size.

Another advantages of water mist systems is that they give excellent protection for people as the fine droplets reflect radiated heat and bind smoke gasses, thus allowing personnel engaged in fire fighting and rescue to get closer to the seat of the fire.

FIRE DETECTION & ALARM SYSTEMS

A Fire Detection system is designed to detect rapidly the onset of fire, give early warning of the situation and so provide the crew with the best possible chance of controlling and extinguishing a fire, before it can destroy property, the ship and even lives. The system comprises a central control and monitoring panel, possibly with repeater panels, a combination of heat, smoke and flame detectors, alarm call points and alarm sounders. The system may be fairly simple or more complex with addressable detectors, and computerised control, etc.

There are to be at least two separate power sources, one of which is taken from the emergency supply. The system is to be operable at all times, with the power supplies and electric circuits continuously monitored for failure or fault. Detectors and manually operated call-points are grouped in sections and activation of any unit initiates an audible and visual alarm at the control panel and indicating units. If an alarm is not acknowledged within two minutes then audible alarms are activated throughout the crew accommodation, control stations and main machinery spaces. The control panel is located either on the bridge or at the main fire control station.

The minimum extent and arrangement of a fire detection and alarm system is dependant on the type and age of a vessel.

Ships built after July 1986.

The indicating units shall at least show the section in which a detector or call-point has operated. At least one indicating unit is to be easily accessible at all times at sea or in port. If the control panel is located in the main fire control station there shall be an indicating panel on the bridge.

Equipment installed before July 1986—Cargo Vessels.

A section may not cover more than one deck within accommodation spaces, service spaces

and control stations, unless the section covers an enclosed stairway. Any section must not contain morel than 100 detectors or more than 50 enclosed spaces.

Equipment installed after July 1986—Cargo Vessels.

The is fitted with remotely and individually identifiable fire detectors the sections may cover several decks and serve any number of enclosed spaces in any sector.

Equipment installed before July 1986—Passenger Vessels.

A section of detectors shall not serve spaces on both sides of the ship nor in more than one deck, unless it is possible to achieve this without reducing the protection afforded to the vessel. Detectors in one section shall not extend more than one vertical zone.

Equipment installed after July 1986—Passenger Vessels.

If the system is fitted with remotely and individually identifiable fire detectors the sections may cover both sides of the ship and more than one deck, but may not extend beyond one vertical zone.

Systems fitted after October 1994

Systems with zone address identification are to be arranged so that:

a) a loop cannot be damaged at more than one point by a fire;

b) a fault (loss of power, short circuit, earth, etc) will not render the whole loop ineffective;

c) the configuration of the system can be restored in the event of failure (electric, electronic, information) and

d) the first initiated fire alarm will not prevent any other detector from initiating further alarms.

TYPES OF DETECTORS

Heat Detectors.

Top Temperature—Rate of Rise detectors give an alarm when the detected temperature exceeds a fixed limit. Normally this will be between 54 and 78^{0}C. However, detectors with a higher temperature rating may be used in areas of high ambient temperature such as a galley, although the permissible operating temperature must not be more than 30^{0}C. above ambient. The detectors will alarm at lower temperatures if the rate of increase in temperature is more than 1^{0}C per minute.

Ionisation Smoke Detectors.

Sense, at an early stage, the invisible smoke particles evolved from a fire.

Optical Smoke Detectors.

Use a light source to determine obscuration or light scatter caused by smoke particles entering the chamber. More advanced units may use laser technology.

Photo Thermal Detectors.

In this type of detector the status of the optical (smoke detecting) chamber is monitored and compared with the heat sensing element. The alarm signal is sent when the comparison indicates a fire situation. The system is able to discriminate between smoke from fires and smoke from other sources such as cigarettes or steam and reducers the incidents of false alarms.

Flame Detectors.

The infrared and ultraviolet bands of the electromagnetic spectrum may be used for flame detection, but more commonly it is infrared flame detectors that are found on board. Infrared (IR) detectors respond to electromagnetic radiation resulting from the burning of carbon and hydrocarbon materials and to the flame flicker frequencies. The units should be immune to false alarms caused by solar rays. If hydrogen is a particular risk a particular type of flame detector will be required.

Beam Detectors

Beam detectors are used to protect large open spaces such as auditoriums. An infra red light beam is projected 30 –60 cm below and parallel to the deckhead and directed to a receiver on the other side of the space. They can protect spaces up to 100m long. If it is not possible to mount the receiver opposite to the transmitter they may both be fitted to the same bulkhead and a reflector provided at the opposite end of the space.. In clear air the receiver registers all the light sent by the transmitter. Smoke from a fire would rise and obscure a portion of the light. This decrease in the amount of light registered causes the beam detector to initiate an alarm

Linear Heat Detectors.

Types of line heat detectors include pressurised tubing, cables that contain dielectric materials, fibre optic cables and other systems. Linear heat detection may be found on cable trays and in environments where smoke detection would not be suitable.

Detectors must be tested periodically by hot air or smoke simulation.

INSTALLATION

Smoke detectors are to be found in accommodation stairways, corridors and escape routes. When locating any detector near beams, ventilation ducts extraction fans, and various other positions care must be taken that the air flow around the location does not impair the performance of the detector.

Type of Detector	Maximum Deck Area per Detector	Maximum Distance Between Centres	Maximum Distance from Bulkheads
Heat	37 m^2	9 m	4.5 m
Smoke	74 m^2	11 m	5.5 m

Flame detectors may be used in addition to smoke and heat detectors but not in lieu of them. The sections of a fire detection system which include accommodation and or service spaces may not include category A machinery spaces.

There are additional requirements regarding the installation of fixed fire detection systems in unattended machinery spaces, cargo holds, special category spaces and ro-ro decks.

MANUAL CALL POINTS

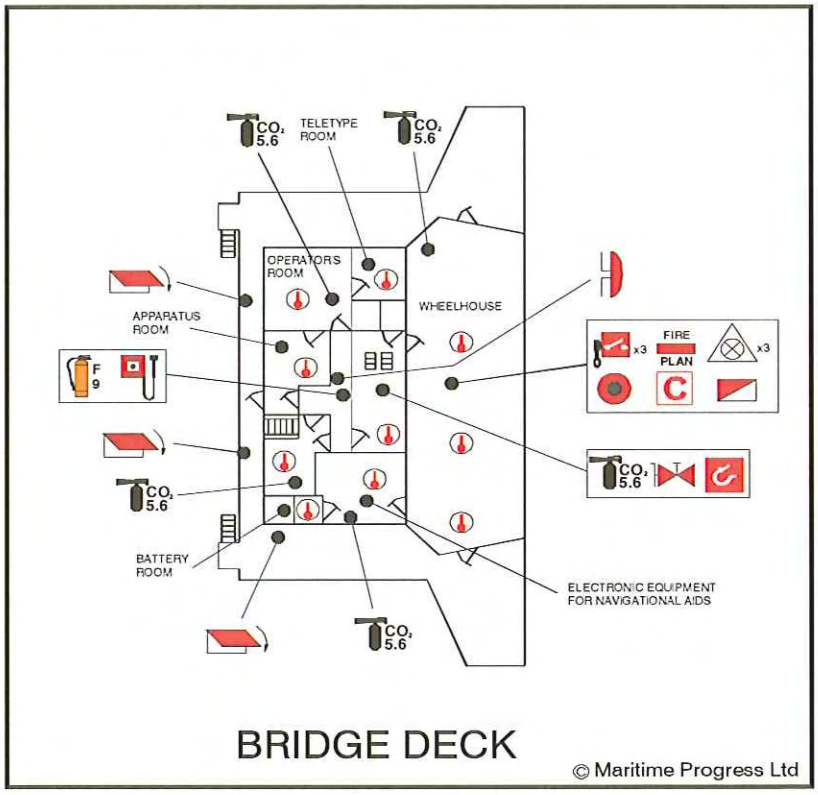
In addition to the detectors manually operated call points are installed throughout the accommodation, service spaces and control stations. There is to be one call point at each exit, and in the corridors of each deck so that no part of the corridor is more than twenty metres from a call point.

FIRE CONTROL PLANS

Passenger ships engaged on international voyages, some other passenger vessels and other ships of over 500 tonnes are required to permanently display a Fire Control Plan. This is often a General Arrangement type drawing on which is clearly shown the:

- fire control stations
- fire sections enclosed by "A" class divisions
- fire sections enclosed by "B" class divisions
- location of the fire detectors and alarms
- location of fire detector control panels and sprinkler control panels
- location of fire extinguishing equipment
- means of access to different compartments and decks
- ventilating system including fan control positions
- position of dampers and identification numbers of the ventilating fans serving each section

Detail from a Fire Plan
The symbols indicate the fire control arrangements and the fire equipment available in each compartment.



As an alternative to a displayed drawing some administrations may allow the required information to be set out in a booklet. In this case a copy of the booklet is to be supplied to each officer, and one copy is to be readily available on board.

A copy of the plan or booklet must be permanently kept in a weathertight enclosure outside of the superstructure. The enclosure is to be coloured red, clearly marked, easily opened and located where it will not be easily cut off in the event of a fire. This copy of the Fire Control Plan is for the use of shore side fire fighting personnel, should they ever be required on board. Often it will be positioned close to the gangway, but if not, there must be signs directing the shore-side fire fighting crew to its location.

FIRE FIGHTING ORGANISATION

Details of the actions to take in the event of fire, the composition of fire parties and the methods of attack will vary from company to company and from ship to ship. However, there are some general principles which are applicable to most situations on conventional vessels. Fire response in vessels with aluminium hulls or other special features may vary from the traditional.

DRILLS

Fire drills should, as far as possible, be conducted with a degree of realism but not of course to the extent that there is danger of injury to any person or the vessel. Training in the practical aspects of fire fighting should be supplemented by giving instruction concerning fire theory, fire prevention, details about the design and use individual items of equipment, organisational considerations, matters peculiar to the particular vessel, etc.

The purpose of conducting fire drills includes the following:

- To prove the equipment
  - what is available ?
  - where is it stowed ?
  - how is it used ?
  - does it work ?
- To test the organisation
  - does everyone know what to do ?
  - can it actually be done ?
  - is it flexible ?
  - what happens if various persons are removed (e.g. through injury) ?
- To build confidence
  - in the equipment and in the system
  - learn leadership skills
  - develop an understanding of problems that might be encountered
  - to enable commanders and party leaders to manage the 'whole' situation.

CONTINGENCY PLANS

Assessment of and reaction to a fire situation may be more effective if some preplanning has taken place.

- Know where chemicals (cleaning fluids, boiler chemicals, etc), paints and compressed gases are stowed.
- Pre-determine the preferred entry route for various compartments and various situations.
- In a given situation will you attack the fire, batten down and contain the fire, or use a fixed flooding system ?
- Do not develop plans that rely on a single person completing a specific act.

MUSTER

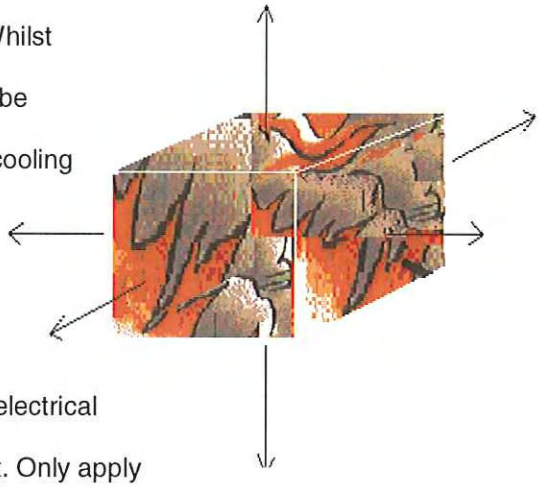
At muster all persons must be accounted for. Thereafter each group leader must, at all times, be aware of the safe situation of each member of his team.

FIRE CONTROL

A fire is contained by:

1. Boundary Cooling 2. Boundary Starvation 3. Ventilation Control

It has already been stated that fire can spread in six directions. Whilst an attack is being made on the fire adjacent compartments must be inspected. Where necessary boundary starvation and boundary cooling must be practised.



BOUNDARY COOLING

Decks and bulkheads must be wetted – having first isolated any electrical circuits – in order to prevent the fire spreading by conducted heat. Only apply the minimum amount of cooling water and do not leave the cooling hoses

unattended. If the area stays wet then it is not necessary to do more than monitor the situation. If heat dries the wet surfaces then cooling must be continued. Take care that there is not a build up of free surface water and consider exhausting the compartment to remove steam.

BOUNDARY STARVATION

Boundary starvation will involve lifting carpets, removing clothes from lockers and drawers, removing cardboard, furniture and any combustible material, including chemicals, cleaning fluids and compressed gases. It may be necessary to remove bulkhead and deckhead panelling and other fixtures.

VENTILATION

The control of ventilation in a fire situation gives rise to two potential difficulties:

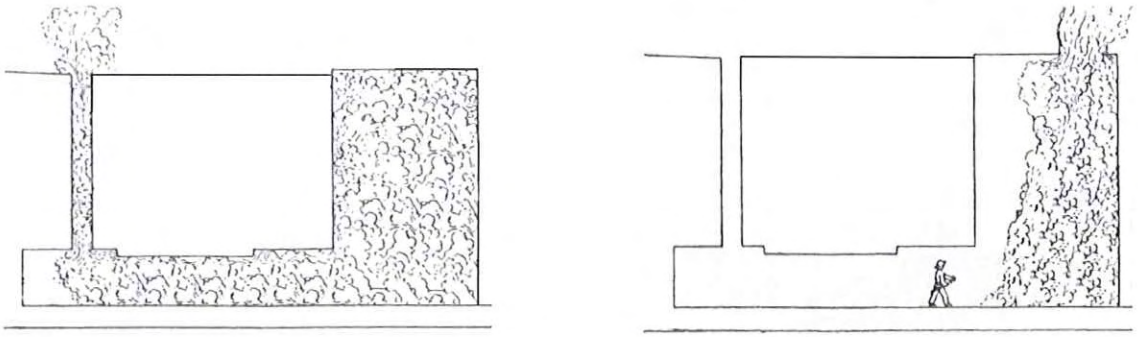
1. To continue ventilation may allow air to perpetuate and even increase the fire.
2. To close off the ventilation will trap heat and smoke, possibly in increasing amounts.

To ventilate or not must be carefully considered. Generally, if no persons are in the space afire it may be completely sealed and containment achieved as described above. Initially, if the seat of the fire is not known, it may be prudent to keep the compartment closed and all ventilation stopped and make a search wearing breathing apparatus.

When a space has been completely closed down, it may, after boundary cooling, be decided that fire fighters should re-enter. A low re-entry point may be the most comfortable to avoid the accumulated heat, smoke and gases, but fire fighting 'upwards' is a difficult and energy consuming. In this situation it is necessary to carefully weigh the advantages and disadvantages of various re-entry points, the difficulties that each present to the fire fighters, and the effect on them of providing through ventilation to carry away heat, smoke and steam.

When determining the amount of ventilation and its nature the following considerations may apply.

- What would be the natural flow of gases in the compartment on fire ?
- What effect would open apertures and forced ventilation have on the flow ?
- Can the hot gases be blown back at the fire fighters?
- Will the venting of hot gases cause the fire to spread or obscure vision elsewhere.?



The left picture shows when there is a fire in a closed compartment (e.g. an engine room) the build-up of smoke and heat will back-up into connected areas such as the escape trunk. In order to tackle the fire men will be required to make an hazardous entry through the smoke and heat exhausting via the escape trunk. The second picture shows that opening the engine room skylights or high level ventilators may permit the fire-fighters a more comfortable entry.

FIRE APPROACH

Often the direction of approach to a fire is determined by its location and the layout of the vessel. If there are alternative approaches that may be made then the fire fighter must be aware of the limitations of each.

1. From the Same Level.

   This is the preferred route as equipment is easier to handle and access is usually the most convenient.

2. From Above.

   If access from the same level is not practical the next consideration should be access from above. However, the fire fighters will encounter an uncomfortable layer of smoke and heat which must be penetrated during entry.

3. From Below

The least favoured option is to approach a fire from below. Although it may be the coolest and most smoke free route access through hatches is often awkward and movement of equipment upwards is often difficult and energy consuming.

LEADERSHIP

- Take charge of the situation.
- Keep the whole picture in mind. Do not focus over-intently on one aspect or detail.
- Give orders in a clear and concise manner, but without hysteria or panic.
- Listen to advice, but do not allow argument.
- Be flexible and continually reassess the situation, but do not allow this to be interpreted as indecisiveness.
- The organisation must be such that it allows for a leader becoming a casualty. Key person substitutes must be clearly identified beforehand, and suitably trained.
- Leadership of individual parties may vary with the circumstance. An engineer may lead a fire attack party in a machinery space, whilst a deck officer may lead the party in other situations.
- Delegate specific duties as may be required: e.g. "You close fire dampers 2 and 4."
- The overall commander or team leader must not take on tasks which inhibit their ability to keep in view the whole picture, or which limit their ability to 'lead'.
- When it is necessary for the commander to give directions these should be routed through the team leaders and not directly to the team members.

THE COMMAND TEAM

The responsibilities of the Command Team mean that ideally it will comprise a number of persons, but because of limited manpower this is often not possible. Each vessel must decide on an appropriate allocation of persons to satisfy the various fire fighting roles that must be filled. In some circumstances the Control Team may be formed by only one or two people.

Responsibilities of the Command Team include:

- ◊ keeping overall control of the various parties.
- ◊ monitoring the event and assessing the effectiveness of the fire attack.
- ◊ accounting for the whereabouts of all persons on board.
- ◊ recording times, events and communications.
- ◊ manoeuvring the vessel as most appropriate for the situation.
- ◊ monitoring the vessel's stability and assessing the free surface effect of any water used.
- ◊ collating and disseminating information from and to all concerned parties.
- ◊ communicating with other vessels and the rescue services.

Contingency must be made for an alternative venue from which the Command Team may operate should the chosen position be inaccessible.

USING A FIRE EXTINGUISHER

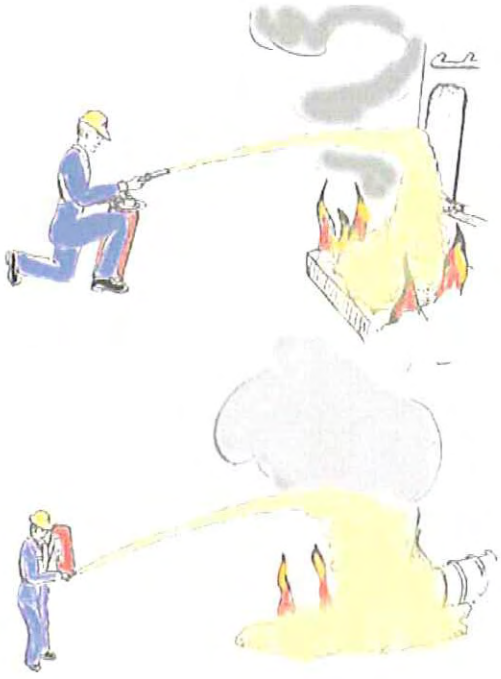
Ensure that the type of extinguisher that you propose to use is suitable for the risk (see Choosing the Correct Extinguisher in section B.1). Whilst still not immediately confronting the fire activate the extinguisher by removing the safety pin and pressing the control lever. This will confirm that the extinguisher is working before approaching the fire. Hold the appliance in front of your body and approach the fire keeping as low as possible. At all times maintain a clear withdrawal route. Do not allow flames, smoke or heat to cut–off your way of escape. If in the open approach from the windward side.

WATER EXTINGUISHERS

Direct the jet into the heart of the fire and low down. Start at the base of the fire nearest you and using a horizontal sweeping action work upwards and away from yourself. If possible break up the burning material to dissipate the heat and make sure that it is thoroughly wetted.

FOAM

Position yourself where you are able to use the full throw of the extinguisher. If the fire is contained (as shown in the top picture) steadily direct the foam on to a vertical surface and let it spread in an unbroken flow over the burning surface.



In the case of an open spill fire (lower picture) aim the foam upwards and slowly sweep from side to side. This will create a foam blanket by allowing the foam to fall (gently) on to the fire.

Do not direct the a foam jet into a liquid as this may only spread the fire. Neither should the jet be directed into the foam 'blanket' as this will break the seal and allow in air which could cause re-ignition.

DRY POWDER

Keeping low, use a swift sweeping action. Starting at the closest point of the fire and working towards the furthest point "drive" the flames off. Powder will give a rapid flame knockdown but has no cooling effect.. When the fire is extinguished stop the discharge and keep watch in case of re-ignition.

CO_2

Keeping low, use a swift sweeping action. Starting at the closest point of the fire and working towards the furthest point "drive" the flames off. Be careful not to direct a forceful discharge directly into the burning material or liquid as this may serve only to scatter it. When the fire is inside electrical equipment or inside machinery put the discharge horn against an opening or grill. On a class A fire or on a fire involving electrical equipment discharge the whole extinguisher contents to maximise the cooling effect. On a liquid fire stop as soon as the fire is out and keep watch in case of re-ignition.

PORTABLE FIRE EXTINGUISHERS – SUMMARY

Type Colour Code Jet Range Duration	For use on	Effect	Method of Use	Possible Dangers
WATER **Red** **Jet – 7m** **5 litres / 60 sec**	Class A	Cooling	Approach low down & as close as possible. Keep on the windward side in open. Direct jet to heart of fire. Use a swift horizontal sweeping action.	Do not use on oils, fats, or liquid fires. Do not use in the vicinity of live electrics.
FOAM **Cream** **Jet – 5m** **5 litres / 30 sec**	Class B	Smothering & Cooling	Approach low. Direct to vertical surface and allow to spread in unbroken flow. For open spill fires aim upwards and slowly sweep from side to side. A blanket will form as the foam gently falls.	Do not use in the vicinity of live electrics.
CO_2 **Black** **Jet – 1-2 m** **5 –10 kg / 12 sec**	Classes A & B Class C in a liquid state	Smothering	Approach low down. Get close. Starting at the nearest side use a sweeping motion to 'drive' the fire off. Not usually effective outside.	Without a horn the extinguisher can entrain air and acting as a 'blow lamp' increase the fire intensity. In explosive atmospheres stand extinguisher on ground. Hold only the insulated parts. CO_2 is asphyxiating – do not stay in area.
DRY POWDER **Blue** **Jet – 4-5 m** **3 –6 kg / 9 sec**	ABC Powder for Classes A, B & C BC Powder for Classes B & C	Smothering & Interference	Approach low down. Get close. Starting at the closest point use a swift sweeping action to 'drive' the flames off.	Avoid inhalation of powder.

USING A FIRE BLANKET

Fire blankets are often found in galleys and pantries and are suitable for contained fat fires (e.g. chip pan), contained liquid fires, and other small fires.

If the fire blanket does not have specific protected hand holds fold back the top edge over the hands to protect them. Allow the blanket to afford protection by letting it hang in front of you. This is achieved by holding your hands up and apart. Hold the blanket so as to keep heat and flame off your face and body, but do not obscure your vision.

Advance and lay the blanket over the fire. If it is a liquid fire make sure the blanket is stretched so that it does not dip into the liquid. Do not throw the blanket down, as this may drive air into the fire and cause it to be more intense or cause a plume of flame.

Once the fire has been extinguished do not remove the blanket until the previously burning item has had time too cool. Removing the blanket too soon may allow re-ignition.

A person with burning clothes should be laid on the floor and wrapped in the blanket; but do not leave them within the blanket as this may trap heat and so cause more injury

USE OF HOSES

Crew members who may be called upon to handle fire hoses should be instructed in the use of, and practice working and moving with, a fully charged hose. They must also be familiar with the various water patterns which may be delivered by adjustable nozzles.

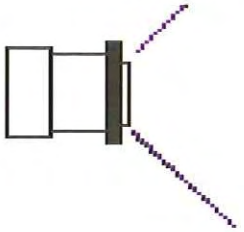
It is recommended that three people are designated for each hose, however this may prove difficult in vessels with small crews. Ideally, one will handle and control the nozzle; a second will be positioned immediately behind the first and assist by taking the weight of the hose; the third person will handle the bight of the hose. At least the first two members of the team should be wearing firemens' outfits, and if appropriate, breathing apparatus.

When bringing a hose into use the spray pattern should be set to Water Wall and directed downwards before giving the order to open the hydrant. Once the flow is established the fire fighter may change the discharge stream to that required and direct it as appropriate. Broader streams produce more water droplets and thus a greater cooling effect, but they also reduce the range.

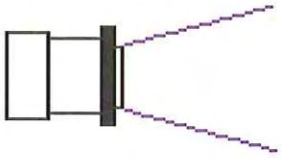
WATER WALL / FULL SHIELD

This shields the fire fighters from radiant heat by producing a 'water curtain' immediately before them. The water wall may be used in combination with other means of attack e.g. another hose set to spray or jet, or foam.

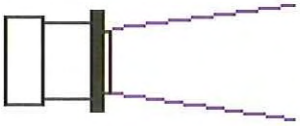
Water Wall / Full Shield More than 90°



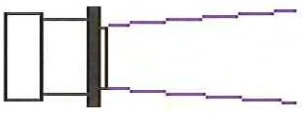
Wide Spray. About 60°



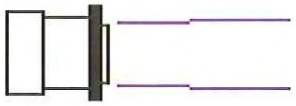
Narrow Spray. About 30°



Broken Spray. About 15°



Jet



When using a water wall in close proximity to the fire some caution must be exercised, for if the water wall is too close the flames may be 'sucked' towards the nozzle.

WIDE SPRAY

For close attacks and indirect application. Indirect application is the use of very short bursts of water into the heat layer *above* the fire. It is used where a direct attack (onto the fire) may cause sufficient air movement to force the heat collected at the deckhead back down round the fire fighters.

NARROW SPRAY

This may be used to control a fire and also to 'push' it away. Additionally, by directing the narrow spray across an opening (e.g. a port) or through an opening a Venturi effect is created, which may assist in dispersing smoke, fumes and heat.

BROKEN SPRAY

This is used from a distance when cooling is required.

JET

The jet gives the greatest reach and so enables the fire fighters to keep a safe distance from the fire. It is used to penetrate and, where required, to break up debris. A jet should not be used during interior attacks until the heat has been controlled and dissipated.

The jet is not to be used on oil or liquid fires

Examples of when to use combinations of water wall, spray and foam are given in later in this section.

USE OF BREATHING APPARATUS

Compressed air breathing apparatus and smoke masks allow safe entry into compartments which do not contain sufficient oxygen to sustain life, or which contains life threatening gases. It is important that the wearers practice with the sets in order that they may become comfortable and confident with them. Practised personnel with rhythmic and steady breathing will use less air, and thus give the CABA sets longer duration, than the untrained.

In order to minimise the amount of air used:

- train frequently, including wearing the mask in difficult circumstances.
- be very familiar with the use of the equipment.
- control breathing so that it is steady. Panting and 'panic' breathing will reduce the available time.
- use clean shaven personnel as a beard will often inhibit a good seal around the mask.
- do not use air unnecessarily (e.g. while waiting to enter a compartment)
- be familiar with the area to be entered.

Other factors affecting the amount of air consumed include age, fitness, state of health, smoker/non-smoker, state of mind and overall workrate.

DURATION OF BA

Factors that affect the amount of air used by the wearer have already been mentioned above. A rough guide to the duration of a cylinder is given by assuming an average air consumption of 40 litres per minute. A safety margin of 10 minutes is also applied. Thus the duration of cylinder with a free air volume of 1240 litres is calculated: (1240/40) - 10 minutes. The estimated available worktime is therefore 20 minutes + 10 minutes safety margin. The worktime will be increased or decreased by

the factors already mentioned. Calculations are usually already completed and permanently marked on the Entry Control Board.

The BA wearer must recognise that he is responsible for his own safety and that of others. The following guidelines must be followed to minimise any risk:

- do not commence with a CABA cylinder which is less than 80% full, unless permitted to do so by the BA Controller (this would only be to complete a simple task).
- the set must be donned in fresh air
- BA wearers should work in teams of not less than two: if one has to withdraw he must be accompanied out of the space by another BA wearer.
- all BA wearers not engaged in *vital* work should proceed towards the sound of a Distress Signal Unit to render assistance.
- helmets are always worn with BA sets
- on entering an incident tallies *must* be left with the BA controller and collected on return

Note: When Air Line breathing apparatus is used there is no duration limit to the provision of air, but there will be a limit to the time that the wearer is able to endure the effects of heat, humidity and toil.

BA ATTENDANT

Each BA wearer should have an attendant to check the set is properly donned and tested before entry. The attendant also tends the lifeline. Because of limited personnel it may be necessary that one person attends two BA wearers.

Checks to be completed by the Attendant

- is the facemask correctly fitted and adjusted ? Use the prescribed procedure to check the face mask is sealing properly (See next section – Face Seal Checks.)
- does the CABA low pressure alarm operate correctly ?
- does the personal distress signal unit (if supplied) operate correctly ?
- is the CABA wearer able to read his gauge ?
- does the wearer have

  lamp, axe, hard hat, signal card, suitable clothing and footwear, gloves, visor, neck-curtain, radio communication (if appropriate), fire extinguisher or hose ?
- remind the wearer

  keep low, read your gauge, come out when the whistle sounds,
- state the mission

  "locate the fire and report", "locate and attack the fire", "search for and retrieve missing persons", limit to the extent of penetration.

CABA FACE SEAL CHECKS

The CABA wearer, witnessed by his attendant, must ensure that the mask is properly sealed around the face.

a) Don the facemask and adjust it correctly.

b) Choose positive pressure mode (if both positive and negative options available).

c) Breath deeply to ensure that the demand and exhalation valves are working correctly.

d) Observe the pressure gauge, close the cylinder valve and then open it a half turn. Take and hold a deep breath, then close the valve.

e) Check that the pressure gauge reading does not drop by more than 5 bar in 10 seconds. Open the cylinder valve fully.

The smoke mask wearer, witnessed by his attendant, must ensure that the mask is properly sealed around the face.

a) Before donning the mask clean air must be pumped through the hose to clear any debris and stale air.

b) Don the facemask and adjust it correctly whilst the operator is still pumping.

c) Breath deeply to ensure that the demand and exhalation valves are working correctly and that the hose is clear .

d) Take and hold a deep breath, then tell the operator to stop pumping.

e) Try to resume breathing. Check that air cannot be drawn in from around the face seal.

f) Signal for the operator to resume pumping.

BA CONTROLLER

The BA Controller plays an important part in overseeing the safety of the BA wearers. He must be fully conversant with the use and limitations of BA equipment. On vessels with limited crew he may also be acting as the BA attendant whose duties are detailed above.

The BA controller must:

- assist with the donning of the sets.
- observe the operational and face seal checks.
- make entries on the control board and ensure that the tally system is being correctly operated.
- determine the point of securing any guide line (if used).
- listen for any signal from a distress signal unit (if used) or other possible signs of the BA wearers experiencing difficulty.
- on vessels with sufficient crew and BA sets have men standing by for relief, at least five minutes before the due time.

- when a wearer has not returned at the appointed time inform the officer in command and initiate the emergency recovery plan.
- on vessels with sufficient crew and BA sets have at least two BA wearers standing by in case of emergency.
- keep the commander fully informed of the situation.

TALLIES AND CONTROL BOARDS

It is important to establish a system of recording the times BA wearers enter an incident and the times that they are due out. A Tally or Control Board system is suitable for this. When several BA wearers are involved in an incident, such as may occur with a shore side fire brigade or on a warship, elaborate systems may be used. However for the small number of persons usually involved in the average vessel a simple system is sufficient.

Tallies – In this system each breathing set is provided with a tally on which is marked:

a) Name of ship.

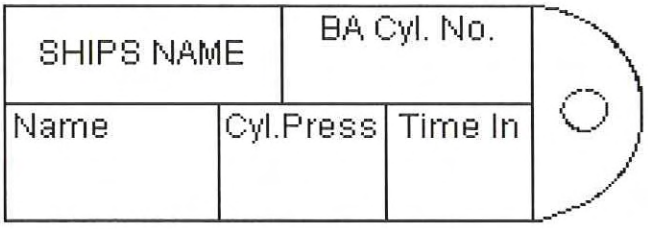
b) BA cylinder number.

Additionally space is provided to mark the:

c) Name of wearer.

d) Cylinder pressure at time of entry.

e) Time of entry



The tally is completed by the BA wearer and checked by the Controller. It is then placed on the Entry Control Board. On the Control Board adjacent to the tally is marked the time the BA wearer's whistle is expected to sound and the time he is due out.

Control Boards

An example of a more elaborate Control Board is given below. It is important to note that the figures given in the example are taken from a military style board and are representative only. Control boards should be carefully tabulated to give the safest and best use when considering the particular equipment and personnel available.

A			B	C	D	E	F	G
Set No.	Name	Task	Cyl. Press.	Minutes to Whistle	Time Started to Breath	Time Relief Due In	Time Return Starts	Time Due Out
3	Miller	Leader Team 1	207	27	1200	1220	1227	1234
5	Smith	Hose tender 1	200	25	1200	1218	1225	1232
1	Salway	Foam nozzle 1	207	27	1200	1220	1227	1234
2	Notly	Assisting	195	25	1200	1218	1225	1232

ENTRY INSTRUCTIONS

1. Before operator enters complete A,B & D
2. Use Endurance Table to complete C.
3. Add C to D to complete F.
4. Subtract 7 minutes to F. to complete E.
5. Add 7 minutes to F to complete G.
6. Check that the head harness is central at top/back of head.
7. Ensure demand valve is in positive pressure mode.
8. Carry out face seal and pressure drop checks.

EXIT INSTRUCTIONS

1. Report to controller.
2. Debrief.

If operator does not emerge by time due out inform commander.

ENDURANCE TABLE	
Pressure (Bar)	*Time to Whistle (Minutes)*
207	*27*
195	*25*
180	*23*
165	*20*
150	*18*
135	*15*
120	*13*

At 4.3 bar the whistle blows and 7 minutes breathing time remains.

Officer in Charge permission is required to START using BA if pressure is below 180 bar.

Note: Times are approximate. Actual duration will depend on individual and task.

Evacuation Signal.

The BA controller, attendants and wearers must all be aware of the agreed evacuation signal. Where there is thought to be undue danger to persons within the incident the evacuation system must be initiated..

THE SEARCH PROBLEM

Guide Lines.

These may be used if available and on the instruction of the officer in charge. They might be considered unnecessary where hoses or lifelines form a traceable route, but may be essential in the absence of any other means of tracing the exit.

Moving Around.

In smoke or other conditions restricting visibility it is necessary to work by touch. Because of the situation there is a very real possibility that the searchers will become casualties themselves, so it is important to be practised in some simple but effective search techniques.

- Shuffle the feet: don't walk. The weight of the body should be placed on the rear foot until the front foot has tested that it is safe to move forward. This is done by pushing the foot along the deck and probing. If safe to do so bring the rear foot up to the front foot and commence the next advance. The feet should not be lifted from the deck, nor should they cross (i.e. the front foot always stays as the front foot). Sliding the foot forward rather than lifting will help detect obstructions and dangers such as projecting nails, stairs, fallen items, etc.
- The searcher should hold a free hand 30 –40 cm in front of his face, slightly cupped with palm towards himself. As he advances he slowly moves his hand up and down to ensure that neither head nor face strike an obstruction. It is important that the back of the hand is forward so that should he contact some sharp, hot or electrically live object there is a tendency for the hand to re-coil from, rather than grasp the object.
- In smoke the air will be coolest near the floor and it will sometimes be beneficial to crawl to avoid excessive heat. When crawling forward raise the free hand in front of you. For the reasons described above the hand should be slightly clenched and with the back

uppermost. From a low, relatively smoke free, position it is sometimes possible to detect the fire glow which has been obscured when standing upright.

- When descending stairs proceed backwards. This will shield the face from heat and allow a more secure hand hold.

Smoke Behaviour.

It may be difficult to determine the seat of a fire merely from the presence of smoke. Smoke may travel a considerable distance from the source and its presence may not necessarily indicate where the fire is seated. Neither is the volume of smoke always a true guide to the size of the fire.

Smoke rises (e.g. up lift shafts, stairwells, etc). when heated and sinks as it cools. It will rise until it meets a deckhead or other obstruction when it will spread sideways (mushroom).

Heat Characteristics.

Usually the temperature increases as the seat of the fire is approached, although in the immediate vicinity of the fire an inrush of air (to feed the fire) may be felt. Cautiously feeling bulkheads, decks, doors, etc for heat is a reliable guide to determining the direction in which the fire seat lays. Watch also for blistering paint and distorted plastic mouldings and fittings.

Doors and Openings.

When searching for a fire, doors which are left open may cause extra draught and so result in the fire spreading. After passing through a doorway the BA wearer should, close the door as far as hoses and lines permit unless his intention is to carry out ventilation control (see section E.2). If it is decided to secure a swing door in the open position it should be wedged so that it is open into the room and not onto the alleyway or staircase.

Disorientated in Smoke.

There is a very real possibility of getting "lost" in smoke, even in a compartment with which, in other circumstances, the searcher may be familiar.

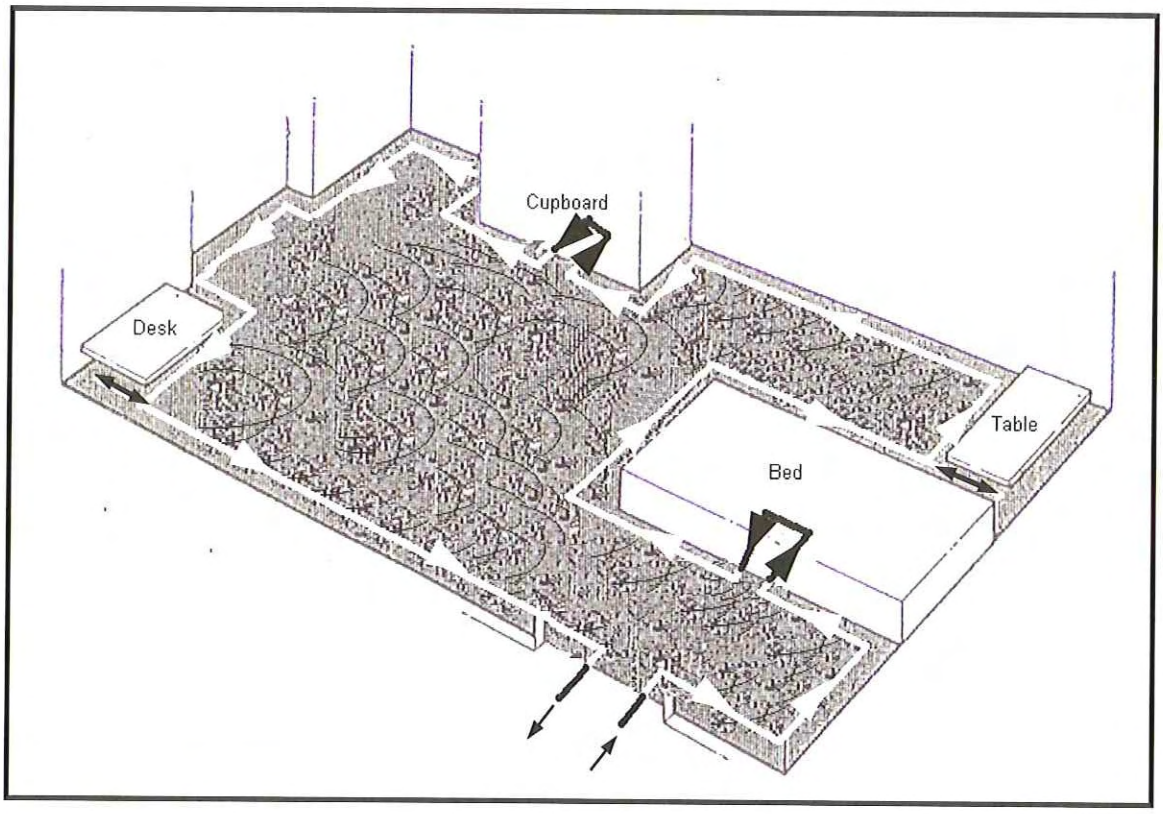
- If possible use personnel who are familiar with the area being searched.
- Take note of any features which will assist in retracing the route to safety.
- Use a hose or life line to retrace a route, but "shuffle" and proceed cautiously as described above. Remember hoses and lifelines may take a route that is more direct, such as across stairwells, than it is possible to walk.
- Guidelines will provide a more reliable guide.

If lost in a space make for a bulkhead and then follow it in a continuous direction until a door is found. Sounds may be a guide as to the whereabouts of an exit.

If it is suspected that a fire fighter is lost in smoke, it may be possible to indicate the location of an exit by standing close to it and giving a series of hand claps.

Search Patterns

When looking for persons the search should be methodical and in accord with a pre-determined pattern. The search may follow either a "right hand" or "left hand" pattern; that is the searchers investigate a compartment by moving continuously and methodically in one direction, either to the right or left. Circulate the area or compartment around the perimeter or bulkhead back to the commencement or entry point. Where possible search in pairs: one man uses the back of his gloved hand to maintain contact with the bulkhead or perimeter; the second adds width to the search by walking abreast of the first and maintains contact with him by placing his hand on the shoulder. The free hand of each searcher is held in front, slightly cupped with palm towards himself. As he advances he slowly moves his hand up and down to ensure that neither head nor face strike an obstruction. The searchers should progress by shuffling their feet as previously described. In larger



spaces the searchers may add more width and keep contact by tying a short length of rope between them.

Normally the search should commence at the point of greatest danger so that the searchers are nearest fresh air and safety at the end of the search. Pay attention to doors and openings so that they are not passed without completing the search of each compartment and alcove. Trapped persons often seem to take refuge in wardrobes, cupboards and recesses – make sure that these are not overlooked.

However, when searchers are wearing lifelines this approach may not be practical in larger spaces enveloped in thick smoke. In this situation there may be a danger of the searchers becoming disorientated. Even hoses may not assist if they become coiled round or cross other hoses.

FIRE FIGHTING ON THE SAME LEVEL

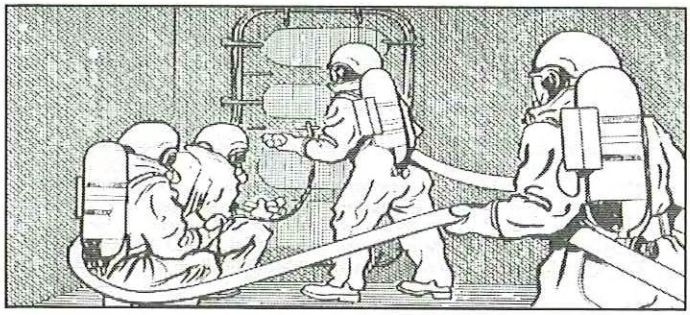
1. The pre-arranged team is formed.

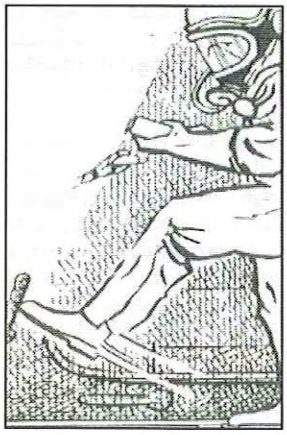
   Hoses fully charged.

   Nozzles at 'waterwall'.

   Ready to open door.

   Lanyard attached to door if appropriate.

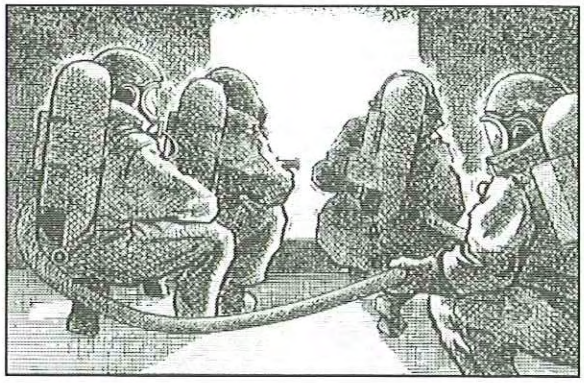




2. Unclips door – hinged side first.

   Last door clip to release is the lowest on the opposite side to hinges.

3. In a controlled manner the door is opened sufficiently to allow one waterwall to seal the opening.



4. The entire team crouch low.

   Opens the door.

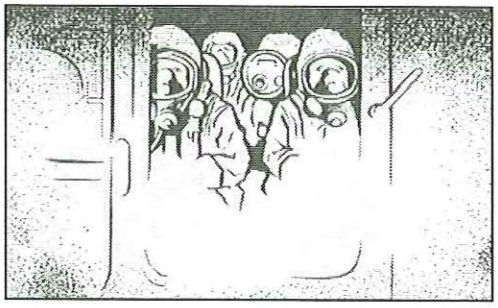
   Both nozzles on waterwall

5. Try to identify the seat of the fire.

   One nozzle set to spray.

   The other nozzle on waterwall

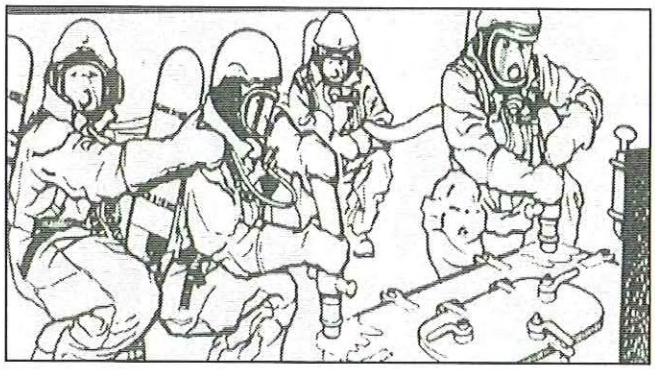
   Team ready to advance and fight the fire.



FIRE FIGHTING FROM ABOVE

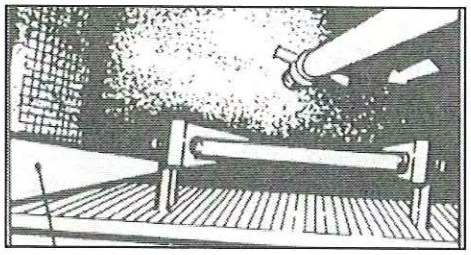
A. Hatch Entry – Non-oil fire

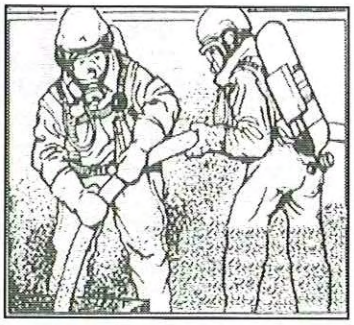
1. Set nozzles to 'waterwall' and 'on'. Place them at the two corners of the hatch on the opposite side to the hinges.



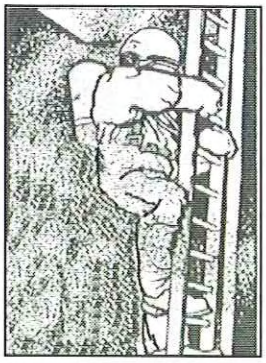
2. Open the hatch sufficiently for waterwalls to seal the opening. Ensure that the hatch cover is securely clipped back.

3. Hose 1 is lowered halfway to the lower deck and swung around to maximise coverage.

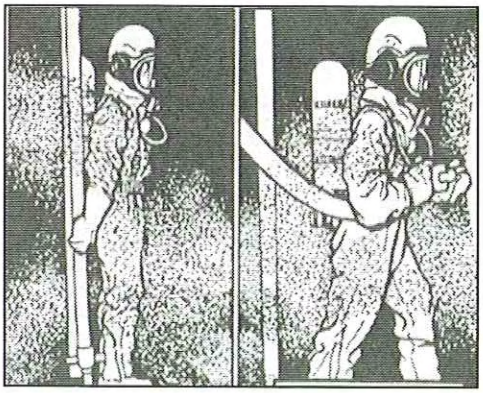




4. Hose 2 is lowered until it just touches the deck



5. One man descends through the waterwall to the bottom of the ladder. Whether the ladder is vertical or sloping descend one rung at a time gripping the stringers with the forearms

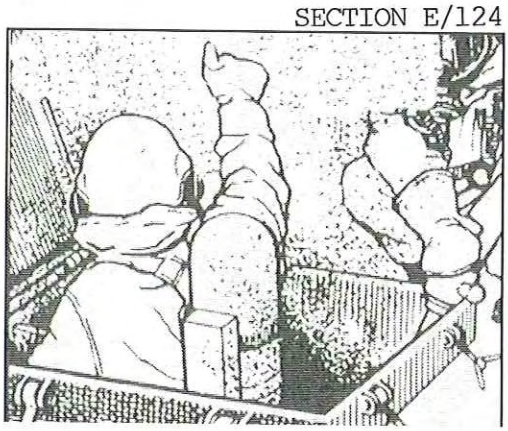


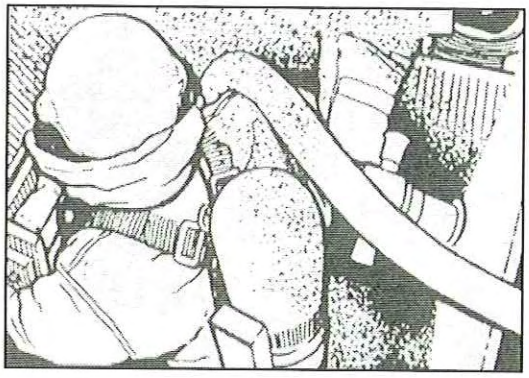
6. At the bottom of the ladder the fire fighter takes a brief moment to orientate himself and takes hold of the hose, directing the waterwall to the front.

7. He then steps to one side of the ladder (which side has been pre-arranged). Crouching low he awaits the arrival of other team member(s).

(continued)

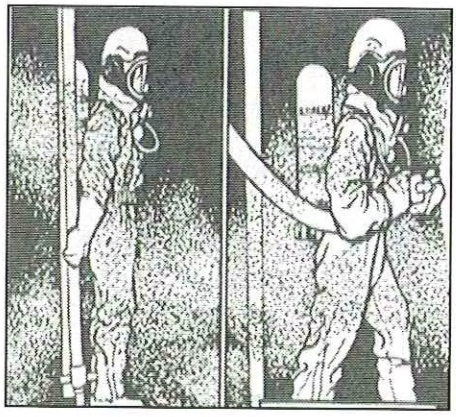
8. A second fire fighter prepares to descend. When shoulders are level with hatch coaming he raises his arm.





9. The hose is passed over his shoulder and back under his armpit so that the waterwall is at his back. The fire fighter grips the hose with his arm and descends.

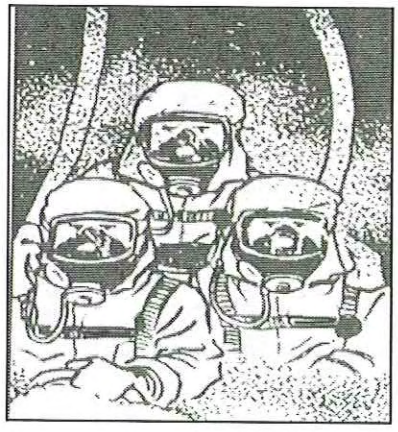
10. The descending fire fighter is protected by his own waterwall



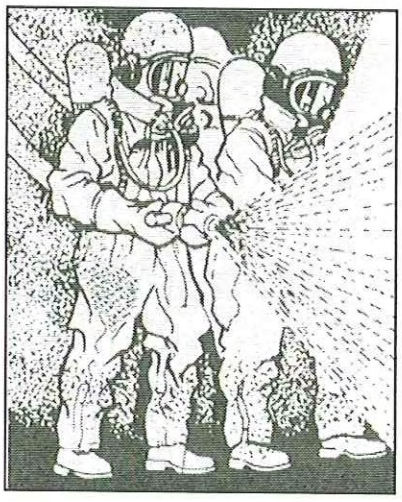
11. At the bottom of the ladder the second fire fighter takes a brief moment to orientate himself. and re-arranges his hose with the nozzle to his front.

The second fire fighter has now joined the first.

12. If available a third person prepares to descend without a hose. He orientates himself at the bottom of the ladder and positions himself behind and between the other two fire fighters.

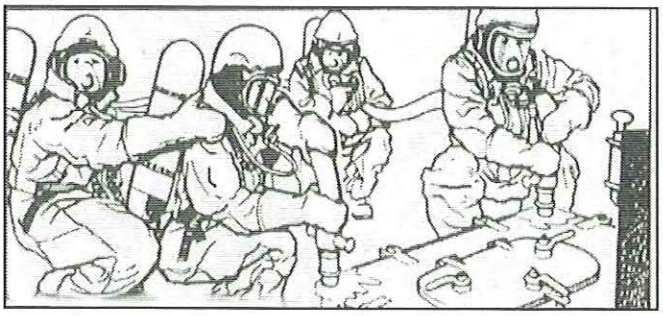


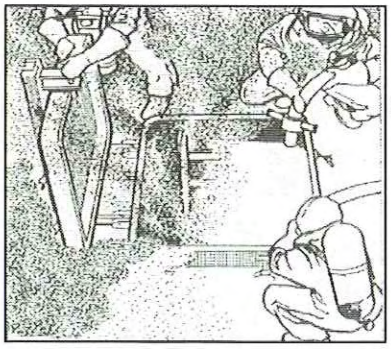
13. The two or three fire fighters stay together working towards the seat of the fire. One nozzle will be on spray and the other on waterwall.



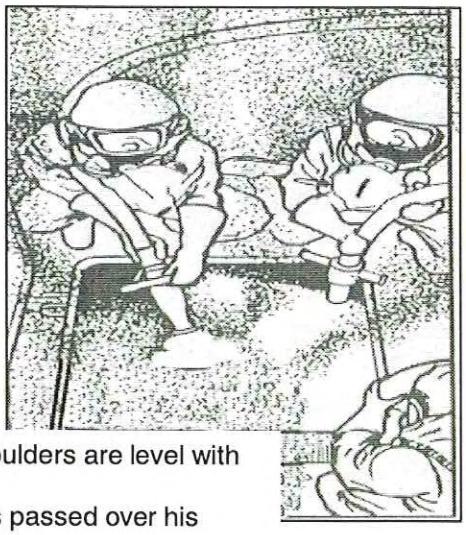
B. Hatch Entry – Oil fire

1. Prepare and charge two hoses to deliver water and prepare another to deliver foam. Set the water nozzles to 'waterwall' and 'on'. Place them at the two corners of the hatch on the opposite side to the hinges.





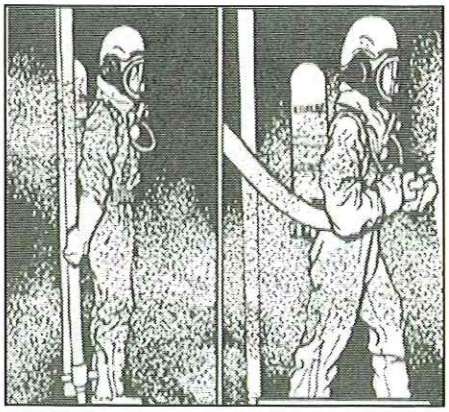
2. Open the hatch sufficiently for waterwalls to seal the opening. Ensure that the hatch cover is securely clipped back.



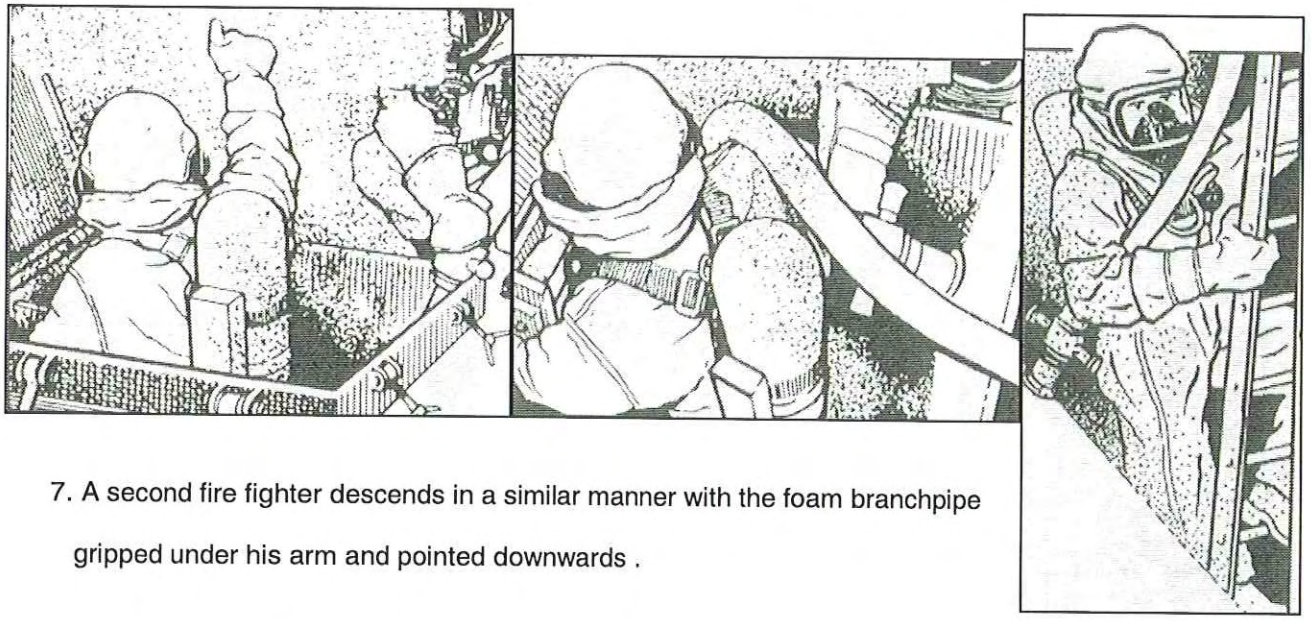
3. Commence production of foam away from the fire, then fight the fire through the waterwalls.

4. A fire fighter prepares to descend. When shoulders are level with hatch coaming he raises his arm. The hose is passed over his shoulder and back under his armpit so that the waterwall is at his back. The fire fighter grips the hose with his arm and descends through the waterwall and protected by his own waterwall also.

5. At the bottom of the ladder the fire fighter takes a brief moment to orientate himself and takes hold of the hose, directing the waterwall to the front.

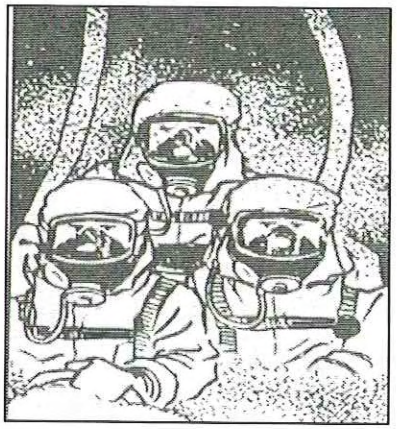


6. He then steps to one side of the ladder (which side has been pre-arranged). Crouching low he awaits the arrival of other team members.

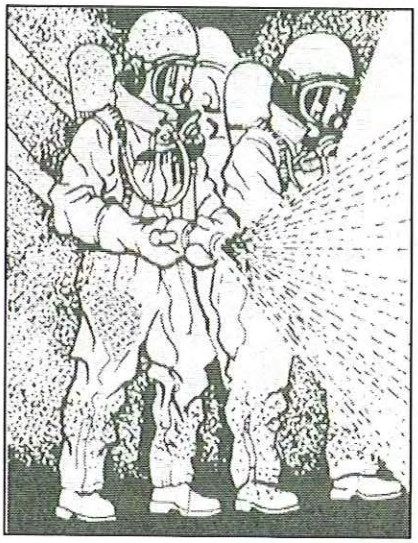


7. A second fire fighter descends in a similar manner with the foam branchpipe gripped under his arm and pointed downwards .

8. At the foot of the ladder he joins the first fire fighter. If a third fire fighter is to enter the incident the first two await his arrival.



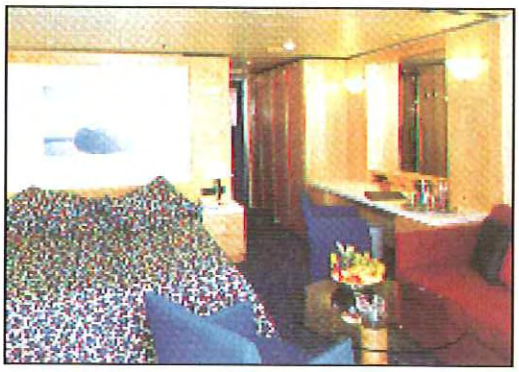
9. If available a third person prepares to descend through the waterwall, but without a hose. At the foot of the ladder he orientates himself and joins the others. Maintaining contact with the other two, and positioning himself behind and between them, the third fire fighter directs the second to deliver foam through the waterwall of the first. Care should be taken to ensure that the water does not break down the foam blanket.



ACCOMMODATION FIRES

Accommodation fires may present some serious problems. In most vessels deckhead and bulkhead voids which carry electrical cables and plumbing services, provide a channel for an unrestricted air supply which may feed a fire. Additionally, each cabin and compartment may have a ventilation trunk linking it with other compartments and providing a means of air supply and smoke distribution. Alleyways, stairwells and lift shafts promote the spread of fire, smoke, fumes and heat to areas remote from their source.

The use of plastics and other synthetic materials in furniture, curtains, bulkhead panels and other décor may, in a short space of time and from even a small fire, produce large volumes of toxic fumes and thick smoke. These are life threatening to anyone in the vicinity or connected via a conduit or ventilation route. Even large areas may quickly become smoke filled.



The fire may be contained by boundary cooling and boundary starvation. Give careful consideration to ventilation control and seek to remove heat, smoke and fumes without feeding air to the fire.
Check remote areas for the spread of heat, smoke and fumes via ventilation ducts, voids and liftshafts, etc.

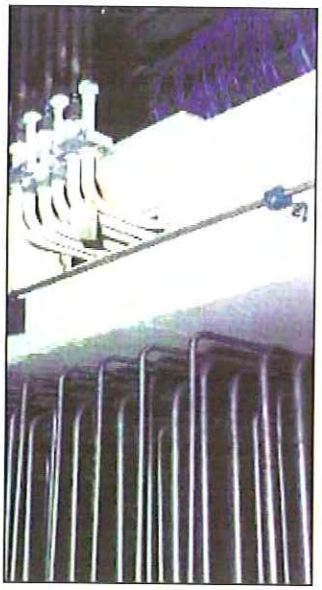
Except in storerooms water spray is often effective in tackling accommodation fires, but care must be taken with respect to the isolation of electrical circuits and stability.

MACHINERY SPACE FIRES

The main dangers in machinery spaces are those posed by oils, often under pressure, in close proximity to heat, machinery running at high temperatures and turning at high speeds, a multitude of electrically driven items, switchboards and generators,

The effect of an oil fire in a machinery space enclosed with metal bulkheads is that there is often a rapid rise in temperature which presents a situation where controlled venting may be required to remove heat and humidity.

Situations that may give rise to a fire in the machinery space include fractured fuel lines, overheated bearings, boiler flash backs, crankcase explosions, electrical faults and overloads, negligence and human error.



Fixed extinguishing installations of CO_2, halon, halon replacement, foam or water spray are usually available for fire fighting in machinery spaces. The decision as to when to use such a system will be taken by the Master. Considerations concerning its use include:

- Are there any persons in the compartment and will use of the system be harmful or fatal to them ?
- Is it possible to use the fixed system partially only (e.g. a partial gas discharge into the fuel separator area only) ?
- Does the system have one-shot only ? Are we prepared to have no cover until it is recharged (possibly many days sailing away) ?
- Having used the fixed system for how long will we be without engine power and manoeuvrability ?

- A fixed gaseous system has no cooling effect. After its use will we be able to reduce the temperature in the space so there is no danger of re-ignition when the space is opened up ?

FIRES IN SPECIALISED VESSELS

Fire fighting arrangements and procedures in vessels carrying specialised products or of a particular construction will be agreed with the appropriate authority and laid down in the owner standing orders.

Vessels with aluminium hulls, such as high speed ferries, present a particular problem. Aluminium will melt at under 700° C, which is less than half the melting temperature of steel. Even at 250° C aluminium will lose strength and be severely deformed at 350° C. An oil based machinery space fire will typically reach 400° C in five minutes and 700° C in 10 minutes. For this type of vessel and for vessels with other particular considerations more sophisticated drenching systems may be fitted and the option of 'fire fighting' may be replaced by immediate 'fire kill'

FIRES IN PORT

A fire on board whist the vessel is in port may pose some additional difficulties, but may also mean that the services of a local fire brigade is readily available.

Additional difficulties may include the fact that not all members of all fire fighting teams are on board; the exact number of crew ashore may not be known and the number of shore representatives and visitors on board may be difficult to determine. Any non-ship personnel on board may not be familiar with the vessel, its sound signals and its procedures. Tallies of crew ashore and visitors on board will help to minimise the additional in-port problems. The number of crew permitted shore leave should be consistent with maintaining adequate emergency cover on board.

LOCAL FIRE BRIGADES

Any fire on board when in port should be immediately reported to the local fire brigade, even if the fire is small. In the UK the priorities of local fire brigades are:

To save life. To save property. To extinguish the fire.

When attending on board the Senior Fire Officer may ask to see a copy of the Fire Control Plan or Book described in section B. The senior ship's officer should brief the Fire Officer and include the following information:

- The location of the fire
- What is burning
- How long has it been burning
- How did it start

- What are the access options
- What are the adjacent risks
- What other risks are there on board (e.g. cargo)
- Is there anyone missing
- What is the stability situation and is there a risk to stability if hoses are used.
- What action has already been taken concerning:

  evacuation of personnel

  electrical circuits isolated

  ventilation in use
- What fixed fire fighting systems are available
- How are the vessels fire zones arranged

Although the local fire brigade may be present the ship's master is still responsible for the safety of the vessel and its crew. The fire brigade officer will liaise with the master but will not hand over control of his personnel. In most incidents it has to be recognised that the local brigade are the expert fire fighters whilst the ship's crew have more detailed knowledge concerning the layout of the vessel: it will therefore be necessary for each party to co-operate with the other in order to overcome the incident.

SHIP SPECIFIC DETAILS
INTRODUCTION

Equipment details in this section have been left blank so that they may be completed by the owner or operator of a specific vessel. This manual will then become a document dedicated to a particular vessel.

The owner/operator should carefully study this section and make any insertions necessary.

Insertions should be made in clearly legible, easy to read print. It is important that the information is concise and accurate.

Some sections may not be applicable to certain vessels (e.g. not all vessels will have Fresh Air Breathing Apparatus). In such cases the appropriate section may be left blank or struck through.

Any change in the Fire Fighting Equipment must be accompanied by the appropriate up-dating of this section, . E.g. Should an extinguisher be exchanged for one of a different type the manual must be amended accordingly.

This manual was prepared according to the equipment and procedures current on (date) ..... Any changes subsequently made to the manual should be recorded on the AMENDMENTS page to be found at the back of this Manual, by the person responsible for the regular maintenance of this manual,

MEANINGS OF THE SHIP'S ALARMS

Emergency	Signal	Location of Primary Alarm	Location of Secondary Alarm	Additional Information
General Emergency				
Man Overboard				
Abandon Vessel				
Abandon Engine Room				
Abandon Cargo Spaces				
Fire Alarm Call Point Activated				
One Fire Detector Activated				
Two Fire Detectors Activated				
Fire in boiler air supply casings and exhausts.				
Fire in boiler air supply casings and exhausts.				
Fire in boiler air supply casings and exhausts.				
Fire in boiler air supply casings and exhausts.				

Meanings of the Ship's Alarms (continued)

Emergency	Signal	Location of Primary Alarm	Location of Secondary Alarm	Additional Information
Fire in scavenging air belts of				
Fire in scavenging air belts of				
Fire in scavenging air belts of				
Fire in scavenging air belts of				
Crankcase oil mist detector				
Crankcase oil mist detector				
Crankcase oil mist detector				
Crankcase oil mist detector				
Main Machinery Space Gas Flooding System Activated				
Space. ..... Gas Flooding System Activated				
Space. ..... Gas Flooding System Activated				
Space. ..... Gas Flooding System Activated				

Meanings of the Ship's Alarms (continued)

Emergency	Signal	Location of Primary Alarm	Location of Secondary Alarm	Additional Information
Space. ..... Sprinkler System Activated				
Space. ..... Sprinkler System Activated				
Space. ..... Sprinkler System Activated				
Space. ..... Sprinkler System Activated				
Space. ..... Extraction Smoke Detection				
Space. ..... Extraction Smoke Detection				
Space. ..... Extraction Smoke Detection				
Space. ..... Extraction Smoke Detection				

FIRE MUSTER DUTIES

Enter here details of the actions required on hearing the fire alarm, muster positions and fire fighting parties and duties.

EXTINGUISHERS (PORTABLE)

Enter here the manufacturer's operating instructions for the types of portable fire extinguishers carried on board.

EXTINGUISHERS (PORTABLE)

Water Extinguishers (Portable)

ID Number	Size (litres)	Location	Make	Cartridge or Stored Pressure	

EXTINGUISHERS (PORTABLE)

Foam Extinguishers (Portable)

ID Number	Size (litres)	Location	Make	Cartridge or Stored Pressure	

EXTINGUISHERS (PORTABLE)

CO_2 Extinguishers (Portable)

ID Number	Size (kg)	Location	Make	

EXTINGUISHERS (PORTABLE)

Halon Extinguishers (Portable)

ID Number	Size (kg)	Location	Make	

EXTINGUISHERS (FIXED & WHEELED UNITS)

Enter here the manufacturer's operating instructions for the types of fixed and wheeled fire extinguishers carried on board.

EXTINGUISHERS (FIXED & WHEELED UNITS)

Foam Extinguishers

ID Number	Size (litres)	Location	Make	CO_2 Cyl Size (kg)	

Dry Powder Extinguishers

ID Number	Size (kg)	Location	Make	CO_2 Cyl Size (kg)	

CO_2 Extinguishers

ID Number	Size (kg)	Location	Make	

FIRE BLANKETS

Enter here the manufacturer's instructions for the fire blankets carried on board.

ID Number	Size	Location

HOSES & COUPLINGS

ID Number	Location	Size (dia)	Length	

Hoses & Couplings (continued)

ID Number	Location	Size (dia)	Length	

NOZZLES

ID Number	Nozzle Type	Size (equivalent dia)	Location	

INTERNATIONAL SHORE CONNECTIONS

ID Number	Coupling Type	Flange Type	Bolts, Nuts & Gasket	Location	

HOSE REELS

ID Number	Location	Size (dia)	Length	

Hose Reels (continued)

ID Number	Location	Size (dia)	Length	

FOAM MAKING EQUIPMENT

Enter here instructions relating to the assembling and operation of portable foam equipment, including mobile foam units.

FOAM MAKING EQUIPMENT

Foam Branchpipes

ID Number	Type	Size (litres/min)	Location	

Inductors

ID Number	Type	Size (litres/min)	Induction Ratio	Location	

Foam Hoses

ID Number	Size (dia)	Length	Location	

MOBILE FOAM UNITS

ID Number	Make	Type	Size (capacity)	Branchpipe (litre/min)	Inductor (ratio)	Hoses (Dia x Length)	Location

FIRE BUCKETS

ID Number	Size (capacity)	Content	Location	

FIREMAN'S OUTFIT – PROTECTIVE CLOTHING

ID Number	Make/Type	Proximity or Entry Suit	Location	

FIREMAN'S OUTFIT – AXES

ID Number	Hand Axe or Long Handle	Electrically Insulated (Yes-No/Volts)	Location	

FIREMAN'S OUTFIT – SAFETY LAMPS

Safety Lamps

ID Number	Make	Model	Location	

Charging Equipment

ID Number	Make	Model	Location	

FIREMAN'S OUTFIT – BREATHING APPARATUS

Enter here the manufacturer's instructions relating to the use of the compressed air breathing apparatus, the air line breathing apparatus, and the smoke mask including pre-use checks and after use cleaning and information on the use of any distress signal unit that may be carried.

FIREMAN'S OUTFIT – BREATHING APPARATUS

Compressed Air Breathing Sets

ID Number	Make	Model	Location	

Air Line Compressed Air Breathing Sets

ID Number	Make	Model	Hose Length (m)	Location	

Cylinders

ID Number	Size (dia)	Size (litres)	Pressure (full charge)	Location	

Air Compressors

ID Number	Make	Model	Charging Rate (litres/min)	Location	

Smoke Mask Breathing Sets

ID Number	Make	Model	Hose Length (m)	Location	

Distress Signal Units

ID Number	Make	Model	Location		

EMERGENCY ESCAPE BREATHING APPARATUS

ID Number	Make	Model	Location	

Cylinders

ID Number	Size (dia)	Size (litres)	Pressure (full charge)	Location	

HELI-DECK EQUIPMENT

Enter here details of any helicopter crash equipment carried, including any manufacture's use and maintenance instructions.

FIXED GAS FIRE EXTINGUISHING SYSTEMS

Enter following this page schematic drawings of all fixed gas extinguishing systems including cargo hold smoke detection systems and steam smothering systems. Within the drawings, or separately, clearly identify the location of all control positions and the operating instructions applicable to each position.

FIXED FOAM FIRE EXTINGUISHING SYSTEMS

Enter following this page schematic drawings of all fixed foam extinguishing systems. Within the drawings, or separately, clearly identify the location of all control positions and the operating instructions applicable to each position.

FIXED DRY POWDER FIRE EXTINGUISHING SYSTEMS

Enter following this page schematic drawings of all fixed dry powder extinguishing systems. Within the drawings, or separately, clearly identify the location of all control positions and the operating instructions applicable to each position.

FIXED WATER FIRE EXTINGUISHING SYSTEMS

Enter following this page schematic drawings of all fixed water spray, deluge and water mist extinguishing systems. Within the drawings, or separately, clearly identify the location of all control positions and the operating instructions applicable to each position.

FIRE DETECTION & ALARM SYSTEMS

Control Panels, Repeater Panels and Indicating Units

Panel Type (Control, Repeater, Indicating)	**Location**	

Fire Zones

Zone Identification	Area Protected

Fire Zones (continued)

Zone Identification	Area Protected

Fire Zones (continued)

Zone Identification	Area Protected

FIRE DOORS

Insert here information that specifically relates to the Fire Doors, particularly the operation of the local and remote controls, and instructions as laid down by the Company's and Master's Standing Orders.

FIRE DOORS

Door No.	Between Space	And Space	Class Eg.A30	Location of Primary Central Controls	Location of Secondary Central Controls	Power Operated? Yes/No	Hold Back device? Yes/No	Additional Information Eg. Movement Alarm Fitted, WT door, etc.

Fire Doors (Continued)

Door No.	Between Space	And Space	Class Eg.A30	Location of Primary Central Controls	Location of Secondary Central Controls	Power Operated? Yes/No	Hold Back device? Yes/No	Additional Information Eg. Movement Alarm Fitted, WT door, etc.

FIRE DAMPERS

No.	Ventilation Duct	Location of Manual Control 1	Location of Manual Control 2	Automatic Yes / No	Auto. Mode (Fusible Link, via detector, etc.)	Additional Information

MEANS OF ESCAPE

Insert here diagrams or drawings showing the escape routes and give details of any specific escape equipment provided.

FIRE CONTROL PLANS

ID Number	Location	

AMENDMENTS

Date	Appliance	Location	Amendment	Recorded by

Fire-fighting Piercing Rod

DESCRIPTION

The Firefighting Piercing Rod is designed to deliver water to areas inaccessible to the fire fighter (inside of the cntr), fig (a). It is designed to penetrate the container, aided by use of a sledge hammer. It is primarily constructed of chrome-plated stainless steel. At the end, constructed with a hardened steel flat head for using & driving by a sledge hammer, fig (b). At the piercing side it is constructed by a hardened steel material in wedge style for easy penetration, followed by a series of nozzles in order to inject inside the hole, a dense fog pattern fig(c). A small fire hose with swivel coupling from one side and specified coupling of vessel's fire hoses from the other side, fig (d).

Fig (a)

Fig (b)

Fig (c)

Fig (d).

GENERAL INFORMATION/ MAINTENANCE

The piercing rod is designed and manufactured to be damage resistant and requires minimal maintenance. Ensure all fire water hoses used are in good condition and that all couplings are secure, leak free. Thoroughly clean all parts and accessories with fresh water after each use. Make sure all components are clean, and the nozzles are free of debris. Safety regulations must be followed at all times. Failure to follow these instructions could result in damage to the Piercing Rod and/or in personal injury.

SAFETY

- ☑ Wear Fireman outfit with breathing apparatus.
- ☑ Be aware that this tool is not electrically insulated.
- ☑ Be aware of others working personnel around you.
- ☑ Store this tool in a secure and dry place.
- ☑ Always observe safe working practices and safety regulations at all times.
- ☑ Always inspect all parts for damage before using.
- ☒ Do not modify this tool in any way because could lead to serious injury.

OPERATION

1) Locate the place of use
2) Open fire hydrant to wash out any debris which might clog the piercing rod.
3) Connect the water supply hose to the piercing rod and the ship's water supply.
4) First Operator trying to achieve proper piercing rod angle and direction.
5) Begin driving Piercing Rod striking with a sledge hammer by a second operator.
6) When the Piercing Rod penetrates the container, start water supply by opening fire hydrant.
7) When fire-fighting is completed, stop supply of the water and remove Piercing Rod.

Remark: The above pictures intend to demonstrate only the use of piercing rod and do not represent an actual emergency or a drill where the firefighters should be protected by a fireman outfit and breathing apparatus.