chemical tankers, gas carriers and combination carriers certified for the carriage of petroleum products. It therefore does not cover the carriage of chemicals or liquefied gases, which are the subject of other industry guides. Finally the guide is not intended to encompass offshore facilities including FPSOs and FSUs. Operators of such units may, however, wish to consider the guidance given to the extent that good tanker practice is equally applicable to their operations.

Comments and suggestions for improvement are always welcome for possible inclusion in future editions. They may be addressed to any of the three sponsoring organisations, as follows: -

International Chamber of Shipping
12, Carthusian Street,
London EC1M 6EB
United Kingdom.

Oil Companies International Marine Forum
27, Queen Anne's Gate,
London SW1H 9BU
United Kingdom.

International Association of Ports and Harbours
7th Floor South Tower,
New Pier Takeshiba,
1-16-1, Kaigan,
Minato-ku
Tokyo 105-0022
Japan.

Competent Person
A person who has been adequately trained to undertake the tasks they are required to perform within their job description. For personnel in the shipping industry they should be able to demonstrate this competence by the production of certificates approved by the vessel's Administration*.*

Corona
A diffuse discharge from a single sharp conductor (less than 5 mm in diameter) that slowly releases some of the available energy. Generally corona is incapable if igniting a gas like propane or vapours like those given-off by gasoline. Corona may ignite vapours like hydrogen or acetylene, which require much lower energies for ignition*.*

Dangerous area
An area on a tanker which for the purposes of the installation and use of electrical equipment is regarded as dangerous.

Designated Person Ashore
Under the **ISM Code**, is a person or persons ashore within a ship's managing office (**Company**) with direct access to the highest levels of management, who has or have the responsibility and the authority to monitor the safety and pollution prevention aspects of the operation of each ship, and to ensure that adequate resources and shore-based support are applied, as required.

Dry chemical powder
A flame inhibiting powder used in fire fighting.

Earthing (also referred to as 'Grounding')
The electrical connection of equipment to the main body of the earth to ensure that it is at earth potential. On board ship, the connection is made to the main metallic structure of the ship which is at earth potential because of the conductivity of the sea.

Enclosed space
A space which has the following characteristics:

- Limited Openings for entry and exit;
- Unfavourable natural ventilation; and
- Is not designed for continuous worker occupancy.

This includes, but is not limited to, cargo spaces, double bottoms, fuel tanks, ballast tanks, pump rooms, compressor rooms, cofferdams, void spaces, duct keels, inter-barrier spaces, engine crankcases and sewerage tanks.

Entry permit
A document issued by a responsible person allowing entry into a space or compartment during a specific time interval.

Explosimeter
See 'Combustible gas indicator'.

Explosion-proof (also referred to as 'Flame-proof')
Electrical equipment is defined and certified as explosion-proof when it is enclosed in a case which is capable of withstanding the explosion within it of a hydrocarbon gas/air mixture or other specified flammable gas mixture. It must also prevent the ignition of such a mixture outside the case either by spark or flame from the internal explosion or as a result of the temperature rise of the case following the internal explosion. The equipment must operate at such an external temperature that a surrounding flammable atmosphere will not be ignited.

Explosive range
See 'Flammable range'.

International Safety Management Code (ISM Code)
An international standard for the safe management and operation of ships and for pollution prevention. The Code establishes safety-management objectives and requires a "Safety Management System" (SMS) to be established by the "Company".

Intrinsically safe
An electrical circuit or part of a circuit is intrinsically safe if any spark or thermal effect produced normally (i.e. by breaking or closing the circuit) or accidentally (e.g. by short circuit or earth fault) is incapable, under prescribed test conditions, of igniting a prescribed gas mixture.

Loading over the top (also known as 'Loading overall')
The loading of cargo or ballast through an open ended pipe or by means of an open ended hose entering a tank through a hatch or other deck opening, resulting in the free fall of liquid.

Loading rate
The volumetric measure of liquid loaded within a given period, usually expressed as cubic metres per hour (m^3/hr) or barrels per hour (bbls/hr).

Lower flammable limit (LFL)
The concentration of a hydrocarbon gas in air, below which there is insufficient hydrocarbon to support and propagate combustion. Sometimes referred to as lower explosive limit (LEL).

Material Safety Data Sheet (MSDS)
A document identifying the substance and all its constituents, providing the recipient with all necessary information to safely manage the substance.

The format and content of an MSDS for MARPOL Annex I cargoes and Marine Fuel Oils is prescribed in IMO Resolution MSC.150 (77).

Mercaptans
A group of naturally occurring sulphur containing organic chemicals. They are present in some crude oils and in pentane plus cargoes. They have a strong odour.

Mooring winch brake design capacity
The percentage of the minimum breaking load (MBL) of a new mooring rope or wire that a winch carries, at which the winch brake is designed to render. Winch brakes will normally be designed to hold 80% of the line's MBL and will be set in service to hold 60% of the mooring line's MBL. Brake holding capacity may be expressed either in tonnes or as a percentage of a line's MBL.

Mooring winch design heaving capacity
The power of a mooring winch to heave in or put a load on its mooring rope or wire. Usually expressed in tonnes.

Naked lights
Open flames or fires, lighted cigarettes, cigars, pipes or similar smoking materials, any other unconfined sources of ignition, electrical and other equipment liable to cause sparking while in use, unprotected light bulbs or any surface with a temperature that is equal to or higher than the minimum ignition temperature of the products handled in the operation.

Non-volatile petroleum
Petroleum having a flash point of 60ºC or above, as determined by the closed cup method of test.

Odour threshold
The lowest concentration of vapour in air which can be detected by smell.

OBO, OIL/ORE
See 'Combination Carrier'.

1.3.2 MEASUREMENT OF HYDROCARBON CONCENTRATION

The measurement of hydrocarbon vapours on tankers and at terminals falls into two categories:

1. The measurement of hydrocarbon gas in air at concentrations below the **Lower Flammable Limit (LFL).**

   This is to detect the presence of flammable (and potentially explosive) vapours and to detect concentrations of hydrocarbon vapour that may be harmful to personnel. These readings are expressed as a percentage of the **Lower Flammable Limit (LFL)** and are usually recorded as **%LFL**. The instruments used to measure %LFL are Catalytic Filament Combustible Gas Indicators, which are usually referred to as Flammable Gas Monitors or Explosimeters.

2. The measurement of hydrocarbon gas as a percentage by volume of the total atmosphere being measured.

   Onboard a tanker, this is usually carried out to measure the percentage of hydrocarbon vapour in an inerted atmosphere. Instruments used to measure hydrocarbon vapours in an inert gas atmosphere are specially developed for this purpose. The readings obtained are expressed as the percentage of hydrocarbon vapour by volume and are recorded as **% VOL**.

   The instruments used to measure percentage hydrocarbon vapours in inert gas are Non-catalytic Heated Filament Gas Indicators and are usually referred to as Tankscopes. Modern developments in gas detection technology have resulted in the introduction of electronic instruments using infra-red sensors which, when suitably designed, can perform the same function as the Tankscope.

1.3.3 FLAMMABLE GAS MONITORS (EXPLOSIMETER)

Modern instruments have a poison resistant flammable pellistor as the sensing element. Pellistors rely on the presence of Oxygen (minimum 11% by volume) to operate efficiently and for this reason Explosimeters must not be used for measuring hydrocarbon gas in inert atmospheres.

1.3.3.1 Operating Principle

A simplified diagram of the electrical circuit incorporating a pellistor in a Wheatstone Bridge is shown in Figure 1-1.

Unlike in early Explosimeters, the pellistor unit balances the voltage and zeros the display automatically when the instrument is switched on in fresh air. In general, it takes about 30 seconds for the pellistor to reach its operating temperature. However, the operator should always refer to the manufacturer's instructions for the start up procedure.

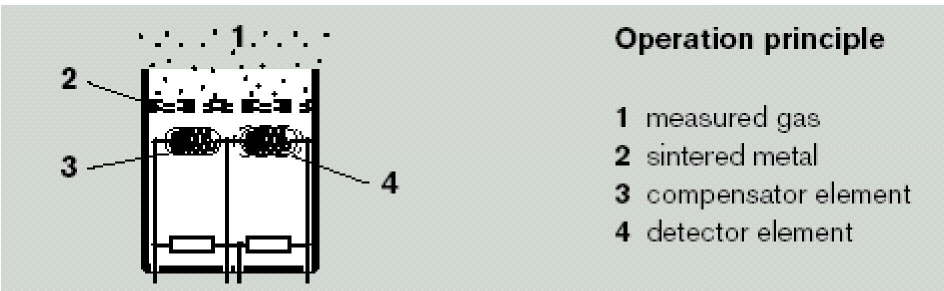


Figure 1.1 Pellistor

In this type of instrument, a beam of light is divided into two, and these are then recombined at the eyepiece. The recombined beams exhibit an interference pattern which appears to the observer as a number of dark lines in the eyepiece.

One light path is through chambers filled with air. The other path is via chambers through which the sample gas is pumped. Initially, the latter chambers are filled with air and the instrument is adjusted so that one of the dark lines coincides with the zero line on the instrument scale. If a gas mixture is then pumped into the sample chambers the dark lines are displaced across the scale by an amount proportional to the change of refractive index.

The displacement is measured by noting the new position on the scale of the line which was used initially to zero the instrument. The scale may be calibrated in concentration units or it may be an arbitrary scale whose readings are converted to the required units by a table or graph.

The response of the instrument is linear and a one-point test with a standard mixture at a known concentration is sufficient for checking purposes.

The instrument is normally calibrated for a particular hydrocarbon gas mixture. As long as the use of the instrument is restricted to the calibration gas mixture it provides accurate measurements of gas concentrations.

The measurement of the concentration of hydrocarbon gas in an inerted atmosphere is affected by the carbon dioxide present when flue gas is used for inerting. In this case the use of soda-lime as an absorbent for carbon dioxide is recommended, provided the reading is corrected appropriately.

The refractive index meter is not affected by gas concentrations in excess of its scale range. The instrument reading goes off the scale and remains in this position as long as the gas chambers are filled with the gas mixture.

1.3.5.2 Instrument Check Procedures

A mixture of known hydrocarbon, e.g. propane in nitrogen at a known concentration, should be used to check the instrument. If the hydrocarbon test gas differs from the original calibration gas, the indicated reading should be multiplied by the appropriate correction factor before judging the accuracy and stability of the instrument.

1.3.6 INFRA-RED INSTRUMENTS

1.3.6.1 Operating Principle

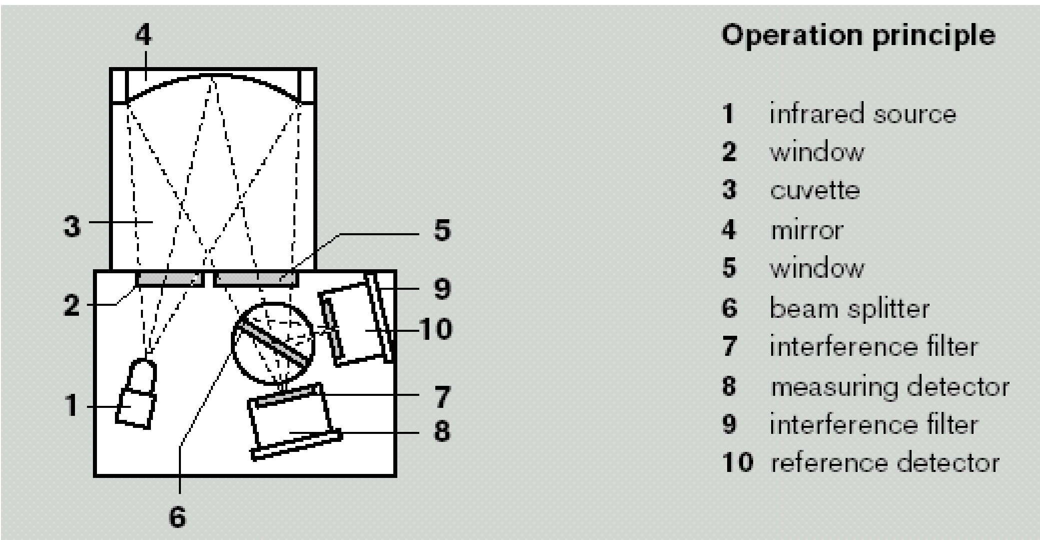


Figure 1.2 - Infrared Sensor

The Infra-red (IR) sensor is a transducer for the measurement of the concentration of hydrocarbons in the atmosphere, by the absorption of infra-red radiation.

The vapour to be monitored reaches the measuring chamber by diffusion or by means of a pump. Infra-red light radiation from the light source, shines through a window into the chamber, is reflected and focussed by the spherical mirror, and then passes through another window and hits the beam splitter. The portion of the radiation which passes the beam splitter passes through a broad band interference filter (= measuring filter) into the housing cover of the measuring detector and is converted into an electric signal.

The portion of the radiation reflected by the beam splitter passes the reference filter to reach the reference detector.

If the gas mixture in the chamber contains hydrocarbons, a part of the radiation is absorbed in the wavelength range of the measurement filter, and a reduced electric signal is given. At the same time, the signal of the reference detector remains unchanged. Gas concentration is determined by comparing the relative values between the reference indicator and the measuring detector.

Differences in the output of the IR light source, dirt on mirrors and windows as well as dust of aerosols contained in the air have an identical impact on both detectors and are therefore compensated.

1.3.6.2 Instrument Check Procedures

This instrument should be checked using a check gas of a known mixture of hydrocarbons. The IR sensor does not require the presence of air or inert gas in the gas concentration as it is reliant solely on the hydrocarbon molecules. In general, these instruments are very stable and require little maintenance. Calibration should be frequently checked in accordance with the manufacturer's instructions and Safety Management System procedures.

1.3.7 MEASUREMENT OF LOW CONCENTRATIONS OF TOXIC GASES

1.3.7.1 Chemical Indicator Tubes

Probably the most convenient and suitable equipment to use for measuring very low concentrations of toxic gases on board tankers is the chemical indicator tube.

These consist of a sealed glass tube containing a proprietary filling which is designed to react with a specific gas and to give a visible indication of the concentration of that gas. To use the device the seals at each end of the glass tube are broken, the tube is inserted in a bellows-type fixed volume displacement hand pump, and a prescribed volume of gas mixture is drawn through the tube at a rate fixed by the rate of expansion of the bellows. A colour change occurs along the tube and the length of discolouration, which is a measure of the gas concentration, is read off a scale integral with the tube.

In some versions of these instruments, a hand operated injection syringe is used instead of a bellows pump.

It is important that all the components used for any measurement should be from the same manufacturer. It is not permissible to use a tube from one manufacturer with a hand pump from another manufacturer. It is also important that the manufacturer's operating instructions are carefully observed.

Since the measurement depends on passing a fixed volume of gas through the glass tube, any use of extension hoses should be in strict accordance with manufacturer's instructions.

The tubes are designed and intended to measure concentrations of gas in the air. As a result, measurements made in a ventilated tank, in preparation for tank entry, should be reliable.

All analysers, regardless of type, should be used strictly in accordance with the manufacturer's instructions. If so used, and subject to the limitations listed below, the analysers may be regarded as reliable.

1.3.10 USE OF OXYGEN ANALYSERS

1.3.10.1 Paramagnetic Sensors

Oxygen is strongly paramagnetic, whereas most other common gases are not. This property therefore enables oxygen to be determined in a wide variety of gas mixtures.

One commonly used oxygen analyser of the paramagnetic type has a sample cell in which a lightweight body is suspended in a magnetic field. When sample gas is drawn through the cell, the suspended body experiences a torque proportional to the magnetic susceptibility of the gas. An equal and opposing torque is produced by an electric current passing through a coil wound round the suspended body. The equalising current is a measure of the magnetic force and is thus a measure of the magnetic susceptibility of the sample, i.e. related to its oxygen content.

Before use, the analyser should be calibrated, using nitrogen or carbon dioxide to purge the sample cell for a zero check and with air at 21% oxygen for span.

[Note: Releasing nitrogen or carbon dioxide in a confined or unventilated area can lower the concentration of oxygen to a level that is immediately dangerous to life or health. Calibration should therefore only be carried out in well ventilated areas.**]**

The analyser readings are directly proportional to the pressure in the measuring cell. The unit is calibrated to a specific atmospheric pressure and the small error due to atmospheric pressure variations can be corrected if required. Reading errors can be more significant during pressure variations using some gas sampling arrangements, but can be avoided by reducing the sampling pressure to atmospheric during readings. Continuous samples should be supplied to the instrument by positive pressure. They should not be drawn through the analyser by negative pressure as the measuring pressure then becomes uncertain.

The filter should be cleaned or replaced when an increase in sample pressure is required to maintain a reasonable gas flow through the analyser. The same effect is produced if the filter becomes wet due to insufficient gas drying. The need for filter cleaning or replacement should be checked regularly.

1.3.10.2 Electrochemical Sensors

Analysers of this type determine the oxygen content of a gas mixture by measuring the output of an electrochemical cell. In one commonly-used analyser, oxygen diffuses through a membrane into the cell, causing current to flow between two special electrodes separated by a liquid or gel electrolyte.

The current flow is related to the oxygen concentration in the sample and the scale is arranged to give a direct indication of oxygen content. The cell may be housed in a separate sensor head connected by cable to the read-out unit.

The analyser readings are directly proportional to the pressure in the measuring cell but only small errors are caused by normal variations in atmospheric pressure.

Certain gases may affect the sensor and give rise to false readings. Sulphur dioxide and oxides of nitrogen interfere if they are present in concentrations of more than 0.25% by volume. Mercaptans and hydrogen sulphide can poison the sensor if their levels are greater than 1% by volume. This poisoning does not occur immediately but over a period of time; a poisoned sensor drifts and cannot be calibrated in air. In such cases reference should be made to the manufacturer's instructions.

- Superstructures and deckhouses which the gas can enter through doors, ports or ventilation intakes.
- The cargo deck which, although it is usually regarded as free of sources of ignition, is a work area and thoroughfare.
- An adjacent jetty which, although it is usually regarded as free of sources of ignition, is a work area and thoroughfare.
- Adjacent vessels, such as, lightering vessels, bunker and stores craft, pilot and crew transfer boats.

1.4.4 VARIABLES AFFECTING DISPERSION

1.4.4.1 The Dispersion Process

A mixture of hydrocarbon gas and air (or inert gas) issuing vertically from an outlet rises under its own momentum as a plume above the outlet. If there is no wind, the plume remains vertical but otherwise it is bent over in the downwind direction. The rise of the plume due to its momentum is opposed by a tendency to sink because its density is greater than that of the surrounding air.

The flow velocity of the issuing gas is at its maximum as it passes through the outlet, and decreases as air is drawn into the plume. This air decreases the hydrocarbon gas concentration and hence the gas density in the plume. The progressive decreases in velocity, hydrocarbon concentration and density, together with the wind speed and other meteorological factors, determine the final shape of the plume and hence of the flammable zone.

The type of vent being used affects the dispersion of the gas plume. During normal loading operations the venting will be either via:

- A high velocity vent installed at a height of 2 m above the deck, which causes the vapour to be vented at a speed of 30m/second irrespective of the loading rate of the cargo, or
- A vent riser with a height of 6m above the deck.

These high velocity vents and risers may not be placed closer than 10m to any accommodation house vent to ensure that cargo vapours will be safely dispersed before they reach these locations.

1.4.4.2 Wind Speed

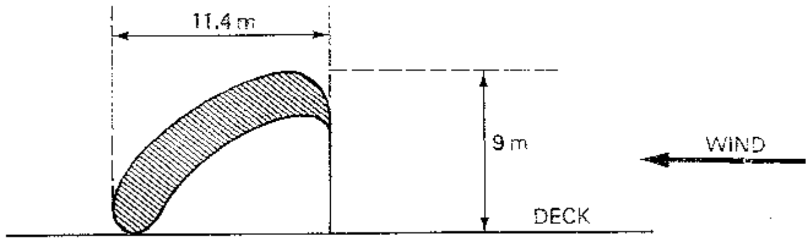
For many years, it has been recognised that the dispersion of hydrocarbon gas/air mixtures is inhibited by low wind speeds. This recognition is based upon experience on tankers and little experimental work has been done to obtain quantitative information on the effect of wind speed. Much depends upon the quantity of gas being vented and how it is vented, but experience at terminals seems to suggest that, at wind speeds above about 5 metres/sec, dispersion is sufficient to avoid any flammability risk.

1.4.4.3 Rate of Flow of Gas

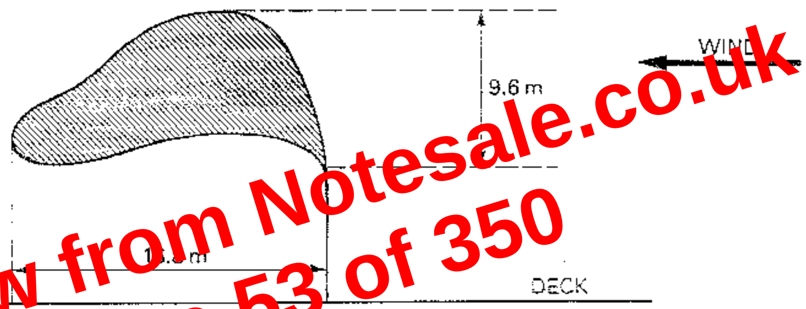
As the rate of flow of a hydrocarbon gas/air mixture of fixed composition is increased through a given opening, several effects come into play. In the first place, the rate of emission of the hydrocarbon constituent increases in proportion to the total gas flow rate and therefore the distance the plume travels before it is diluted to the LFL should be greater. On the other hand, the higher the velocity, the more efficient is the mixing of the initially hydrocarbon-rich gas with the air and this tends to counterbalance the first effect.

In addition, at low rates of total gas flow, the initial momentum of the plume may not be enough to counteract the tendency of the plume to sink because of its initially high density.

The results of the interaction of these different processes at low wind speed are illustrated (Figure 1.3). The gas mixture used in obtaining these diagrams was 50% by volume propane and 50% by volume air and is typical of that to be expected when topping off a crude oil cargo. At the lowest flow rate (Figure 1.3 (a)) the density effect predominates and the gas sinks back towards the deck. At the highest flow rate (Figure 1.3 (c)) mixing is far more efficient and there is no tendency for the plume to sink.



(a) Total Gas Flow 9.2 cubic metres/minute
Approximate Loading Rate 465 tonnes/hour



(b) Total Gas Flow 27.6 cubic metres/minute
Approximate Loading Rate 1400 tonnes/hour

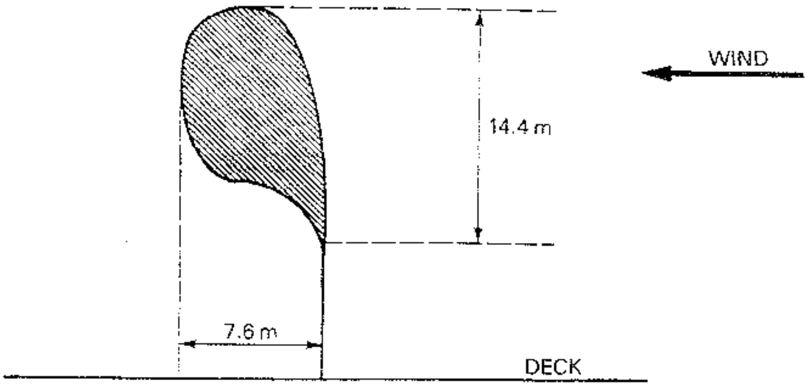
Figure 1.3 (a) and (b) The Effect of Gas Flow Rate on Flammable Zone

The flammable zones generated by the same operations with motor or aviation gasolines would be similar but with a more pronounced density effect, and this effect would be even more pronounced with a natural gasoline-type cargo. Also, the greater dilution required to reach the LFL with motor or aviation gasolines (see Section 2.2.2) would tend to make the flammable zones larger than with crude oils, and this effect would be even more pronounced with the natural gasolines. Thus, the dispersion problem becomes progressively more pronounced as one goes from crude oils, through motor or aviation gasolines, to natural gasoline-type cargoes.

1.4.4.4 Concentration of Hydrocarbon Gas

With a constant total rate of flow of gas, changes in hydrocarbon concentration have two effects. The rate of emission of hydrocarbon gas increases in proportion to the concentration so that, other things being equal, the extent of the flammable zone increases. Also, the initial density of the gas mixture as it issues from the opening becomes greater so that there is a greater tendency for the plume to sink.

At low concentrations, therefore, a flammable zone similar in outline to that in Figure 1.3 (c) is to be expected, but it is likely to be small because of the relatively small amount of hydrocarbon gas. As the concentration increases, the flammable zone tends to assume such shapes as depicted in Figure 1.3 (b) and 1.3 (a) as the increasing density exerts its influence. In addition the overall size of the zone becomes greater due to the greater rate of emission of hydrocarbon gas.



(c) Total Gas Flow 46 cubic metres/minute
Approximate Loading Rate 2300 tonnes/hour

Figure 1.3 (c) The Effect of Gas Flow rate on Flammable Range

The illustrations in Figures 1.3 (a-c) are based upon wind tunnel data of:

Gas mixture: 50% by volume propane in air

Diameter of opening: 254 millimetres

Wind speed: 1.[illegible] metres/sec

1.4.4.5 Cross Sectional Area of the Opening

The area of the opening through which the hydrocarbon gas/air mixture issues determines, for a given volumetric rate of flow, the linear flow velocity and hence the efficiency of the mixing of the plume with the atmosphere. Effects of this kind occur, for example, in gas freeing. If fixed turbo-blower fans are used, the mixture is usually vented through a standpipe with a cross-sectional area small enough to give a high velocity and to encourage dispersion in the atmosphere. When using small portable blowers, which normally have to be operated against a low back pressure, it is usual to exhaust the gas through an open tank hatch. The efflux velocity is then very low with the outlet close to the deck, circumstances which encourage the gas to remain close to the deck.

1.4.4.6 The Design of the Vent Outlet

The design and position of a vent outlet must comply with current SOLAS requirements, as contained in Chapter I I-2, Part D, Fire Safety Measures for Tankers.

In certain operations, such as gas freeing, vapour may be vented from the tank through apertures other than these designated tank vents.

1.4.4.7 Position of the Vent Outlet

If vent outlets are situated near structures such as deckhouses, the shape of the flammable zone is influenced by turbulence produced in the air as it passes over them. A diagram illustrating the kind of eddies formed is given in Figure 1.4. This shows how, on

Chapter 2

BASIC PROPERTIES OF PETROLEUM

This Chapter describes the physical and chemical properties which have the greatest bearing on the hazards arising from handling petroleum liquids. These properties are vapour pressure, the flammability of the gases evolved from the liquids and the density of these gases.

2.1 VAPOUR PRESSURE

2.1.1 TRUE VAPOUR PRESSURE

All crude oils and the usual petroleum products are essentially mixtures of a wide range of hydrocarbon compounds (i.e. chemical compounds of hydrogen and carbon). The boiling points of these compounds range from -162ºC (methane) to well in excess of +400ºC, and the volatility of any particular mixture of compounds depends primarily on the quantities of the more volatile constituents (i.e. those with a lower boiling point).

The volatility (i.e. the tendency of a crude oil or petroleum product to produce gas) is characterised by the vapour pressure. When a petroleum mixture is transferred to a gas free tank or container it commences to vaporise, that is, it liberates gas into the space above it.

There is also a tendency for this gas to re-dissolve in the liquid, and equilibrium is ultimately reached with a certain amount of gas evenly distributed throughout the space. The pressure exerted by this gas is called the equilibrium vapour pressure of the liquid, usually referred to simply as the vapour pressure.

The vapour pressure of a pure compound depends only upon its temperature. The vapour pressure of a mixture depends on its temperature, constituents and the volume of the gas space in which vaporisation occurs; that is, it depends upon the ratio of gas to liquid by volume.

The True Vapour Pressure (TVP), or bubble point vapour pressure, is the pressure exerted by the gas produced from a mixture when the gas and liquid are in equilibrium at the prevailing temperature. It is the highest vapour pressure which is possible at any specified temperature.

As the temperature of a petroleum mixture increases, its TVP also increases. If the TVP exceeds atmospheric pressure the liquid commences to boil.

The TVP of a petroleum mixture provides a good indication of its ability to give rise to gas.

Unfortunately, it is a property which is extremely difficult to measure, although it can be calculated from a detailed knowledge of the composition of the liquid. For crude oils, it can also be estimated from the stabilisation conditions, making allowance for any subsequent changes of temperature or composition. In the case of products, reliable correlations exist for deriving TVP from the more-readily measured Reid Vapour Pressure and temperature.

2.1.2 REID VAPOUR PRESSURE

The Reid Vapour Pressure (RVP) test is a simple and generally used method for measuring the volatility of petroleum liquids. It is conducted in a standard apparatus and in a closely defined way. A sample of the liquid is introduced into the test container at

Although the liquid, for example, water, may have a very high conductivity, the relaxation of the charge on the droplets is hindered by the insulating properties of the surrounding gas. Fine particles present in inert flue gas or created during discharge of pressurised liquid carbon dioxide are frequently charged. The gradual charge relaxation, which does occur, is the result of the settling of the particles or droplets and, if the field strength is high, of corona discharge at sharp protrusions.

3.2 GENERAL PRECAUTIONS AGAINST ELECTROSTATIC HAZARDS

3.2.1 OVERVIEW

Measures that must be taken to prevent electrostatic hazards whenever a flammable atmosphere could potentially be present are:

- The bonding of metal objects to the metal structure of the ship to eliminate the risk of spark discharges between metal objects that might be electrically insulated. This includes metallic components of any equipment used for dipping, ullaging and sampling.
- The removal from tanks or other hazardous areas, of any loose conductive objects that cannot be bonded.
- Restricting the linear velocity of the cargo to a maximum of 1 metre per second at the individual tank inlets during the initial stages of loading i.e. until after the bottom structure is covered, all splashing and surface turbulence has ceased, and any water that may have been present is cleared from the lines.
- Banning the use of all metallic equipment and all non-metallic containers of more than 1 litre capacity for dipping, ullaging and sampling during loading and for 30 minutes after completion of loading. After the 30 minute waiting period, metallic equipment may be used for dipping, ullaging and sampling but it must be effectively bonded and securely earthed to the structure of the ship before it is introduced into the tank and must remain earthed until after removal.

Non-metallic containers of less than 1 litre capacity may be used for sampling in tanks provided that they have no conducting components and they are not rubbed prior to sampling. Cleaning with a high conductivity proprietary cleaner, a solvent such as 70:30% IPA:toluene mix, or soapy water is recommended to reduce charge generation.

Operations carried out through a correctly designed and installed sounding pipe are permissible at any time. It is not possible for any significant charge to accumulate on the surface of the liquid within the sounding pipe and therefore no waiting time is required. However, the precautions to be observed against introducing charged objects into a tank still apply and, if metallic equipment is used, it should be bonded before being inserted into the sounding pipe.

See Section 11.7.2.3 for guidance on the procedures to be adopted when ullaging, dipping and sampling static accumulator cargoes.

3.2.2 BONDING

The most important countermeasure that must be taken to prevent an electrostatic hazard is to bond all metal objects together to eliminate the risk of discharges between objects that might be charged and electrically insulated. To avoid discharges from conductors to earth, it is normal practice to include bonding to earth (‘earthing’ or ‘grounding’). On ships, bonding to earth is effectively accomplished by connecting metallic objects to the metal structure of the ship, which is naturally earthed through the sea.

Some examples of objects which might be electrically insulated in hazardous situations and which must therefore be bonded are:

- Ship/shore hose couplings and flanges, except for the insulating flange or single length of non-conducting hose required to provide electrical isolation between the ship and shore. (See Section 17.5).
- Portable tank cleaning machines.
- Conducting manual ullaging and sampling equipment.
- The float of a permanently fitted ullaging device if its design does not provide an earthing path through the metal tape.

The best method of ensuring bonding and earthing will usually be a metallic connection between the conductors. Alternative means of bonding are available and have proved effective in some applications, for example: semi-conductive (dissipative) pipes and 'O' rings, rather than embedded metallic layers for GRP pipes and their metal couplings.

Any earthing or bonding links used as a safeguard against the hazards of static electricity associated with portable equipment, must be established whenever the equipment is set up and not disconnected until after the equipment is no longer in use.

3.2.3 AVOIDING LOOSE CONDUCTIVE OBJECTS

Certain objects may be insulated during tanker operations, for example:

- A metal object such as a can floating in a static accumulating liquid.
- A loose metal object while it is falling in a tank during washing operations.
- A metallic tool lying on a piece of old lagging left behind after maintenance

Every effort should be made to ensure that such objects are removed from the tank, since there is evidently no possibility of deliberately bonding them. This necessitates careful inspection of tanks, particularly after shipyard repairs.

3.3 OTHER SOURCES OF ELECTROSTATIC HAZARDS

3.3.1 FILTERS

Three classifications of filters may be used in tanker operations, as follows:

Coarse (>150 microns). These do not generate a significant amount of charge, and require no additional precautions provided that they are kept clean.

Fine (<150microns >30 microns). These can generate a significant amount of charge and therefore require sufficient time for the charge to relax before the liquid reaches the tank. It is essential that the liquid spends a minimum of 30 seconds (residence time) in the piping downstream of the filter. Flow velocity should be controlled to ensure that this residence time requirement is met.

Microfine (< 30 microns). To allow sufficient time for the charge to relax, the residence time after microfine filters must be a minimum of 100 seconds before the product enters the tank. Flow velocity should be adjusted accordingly.

3.3.2 FIXED EQUIPMENT IN CARGO TANKS

A metal probe, remote from any other tank structure but near a highly charged liquid surface, will have a strong electrostatic field at the probe tip. Protrusions of this type may be associated with equipment mounted from the top of a tank, such as fixed washing

The processes by which unearthed conductors give rise to ignitions in a mist are fairly complex, and a number of conditions must be satisfied simultaneously before an ignition can occur.

These conditions include the size of the object, its trajectory, the electrostatic level in the tank and the geometrical configuration where the discharge takes place.

As well as solid unearthed conducting objects, an isolated slug of water produced by the washing process may similarly act as a spark promoter and cause an ignition. Experiments have shown that high capacity, single nozzle, fixed washing machines can produce water slugs, which, owing to their size, trajectory and duration before breaking up, may satisfy the criteria for producing incendive discharges. However, there is no evidence of water slugs capable of producing incendive discharges being produced by portable types of washing machine. This can be explained by the fact that if the jet is initially fine, the length of slugs that are produced are relatively small so that they have a small capacitance and do not to readily produce incendive discharges.

Following extensive experimental investigations and using the results of long-term experience, the tanker industry has drawn up the tank washing guidelines set out in Section 11.3. These guidelines are aimed at preventing excessive charge generation in mists and at controlling the introduction of unearthed conducting objects when there is charged mist in the tank.

Charged mists very similar to those produced during tank washing occur from time to time in partly ballasted holds of OBOs. Due to the design of these ships, there may be violent mist-generating impacts of the ballast against the sides of the hold when the ship rolls in even a moderate sea. The impacts also give rise to free flying slugs of water in the tank, so that if the atmosphere of the tank is flammable all the elements of an ignition are present. The most effective counter-measure is to have tanks either empty or fully pressed up so that the violent wave motion in the tank cannot take place.

3.3.5 INERT GAS

Small particulate matter carried in inert gas can be electrostatically charged. The charge separation originates in the combustion process and the charged particles are capable of being carried through the scrubber, fan and distribution pipes into the cargo tanks. The electrostatic charge carried by the inert gas is usually small, but levels of charge have been observed well above those encountered with the water mists formed during washing. Because the tanks are normally in an inert condition, the possibility of an electrostatic ignition has to be considered only if it is necessary to inert a tank which already contains a flammable atmosphere or if a tank already inerted is likely to become flammable because the oxygen content rises as a result of ingress of air. Precautions are then required during dipping, ullaging and sampling. (See Section 11.7.3.1).

3.3.6 DISCHARGE OF CARBON DIOXIDE

During the discharge of pressurised liquid carbon dioxide, the rapid cooling which takes place can result in the formation of particles of solid carbon dioxide which become charged on impact and contact with the nozzle. The charge can be significant with the potential for incendive sparks. Liquefied carbon dioxide should not be used for inerting or injected for any other reason into cargo tanks or pump rooms that may contain flammable gas mixtures.

3.3.7 CLOTHING AND FOOTWEAR

People who are highly insulated from earth by their footwear or the surface on which they are standing can become electrostatically charged. This charge can arise from physical separation of insulating materials caused, for instance, by walking on a very dry insulating

4.2.3.1 Use of Portable Stoves and Portable Cooking Appliances

The use of **portable** stoves and cooking appliances onboard ship should be controlled and, when in port, their use should be prohibited.

4.2.3.2 Steam Cookers And Water Boilers

Cookers and other equipment heated by steam may be used at all times.

4.2.4 ENGINE AND BOILER ROOMS

4.2.4.1 Combustion Equipment

As a precaution against funnel fires and sparks, burners, tubes, uptakes, exhaust manifolds and spark arresters should be maintained in good working condition. If there is a funnel fire or sparks are emitted from the funnel, the tanker should, if at sea, consider altering course as soon as possible to avoid sparks falling on the tank deck. Any cargo, ballasting or tank cleaning operations that are taking place must be stopped and all tank openings closed.

4.2.4.2 Blowing Boiler Tubes

Boiler tubes should be soot blown prior to arrival and after departure from a port. The officer on bridge watch should be consulted prior to the operation commencing and the vessel's course altered if necessary. Boiler tubes should not be soot blown when the vessel is in port.

4.3 PORTABLE ELECTRICAL EQUIPMENT

4.3.1 GENERAL

All portable electrical equipment, including lamps, should be approved by a competent authority and must be carefully examined for possible defects before being used. Special care should be taken to ensure that the insulation is undamaged and that cables are securely attached and will remain so while the equipment is in use. Special care should also be taken to prevent mechanical damage to flexible cables (wandering leads).

4.3.2 LAMPS AND OTHER ELECTRICAL EQUIPMENT ON FLEXIBLE CABLES (WANDERING LEADS)

Portable electric lamps and portable electric equipment for use in hazardous areas must be of an approved type. Special care should be taken to prevent any mechanical damage to flexible cables or wandering leads.

The use of portable electrical equipment on wandering leads should be prohibited within cargo tanks and adjacent spaces, or over the tank deck unless, throughout the period the equipment is in use:

- The compartment within which or over which the equipment and the lead are to be used is safe for Hot Work (see Section 9.4); and
- The adjacent compartments are also safe for Hot Work, or have been purged of hydrocarbon to less than 2% by volume and inerted, or are completely filled with ballast water, or any combination of these (see Section 9.4); and
- All tank openings to other compartments not safe for hot work or purged as above are closed and remain so; or

4.8.3 SHIP'S RADAR EQUIPMENT

Marine radar systems operate in the high radio frequency (RF) and microwave range. Radiation from the scanner fans out in an almost horizontal narrow beam as the scanner rotates. In port it will pick up cranes, loading arm gantries and other such structures, but it will not normally spread down to the ship's deck or jetty.

Contemporary civilian radar, operating on 3 cm and 10 cm wavelengths, are designed with a peak power output of 30 kW and, if properly sighted, present no radio ignition hazard due to induced currents.

Unlike X-rays and nuclear radiation, RF radiation does not penetrate the human body, but at short ranges (<10m) can cause heating of skin or eyes. The National Radiological Protection Board advises that, assuming sensible precautions are taken, such as not looking directly into the scanner, there is no significant health risk from marine radar emissions.

Commercial radar scanner motors are not rated for use in flammable atmospheres but, apart from on smaller vessels, are generally situated well above shore hazardous zones. Any risk is reduced further on vessels, such as gas and chemical carriers, operating a closed loading system with vapour return. It is however advisable to consult with the terminal before using radar equipment during cargo operations.

4.8.4 AUTOMATIC IDENTIFICATION SYSTEMS (AIS)

An AIS is required to be operating while a ship is underway and while at anchor. Some port authorities may request that the AIS is kept on when a vessel is alongside. The AIS system operates on a VHF frequency and transmits and receives information automatically. The size of the ship and its positioning at the terminal berth may present some risk of a VHF transmission affecting the terminal control systems or infringing the terminal's hazardous areas. In these circumstances, the unit should be switched to low power (1 watt or less). Where this is not possible, the AIS should be switched off and, if necessary, the port authority informed. If it is switched off whilst alongside, it must be reactivated upon leaving the berth.

The use of AIS equipment may impact upon the security of the ship or terminal at which it is berthed. In such circumstances, its use may be determined by the port authority, depending on the security level within the port.

4.8.5 TELEPHONES

When there is a direct telephone connection from the ship to the shore control room or elsewhere, telephone cables should preferably be routed outside the dangerous zone.

Whenever this is not feasible, the cable should be routed and fixed in position by qualified shore personnel and should be protected against mechanical damage such that no danger can arise from its use.

4.8.6 MOBILE TELEPHONES

Most mobile phones are not intrinsically safe and are only considered safe for use in non-hazardous areas. Mobile phones should only be used onboard a ship with the Master's permission. Unless certified as being intrinsically safe (see below), their use should be restricted to designated areas of the accommodation space where they are unlikely to interfere with the ship's equipment

Although transmission power levels of non-intrinsically safe mobile phones are insufficient to cause problems with sparking from induced voltages, the batteries can contain sufficient power to create an incendive spark if damaged or short-circuited. It should be borne in mind that equipment such as mobile telephones and radio pagers, if switched on, can be activated remotely and a hazard can be generated by the alerting or calling

For fires involving hydrocarbon liquids, water is used primarily to minimise escalation of a fire by cooling exposed surfaces. Water spray and water fog may be used for making a heat screen between the fire and fire-fighting personnel and equipment. If foam is not available, a water mist can be used to extinguish fires involving shallow pools of heavy oil.

Water in any form should not be applied to fires involving hot cooking oil or fat since it may cause the fire to spread. Concentrated water streams should not be directed at fires involving liquefied gas.

Water streams applied to liquefied gas spills and fires will increase the hazard by increasing vapour cloud size as the water vaporises more liquid. Water spray or water fog can be used with liquefied gas fires and spills for cooling and fire intensity control and for enhanced vapour cloud dispersion.

Water jets should not be directed at energised electrical equipment as this could provide a path for electricity from the equipment with consequent danger of electric shock to fire-fighting personnel.

5.3.1.2 Foam

Foam has a limited heat absorbing effect and should not normally be used for cooling.

5.3.2 SMOTHERING AGENTS

5.3.2.1 Foam

While all foams have a cooling effect to some degree, their primary extinguishing action is by smothering. Foam is an aggregation of small bubbles, of lower specific gravity than oil or water, which flows across the surface of a burning liquid and forms a coherent smothering blanket. A good foam blanket seals against flammable vapour loss, provides some cooling of the fuel surface by the absorption of heat, isolates the fuel surface from the oxygen supply, and separates the flammable vapour layer from other ignition sources (e.g. flame, extremely hot metal surfaces), thereby eliminating combustion. A good foam blanket will resist disruption due to wind and draft or heat and flame impingement and will reseal when its surface is broken or disturbed. Foam is an electrical conductor and should not be applied to energised electrical equipment.

There are a number of different types of foam concentrates available. These include standard protein foam, fluoro-protein foams and synthetic concentrates. The synthetics are divided into Aqueous Film Forming Foam (AFFF) and hydrocarbon surfactant-type foam concentrates for use with alcohols, such as MTBE and other polar solvent liquids and fuels blended with significant quantities of these liquids. Normally the protein, flouro-protein and AFFF concentrates are used at three percent to six percent by volume concentration in water. The hydrocarbon surfactant-type concentrates are available for use at one percent to six percent by volume concentrations.

High expansion foam, made from hydrocarbon surfactant concentrates, is available having expansion ratios from about 200:1 to 1,000:1. A foam generator, which may be fixed or mobile, sprays foam solution onto a fine mesh net through which air is driven by a fan. High expansion foam has limited uses. It is most often used to rapidly fill an enclosed space to extinguish a fire by displacing free air in the compartment. High expansion foam is generally unsuitable for use in outside locations as it cannot readily be directed onto a hot unconfined spill fire and is quickly dispersed in light winds.

High expansion foam systems are being enhanced with the introduction of a new development called "Hot Foam" which is now being increasingly used on ships as a replacement for Halon. Heated water and foam are mixed to reduce possible damaging effects caused by rapid cooling.

Medium expansion foam has an expansion ratio from about 15:1 up to 150:1. It is made from the same concentrates as high expansion foam, but its aeration does not require a

PART 2 – TANKER INFORMATION

7.1.6.3 Simultaneous Cargo/Ballast Operations

In the case of simultaneous loading and discharge operations involving cargo or ballast, venting to the atmosphere can be minimised, or possibly completely avoided, by interconnecting the tanks concerned through the inert gas main. Depending on the relative pumping rates, pressure in the tanks may be increased or a vacuum drawn, and it may therefore be necessary to adjust the inert gas flow accordingly to maintain tank pressures within normal limits.

7.1.6.4 Vapour Balancing during Ship to Ship Transfers

Vapour balancing is used to avoid the release of any gases to the atmosphere through vents and to minimise the use of the inert gas systems when transferring cargo from ship to ship. The inert gas mains of the vessels are connected using a flexible hose. As a minimum, the following recommendations should be followed:

- Equipment should be provided on at least one of the vessels to enable the oxygen content of the vapour stream to be monitored. This should draw samples continuously from a location close to the vapour manifold connection and should include the facility for audible and visual alarms should the oxygen content of the vapour stream exceed 8% by volume. The oxygen analyser and associated alarms should be tested for proper function prior to each cargo transfer operation.
- The oxygen content of the vapour space of each tank connected to the IG main of both ships should be checked and confirmed to be less than 8% by volume.
- The vapour transfer hose should be purged of air and inerted prior to commencing transfer of vapours.
- The vapour manifold valves should not be opened until the pressure in the cargo system of the receiving vessel exceeds that of the vessel discharging cargo.

During the cargo transfer:

- The inert gas system on the discharging vessel should be kept operational and on stand-by, with the inert gas main deck isolating valve closed.
- The inert gas pressure on both ships should be monitored and each ship advised of the other's pressure on a regular basis. The inert gas system should be used if the inert gas pressure in the discharging vessel falls to a low level (300mm wg).
- Transfer operations should be suspended if the oxygen content of the vapour stream exceeds 8% by volume and should only be resumed once the oxygen content has been reduced to 8% or less by volume.
- The cargo transfer rate must not exceed the design rate for the vapour balancing hose.

7.1.6.5 Loaded Passage

A positive pressure of inert gas should be maintained in the ullage space at all times during the loaded passage in order to prevent the possible ingress of air. (See also Section 7.1.5.3). If the pressure falls below the low-pressure alarm level, it will be necessary to start the inert gas plant to restore an adequate pressure in the system.

Loss of pressure is normally associated with leakages from tank openings and falling air and sea temperatures. In these cases, it is all the more important to ensure that the tanks are gas tight. Gas leaks are usually easily detected by their noise and every effort must be made to eliminate leaks at tank hatches, ullage lids, tank cleaning machine openings, valves, etc.

Leaks which cannot be eliminated should be marked and recorded for sealing during the next ballast passage or at another suitable opportunity.

When these breakers are liquid filled, it is important to ensure that the correct fluid is used and the correct level is maintained. The level can normally only be checked when there is no pressure in the inert gas main line. Evaporation, condensation and possible ingress of sea water should be taken into consideration when checking the liquid condition and level. In heavy weather, the pressure surge caused by the motion of liquid in the cargo tanks may cause the liquid in the pressure/vacuum breaker to be blown out. This may be more liable to happen on combination carriers than on tankers.

7.1.8.2 Pressure/Vacuum Valves

These are designed to provide for the flow of the small volumes of tank atmosphere caused by thermal variations in a cargo tank and should operate in advance of the pressure/vacuum breakers. To avoid unnecessary operation of the pressure/vacuum breaker, the pressure/vacuum valves should be kept in good working order by regular inspection and cleaning.

7.1.8.3 Full Flow Pressure/Vacuum Venting Arrangements

In inert gas systems fitted with tank isolating valves, protection from over and under pressurisation of the cargo tanks may be provided by using high velocity vent and vacuum valves as the full flow protection device. Where this is the case, particular attention should be paid to ensuring that the valves operate at the required pressure and vacuum settings. Planned maintenance procedures should be established to maintain and test these safety devices.

7.1.8.4 Individual Tank Pressure Monitoring and Alarm Systems

In inert gas systems fitted with tank isolating valves, indication of the possible over and under pressurisation of the cargo tank is provided by using individual tank pressure sensors connected to an alarm system. Where such systems are used, planned maintenance procedures should be established to maintain and test these sensors and confirm that they are providing accurate readings.

7.1.9 EMERGENCY INERT GAS SUPPLY

The International Convention for the Safety of Life at Sea (SOLAS 1974), as amended, requires that suitable arrangements are provided to enable the inert gas system to be connected to an external supply of inert gas.

These arrangements should consist of a 250 mm nominal pipe size bolted flange, isolated from the inert gas main by a valve and located forward of the non-return valve. The design of the flange should be compatible with the design of other connections in the ship's cargo piping system.

7.1.10 PRODUCT CARRIERS REQUIRED TO BE FITTED WITH AN INERT GAS SYSTEM

7.1.10.1 General

The basic principles of inerting are exactly the same on product carriers as on crude carriers.

There are, however, some differences in operational detail, as outlined in the following sections.

7.1.10.2 Carriage of Products Having a Flashpoint Exceeding 60ºC

The 1974 SOLAS Convention, as amended, implies that tankers may carry petroleum products having a flashpoint exceeding 60ºC (i.e. bitumens, lubricating oils, heavy fuel oils, high flashpoint jet fuels and some diesel fuels, gas oils and special boiling point liquids) without inert gas systems having to be fitted or, if fitted, without tanks containing such cargoes having to be kept in the inert condition.

performing any hot work in that space. Should the company designate such a place, it should be assessed for possible risks, and the conditions defined under which hot work can be undertaken in that place. These conditions should include the need for additional controls, including consideration of the conditions under which hot work may be carried out in the designated space, when taking bunkers alongside or at anchor.

9.4.1.2 Hot Work Outside the Designated Space

Hot work undertaken outside the designated space should be controlled under the SMS by means of a permit to work system.

The master should decide whether the use of hot work is justified, and whether it can be safely undertaken. The master or Responsible Officer must approve the completed permit before any hot work can begin.

Consideration should be given to only performing one hot work operation at a time, due to the resource limitations usually present onboard a tanker. A separate permit should be approved for each intended task and location.

The Master should inform the company of details of the work proposed.

A risk assessment should be carried out to identify the hazards and assess the risks involved. This will result in a number of risk reduction measures that will need to be taken to allow the task to be carried out safely.

A written plan for undertaking the work should be completed, discussed and agreed by all who have responsibilities in connection with the work.

This plan should define the preparations needed before work commences, the procedures for actually carrying out the work and the related safety precautions. The plan should also indicate the person authorising the work and the people responsible for carrying out the specified work, including contractors if appropriate. (See also Section 9.8).

The work area should be carefully prepared and isolated before hot work commences.

Fire safety precautions and fire extinguishing measures should be reviewed. Adequate fire-fighting equipment must be prepared and laid out and be ready for immediate use.

Fire watch procedures must be established for the area of hot work, and in adjacent, non-inerted spaces where the transfer of heat, or accidental damage, may create a hazard, e.g. damage to hydraulic lines, electrical cables, thermal oil lines, etc. The fire watch should monitor the work and take action in case of ignition of residues or paint coatings. Effective means of containing and extinguishing welding sparks and molten slag must be established.

A separate risk assessment should be carried out with regard to the need for personal protective equipment and the means of evacuation of the fire watch personnel in an emergency.

Isolation of the work area and fire precautions should be continued until the risk of fire no longer exists.

Personnel carrying out the work should be adequately trained and have the competency required to carry out the proposed job.

The atmosphere of the area should be tested and found to be less than 1% LFL.

The work area must be adequately and continuously ventilated and the frequency of atmosphere monitoring must be established.

The hot work permit should be issued immediately before the work is to be performed. In the event of a delay to the start of the work, all safety measures should be re-checked and recorded before work actually commences.

No hot work should be undertaken in a dangerous or hazardous area until it has been made safe, and has been proven to be safe, and all appropriate approvals have been obtained.

Work Location / Minimum Requirements	ER Workshop	Other parts of non-hazardous area	Open deck aft of accommodation	Dangerous Spaces (other than Pumprooms)	Maindeck (deck plating)	Work on fixtures/fittings in the main deck area	Work on any cargo-related pipe-lines incl. heating coils in a cargo tank.	Cargo Pumprooms	Cargo or ballast tanks
Work in designated space with shield or curtain erected.	✓								
Adequate ventilation.	✓	✓		✓			✓	✓	✓
Confirmation from Master or designate that work is OK to proceed.	✓								
Hot work permit to be issued on board.		✓							
Hot work permit issued in agreement with Company.				✓	✓	✓	✓	✓	✓
Hot work permit approved by Master or Responsible Officer.		✓	✓	✓	✓	✓	✓	✓	✓
Tank atmosphere checks carried out and entry permit issued.				✓			✓		✓
Tank to be washed and gas freed.							✓		✓
Cargo tanks to be purged and inerted to <8% O_2 and not more than 2% HC.					✓	✓	✓	✓	✓
Work to be carried out >500 mm from the tank deck or bulkheads.				✓		✓		✓	
Work to be carried out >500 mm from a F.O. tank deck or bulkheads.			✓	✓		✓		✓	
Local cleaning to be carried out as per requirements.				✓			✓	✓	✓
All inter-connecting pipelines flushed and drained.							✓	✓	✓
Tank valves isolated.							✓	✓	✓
Work planning meeting to be held and risk assessment completed.	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 9.1 Example of SMS Guidance for Hot Work on an Inerted Ship

9.4.4.3 Hot Work in Enclosed Spaces

Where hot work involves entry into an enclosed space, the procedures outlined in Chapter 10 for enclosed space entry should be followed.

A compartment in which hot work is to be undertaken should be cleaned and ventilated. Particular attention should also be given to the condition of any adjacent spaces.

9.4.4.4 Hot Work in Cargo Tanks

General

All sludge, cargo-impregnated scale, sediment or other material likely to give off flammable vapour, should be removed from the work area. The extent of the cleaned area should be established following a risk assessment of the particular work to be carried out. Special attention must be given to the reverse side of frames and bulkheads. Other areas that may be affected by the hot work, such as the area immediately below the work location, should also be cleaned.

Table 9.2 provides guidance on the safe distance for areas to be cleaned and represents minimum requirements which may need to be extended, based on the output of the risk assessment. Cleaning distances are based on the type of work being carried out and the height above the tank bottom. Cleaning is taken to mean the removal of all sludge, cargo-impregnated scale, sediment or other material likely to give off a flammable vapour.

Height of Work Area	Operator's Side			Opposite Side		
	Gas Cut	Welding	Gouging	Gas Cut	Welding	Gouging
0 – 5 metres	1.5 m	5.0 m	4.0 m	7.5 m	2.0 m	2.0 m
5 – 10 metres	1.5 m	5.0 m	5.0 m	10.0 m	2.0 m	2.0 m
10 – 15 metres	1.5 m	5.0 m	7.5 m	15.0 m	2.0 m	2.0 m
> 15 metres	1.5 m	5.0 m	10.0 m	20.0 m	2.0 m	2.0 m

Table 9.2 Radius of Areas to be Cleaned in Preparation for Hot Work in Tanks

Consideration should be given to using fire resistant blankets or putting a water bottom in the tank to prevent falling sparks coming into contact with paint coatings.

All inter-connecting pipelines to other compartments should be flushed through with water, drained, vented and isolated from the compartment where hot work will take place. Cargo lines may be subsequently inerted or completely filled with water, if considered necessary.

Heating coils should be flushed or blown through with steam and proved clear of hydrocarbons.

An adjacent fuel oil bunker tank may be considered safe if tests give a reading of less than 1% LFL in the vapour space of the bunker tank, and no heat transfer through the bulkhead of the bunker tank will be caused by the hot work.

Non–inerted ships

The possibility of using an external source of inert gas should be considered if practicable.

The compartment should be cleaned, gas freed to hot work standard and ventilated.

Adjacent cargo tanks, including diagonally positioned cargo tanks, should either have been cleaned and gas freed to hot work standard, or completely filled with water.

- Alongside at a lay-by berth, not normally used for cargo operations.
- Alongside a commercial jetty.
- At sea.

Such repair work is only carried out on an exceptional basis and attention will need to be given to ensuring that the scope of the ship's SMS fully embraces the planned activities and the exposures to the shore labour employed.

The guidance given in this Section is intended to supplement, not replace, the guidance given elsewhere in this publication.

9.8.3 SUPERVISION AND CONTROL.

The master, company superintendent or other specifically appointed person, should maintain full control of the repair work, ensuring that the vessel is maintained in a safe condition at all times and that all work is carried out in a safe and proper manner.

Specific procedures will be required when the vessel is to be repaired in a 'dead ship' condition, or when there are limitations on the electrical power available.

9.8.4 PRE-ARRIVAL PLANNING

Prior to arrival at the repair berth, anchorage or other facility, the following should be taken into consideration when undertaking the initial planning:

- Type and location of the berth or anchorage.
- Moorings – numbers, type.
- Condition of the vessel – gas free / inert.
- Safe access – by launch, gangway or other means.
- Number of persons involved, including contractors.
- Location of work to be undertaken – engine room, cargo spaces, above deck, accommodation, etc.
- Facilities for disposal of slops / sludge.
- Arrangements for permits and certification.
- Understanding of port / terminal requirements.
- Availability of main power / main engine(s).
- Emergency procedures, onboard and ashore.
- Availability of assistance e.g. fire fighting, medical facilities, etc.
- Connection to shore side services – water, power etc.
- Weather conditions.
- Draught / trim limitations (to avoid unnecessary ballast handling).
- Restrictions on smoking and other naked lights.

9.8.5 MOORING ARRANGEMENTS

When moored to a repair berth, the number and size of mooring lines used should be adequate for all likely weather and tidal conditions.

Whenever practicable, an alternative power source should be provided for the deck machinery, in order that moorings can be adjusted if main power is not available.

On repair berths, the mooring pattern may be restricted due to crane movements or other activity on the dock side. Such restrictions should be taken into account when planning the berthing of the vessel.

Moorings should be clear of hot work areas or other locations where the lines may be damaged by the repair work in progress.

When at anchor, adequate cable should be used, particularly if the main engine(s) will not be available at any time.

9.8.6 SHORE FACILITIES

Whenever practicable, the vessel should be physically isolated from regular terminal facilities or berths where other vessels are being worked.

If any repairs are to be carried out concurrent with cargo handling operations, specific permission should be granted by the terminal operators.

The master should establish whether any significant operations are to take place involving other vessels in the vicinity of the berth at which repairs are being undertaken i.e. departure / arrival of other vessels, bunkering, fuel oil transfer etc.

The master should be familiar with any specific safety requirements of the facility and/or harbour authorities.

A gangway watch should be posted to restrict visitors and to control access to the vessel.

On a lay-by berth where the vessel is not gas free, a sign should be placed at the foot of the gangway worded “No Unauthorised Access — This Ship Is Not Gas Free.”

Port security plans should be implemented and followed as may be appropriate.

Contractors should advise the master of the number and movement of workers on board each day during the repair period.

Procedures for the use of cranes or other lifting equipment should be determined upon arrival.

Garbage disposal procedures should be agreed between the vessel and the facility, with regular disposal of accumulated garbage being arranged.

Emergency alarm signals should be agreed and, whenever practicable, a drill held prior to commencing repair work. Subsequent drills should be arranged when the repairs are to be carried out over an extended period.

Any restrictions on activities such as bunkering, storing or taking luboils are to be agreed.

9.8.7 PRE-WORK SAFETY MEETING

Work planning meetings should be held prior to the commencement of any work, and on each subsequent workday.

Work planning meetings will normally include representatives from the vessel and all the contractors involved.

The prime function of these meetings is to ensure that all personnel involved are aware of the daily schedule, the interrelation between contractors, particular areas of concern, special precautions to be taken, etc.

9.8.8 WORK PERMITS

Permits should be issued for the relevant repair work jobs, including any repairs being carried out by ship’s staff. In particular permits should be issued for:

- Enclosed space entry.

9.8.12 SAFETY OFFICER

A dedicated 'safety officer' should be appointed by the master to coordinate the permit and certification processes associated with the repair period.

The safety officer should be fully aware of all his duties and responsibilities.

9.9.13 SAFE ACCESS

All access points should provide a safe means of access and be provided with adequate guard and safety rails, safety nets, etc., as may be appropriate.

There should be an adequate means of access at all times.

The number of access points should be sufficient to enable timely evacuation of all personnel onboard.

9.8.14 HOT WORK

The following supplements the guidance given in Section 9.4 which should be followed for any repair activities involving hot work.

Hot work should be prohibited within or on the boundaries of cargo tanks, ballast tanks, slop tanks, bunker tanks, pump rooms and forward cofferdams, including the deck and vessel shell plating, except when special preparations have been made prior to entering the berth or facility and the necessary special conditions have been met.

Where the vessel, or compartments within the vessel, are not gas free, then hot work should not be carried out within 30 metres of any non-gas free spaces.

Proper control of electrical welding equipment should be exercised and correct grounding cables should be used. Welding current should not be returned to the transformer via the vessel's hull.

Notices should be posted to indicate the current state of any tank or void space, e.g. stating whether it is either gas free and suitable for hot work, or only safe for entry.

Hot work should be suspended immediately if any of the specific safety requirements cannot be complied with.

Any hot work on or above the weather decks should be stopped if the inert gas pressure reaches the relieving pressure of the ressure/vacuum valves. If it is found necessary to release tank pressure to atmosphere, all work should be suspended until the operation has been completed. Consideration may need to be given to clearing the deck area of men during venting, especially when there is the possibility of toxic gas (e.g. H2S) being present. A new permit should be issued prior to resuming work.

9.9 SHIPBOARD EMERGENCY MANAGEMENT

9.9.1 GENERAL

The ISM Code requires that companies establish procedures to identify, describe and respond to potential emergency shipboard situations. This section provides guidance on meeting this responsibility, by addressing those aspects covered by the scope of this guide.

9.9.2 TANKER EMERGENCY PLAN

9.9.2.1 Preparation

Planning and preparation are essential if personnel are to deal successfully with emergencies on board tankers. The master and other officers should consider what they would do in the event of various types of emergency, such as fire in cargo tanks, fire in the engine room, fire in the accommodation, the collapse of a person in a tank, the ship breaking adrift from her berth and the emergency release of a tanker from her berth.

They will not be able to foresee in detail what might occur in all such emergencies, but good advance planning will result in quicker and better decisions and a well organised reaction to the situation.

The following information should be readily available:

- Type of cargo, amount and disposition.
- Whereabouts of other hazardous substances.
- General arrangement plan.
- Stability information.
- Fire-fighting equipment plans.

9.9.2.2 Emergency Organisation

An emergency organisation should be set up for mobilisation in the event of an emergency. The purpose of this organisation will be to:

- Raise the alarm.
- Locate and assess the incident and possible dangers.
- Organise manpower and equipment.

The following provides guidance for use in planning an emergency organisation, which should cover the following four elements:

Command Centre
There should be one group in control of the response to the emergency, with the master or the senior officer on board in charge. The command centre should have means of internal and external communication.

Emergency Party
This group should be under the command of a senior officer and should assess the emergency and report to the command centre on the situation, advising what action should be taken and what assistance should be provided, either from on board or, if the ship is in port, from ashore.

Back up Emergency Party
The back up emergency party, under the command of an officer, should stand by to assist the emergency party as instructed by the command centre and should provide back up services, e.g. equipment, stores, medical services, including cardio-pulmonary resuscitation, etc.

Engineering Group
This group should be under the command of the chief engineer or the senior engineering officer on board and should provide emergency assistance as instructed by the command centre. The prime responsibility for dealing with any emergency in the main machinery spaces will probably rest with this group. It may be called on to provide additional manpower elsewhere.

- Approved self-contained, positive pressure breathing apparatus and resuscitation equipment is ready for use at the entrance to the space.
- A rescue harness, complete with lifeline, is ready for immediate use at the entrance to the space.
- Fully-charged safety torch is ready for immediate use at the entrance to the space.
- A responsible member of the crew is in constant attendance outside the enclosed space, in the immediate vicinity of the entrance and in direct contact with a responsible officer. These persons should be trained in the actions to be taken in the event of an emergency.
- Lines of communications have been clearly established and are understood by all concerned.

The personnel undertaking the task should ensure that such safeguards are put into effect prior to entering the space.

The personal protective equipment to be used by people entering the space must be prescribed. The following items should be considered:

- Protective clothing including work clothing or protective suits, safety boots, safety helmet, gloves, safety glasses.
- For large spaces, or where climbing access will be undertaken, the wearing of safety harnesses may also be appropriate.
- Approved safety torches.
- Approved UHF radio.
- Personal gas detector or an area gas detector and alarm.
- Emergency Escape Breathing Device(s).

10.6 EMERGENCY PROCEDURES

10.6.1 EVACUATION FROM ENCLOSED SPACES

If any of the conditions that are stated on the permit for entering the space change, or the conditions in the tank are suspected of becoming unsafe after personnel have entered the space, they should be ordered to leave the space immediately and not be permitted to re-enter until the situation has been re-evaluated and the safe conditions stated on the permit have been restored.

10.6.2 RESCUE FROM ENCLOSED SPACES

When an accident involving injury to personnel occurs in a dangerous space, the first action must be to raise the alarm. Although speed is often vital in the interests of saving life, rescue operations should not be attempted until the necessary assistance and equipment has been mustered. There are many examples of lives being lost through hasty, ill-prepared rescue attempts.

Prior organisation is of great value in arranging quick and effective response. Lifelines, rescue harness, breathing apparatus, resuscitation equipment and other items of rescue equipment should always be kept ready for use and a trained emergency team should be available. An agreed means of communication should be agreed in advance.

This equipment consists of a face mask which is supplied by air through a small diameter hose leading outside the space where it is connected to either compressed air cylinders or an air line served by a compressor. If the ship's air supply is used, it is essential that it is properly filtered and adequately monitored for toxic or hazardous constituents. The hose is attached to the user by means of a belt or other arrangement, which enables rapid disconnection in an emergency. Air to the face mask is regulated by a flow control valve or orifice.

If the air supply is from a compressor, the arrangement will include an emergency supply of air cylinders for use in the event of the compressor failing. In such an emergency, the user should be signalled to vacate the space immediately.

A trained and competent person must be in control of the air line pressure and be alert to the need to change over to the alternative supply should normal working pressure not be maintained.

When using the air line breathing apparatus:

- Check and ensure that the face mask is adjusted to be airtight.
- Check the working pressure before each use.
- Check the audible low pressure alarm before each use.
- To avoid damage, keep the air lines clear of sharp projections.
- Ensure that the air hose does not exceed 90 metres in length.
- Allow ample time to vacate the space when the low pressure alarm sounds. The duration of the emergency air carried by the user will depend on an individual's weight and fitness and each user should be aware of his particular limitations.

Should there be any doubt about the efficiency of the equipment, the user should vacate the space immediately.

The user should carry a completely separate supply of clean air for use in emergency evacuation from the space in the event of the air line failing. It is recommended that the user should carry an Emergency Escape Breathing Device (EEBD, see below).

10.8.3 EMERGENCY ESCAPE BREATHING DEVICE (EEBD)

This is a compressed air or oxygen breathing device used for escape from a compartment that has a hazardous atmosphere. It is primarily for use in accordance with the SOLAS requirements for escape from machinery or accommodation spaces in the event of a fire. Additional sets should be provided for use as emergency escape equipment during enclosed space entry. Each set has a duration of not less than 10 minutes. The device can be one of two types:

Compressed Air Type

These sets consist of an air bottle, reducing valve, air hose, facemask or hood and a flame retardant high visibility bag or jacket. They are normally constant flow devices providing compressed air to the wearer at a rate of approximately 40 litres per minute, giving a duration of 10 (as a minimum) or 15 minutes, depending on the capacity of the bottle. Compressed air EEBD's can normally be recharged onboard with a conventional SCBA compressor.

The pressure gauge, supply valve and hood should be checked before use.

Re-breathing Type

These sets normally consist of a robust watertight carrying case, compressed oxygen cylinder, breathing bag, mouthpiece and a flame retardant hood. They are designed for single use by the wearer. When the hood is placed over the user's head and the set

- The inert gas main is isolated from the atmosphere and, if a cross connection is fitted, also from the cargo main.
- The inert gas plant is operating.
- The deck isolating valve is open.

A low but positive inert gas pressure after completion of discharge will permit the draining of the manifold driptray into a tank and, if required, allow manual dipping of each tank.

11.1.13.4 Pressurising of Cargo Tanks

When high vapour pressure petroleum (e.g. natural gasoline and certain crude oils) reaches a low level in cargo tanks, the head of liquid is sometimes insufficient to keep cargo pumps primed. If an inert gas system is installed, it can be used for pressurising cargo tanks in order to improve pump performance.

11.1.13.5 Crude Oil Washing

If the ship needs to crude oil wash all or some of its tanks during discharge, the responsible officer should incorporate a crude oil washing plan in the required discharge plan set out in Section 22.6.

A full description of the requirements relating to crude oil washing is given in Section 11.5.

11.1.13.6 Commencement of Discharge Alongside a Terminal

Shore valves must be fully open to receiving tanks before the tanker's manifold valves are opened. If there is a possibility that, owing to the elevation of the shore tanks above the level of the ship's manifold, pressure might exist in the shore line and no non-return (check) valves are fitted in the shore line, the ship must be informed and the tanker's manifold valves should not be opened until an adequate pressure has been developed by the pumps.

Discharge should start at a slow rate and only be increased to the agreed rate once both parties are satisfied that the flow of oil to and from designated tanks is confirmed.

11.1.13.7 Commencement of Discharge at an Offshore Terminal

Before commencing discharge at an offshore terminal, communications between ship and shore should be tested and fully understood. The ship must not open its manifold valves or start its pumps until a clear signal has been received from the shore that the terminal is ready. Discharge must be started slowly until the system has been tested and then gradually brought up to the maximum agreed flow rate or pressure. A close watch should be kept on the sea in the vicinity of the hoses to detect leaks. During darkness, a bright light should, where safe and practicable, be shone on the water in the vicinity of the hoses.

11.1.13.8 Commencement of Discharge through a Stern Discharge Line

Before commencing discharge through a stern discharge line, a dangerous area extending not less than 3 metres from the manifold valve should be clearly marked and no unauthorised personnel should be allowed within this area during the entire discharge operation.

A close watch must be maintained for any leakage and all openings, air inlets and doors to enclosed spaces should be kept tightly closed.

Fire fighting equipment must be laid out and ready for use in the vicinity of the stern discharge manifold.

11.1.13.9 Periodic Checks during Discharge

Throughout discharging, the ship should monitor and regularly check all full and empty tanks to confirm that cargo is only leaving the designated cargo tanks and that there is no

11.1.14.2 Line Displacement with Water

On tankers that have a segregated ballast system, the practice of using cargo pumps on a sea suction should be avoided if at all possible. However, some terminals will require the ship to displace the contents of the hoses or arms, and perhaps also the shore pipelines, with water on completion of cargo operations. Due to the added risk of pollution, this practice should only be undertaken if it is essential and must be carefully planned and executed. Prior to commencing the displacement, the ship and terminal should reach agreement on the procedures to be adopted, particularly the amount to be pumped and the pumping rate.

Particular attention must be paid to venting the cargo pumps and guaranteeing that no outflow of oil occurs when opening the sea valve.

Reference should be made to the ICS/OCIMF publication ‘Prevention of Oil Spillages through Cargo Pumproom Sea Valves’.

11.1.14.3 Line Draining

On completion of loading, the ship’s cargo deck lines should be drained into appropriate cargo tanks to ensure that thermal expansion of the contents of the lines cannot cause leakage or distortion. The hoses or arms, and perhaps a part of the pipeline system between the shore valve and the ship’s manifold, are also usually drained into the ship’s tanks. Sufficient ullage must be left in the final tanks to accept the product drained from hoses or arms and ship or shore lines.

On completion of discharge, the ship’s cargo deck lines should be drained into an appropriate tank and then be discharged ashore or into a slop tank.

When draining is complete, and before hoses or arms are disconnected, the ship’s manifold valves and shore valves should be shut and the drain cocks at the vessel’s manifold should be opened to drain into fixed drain tanks or portable drip trays. Cargo manifolds and arms or hoses should be securely blanked after being disconnected. The contents of portable or fixed drip trays should be transferred to a slop tank or other safe receptacle.

11.1.14.4 Clearing Hoses and Loading Arms to the Terminal

If hoses or arms have to be cleared to the terminal using compressed air or inert gas, the following precautions should be strictly observed in order to avoid the possible creation of a hazardous static electrical charge or mechanical damage to tanks and equipment:

- The procedure to be adopted must be agreed between ship and terminal.
- There must be adequate ullage in the reception tank.
- To ensure that the amount of compressed air or inert gas is kept to a minimum, the operation must be stopped when the line has been cleared.
- The inlet to the receiving tank should be located well above any water that may be in the bottom of the tank.
- The line clearing operation must be continuously supervised by a responsible person.

11.1.14.5 Clearing Hoses and Loading Arms to the Ship

The clearing of hoses and loading arms to the ship using compressed air should not be undertaken due to the risks of:

- Static charge generation.
- Compromising inert gas quality.
- Over-pressurisation of tanks or pipelines.

Chapter 12

CARRIAGE AND STORAGE OF HAZARDOUS MATERIALS

This Chapter provides guidance on the carriage and stowage of hazardous materials carried on board tankers as cargo, ship's stores, or as cargo samples.

This Chapter does not attempt to give guidance on the many hazardous chemical cargoes that may be shipped from time to time.

Guidance on the properties of such cargoes may be obtained from the ICS Tanker Safety Guide (Chemicals) or from the shipper. Recommendations on handling and stowage, necessary for compliance with the SOLAS Convention and any national requirements, are given in the International Maritime Dangerous Goods (IMDG) Code.

12.1 LIQUEFIED GASES

In addition to the general precautions for handling packaged petroleum and other flammable liquids given in Section 12.5 below, the following safeguards should be observed when handling packaged liquefied gas cargoes:

- Pressurised receptacles should be suitably protected against physical damage from other cargo, stores or equipment.
- Pressurised receptacles should not be over-stowed with other heavy cargo.
- Pressurised receptacles should be stowed in such a position that the safety relief device is in contact with the vapour space within the receptacle.
- Valves should be suitably protected against any form of physical damage.
- Cylinders stowed below deck should be in compartments or holds capable of being ventilated and away from all sources of heat, accommodation and working areas.
- Oxygen cylinders should be stowed separately from flammable gas cylinders.

Temperatures should be kept down and hold temperatures should not be permitted to rise above 50ºC. Hold temperatures should be constantly checked and, if they approach this level, the following measures should be taken:

- The cargo hold should be ventilated.
- The liquefied gas containers should be sprayed with water if loading or discharge operations are carried out in direct tropical sunlight.
- An awning should be rigged over the hold.
- The deck should be dampened down.

12.2 SHIP'S STORES

12.2.1 GENERAL

Any chemical or hazardous material placed onboard ship as cargo or ship's stores should be accompanied by a Material Safety Data Sheet (MSDS). Where an MSDS is not provided for an item taken into ship's stores, it should be isolated and stored in accordance with guidance provided on its container or packaging. It should not be put into use until satisfactory user information is provided.

12.2.2 PAINT

Paint, paint thinners and associated cleaners and hardeners should be stowed in storage locations protected by fixed fire extinguishing arrangements approved by the Administration. (SOLAS II-2, Regulation 18.7, as amended refers).

12.2.3 CHEMICALS

All chemicals should be stowed in a designated and dedicated storage location. Care should be taken to ensure that incompatible chemicals are stowed separately. Information on the fire fighting medium for each chemical should be readily available by means of the product's MSDS.

12.2.4 CLEANING LIQUIDS

It is preferable to use cleaning liquids that are non-toxic and non-flammable. If flammable liquids are used, they should have a high flashpoint. Highly volatile liquids, such as gasoline or naphtha, should never be used in engine and boiler rooms.

Flammable cleaning liquids should be kept in closed, unbreakable, correctly labelled containers and should be stored in a suitable compartment when not in use.

Cleaning liquids should only be used in places where ventilation is adequate, taking into consideration the volatility of the liquids being used. All such liquids should be stowed and used in compliance with the manufacturer's instructions.

Direct skin contact with, or the contamination of clothing by, cleaning liquids should be avoided.

12.3 CARGO SAMPLES

All cargo samples should be stowed securely in lockers that have access external to the accommodation. Consideration should be given to storing samples in a location protected by a fixed fire fighting system, such as a paint locker. The number of samples retained onboard should be carefully managed and, when no longer required, they should be disposed of either to a slop tank onboard or to a terminal's waste oil system.

Owners should have a policy that addresses the disposal of samples with the aim of minimising the period of retention after the relevant cargo has been discharged.

Unless the operator advises to the contrary, it is suggested that samples are retained for a period of three months after the cargo has been discharged.

12.4 OTHER MATERIALS

12.4.1 SAWDUST, OIL ABSORBANT GRANULES AND PADS

The use of sawdust for cleaning up small oil spills onboard ship is discouraged. If sawdust is stored on board, care should be taken to ensure that it is stowed in a dry condition and, if possible in a cool location. Moist sawdust is liable to spontaneous combustion. (See Section 4.9).

When sawdust has been used to clean up a minor oil spill, the contaminated sawdust should be stowed separately, in a sealed container and in a safe location, clear of the accommodation and hazardous areas.

Chapter 14

SPECIAL SHIP TYPES

This Chapter sets out safety measures to be taken on combination carriers in addition to those necessary for conventional tankers. For this purpose, a combination carrier is a tanker designed to carry oil or solid cargoes in bulk, and is one of two main types, an Oil/Bulk/Ore ship or an Oil/Ore ship.

Other types of combination carriers, which may for example carry liquefied gas and petroleum, or containers and general cargo, are not covered.

Some LPG Carriers are certified to carry other petroleum products, such as, light naphtha, jet fuel and motor gasolines. Section 14.2 provides guidance relating to LPG carriers when engaged in petroleum trades.

14.1 COMBINATION CARRIERS

14.1.1 GENERAL INSTRUCTIONS

Petroleum and dry bulk cargoes must not be carried simultaneously.

Attention should be paid to the gas contents of wing tanks when the vessel is discharging bulk ore. Similarly, it should be realised that damaged bulkheads may lead to flammable gas mixtures in ore holds.

Between cargo holds there may be a void space, through which various piping systems can pass and which provide access to tank valves and double bottom tanks.

A single duct keel may be fitted along the centre line. On some ships, two duct keels are fitted, one on either side of the centre line.

Some duct keels and pipe tunnels may be fitted with wheeled trolleys on rails to permit easier access for personnel and equipment. These spaces may be fitted with fixed lighting, fixed washing systems and a fixed gas monitoring system.

Because of their restricted natural ventilation, these spaces may be oxygen deficient. Furthermore, they are adjacent to cargo holds and ballast tanks, so both hydrocarbon vapour and inert gas may leak into them.

These spaces should be regularly monitored for gas concentrations. Enclosed space entry requirements given in Chapter 10 should be strictly applied. The rescue of an unconscious or injured person from these confined spaces may be extremely difficult.

14.1.2 TYPES OF COMBINATION CARRIERS

14.1.2.1 Oil/Bulk/Ore (OBO)

The OBO ship is capable of carrying its full deadweight when trading as an ore carrier with cargoes of heavy ore concentrates. This type of ship is also designed to carry other types of dry bulk cargo, such as grain or coal.

On older vessels, holds are usually arranged to extend the full breadth of the ship, with upper and lower hopper tanks and double bottom tanks. In some cases, holds may have wing tanks. Oil or dry bulk cargo is carried in the holds. In addition, oil may be carried in one or more sets of upper hopper tanks, and where there are wing tanks, they may also

Terminal operators should appreciate that combination carriers may be subject to loading rate limitations and to specific discharge procedures. These arise from the danger of hatch seals leaking if placed under excessive pressure, as well as from the free surface effects.

If a loss of stability becomes evident during loading or discharge, all cargo, ballast and bunker operations must cease and a plan be prepared for restoring positive stability. If the vessel is at a terminal, this plan should be agreed by the terminal representative and it may be necessary or prudent to disconnect the loading arms or hoses.

The specific action required to restore stability will be determined by the vessel's detailed stability information in relation to a particular condition.

In general the following principles apply:

- The vertical centre of gravity must be lowered in the most effective way.
- Where slack double bottom tanks exist, these should be filled, starting with those on the low side, followed by those on the high side.
- If the pressing-up of slack double bottom tanks is insufficient to regain stability, it may be necessary to consider filling empty double bottom ballast tanks. It must be recognised that this will initially result in a further loss of stability caused by the additional free surface effect. However, this will soon be corrected by the effect of the added mass below the vessel's original centre of gravity.
- No attempt should be made to correct a list by filling compartments on the high side as this is likely to result in a violent change of list to the opposite side.
- The restraint provided by moorings should be considered. To attempt to control a list by adjusting mooring rope tension could be dangerous and is therefore not recommended.

On completion of loading, the number of slack holds should be at a minimum and, in any event, not more than that specified in the stability information book.

14.1.4 SLOSHING

'Sloshing' is the movement of liquid within a hold when the vessel is rolling or pitching.

It can give rise to:

- Structural damage caused by the slamming effect of the liquid against the ship's side or bulkheads.
- An electrostatically charged mist in the ullage space in holds partially filled with a mixture of oil and water, such as dirty ballast or retained tank washings. This can occur with only a slight rolling motion.

In order to eliminate these problems, slack holds should be avoided wherever possible. This may be difficult when loaded with an oil cargo, but may be more readily achieved when the vessel is in ballast.

14.1.5 LONGITUDINAL STRESS

Consideration should be given to the distribution of the weights along the ship, taking account of the ship's longitudinal strength.

14.1.6 VENTING OF CARGO HOLDS

The vent lines from the cargo holds may lead to either individual vent outlets, to a main gas line venting system which expels the hydrocarbon vapour through a riser at a safe height above the deck, or to an inert gas pipeline system.

14.1.13 CARGO CHANGEOVER CHECK LISTS

The following check lists are of a general nature and each ship should use them as a guide when developing their own comprehensive checklists.

Oil to Dry Bulk Cargo

- Wash cargo holds and tanks, including access trunks.
- Flush all main suctions into cargo holds and tanks and strip dry.
- Gas free all cargo holds and tanks.
- Hose off, blow through, disconnect and stow portable heating coils as required. Plug securing sockets as necessary.
- Ensure fixed heating coils are free of oil before blanking ends.
- Complete hand hosing and digging of holds and sumps to the requirements of the next cargo.
- Drain cargo holds and suction wells.
- Blank off main suctions to holds as necessary. Ensure the stripping discharge line to after hold is securely blanked.
- Ensure sounding pipes to bilge wells are open and clear of obstructions.
- Fit main and stripping suction recess doors as necessary. Also fit heating coil connecting pipe recess doors.
- Wash cargo pipeline system thoroughly, including pumps, deck lines, bottom lines and pumproom.
- Ensure gauging system, where fitted, is stowed or blanked as necessary to manufacturer's recommendations.
- Drain, vent and prove gas free all gas lines and risers.
- Blank off gas lines to holds as necessary.
- Set venting system to the requirements of the next cargo.
- Check hatch cover sealing arrangements and closing devices.
- Check ballast tanks, void spaces, cofferdams and pumprooms for flammable gas. Ventilate as necessary and prove gas free.
- If slops are retained, ensure designated pipeline segregations are fitted, slop tanks are fully inerted and the relevant venting system adopted, as necessary.

Dry Bulk Cargo to Oil

- Sweep holds clean and lift cargo remains out of hold for disposal.
- Wash cargo remains off bulkheads with a high pressure water jet, stripping slowly to remove water, leaving solid residues.
- Remove solid residues from the tank top and sumps, and prove that the stripping suction is clear.
- Remove suction doors and attach securely to stowage positions.
- Close off sounding pipes to sumps as required.
- Remove blanks from main cargo suctions and stripping discharges to after hold.
- Lower and secure heating coils in place, connect and prove tight, as necessary.
- Remove requisite blanks from gauging system and render fully operational.

14.2.3 PRE-LOADING PREPARATIONS

The stripping system should be carefully inspected before loading and, on vessels where portable pumps have to be fitted, these should be tested prior to installation using fresh water. Portable pumps should be lowered into cargo tanks inside canvas bags so as to prevent ‘aluminium grazing’ on the steelwork structures.

To protect the diaphragms of air-driven portable pumps, a positive pressure should always be maintained on the ‘drive’ side of the pump throughout the period of cargo carriage. This can be achieved with air or nitrogen.

The cargo compressor room should be totally isolated from the cargo system. Some vessels may require the use of a compressor for inert gas cooling and additional measures must be taken in order to ensure safe operation in the vicinity of the petroleum products.

Inert gas should be dry enough to prevent water residues. This is especially important with pentane derivatives, where water mixed with the product will create a noxious liquid.

Means of preventing hydrocarbon vapour passing back to the engine room or inert gas room must be in place. This can take the form of a deck seal or similar arrangement. This should be cleaned and all alarms and associated shutdowns tested.

The setting of the cargo tank safety valve must be such as to ensure that it lifts before the deck seal arrangement safety valve.

The vessel should arrive at the loadport with all tanks inerted to less than 8% oxygen by volume, at ambient temperature and with no traces of the previous cargo. If ammonia was the previous cargo, the operators should be consulted regarding the maximum allowable ammonia vapour content (ppm).

14.2.4 LOADING OF PENTANE PLUS AND NAPHTHA

Some terminals allow the ambient temperature loading of pentane plus or naphtha into a tank containing propane or butane vapour at ambient temperature and atmospheric pressure. This means that there must be no heel of liquefied gas present in the tank.

The loaded cargo will displace the gas as the tank fills. Some absorption will occur during this process. When the tank is full of liquid cargo, the gas absorbed during the loading and the small quantity of gas remaining above the cargo will, in the absence of any other components, probably reach an equilibrium and may have no apparent effect on the pressure.

However, it must be kept in mind that some terminals do not allow this practice of loading cargo into tanks containing LPG vapour.

14.2.5 CARGO SAMPLING

Dependent upon owner’s and charterer’s requirements, various cargo samples and water dips will have to be taken from the tanks prior to and during cargo operations.

Closed loading and sampling are to be carried out at all times. Ships should ensure that the fitted vapour locks are fully functional.

14.2.6 LOADING, CARRIAGE AND DISCHARGE PROCEDURES

During loading, carriage and discharge, a positive pressure must always be maintained in the cargo tanks. Special vapour recovery requirements may apply at certain terminals.

The holds or void spaces adjacent to the cargo tanks should always be inerted during the entire carriage period.

- **Minimum Parallel Body Length forward and aft of the manifold:** This is to ensure that the vessel will rest against the fenders when in position with the cargo connection made.
- **Maximum Beam:** Required, for example, due restrictions imposed by a lock, dock or river transit.
- **Maximum Allowable Manifold Height above the Water:** To ensure that the vessel can keep the cargo arms connected throughout the discharge and at all states of the tide. At some tidal locations, it may be necessary to disconnect the loading arms during the high water period.
- **Minimum Allowable Manifold Height above the Water:** Required, for example, to ensure that a loaded vessel can be connected to the cargo arms. At some tidal locations it may be necessary to disconnect the cargo arms during the low water period.
- **Maximum Air Draft:** This is specified to ensure that vessels can pass beneath bridges and overhead obstructions, power cables etc. The local harbour authority may define a minimum safe clearance distance.

In defining these criteria, care should be taken in establishing the baseline data from which they are derived and ensuring that they are correctly reconciled. In addition, terminals should clearly identify the units of measurement used.

15.7 DOCUMENTATION

Terminals should maintain a set of up-to-date documents to ensure compliance with regulations, procedures and good practice. This should provide comprehensive information on facilities and equipment associated with the management of the ship/shore interface.

Documentation should provide current information on topics that include the following:

- Legislation, including national and local requirements and HSE legislation.
- Industry guidelines, company policies, HSE Policy.
- Operating manuals, maintenance and inspection procedures, site plans and drawings.
- Records, for example, of internal and external audits, inspections, meetings, HSE records, permits and local procedures.
- Certificates issued for equipment and processes.

Documentation available on site should include a comprehensive set of ‘as-built’ construction drawings and specifications of the berth and associated terminal facilities, including any and all modifications made since it was first commissioned. This documentation should form the basis of any structural, water depth, or other surveys carried out to inspect the fabric of the facilities.

A record of the major equipment items should be kept. This will include, for example, specifications, purchase orders and inspection and maintenance data. Major equipment could include transfer arms, access towers, large valves, pumps, meters, fenders and mooring hooks.

such as control panel indicator and warning lamps, outdoor flashing lights, bells and horns are connected.

19.2.4 AUTOMATIC DETECTION SYSTEMS

Automatic detection systems consist of mechanical, electrical or electronic devices that are installed to provide detection of environmental changes created by fire or by the presence of toxic or combustible gases. Fire detectors operate on one of three principles, sensitivity to heat, reaction to smoke or gaseous products of combustion, and sensitivity to flame radiation.

19.2.4.1 Heat Sensing Fire Detectors

Heat detectors fall into two general categories, fixed temperature devices and rate-of-rise devices. Some devices combine both principles (rate-compensated detectors). Generally, heat detectors are best suited for fire detection in confined spaces subject to rapid and high heat generation, directly over hazards where hot flaming fires are expected, or where speed of detection is not the prime consideration.

19.2.4.2 Smoke Sensing Fire Detectors

Smoke sensing detectors are designed to sense smoke produced by combustion and operate on various principles, including ionisation of smoke particles, photo-electric light obscuration or light scattering, electrical resistance changes in an air chamber and optical scanning of a cloud chamber.

19.2.4.3 Gas (Product of Combustion) Sensing Fire Detectors

Gas sensing fire detectors are designed to sense and respond to one or more of the gases produced during the combustion of burning substances. These detectors are seldom recommended, as fire tests have shown that detectable levels of gases are reached after detectable smoke levels.

19.2.4.4 Flame Sensing Fire Detectors

Flame detectors are optical detection devices that respond to optical radiant energy emitted by fire. Flame detectors responsive to infrared or ultraviolet radiation are available, but ultraviolet-sensitive detectors are generally preferred.

19.2.5 SELECTION OF FIRE DETECTORS

When planning a fire detection system, detectors should be selected based on the types of fires that they are potentially protecting against. The type and quantity of fuel, possible ignition sources, ranges of ambient conditions, and the value of the protected property, should all be considered.

In general, heat detectors have the lowest cost and false alarm rate, but are the slowest to respond. Since the heat generated by small fires tends to dissipate fairly rapidly, heat detectors are best used to protect confined spaces, or if located directly over hazards where flaming fire could be expected. The operating temperature of a heat detector should be at least 13°C above the maximum expected ambient temperature in the area protected.

Smoke detectors respond faster to fires than heat detectors. Smoke detectors are best suited to protect confined spaces and should be installed either according to prevailing air current conditions or on a grid layout.

Photoelectric smoke detectors are best used in places where smouldering fires, or fires involving low temperature pyrolysis, may be expected. Ionisation smoke detectors are useful where flaming fires would be expected.

Flame detectors offer extremely fast response, but will warn of any source of radiation in their sensitivity range. False alarm rates can be high if this kind of detector is improperly applied. Their sensitivity is a function of flame size and distance from the detector. They used for other purposes, and should be capable of being heard in all areas of the facility regardless of background noise.

Auxiliary alarm devices should be provided for indoor locations or remote areas where the general alarm cannot be heard. These alarms may be bells, or air or electric horns. Whichever devices are provided, they should be the same throughout the facility and should be distinct from other warning devices.

19.3.4 ALTERNATIVE ALARM AND SIGNALLING SYSTEM DESIGN

Although a coded alarm system is preferable, a non-coded, annunciator-type system can be used. Either system can consist of telephones or manual fire alarm stations at strategic locations. Coded manual fire alarm stations can be connected to the general alarm to sound a coded signal without manual intervention. Non-coded stations can be arranged to show fire location on a fire alarm annunciator in the central control room or supervisory station so that the attendant can energise the code transmitter. Both the coded or non-coded annunciator type systems should be controlled from a central fire alarm control panel.

19.3.5 DETECTION AND ALARM SYSTEM CIRCUIT DESIGN - FIRE EXTINGUISHING SYSTEM INTERFACE

Alarm and extinguishing system actuation relays, where required, should consist of normally de-energised closed loops that require an input of sufficient electrical energy to activate the alarm or extinguishing system devices. This arrangement not only prevents a false tripping of an extinguishing system upon loss of power, but also provides circuit fault supervision with a fault signal upon power loss.

19.3.6 ELECTRIC POWER SOURCES

Electric power should be available from two highly reliable sources. The usual arrangement is an alternating current (AC) primary power supply, with a trickle charger supplying an emergency battery system for standby power. In some locations, authorities may require an engine driven generator as a secondary power supply in the event the primary supply fails.

The capacity of secondary power supplies varies with the type of alarm system and the requirements of local regulatory authorities. For local or proprietary alarm systems where signals are registered only at the facility or plant central control room or central supervisory centre, batteries are usually sized for loss of primary power for a minimum period of 8 hours and for at least 12 hours if the supply is not reasonably reliable.

In auxiliary and remote station systems where trouble signals from the loss of local operating power might not be transmitted to the receiving station, a 60 hour emergency power supply capacity is usually required in order that the emergency supply can operate the entire system if the power were out over a weekend.

19.4 DETECTION AND ALARM SYSTEMS AT TERMINALS HANDLING CRUDE OIL AND PETROLEUM PRODUCTS

19.4.1 GENERAL

The installation of detection and alarm systems on terminals transferring crude oil and flammable and combustible hydrocarbon liquids depends on a number of factors that include the following:

- The commodities or products transferred.
- Tanker size and number berthed per year

- Pumping rates.
- The proximity of hazardous equipment with respect to other equipment or hazards, i.e. equipment spacing, electrical area classification.
- The proximity of tankers to the terminal and to hazardous terminal equipment.
- The proximity of the terminal to residential, commercial or other industrial properties.
- The installation of emergency isolation valves.
- The number and nature of fixed fire extinguishing systems interacting with detection and alarm systems.
- Whether the terminal is continuously manned or periodically unmanned.
- The ability of the emergency response unit at the facility or within the facility's organisation to provide a timely and effective response.
- Proximity to any outside emergency response units and their ability, availability and time of response.
- Requirements imposed by local regulatory bodies.
- The desired degree of protection beyond regulatory requirements.
- The degree of effective protection a particular vendor's detection and alarm system offers.

The alarm system should have the capability to raise local audible and visual alarms and should annunciate an alarm at a continuously attended central fire control panel. Where fixed gas detection equipment is installed, the panel should indicate the location of the activated gas sensor.

The installation of fire detection equipment that is designed to automatically activate fixed fire fighting equipment may be advisable where a terminal extends away from shore in such a way that manual fire fighting is difficult, dangerous, or ineffective; where fire fighting vessels are not available and accessibility with fire fighting vehicles is poor, or in locations where responsible personnel are limited or are not always available for rapid response.

Where installed, the alarm system should raise a local audible alarm, and possibly a general alarm if the facility is manned and depending upon local circumstances. An alarm should also annunciate at a continuously attended central fire control panel, indicating the location of the activated detection and fire extinguishing system.

In most cases, a manually operated fire protection system is desirable. In this case, the detection system, where installed, sounds a local alarm and sends a signal to a continuously attended control panel upon actuation of a detector. If conditions warrant, the fire protection system may be manually activated by an operator, the fire brigade, or by personnel who monitor the alarm.

Equipment and facility areas that are sometimes monitored with automatic fire or gas detection systems include transfer pumps, valve manifolds, loading arm areas, control rooms, electrical switch gear enclosures, operator’s sheds, below deck areas, and other equipment or areas susceptible to hydrocarbon leaks and spills or that contain ignition sources.

If a detection system covers more than a single detection zone, an annunciator panel should be installed in a continuously attended location in order that the particular activated detection zone can be identified.

19.4.2 CONTROL ROOMS/CONTROL BUILDINGS

When determining necessary detection and alarm equipment for control rooms, the first consideration should always be the requirements of local regulations. Once these have been met, the installation of gas and fire detection devices with associated alarm

In locations where fire fighting vessels are well equipped, continuously available and able to be in attendance very quickly from time of call, for example, within 15-20 minutes, then the scale of fire fighting equipment provided at a berth may be established after consideration of, and in relation to, the calibre of local water borne, fire fighting equipment.

The water borne fire fighting capability is normally best provided by working tugs or workboats fitted with fire fighting equipment, including foam facilities, which should be capable of tackling a deck fire on the largest tanker likely to use the port.

Where the fire-fighting capability of tugs is part of a terminal's planned response to fires on tankers or on the terminal itself, they must be made available as soon as they are required if their contribution is to be effective. Should these tugs be assisting a ship berthing or unberthing at the terminal or in some other part of the harbour when a fire emergency occurs, arrangements must be made to ensure that they can be released in the shortest possible time to assist in fire-fighting. When these tugs are idle between routine tasks, they must be moored with easily slipped moorings, within easy reach and, where possible, within sight of the terminal, and must keep a continuous radio and visual watch on the terminal. Where the attendance of these fire-fighting tugs at a fire cannot be assured within a reasonable time scale, their contribution should not be included when assessing the fire-fighting requirements for the terminal.

In special circumstances, such as terminals handling a high number of tankers or harbours with multiple terminals, consideration may be given to the provision of a specifically equipped fire-fighting vessel.

Fire fighting craft, especially those at terminals with sea island berths, should be equipped with an International Shore Connection for providing firewater to a ship's fire water main, or should have a suitable adaptor for this purpose. The craft should also have a similar connection to enable it to supply water to the terminal fire main. One 63 mm hose connection should be provided for every 57 m^3/hr. of required pumping capacity.

The decision to use tugs to assist in fighting a fire on a tanker or on the terminal, or to use them to sail other vessels in danger of becoming involved, should be made by the person in overall charge of the fire-fighting and in conjunction with the harbour authority. Fire-fighting tugs should be equipped with UHF/VHF radio with separate channels for towing and fire-fighting and, when fire fighting they must be in direct contact with, and under the control of, the person in overall charge of the fire-fighting.

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

A decision should be made as part of the terminal emergency plan as to whether trained fire fighters should board the tug or whether the crew will be used for fire-fighting duties. The decision should be supported with appropriate training for the designated fire fighters.

19.7 PROTECTIVE CLOTHING

All fire protective clothing gives some protection against radiant heat and consequently from burns. Conventional, heavy fire fighting jackets are very good in this respect.

However, modern practice is to provide fire protective clothing that is manufactured from a light-weight, fire resistant fabric incorporating an aluminium covering, sometimes referred to as a fire proximity suit. This type of suit is not suitable for direct fire exposure. Heavier suits, termed fire entry suits, will allow personnel wearing breathing- apparatus with suitable rescue and back-up provisions to withstand direct flame exposure for a limited period.

- The true vapour pressure of the cargo to be loaded.
- The loading rates.
- Atmospheric conditions.

- Any bunkering or storing operations.
- Emergency stop procedure.

A bar diagram is considered to be one of the best means of depicting this plan.

22.6 AGREED DISCHARGE PLAN

On the basis of the information exchanged, an operational agreement should be made in writing between the responsible officer and the terminal representative covering the following:

- Ship's name, berth, date and time.
- Names and signatures of ship and shore representatives.
- Cargo distribution on arrival and departure.
- The following information on each product:
  - Quantity.
  - Shore tank(s) to be filled.
  - Ship's tank(s) to be discharged.
  - Lines to be used ship/shore.
  - Cargo transfer rate.
  - Operating pressure.
  - Maximum allowable pressure.
  - Temperature limits.
  - Venting systems.
- Restrictions necessary because of:
  - Electrostatic precautions.
  - Use of automatic shut-down valves.

The discharge plan should include details and timing of the following: -

- Crude Oil Washing
- Planned slowdowns or stoppages
- Expected trim and freeboard conditions

22.7 REPAIRS

22.7.1 REPAIRS ON THE TANKER

When any repair or maintenance is to be done on board a tanker moored at a berth, the responsible officer must inform the terminal representative. Agreement should be reached on the safety precautions to be taken, with due regard to the nature of the work.

24.12 CONTROL OF NAKED FLAMES AND OTHER POTENTIAL IGNITION SOURCES

The hazards associated with smoking, galleys, electrical equipment and other potential sources of ignition, are discussed in Chapter 4.

24.13 HELICOPTER OPERATIONS

Helicopter operations must not be permitted over the tank deck unless all other operations have been suspended and all cargo tank openings have been closed.

Helicopter operations should only be conducted in accordance with the ICS 'Guide to Helicopter/Ship Operations'.

- Method of determining the temperature of the bunkers during loading.
- Communications procedure for the operation, including emergency stop.
- Monitoring of the bunkering operation and checking it conforms to the agreed procedure
- Changing over tanks during loading.
- Establishing maximum loading volume for all tanks.
- Special precautions when loading into double bottom tanks.
- Containment arrangements and cleanup equipment to be available.
- Manning requirement to execute the operation safely.

Once the procedure is produced it should be implemented by use of a check list, an example of which is included in Section 25.4.3.

25.3 THE BUNKERING OPERATION

The personnel onboard who are designated to manage the bunkering operation should not be involved in other operations. Spillages are often caused by staff being distracted by another task.

Prior to commencing the operation, all pre-loading checks should be carried out and communication systems verified as working.

The loading rate should be checked regularly.

Care should be taken when changing over from one tank to another to ensure that an excessive back pressure is not put on the hose or loading lines.

When topping-off tanks, the loading rate should be decreased to reduce the possibility of air locks in the tank causing mist carry over through the vents and to minimise the risk of the supplier not stopping quickly enough.

On completion of loading, all hoses and lines should be drained to the tank or, if applicable, back to the barge prior to disconnection. The practice of blowing the lines with air into bunker tanks is a common one, but has a high risk of causing a spillage unless the tank is only part full and has sufficient ullage on completion of loading.

25.4 THE BUNKERING SAFETY CHECK LIST

25.4.1 GENERAL

The responsibility and accountability for the safe conduct of operations while a ship is receiving bunkers by barge is shared jointly between the masters of the tanker and the barge. The responsibility for the bunkering operation is usually delegated to designated responsible officers on the ship and on the barge. Before the bunkering operation commences, the responsible officers should:

- Agree in writing on the handling procedures including the maximum transfer rates.
- Agree in writing on the action to be taken in the event of an emergency during transfer operations.
- Complete and sign the Bunkering Safety Check List.

The Bunkering Safety Check List is based upon the Ship Shore Safety Check List (see Section 26.3) and the Pre-Transfer Bunkering Check List contained in the IMO Document 'Safe Transport of Dangerous Cargoes and Related Activities in Port Areas'.

25.4.3 BUNKERING SAFETY CHECK LIST

Location	....	**Date**	....
Ship	....	**Barge**	....
Master	....	**Master**	....

1. BUNKERS TO BE TRANSFERRED

Grade	Tonnes	Volume at Loading Temp.	Loading Temperature	Maximum Transfer Rate	Maximum Line Pressure
Fuel Oil					
Gas Oil/Diesel					
Lub. Oil in Bulk					

2. BUNKER TANKS TO BE LOADED

Tank I.D.	Grade	Volume of Tank @ xx%	Vol. of Oil in Tank before Loading	Available Volume	Volume to be Loaded	Total Volumes by Grade

3. CHECKS PRIOR TO BERTHING

Bunkering	Ship	Barge	Code	Remarks
1. The barge has obtained the necessary permissions to go alongside receiving vessel.				
2. The fenders have been checked, are in good order and there is no possibility of metal to metal contact.		R		
3. Adequate electrical insulating means are in place in the barge/ship connection. **(34)**				
4. All bunker hoses are in good condition and are appropriate for the service intended. **(7)**				

3. CHECKS PRIOR TO TRANSFER

Bunkering	Ship	Barge	Code	Remarks
5. The barge is securely moored. **(2)**			**R**	
6. There is a safe means of access between the ship and barge **(1)**			**R**	
7. Effective communications have been established between responsible officers. (VHF/UHF Ch ....) **(3)**			**A R**	Primary System: Backup System: Emergency Stop Signal:
8. There is an effective watch on board the barge and ship receiving bunkers. **(22)**				
9. Fire hoses and fire fighting equipment on board the barge and ship are ready for immediate use. **(6)**				
10. All scuppers are effectively plugged. Temporarily removed scupper plugs will be monitored at all times. Drip trays are in position on decks around connections and bunker tank vents. **(10) (11)**			**R**	
11.Unused bunker connections are blanked and fully bolted. **(13)**				
12.The transfer hose is properly rigged and fully bolted and secured to manifolds on ship and barge. **(7)**				
13.Overboard valves connected to the cargo system, engine room bilge's and bunker lines are closed and sealed. **(16)**				
14.All cargo and bunker tank hatch lids are closed. **(15)**				
15.Bunker tank contents will be monitored at intervals not exceeding ……. minutes			**A R**	
16.There is a supply of oil spill clean up material readily available for immediate use.				
17.The main radio transmitter aerials are earthed and radars are switched off. **(42)**				
18.The VHF is on low power. **(40)**				

Bulk Liquid - General	Ship	Terminal	Code	Remarks
49. Security protocols have been agreed between the Ship Security Officer and the Port Facility Security Officer, if appropriate.			**A**	

If the ship is fitted, or required to be fitted, with an Inert Gas System (IGS) the following statements should be addressed.

Inert Gas System	Ship	Terminal	Code	Remarks
50. The IGS is fully operational and in good working order.			**P**	
51. Deck seals, or equivalent, are in good working order.			**R**	
52. Liquid levels in pressure/vacuum breakers are correct.			**R**	
53. The fixed and portable oxygen analysers have been calibrated and are working properly.			**R**	
54. All the individual tank IGS valves (if fitted) are correctly set and locked.			**R**	
55. All personnel in charge of cargo operations are aware that in the case of failure of the Inert Gas Plant, discharge operations should cease, and the terminal be advised.				

If the ship is fitted with a crude oil washing (COW) system, and intends to COW, the following statements should be addressed.

Crude Oil Washing	Ship	Terminal	Code	Remarks
56. The Pre-Arrival COW checklist, as contained in the approved COW manual, has been satisfactorily completed.				
57. The COW check lists for use before, during and after COW, as contained in the approved COW manual, are available and being used.			**R**	

If the ship is planning to tank clean alongside, the following statements should be addressed.

Tank Cleaning	Ship	Terminal	Code	Remarks
58. Tank cleaning operations are planned during the ship's stay alongside the shore installation.	**Yes/No***	**Yes/No***		
59. If 'yes' the procedures and approvals for tank cleaning have been agreed.				
60. Permission has been granted for gas freeing operations.	**Yes/No***	**Yes/No***		

** Delete Yes or No as appropriate*

PART ‘C’ – BULK LIQUID CHEMICALS - VERBAL VERIFICATION

Bulk Liquid Chemicals	Ship	Terminal	Code	Remarks
1. Material Safety Data Sheets are available giving the necessary data for the safe handling of the cargo.				
2. A manufacturer’s inhibition certificate, where applicable, has been provided.			**P**	
3. Counter measures against accidental personal contact with the cargo have been agreed.				
4. Sufficient protective clothing and equipment (including self-contained breathing apparatus) is ready for immediate use and is suitable for the product being handled.				
5. The cargo handling rate is compatible with the automatic shut down system, if in use.			**A**	
6. Cargo system gauges and alarms are correctly set and in good order.				
7. Portable vapour detection instruments are readily available for the products being handled.				
8. Information on fire-fighting media and procedures has been exchanged.				
9. Transfer hoses are of suitable material, resistant to the action of the products being handled.				
10. Cargo handling is being performed with the permanent installed pipeline system.			**P**	

26.4 GUIDELINES FOR COMPLETING THE SHIP/SHORE SAFETY CHECK LIST

PART 'A' - BULK LIQUID GENERAL – PHYSICAL CHECKS

1. There is safe access between ship and shore.

The access should be positioned as far away from the manifolds as practicable.

The means of access to the ship should be safe and may consist of an appropriate gangway or accommodation ladder with a properly secured safety net fitted to it.

Particular attention to safe access should be given where the difference in level between the point of access on the vessel and the jetty or quay is large, or is likely to become large.

When terminal access facilities are not available and a ship's gangway is used, there should be an adequate landing area on the berth so as to provide the gangway with a sufficient clear run of space and so maintain safe and convenient access to the ship at all states of tide and changes in the ship's freeboard.

Near the access ashore, appropriate life-saving equipment should be provided by the terminal. A lifebuoy should be available on board the ship near the gangway or accommodation ladder.

The access should be safely and properly illuminated during darkness.

Persons who have no legitimate business on board, or who do not have the master's permission, should be refused access to the ship.

The terminal should control access to the jetty or berth in agreement with the ship.

2. The ship is securely moored.

In answering this question, due regard should be given to the need for adequate fendering arrangements.

Ships should remain adequately secured in their moorings. Alongside piers or quays, ranging of the ship should be prevented by keeping all mooring lines taut. Attention should be given to the movement of the ship caused by wind, currents, tides or passing ships and the operation in progress.

Wire ropes and fibre ropes should not be used together in the same direction (i.e. as breast lines, spring lines, head or stern lines) because of the difference in their elastic properties.

Once moored, ships fitted with automatic tension winches should not use such winches in the automatic mode.

Means should be provided to enable quick and safe release of the ship in case of an emergency. In ports where anchors are required to be used, special consideration should be given to this matter.

Irrespective of the mooring method used, the emergency release operation should be agreed, taking into account the possible risks involved.

Anchors not in use should be properly secured.

3. The agreed ship/shore communication system is operative.

Communication should be maintained in the most efficient way between the responsible officer on duty on the ship and the responsible person ashore.

When telephones are used, the telephone both on board and ashore should be continuously manned by a person who can immediately contact his respective supervisor.

Jetty manifolds should ideally be provided with fixed drip trays; in their absence portable drip trays should be used.

Spill or slop transfer facilities should be well maintained and, if not an automatic system, should be readily available to deal with issues such as spilled product or rainwater.

13. The ship's unused cargo and bunker connections are properly secured with blank flanges fully bolted.

Unused cargo and bunker line connections should be closed and blanked. Blank flanges should be fully bolted and other types of fittings, if used, properly secured.

14. The terminal's unused cargo and bunker connections are properly secured with blank flanges fully bolted.

Unused cargo and bunker connections should be closed and blanked. Blank flanges should be fully bolted and other types of fittings, if used, properly secured.

15. All cargo, ballast and bunker tank lids are closed.

Apart from the openings in use for tank venting (refer to item 29), all openings to cargo tanks should be closed and gastight.

Except on gas tankers, ullaging and sampling points may be opened for the short periods necessary for ullaging and sampling, which activities should be conducted taking account of the controls necessary to avoid electrostatic discharge.

Closed ullaging and sampling systems should he used where required by international, national or local regulations and agreements.

16. Sea and overboard discharge valves, when not in use, are closed and visibly secured.

Experience shows the importance of this item in pollution avoidance on ships where cargo lines and ballast systems are interconnected. Remote operating controls for such valves should be identified in order to avoid inadvertent opening.

If appropriate, the security of the valves in question should be checked visually.

17. All external doors, ports and windows in the accommodation, stores and machinery spaces are closed. Engine Room vents may be open.

External doors, windows and portholes in the accommodation should be closed during cargo operations. These doors should be clearly marked as being required to be closed during such operations, but at no time should they be locked.

This requirement does not prevent reasonable access to spaces during operations, but doors should not be left open unattended.

Engine Room vents may be left open. However, consideration should be given to closing them where such action would not adversely impact on the safe and efficient operation of the engine room spaces served.

18. The ship's emergency fire control plans are located externally.

A set of fire control plans should be permanently stored in a prominently marked weather-tight enclosure outside the deckhouse for the assistance of shoreside fire-fighting personnel. A crew list should also be included in this enclosure.

A written agreement should be made between the ship and shore supervisors indicating whether the cargo handling rate will be adjusted or alternative systems will be used.

6. Cargo system gauges and alarms are correctly set and in good order.

Ship and shore cargo system gauges and alarms should be regularly checked to ensure they are in good working order.

In cases where it is possible to set alarms to different levels, the alarm should be set to the required level.

7. Portable vapour detection instruments are readily available for the products being handled.

The equipment provided should be capable of measuring, where appropriate, flammable and/or toxic levels.

Suitable equipment should be available to calibrate those instruments capable of measuring flammability. Calibration should be carried out before the operation commences.

8. Information on fire-fighting media and procedures has been exchanged.

Information should be exchanged on the availability of fire-fighting equipment and the procedures to be followed in the event of a fire on board or ashore.

Special attention should be given to any products which are being handled which may be water reactive or which require specialised fire-fighting procedures.

9. Transfer hoses are of suitable material, resistant to the action of the products being handled.

Each transfer hose should be indelibly marked so as to allow the identification of the products for which it is suitable, its specified maximum working pressure, the test pressure and last date of testing at this pressure, and, if used at temperatures other than ambient, its maximum and minimum service temperatures.

10. Cargo handling is being performed with the permanent installed pipeline system.

All cargo transfer should be through permanently-installed pipeline systems on board and ashore.

Should it be necessary, for specific operational reasons, to use portable cargo lines on board or ashore, care should be taken to ensure that these lines are correctly positioned and assembled in order to minimise any additional risks associated with their use. Where necessary, the electrical continuity of these lines should be checked and their length should be kept as short as possible.

The use of non-permanent transfer equipment inside tanks is not generally permitted unless specific approvals have been obtained.

Whenever cargo hoses are used to make connections within the ship or shore permanent pipeline system, these connections should be properly secured, kept as short as possible and be electrically continuous to the ship and shore pipeline respectively. Any hoses used must be suitable for the service and be properly tested, marked and certified.

26.5 EMERGENCY ACTIONS

The actions to be taken in the event of an emergency at a terminal should be contained in the terminal's Emergency Plan. (See Chapter 20). Particular attention should be given to the decision to remove the vessel from the berth in the event of one of the following emergencies occurring (see also Section 20.5).

26.5.1 FIRE OR EXPLOSION ON A BERTH

Action by Vessels

Should a fire or explosion occur on a berth, the ship or ships at the berth must immediately report the incident to the terminal control room by the quickest possible method (VHF/UHF, telephone contact, sounding ship's siren, etc.). All cargo, bunkering, deballasting and tank cleaning operations should be shut down and all cargo arms or hoses should be drained ready for disconnection.

The ships' fire mains should be pressurised and water fog applied in strategic places. The ships' engines, steering gear and unmooring equipment must be brought to a state of immediate readiness. A pilot ladder should be deployed on the offshore side.

Action by Vessels at Other Berths

On hearing the terminal alarm being sounded or on being otherwise advised of a fire at the terminal, a ship whose berth is not involved in the fire, should shut down all cargo, bunkering and ballasting operations. Fire-fighting systems should brought to a state of readiness and engines, steering gear and mooring equipment should be made ready for immediate use.

26.5.2 FIRE ON A TANKER AT A TERMINAL

Action by Ship's Personnel

If a fire breaks out on a tanker while at a terminal, the tanker must raise the alarm by sounding the recognised alarm signal consisting of a series of long blasts on the ship's whistle, each blast being not less than 10 seconds in duration, unless the terminal has notified the ship of some other locally-recognised alarm signal. All cargo, bunkering, or ballasting operations must be stopped and the main engines and steering gear brought to a stand by condition.

Once the alarm has been raised, responsibility for fighting the fire on board the ship will rest with the master or other responsible officer assisted by the ship's crew. The same emergency organisation should be used as when the ship is at sea (see Section 9.9.2.2) with an additional group under the command of an officer or senior rating to make preparations, where possible, for disconnecting metal arms or hoses from the manifold.

On mobilisation of the terminal and, where applicable, the civil fire-fighting forces and equipment, the master or other responsible officer, in conjunction with the professional fire fighters, must make a united effort to bring the fire under control.

Action by Terminal Personnel

On hearing a tanker sounding its fire alarm, the person in charge of a berth must immediately advise the control room. The control room personnel will sound the terminal fire alarm, inform the port authority and commence shutting down any loading, discharging, bunkering or deballasting operations which may be taking place.

The terminal's fire emergency plan will be activated and this may involve shutting down cargo, bunkering, and ballast handling operations on ships on adjacent or neighbouring berths. All other ships at the terminal should be informed of the emergency and, where considered necessary, make preparations to disconnect metal arms or hoses and bring their engines and steering gear to a state of readiness.

Figure 26.1 Example of Fire Instructions Notice

IN CASE OF FIRE, DO NOT HESITATE TO RAISE THE ALARM

TERMINAL FIRE ALARM:

At this terminal, the fire alarm signal is ....

IN CASE OF FIRE:

1. Sound one or more blasts on the ship's whistle, each blast of not less than ten seconds duration supplemented by a continuous sounding of the general alarm system.
2. Contact the terminal.

   Telephone ....

   UHF/VHF channel ....

ACTION – SHIP

Fire on your Ship:	**Fire on another Ship or Ashore:**
• Raise alarm • Fight fire with aim of preventing spread • Inform terminal • Cease all cargo/ballast operations and close all valves • Stand by to disconnect hoses or arms • Bring engines to standby	Stand by, and when instructed: • Cease all cargo/ballast operations and close all valves • Disconnect hoses or arms • Bring engines and crew to standby, ready to unberth

ACTION – TERMINAL

Fire on a Ship:	**Fire Ashore:**
• Raise alarm • Contact ship • Cease all cargo/ballast operations and close all valves • Stand by to disconnect hoses or arms • Stand by to assist fire fighting • Inform all ships • Implement terminal emergency plan	• Raise alarm • Cease all cargo/ballast operations and close all valves • Fight fire with aim of preventing spread • If required, standby to disconnect hoses or arms • Inform all ships • Implement terminal emergency plan

IN THE CASE OF FIRE, TERMINAL PERSONNEL WILL DIRECT THE MOVEMENT OF VEHICULAR TRAFFIC ASHORE.