Loss Prevention Guide

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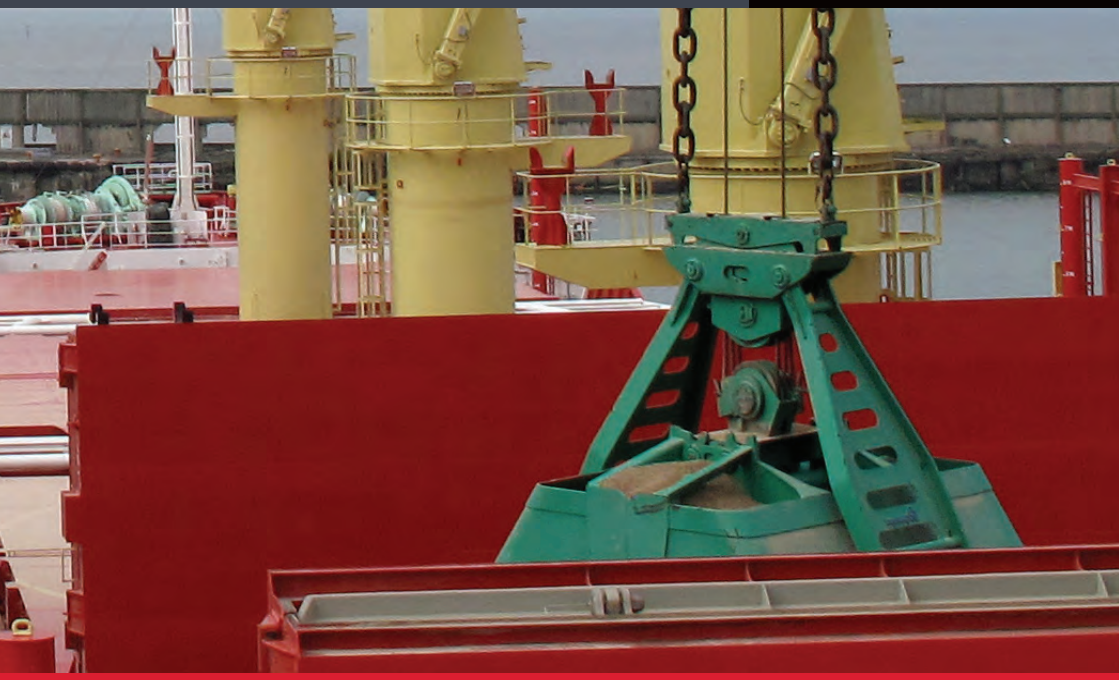

BULK CARGOES: A GUIDE TO GOOD PRACTICE

Charles Bliault, Martin Jonas and The North of England P&I Association

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THE NORTH OF ENGLAND P&I ASSOCIATION

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TERMS OF USE

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Chapter 1

INTRODUCTION

For more than 100 years some cargoes such as grain and coal have been shipped around the world in bulk. The range of cargoes carried in bulk has increased dramatically during recent decades, rising to over 3 billion tonnes a year. The types of bulk cargoes carried – in addition to grain and coal – now include animal foodstuffs, fertilizers, mineral concentrates and ores, scrap metal and biofuels such as wood pellets. The vast majority of bulk cargo voyages are completed without incident but there have been many occasions when things have not gone to plan. In some instances the cargo suffered damage but there was no harm done to the ship or the crew. On other occasions the ship suffered damage as a result of the cargo shifting. Unfortunately some ships have been lost with all hands because of problems with the cargo or because of defects or damage to the ship.

Along with the huge variety of bulk cargoes, masters of ships that carry them need to contend with a wide range of hold cleanliness, cargo care and cargo carriage requirements. Each type presents the master with a different set of problems. In addition, loading and unloading operations must be monitored closely to ensure the correct procedures are followed. Problems associated with care and carriage of bulk cargoes include possible shifting, either because it has not been stowed correctly or because it has been loaded with too high a moisture content. Chemical reactions within cargo, such as emission of toxic or flammable gases, spontaneous heating that might lead to combustion or severe corrosive effects, can occur at any time during the voyage. Also, if cargo is loaded or unloaded unevenly, the ship might be structurally damaged during loading or unloading or during the voyage, particularly if part of the cargo shifts. In addition, the master must ensure weather-deck hatch covers are in satisfactory condition, cargo compartments are cleaned and maintained to the standard required for the cargo to be loaded, and the ship is fitted for carriage of the specific cargo.

During carriage of a bulk cargo the crew should monitor its condition and the atmosphere in the head space above it as required, ensuring at all times correct procedures are followed for safety of personnel. When ballast water is used, this should be managed to ensure there is the required amount of ballast on board, structural limits are not exceeded, ballast water is pumped in and out in accordance with loading and unloading procedures, and it is exchanged or treated during ocean voyages. Other operations and procedures requiring proper management include fumigation of cargo, measurement of cargo on board and use of grabs and ship's gear.

This guide explains basic rules to be remembered on every occasion during loading, carriage and unloading of bulk cargoes. It describes where various regulations, recommendations and general guidance can be found, and discusses procedures, preparations and good seamanship practice for appropriate and safe carriage of cargoes in bulk. It also describes the problems and recommended procedures associated with particular types of bulk cargo, and then gives some guidance on points to be remembered during passage planning and the voyage itself. It is not intended the guide will give all information necessary to carry each and every product and commodity. To do so would

require inclusion of all appropriate codes and guides published for all cargoes. Instead, it sets out basics and points to publications which give the rules to be followed, and sets out guidance and recommendations with regard to problems and questions often encountered by masters of ships carrying bulk commodities.

Chapter VI of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, gives requirements for carriage of all cargoes in three parts: general provisions, special provisions for bulk cargoes other than grain, and carriage of grain. The regulations refer to codes of practice published by the International Maritime Organization (IMO). The latest version of each appropriate code must be on board and code procedures and requirements must be followed completely on each and every occasion.

Despite there being codes of safe practice and publications giving advice on loading, unloading and carriage of bulk cargoes, incidents continue to occur. During these incidents damage is sustained by the cargo or by the ship and/or the people on board are injured. It has been recognised for some time that, when ship's staff have greater knowledge and are more aware of hazards, those hazards can be minimised or avoided and accidents can be prevented. The object of this guide is to increase seafarers' knowledge of things acting on cargo operations and carriage, of basic requirements for bulk shipment operations, and of relevant codes and guidelines. The overall objective is to aid loss prevention.

Chapter 2 includes some basic information and pointers to where regulations, recommendations and guidance can be found, and Chapter 3 gives more specific information about and guidance on IMO publications that affect the operation of ships carrying bulk commodities. Chapter 4 describes the various operations that take place on board and Chapter 5 sets out the routine procedures which must be followed if the cargo is to be carried without significant problems being encountered.

Chapter 6 provides general information and guidance on types of cargoes and their specific hazards, after which Chapter 7 looks at a number of commodities which have their own specific problems and requirements. Each of those commodities, and their particular problems, is described. Guidance is given on hold preparation, loading, carriage, discharge and subsequent cleaning operations.

The voyage is dealt with in Chapter 8. For each part of a voyage, in sequence, operations are discussed, any associated problems are highlighted and the possible outcomes of failure to carry out tasks properly are described. Required and seamanlike procedures are set out in 'Loss prevention action'. This arrangement of the information is intended for ease of use and there are references to sections of Chapters 2 and 7 for more detailed guidance.

Chapter 2

GENERAL INFORMATION

BASIC RULES TO BE FOLLOWED

There is a wide range of commodities and products carried in bulk and there are various procedures to ensure the cargo is carried without problems arising. Here are some rules that are essentially common-sense and follow good seamanship practice. They should all be borne in mind during every voyage when bulk cargo is carried – the only exception being fumigation, which is only required for certain cargoes.

Planning and hold preparation

- Establish the identity and nature of the cargo to be loaded. The name of the cargo should be internationally recognised either as a grain under the International Grain Code or as a bulk cargo shipping name (BCSN) as listed in the International Maritime Solid Bulk Cargoes (IMSBC) Code. A trade name is not necessarily a BCSN. The shipper must provide a cargo declaration showing the BCSN.
- Ensure the cargo being put forward for carriage is a cargo which can be safely carried on board. Reference should be made to the Document of Compliance for Ships Carrying Dangerous Goods, the certificate of compliance with the IMSBC Code (if on board) or the Grain Loading Manual, as appropriate.
- Ensure the ship is capable of carrying the cargo – consideration should be given to the weight, density and stowage factor of the cargo, the volume of the holds, the maximum permissible tank top loading and any draught restrictions. Be thoroughly familiar with the regulations, recommendations and requirements of appropriate IMO publications.
- Obtain details of all local regulations and requirements which apply to the cargo to be carried and be guided accordingly.
- Be thoroughly familiar with the contents of the ship's safety management system (SMS) procedures and ensure all appropriate procedures are followed.
- Remember both the IMSBC Code and the International Grain Code are mandatory, and they apply to all ships carrying grain or solid bulk cargo – general cargo ships and all types of bulk carrier.
- Ensure the ship is properly fitted to carry the cargo safely.
- Ensure cargo compartments are properly and appropriately maintained and they are cleaned and prepared to the standard required for the cargo.
- Obtain carriage instructions from the ship operator and/or charterer, including ventilation requirements.
- Ensure the ship is suitable for the intended loading terminal.
- Carry out all necessary calculations to produce a pre-stowage plan, complete strength and stability calculations and, if appropriate, grain stability calculations to ensure the cargo, in the chosen stowage arrangement, can be safely carried to destination.
- Carry out draught, trim, strength and stability calculations for all stages of loading and de-ballasting operations and prepare a loading plan.

Loading

- Obtain copies of all appropriate certificate(s) for the cargo before loading is started (as appropriate, moisture content, transportable moisture limit (TML), density and so on) and ensure the document(s) are in the correct form, can be clearly understood and give all appropriate information for safe loading and carriage of the intended cargo.
- Establish contact and maintain contact with the terminal representative at the loading berth to exchange information and reach agreement with regard to the loading and de-ballasting procedures, and to ensure the loading operation proceeds as intended.
- Monitor the draught or air draught of the ship as the loading and de-ballasting progresses to ensure operations are progressing as planned.
- Examine the cargo during loading to ensure it is as described in the documentation and to establish its apparent condition. Ensure the cargo is, so far as can be determined, in a condition suitable for safe carriage to destination.
- Closely monitor loading and de-ballasting procedures to ensure the cargo and de-ballasting operations are proceeding as planned and if they are not, suspend operations until further discussions have been held between ship's personnel and the terminal representative.
- If the cargo is to be fumigated, ensure the operatives of the fumigation company are appropriately trained and they carry out the fumigation in accordance with International Maritime Organization (IMO) recommendations.

The voyage

- Ensure all the appropriate carriage instructions, including with regard to ventilation and fumigation (as appropriate), are followed during the voyage.
- Carry out draught, trim, strength and stability calculations for all stages of offloading and ballasting operations and prepare an unloading plan.

Unloading

- Establish contact and maintain contact with the terminal representative at the offloading berth to exchange information and reach agreement with regard to the offloading and ballasting procedures, and to ensure the offloading operation proceeds as intended.
- Ensure the ship is suitable for the intended discharging terminal.
- Monitor the draught and air draught of the ship as the offloading and ballasting progresses to ensure operations are progressing as planned.
- Closely monitor offloading and ballasting procedures to ensure the cargo and ballasting operations are proceeding as planned and, if they are not, operations should be suspended until further discussions have been held between ship's personnel and the terminal representative.

General

- Keep ship operator and any charterer fully advised of the various aspects of the pre-loading calculations and operations, the loading operation, the voyage and the unloading operation throughout their progress.
- Be aware of the possible need to involve the local P&I representative to provide additional information and guidance.

TYPES OF SHIPS

The variety of types of cargo carried in bulk form is vast. Some of the cargoes are raw materials which may require processing before being used, while others may be fully processed and will be used directly after delivery. Some commodities are shipped in huge quantities over large distances between continents, whereas some bulk products are carried over short distances in small parcels. Also, some are very dense with a small stowage factor, while others are light having a very large stowage factor, but all have particular characteristics which must be taken into account.

The ships that carry these cargoes range from small general cargo ships, through large multi-purpose ships to very large bulk carriers which are designed for a particular trade.

General cargo ships

All types of general cargo ships carry, at some time, shipments of bulk commodities. The types include multi-purpose ships, container and general cargo ships, 'tween deckers, heavy lift ships and straightforward general cargo ships. Shipments of bulk cargoes might, on some occasions, occupy the entire deadweight of the ship, while on other occasions it might occupy only one or perhaps two lower hold compartments, with break bulk products being carried in other holds and/or in the 'tween decks.

When cargoes in bulk are carried, the requirements with regard to stowage, as set out in the IMSBC Code and/or in the International Grain Code, must always be complied with. Requirements for ventilation and access for inspections must always be borne in mind during the planning of a voyage with such a combination of cargoes.

Bulk carriers

To cater for the bulk trades of the world, distinctive types of bulk carrier have been developed. The development of these types of ship has also been influenced by international regulations and the basic requirements that the cargo is carried safely and such that the ship is not in any way overstressed at any stage. The various requirements have, in turn, led to the development of bulk carriers with special characteristics for the carriage of certain commodities.

As the size of shipments became larger and the size of bulk carriers increased, particularly influenced by the carriage of grain, two features became almost universal in these large ships: longitudinal framing to improve longitudinal strength and the incorporation of top-side tanks and hopper tanks.

The tanks, which are usually separate from the cargo holds, provide additional ballast capacity for long return ballast passages. The lower hopper tanks also assist in the discharge operation because cargo flows down the slope plating to the reduced area of the tank top closer to the square of the hatch, where it is more accessible to grabs or discharge elevators. Top-side tanks means that grain cargoes can be carried safely without the fitting of grain feeders and shifting boards, which were necessary to reduce the grain heeling moments when general cargo ships were used. Hopper tanks reduce the GM of a bulk carrier, which might otherwise be very large when a dense cargo such as iron ore is being carried.

Further developments have included arrangements of side tanks for ore-bulk-oil (OBO) and similar carriers, smaller hatch openings for ships carrying only bulk commodities, and double-hull construction in combination with large open hatch

arrangements for multi-purpose ships operating on trades where solid bulk commodities will be carried during some periods but where break bulk or unitised cargoes, such as timber, pallets or containers, might be carried at other times. In addition to these generally larger type bulk carriers, there are of course general cargo ships and smaller bulk carriers which will carry a variety of types of cargo and commodities.

Very large ore carriers

Very large ore carriers (VLOCs) are of deadweight more than 180,000 tonnes, some of which have a deadweight of more than 300,000 tonnes, and are employed on particular trades primarily between Australia and China, and between Brazil and Europe or China.

Cape-size bulkers

Cape-size bulkers are of deadweights in the range from about 80,000 to 180,000 tonnes and of loaded draught in excess of 17 m, and are normally employed in the carriage of materials such as iron ore and coal. These large ships can be accepted into only a small number of ports around the world and therefore their trade routes are somewhat limited. They are not fitted with cargo handling equipment and they are normally designed with nine hatches and holds. Often two holds are fitted for the carriage of ballast water, and the ships are frequently designed and strengthened for carriage of heavy cargoes in alternate holds. Cape-size bulkers may also be designed and equipped to take a limited quantity of ballast in two holds in addition to the ballast holds while in port. This is to reduce the air draught and to allow loading or discharging equipment to plumb the hatch when cargo operations commence.

Panamax bulkers

Panamax bulkers are designed to have a deadweight capacity in the range from about 50,000 to around 80,000 tonnes while being suitable for transit of the Panama Canal. The limiting dimensions of the original canal are length 289.5 m, breadth 32.3 m and draught 12.04 m in tropical fresh water. These bulkers have a summer draught in sea water in excess of the canal limit (possibly around 13.5 m) and therefore will be only partly loaded, in deadweight terms, when at the required fresh water draught of 12.04 m. However, when some cargoes with a large stowage factor are carried, such as grain, the holds will be full or nearly full to capacity when the bulker is loaded to the required 12.04 m draught. Many of these bulkers have a length of 225 m and a beam of 30 m, a little less than the maximum for the canal. These bulkers are engaged on worldwide trades because most major ports can accommodate them. They are employed in the carriage of most types of cargo, including bauxite, coal, grain, iron ore and seed cake, and often carry different grades or types of cargo during a voyage. They are usually designed with seven hatches and holds, are often strengthened for the carriage of heavy cargoes in alternate holds and one or two of the holds will be fitted for the carriage of water ballast. Panamax bulkers may also be designed and equipped to take a limited quantity of ballast in two holds in addition to the ballast hold, while in port, to reduce the air draught and to allow the loading or discharging equipment to plumb the hatch, and cargo operations to proceed. They are normally not fitted with cargo handling equipment.

New panamax bulkers

Expansion of the Panama Canal includes a third lane of locks, which are larger than the original two lanes. These new locks have dimensions; length 427 m, breadth 55 m and depth 18.3 m, such that the new panamax limiting dimensions will be; length 366 m, beam 49 m and draught 15.2 m.

Handy-size bulkers

Handy-size bulkers, over the whole group, have a deadweight capacity in the range from around 10,000 to around 50,000 tonnes. Small handy-size bulkers are in the range from 10,000 to 28,000 tonnes, while larger ships in this group, sometimes known as handymax or supramax bulkers, have a deadweight of more than 40,000 tonnes. Handy-size bulkers of deadweight more than about 28,000 tonnes are usually constructed with five holds and hatches, are often strengthened for heavy cargoes in alternate holds and such that hold no.3 can take ballast water. They are often fitted with deck cranes for handling cargo. Smaller handy-size bulkers will have different characteristics with regard to the number of cargo compartments, the construction of these compartments, and the cargo handling gear, if any. All handy-size bulkers are ideal for smaller shipments of commodities or a number of grades of a type of cargo.

Mini-bulkers

Mini-bulkers, having a carrying capacity of less than 10,000 tonnes, are employed for the most part along coastal routes but will also trade over greater distances. Many of these ships have one, or two, box-shaped compartments, possibly with moveable transverse bulkheads and with portable pontoons for the fitting of a single 'tween deck. They will routinely carry break bulk items, perhaps heavy lift or project type cargoes, as well as bulk commodities ranging from fertiliser to grain and, when fitted with transverse bulkheads, they can carry small shipments of different commodities at the same time.

Some bulk carriers are designed and built for specific trades or for the carriage of specific cargoes. Ore carriers have deep double-bottom tanks and two longitudinal bulkheads to produce side tanks to port and to starboard, so that when ore is carried in the centre holds only, the centre of gravity of the cargo is kept fairly high. This design arrangement was modified to produce ore–oil carriers with ore being carried in the centre holds during one voyage and oil being carried in the wing tanks and the holds, if appropriate, during another leg of a voyage. OBO carriers were fitted such that, as the name suggests, the ship could carry a wide variety of bulk cargoes or oil. These specialised ships do not now carry such a variety of cargoes. The required maintenance and repair of pipework systems was not economically viable and only a few ships remain in service, carrying only dry bulk cargoes.

Wood chips, a very light commodity, are unlikely to shift during an ocean voyage and bulkers with a large cubic capacity and no top-side or hopper tanks have been built for their carriage. Cement must be kept dry at all times and a closed system of loading and offloading is advantageous. For this, some handy-size bulkers have been fitted with loading ports in the weather-deck hatch covers, such that the cement can be loaded by spout via these ports without the hatch covers being opened and some bulkers have been built specifically for the carriage of cement with no weather-deck hatches but with piping arrangements on the weather-deck instead.

While handy-sized bulk carriers are designed specifically for the carriage of bulk commodities, they are often used for the carriage of a wide variety of break bulk items as well. Such break bulk items might include steel products, timber and other forest products, cased machinery and bags of produce. Many ships employed on such trades are bulk carriers while others are multi-purpose bulkers. Also, other multi-purpose ships have characteristics not associated with bulk trades: large hatchways, no hopper tanks and no top-side tanks. Such arrangements might lead to the inability to carry grain, but other bulk commodities such as bauxite, seed cake and sand can be carried, and such a ship has a greater bale capacity ideal for timber, logs, palletised units and similar commodities.

Block loading

Block loading is the name given to a condition in which adjacent holds are heavily loaded while one or more of the other holds remain empty. Block loading is used when it is required to load a number of cargo parcels in one or more load-ports for offloading at one or more discharge ports or berths. Block loading places an increased load on the transverse bulkhead and cross-deck structure between the two full holds. Classification societies have provided some ships with approved plans for block loading.

If block loading is to be employed and the ship is approved to do so, the following should be remembered.

Block loading checklist

- The maximum permitted load in any hold should never be exceeded.
- When loading adjacent holds, use only those holds specified in the loading manual.
- If a departure from the above is considered, or if the ship has not been provided with approved block loading conditions, then the classification society should be consulted for further guidance.

TERMS IN GENERAL USE

The definitions for the terms given in this section are for general guidance only, and are explanations of the meaning of the terms which are in general usage. They are not legal definitions. The definitions and explanations have in some cases been taken from International Maritime Organization (IMO) publications and some are given in other publications, although most were drawn up by the authors.

Angle of repose

The maximum slope angle of non-cohesive (that is free-flowing) granular material. It is the angle between the horizontal plane and the cone slope of such material.

Bale capacity

The volume of a cargo compartment inside the beams, frames and other stiffening members, such that the space between those beams, frames and other stiffening members is not included.

Box hold

A hold which is, or is very nearly, of rectangular cross-section both across its full length and breadth. The ship will be of double-hull construction, with no exposed frames, having neither topside tanks nor hopper tanks to the sides, and end bulkheads will not be fitted with inward-sloping base-stool spaces. The hatchway will be of open, or nearly open, hatch design, with no or small under-deck areas on any side. Exceptions might be due to hull flare, where the sides of the hold(s) might be stepped inwards or angled inwards; this should be made clear in any charterparty.

Bulk cargo shipping name (BCSN)

Commonly carried solid bulk cargoes, other than grain, have been assigned a bulk cargo shipping name (BCSN) which is used in the IMSBC Code. A bulk cargo must be identified on the transport documents, in particular on the cargo declaration, by the BCSN. In this guide, references to specific BCSNs are given in all upper case (e.g. COAL).

Can test

A complementary procedure, described in section 8 of the IMSBC Code, which can be carried out by the master to assess the approximate possibility of flow of a cargo which may liquefy, that is a Group A cargo. This is complementary to, but can never replace, proper sampling followed by laboratory testing.

Cargo declaration

Information about the bulk cargo to be shipped must be given, prior to loading, to the master by the shipper in accordance with section 4 of the IMSBC Code. That information is to be accompanied by a cargo declaration.

Chemical hazard

Some solid materials transported in bulk may present a hazard during transport because of their chemical nature or properties. Such hazards include being easily ignited, being liable to spontaneous heating or combustion, being liable to evolve flammable gases, being liable to yield oxygen or oxidise, or being toxic, infectious, radioactive or corrosive.

Competent authority

A national regulatory body or authority designated or otherwise recognised as such for any purposes in connection with the IMSBC Code. It should be noted that the competent authority shall operate independently from the shipper of cargo.

Condition survey

Surveys carried out in conjunction with an on-hire or off-hire inspection to establish the general conditions and cleanliness of the cargo holds. These surveys do not routinely require inspections for the hold cleanliness or suitability of a hold for the carriage of any particular cargo, but specific instructions in this regard may be given to the surveyor if appropriate.

Dangerous goods in bulk

Cargoes assigned a UN number and hazard class under the International Maritime Dangerous Goods (IMDG) Code. All dangerous goods carried in bulk are Group B

cargoes. However, some Group B cargoes are not subject to the IMDG Code but are classed as materials hazardous only in bulk (MHB).

Deadweight

The weight carrying capacity of the ship in tonnes, or tons, including the weight of cargo, stores, fresh water, fuel, crew, the ship's constant and other items normally carried, when loaded to a particular load line, for example the summer load line in sea water.

Density

The mass of a unit volume of cargo, usually expressed in tonnes per cubic metre (t/m^3).

Displacement

Either load or light, is the weight, in tonnes or tons, equivalent to the quantity of water displaced by the ship when floating at a particular draught.

Document of Authorisation

A document which is issued by the administration (the flag state or a classification society acting on its behalf), which is evidence the ship is capable of carrying grain in bulk in accordance with the requirements of the International Grain Code.

Document of Compliance for Ships Carrying Dangerous Goods

A document sometimes referred to as a 'Document of Compliance for the carriage of dangerous goods' or 'Document of Compliance with the IMDG Code', which is issued by the administration (the flag state or a classification society acting on its behalf) as evidence the ship is in compliance with the construction and equipment requirements of SOLAS chapter 11-2, regulation 19. That regulation sets out details of additional safety measures for fire safety for ships carrying dangerous goods. The document is a mandatory requirement for such ships. The document is not required for those cargoes specified as class 6.2 and 7, as defined in SOLAS chapter VII, regulation 2, and dangerous goods in limited quantities. Reference is also made to the document in paragraph 4.8.3 of the IMSBC Code. The Document of Compliance should not be confused with a 'certificate of compliance with the IMSBC Code', which is not a class or IMO required certificate but which is sometimes issued together with attachments to provide information to enable the master to determine which types of solid bulk cargoes are permitted to be carried on board.

Draught

The depth to which a ship is immersed in the water. The US spelling 'draft' is also in common usage.

Flow moisture point (FMP)

The percentage moisture content (wet basis) at which a flow state develops under the prescribed method of test in a representative sample of the material. See transportable moisture limit (TML).

Flow state

The state that occurs when a mass of granular material is saturated with liquid to an extent that, under the influence of prevailing external forces such as vibration, impaction or ship's motion, it loses its internal shear strength and behaves as a fluid.

Grain

Includes wheat, maize (corn), oats, rye, barley, rice, pulses, seeds and processed forms of seeds, the behaviour of which is similar to that of grain in its natural state, as given in the International Grain Code, but also includes soya beans, sorghum, sunflower seeds and a variety of other oil seeds and grains. Also, non-cohesive bulk commodities having an angle of repose less than or equal to 30º which, therefore, flow like grain and may be considered, for stowage and stability purposes, to be grain. Those other bulk commodities may have hazards as given in the IMSBC Code and will be assigned a BCSN.

Grain capacity

The total volume of a cargo compartment from the tank top to the underside of the deck plating, including all space between frames, beams and other strength members, into which grain could in theory be stowed.

Grain clean

The standard of cleanliness of a cargo compartment which is required to be met before grain can be loaded into it. The government agency with authority at the loading port will normally have guidelines for the standard of cleanliness required. The standard required is different at the ports of different exporting countries, and for different types of grain, and therefore there is a fairly narrow band within which the various requirements fall rather than there being a single clear definition.

Grain heeling moment

If part or all of a grain cargo were to shift in the hold(s), that movement would produce an upsetting moment equal to the product of the weight of the grain which has shifted and the distance moved. That moment is a grain heeling moment and it will cause the ship to list.

Grain Loading Manual

A booklet which contains information to enable the master to carry out calculations to demonstrate that the ship complies with the requirements of the International Grain Code when carrying grain in bulk on an international voyage. The information set out in the booklet shall include that which is listed in regulation A 6 of the International Grain Code.

Gross tonnage

A dimensionless index of the overall internal volume of a ship, which is a function of the moulded volume of all enclosed spaces of the ship, including the machinery space, navigation spaces and other designated parts of the ship.

Group A

IMSBC Code – cargoes which may liquefy if shipped at a moisture content in excess of their transportable moisture limit (TML).

Group B

IMSBC Code – cargoes which possess a chemical hazard which could give rise to a dangerous situation on board the carrying ship.

Group C

IMSBC Code – cargoes which are neither liable to liquefy (Group A) nor possess chemical hazards (Group B).

Harmful to the marine environment (HME)

Substances, including marine pollutants and environmentally harmful substances (EHS), as defined by the International Convention for the Prevention of Pollution from Ships (MARPOL), annex V, as amended.

Liquefy, liquefaction

A cargo which contains a certain proportion of small particles and a certain amount of moisture may liquefy, that is, reach a flow state, under the influence of prevailing external forces such as vibration, impaction or ship's motions.

Loading plan

A plan, often referred to as a loading schedule or loading sequence, prepared in accordance with the requirements of the Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code) – see paragraph 4.3.1 and appendix 2 of the BLU Code. A loading plan is different from both a pre-stowage plan and a stowage plan.

Materials hazardous only in bulk (MHB)

These are materials which may possess chemical hazards when carried in bulk other than materials classified as dangerous goods in the IMDG Code. These materials are Group B cargoes under the IMSBC Code.

Maximum allowable heeling moment

The angle of heel due to a shift of grain shall not be greater than 12°, or the angle at which the deck edge is immersed, whichever is the lesser, as given in the International Grain Code, paragraph A 7.1.1. The maximum allowable heeling moment is the total grain heeling moment which would cause the ship to list to 12° on the basis all other stability requirements are complied with, and is obtained from the Grain Loading Booklet using the ship's displacement and centre of gravity, KG (or metacentric height, GM) for entry into a table or graph. The total, actual, grain heeling moment, as calculated from the distribution of cargo on board, must not exceed the maximum allowable heeling moment.

Moisture content

From the IMSBC Code, means that portion of a representative sample, of a bulk commodity, which is water, ice or other liquid, expressed as a percentage of the total wet mass of that sample.

Moisture migration

In a cargo such as a mineral concentrate, it is the movement of moisture in the cargo by settling and consolidation of the cargo due to vibration and the ship's motions such that the water is progressively displaced, and which may result in part of the cargo developing a flow state. In a grain cargo, it is the movement, generally upwards, of moisture in the interstitial air between the grains, generally driven by temperature gradients in the heating cargo.

Net tonnage

A dimensionless index of the cargo space volume of a ship, which is a function of the moulded volume of all cargo spaces of the ship. Port charges, canal dues and other charges are based on the net tonnage.

On-hire/off-hire survey

Surveys carried out at the beginning and end of a charter period to establish the extent and nature of any damages sustained by the ship in the cargo working areas during the charter period. The findings of the off-hire survey are compared with the findings of the on-hire survey to establish the differences. These surveys do not routinely involve inspections with respect to hold cleanliness or suitability for carriage of any particular cargo, but specific instructions in this regard may be given to the surveyor if appropriate. See Pre-Loading Survey.

Open hatch

A hatchway which extends over the full width of the hold and to, or nearly to, the full length of the hold which it serves. The ship will generally be of double-hull construction and will generally have box holds. The hold side bulkhead plating will extend vertically from the tank top up to the main deck and further up to form the coaming plating of the hatchway to port and to starboard. Forward and aft there will either be small under-deck areas or the plating of double-skin construction end bulkheads will extend vertically from the tank top up to the main deck and further up to form the coaming plating of the hatchway forward and aft.

Oxygen depletion

Many solid bulk cargoes are susceptible to oxidation, that is, they take oxygen from the atmosphere in the cargo space, and they are therefore liable to cause oxygen depletion in a cargo space.

Pre-loading survey

Surveys carried out before and during the loading of a particular cargo to establish whether or not the cargo holds are in a condition suitable for the carriage of the particular cargo and may be to establish the condition of the cargo loaded. The instructing party

or parties should provide the surveyor with details of the cargo to be loaded and a list of requirements, which will normally include details of one or more of: the condition and weathertightness of the hatch covers; the cleanliness and suitability of the holds; the condition of the cargo and of the storage arrangements before loading, the condition of the cargo at the time of loading and the nature and extent of any defects or damages found.

Pre-stowage plan

A plan prepared before loading has begun to show the arrangement of the ship and the cargo compartments, and the intended distribution of cargo to be loaded. The weight of cargo and the type of cargo to be stowed in each compartment is also shown along with loading sequence. Additional information should include; the name of the ship, the name of the load port and the date of preparation of the plan.

Shipper

Means any person or company by whom or in whose name, or on whose behalf: (a) a contract of carriage of goods by sea has been concluded with a carrier, or (b) the goods are actually delivered to the carrier in relation to the contract of carriage by sea.

Spontaneous heating

Certain solid bulk cargoes are liable to heat spontaneously and possibly to ignite. The process of self-heating is a result of the growth and respiration of microbial organisms and/or a chemical process, dependent upon the type of cargo, and might involve wetting and/or oxidation of the cargo. Heating by microbial activity might be followed at a raised temperature by heating by chemical processes in some cargo types.

Stowage factor

The volume which a unit weight of cargo will occupy within a cargo compartment or an on-shore storage silo. Usually expressed in cubic metres per tonne (m^3/t) but is often given, particularly in the USA for grain, in cubic feet per long ton (ft^3/ ton).

Stowage plan

A plan prepared after completion of loading showing the final arrangement of the ship and the cargo compartments, and the distribution of the cargo in the cargo compartments, with the weight of cargo and the type of cargo actually stowed in each compartment. Additional information should include; the name of the ship, the name of the load port, or ports, and of the discharge port or ports, the date of completion of loading, the final draughts forward, mid and aft, and any other appropriate or relevant details.

Transportable moisture limit (TML)

Applying to a cargo which may liquefy, the maximum moisture content at which the cargo is considered to be safe for carriage. This is the value which the shipper must declare. If a flow moisture point (FMP) is also declared, the TML is 90% of the FMP (except in the case of peat moss where it is 80%). See flow moisture point (FMP).

Trimming

There are three definitions for trimming, as given in the BLU Code, as follows.

- Loading cargo – the partial or total levelling of the cargo within the holds, by means of loading spouts or chutes, portable machinery, equipment or manual labour.
- Unloading cargo – the shovelling or sweeping up of smaller quantities of the cargo in the holds by mechanical means (such as bulldozers) or other means to place them in a convenient position for discharge.
- Ship – adding, removal or shifting of weight in a ship to achieve the required forward and aft draughts.

Unloading plan

A plan, often referred to as an unloading schedule or an unloading sequence, prepared in accordance with the requirements of the BLU Code (see paragraph 4.3.1 and appendix 2 of the BLU Code).

Watertight

With respect to bulkheads, doors in these bulkheads and so on, it is a requirement that water will not pass in either direction through them and they will withstand the pressure of a head of water up to the freeboard deck on either side.

Weathertight

In any sea conditions, water will not penetrate into the ship. This means that, with respect to hatch covers, ventilators, weather-doors around the accommodation and elsewhere, when water is shipped on board these fittings will prevent the water from passing from outside into the associated space or compartment.

Zero tolerance

Zero tolerance level of acceptance may be used by inspectors during pre-loading inspections of cargo compartments. The inspectors of the authorities of some countries require there to be no infestation, no previous cargo residues and, sometimes, no loose paint and no loose rust scale, that is, a zero tolerance.

The terms listed and defined in this section are of great importance and their meaning should be known and understood by the masters of ships carrying bulk cargoes. In the various IMO codes, and in other publications, there are many words, terms and phrases which are used in the text and are defined at the beginning of the code or publications. These definitions should also be known and understood when studying the particular code or publication.

Chapter 3

SAFETY, RULES AND REGULATIONS

SAFETY

During many routine operations which are carried out on board ship, hazards and dangerous situations are encountered, and sometimes incidents, accidents and/or injuries occur; often the result of poor practices. Before any operation is started, the work to be done should be planned, a risk assessment should be undertaken where and as appropriate, all necessary protective equipment and clothing should be available and in good condition and a permit to work certificate, if appropriate, should be completed and issued. That is to say, all aspects of the work to be done should be carefully considered and 'safety first' in all operations should be the rule. Also, all safety management procedures should be followed.

A risk assessment exercise should be completed whenever an operation is planned, to establish whether or not the operation can be carried out safely. The operation may be the simple task of moving or refitting a piece of machinery or may be the extensive overhaul of a crane or hatch cover – whatever the task a risk assessment should be done.

During the assessment, and in conjunction with the planning of the operation, the following should be established.

Risk assessment checklist

- What personnel are required.
- What equipment is required.
- What personal protective equipment (PPE) and safety equipment is required.
- What length of time is required.
- What time of day is the task to be undertaken and/or what lighting is required.
- What weather conditions are required.
- What safe access is there for the operation.
- Any other factor for the particular operation.

Following the risk assessment, the operation should not be commenced until all the requirements of the risk assessment can be satisfactorily met such that there are no significant risks. If risks exist because everything cannot be put in place at an appropriate time, the operation should not start and should be postponed so that a risk control action plan can be prepared and put into effect.

During the period of a complete voyage there are a number of different stages, and various operations which are necessary for the proper carriage and care of the cargo loaded. These stages and operations usually include the following.

Bulk cargo carriage operations

- Maintenance on deck, in the cargo holds and in other compartments.
- Cleaning and preparation of the cargo holds before loading.
- Routine inspections; on deck, in the cargo holds, in ballast tanks and in other compartments.
- Loading operations, including; opening and closing of hatch covers, cargo loading, crane and cargo handling operations, and cargo inspections.
- Fumigation, including; application of the fumigant by a fumigation company, period of fumigation in transit and subsequent ventilation.
- Loaded voyage, including; inspections on deck, ventilation of holds, inspections of cargo and testing of the atmosphere in cargo holds and in other compartments.
- Offloading operations, including; cargo offloading, crane and cargo handling operations, opening and closing of hatch covers and cargo inspections.

There are various other activities on board ship which must be properly planned and carefully carried out, including mooring and anchoring operations, rigging of access and accommodation ladders and so on, which are not covered in this guide.

To complete a task or operation safely and correctly, certain pieces of personal protective equipment will be needed. Items which will be used by ship's staff during most operations will include; overalls, steel toe-capped safety shoes, safety helmets, ear defenders, gloves and goggles. In addition, other pieces of equipment, including safety harnesses, lifelines, dust masks, portable gas detectors and portable radios, may be required. With regard to work associated with the proper carriage and care of bulk cargo, equipment including staging, ladders, hoses and water cannon, portable pumps and other cleaning equipment may be required.

All protective equipment and other equipment used during operations should be in good condition and appropriate for the task in hand.

There are a number of publications which give information and guidance on safety procedures in general and which focus on particular aspects of on-board operations.

ISM Code

Under the International Safety Management (ISM) Code the ship operator should establish procedures, plans and instructions for key shipboard operations concerning the safety of personnel, the maintenance and operation of the ship and protection of the environment. These procedures, plans and instructions should form part of the safety management system and the requirements should be set out in the safety management system. Therefore there should be a manual in which all the various procedures to be adopted for safe working practices on board during all tasks and operations carried out during an ordinary voyage are set out.

IMSBC Code

Section 3 of the IMSBC Code deals with the safety of personnel on board and the section deals with five topics, in particular: poisoning, corrosive and asphyxiation hazards; health hazards due to dust; flammable atmospheres; ventilation, and cargo under in-transit fumigation. For each of these topics guidance and recommendations with regard to safe practices are given.

In the supplement to the code there is a section entitled 'Revised recommendations for entering enclosed spaces aboard ships'. That section gives detailed recommendations and guidance with regard to all aspects of entering into enclosed spaces and provides

information on the management and risk assessment aspects, various precautions and tests to be carried out, and the hazards which might be encountered.

Also set out in the supplement to the code are 'Recommendations on the safe use of pesticides on ships applicable to the fumigation of cargo holds'. These recommendations give details of the methods of chemical disinfection of empty cargo holds and of cargoes already loaded, these methods being used either wholly in port or continued in transit. The guidance and recommendations set out methods to be used by the fumigation provider and the fumigator-in-charge of an operation to fumigate cargo on board, procedures to be followed after the fumigation of cargo has been carried out and while the ship is still alongside, and procedures to be followed by the crew after the ship has departed the port where the fumigation was undertaken if the fumigation is to be continued in transit. The procedures set out should be strictly followed. At appendix I to the recommendations there is a list of fumigants suitable for shipboard use. Other appendices include a warning sign and a model checklist for in-transit fumigation.

Code of Safe Working Practices for Merchant Seamen

The Code of Safe Working Practices for Merchant Seamen (COSWP) is issued in the UK by the Maritime and Coastguard Agency. The code gives, in great detail, information, recommendations and guidance upon all aspects of safety on board ships. The code is set out in sections and chapters which deal with the various activities and procedures coming under the section heading and a great deal of information and guidance is given for each topic. There is also extensive guidance on risk assessment.

Loss prevention guide

Additionally, North's loss prevention guide on *Personal Injury Prevention* can be consulted for further guidance.

In compliance with the ISM Code there should be on board a safety management system giving detailed recommendations and guidance on procedures for safe working practices to be allowed when carrying out routine operations on board. These recommendations should be followed at all times. Additionally, guidance and regulatory requirements should be obtained, as appropriate, from the IMSBC Code and, if available, COSWP. Appropriate planning and risk assessment of all operations should be completed and all the appropriate personnel safety equipment and working equipment should be available and in good condition and, where appropriate, a permit to work should be issued.

Key areas with regard to operations on board ships carrying bulk cargoes, where special procedures should be followed, include:

Areas and activities requiring special procedures

- Enclosed spaces such as cargo compartments and other spaces when fumigation of cargo in transit is being carried out, and cargo compartments and adjacent spaces when cargoes which will cause oxygen depletion are carried.
- Working aloft.
- Hold cleaning and maintenance operations.
- Cargo operations.
- Inspections of cargo before and during loading, the voyage and offloading.

Accidents or incidents may involve asphyxiation or poisoning of personnel; slips, trips or falls; injury as a result of falling objects and/or injuries as a result of the collapse or failure of a working platform or structure.

In the event of an accident or an incident which involves injury to personnel or fatality, an investigation should be carried out to establish details of the events and circumstances leading up to and associated with the incident or accident and to establish, if possible, the reason for and/or the causes of the incident or accident. During the investigation all persons involved should be encouraged to fully cooperate with the investigation so that all available information will be taken into consideration. When all available information and all available records have been reviewed, conclusions should be drawn up and a report should be prepared. From an accident report and its conclusions, lessons can be learned and action to prevent re-occurrence can be taken.

WHERE THE REGULATIONS, RECOMMENDATIONS AND GUIDANCE CAN BE FOUND

The IMO publish conventions and codes of practice which set out requirements which must be followed and complied with. Additionally, there are a number of books which give recommendations and guidance for the safe handling and carriage of bulk cargoes. This section gives some brief notes on the principal conventions, applicable codes and other publications. More detailed information and guidance is given later in this Chapter. It must be remembered that these publications are being reviewed constantly and amendments are published regularly.

International regulations

SOLAS

The International Convention for the Safety of Life at Sea (SOLAS) is one of the principal conventions of the IMO, and is mandatory. The IMO periodically discuss and adopt new requirements and amendments to SOLAS. These are published regularly and must be complied with.

SOLAS incorporates requirements with regard to all aspects of the construction, the equipment and the fittings of and the operation of a ship, including in chapter VI, 'Carriage of cargoes', and chapter VII, 'Carriage of dangerous goods'. SOLAS is dealt with in more detail later in this Chapter and in Chapter 8.

MARPOL

The International Convention for the Prevention of Pollution from Ships (MARPOL), 1973, as modified by the Protocols of 1978 and 1997, is another principal convention of the IMO and is mandatory.

MARPOL incorporates regulations covering the various sources of ship-generated pollution in six annexes. Annex I gives regulations for the prevention of pollution by oil. Annex V gives regulations for the prevention of pollution by garbage from ships. 'Guidelines for the implementation of MARPOL Annex V', issued by the IMO, were drawn up to assist governments, ship operator, port and terminal operator and others involved with the implementation of the annex. MARPOL annex V is fully discussed in this Chapter and in Chapter 4.

IMSBC Code

The International Maritime Solid Bulk Cargoes Code (IMSBC Code) provides information and recommendations for the safe stowage and shipment of bulk cargoes. The IMSBC Code is mandatory and applies to all ships carrying solid bulk cargoes.

The IMSBC Code is set out in sections 1 to 13 and appendices 1 to 4. In sections 1 to 12, general information is given including definitions, general precautions to be followed and the methods for various tests and procedures to be followed. Section 13 includes a table giving references to related information and recommendations.

Appendix 1 gives individual schedules for solid bulk cargoes in alphabetical order. Each schedule gives a description of the cargo, its characteristics in a table, and then hazards, stowage, requirements, and additional information as appropriate. Appendix 2 gives details of laboratory test procedures, associated apparatus and standards. Appendix 3 gives the properties of solid bulk cargoes. Appendix 4 is an index giving a list of bulk cargo shipping names (BCSNs) and other associated cargo names with the associated Group and other references.

The IMSBC Code is dealt with in more detail in this Chapter.

At the back of the IMSBC Code is the supplement which includes full versions of publications as follows:

- BLU Code
- BLU Manual
- uniform method of measurement of the density of bulk cargoes
- list of solid bulk cargoes for which a fixed gas fire-extinguishing system may be exempted or for which a fixed gas fire-extinguishing system is ineffective
- revised recommendations for entering enclosed spaces aboard ships
- recommendations on the safe use of pesticides in ships applicable to the fumigation of cargo holds
- contact names and addresses of designated national competent authorities responsible for the safe carriage of grain and solid bulk cargoes.

BLU Code

Many bulk carriers have suffered extensive damage while alongside, either during loading operations or during unloading operations, because the ship was over-stressed as a result of improper distribution of the cargo in the various cargo compartments. Additionally, other ships have suffered extensive damage, or have been lost, often with heavy loss of life, because of over stressing in the seaway as a result of improper distribution of the cargo.

The Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code) was developed to set out procedures and practices which should be followed during loading and unloading by both those on board and those ashore. The objective is to eliminate the possibility of the ship being over-stressed as a result of cargo distribution on board. It was first published in 1998. In 2007 a Supplement became effective which sets out amendments such that the code covers all solid bulk cargoes, including grain. The BLU Code gives procedures to be followed by those on board the bulk carrier, procedures to be followed by those ashore and details of information which must be exchanged between those on board and those ashore. The BLU Code primarily

covers the safety of ships loading and unloading solid bulk cargoes, and reflects current issues, best practices and legislative requirements.

The BLU Code is dealt with in more detail in this Chapter and Chapter 8.

BLU Manual

The Manual on Loading and Unloading of Solid Bulk Cargoes for Terminal Representatives (BLU Manual) is intended to augment the BLU Code and to provide more detailed guidance to terminal representatives and others involved in the handling of solid bulk cargoes. The text of the BLU Manual is laid out such that the text with a grey bar is repeated from the BLU Code and the text without a grey bar contains guidelines for the terminal representative.

International Grain Code

The provisions of the International Code for the Safe Carriage of Grain in Bulk (International Grain Code as it is usually referred to) first appeared in chapter IV of the International Convention for the Safety of Life at Sea, 1948 as the Grain Rules, and these rules outlined requirements for the safe carriage of grain in bulk. The Grain Rules were subsequently amended and extended to take into account the development of ships and operational experience, and it was later decided that the detailed regulations on the carriage of grain should be set out in a separate mandatory code. The code applies to all ships carrying grain.

The International Grain Code lays out the special requirement for ships intending to carry grain and the stability requirements for these ships when loaded. The methods for calculating the results of a shift of a grain cargo, in terms of residual dynamic stability and angle of heel are given and the requirements are set out. The International Grain Code is dealt with in more detail in this Chapter and the carriage of grain is dealt with in detail in Chapter 7.

Recommendations on the Use of Pesticide in Ships Applicable to the Fumigation of Cargo Holds

Insects (and mite pests) of plant and animal products can be present in such cargoes when they are loaded and might remain in the cargo during the voyage. These insects might move from one product to another (cross-infestation) and might remain in the cargo compartment after the cargo has been discharged, such that they might then attack subsequent cargoes (residual infestation). Control of infestation may be required for compliance with phytosanitary requirements and for commercial reasons, to prevent infestation and contamination of, and damage to, cargoes of human and animal food, both raw and processed materials. In view of the various hazards, the IMO produced these recommendations.

Fumigation is dealt with in Chapter 5 and Chapter 8.

IS Code

The International Code on Intact Stability, 2008 (IS Code) contains the requirements for intact stability criteria for different types of ship, and gives details of information required on board, general precautions against capsizing and operational procedures related to weather conditions. Aspects of the IS Code are dealt with in this Chapter and Chapter 8.

BWM Convention

Over the years it has been found that harmful aquatic organisms and pathogens have been transported from oceans, rivers and seas over great distances to other regions of the globe via ballast water. Marine organisms introduced into some regions by the discharge of ballast water and associated sediments have created problems. In the light of these problems guidelines for the control and management of ships' ballast water and sediments were developed.

The International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (Ballast Water Management Convention or BWM Convention), as amended, sets out guidelines for the management of ballast water on board, the exchange of ballast water during ocean voyages, the treatment of ballast water and general procedures and requirements to be followed. Further comments are given in this Chapter and in Chapter 8.

ISM Code

Chapter IX of SOLAS deals with management for the safe operation of ships, and sets out definitions, application of the requirements, requirements with regard to safety management, certification, maintenance of conditions, and verification and control.

The International Safety Management Code (ISM Code) and Guidelines on implementation of the ISM Code provide an international standard for the safe management and operation of ships and for pollution prevention. That is, the ISM Code gives details on how a safety management system may be arranged, implemented, verified and controlled. The ISM Code is dealt with in detail in this Chapter.

International standards

Standards are published by the International Organization for Standardization (ISO) which is a worldwide federation of national standard-setting bodies. Other bodies also set standards which are internationally recognised. Standards are issued on a wide range of subjects including sampling procedures, testing procedures and the quality and composition of materials.

National regulations

Many maritime nations issue their own regulations that are in addition to those which bring into force the international regulations. For example, in the UK, maritime shipping notices (MSNs), marine guidance notices (MGNs) and marine information notices (MINs) are issued. MSNs are mandatory and relate directly to the regulations and the codes and should be read together with these regulations and codes. MGNs and MINs contain additional guidance and information on particular subjects. Most maritime nations issue a similar range of mandatory requirements and guidance, and information notices.

Government agencies in the UK and the competent authorities of other exporting countries produce instructions and guidance booklets which give recommendations and requirements with regard to hold cleanliness and the stowage and carriage of cargoes loaded at their ports.

Publications

Thomas' Stowage

Thomas' Stowage (first published as *Stowage – The Properties and Stowages of Cargoes* in 1928) is, rightly, used throughout the shipping industry for guidance and information about the properties and stowage of cargoes. The book provides a great deal of information about the stowage and care required by particular types of cargo. There are sections on bulk cargoes and information about commodities such as grain and ores and their associated problems. For each commodity examples of stowage factors are given.

Grain – Carriage by Sea

This book gives a lot of information about grain production and grain trades.

Coal – Carriage by Sea

This book gives details of coal production around the world, describes problems which might be encountered and discusses sampling and analysis methods.

Bulk Carrier Practice

First published in 1993, this book gives in great detail the processes associated with practical operating procedures of bulk carriers. It takes the reader through preparations which are essential before loading, during the loading operations, voyage planning and all the various documents involved.

Watchkeeping Safety and Cargo Management in Port

First published in 1995, this book gives practical guidance for the officer on watch in port. It is designed to assist officers in the prevention of loss, to enhance the standards of watchkeeping and cargo work in port, and to promote the commercial awareness of the watchkeeping deck officer.

Further details of these publications can be found in the Bibliography.

SOLAS

The International Convention for the Safety of Life at Sea (SOLAS) incorporates requirements with regard to all aspects of the construction, equipment, the fittings of, and the operation of, all ships entitled to fly the flags of states, the governments of which are 'contracting governments'. Of particular interest here are chapters II, VI, VII, IX and XII. Chapter VI deals with the carriage of cargoes (including bulk cargoes and grain) and other chapters deal with factors which apply to ships carrying bulk commodities. With regard to chapter VI, the latest version of parts A and B, together with part A-1 of chapter VII, carriage of dangerous goods in solid form in bulk, as amended, are given in section 1 of the IMSBC Code. The parts of SOLAS which have relevance to the carriage of bulk cargoes are given in this section. However, these are only notes which draw attention to the regulations and it is strongly recommended that the regulations in the current edition of SOLAS, as amended, are studied and their content complied with.

It should be noted that the main text is mandatory and references to codes, guidelines and recommendations in the footnotes are for ease of reference. The status of these other codes and so on should always be established.

The following table is designed to assist with finding regulations in SOLAS.

SOLAS topics, chapters and regulations

Topic	Chapter	Regulation
Construction		
Access to cargo spaces	II–1	3–6
Structural strength	XII	5 & 6
Survey and maintenance	XII	7
Water ingress alarms	XII	12
Pumping systems	XII	13
Restrictions – empty hold	XII	14
Intact stability information		
Information supplied to master	II–1	5 & 5.1
Loading, unloading and stowage of bulk cargoes	VI	7
Carriage of grain	VI	8 & 9
Damage stability – bulk carriers	XII	4
Information on compliance – bulk carriers	XII	8
Requirements of regulation 4.3 not complied with	XII	9
Loading instrument	XII	11
Acceptability for shipment – stability information	VI	6
Fire protection, detection and extinction		
Definitions	II–2	3
Containment of fire	II–2	9
Fire fighting	II–2	10
Carriage of dangerous goods	II–2	19
Management for the safe operation of ships		
Management	IX	1 to 6
Dangerous goods		
Carriage in solid bulk form	VII	7 & 7–1 to 7–5
Fire protection, detection, extinction	II–2	19
Carriage of cargoes in bulk		
Cargo information	VI	2
Oxygen analysis and gas detection equipment	VI	3
Use of pesticides in ships	VI	4
Material safety data sheets	VII	5–1
Acceptability for shipment – stability information	VI	6
Loading, unloading and stowage	VI	7
Carriage of grain	VI	8 & 9
Carriage of dangerous goods	VII	7 & 7–1 to 7–5
Density declaration	XII	10
Ventilation		
Ventilation systems	II–2	9
Ventilation for ships carrying dangerous goods	II–2	19

The following table provides a summary of relevant regulations in SOLAS.

Notes on relevant SOLAS chapters and regulations	
Chapter II–1	***Construction – Structure, subdivision and stability, machinery and electrical installations***
Regulation 3–6	*Access to and within spaces in, and forward of, the cargo area of oil tankers and bulk carriers* – the requirements are meant for the inspections of the structures but it is important for the safe operation of the ship and to enable cleanliness inspections to be carried out safely, that safe means of access are fitted and maintained.
Regulation 5 & 5–1	*Intact stability information and stability information to be supplied to the master* – reference is made to the International Code on Intact Stability, 2008. All ships shall be inclined upon completion, and the master shall be supplied with stability information, that is a Stability Booklet.
Chapter II–2	***Construction – Fire protection, fire detection and fire extinction***
Regulation 3	*Definitions* – these include those for Class A, B and C bulkheads (sections 3.2, 3.4 and 3.10).
Regulation 9	*Containment of fire* – section 2.3 applies to cargo ships except tankers and gives the requirements for fire integrity of bulkheads and decks at sub-section 2.3.3. Section 7 deals with ventilation systems and gives construction requirements.
Regulation 10	*Fire-fighting* – section 7 deals with fire-extinguishing arrangements in cargo spaces. Cargo spaces of cargo ships of 2,000 GT and upwards are to be fitted with a fire-extinguishing system – carbon dioxide or inert gas, or a system of equivalent protection – unless cargo intended to be carried constitutes a low fire risk and the administration grants an exemption. Section 10 deals with fire-fighter's outfits, a minimum of two being required, and spare charges.
Regulation 19	*Carriage of dangerous goods* – this regulation provides additional safety measures for ships carrying dangerous goods. In particular, section 3.4 – *Ventilation*, section 3.5 – *Bilge pumping*, section 3.6 – *Personal protection*, section 3.8 – *Insulation of machinery space boundaries*, and section 4 – *Document of compliance*; a Document of Compliance, which sets out special requirements for ships carrying dangerous goods, is a mandatory requirement for such ships. Sometimes referred to as a Document of Compliance with the IMDG Code.
Chapter VI	***Carriage of cargoes – Part A – General provisions***
Regulation 2	*Cargo information* – the shipper shall provide the master or his representative with appropriate information on the cargo. The information required is extensive and reference is made to the IMSBC Code.
Regulation 3	*Oxygen analysis and gas detection equipment* – when a bulk cargo, which is liable to emit a toxic or flammable gas, or cause oxygen depletion in the cargo space, is carried, an appropriate instrument for measuring the concentration of gas or oxygen should be provided on board.

Regulation 4	*The use of pesticides in ships* – reference is made to the IMO recommendations on the safe use of pesticides in ships.
Regulation 5–1	*Material safety data sheets* – when carrying MARPOL annex 1 cargoes, a materials safety data sheet must be provided before loading.
Chapter VI	***Carriage of cargoes – Part B – Special provisions for bulk cargoes other than grain***
Regulation 6	*Acceptability for shipment* – prior to loading a bulk cargo, the master shall be in possession of the necessary stability information. It follows from this that the master should complete the necessary trim, strength and stability calculations. When mineral concentrates and other cargoes which may liquefy are to be carried (that is Group A cargoes), the actual moisture content of the cargo must be less than its transportable moisture limit (TML).
Regulation 7	*Loading, unloading and stowage of bulk cargoes* – reference is made to the Code of Practice for Safe Loading and Unloading of Bulk Cargoes (BLU Code). In section 2 it is repeated (from SOLAS chapter II-1, regulation 5-1) that a Stability Booklet should be provided and details of additional requirements for a bulk carrier should be given. Also, general guidance is provided.
Chapter VI	***Carriage of cargoes – Part C – Carriage of grain***
Regulation 8	*Definitions* – this gives definitions of the International Grain Code and of the term 'grain'.
Regulation 9	*Requirements for cargo ships carrying grain* – a cargo ship carrying grain shall comply with the requirements of the International Grain Code. The International Grain Code is, therefore, mandatory.
Chapter VII	***Carriage of dangerous goods – Part A-1 – Carriage of dangerous goods in solid form in bulk***
Regulations 7 & 7–1 to 7–5	These regulations deal with the carriage of dangerous goods in solid form in bulk, which are materials covered by the IMDG Code and which are loaded directly into the cargo space without any intermediate form of containment. They give requirements with regard to documents, stowage and segregation, and the reporting of incidents involving dangerous goods. Carriage of these bulk commodities shall be in compliance with the relevant provisions of the IMSBC Code.
Chapter IX	***Management for the safe operation of ships***
Regulations 1 to 6	These regulations set out the basic requirements for a safety management system and draw attention to the requirements of the ISM Code, which is therefore mandatory.
Chapter XII	***Additional safety measures for bulk carriers***
Regulation 1	*Definitions*
Regulation 2	*Application*
Regulation 3	*Implementation schedule*

Regulation 4	*Damage stability requirements applicable to bulk carriers* – requirements appropriate for high-density cargoes are set out.
Regulation 5	*Structural strength of bulk carriers* – this is in respect of single side skin construction bulk carriers designed to carry solid bulk cargoes having a density of 1,000 kg/m^3 and above, and deals with strength and flooding requirements.
Regulation 6	*Structural and other requirements for bulk carriers* – this gives additional requirements for ships carrying solid bulk cargoes having a density of 1,780 kg/m^3 and above.
Regulation 7	*Survey and maintenance of bulk carriers* – this deals with surveys required on board bulk carriers and maintenance requirements if solid bulk cargoes having a density of 1,780kg/m^3 and above are to be carried.
Regulation 8	*Information on compliance with requirements for bulk carriers* – the Stability Booklet, in accordance with chapter VI, regulation 7.2, is to be endorsed to indicate that regulations 4, 5, 6 and 7, as appropriate, are complied with. Restrictions regarding the carriage of solid bulk cargoes having a density of 1,780 kg/m^3 are also given.
Regulation 9	*Requirements for bulk carriers not being capable of complying with regulation 4.3 due to the design configuration of their cargo holds* – this gives additional requirements to allow a relaxation of the application of regulations 4.3 and 6.
Regulation 10	*Solid bulk cargo density declaration* – prior to loading bulk cargoes, the shipper shall declare the density of the cargo in addition to providing other required information.
Regulation 11	*Loading instrument* – bulk carriers of 150 m in length and upwards shall be provided with a loading instrument capable of providing information on hull girder shear forces and bending moments.
Regulation 12	*Hold, ballast and dry space water ingress alarms* – bulk carriers are to be fitted with water level detectors in each hold, in ballast tanks forward of the collision bulkhead and in dry or void spaces forward, with audible and visual alarms located on the navigation bridge.
Regulation 13	*Availability of pumping systems* – this gives the requirements for pumping systems for tanks forward of the collision bulkhead and of forward end dry spaces.
Regulation 14	*Restrictions from sailing with any hold empty* – this gives the requirements for single skin bulk carriers of 150 m or more in length, and over 10 years of age, carrying cargoes having a density of 1,780 kg/m^3 and above, with regard to a hold loaded to less than 10% of the hold's maximum allowable cargo weight.

IMSBC CODE

The Code of Safe Practice for Solid Bulk Cargoes (BC Code) was first published in 1965, and several updating editions were published. In 2009 the BC Code developed into the International Maritime Solid Bulk Cargoes Code (IMSBC Code), which became mandatory under SOLAS in January 2011. There should be a copy of the latest version of the code on board.

The IMSBC Code is periodically revised by the Maritime Safety Committee of IMO and amendments are issued which later enter into force and become mandatory parts of the IMSBC Code. All such amendments are available on the IMO website and their contents should be taken into consideration alongside the guidance in the IMSBC Code. An example is annex 6 of resolution MSC.354(92) (Adopted on 21 June 2013) – Amendments to the International Maritime Solid Bulk Cargoes (IMSBC) Code – which includes the addition of paragraphs into sections of the code, additions and alterations to some schedules in appendix 1 and new schedules for appendix 1.

The IMSBC Code is periodically revised with the intention of an updated version being published every two years. Most of the entries in the code are mandatory under SOLAS at the time of publication, while some parts are to be used on a voluntary basis for a period (that is, voluntary use by the flag state of the ship) until being brought fully into force at a later date.

To keep pace with the expansion and progress of industry, the IMSBC Code, as amended, includes:

- fully updated individual schedules for commonly carried solid bulk cargoes
- references to the text of SOLAS 1974, as amended
- updated information from the IMDG Code as amended.

If there is any doubt about the requirements, the more onerous requirements should be followed. The basic requirements, parts and practical implications of the IMSBC Code are discussed in the following sections.

Basic requirements

The purpose of the IMSBC Code is to provide the procedures to be adopted when solid bulk cargoes other than grain are to be shipped. The code is mandatory under SOLAS. The aim is to facilitate the safe stowage and shipment of solid bulk cargoes by providing information on the dangers associated with the shipment of certain types of cargoes, and instructions on the procedures to be adopted when shipment is being planned. It gives an extensive list of typical cargoes shipped, with advice on properties, handling and carriage of these cargoes, but the list is not exhaustive which means that not all types of cargo which are shipped are named separately. It also gives test procedures that should be used to determine various characteristics of the solid bulk cargoes. The notes following briefly describe and draw attention to the various parts of the code, but it is strongly recommended that the code itself be studied and its content complied with.

The IMSBC Code draws attention to three categories of hazard associated with shipments of solid bulk cargoes, as follows.

IMSBC Code hazard categories

1. Improper distribution of the cargo which may lead to structural damage to the ship.
2. The loss of, or reduction in, the stability of the ship during the voyage, which might result from: (a) a shift of cargo due to inadequate trimming or improper distribution of the cargo; (b) a wet cargo liquefying under the stimulus and vibration or motion of the ship, and then sliding or flowing to one side of the cargo compartment.
3. Chemical reactions within the cargo which may cause the emission of toxic or flammable gases, spontaneous combustion or severe corrosive effects.

To avoid the development of hazards, the characteristics of the cargo must be known prior to shipment. The loading operation and the discharge operation must be properly and adequately planned, and any procedures which are to be carried out during the voyage must be planned beforehand to ensure the necessary equipment is on board. In addition the safety of personnel must be taken into account at all times.

In appendix 1, individual schedules of solid bulk cargoes, the characteristics of cargoes have been divided into three groups; Group A, Group B and Group C.

IMSBC cargo groups

- Group A – cargoes which may liquefy if shipped at a moisture content in excess of their transportable moisture limit.
- Group B – cargoes which possess a chemical hazard which could give rise to a dangerous situation on the ship.
- Group C – cargoes which are neither liable to liquefy (Group A) nor possess chemical hazards (Group B).

Some cargoes may fall into both Group A and Group B.

General provisions – section 1

IMSBC section 1 provides some general and some specific guidance and requirements. Solid bulk cargoes which are shipped, and for which there is a bulk cargo shipping name (BCSN), are listed in the schedules of appendix 1, together with their properties and methods of handling. However, the schedules are not exhaustive and the properties are given for guidance only, as stated in sub-section 1.2. It is essential that valid current information is obtained from the shipper before loading begins and that the information is provided using the cargo information form set out in section 4.

Sometimes solid bulk cargoes which are not listed in appendix 1 are put forward for shipment. Before any such cargo is loaded it must be assessed, at least by the competent authority of the port of loading, and sometimes also by the competent authority of the port of unloading (see sub-section 1.3). The shipper shall provide the characteristics and properties of the proposed cargo and the competent authority of the port of loading will assess the acceptability of the cargo for safe shipment.

If the cargo possesses hazards such that it is a Group A or Group B cargo, the competent authority of the unloading port and the flag state become involved to determine the suitable conditions for carriage of the cargo.

If the cargo presents no specific hazards, the cargo shall be authorised for carriage

as Group C by the competent authority of the loading port and the competent authority of the unloading port and of the flag state shall be advised of that authorization. The competent authority of the loading port shall provide the master with a certificate stating the characteristics of the cargo, its required conditions of carriage and handling requirements. When these procedures have been followed and completed satisfactorily, the cargo may be loaded. The assessment and the issuing of a certificate cannot be carried out by the shipper.

The provisions of the code apply to all ships and all solid bulk cargoes, and are mandatory.

Sections 11, 12 and 13, and appendices 2, 3 and 4 are recommendatory or informative (see sub-section 1.4). Sub-section 1.5 deals with exemptions and equivalent measures. In sub-section 1.6, chapter VI and chapter VII of SOLAS are repeated. In sub-section 1.7 definitions for words used in the code are set out, some of which have been used in the preparation of the 'Terms in general usage' section in Chapter 2.

Loading requirements and procedures – sections 2–5

Appropriate loading and offloading procedures shall be followed, as stated in section 2. Attention is drawn to the Code of Practice for Safe Loading and Unloading of Bulk Cargoes (BLU Code), the need to prevent the structure of the ship from being over-stressed during cargo operations and the need to distribute the cargo satisfactorily so that the ship has adequate stability during the voyage. Guidance on the loading of high-density cargoes is given and it is recommended that the ship's stability information booklet be consulted. Additional guidance is given with regard to the inspection of cargo compartments before loading, including bilges, their covers, sounding pipes and other service lines, and with regard to the ventilation and airconditioning systems of accommodation spaces which might need to be screened during cargo operations.

Section 3 draws attention to safety precautions for personnel on board the ship which are necessary during the loading, transport and discharge of solid bulk cargoes. It points out that, with some commodities, there may be one or more hazards, such as poisoning of personnel, corrosive to human flesh and/or an asphyxiation hazard. When a bulk cargo is being carried which is liable to emit toxic or flammable gas, or is liable to cause oxygen depletion in a cargo compartment, an appropriate instrument for measuring the concentration of gas or oxygen shall be carried on board and should be used as appropriate. The section goes on to draw attention to the health hazards due to dust in the atmosphere, and to the need for protective clothing and other precautions. An explosive atmosphere might be created either by dust or by flammable gases emitted by the cargo. Appropriate ventilation shall be undertaken to minimise the risks involved.

Sub-section 3.6 briefly mentions in-transit fumigation, which is dealt with in the supplement of the code. An amendment draws attention to ways in which fumigant leaks may occur into spaces which are connected to the cargo hold via ducts, tunnels and so on, and the need for appropriate ventilation procedures with appropriately closed ventilation flaps and closing devices. Fumigation is discussed in Chapter 5 and Chapter 8.

As stated in section 4, the cargo to be shipped shall be correctly identified and its United Nations (UN) number shall be given when appropriate. The shipper of the cargo

shall provide the master, or the master's representative, with appropriate information about the cargo and its characteristics, prior to loading, to enable the appropriate precautions for the stowage and safe carriage to be put into effect.

In sub-section 4.2 there is a list of information which shall be confirmed in writing and in the appropriate shipping documents as follows.

IMSBC cargo information to be confirmed in writing

- Bulk cargo shipping name (BCSN) when the cargo is listed in this code – secondary names can be used in addition to the bulk cargo shipping name.
- Cargo group (A, B or C).
- IMO class of the cargo if applicable.
- UN number, preceded by letters 'UN', for the cargo if applicable.
- Total quantity of the cargo offered.
- Stowage factor.
- Trimming and the trimming procedures as necessary.
- Likelihood of shifting, including angle of repose, if applicable.
- Additional information in the form of a certificate on the moisture content of the cargo and its transportable moisture limited in the case of a concentrate or other cargo which may liquefy
- Likelihood of formation of a wet base (see sub-section 7.2.3 of the code).
- Toxic or flammable gases which may be generated by cargo if applicable.
- Flammability, toxicity, corrosiveness and propensity to oxygen depletion of the cargo if applicable.
- Self-heating properties of the cargo, and the need for trimming if appropriate.
- Properties on emission of flammable gases in contact with water, if applicable.
- Radioactive properties, if applicable.
- Any other information required by national authorities.

If a cargo to be loaded is not listed in appendix 1 of the code, it can only be shipped after an appropriate certificate has been issued by the competent authority at the port of loading in accordance with the requirements of sub-section 1.3 of the code.

In addition, and in accordance with paragraph 3.4 of the Guidelines for the Implementation of MARPOL annex V, as amended, there should be a 'MARPOL statement' in which the shipper classifies and declares whether or not the cargo is harmful to the marine environment (HME).

If waste cargoes are being transported for disposal, or for processing for disposal, the name of the cargo shall be preceded by the word 'WASTE'.

At paragraph 4.2.3 of the sub-section it is required that information provided by the shipper shall be accompanied by a declaration; a copy of an example of a cargo declaration is given on the same page in the code.

Sub-section 4.3 deals with certificates of test and gives details of what such certificates should include. Sub-sections 4.4 to 4.6 deal with the sampling procedures, including guidance on factors to be taken into account during representative sampling, the frequency of sampling and testing for transportable moisture limit and moisture content determination. It also describes a simplified sampling procedure which is suitable for some concentrate stockpiles but not for unprocessed ores, nor for concentrates with non-uniform moisture. Sampling should be conducted only by persons who have been suitably trained in such sampling procedures and who are under the supervision of someone who

is fully aware of the properties of the consignment and also the applicable principles and practices of sampling. Sub-section 4.7 lists standardised sampling procedures.

Finally, in sub-section 4.8, details of documents required on board are given. These include, if appropriate, a Document of Compliance – Special Requirements for Ships Carrying Dangerous Goods. This is sometimes referred to as a Document of Compliance with the IMDG Code, not to be confused with the non-mandatory 'certificate of compliance with the IMSBC Code'.

All cargoes should be trimmed reasonably level. Trimming of a stowage of cargo reduces the likelihood of the cargo shifting and, by compacting the cargo to an extent, minimises the amount of air entering the cargo, which could lead to spontaneous heating. Section 5 gives specific precautions for types of ship and cohesive and non-cohesive bulk cargoes. Additional mandatory trimming requirements are given in the schedules for individual cargoes in appendix 1 of the code, for example MINERAL CONCENTRATES must be trimmed to ensure the height difference between peaks and troughs does not exceed 5% of the ship's breadth and so on. With regard to non-cohesive cargoes, additional requirements are given for cargoes with an angle of repose less than or equal to 30°, from 30° to 35° inclusive, and greater than 35°.

With regard to cargoes having an angle of repose less than, or equal to, 30° – and which flow freely like grain – these cargoes should be carried according to the provisions of the IMO International Grain Code. In effect they should be carried as if they were grain. However, some of these cargoes (for example, prilled fertilisers) may also have a high density, and therefore the strength of the ship's structures must be considered, in particular the maximum permissible loading of the tank top structures. It might be that cargo compartments are not filled to capacity when the maximum permissible loading is reached, and therefore securing of the cargo surface will be necessary.

Hazards and test methods and procedures – sections 6–9

Solid bulk cargoes may possess one or more characteristics and/or hazards. These sections of the code provide guidance and recommendations with regard to the determination of the level and type of characteristics associated with any particular cargo, including the determination of; angle of repose, moisture content, flow moisture point (FMP) and transportable moisture limit (TML), and there is a description of the 'can test'. Chemical hazards are also discussed.

Methods of determining the angle of repose of cargoes are given in section 6. There is a laboratory test method and an alternative shipboard test method. Both are fully described in section 2 of appendix 2 of the code.

Section 7 brings to the attention of masters and others who are responsible for the loading and carriage of bulk cargoes which may liquefy the risks associated with cargo shift, and the precautions to minimise the risk. Cargoes which may liquefy are designated Group A. Due to the ship's motion, such cargoes may develop a flow state. If a flow state is produced, the cargo may flow to one side of the ship as the ship rolls one way, but may not completely return when the ship rolls back the other way such that the ship develops a list. This list may increase progressively to a dangerous level as the ship continues to roll, and the ship may capsize quite suddenly. Cargoes which may liquefy contain a certain proportion of small particles and a certain amount of moisture. It is therefore extremely important that the TML and moisture content values of the cargo are provided to the

master. Useful information about how liquefaction occurs, and about the characteristics of the cargo, is given along with information about precautions with regard to the carriage of bulk commodities. This topic is clarified and discussed in more detail in Chapter 6.

Test procedures for the determination of the moisture content of samples of cargoes which may liquefy, and of the FMP and TML of the material, are given in appendix 2 of the code. Such tests should be carried out in a laboratory equipped with the required equipment (see Chapter 6).

If the master of a ship has doubts with regard to the appearance or condition of a material being loaded, the master can carry out a test for 'approximately determining the possibility of flow of the cargo' – a 'can test', see sub-section 8.4.

Can test procedure

A cylindrical can or similar container is half-filled with a sample of the cargo and is then brought down sharply to strike a hard surface, from a height of about 0.2 m, repeatedly 25 times within less than a minute. If there is moisture or a fluid condition on the surface, the master should insist upon arrangements being made for additional laboratory tests to be conducted on the cargo before it is accepted for shipment.

Materials possessing chemical hazards are dealt with in section 9. The section describes the various classes of hazard and then gives details, with diagrams, of appropriate stowage and segregation requirements for these various classes. This topic is clarified and discussed in more detail in Chapter 6.

Additional advice and information – sections 10–13

Section 10 on transport of solid waste in bulk defines wastes are solid cargoes containing, or contaminated with, one or more of the materials which possess chemical hazards (other than radioactive materials) and which are being carried for dumping, incineration, or other methods of disposal. This section gives guidance on when shipments are permitted, what documentation is necessary, and gives details of classification of wastes. Wastes should be stowed and handled in accordance with the various sections of the code and should be segregated in accordance with the appropriate parts of section 9. In the event of an accident, the competent authorities of the countries of origin and destination should be immediately informed, and advice on the action to be taken should be obtained from them.

Section 11 on security provisions states that it should be borne in mind that some substances shipped as bulk cargo may be used as constituents for, or to enhance the effect of, weapons. Recommendations are given with regard to security matters. Section 12 is a stowage factor conversion table for converting stowage factors between cubic metre per tonne and cubic feet per long ton. Section 13 on references to related information and recommendations gives a list of IMSBC Code references and the appropriate IMO instruments, mostly regulations in SOLAS.

Appendices

Appendix 1 on individual schedules of solid bulk cargoes gives the characteristics of cargoes and the group status. Group A are cargoes which may liquefy if shipped at a

moisture content in excess of their TML; Group B are cargoes which possess a chemical hazard which could give rise to a dangerous situation on the ship; and Group C are cargoes which are neither liable to liquefy (Group A) nor possess chemical hazards (Group B).

It is a list of many solid bulk cargoes arranged in alphabetical order, and for each cargo there is a description of the material, its characteristics given in a table (including its group), and then further information with regard to hazards, stowage and segregation, and other requirements with regard to the stowage and carriage of the material. Where appropriate, additional emergency procedures or other information are also given.

Appendix 2 on laboratory test procedures, associated apparatus and standards gives test procedures to be used for determining the moisture content, FMP and TML of solid bulk cargoes which may liquefy; the angle of repose of granular materials; the self-sustaining, exothermic decomposition of fertilisers containing nitrates; resistance to detonation; and self-heating of charcoal.

Appendix 3 on properties of solid bulk cargoes gives a list of cargoes which are non-cohesive when dry. The angle of repose of the material being loaded should be determined so the correct carriage procedures can be followed. A description of the properties of cargoes which may liquefy is given. All cargoes which contain a proportion of fine particles are, potentially, liable to liquefy and should be tested for flow properties before being accepted for loading. Also, for cargoes which may possess a chemical hazard, it is given that it is important to consult authorities at the port of loading and unloading with regard to requirements which may be in force; this topic is dealt with in Chapter 6.

Appendix 4, the index, gives the bulk cargo shipping name and the group(s).

Practical implications

Stowage of cargo

Structural damage due to improper distribution of the cargo might occur during the loading or unloading of the cargo if, during either process, there is an excessive amount – and, therefore, excessive weight – of cargo in the end compartments of the ship, or in the mid-length holds of the ship, such that the maximum permitted shear forces and bending moments of the ship are exceeded. To avoid over-stressing the ship, loading and unloading sequence plans should be drawn up, and strength and stability calculations should be completed for each stage of each operation to ensure the proposed plans are safe. Reference should be made to the BLU Code, which gives guidance on the subject; see the appropriate section later in this Chapter. Advice on this topic is given in section 2 of the IMSBC Code, and other guidance is given for individual cargoes in appendix 1.

During the voyage, the ship might suffer a loss of, or reduction in, its stability as a result of a shift of cargo, as a result of inadequate trimming or distribution of the cargo in one or more cargo compartments, and/or as a result of the cargo liquefying.

Therefore, for the sake of safety, the characteristics of the cargo must be known and must be acceptable for carriage. The cargo in each hold must be stowed and distributed correctly and the surface of the stow in each hold must be adequately trimmed. With regard to the characteristics of the cargo to be loaded, dealt with in section 4 of the code, these must be provided by the shipper on a cargo declaration form (an example of such a form is given in section 4 of the code) and shall include the bulk cargo shipping name (BCSN); BCSNs are the names used in appendix 1. Provision is made for not-listed

bulk cargoes in section 1.3 of the code, which gives details of the information required to be presented to the Local Administration (competent authority) of the loading port for assessment for safe carriage. This should be done by the shipper of the cargo before loading is arranged. After that, the competent authorities which then become involved can carry out an assessment and, if appropriate, a certificate can be issued to the master – the shipper cannot issue the certificate.

If the cargo is not trimmed adequately, or if its distribution within the cargo compartment results in there being space adjacent to the pile, some of the cargo might shift when the ship rolls and pitches in the seaway during periods of adverse weather and sea conditions.

Cargoes are described as cohesive or non-cohesive. Cohesive commodities are mostly damp, although some are carried dry, and their particles tend to stick together such that a stowage will not flow to form an angle of repose. A cargo which is described as being cohesive will shift if the motion of the ship disrupts the stow. Non-cohesive cargoes, such as grain or similar cargoes, flow and will form a cone if simply poured onto a flat surface. Therefore a list of non-cohesive cargoes, other than grain, is given in appendix 3. A pile of such a cargo on a tank top or 'tween deck will flow downhill when the ship rolls or pitches.

Therefore trimming of all bulk cargoes should be carried out. Advice on this subject is given in sections 2, 5 and 6, and section 2 of appendix 2 gives the test procedure to determine the angle of repose of a material. See also Chapter 5.

Characteristics of the cargo

The characteristics of bulk cargoes have been divided into three groups; Group A, Group B and Group C. Before the loading of any bulk cargo, its characteristics should be known, and tests should be completed, as appropriate, to determine these characteristics.

Some cargoes possess characteristics, primarily a certain proportion of small particles, such that when they are damp they will liquefy under the stimulus of vibration and motion of the ship during the voyage. These cargoes are included in Group A and are shown as such in the individual schedules in appendix 1. For a Group A cargo, the moisture content, the FMP and the TML of the material to be loaded must be determined, and certificates of test must be given to the master, and the moisture content must be below the TML before loading. If liquefaction of the cargo develops, the cargo may shift resulting in the ship taking an angle of list. If the cargo continues to shift to one side, the ship will list more heavily to that side. Where, and if, the shift is excessive there is the risk that the ship might capsize and sink. In view of this, Group A cargoes should only be loaded when the moisture content of the cargo is less than the TML for the cargo. Advice on this subject is given in the IMSBC Code sections 7 and 8, and in the entries for individual cargoes in appendix 1, with advice on test procedures being given in appendix 2.

Additionally, some fine-particle cargoes do drain water slowly and water will accumulate at the bottom of the stowage and may cause liquefaction of the low-level cargo, even in cargoes where the average moisture content is below the TML. This is referred to as a 'wet base' and if the cargo is susceptible to the formation of a wet base the cargo declaration produced by the shipper must confirm this.

Liquefaction can also occur in a portion or level of the stowage, for example if a batch of material with moisture content above the TML is included with drier cargo. See also Chapter 6.

Chemical reactions within a cargo can result in the emission of toxic or flammable gases, spontaneous combustion, or severe corrosive effects. Such cargoes are included in Group B. These chemical reactions might cause a hazard to personnel on board, might cause deterioration in the quality of the cargo, and/or might cause damage to the ship's structures. The characteristics of the cargo should be identified before shipment by the shipper, and appropriate tests should be completed to determine these characteristics. Materials with chemical hazards should be stowed on board in accordance with the appropriate stowage and segregation requirements, and any other special requirements which have been found appropriate. The entries for many individual cargoes in appendix 1 of the IMSBC Code give details of stowage and segregation requirements, and section 9 gives details of segregation methods. Advice on this topic can also be found in section 3 (on safety of personnel and ship), and test procedures are given in sections 3, 4, 5 and 6 of appendix 2, with further information in appendix 3.

Some cargoes which may liquefy may also heat spontaneously or may possess a chemical hazard. Such cargoes are designated as 'Group A and Group B' in appendix 1 of the IMSBC Code. Other cargoes might possess a chemical hazard when shipped in a certain condition (for example, seed cake which might self-heat) but under different conditions of shipment will possess no special hazards; such cargoes are listed as 'Group B or Group C' in appendix 4, the Index, whereas in appendix 1 each type of the particular cargo is given a different entry. Similarly, some materials possess a chemical hazard and might liquefy if shipped with predominantly fine material, for example coal – listed as 'Group B (and Group A)' cargoes, and some materials may liquefy or might possess no special hazard under different conditions – listed as 'Group A or Group C', for example ilmenite sand. A careful study of appendix 1 should be made, together with the cargo information document or cargo declaration, to confirm the bulk cargo shipping name (BCSN) of the cargo and its appendix 1 group or groups.

The IMSBC Code gives a great deal of information about the hazards which might affect any particular dry bulk commodity, and gives procedures to be followed. The contents of the various sections and appendices are given in this section but it is strongly recommended that the code itself is studied. In Chapters 6 and 7 the various problems associated with solid bulk cargoes in general and with regard to some particular commodities are clarified and discussed.

INTERNATIONAL GRAIN CODE

The International Grain Code or, to give it its full title, the International Code for the Safe Carriage of Grain in Bulk, sets out guidance and requirements with regard to the stowage and carriage of grain. In particular, the Code describes how the grain should be stowed on board and the stability requirements associated with its carriage. The International Grain Code is mandatory under SOLAS chapter VI.

Grain includes wheat, maize, oats and so on, and various other pulses, oils seeds and grains. Also, non-cohesive bulk commodities having an angle of repose of less than 30° may be considered to be grain for stowage and stability purposes.

The basic philosophy of, and the requirements set out in, the International Grain

Code revolve around the fact that grain is non-cohesive and will therefore flow or shift into any available spaces within the compartments, resulting in the ship listing to one side. In view of this, the available space into which grain can shift must be restricted and/or minimised to limit any list caused. Modern bulk carriers which are suitable for the carriage of grain in bulk are often fitted with sloping top-side tanks, which restrict the potential movement of a grain cargo. Otherwise they have open hatches and box holds, such that compliance with the stability requirements is reasonably straightforward.

The basic requirements, parts and practical implications of the IMSBC Code are discussed in the following sections.

Basic requirements

The basic requirements are as follows.

International Grain Code requirements

- A Document of Authorisation shall be issued for the ship as evidence the ship is capable of complying with the requirements of the code.
- A Grain Loading Manual shall be provided to enable the master to carry out calculations as required.
- Upon completion of loading a grain cargo, and throughout the loaded voyage, the ship shall comply with stability requirements set out in the code, see section A 7, including that the angle of heel due to a shift of grain shall not be greater than 12°, the static stability diagram should comply with requirements and the ship's initial GM shall be not less than 0.30 m.
- The stowage of the grain cargo shall be such that the compartments are filled when possible and the surface of the stowage in any partly filled compartments shall be trimmed level.
- If necessary, as a result of excessive grain heeling moments of partly filled compartments, to reduce the total grain heeling moment to an acceptable level (that is to below the maximum permissible grain heeling moment for the ship's condition), over-stowing of the bulk grain may be carried out or the surface may be secured by strapping or lashing or by wire mesh.
- If the ship is not provided with a Document of Authorisation, alternative methods of the stowage of the grain must be carried out.

A copy of the International Grain Code should be available on board every ship which is likely to carry grain in bulk (or any other cargo which has the characteristics of grain) so that the master and the other personnel involved in planning grain cargoes can understand the requirements, and the reasoning behind these requirements as set out in the code. The code is arranged in two parts. Part A includes specific requirements and is in 18 sections, whereas part B deals with the calculation of assumed heeling moments and general assumptions and is set out in five sections. At the end of the code there is an appendix which sets out part C of the revised chapter VI of SOLAS, which deals with the carriage of grain.

Set out in the rest of this section are brief descriptions of the recommendations and requirements of Part A of the code, and a general description of Part B, after which the various requirements will be discussed.

General provisions – sections A 1– A 5

The code applies to ships regardless of size, as stated in section A 1. This includes ships of less than 500 GT engaged in the carriage of grain in bulk, to which part C of chapter VI of SOLAS, 1974, as amended, applies. In section A 2 there are definitions for words and phrases which are used in the code. The definitions for 'filled compartments, trimmed'; 'filled compartments, untrimmed'; and 'partly filled compartments' should be understood.

International Grain Code trimming requirements

- Filled compartments, trimmed – the grain should be trimmed level in the square of the hatchway, and in the under-deck spaces forward and aft, to fill these areas so far as possible.
- Filled compartments, untrimmed – the grain should be trimmed level in the square of the hatchway, but may be at the natural angle of repose forward of and abaft the hatchway.
- Partly filled compartments – the grain stowage should be trimmed level overall.

Also, note the definition for the term 'stowage factor' which, for the purposes of calculating the grain heeling moment caused by a shift of grain, means the volume per unit weight of the cargo as attested by the loading facility, that is no allowance shall be made for lost space when the cargo space is nominally filled. This means that when calculating the stowage factor of grain in a filled compartment, the appropriate volume for the hold, trimmed ends or untrimmed ends, should be used without any allowance for vacant space above the cargo surfaces. This topic is further discussed in Chapter 5.

The term 'specially suitable compartment' (given in paragraph A 2.7) refers to a cargo space which is constructed with at least two vertical or sloping, longitudinal, grain-tight divisions which are coincident with the hatch-side girders, or are so positioned as to limit the effect of any transverse shift of grain. Specially suitable compartments include holds with top-side tanks and box holds with open hatches.

Every ship which is designed for the carriage of grain, in accordance with section A 3, should have on board a Document of Authorisation which shall be accepted as evidence the ship is capable of complying with the requirements of the regulations. That Document of Authorisation shall be available on board for presentation to the local authority if required. There should also be on board a Grain Loading Manual for use by the master to complete calculations to demonstrate that, in the loaded condition, the ship meets the stability requirements set out in the code. If a ship does not have a Document of Authorisation, the master must demonstrate that the grain can be stowed in accordance with the appropriate parts of the code.

Section A 4 deals with equivalent stability information under chapter 1 regulation 5 of SOLAS which may be used. If it is used, particulars shall be included in the Document of Authorisation or in the Grain Loading Manual. If the voyage is considered to be in sheltered conditions, an exemption from the requirements of the code may be granted under section A 5.

Stability information and requirements – sections A 6–A 9

In order for the master to carry out calculations to ensure the ship complies with the requirements of the International Grain Code, the master should be provided with a booklet giving stability information and a Grain Loading Manual, and these documents must include the items listed in section A 6.

The intact stability characteristics of any ship carrying bulk grain shall be shown to meet, throughout the voyage as required by section A 7, at least the following criteria after taking into account the possible shift of grain and the grain heeling moments due to a grain shift.

International Grain Code stability criteria

- The angle of heel due to the shift of grain shall not be greater than 12° or in the case of ships constructed on or after 1 January 1994 the angle at which the deck edge is immersed, whichever is the lesser.
- In the static stability diagram, the net or residual area between the heeling arm curve and the righting arm curve up to the angle of heel of maximum difference between the ordinates of the two curves, or 40° or the angel of flooding (θ_1), whichever is the least, shall in all conditions of loading be not less than 0.075 metre-radians.
- The initial metacentric height, after correction for the free surface effects of liquids in tanks, shall be not less than 0.30 m.

Before a grain cargo is loaded the master should carry out the appropriate calculations and should ensure the ship is upright on completion of loading.

In section A 8 it is stated that, for the purposes of the section of the code, an 'existing ship' is one where the keel was laid before 25 May, 1980. The section then goes on to discuss documents of authorisation.

The requirements for the carriage of a partial cargo of grain in ships not having a Document of Authorisation are set out in section A 9. The total weight of grain to be loaded should not exceed one third of the deadweight of the ship and grain must be stowed such that all full trimmed compartments have a centreline division or the surface may be fitted with a saucer, as described in section A 14. All free grain surfaces must be trimmed and secured in accordance with the requirement of the code including those regarding metacentric height.

Stowage of bulk grain and grain fittings – sections A 10–A 18

The basic requirements for the stowage of grain are set out in section A 10. To minimise the effect of grain shifting, all free grain surfaces should be trimmed level. That is:

- grain surfaces within the hatchway of all filled compartments which have untrimmed ends
- all surfaces in spaces under the decks and elsewhere in filled compartments which have trimmed ends
- all grain surfaces in partly filled compartments.

A filled compartment may be classified as being a filled compartment, untrimmed (that is, with untrimmed ends) only if the administration issuing the Document of Authorisation grants a dispensation or if the compartment is a specially suitable compartment as defined in paragraph A 2.7, in which case trimming of the grain in the ends of the compartment may be not required in accordance with a dispensation.

The section deals with the carriage of grain in general cargo and 'tween-deck type ships, and stowage arrangements which might require the fitting of longitudinal divisions or the over-stowing of grain, or the securing of grain surfaces to prevent the shifting of grain cargoes in such ships.

Under paragraph A 10.7, any one of three methods may be used to secure the surface of a bulk grain stowage in a partly filled compartment to prevent any shifting during the voyage, so the grain heeling moment for the compartment is reduced effectively to zero. The methods involve either stowing bagged grain or other suitable cargo over the trimmed surface of the grain (section A 16), the fitting of strapping or lashing over the trimmed but very slightly crowned surface of the stowage (section A 17), or the fitting of layers of wire reinforcing mesh retained in place by lashings over the trimmed but very slightly crowned surface of the stowage (section A 18). Full details of the methods and the arrangements required are set out in the three sections.

Under paragraph A 10.9 it may, under certain circumstances, be required that a longitudinal division is installed. The construction and strength of the required grain fittings to reduce the adverse heeling effect of grain shifting is set out in sections A 11, A 12 and A 13.

Section A 9 deals with the optional stability requirements for ships without a Document of Authorisation when carrying partial cargoes of bulk grain. Sections A 14 and A 15 give alternatives for reducing the heeling moment which may be used in place of longitudinal divisions. A saucer of the required dimensions, within the surface of the grain stowage, may be filled with bagged grain or the saucer may be filled with bulk grain which is then secured over its top surface.

Part B of the code gives details of the various assumptions to be used during the calculation of adverse heeling moments resulting from a shift of cargo surface. That is, details are given of various angles to the horizontal of the surface of a grain stowage untrimmed following loading, and the angle to which the surface of the stowage will be inclined to the horizontal after a shift of cargo in various situations and compartments. Also given are various measurements to be assumed in calculations. Using the assumed angles and other information, and the dimensions of a cargo compartment, the assumed volumetric heeling moment for a shift of grain can be calculated. In practice, naval architects will use the assumed angles and measurements given in Part B of the code when they complete their calculations for the production of the ship's Grain Loading Manual and the loading program in the ship's computer that the master will use for the calculations. Therefore under normal circumstances, the master has no need to consult Part B of the code.

Practical implications

The International Grain Code sets out recommendations and guidance with regard to the carriage of grain in bulk aboard the various types of ship including bulk carriers, general cargo ships, 'tween deck ships and other types. It also provides guidance to the masters of ships that will be carrying grain cargoes. This guide deals only with bulk carriers for which a Document of Authorisation has been issued and not with requirements for other types of ship. If guidance is required on the carriage of grain in bulk on board a ship without a Document of Authorisation, this should be obtained from the ship's flag state.

Maximum permissible heeling moments – 12º list

Grain is non-cohesive and therefore might shift if the carrying ship lists or rolls to one side, and if there is vacant space into which the grain can move. It is required under section A 7 that the grain shall be stowed on board in such a way that, if there is a shift of grain, that shift does not result in the ship listing to more than 12º. When there is a shift of grain to one side, in one or more of the compartments, the centre of gravity of that volume, or stowage, of cargo will move to one side of the ship, and movement will create a heeling moment which will cause the ship to heel towards the direction of movement. In order for the ship to be heeled by 12º, a certain heeling moment must be applied to the ship and that necessary heeling moment will depend upon the characteristics of the ship, including its draught, its displacement and other factors, and its GM at the time of the shift. This heeling of the ship by a shift of grain is caused by the same mechanism as that which will cause a ship to list to one side when cargo is moved on board or when there is loading or unloading at one side.

Set out in the ship's Grain Loading Manual will be, among other things, in accordance with section A 6.

Grain Loading Manual contents

- Curves or tables of volumes, vertical centres of volumes and assumed volumetric heeling moments for every compartment, filled or partly filled, or combination thereof, including the effects of temporary fittings.
- Tables or curves of maximum permissible heeling moments for varying displacements and varying vertical centres of gravity to allow the master to demonstrate compliance with the requirements of A 7.1; this requirement shall apply only to ships the keels of which are laid on or after the entry into force of this code.
- Details of any temporary fittings, loading instructions with regard to the requirements of the code, a worked example as guidance for the master and typical loaded service departure and arrival conditions.

Calculations required

Using the information and guidance in the Grain Loading Manual, the master can carry out calculations to demonstrate, before loading begins, that when the cargo has been loaded on board in the planned arrangement, in accordance with the pre-stowage plan, the ship will comply with the requirements set out in section A 7 of the code, and any other requirements. With regard to heeling of the ship due to a shift, it must be demonstrated that if there were to be, at any time during the voyage, a shift of all the grain on board that is able to shift, the ship will list to no more than 12º to one side.

In calculations for the angle of heel due to a shift of cargo (which should be completed before loading begins), some calculations compare the total grain heeling moment of the cargo, that is, the sum of the grain heeling moments for each individual hold, with the maximum permissible, heeling moment for the ship in its loaded condition, as obtained from the table in the Grain Loading Manual, while other calculations determine the possible angle of heel which would be produced if there were to be a shift of cargo. Either method of calculation is acceptable. It should be noted that the grain heeling moment for a cargo in any particular compartment is the volumetric heeling moment of that stowage obtained from the volumetric heeling moment curve or table in the Grain Loading Manual divided by the stowage factor of the grain to be loaded.

Excessive total grain heeling moment

If the total grain heeling moment for the cargo to be loaded would be greater than the maximum permissible heeling moment for the loaded condition of the ship, action must be taken to rectify the situation. Either the arrangement of the cargo on board, or the amount of cargo to be loaded, must be adjusted or altered, or it might be possible to eliminate the heeling moments of the stowages in any partly filled compartments by over-stowing those stowages, strapping or lashing, or by securing the top of stowages with wire mesh, as given in sections A 16, A 17 and A 18 of the code. If such arrangements are satisfactorily completed in partly filled compartments, the grain heeling moments for those compartments are reduced to zero and only the grain heeling moments for the other holds loaded with grain should be used in the calculations.

General good practice

During the loading of a grain cargo, that loading operation should be monitored in accordance with the BLU Code requirements. Upon completion of the loading of cargo into each compartment, the surface of the stowage should be trimmed to level the free grain surface to minimise the effect of grain shifting, that is in all filled compartments and in all partly filled compartments. It is recommended that, following completion of all loading of a grain cargo, the calculations for the intact stability characteristics of the ship, including the angle of heel due to shift of grain, should be re-worked on the basis of the ship's loaded condition. This should take into account the weights of all liquids on board and the free surface moments of all tanks involved, and the actual distribution of cargo and the actual stowage factor of cargo as determined from measurements taken on board.

Further information and guidance on the carriage of grain can be found in Chapter 7.

BLU CODE AND BLU MANUAL

The Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code), published in 1998 as amended, sets out guidance and requirements with regard to the loading and the unloading of bulk cargoes (including grain), to be followed by those on board the carrying ship and those at the loading or unloading terminal. The *Manual on loading and unloading of solid bulk cargoes for terminal representatives* (BLU Manual) provides more detailed guidance for personnel ashore at the terminal.

The basic philosophy of the requirements set out in the BLU Code is that there should be clear and adequate communications and exchange of information between those operating the terminal ashore, and the master and crew on board the ship before arrival and throughout the loading or unloading operation. This is so that:

- all concerned are familiar with the planned and agreed operation
- the operation progresses safely and as required by both parties
- those on board the ship are aware of operations being undertaken ashore and any changes in those onshore operations
- the terminal representative is aware of the requirements of the master throughout operations, of any changes in the master's requirements, and of any changes in operations which are being undertaken on board the ship.

Finally, the code requires full discussion of all requirements, and of any changes

in the various operations that are underway and which occur during the loading or unloading of the ship.

The basic requirements, various parts and practical implications of the BLU Code and BLU Manual are discussed in the following sections.

Basic requirements

The basic requirements of the BLU Code are as follows.

BLU Code requirements

- Terminal operator should appoint a terminal representative to oversee operations.
- The master is responsible at all times for the safe loading or unloading of the ship and details of the loading or unloading operation should be confirmed between the master and terminal representative in the form of an agreed loading or unloading plan.
- If there is non-compliance with the agreed loading or unloading plan or if a situation develops which endangers the safety of the ship, the master has the right to stop the loading or unloading operation.
- The terminal representative has the right to stop the loading or unloading operation if the safety of the ship is endangered.

It is recommended that a copy of the BLU Code is made available to every ship, charterer and bulk cargo loading or unloading terminal so that advice on operational procedures is readily available and respective responsibilities can be identified. In paragraph 6 of the introduction of the code it is required that a terminal or port information guide should be published setting out information and requirements of the terminal or port, with recommended contents given in appendix 1. A copy of the information book should be obtained by the master.

The code is arranged in sections 1 to 6 and appendices 1 to 5. In the six sections of the code guidance and recommendations are set out with respect to the various stages of an operation. These range from the planning stage before the ship arrives at the terminal, through the exchange of safety and procedural information and the agreement of a loading or unloading plan when the ship arrives alongside, through the various loading or unloading stages, to the final completion of all operations. Set out in the following sub-sections are brief descriptions of the contents of the code, after which the various requirements will be discussed.

Preliminary requirements and procedures

In section 1 there are definitions for words and phrases which are of importance for the understanding of the meaning of recommendations and guidance given in later sections; these should be studied and understood.

So the loading or unloading operation can be completed satisfactorily, safely and without significant incidents occurring, the ship should be in all respects suitable for the intended calls at the loading port and at the intended unloading port (that is at all ports of loading and unloading), and should be in all respects suitable for the carriage of the intended cargo. Also, the terminals, both at the loading port(s) and the unloading port(s), should be suitable for the loading and respectively unloading of the nominated ship. The various requirements are set out under the sub-headings of general, ships and terminals in section 2.

Before the ship arrives at the loading or unloading terminal, there should be a thorough exchange of information between the ship and the terminal, and any charterer, so that the master on board the ship, the charterer and the terminal representative ashore are fully aware of the situation with regard to the approaching ship and the terminal to be used for the intended loading or unloading of cargo. Section 3 begins with two sub-paragraphs as follows.

BLU Code pre-arrival information

3.1.1 It is important that the ship be provided with information about a terminal so the loading or unloading can be planned. Similarly the terminal will need information about the ship to enable preparations to be made to load or unload the ship. It is important that the information be explained in sufficient time to allow preparations to be made.

3.1.2 Before loading commences there should be an agreement between the master and the terminal representative as to the rate of loading and the order in which the cargo is to be distributed so as to achieve the final loading plan. In general this agreement should be based on one or more of the following options…

There then follow three options which set out limitations or restrictions that may be encountered.

Set out in section 3 is information which is required to be given by the ship to the terminal and information which should be given by the terminal to the ship. Using the information exchanged in this manner, the master and the terminal representative can plan the intended operation. The charterer, with respect to the shipment of cargo, should be kept advised of planned cargo operations and of all agreed changes to these plans.

The master is responsible at all times for the safe loading and unloading of the ship, the details of which should be confirmed to the terminal representative in the form of a loading or unloading plan – section 4.

Before the ship arrives at the terminal, the loading or unloading plan should be prepared (such a plan is sometimes referred to as a 'loading/unloading sequence' or 'loading/unloading schedule'). A form of such a plan is given in appendix 2 to the code, and a copy of the fully prepared plan should be presented to the terminal representative before the ship's arrival. Following arrival, the loading or unloading plan and operations in general should be fully discussed, any required or necessary changes to the plan should be made and agreed, and agreement should be reached between the master and the terminal representative with regard to the various operations to be completed. The agreed plan should be signed by representatives of the ship and of the terminal. Also, a checklist 'Ship–shore safety checklist for loading or unloading dry bulk cargo carriers', given as appendix 3 to the code, should be completed before any loading or unloading is commenced.

There are lists of requirements to ensure continued communication between those on board and those ashore, and to ensure the safe loading or unloading of the cargo. As a general principle, all aspects of the operation that are discussed and agreed, and which affect the loading operation and/or the voyage, should be advised to the appropriate charterer and, if necessary, discussed with their representatives. Similarly, the ship operator should be kept up-dated with regard to all operations and any changes made.

Cargo loading and handling of ballast

During the loading of cargo and the pumping out of any ballast water there should be continued good communications and exchange of information between the master, the terminal representative and all others as appropriate who are involved in monitoring the operation, as set out in section 5. During the final stages of a loading operation, discussions with regard to the final trimming of the ship should be undertaken to ensure the operation is completed as intended. Also, any necessary trimming of the cargo stowage should be discussed and appropriately carried out. The section includes lists of the duties of those on board and those ashore.

Unloading cargo and handling of ballast

In section 6 there are procedures to be followed during the unloading of cargo and the taking on board of ballast. The duties required of the master and those on board, and of those ashore, are set out. During an unloading operation it is important, as with the loading operation, that good communications are maintained and monitoring of operations are continued so the overall operation progresses as intended.

Practical implications of BLU Code

The layout of the code is on a sequential basis: pre-arrival information exchanges, pre-cargo operations exchanges and then monitoring of operations and ongoing discussions. The key topics upon which there are guidance and recommendations are as follows:

- ship and terminal suitability
- training and competence of personnel
- exchanges of information
- agreement of loading or unloading plan
- monitoring of operations
- agreement of any necessary adjustments to the plan and operations.

The BLU Code stresses the need for exchanges of information and ongoing discussions between the master and the terminal representative. As a general rule, and so far as possible and appropriate, communications and exchanges between the master and the terminal representatives (at both the loading port(s) and unloading port(s)) should be passed to any charterer interested in the shipment, as well as the ship operator. Any such charterer and the ship operator should be kept informed of the various aspects of the loading operation, the voyage and the unloading operation throughout their progress.

Suitability of ship and terminal

The ship should be in all respects seaworthy, suitable and fit to load the cargo at the loading terminal, to carry the cargo to the unloading terminal and to unload the cargo at the unloading terminal. All machinery and equipment on board should be properly maintained and in good functional order and properly certificated. The crew should be competent for the completion of all necessary tasks and proficient in appropriate languages. With regard to the terminal, it should be such that the ship is able to safely berth alongside the installation. Terminal equipment should be properly maintained

and appropriately certificated and terminal staff should be trained to carry out the cargo operations safely and as required.

Before arrival

Before arrival at the loading or unloading terminal there should be an exchange of information between the ship and the terminal so operations can be properly planned. The master should provide information about the ship, including the estimated time of arrival at the port, the ship's draught and air draught, the arrangement of the ship and its capacities, and about the loading or unloading operation which is required. When the terminal representative receives the ship's information, arrangements for the appropriate berth can be made and information about the intended berth can be passed back to the master. For example, the terminal personnel need information about the ship, including its overall length, beam, and arrival and departure draughts, so an appropriate berth that can accommodate the ship can be nominated. Also, the terminal representative needs to know details of any on-board cargo handling gear and details of the cargo holds to be used to make any appropriate arrangements for the necessary onshore cargo handling equipment.

Preparations for loading

When masters receive details of the cargo to be loaded, they should carry out trim, strength and stability calculations to establish that the cargo can be safely carried, and they should prepare a pre-stowage plan showing the arrangement of the cargo on board. Having completed these initial calculations, they should carry out additional calculations and prepare a loading plan showing the full sequence of loading and de-ballasting, which they require to complete the loading of the intended cargo. That plan should be in the form as given in appendix 2 of the code. When completed, a copy of the loading plan should be passed to the terminal representative, probably via the agent, so that terminal staff can study the plan to establish whether or not the loading of the intended cargo can be carried out as required by the master.

After the ship has arrived at the loading terminal and before loading of cargo is started, discussions should be held between the master or the master's representatives on board and the terminal representative who attends on board. Initially, the ship–shore safety checklist should be completed, to ensure both ship's staff and terminal staff are aware of all appropriate safety and operational items. Next, the loading plan should be discussed and agreement should be reached that the terminal can and will follow the sequence of the plan.

The plan should then be signed by both the terminal representative and the master or the master's representative on board. Loading can then begin. The master and the duty deck officers should monitor the loading operation and other operations which are ongoing on board, including the de-ballasting operations, the adjustment of mooring lines as appropriate and other operations. Ship's staff should also check that the cargo is the correct commodity (see also the various items in Chapter 8 of this guide). The terminal representative and shore personnel should monitor the loading operation from their perspective to ensure the operation progresses in accordance with the master's loading plan.

Loading operations

As it states at paragraph 5.1.5 of the code, to monitor effectively the progress of the cargo loading operation, it is essential for both the master and the terminal representative to have readily accessible information on the total quantity loaded, as well as the quantities per pour. That is to say, both the master and the terminal representative should keep a close tally of the weight of cargo loaded into each of the working holds and of the total weight of cargo on board. Additionally, the master must keep a good check on the pumping out of ballast water.

If operations are not progressing in accordance with the schedule set out in the loading plan, either because of difficulties ashore or on board, discussions should be held between the master, or the master's representative on board, and the terminal representative. Agreement should be reached with regard to how best to continue the loading operation and what changes, if any, should be made to the loading plan. The operation should be stopped if necessary and should be re-started only when agreements have been reached.

During the final stages of the operation there should be close monitoring of operations by those on board and those ashore, ensuring the final trimming of the ship and of cargo stowages is completed as required and the cargo is stowed as required by the loading plan. Following completion of loading, the master and the terminal representative should agree in writing that the ship has been loaded in accordance with the loading plan, including any agreed variations. This is stated at paragraph 5.1.6 of the code.

Preparations for unloading

Prior to arrival at the unloading port, there should be a full exchange of information between the ship and the terminal to ensure the unloading operation can be undertaken as intended. The master should complete all necessary trim, strength and stability calculations and produce an unloading plan. The plan should show the full schedule for unloading the cargo and taking on ballast water, and a copy should be passed to the terminal for consideration. As with the pre-arrival load-port exchange of information, the master should provide the terminal with details of the ship's estimated time of arrival, details of the ship and details of the offloading of cargo which is required. The terminal representative, in turn, should provide the master with the appropriate information as set out in section 3 of the code. Also, as with procedures at the loading port, when the ship is alongside a ship–shore safety checklist should be completed and agreement should be reached with regard to the unloading plan, after which the plan should be signed.

Unloading operations

The unloading of cargo and the taking on board of ballast should be closely monitored by ship's staff to ensure the unloading plan is being followed. They should also monitor the moorings to ensure the ship is secure alongside, and monitor the weather conditions and the draught of the ship as the unloading operation progresses. The terminal representative should also monitor the offloading operation to ensure the operation progresses as required by the master and as set out in the unloading plan.

To maintain effective monitoring of the progress of the cargo unloading plan, it is

essential for both the master and the terminal representative to have readily accessible information on the total unloaded quantity as well as the quantities unloaded per hatch, as given in paragraph 6.1.4 of the code. If problems arise ashore or on board, such that a deviation from the unloading plan is required, discussions should be held between the master, or the master's representative on board, and the terminal representative and agreement should be reached with regard to any alterations. If appropriate, the unloading operation should be stopped while such discussions are held and the operation should only be re-started after agreements have been reached with regard to any necessary changes to the unloading plan.

The BLU Code requires that there is ongoing communication and exchange of information between those on board and those in the terminal, from before the ship arrives at the terminal until completion of the loading or unloading operation, and both those on board and those ashore fully monitor all operations being undertaken. Further, if there are difficulties being encountered either on board the ship or ashore, these difficulties should be discussed without delay and any alterations to the loading or unloading plan should be discussed and agreed, and then implemented.

The BLU Code includes five appendices as follows.

BLU Code appendices

1. Recommended contents of port and terminal information books.
2. Loading or unloading plan.
3. Ship–shore safety checklist for loading and unloading dry bulk cargo carriers.
4. Guidelines for completing the ship–shore safety checklist.
5. Form for cargo information (recommended layout).

BLU Manual

The BLU Manual, or the manual on loading and unloading of solid bulk cargoes for terminal representatives, is set out with six sections, followed by six annexes. The six sections comprise the full text of the BLU Code, with additional guidance notes intended primarily for terminal staff, although much of the guidance and information is of use to the master and ship's staff. These notes include guidance as to what checks should be made with regard to the ship nominated for loading or unloading, the suitability of the terminal for that nominated ship and other pre-arrival matters to be considered.

With regard to loading and unloading operations, notes are set out with regard to methods and safeguards to be followed to comply with the loading or unloading plan. It is emphasised that discussions should be held to reach agreement upon, so far as possible, a mutually acceptable plan for the operations to be undertaken. It is a requirement that information with regard to the port or terminal, and its normal operations, should be provided to the master. There is also guidance for the terminal manager on what operations should be carried out on board and with regard to the master's responsibilities during loading or unloading.

The annexes to the BLU Manual are as follows.

BLU Manual annexes

1. Pre-arrival ship–shore exchange of information.
2. Avoidance of damage during cargo handling.
3. Repair of damage incurred during loading and unloading.
4. Training of terminal personnel involved in loading and/or unloading bulk carriers.
5. Hazards.
6. Emergency procedures.

These annexes provide extensive information and guidance for both the master and the terminal representative and should be studied. There should be a full exchange of information before arrival. The table in annex 1 sets out the basic requirements and the table should be used together with information given in section 3 of the BLU Code itself, and all of that information should be supplemented by any other details of the particular situation of the ship and the terminal. If this procedure is followed, there should be no misunderstandings.

Annex 2 gives advice with regard to good practices to be observed by the operator of cargo handling machinery to avoid damage to a ship's structures and fittings. If damage is sustained, guidance upon procedures for inspections and possible repairs are given in annex 3. Charterer's instructions regarding stevedores' damage should be followed. As mentioned in section 2 of the BLU Code, all terminal personnel should be trained in all aspects of safe loading and unloading of bulk carriers commensurate with their responsibilities; annex 4 provides some guidance for terminal operator in this regard.

Annex 5 gives a table of hazards which may be encountered and their possible sources or causes. In section 6 of the BLU Manual there is paragraph 6.1.1 which gives a list of safety issues to be considered during the unloading operations; these matters must also be taken into account, as appropriate, when a ship is alongside and shore personnel are in attendance on board.

Lastly, annex 6 gives a list of emergency situations and topics for emergency plans. Terminals should have written procedures for dealing with emergency situations. These procedures should be discussed between the terminal representative and the master following the ship's arrival alongside.

It is recommended that the BLU Code and the BLU Manual should be studied and all aspects should be implemented and followed as appropriate.

ISM CODE

For a ship to be operated safely and efficiently and control environmental pollution, there should be systems in place which govern all the normal and emergency operations on board ship. Also, records should be kept to demonstrate that the ship is being operated efficiently, safely and without causing pollution. Requirements in this regard are set out in the latest edition of the International Safety Management Code (ISM Code).

The various parts, requirements and practical implications of the ISM Code are discussed in the following sections.

SOLAS regulations

The ISM Code is mandatory under SOLAS chapter IX, which deals with management for the safe operation of ships. Chapter IX of SOLAS is set out in six regulations, as follows.

SOLAS chapter IX regulations on ISM Code	
Regulation 1	*Definitions* – definitions including the ISM Code, the expression company (for the purposes of the code), and for various craft to which the code applies.
Regulation 2	*Application* – details of the ships to which, and when, chapter IX applies.
Regulation 3	*Safety management requirements* – details of safety management requirements, including the requirement that the company and the ship shall comply with the requirements of the ISM Code and the ship shall be operated by a company holding a Document of Compliance.
Regulation 4	*Certification* – details of required certification with regard to documents of compliance and the Safety Management Certificate.
Regulation 5	*Maintenance of conditions* – the safety management system is to be maintained in accordance with the requirements set out and shall be maintained in accordance with the provisions of the ISM Code.
Regulation 6	*Verification and control* – there must be periodical verification of the proper functioning of the ship's safety management system.

Therefore the requirements set out under chapter IX of SOLAS are the basic requirements that should be met with regard to a safety management system.

ISM Code – general description

The ISM Code provides an international standard for the safe management and operation of ships and for pollution prevention. It gives details of how safety management systems may be arranged, implemented, verified and controlled.

Under the code, the ship and the company which has assumed responsibility for the operation of the ship are considered to be directly linked through the management system, and link is established by the appointment of a designated person (DP), sometimes referred to as the designated person ashore (DPA), to act as the point of contact between the ship and the senior management of the company. To ensure the individual can effectively undertake the task, the designated person must be given direct and open access to both the master on board the ship and the management of the company ashore.

The code sets out requirements with regard to the various objectives of a safety management system, the manner in which that system should function, the responsibilities and authorities of the various people involved, key tasks and procedures which should be identified, systems which should be involved in the operation of the ship and verification, review and evaluation procedures. To set out these various requirements, a safety management manual should be produced. Additionally, checklists

and other records should be kept as evidence of ongoing compliance with the safety management procedures.

The code is set out in two parts. Part A – implementation – is arranged in sections 1–12 and gives the objectives, functionality and general management of the system. Part B – certification and verification – is arranged in sections 13–16 and sets out requirements with regard to the issue of Documents of Compliance and Safety Management Certificates, the verification of procedures and the forms in which the certificates should be drawn up.

Set out in the following sub-sections are brief descriptions of the contents of each of the sections of Part A of the code, and a general description of Part B, after which the various requirements will be discussed.

Part A – implementation

First there are definitions which apply to the code. Next the objectives of the code are given, 'to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment and to property.'

The safety management objectives of the company, as given in section 1, should, amongst other things provide for safe practices in ship operation and safe working environment; assess all identified risks to its ships, personnel and the environment and establish appropriate safeguards; and continuously improve safety management skills of personnel ashore and aboard ships, including preparing for emergencies related both to safety and environmental protection.

The safety management system should ensure compliance with mandatory rules and regulations; and that applicable codes, guidelines and standards recommended by the organisation, administrations, classification societies and marine industry organisations are taken into account.

It is stated that the code applies to all ships. Every company should develop, implement and maintain a safety management system which includes the following functional requirements.

Safety management system requirements

- Safety and environmental-protection policy.
- Instructions and procedures to ensure safe operation of ships and protection of the environment in compliance with relevant international and flag state legislation.
- Defined levels of authority and lines of communication between, and amongst, shore and ship based personnel.
- Procedures for reporting accidents and non-conformities within the provisions of the code.
- Procedures to prepare for and respond to emergency situations.
- Procedures for internal audits and management reviews.

The company should establish, in accordance with section 2, a safety environmental policy which describes the objectives as set out in section 1 of the code and companies should ensure the policy is implemented and maintained.

The company should define and document the responsibility, authority and inter-relation of various people and ensure adequate resources are available.

The company should designate a person or persons ashore to ensure safe operation of the ship and to provide a link between the company and those on board. That designated person or persons should monitor the safety and pollution prevention aspects of the operation of the ship and ensure adequate resources and shore-based support are applied, as required.

The company should define and document the master's responsibilities.

The company should ensure there are the appropriate personnel, including a qualified master, to properly man each ship and should ensure all personnel are properly trained and familiar with their duties. Appropriate procedures should be established and followed.

The company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel and ship, and for protection of the environment. The various tasks should be defined and assigned to qualified personnel.

The company should identify potential emergency shipboard situations, and establish procedures to respond to them. There should also be procedures for drills and exercises, and the safety management system should include measures to ensure the company is able to respond to hazards, accidents and emergency situations involving its ships at any time.

The safety management system should include procedures to ensure all non-conformities, accidents and hazardous situations are reported, investigated and analysed, with the objective of improving safety and pollution prevention. There should be procedures for the implementation of corrective action, including measures intended to prevent re-occurrence.

There should be procedures to ensure the ship and its equipment are maintained in accordance with the provisions of the relevant rules and regulations and with regard to additional requirements established by the company. Such procedures should be set out in the ship's operational maintenance routine, and these procedures should include the requirements that; inspections are carried out at appropriate intervals, non-conformities are reported and appropriate corrective action is taken when failings are found, and records of all activities are maintained.

The company should set out procedures to control all documents and data which are relevant to the safety management system. A safety management manual should be produced in which descriptions of the various parts of the safety management system are set out and descriptions of how these parts of the system are to be implemented.

Internal audits should be carried out on board and ashore at intervals not exceeding 12 months to verify whether safety and pollution prevention activities comply with the safety management system. Section 12 goes on to describe evaluation of the safety management system, audits and possible corrective actions, and other required procedures.

Part B – classification and verification

Part B of the code gives details, in sections 13 to 16, of requirements with regard to certification and periodic verification, interim certification, verification, and forms of certificates. It is required that the company should be issued with a Document of Compliance, or with an Interim Document of Compliance, as evidence the company is capable of complying with the requirements of the code. The ship should be issued with a

Safety Management Certificate after it has been verified that the company and its shipboard management operate in accordance with the approved safety management system.

A copy of the Document of Compliance should be placed on board and the Safety Management Certificate should be held on board by the master. There should be intermediate verification of the certificates at intervals set out in the code. Also given are the circumstances under which the documents should be withdrawn. The Appendix at the end of Part B gives examples of forms of Document of Compliance, Safety Management Certificate, Interim Document of Compliance and Interim Safety Management Certificate.

At the back of the code there are guidance notes as follows.

ISM Code guidance notes

- Guidelines on implementation of the International Safety Management (ISM) Code by Administrations.
- Guidelines for the operational implementation of the International Safety Management (ISM) Code by Companies.
- Guidance on qualifications, training and experience necessary for undertaking the role of the designated person under the provisions of the International Safety Management (ISM) Code. Guidance on near-miss reporting.

The guidance notes give very useful information relating to these specific topics and should be studied, as should the ISM Code itself.

Practical implications

The ISM Code sets out recommendations and guidance with regard to the implementation of a safety management system on the ships operated by a company. This section has set out the main points of the code, many parts being quoted, and these notes should be read in conjunction with the code. In brief, the company needs to identify all the safety and environmental matters that will be encountered during the various operations of the ship, and then formulate a system of procedures.

Also, systems should be drawn up with regard to the responsibilities and authority of the company, the designated person and the master, and with regard to shipboard operations, emergency preparedness and the maintenance of the ship and its equipment. The procedures should also include those for verification, review and evaluation of the safety management system and the reports and analysis which are required in cases of non-conformities, accidents or hazardous occurrences.

It is normal practice for these various parts of the requirements of the code to be set out in a safety management manual. The manual should be divided up into chapters which deal with various aspects of the objectives set out by the company and the functional requirements developed by the company. In addition to the manual, there will be annexes containing copies of checklists that should be used during various procedures, forms for reporting findings of various inspections on board and forms for the various audits, reviews, non-conformities and so on.

It is recommended that the ISM Code, and the guidelines on the implementation of the ISM Code, should be studied in its entirety.

Chapter 4

OPERATIONS AND MAINTENANCE

HATCH COVERS AND OTHER WEATHER-DECK OPENINGS

Bulk carriers have relatively large weather-deck hatch openings which are fitted with steel covers comprising one or more large steel construction panels or pontoons. These covers are the result of complex engineering design and construction to allow them to be opened and closed easily and fairly quickly, such that they have the required strength to withstand the rigours of an ocean voyage and will remain weathertight during adverse conditions. Their design, which requires millimetre accuracy, allows a certain amount of flexibility of the covers while maintaining weathertightness.

On the weather-deck – forward around the hatchways, right forward in way of storerooms, and aft around the superstructure – there will be other openings, possibly including hold access hatchways, deckhouse doors, crane access doors, ventilators and access doors into the forward stores, aft stores and into the accommodation spaces. The doors and covers of these openings, as well as the covers of the main hatchways, must be maintained in a weathertight condition.

Under the International Convention on Load lines 1966 it is required that all hatch covers and covers to other openings on deck are to be weathertight. Weathertightness means that water will not enter the hull of the ship in the worst sea and weather conditions likely to be encountered by the ship in service. This means that the hatch covers, ventilator flaps, weather-doors and other covers should prevent water shipped on board from entering the hold, stores, accommodation and so on from the outside inwards.

Watertightness, on the other hand, is a requirement that water will not pass a bulkhead or cover in either direction, and will withstand the pressure of a head of water up to the freeboard deck on either side.

To ensure hatch covers, accommodation doors, ventilation flaps and other covers are weathertight, they are all fitted with gaskets or rubber packing seals of some form, which mate against a compression bar or surface to make a seal. The covers, doors and flaps are held in place to maintain the seal by cleats, wedges or screw dogs of some form. The only exception to this is the pontoon-type hatch covers fitted on board some logger-type bulk carriers, which are made weathertight by tarpaulin sheets spread overall and held in place by steel battens and wooden wedges.

To ensure covers remain in good condition and continue to achieve weathertightness, all parts of the arrangements including the rubber packing, securing mechanisms, closing mechanisms and the steelwork of the covers themselves, and where appropriate the hinges and wheels, should be maintained in good and efficient operational condition in accordance with the manufacture's requirements.

North's loss prevention guide *Hatch Cover Maintenance and Operation* should be consulted for detailed information. The basic requirements and guidance are set out here.

Types of hatch cover

There are four main types of hatch cover fitted to bulk carriers today: single-pull rolling covers which open and stack to one or both ends of the hatchways; folding pairs of panels which open and stow vertically at the ends of the hatchway; pairs of side-rolling panels, one rolling to each side of the hatchway; and portable pontoons.

There are variations to the basic designs, including: folding covers which open to the sides of the hatchway; rolling pairs of covers which open forward and aft on bulkers designed with sufficient deck space; side-rolling hatch covers where only one of the two panels has a drive mechanism and the other panel is moved piggy-back fashion; and various arrangements of stacking or piggy-back pontoons.

On board cape-size bulkers, very large ore carriers and many panamax bulkers, side-rolling pairs of panels are fitted. Folding covers are fitted on some panamax bulkers, most handy-sized bulkers and on many mini-bulkers. Single-pull covers are fitted on older handy-size bulkers but this type of cover is now being fitted only to a few new ships. Stacking portable pontoons are fitted to open-hatch ships and smaller mini-bulkers.

Single-pull covers

Single-pull covers comprise a number of panels, usually between four and seven panels, which are connected one to another by either chains or bars. The covers are opened or closed by one of two methods. One involves pulling the leading panel by a wire shackled to a ring fitted at the centre of the leading edge of the leading panel and led via sheaves to a winch or crane hook. The other is by a system of chains attached to brackets at the sides of the leading panel and driven by an electric or hydraulic motor fitted at the hatch end.

The panels are stacked vertically at one end of the hatchway when in the open position and are pulled in sequence across the hatchway. When being closed, the panels are pulled one at a time from their stowage position, they tilt through 90º to become horizontal and the leading edge of each successive panel engages with the trailing edge of the adjacent panel until all panels have been pulled into position. During opening, the panels disengage in sequence and tilt into their stowage positions. During the opening and closing process the panels move on their wheels fitted to both sides, and these wheels run along trackways on the coaming such that the base of the side plating of the covers, and therefore the packing rubber, is kept above and clear of the coaming compression bar by a distance of around 10 mm to 15 mm.

When it is necessary to batten the hatches down for sea, the panels must be lowered onto the coaming to make the seal between the packing rubber and the coaming compression bars. This is achieved either by concentric wheels or by hydraulic pot lifts. Securing of the covers in place is achieved by cross-joint wedges fitted at intervals across the trailing edge of each panel except the last panel, and by quick-acting cleats fitted at intervals along all side and end coamings. These devices are closed and locked to maintain the seals at the cross-joints and the coamings. Other features of single-pull covers are the raised stowage track, which extends from the hatch coaming in way of the stacking area and the stowage or balancing rollers fitted to both sides of each panel to allow the panels to rotate from the horizontal to the vertical stowage position.

Folding covers

Folding covers comprise folding pairs of steel panels. The simplest arrangements comprise one or two pairs of panels, one forward of and/or one aft the hatchway. Each pair is hinged together in way of a cross-joint, and the forward-most and aft-most panels are hinged to the ship's structure in way of the hatch end coaming. Hydraulic cylinders and rams are fitted either at each hatch end or within the pairs of panels to open and close the covers.

For longer hatch openings, arrangements comprising four panels arranged in two pairs at each end of the hatchway might be fitted. The second pair of panels might be operated by hydraulic cylinders fitted internally in the panels or by externally-fitted hydraulic cylinders which rotate bell cranks or link arms to port and to starboard to open and close the trailing pair of covers. These covers open and close while running on wheels fitted at the trailing edge of each panel, and these wheels run along coaming trackways. The seals at cross-joints are maintained by wedging arrangements which act in the final stages of closing, and coaming seals are maintained either by cleats which are manually or hydraulically operated or by wedge cleating systems which come into effect during the final stage of the closing operation.

Fig. 1. Folding hatch covers

Side-rolling covers

Side-rolling covers consist of two large panels, normally one to port and one to starboard at each hatchway. The panels are fitted with wheels which run along rails fitted to the top of the end coamings and which are extended to port and to starboard on support structures, where the panels are stowed in the open position. Opening and

closing of the panels is achieved by hydraulically or electrically driven rack and pinion mechanisms or by chain-drive systems. As with single-pull-type covers, the panels are raised above the coaming top during opening and closing operations and must be lowered onto the coamings to make the seal between the rubber packing and coaming compression bar.

The panels are usually raised and lowered by pot lifts fitted in the coamings in way of the position of the rolling wheels when the covers are in the closed position, although recent designs have incorporated inclined sections of the rails at the inner ends of the rail tracks which allow the panels to descend onto the coaming. Securing of the covers is usually achieved by draw-bolt cleats fitted at intervals along the centreline cross-joint and by quick-acting cleats fitted at end and side coamings.

Fig. 2. Side-rolling hatch covers

To assist with the closing and battening of the covers for sea and for compression along the centreline cross-joint, wedge-shaped stop locators are fitted on the end coamings forward and aft, and mating stopper pads are fitted onto the panels forward and aft in way of the centreline joint. When the panels are lowered onto the coaming by use of the pot lifts, the adjacent bearing surfaces, which are angled down and inboard, create a wedging action which forces the panels inwards and the compression bar of one panel into the packing rubber seal of the other panel.

Stacking covers

Stacking covers were developed for ships such as mini-bulkers, where a large hatch opening is required with very little deck space left at each end of the hatchway. These comprise a number of steel panels which may be stacked one atop another to allow opening of the hatchway. These covers are stacked using either hydraulic jacks fitted at one or both ends of the hatchway or by means of a small gantry crane which runs forward and aft along trackways.

Where the arrangement includes hydraulic jacks, the panels are fitted with wheels to each side, and one or more of the panels is fitted with an internal electric drive motor. For opening of the covers, the dumb panels (those without a drive motor) are moved forward or aft by the drive-panel, to be lifted one at a time by the jacks. When the first panel has been lifted, the covers as a whole are driven aft or forward so that the next panel is in position adjacent to the rams, that panel is lifted and so on, as required. If the system includes a gantry crane, the gantry crane lifts the panels one at a time from their stowage location and then carries that panel, forward or aft as required, to where it is to be stowed atop another panel. On a bulker fitted with such stacking covers, at no time can the entire hatchway be open because there will always be an area covered by panels.

With the gantry-crane-operated system, when the panels are placed into position on the coaming they will be seated on the coaming and form a seal between their

compression bars and the packing rubber. With the hydraulic ram system, the panels roll forward and aft along the coaming trackways on their wheels, clear of the coaming, and pot lifts are used to lower the panels onto the coaming for the seals to be made. Maintenance of the seals is usually by means of wedges at the cross-joints and quick-acting cleats at side and end coamings.

On many ships with box holds and open hatches, and where one or two gantry cranes are fitted, each hatchway is provided with a single pontoon. These pontoons are lifted on and off and are stowed on the closed hatch pontoon of another hatchway. Securing of the pontoons is by quick-acting cleats at the side and end coamings.

Weathertightness and securing

Hatch covers, and the doors and covers of all openings, should be weathertight so that water will not enter the compartment being protected.

When closed in the sea-going position, the hatch covers are secured in place by manually-operated or automatic cleating and/or dogging devices. All steel hatch covers, except pontoons with tarpaulin covers (see later in this Chapter), have primary and secondary drainage systems to ensure any water shipped over the hatch covers will not find its way into the cargo compartment. They have arrangements to ensure the weight of the hatch cover panels themselves – and any cargo stowed on top or water shipped over the covers – is transferred to the steel structure of the coamings rather than being taken by the rubber packing of the coaming seals.

Seals and drainage

At the coamings and at each cross-joint (including the centreline cross-joint of side-rolling panels) there is a seal comprising a length of rubber packing forced against a steel surface. There are two main types of such seal.

The first type is lengths of box-type rubber seal fitted along the sides and ends of panels in way of the hatch coaming seals and to alternate cross-joint structures of the panels, and upstanding compression bars fitted to the rest plates of the coamings and to the other cross-joint structures of the panels, such that the lengths of rubber seal are forced onto and mate with the compression bars.

The second type is lengths of sliding rubber seal, either of roughly triangular shape or with a rounded outer surface, which are fitted apex outward along the sides and ends of panels, in way of the hatch coaming seals, and to alternate cross-joint structures, and flat stainless steel plate welded to the rest plates of the coamings and to the other cross-joint structures of the panels for the sliding rubber seal to bear against.

There are other types of packing in use which either bear against upstanding compression bars or flat plates.

When the hatch covers are closed and, if necessary, lowered into the sea-going position, they will then be secured into that position either manually using cleats and dogs or automatically as a result of the final closing operation. When in that position, the rubber seal will have been compressed to its design compression amount, although that compression will be affected by the amount of wear suffered by the system since the components were new.

The weight of each panel will be taken either by a steel-to-steel contact between the side skirt plating of the panel at the sides and ends of the hatch cover and the top

plate of the hatch coaming, or by bearing pads fitted both to the hatch panels and to the coaming structures. If such pads are fitted and correctly taking the weight of each panel, there will be a small gap between the lower edge of the side skirt plating of the panels and the top plating of the coaming structures.

When a ship is at sea, and particularly when in adverse weather and sea conditions, the ship will roll and pitch, resulting in longitudinal and transverse flexing. The hatch panels are designed to move and flex relative to adjacent panels and relative to the structure of the coaming, thus maintaining weathertight integrity. If the hatch covers are weathertight, which they should be, none of the water shipped over the hatch covers will find its way into the cargo compartments below. The hatch cover arrangements are constructed such that there is an outer, primary drainage system which should ensure sea water shipped on board will drain away easily and safely from the hatch covers, and a secondary drainage system which should ensure any water which does pass the seal between the packing rubber and the compression bar or plate should be channelled away safely to the open weather-deck.

When water is shipped over the hatch cover panels and coaming arrangements, although most of it will flow over the side and top plating of the covers and then away safely to the deck, some of the water will flow into the cross-joint structures between the panels and onto the outside of these seals. Water within the upper part of the cross-joint structure will flow to port and to starboard in the outer channels and out to the deck via drain holes fitted in the panel sides without penetrating the cross-joint seal. Likewise, at the coamings water will flow against and then away from the coaming seals, either away from the steel-to-steel contact in that area or, if the arrangements incorporate bearing pads, away from the sides and ends of the covers without penetrating the coaming seals. These are primary drainage systems.

There are then the secondary drainage systems. At each of the four coaming structures (forward, aft, port and starboard) the vertical coaming plate extends upwards, above the adjacent horizontal coaming rest plate, to form an inner coaming channel between the compression bar or sliding seal plate which is welded to the top of the coaming rest plate and the coaming plate upstand. At the after port and after starboard corner of the hatch coaming, and elsewhere as appropriate, in way of the inner coaming channel, drain holes will have been provided with a drainpipe below to allow water to drain out to the deck. Additionally, these drainpipes will have been fitted with a non-return bottle or flattening hose so that sea water shipped on deck cannot flow up into the drainpipe.

Within the construction of each cross-joint arrangement there is a steel gutter fitted on the inside of the covers, below the sealing rubber, which extends the full width, or length, of the hatch and terminates above the inner coaming channel. If, for some reason, water is able to flow past the seal at a cross-joint, that water should flow into the cross-joint gutter and outward to the inner coaming channel. If water manages to flow past a coaming seal, that water would pass directly into the inner coaming channel. Any water gaining entry to the inner coaming channel will flow towards the drainpipes and then safely out to the weather-deck. Therefore, even if there is seepage of water past any of the seals, that water should not enter the cargo compartment to cause damage to cargo, provided the drainage channels and drain pipes are free from blockage.

Securing systems

Hatch panels are secured in position one adjacent to another atop the hatch coaming by a system of cleats or wedges. The system which is fitted will depend upon the type of covers and the manner in which they are opened and closed.

Single-pull covers, side-rolling covers and portable pontoons usually have a securing system comprising one or more type of cleats, including quick-acting cleats and/or draw-bolt-type cleats, and wedges. Quick-acting cleats are fitted to the end and side coamings of the hatchway, with the steel snug – upon which the head of the cleat is located – welded to the side or end skirt plate of the hatch panels. Draw-bolt-type cleats, and their associated brackets, are welded in way of panel cross-joints. Similarly, steel wedges fitted with steel saddles through which the wedges are driven, and associated steel landing plates, are welded in place to the top plating of panels in way of cross-joints.

Folding covers are usually fitted with securing devices which comprise pairs of wedges welded in place variously to the top of the hatch coaming at both sides of the hatchway, with associated wedges welded to the side structures of the hatch panels, and pairs of wedges welded to the cross-joint structures of adjacent panels. As the covers are closed, the surfaces of pairs of wedges slide together, thereby ensuring that the panels are correctly seated onto the coaming, and so that the cross-joint structures of adjacent panels are correctly seated together. Some folding-type hatch covers are additionally provided with quick-acting cleats or draw-bolt cleats.

The securing system of a hatch cover is designed to keep the panels firmly seated down onto the hatch coaming, and to keep the cross-joint structures of adjacent panels firmly seated together, to ensure the packing rubber is compressed against the upstanding compression bar or flat compression plate to make the required seal. The cleats or wedges should be set up so as to ensure the packing rubber is compressed to the design compression, as given in the manufacturer's manual for the covers. Also, the securing system is fitted to maintain the panels in position during the voyage, and to restrain them against excessive movement, one panel against another, and the panels against the hatch coaming. However, at the same time, the cleats and/or wedges must be set up so as to allow the panels to flex slightly as the ship rolls and pitches in the seaway.

If any of the parts or fittings of the hatch cover arrangements are not satisfactorily maintained, or if they suffer damage or defect, the result is likely to be inadequate compression of rubber seals allowing ingress of sea water.

Maintenance of hatch cover arrangements

The hatch cover arrangements provided on board a modern bulk carrier are complex steel structures which are designed to operate to millimetre accuracy. There are three areas which require attention: operating parts, sealing and securing parts, and construction parts.

With regard to the required maintenance of the hatch cover arrangements, there are three general types of work: routine and ongoing work, repairs in way of damage sustained, and major repair work.

Guidance with regard to the operation, inspections and maintenance of the hatch cover arrangements is given in the manufacturer's manuals and in the ship's ISM procedures. These should provide guidance with regard to the following.

Hatch cover manuals – checklist

- An inspection regime which might include close inspections of the arrangements by the crew on a monthly basis and at other appropriate times; for example, before and after loading and discharge of cargo.
- Planned maintenance to be carried out variously by ship's staff on an ongoing basis and by shore repairers during dry-docking periods.
- Inspections during visits by a company superintendent on a regular basis.
- A system for repairs to be carried out when necessary, either by those on board or by shore repairers as appropriate.

Drawing all of the above together, the various parts of the hatch cover arrangements should be inspected to ensure any defects or damages are quickly identified, and the arrangements should be maintained in satisfactory working condition by carrying out repairs and maintenance, as and when appropriate.

In addition to the routine inspections, there may be inspections by shore-based organisations, including classification societies, P&I clubs and port state control inspectors. Such inspections will have a different focus. The covers should be maintained such that they will satisfy these inspections.

Ideally, when the hatch covers are opened or closed, brief inspections should be carried out to ensure there are no significant defects and all parts are operating correctly. When cargo is being loaded or discharged, and particularly when loading has been completed, inspections of the coaming channels, cross-joint channels, drainpipes and their non-return devices, should be carried out to ensure these are free of cargo deposits or other debris and are clear and will allow the passage of water. If they are not and they are dirty, contaminated or blocked, the affected area should be cleaned and cleared without delay. During battening-down operations, it should be ensured that all cleats and wedges operate properly, and are not over-tightened, so that the hatch panels are correctly seated and secured; if they are not the appropriate adjustments should be made.

Routine – possibly monthly – inspections of the arrangements should be carried out. All accessible parts of the arrangements, including all operating parts, all sealing and securing parts, and all construction parts of the arrangements, should be inspected for defects and damages. Details of everything found should be recorded. Following such inspections any repairs, maintenance or renewals which can be completed by ship's staff should be carefully carried out with reference to the manufacturer's manual where appropriate. When larger defects are found which cannot be rectified by ship's staff using spares already on board, arrangements should be made for repairs to be carried out by a shore repair company, without undue delay.

Ahead of a dry-docking period, thorough examinations of all parts of the hatch cover arrangements should be carried out, and details of necessary repairs and maintenance should be added to the dry-docking list. For the hatch cover arrangements to be considered to be in good condition, the various parts should be sound and operate correctly as follows.

Hatch cover condition requirements

- All wheels and rollers should move freely and be lubricated correctly, and their bushes and other parts should not be significantly worn.
- All parts of hinges should be free and lubricated correctly, and their bushes and other parts should not be significantly worn.
- All chains and connecting rods should be correctly adjusted and should not be significantly worn or corroded.
- All hydraulic pumps, cylinders and pipelines should operate in accordance with the manufacturer's manual and there should be no significant oil leaks.
- The steelwork of the hatch panels and of the coaming structure should be without significant distortion or wastage and should be adequately paint-coated.
- All compression bars and plates, fitted to the coamings and hatch panels, should be without significant distortion or wastage.
- All coaming and hatch panel drainage channels and non-return devices should be clear and clean, and paint-coated where appropriate.
- All sections of packing rubber should be properly fitted in the retaining channels, should be straight and fair, should be without any significant damage or distortion, and should be pressure-marked but not heavily compressed. With regard to pressure marking of the packing, it should be along the centre line of the packing and should not be deeper than half the design compression as given in the manufacturer's manual.
- All securing devices (cleats, draw-bolts, wedges) should be correctly adjusted and in sound condition, with threads adequately greased and adjustment nuts free where fitted.

A suitable supply of spare parts should be maintained on board so that ship's staff are able to carry out any repairs or maintenance work which is necessary during the voyages between dry-docking periods. These parts should include lengths of rubber packing, and packing corner pieces, and the glue required for the fitting of that packing, cleats, wheels and rollers, and seals, pipes, hoses and bearings if the hatches are operated by hydraulic rams and/or pumps.

Other openings

Other openings include accesses and ventilators for the cargo holds, and accesses leading into, and ventilation systems for, forward storerooms, accommodation spaces and other compartments at weather-deck level, all of which are provided with covers or doors which are designed and fitted to close the opening and render it weathertight. These doors and covers will be made from sheet steel and will be fitted with a rubber seal or gasket which fits against some sort of compression bar or coaming bar. Most covers and doors are hinged and are provided with screw or wedge dogs to secure the closing device in place and to maintain it weathertight. Ventilator flaps and covers might be operated by a hand-wheel on a spindle for closing and securing.

All of these closing devices should be regularly inspected, and a record of all inspections and findings, including details of all defects and damages, should be kept. Where maintenance and necessary repairs can be carried out by ship's staff, that work should be done as and when appropriate, and appropriate records should be kept. If damages or defects are found which require rectification by shore repairers, arrangements should be made for that work to be carried out without undue delay.

Testing of covers

Fig. 3. Hose-testing of hatch covers

It is a requirement under the Loadline Convention that water will not enter the hull and, in view of this, before a loadline certificate is issued or renewed it is often a requirement that the weather-deck hatch covers and other openings be tested for their weathertight integrity. A common method of testing is the hose test. Alternatively, an ultrasonic test might be carried out. In addition to these two types of testing, chalk testing and light testing are other methods used in certain circumstances.

During a hose test the hatch coaming and cross-joint seals are subjected to a jet of water from the outside, whereas, during ultrasonic testing, high-frequency sound is transmitted from a transmitter in the hold, and a detector is passed along the outside of the seals to determine whether or not the seals are adequately tight. For a hose test, a wash-deck hose should be

Fig. 4. Ultrasonic testing of hatch covers

used with about 2 bar of water pressure and with the nozzle no more than about 1m from the seal towards which the jet of water is being directed. The surveyor will position himself in the hold and will be in communication with the chief or duty officer, or a second surveyor, who will be in charge of the party on deck and directing the water jet. As the jet is passed along each joint in turn, the surveyor in the hold is notified of progress and will watch for any ingress of sea water.

Fig. 5. Ultrasonic testing equipment

When carrying out an ultrasonic test, the instructions of the manufacturer should be followed by the surveyor. The transmitter is first placed in the cargo compartment, an open-hatch value (OHV)is then obtained, after which the detector is passed along each seal in turn to find any leakage of ultrasonic sound. When the test is completed, any area giving a reading in excess of 10% OHV, indicates a point where water ingress is possible. Rules with regard to the use of ultrasonic testing equipment have been drawn up by the International Association of Classification Societies (IACS) and there are training courses available for surveyors to attend to become competent in the procedures and in the use of the equipment.

The use of ultrasonic testing equipment operated by a certificated surveyor is widely recommended when a weathertightness test of hatch covers is required.

When a test is carried out in way of the main hatch covers, similar tests should be carried out in way of all other openings into the cargo compartment, including ventilator covers, access hatchway covers, doors into mast-houses or crane pedestals and so on. All of these openings, as well as the main hatch covers, should pass the test in order for the

Fig. 6. Hatch-end ventilators must also be tested for weathertightness

test to be declared successful. If there is leakage in way of any of the seals, action should be taken to identify and then repair the area where leakage occurred.

When a test is carried out, a record of the test, what exactly was tested and how, and details of the results, should be kept for future reference. Also, an entry should be made in the deck log book.

When carrying out a hose test, or when placing the transmitter in the hold prior to an ultrasonic test, the surveyor should additionally carry out a light test of the main hatchway with the hatch panels in the closed and secured position. When the surveyor's eyes have become accustomed to the dark within the cargo compartment, the surveyor should examine from the tank top, or from the surface of the cargo, the inside of the hatch coaming and the cross-joint seals. If light is seen at any point, there is clearly a defect via which sea water can enter the cargo compartment. When the hatch covers are reopened, the area involved can be identified and appropriate repairs can be carried out without delay. Such a light test should only be carried out if it is considered safe to do so.

Fig. 7. A successful chalk testing of the weather door of a mast house

The other type of test for weather-deck hatch covers – the chalk test – is usually only carried out at shipyards before and after major repairs are carried out, to establish where the compression bars or compression plates are making good contact with the packing rubber, and where they are not, so adjustments to the arrangements can be made if and where appropriate. With regard to smaller openings such as ventilators and weathertight doors, a chalk test can prove to be a very successful, and a quick and easy, way of demonstrating weathertightness.

Opening and closing operations

Hatch covers which are well maintained with their associated rolling and operating parts in good condition will be capable of opening and closing smoothly, in the normally expected period of time and without problems arising. Also, if the operation is carried out correctly by the deck personnel, observing correct procedures and safety precautions, the likelihood of incidents or accidents occurring will be greatly reduced.

Rolling hatch covers might move quickly and/or quietly, and may cause injury to personnel who are positioned close to the hatch cover but are unaware of the operation being undertaken. For these reasons there are procedures to be followed when opening or closing a hatch cover, which can be summarised as follows.

Hatch cover opening and closing procedures

- Ensure an adequate number of properly trained crew members are assigned to carry out the opening or closing operation.
- Ensure all securing devices have been removed; cleats and so on at coamings and cross-joints if opening or hatch-open locking devices if closing.
- Ensure all parts are free to move as required.
- Ensure all trackways and channels are clear and unobstructed: all inner coaming channels and cross-joint channels, and drains, should be clean and clear with no cargo residues or other debris present and all trackways for wheels and rollers should be clear with no debris or other obstructions present before closing; all trackways for wheels and rollers, and all areas of the coaming, should be clear with no debris or other obstructions present before opening.
- Set up any necessary fencing in way of the moving hatch covers or their machinery.
- Ensure there are no personnel, ship's crew or shore staff, on the hatch covers, or in way of the hatch coamings, the hatch cover stowage areas, any machinery or any of the hatch cover wheels, and give a warning that the covers are about to be opened or closed.
- Ensure a look-out is kept on all sides of the moving covers to ensure no personnel approach the moving covers.
- Open and close covers in a controlled manner.
- When the covers are open or closed fit appropriate locking and securing devices.
- Finally, confirm to other personnel that the operation has been completed.

The procedures of the ship's safety management system may have a more detailed guidance and the manufacturer's manual will give specific information which relates to the particular hatch covers fitted on board. Ship's staff should be guided accordingly.

Sealing tape, foam and silicon sealant

Sealing tape – otherwise known as marine tape or Ram-Nek tape – can be fitted over the outside of cross-joints and along coaming joints. Many shippers of water-sensitive cargoes, such as steel products, require tape to be fitted, regardless of the condition of the hatch covers, as an additional secondary precaution against the possibility of ingress of sea water during the voyage. Also, but ill-advisedly, it is often fitted to hatch covers which are in poor condition, in a misguided attempt to make the cross-joints and coaming seals weathertight.

If shippers require tape to be fitted, it should be fitted, but all cross-joint end drains, to port and to starboard must be left open, and all coaming drains must, similarly, be left open and free. A record should be kept that the tape was fitted at the request of the shipper, or whoever made the request. If the cargo being carried is being fumigated during transit, the fumigators might use marine tape to seal the hatches, the coaming drains and other accesses, ventilators and so on, in which case the tape should be left in place throughout the period of fumigation.

Tape should not be fitted to defective hatches in an attempt to make them weathertight. The primary reason for this is that, when the ship encounters heavy weather and sea conditions and seas are shipped on deck, it is most likely that the tape will be washed away and ingress of water into the cargo compartments will occur via the defective hatch seals. It is far better to carry out repairs in way of defects, and to be sure

the hatches are weathertight, than to spend money on the very expensive marine tape which is likely not to provide the protection anticipated. Also, if tape is used in way of the joints, water might become trapped in the structure of the joint, be it a coaming or cross-joint area, and water might seep into the cargo compartment in any event when the panels flex as the ship rolls and pitches in the seaway. Furthermore, the presence of such moisture will accelerate corrosion of the steelwork.

On many occasions a type of yellow expanding foam has been seen protruding from cross-joints, coaming joints, drainpipes and other parts of the hatch cover arrangements, and has been seen applied to other, supposedly weathertight, openings. The foam is applied from a spray can as a liquid, and this rapidly expands to form a yellow foam which then dries hard. The application of the foam is intended to render hatch covers and other weather-deck openings weathertight, but the application of the foam might create more problems than it is likely to solve. As the foam expands and then hardens, it might cause a slight opening of the joint in way of which it has been applied and it might block the various drains and channels of the drainage system. Also, the foam hardens as it dries with no flexibility, and therefore the foam cannot act like pieces of rubber packing which are flexible and which will maintain a seal with the compression bar or plate as the ship and the hatch covers move and flex during the voyage. This being the case, when seas are shipped on deck and over the hatch covers where foam has been applied, some of that water is likely to penetrate past the hard foam and past the partly open or defective joint into the cargo compartment below, thereby defeating the object of applying the foam in the first place.

On some occasions silicon sealant has also been used, in conjunction with tape and expanding foam, in an attempt to make defective hatches weathertight. The use of such sealing compound cannot be effective because of the size and construction of the hatch panels and coaming, and because of the movement of the panels when the ship is at sea.

Marine tape, expanding foam and silicon sealant should not be fitted to the seals of weather-deck hatch covers, or to any other weathertight closing device, in an attempt to make weathertight a seal which is in poor condition. Rather, maintenance and repairs should be carried out to ensure the fittings are in good weathertight condition. If, however, the shipper of a cargo or another interested party requires sealing tape to be fitted, the tape should be fitted in the correct manner, and in accordance with the requirements of the shipper or whoever has made the request, and it should be recorded that the tape has been fitted at the request of the party concerned.

Use of tape, foam or sealant may be acceptable as an additional precaution on well-maintained weathertight hatch covers but it is not acceptable as an alternative to proper permanent repairs.

Pontoons and tarpaulins

Some logger-type bulk carriers are fitted with pontoon and tarpaulin hatch cover arrangements. These comprise heavily built, but fairly low, coaming structures and portable steel pontoons which are lifted into and out of position in the coaming by the use of ship's gear. When closed, the hatchway is made weathertight by the use of tarpaulin sheets. To close and make weathertight such a hatch, the following sequence is adopted.

Procedure for making pontoon and tarpaulin hatch weathertight

- The steel pontoons are first lifted and placed into position.
- The tarpaulins – usually two good condition tarpaulins or preferably three – are spread over the hatchway and down the sides and ends.
- The sides and ends of the tarpaulins are rolled or gathered together against the coaming plates of the hatchway and then tucked to the inside of cleats welded at intervals along the coaming plates.
- Steel battens are then positioned against the tarpaulin, and wooden wedges are driven home between the steel battens and the welded steel cleats.
- Locking bars are lastly fitted across the hatchway.
- As an alternative to locking bars, large nets are often spread over the fitted and secured tarpaulin sheets and are drawn tight and secured to lashing points on the hatch coaming as an additional aid to keep the tarpaulins in place.

As with mechanical hatch cover arrangements, it is essential that inspections and maintenance are carried out routinely and at times when the hatch pontoons are being removed and refitted. The tarpaulin sheets, large nets, wooden wedges and battens should all be in satisfactory, sound condition. If any items are found to be defective, they should be discarded, and replacements should be brought into use. The steelwork of the portable pontoons, and of all parts of the coaming arrangements, should be sound and without damages, including corrosion and wastage, and contact damages which might cause displacement or deformation. Any defects found should be rectified without undue delay. Details of inspections, findings during these inspections, and repairs or renewals carried out, should be recorded for future reference.

It is essential that all parts of the hatch cover arrangements are maintained in sound condition to ensure, when closed and secured, the hatchway is, and will remain, weathertight throughout the forthcoming voyage. As with steel covers, hose testing of the arrangements should be carried out as and when appropriate and a record of such tests should be kept in the deck log book.

HOLD CLEANLINESS, CLEANING AND MAINTENANCE

The preparation of cargo compartments before the loading of the next cargo is one of the most important and most involved operations which is routinely carried out by the crew. The operation involves, first, determining what level of cleanliness is required, then ensuring that the appropriate equipment and materials are on board for the cleaning operation, then carrying out of the actual cleaning of the cargo compartments and finally carrying out various inspections and tests.

Additional preparation which is needed for the designated cargo should then be done and any maintenance which is required should be carried out. Operations must be carried out in a certain sequence and can be divided into nine distinct categories. Each of these categories is discussed in detail in the following sub-sections.

Charterparty and voyage requirements

The charterparty will detail the requirements for the condition of the ship upon delivery and upon re-delivery and may give other requirements for hold cleaning and

cleanliness. Voyage instructions will give requirements with regard to the particular voyage to be undertaken.

A time charterparty will include a number of clauses which give information on requirements for the general and ongoing condition of the cargo compartments. These include clauses with regard to the delivery of the ship into the charter period, cargo exclusions, hold condition, intermediate hold cleaning, redelivery condition of the ship, on/off-hire surveys and possibly others.

A charterparty may typically stipulate that when a ship is delivered it is required that the holds will be clean, swept, washed down, free of salt, rust, residues of previous cargoes and ready in all respects for loading charterer's intended cargo. This means, under normal circumstances, that the holds should be grain clean. A description of the term grain clean is given later in this section. If a charterer intends to carry cargoes which require a very high level of cleanliness of the cargo compartments, either that initial wording will be changed or an additional clause will be inserted within the additional clauses to the charterparty. Also, it is often stated that the ship should be maintained in class and kept in a thoroughly efficient state of hull, cargo spaces and so on for and during the service. This means that the ship should be carefully and fully maintained by the owner throughout the charter period.

The cargo exclusions clause will give details of all cargoes which will not be carried (under normal circumstances) during the charter period and this list will indicate what types of product will be carried – the types of cargo not listed – and therefore what level of cleanliness is required to be achieved during intermediate hold cleaning. In many charterparties, at the end of the list of excluded cargoes, there are details of cargoes, which might be included in the list of excluded cargoes, which may be carried a certain number of times during the charter period although, usually, not at the end of the charter period. These additional sub-clauses include details of requirements for the particular cargoes, such as additional preparation for loading and additional cleaning after discharge.

A hold condition clause might simply say that the ship is to be grain clean and ready to load cargo or might specify other, or additional, requirements. If it is intended that clean commodities, such as alumina or kaolin, are to be carried during the charter period, the clause might require compartments to be clean and free of any rust scale, loose rust scale, loose paint, previous cargo residues and so on. It is important that the master reads the clause carefully and complies with its terms. If, however, the requirements are not sufficiently precise, the master should obtain guidance as to how to proceed.

The intermediate hold cleaning clause will give details of cleaning requirements and is likely to require that such cleaning is performed while the ship is en route to the next load port. It is likely to state that failure to pass hold inspection will result in the ship being placed off-hire. The clause should state who is responsible for ensuring sufficient time, equipment and material is available for the crew to clean cargo compartments between the end of discharge and next commencement of loading to bring them back to the required standard, or what other arrangements have been made.

A re-delivery clause will state the level of cleanliness required at the time of re-delivery and might state that the holds may be left uncleaned under certain circumstances. On-hire and off-hire surveys might be required at the time of delivery and at the time of re-delivery in order for the owner and charterer to have a record of the condition of the cargo compartments and surrounding steelwork at the beginning and the end of the charter period.

Overall, the charterparty will give requirements with regard to the cleanliness of the cargo compartments at the beginning of the charter period and throughout the voyages which are undertaken. The master should be fully aware of the standard of cleanliness required by the charterer (and it is for the charterer to use clear words in the charterparty to define this standard) and should ensure when the ship is taken on hire and before the loading of each cargo the cargo compartments are at or above the required standard. Additionally, the master should be aware of what types of cargo are likely to be carried during the charter period and the standard of cleanliness of the holds which is required for the safe carriage of these commodities.

Before the beginning of the charter period and before each separate cargo is loaded, the master will be provided with detailed voyage instructions. These instructions should include information about how the ship is to proceed to the load port and to the port of discharge for the cargo, details of the cargo to be loaded, hold cleanliness requirements, details of any inspections which will be carried out and any other appropriate information.

If the cargo is to be grain or any other cargo which is moderately clean to moderately dirty, it is likely to be stated that the cargo compartments should be clean, swept, dry, free of rust scale and so on – that is basically grain clean. If the cargo is a dirty cargo, there may be no requirements beyond that of clean, swept holds. If the cargo is a clean cargo, the specific requirements should be set out in the voyage instructions in great detail. The requirements for a clean cargo might include holds to be free of any rust, free of any peeling paint, free of any previous cargo residues and other specific requirements. The master should follow the instructions and seek advice if any specific requirements cannot be met in the timescale required. Additionally, if the instructions and requirements set out in the voyage instructions are very different from the requirements set out in the charterparty, the master should seek instructions with regard to how to proceed.

The voyage instructions may also include the requirement that the cargo compartments will be inspected prior to commencement of loading, in order for the inspector to determine the actual condition of the cargo compartments. The master should be in no doubt that if the cargo compartments are not at the required level of cleanliness specified, the inspector will fail the cargo compartments and will not allow the loading of cargo to be started. In such a situation the ship might be placed off-hire.

A voyage charterparty will give details of the cargo to be carried and will require that the owner exercise due diligence to ensure the ship is seaworthy and suitable to carry the designated cargo. It is likely that no specific requirements with regard to hold cleanliness will be given. The master should ensure he is familiar with the cargo to be carried, and its requirements, and the holds are cleaned and prepared to the usual standard for the particular cargo. As with the loading of any bulk commodity, there are likely to be pre-loading inspections of the holds by a surveyor and if the cleanliness is not at the usual standard the holds will be failed.

If masters have any doubts they should seek advice.

Requirements for particular cargoes

Bulk cargoes include a very wide range of commodities. Some are very clean and require cargo compartments to be, likewise, very clean. Other cargoes are themselves dirty such that their carriage will result in the cargo compartments becoming dirty, although hold cleanliness for such cargoes is less stringent. For the most part, however,

cargoes are fairly clean and require cargo compartments to be at a standard which is commonly referred to as 'grain clean'. Some of these commodities require the steelwork in the holds to be coated with lime wash or a chemical barrier (see 'Additional preparation' later in this section).

Thus the level of cleanliness required before loading, and additional preparation, will depend upon the type of cargo to be loaded. There are three general categories of cargo in this respect.

- Clean cargoes – those which require cargo compartments to be very clean before loading because they will be damaged by any form of contamination.
- Moderately clean to moderately dirty cargoes – require the cargo compartments to be grain clean before loading. Cleaning operations after discharge should be relatively easy, although there are exceptions.
- Dirty cargoes are unlikely to be contaminated by any small amounts of rust or paint from the steel structures within the hold but their carriage will make the holds very dirty and make the cleaning operation more difficult.

The following table gives examples of commodities in each of the three broad classifications of cargo with respect to their cleanliness requirements.

Cargoes classified by cleanliness

Clean cargoes	Moderately clean to moderately dirty cargoes	Dirty cargoes
• Alumina • Chromite ore • Fluorspar • Kaolin • Milled rice • Mineral sands including ilmenite, rutile, zircon and others • Soda ash • Types of nitrate cargoes exported from Chile	• Cement • DRI • Fertilisers • Grain • Iron ore and associated cargoes • Mineral concentrates • Salt • Seed cake • Some types of coal • Some types of scrap metal • Sugar • Sulphur	• Bauxite • Nickel ore • Petcoke • Some types of coal • Some types of scrap metal

There are three aspects to be considered here. First, the properties of the cargo to be loaded and whether or not any property will affect the ship's steelwork, second, whether or not that commodity is likely to be affected by any level of contamination while it is on board the ship and, third, whether or not the properties of the cargo will affect the post-discharge cleaning operation.

Clean cargoes are, mostly, fully processed or semi-processed materials which contain few, if any, impurities. If any other impurities are added to the cargo (for example rust, paint and so on) the further processing and use of the material will be adversely affected.

For these cargoes, cargo compartments should be in a very clean condition before loading.

Cargoes which are in the range from moderately clean to moderately dirty include raw materials and some processed materials. Many of these materials naturally have within their bulk a small amount of foreign matter, although that foreign matter will not affect the condition of the material itself. For example, grain will include some other grains, pieces of stalk and other foreign material, while iron ore and other mineral cargoes will contain some foreign materials; any such foreign matter will be removed during further processing.

Most dirty cargoes, because of the manner in which they are produced, will contain oily or muddy residues which will cling to the steel structures of the cargo compartment in which they are stowed. Additionally, these commodities will contain small amounts of impurities which either will be removed during any further processing or will not affect the condition of the material and its intended use.

Cement, salt and sulphur are special cases because they do not usually contain any impurities and are therefore moderately clean cargoes, but they require additional preparation and/or cleaning to be carried out. Cement residues will cling to the steel structures in the cargo compartment and cement is, because of this, sometimes referred to as a dirty cargo. Salt and sulphur require lime washing of the in-hold steelwork or the application of a chemical barrier coat which will require additional cleaning after discharge (see 'Additional preparation' later in this section).

During the carriage of a clean cargo there must be no contamination of that cargo, because if there is any contamination the commodity will be considered to be damaged. With regard to moderately clean cargoes to moderately dirty cargoes, and dirty cargoes, any very small contamination of the cargo by very small amounts of rust scale and paint should not cause contamination of the cargo to an extent that the commodity becomes damaged. Also, it might in some circumstances be the case that some very small amounts of previous cargo residues might not cause contamination of the cargo carried. However, before loading of any cargo in the moderately clean to moderately dirty category, cargo compartments should be cleaned to the grain clean standard, as described in the next section, to eliminate the possibility of contamination of the cargo during its carriage.

For the carriage of dirty cargoes, it is likely that no specific requirements with regard to the level of cleanliness before loading will be given and any requirements which are given might well be at a standard somewhat lower than grain clean. The main problem with dirty cargoes is not the possibility that the cargo might be contaminated during the voyage. It is that, following the offloading of the cargo, the cleaning of the cargo compartments back to a reasonable standard will be somewhat more difficult for the crew to achieve than if a moderately clean, for example, cargo had been carried.

Levels of cleanliness and condition

Most cargoes require cargo compartments to be at the grain clean standard before loading, while others require a cleaner standard and some will not require that relatively high standard. In addition to the compartments being at a particular standard of cleanliness, the steelwork within the cargo compartments, and of the hatch cover arrangements, should be in a good, sound condition such that the cargo will not suffer damage or contamination as a result of the condition of the steelwork.

Other terms of cleanliness which are sometimes used include: hospital clean, clean swept, shovel clean and load-on-top.

Clean cargoes

Clean cargoes require a standard of cleanliness which is cleaner than grain clean (sometimes referred to as 'hospital clean'). For such cargoes there should be no rust, no loose rust, no loose paint flakes and no residues of previous cargoes. In addition, compartments should be dry and odour free. Ideally, all steel surfaces and all fixtures and fittings, including the tank top plating within the cargo compartments, should have a good, overall paint coating.

Repeated carriage of a cargo

Some ships are employed for the carriage of a single type of cargo, for example coal, bauxite or iron ore, and therefore if there are some small amounts of cargo residues in the cargo compartments at the time of loading the next cargo these residues will not cause contamination of the cargo to be loaded. Under such circumstances, it may be acceptable for the cargo compartments to be cleaned to a standard lower than the grain clean standard. Such requirements are likely to be set out in the charterparty or the voyage instructions to the master.

Grain clean

For all other commodities carried in bulk, from moderately clean through to moderately dirty, the normal standard of cleanliness required is grain clean. The grain clean standard is not so much a single defined standard which is used worldwide but is a band within which are the requirements of the authorities of all grain exporting countries. The higher standard requirements of some exporting countries are at one end of the band with the lesser requirements of the authorities of other exporting countries at the other end of the band. A level of cleanliness within the grain clean band is acceptable for all cargoes other than clean cargoes.

Fig. 8. A grain-clean hold

Grain is exported from many countries and continents around the world, primarily the USA, Canada, South America and Australia, with smaller tonnages being exported from South Africa and Europe. Prior to commencement of loading a grain cargo, the compartments will be inspected by a government department inspector who will examine the holds to establish whether or not they are suitable for the carriage of the grain, that is, in accordance with the standard required by the authority of the exporting country concerned. The standard required by inspectors at South American ports might be a little below the standard required at a US port, while inspectors at Australian ports and Canadian ports might require a somewhat higher level of cleanliness in accordance with their guidelines. Also, the type of grain to be loaded might also affect the level of cleanliness required by a particular government department inspector.

The US Department of Agriculture gives a standard of fitness which is about the average of the worldwide requirements, a standard that should be easily achievable on board a reasonably well maintained ship.

US Department of Agriculture standard of fitness for grain holds

A stowage area must comply with the standard of fitness established herein to be considered clean; dry; free of infestation, rodents, toxic substances, and foreign odour; and be otherwise suitable to store and carry bulk or sacked grain, rice, beans, peas, lentils or processed commodities.

The requirement is given in the Directive of the Federal Grain Inspection Service for Stowage Examination Services, section 7, Standards of Fitness, 14 March 2005. The directive gives advice with regard to the presence of previous cargo residues, rust scale and paint and other conditions and requirements; the following notes are based on these requirements.

Previous cargo residues. If the compartment contains any of a number of listed items (including fertiliser, old grain, loose cement and so on, or other debris) the compartment must be declared unfit for loading. In other words, there should be no previous cargo residues within the cargo compartment. This is because these residues will cause contamination of the grain to be loaded. The implication here is, however, that if there are some small residues of a previous cargo which are hard and attached to the steelwork and will not affect the grain cargo, the cargo compartment might be passed as fit for loading despite the presence of these residues.

Rust and paint scale. It is required that the cargo compartment be examined to determine how much (if any) loose rust scale and loose paint scale there is. Loose scale, it is stated, will break when struck with the fist or when light pressure is applied with a knife blade under the edge of the scale. A cargo compartment will be declared to be unfit for loading when there is a single area of loose rust scale or loose paint scale of area greater than 25 ft^2 (about 2.3 m^2) or if there are several patches which in total exceed 100 ft^2 (about 9.2 m^2). With regard to hard rust scale within a cargo compartment, that is rust scale which is firmly attached to the steel surface and which cannot be dislodged in the way loose scale can be, and which is not likely to be dislodged during the voyage

and during ordinary cargo operations, this is allowed to be present on the steel surfaces in a hold which is declared to be grain clean. Also, rust scale should not be confused with oxidation rust which forms on exposed metal surfaces and does not flake off in the same way and is allowed to be present.

Unsanitary conditions. There must be no animal or bird droppings, decaying animal or vegetable matter, sewage or any other unsanitary conditions within the cargo compartment.

Standard of dryness. The hold must be dry with no standing water, puddles or any leakage of water.

Foreign odour. There must be no contamination from odour of cleaning chemicals, paint or other matter or materials in the cargo compartment.

Infestation. The hold must be free of infestation of any kind; if infestation is found the compartment should be fumigated (see section on 'Fumigation' in Chapter 5).

In addition to US Department of Agriculture requirements, the following should also be considered.

Paint. With regard to the paint coating, that should be dry and cured throughout, including any touch-up paint which has been applied recently, such that no odour is given off by the paint.

Staining and cargo residues.The colour of the paint is of no relevance to the requirements of the inspector and therefore any touch-up coatings could be of a different colour to the main paint coating. Also, if the paint coating has been stained by a previous cargo, that is to say if the colour of the paint has been changed by the chemical content of a previous cargo, that staining will be of no particular interest to the surveyor. If the 'staining' of the paint coating is, in fact, a thin coating of previous cargo residue it should not be considered to be staining – it is cargo residue – and must be removed before the cargo compartment can be considered to be grain clean.

Further comments. For a cargo compartment to be declared by the inspector to be grain clean, the compartment should be thoroughly cleaned, albeit a small amount of loose rust and/or loose paint might be acceptable but with no cargo residues or other potential contaminants present.

The grain clean standard may be considered to be a band in which the requirements of the authorities of all grain exporting countries are included. The inspectors of countries with lesser requirements are likely to be a little more flexible with regard to the amount of loose rust scale and loose paint, whereas the inspectors of countries with higher standard requirements will not be flexible and might require there to be no loose rust scale and no loose paint, or a very small amount of these. With regard to infestation, the inspectors of all exporting countries require there to be no infestation whatsoever.

The authorities of some importing countries require pre-loading inspections of cargo compartments to be carried out in accordance with their import legislation requirements because they will not allow the offloading of cargo which is contaminated, to any extent, by certain other commodities. In the circumstances, the surveyor carrying out the pre-loading inspection will ensure, following the requirements of the authority of the importing country, that there are no previous cargo residues in the cargo compartments, that is, the surveyor will conduct the examinations with a zero tolerance level of acceptance of the compartment for loading of the designated cargo. In addition, the surveyor will closely examine the steelwork for the possibility that insects, insect larvae or eggs might be present behind in-hold steel structures or behind loose paint or loose rust scale. Again, a zero tolerance level of acceptance will apply and if there is any possibility of any infestation of any kind, the cargo compartment will be declared to be unfit for loading.

As already stated, the grain clean standard of cleanliness set by the US Department of Agriculture is accepted worldwide as the standard required for most bulk commodities. The master of a ship which is to carry a range of bulk cargoes which are in the band of moderately clean to moderately dirty, and for which no specific additional requirements have been given, should keep in mind the requirements of that standard and should ensure the holds of the ship are cleaned to that standard during each intermediate hold cleaning operation.

Cleaning of the cargo compartments, tests and inspections

The amount of cleaning to be done will be dependent upon the type of cargo previously carried and upon the cargo to be loaded next. The work might be fairly simple if the previous cargo and the next cargo are similar but, if the previous cargo was dirty and the next cargo is a clean commodity, the cleaning operation might be somewhat difficult. During the operation various tests should be undertaken to ensure the integrity of the steelwork and other fittings, and inspections should be carried out to ensure the work is completed as required.

Fig. 9. An end bulkhead which displays black residues after the carriage of a coal cargo

Before the crew can begin to clean the cargo compartments, after the offloading of the previous cargo carried, the master should establish the nature of the next cargo and the level of cleanliness required. Alternatively, if the identity of the next cargo is not known at the end of the discharge operation of the previous cargo and no instructions are given, the master should either follow the requirements set out in the charterparty if that document requires a high standard of cleanliness, or anticipate that the next cargo requires the compartments to be grain clean. The master should instruct the crew accordingly. Before departure from the previous discharge port the master should ensure there are on board all the required materials and equipment for the appropriate cleaning of the cargo compartments.

The amount of work to be done to prepare the cargo compartments for the next cargo will depend on a number of factors, including: the general condition of the cargo compartments; the nature of the previous cargo carried; the amount of residues remaining in the cargo compartments following completion of the discharge operation, and the nature of the next cargo. The cleaning operation can be divided into three parts; sweeping and the removal of accessible residues, washing to remove other dirt and debris and final preparation and drying.

Initially, and possibly during the later stages of offloading of the previous cargo, the crew should carry out a sweeping operation to remove any residues from behind any steel structures and fittings, including pipe guards, frames and other ship's side structures, ladders, trunkings and any other fittings in the hold. Also, the bilge covers should be removed and any residues within the bilge wells should be removed onto the tank top plating. All of these residues should be collected together and lifted to the weather-deck where they can be kept for appropriate disposal. Additionally, the underside of the weather-deck hatch covers should be swept to remove all residues.

The water washing of the holds should then be carried out, from the top down. First, the underside of the weather-deck hatch covers and the upper areas of the holds should be washed down, including the weather-deck hatch coamings, any access hatchways and other upper parts of the compartment, such as side and end structures and top-side tanks. Next, washing from the tank top should be carried out to dislodge any residues and other matter and debris from the various structures and fittings. Any debris which is dislodged and brought down to the tank top should be collected together and removed to the weather-deck for later disposal. Hold washings can, normally, be pumped overboard in accordance with MARPOL (see section on 'Ballast, bilge and wash water, and cargo residues' later in this Chapter).

It is normally the case that the sea water hoses are used for washing-down work. However, many ships are now equipped with medium pressure water cannon equipment (by Stromme, for example its Combi-Jet or Maxi-Jet) and/or with high pressure washing equipment. A water cannon has connections for compressed air and sea water, both at a pressure of about 7–10 bar, to produce a water jet which can deliver water over a distance of 30–40 m or more. High pressure washing equipment produces a jet of water at a pressure of 350 bar or greater via high pressure delivery lines and a lance, and must be used at close range to the surface to be cleaned. Such medium and high pressure equipment is capable of removing residues of cargo which tend to adhere to the steelwork of the cargo compartment, such as cement and petcoke residues. Additionally, such water jets will bring down loose rust and loose paint.

When the wash down has been completed, water remaining on the tank top should be brushed or squeegeed to the bilges and the steelwork should be dried and/or allowed to dry by ventilation. Inspections of the steelwork should be carried out at that stage to establish the level of cleanliness achieved and to establish if there are any cargo residues remaining on the steelwork, and the level of any loose rust scale and loose paint on the steelwork. If any cargo residues or significant quantities of loose rust and paint are found, the crew should use scrapers, brushes or other appropriate equipment to remove it from the steel structures. Finally, when all washing down and cleaning has been completed, the hold bilges should be cleaned and dried as necessary, and all recesses, manhole covers and other fittings within the tank top should be cleaned and dried.

After the basic cleaning and washing down operation has been completed, tests and inspections should be carried out.

The hold bilges should be tested to ensure the non-return valves and the pipework system are functioning correctly such that a flow-back of water will not occur, and the bilge high level alarms must be tested and shown to operate satisfactorily. If there are pieces of debris in the hold wash water some of these pieces might become trapped

Fig. 10. The Stromme Combi-Jet with connections for a sea-water hose and a compressed air line

within the non-return valves in the engine room, between the sealing disc and the valve seat, such that when the valve is closed there can be leakage of water back from the engine room pipework to the bilges. If such a back-flow of water occurs during a loaded voyage, wetting damage to the cargo will be the result. Following completion of these tests, it is usual practice to put the bilge covers back in place and then to seal these covers. The customary practice is to cover the strainer plates with burlap or other material and to then cement the outer areas of the plates and material in place. Alternatively, strong tape can be fitted around the edges of the bilge cover plates.

Leakage of water into the cargo compartments from adjacent tanks or via the weather-deck hatch covers and other openings on deck will occur if defects exist. To demonstrate that due diligence has been exercised, following completion of the cleaning operations, inspections should be made as follows.

Hold cleaning inspection checklist

- Weather-deck hatch covers should be inspected for their weathertight integrity and, if possible, a hose test or ultrasonic test should be carried out.
- All air pipes and sounding pipes within the cargo compartment, and the steel plating of side tanks, top-side tanks, hopper tanks and double-bottom tanks, as appropriate, should be checked for defects and leakage, so far as is possible and is safe to carry out. Tanks which are not fully ballasted should be ballasted temporarily, if possible and safe to do so, to carry out the required inspections and tests.
- Manholes should be checked for leakage and their securing nuts should be checked for tightness.
- All steelwork and all fixtures and fittings should be inspected and their condition should be assessed.
- Maintenance of such items, as necessary, should be arranged.

Records of all inspections and work done should be kept.

The equipment used during ordinary hold cleaning operations will include: hoses to deliver sea water; brushes, shovels, buckets and similar items for the removal of previous cargo residues, rust scale and paint, and other debris; scrapers to remove debris, rust and paint; and possibly ladders for access. In addition, other equipment might be used, including high pressure or medium pressure washing equipment and extending ladders, scaffolding towers or a cherry picker to gain access to higher areas. The master and chief officer should bear in mind that ladders, scaffolding and cherry pickers should be properly secured and can only be used when the ship is stable and not rolling or pitching.

During an ordinary cleaning operation it is often required that the weather-deck hatch covers be peaked or partly opened, to allow light into the cargo compartment, to allow access for the hoses and possibly compressed air lines, and to allow a good flow of air into and around the hold. The master should allow the opening of the hatch covers only when weather and sea conditions and the motions of the ship allow. All appropriate safety precautions, including those for the entry into enclosed spaces, must be complied with.

Fresh water rinsing of the steelwork is often required. The master should ensure the required equipment is on board and there is sufficient fresh water on board, in addition to any domestic and engine room requirements.

When high pressure and medium pressure equipment is used to remove previous cargo residues, loose rust and detached paint from the steelwork, water will be forced by the jet to behind paint and rust which is only partly detached and has not actually fallen away from the steelwork during the cleaning operation. However, during the following days it is likely that the water will penetrate further behind the paint and scale, such that it will become loose and will fall away. Bearing this in mind, a thorough inspection of all cargo compartments should be carried out a couple of days after completion of the cleaning operation to establish whether or not any rust or paint has become detached and has fallen to the tank top. If rust and paint is becoming loose, additional cleaning to remove all accessible loose rust and paint should be carried out. In any event, a thorough inspection of all the cargo compartments should be undertaken, when possible, in the days before arrival at the next loading port.

Time needed to clean – circumstances prevailing

The time needed to clean each cargo compartment will depend upon the type of cargo previously carried and upon the condition of the steelwork in the compartment. Additionally, particular circumstances of the voyage might delay the cleaning operation or extend the period. For example, if the ship encounters adverse weather and sea conditions, cleaning in the cargo compartments might not be possible. The master should keep the owner and other parties notified of the progress of the operation and of any problems encountered.

The normal method of cleaning cargo compartments after the offloading of the previous cargo will include: the sweeping down of the ship's side and end structures, then sweeping together and removal of these residues; the cleaning of the bilges; the hosing down of the steelwork; the cleaning of the weather-deck hatch covers; and, finally ventilation to allow drying of the steelwork.

It is normally expected that, as a general rule, the deck crew of a panamax-type bulk carrier which is in a reasonably good condition will take about one full day to clean each hold by this method after the carriage of a moderately dirty cargo to make ready for the loading of a cargo which requires holds to be at the grain clean standard.

The one-day per hold cleaning time standard is only applicable when the ship is in a moderately good condition and when the previous cargo was only moderately dirty, for example seed cake, iron ore or non-oily coal. There are a number of factors which will increase or decrease the cleaning period. First, if the ship encounters a prolonged period of adverse weather conditions during the ballast passage, the cleaning period will be extended accordingly. Next, if the previous cargo was a dirty cargo, for example bauxite or petcoke, the crew may take longer to remove the cargo residues. Also, if the steelwork of the holds is in poor condition, and affected by significant amounts of loose rust scale and loose paint, the cleaning away of that rust and paint will take an extended period. On the other hand, if the crew is equipped with high pressure or medium pressure cleaning equipment, the washing down of the steelwork will take less time. Additional equipment such as extendable ladders, staging towers or a cherry picker will, likewise, reduce the cleaning period.

Additionally, there might be a coating such as lime wash on the steel structures provided for the previous cargo, or there might be significant hardened cargo residues on the structures, and cleaning chemicals might be essential for the removal of any coating or stubborn cargo residues during the cleaning process; these will variously increase or decrease cleaning time dependent upon the circumstances.

The cleaning of the holds of a general cargo ship might involve difficulties not encountered on board bulk carriers, such as those associated with the cleaning of 'tween decks and their hatches, ventilation trunkings or spar ceiling. These are likely to increase the time required for the preparation of the holds to more than one day per hold. Mini-bulkers with only one or two box-shaped holds are fairly easy to prepare for the next cargo and a cleaning operation should be completed within six hours so long as no unexpected problems are encountered.

The master should discuss the cleaning operation with the chief officer, and with the crew as appropriate, and should plan the operation according to the various circumstances. If there is a good plan of action, the time for cleaning should be minimised. The master should notify the ship operator, the charterer, and any other appropriate party, of the estimated length of time required for the cleaning operation. The master should also notify them what cleaning work is being carried out and the level of cleanliness intended to be achieved. By such information, the owner, charterer and other parties can confirm their requirements or can notify the master of any alternative or different requirements, thereby avoiding any unnecessary confusion and any delays at an early stage.

When calculating the likely time needed for cleaning, the master should bear in mind the type of ship and the size of the cargo compartments, the condition of the cargo compartments, the equipment which will be used, the efficiency of the crew and the weather conditions. The master may bear in mind the standard of one day to clean one hold of a panamax bulk carrier.

As the operation progresses the master should notify the ship operator, the charterer and any other appropriate party of the progress of the work and of the likely completion time and date. When the operation is finished the master should report the situation and confirm that the holds are ready for loading. Similarly, if problems are encountered which cause a delay in the cleaning or an extension in the cleaning time (for example adverse weather on passage or unexpectedly heavy cargo residues) the master should notify the ship operator, the charterer and any other appropriate party of the difficulties and of the new likely completion date. If, in the circumstances, it is found to be not possible to complete the cleaning of the holds in the time available, the parties should be advised as soon as possible so alternative arrangements can be made, which might include; postponing the loading to a later date, arranging for the crew to carry on with the work while the ship is at anchor or at a lay-by berth and/or for shore cleaners and equipment to be employed.

Additional preparation

There are a number of commodities which require additional preparation of the cargo compartments before loading because of their characteristics, and some cargoes require work to be done in the cargo compartments after discharge which is additional to the normal cleaning and preparation work, again because of their characteristics. Sometimes, because of the circumstances of the voyage, it will be necessary to use shore labour either to assist with cleaning operations after the discharge of a cargo or with hold preparation before loading.

Some commonly carried cargoes which require additional work include the following.

Cargoes which require additional hold preparation

Cargo	Additional hold preparation
Salt	If there is any exposed rust on the steelwork in the cargo compartments that rust will cause discolouration of the salt and lead to claims after the discharge. Additionally, salt loaded wet may attack any bare steel surfaces. Lime washing and/or chemical barrier coating is therefore a requirement before loading, and chemical cleaners may be used after discharge to make cleaning easier.
Sulphur	Corrosion of any bare steel in the cargo compartments is likely to occur if the structures are not protected by either lime washing or a chemical barrier coating before loading, and chemical cleaners may be used after discharge to make cleaning easier.
Dirty cargoes	Cargoes such as petcoke, some scrap cargoes, some coal cargoes, bauxite, and others, will deposit oily or muddy residues on the steel surfaces of the hold during the voyage and these residues are sometimes difficult to remove. A chemical barrier coating is sometimes applied to the steel surfaces before loading, and chemical cleaners may be used after discharge to make cleaning easier.
Cement	This, and cement clinker cargoes, may leave hard residues on the steel structures in the hold. While a chemical barrier coating is not usually applied before loading, it may assist with post-discharge cleaning operations. Chemical cleaners are often required for the removal of these hard cement residues after discharge.

When lime wash or a chemical barrier coat is applied to the steelwork it is often necessary to use chemical cleaning products and/or high pressure water washing equipment to remove the coating.

Lime washing

Lime washing of a cargo compartment provides a water insoluble barrier between the cargo and the steel structures. The wash is a mixture of lime and fresh water. The process of making lime wash is as follows.

Process for making lime wash

- The lime, which is delivered on board in bags, will be fine white powder (the scientific name of which is calcium oxide and its common name is quick lime) and is produced by heating crushed limestone. The lime must be handled carefully by crew members wearing gloves and protective clothing.
- Preparation of the lime wash is achieved by mixing about 65 kg of lime with 200 litres of fresh water, preferably warm water, in a suitable drum. Alternatively, the mix may be taken to be one part by weight of lime to three parts of fresh water.
- When thoroughly mixed the lime wash is in the form of fairly thin, white paint.
- When lime reacts with water to make the lime wash, the mixture gets hot and crew members should bear this in mind, along with other appropriate safety procedures and precautions.
- Following application, the lime wash dries and cures to produce a hard coat of calcium carbonate.

Fig. 11. Mixing lime and water in drums on deck for lime washing of the hold below

Fig. 12. Lime washing in progress, the tank top still to be done

Fig. 13. The lime wash finished and drying, including the tank top

There have been suggestions that additives may be mixed in with the lime wash, for example a small amount of sugar or evaporated milk, it being proposed that the additives will make the lime wash easier to remove during the subsequent cleaning operation. The additives might, in fact, make the application of the lime wash a little easier and might allow the lime wash to be removed more easily because of the hygroscopic nature of the additive. However, it is recommended that no additives are used because if the lime wash is more easily removed because of these additives, its effectiveness during the voyage might also be compromised.

The lime wash should be applied to all steel structures up to a level above the surface of the cargo when in stowage. That is to say, it is likely that under-deck areas and the upper parts of side and end structures may not require coating. The stowage factor of the cargo and the dimensions of the cargo compartment should be used to calculate the likely height of the stowage. For the coating of one hold of a handy-size bulk carrier or a panamax bulk carrier, in the region of 300–500 kg of lime might be required if the paint coating of the steel structures is fully intact. If the steel structures and the paint coating are in poor condition, it might require 600 kg or more of lime to provide an effective lime wash barrier. The master should be aware of the condition of the cargo compartments of the ship and should ensure there is sufficient lime on board for the necessary coating.

The lime wash may be applied by paint roller or paint spray equipment. However, equipment designed for the purpose, including a tank, compressed air hoses, delivery hoses and an application lance are manufactured and will produce a good coating in less time. The coating should be applied to all side and end structures, all fixtures and

fittings, and to the tank top plating, taking extra care to ensure concealed structures, particularly pipes and pipe guards, are sufficiently coated. The coating should have an appreciable thickness, of 2–3 mm, but must not be applied too thickly, to cover bare metal and fittings, because the surface of the coating will become hard first leaving the underlying lime wash still damp and flexible. Two, or possibly three, thinner coats of the lime wash will provide a more efficient barrier than will one thick coating.

Upon completion, there should be no underlying structures or surfaces visible. The lime wash should be allowed to cure so that the lime converts to calcium carbonate to produce an overall bright white appearance. The period required for curing will be about a full day, this being dependent upon atmospheric conditions and the ambient temperature; damp conditions might extend the period of curing while higher temperatures will reduce the period a little. The master should allow for curing time and arrange for the commencement of loading accordingly. Before loading is actually started, inspections of the lime wash coating should be carried out to confirm that the coating is properly cured, and all structures and fittings are adequately coated; if not, the coating might not be fully effective.

Removal of the coating after offloading of cargo usually cannot be achieved by the use of ordinary fire hoses or medium pressure equipment. High pressure water lances can be successfully used or, alternatively, muriatic acid (dilute hydrochloric acid) can be applied by spray equipment to break down the calcium carbonate, after which washing by either medium pressure or high pressure equipment will remove the lime wash to reveal the underlying paint coating.

Chemical barrier coatings

There are a number of products which can be applied using spray equipment to the steel structures to form a barrier between those steel surfaces and the cargo which is to be loaded. These products are marketed under various names, such as Hold Block, Pre-load or Slip-coat. Some products are water-resistant (marked WR) and are specifically designed for moisture-containing cargoes such as sulphur and salt, while others prevent cargo residues adhering to the steel surfaces and are intended for use when cargoes such as petcoke, oily coal and bauxite are to be carried.

When the chemicals are delivered on board, detailed instructions about their use and application should be provided, including material safety data sheets (MSDS). These instructions must be read and fully understood before the chemicals are used, and must be followed in their entirety during the application. Specially designed equipment should be used to apply the product to the steelwork which is a clear fluid and dries to form a clear barrier coating. Drying time will depend upon the atmospheric conditions but the master should allow at least half a day.

These products are, mostly, biodegradable and not harmful to the marine environment. However, before such a chemical is brought into use, the master should ensure the product is produced from chemicals which are not harmful to the marine environment, in view of the cleaning operations which will follow the offloading of the cargo.

Cleaning chemicals

There are a number of products which can be used to assist with the cleaning of the steelwork of cargo compartments, being specifically designed for the removal of oil

residues from cargoes such as petcoke and coal. Other products are designed to remove chemical barriers applied to steelwork before the loading of cargo, some of which are water-resistant. The correct product for the intended cleaning operation should be obtained. The products should be applied by spray equipment and then left to break down the oil residues or barrier coating, as necessary, but should not be allowed to dry, after which the product should be washed away using high pressure or medium pressure water washing equipment.

Fig. 14. A water cannon in use with a chemical cleaning product to clean the hold after a petcoke cargo

When the chemicals are delivered on board, detailed instructions about their use and application should be provided, including material safety data sheets (MSDS). These instructions must be read and fully understood before the chemicals are used, and must be followed in their entirety when the products are brought into use. The master should ensure the products to be used are entirely compatible with the cargo carried, the hold coatings and any other chemicals in use in the cargo compartments. If there is any doubt, the products should not be used and advice should be obtained.

These products are, mostly, biodegradable and not harmful to the marine environment, but the master should ensure this is the case for the chemicals intended for use on board the ship.

When cement or cement clinker has been carried in bulk and residues of the cargo remain on the in-hold steelwork as a thin, hard, shell coating, muriatic acid may be used for the removal of these residues. The muriatic acid (dilute hydrochloric acid) should be sprayed over the affected area, allowed to react with the cement, and then washed away by the use of high pressure or medium pressure water washing equipment. Disposal of the wash water should be carefully considered, see also section on 'Ballast, bilge and wash water, and cargo residues' later in this Chapter.

Safety

When chemicals are to be used by crew members, a risk assessment should be carried out followed by a meeting to discuss the safety precautions which are to be put in place. All required safety precautions, including those listed in MSDS, should be carried out and all appropriate safety and protective equipment should be used.

Shore labour and equipment

The use of shore labour and additional or specialist equipment from ashore might sometimes be necessary because of the nature of the next voyage or the circumstances of the present voyage.

As discussed in the previous paragraphs, chemical products might be used for cleaning of the steelwork or to form a barrier coat. These products are usually applied by spray equipment. It might be that the required spray equipment is already on board the ship as part of the ship's equipment but, if not, the necessary spray equipment can be provided by shore-based companies in many ports, particular at those ports where the application of chemicals might be required. Before such equipment is brought into use by crew members, a suitable risk assessment should be carried out and required safety precautions should be observed. Alternatively, equipment can be brought on board and shore labour can be employed to use the equipment for the required applications.

Under some circumstances, the ordinary cleaning of cargo compartments cannot be carried out by the crew during the ballast passage, for example, if cargo is to be loaded at the same port or at a port near the port of discharge of the previous cargo carried. Also, during an ordinary cleaning operation it might be found by the crew that cargo residues that remain adhering to the steelwork cannot be removed by using the equipment they have on board. Under these circumstances, it will be necessary for specialised equipment and materials to be brought on board and, possibly, shore labour to be employed, to achieve the required cleaning of the cargo compartments. The master should assess the situation and advise the owner, charterer and any other appropriate parties of the progress of the cleaning operation being undertaken. The master should notify the parties when the cleaning operation cannot be completed by the ship's crew alone and when shore equipment and labour are required. When it is necessary for shore labour and equipment to be utilised, the appropriate arrangements should be made in good time so there are no unnecessary delays.

When shore labour is employed on board for the preparation of cargo compartments, close monitoring of that work should be done by the master and the ship's deck officers. Prior to commencing such operations there should be discussions between the master and the supervisor of the shore labour with regard to the scope of work to be done and the equipment and materials needed, and records of the work done and the materials and equipment used should be kept. It should be ensured that appropriate safety procedures are enforced at all times, including the use of protective equipment and clothing.

Paint touch-up

Following completion of normal cleaning operations, it is often found that some areas of the steel plating, fittings or fixtures within the cargo compartment require a touch-up coating of paint. It is usually good practice to apply a touch-up coat of paint, so that the cargo compartment has a full and complete paint coating before the cargo is loaded. Any

paint coating applied should be done in accordance with the ship's paint specification and maintenance schedule. However, such painting is not always appropriate because it might not be required for the next cargo and might lead to delays for drying and the dissipation of odours.

The touch-up paint coating must be fully cured and there must be no residual odour of the paint when loading of cargo is commenced. If the paint coating is not dry and is still giving off odour, cargo in way of the areas involved might be contaminated or tainted, which in turn might lead to claims being submitted by cargo interests' representatives. Masters must bear all these factors in mind before they allow the painting work to be undertaken.

Fig. 15. Touch-up painting being undertaken

Maintenance of the cargo compartments, testing and inspections

Maintenance of the steelwork within the cargo compartments and of the weather-deck hatch cover arrangements should be carried out to ensure the compartments are fit to carry the designated cargo and such work is additional to any cleaning of the cargo compartments. Tests and inspections should be carried out to establish what maintenance is required and to ensure any maintenance work carried out is completed satisfactorily in accordance with company and manufacturers' procedures and requirements. The ship should be carefully and fully maintained by the owner so it is maintained in class and in a seaworthy condition.

Cleaning of the cargo compartments will involve the removal of previous cargo residues and any loose rust scale and loose paint which is accessible to the crew, or shore labour if employed, using ordinary equipment which is normally available. That is to say, the crew or shore labourers will use shovels, scrapers and similar pieces of hand

equipment to remove debris from the steel structures, and will use ordinary hoses, or water washing equipment if available, to wash the steel surfaces down. Additionally, fresh water hoses might be used for rinsing off after sea water hosing. Additional preparation might be appropriate in the form of lime washing or chemical treatments of the steel surfaces. Any other work carried out may be considered to be maintenance and not cleaning.

Maintenance will involve the use of equipment and machinery which is not ordinarily used for the cleaning of the cargo compartments. This might include compressed air-driven tools, high pressure water washing equipment or shot-blasting machinery to remove hard adhering rust scale and paint, and burning equipment and welding machines for the removal and renewal of wasted or distorted sections of steelwork. Access equipment, including extendable ladders, extensive sections of scaffolding, cherry pickers and staging might also be used.

Fig. 16. The steelwork of the hold has been poorly maintained and displays extensive areas of loose rust scale and loose paint, and also areas of hard adhering rust scale

There should be on board a programme for the planned maintenance of all parts of the structures of the cargo compartments, and an inspection regime and a system for reporting defects should be set out under the safety management system for the ship. During and following the cleaning operation in the cargo compartments, inspections and tests should be carried out, to ensure bilge and ballast systems operate correctly and there are no leakages or defects in way of the structures. These are routine during cleaning operations. Additionally, inspections should be carried out, from a maintenance point of view, of all structures within and around the cargo compartments. The areas to be inspected include (where appropriate) the following.

Cargo areas to be included in maintenance inspections

- Weather-deck hatch cover arrangements and all openings and other fittings on deck.
- Top-side tank plating within the cargo compartments and all upper areas of the holds, including under-deck structures and the inner plating of hatch coamings.
- End bulkheads, including any upper void spaces and bottom stool spaces where applicable.
- Side structures, including plating, frames, brackets, air pipes, sounding pipes and other fittings.
- Hopper tank plating, including manhole recesses and covers.
- Tank top plating, including manhole recesses and covers.
- Bilge wells, including covers, strum boxes, valves, pipework and any other fittings within the bilge wells.
- Hold ladders forward and aft and their associated brackets, rails and other fittings.
- Light fittings, their cabling and any brackets.
- Internals of all adjacent tanks and spaces including top-side tanks, side tanks, double-bottom and hopper tanks and void spaces.

The inspections should be carried out by the chief officer and/or the chief engineer and all findings should be recorded. The findings of the inspections should be discussed with the master and when wastage of steelwork and/or damages to structures or fittings are found, appropriate notification and/or repair work should be put in hand. If the structural integrity or the safety of the ship and/or those on board is affected by the defects, the classification society should be notified. Also, if maintenance and repair work is to be carried out, the charterer and other parties should be notified and they should be told if there is likely to be any delay in the ship's schedule as a result of that work. The work should be carried out at the earliest possible time and as efficiently as possible.

Before a grain cargo is loaded an inspector from a government department of the exporting country will attend on board to carry out inspections within the cargo compartments to establish whether or not those compartments are in a clean and suitable condition for the carriage of the intended grain cargo. Also, a government department inspector will carry out an inspection of the structures within the cargo compartment to ensure they are sound and without significant defect or damage, such that the overall strength of the ship is not compromised. If inspectors find any significant defects or damages, they will report the findings, will require rectification work to be carried out and a fitness for loading certificate will not be issued. The matter may then come under port state control governance and the ship may be detained until completion of the necessary work.

While it is commonly the case that such inspections are carried out prior to loading of a grain cargo, similar inspections may be carried out in the ports of some countries before the loading of other bulk commodities.

The master should be fully aware that the ship should be maintained and be in a seaworthy condition and should ensure the planned maintenance regime is followed in accordance with the ship's safety management system.

Pre-loading inspection

During a pre-loading inspection of the cargo compartments the surveyor will establish whether or not those compartments are in a condition suitable for the carriage

of the particular cargo to be loaded. The surveyor might be appointed by the shipper and/or receiver of the cargo or by the government department of the exporting or importing country.

The master should ensure all the necessary co-operation from the appropriate crew members is provided to the surveyor and all equipment which is necessary for the inspection is made available to the surveyor. See the next section for details of inspections.

Safety

The safety management system for the ship should include the various procedures to be adopted for safe working practices during all tasks and operations, including those involved in the cleaning and maintenance of the cargo compartments. These procedures, and any other or additional procedures should be followed, operations should be planned and work assessments should be completed, and all appropriate personnel safety equipment and appropriate working equipment should be available and in good condition. Where appropriate, a permit to work should be issued.

Safety matters are dealt with in more detail in Chapter 3.

ON/OFF-HIRE, CONDITION, BUNKER AND PRE-LOADING INSPECTIONS

It is often required under a time charterparty that on-hire and off-hire inspections are carried out at the beginning and the end, respectively, of the charter period. It is also often a requirement that condition surveys are to be carried out at the beginning and end of a time charter period – these surveys should not be confused with a condition survey requested by a P&I club or another party. It is often a requirement of a voyage charterer, or of the shipper of the cargo or another interested party, that a pre-loading inspection is carried out before a particular cargo is carried.

The various types of inspection should not be confused, because the requirements and results of each type of inspection are very different. Regrettably, the wording of the requirement for surveys is imprecise and therefore each type of survey, and what is required, will be fully discussed here. In brief, survey requirements are as follows.

Types of inspection surveys

Survey type	Items examined		
	Damage to steel in the cargo working areas	Hold condition and cleanliness	Cargo
On-hire	✓	✗	✗
Off-hire	✓	✗	✗
Condition	✗	✓	✗
Pre-loading	✗	✓	✓

On-hire and off-hire inspections

When it is agreed between owner and charterer that an on-hire inspection is to be conducted at the beginning of a charter period, a surveyor should be instructed to carry out an on-hire survey at the first port of loading, or at any other convenient place. These instructions should include some background information so the surveyor can arrange the inspection accordingly. Information required might include details of the ship and the place where the inspection is to be carried out, details of cargoes likely to be carried, whether or not the ship is to load cargo from barges placed alongside or to load logs brought alongside, and whether or not the cargo will be loaded and discharged by use of ship's cranes, and possibly ship's grabs, or if all cargo will be handled by on-shore cargo handling equipment.

The items and areas which are routinely inspected during an on-hire inspection are as follows.

On-hire and off-hire inspection checklist

- Main deck areas, including the main deck plating, ship's side rails or bulwarks, other ship's side fittings such as air pipes, stanchions for timber cargoes and sounding pipes, and fittings between the hatchways, including air pipes, sounding pipes and ventilators.
- Weather-deck hatch cover arrangements, including the hatch panels or pontoons, the hatch coaming structures and the opening, closing and securing arrangements.
- Deck houses, if fitted.
- Deck cranes and their pedestals, including the crane housings and crane jibs.
- Cargo holds, including access hatchways, access ladders, tank top plating, ship's side structures to port and to starboard, end bulkheads forward and aft, plating of tanks to port and to starboard, as appropriate, under-deck structures and the inner hatch coaming plating.
- Hull plating to port and to starboard.

The surveyor should inspect all of those parts of the ship to determine the extent of any damages to those areas and items in terms of the area or the length and breadth of the damage, together with the depth or other appropriate dimensions of the damage. The surveyor should then make a list of the damaged areas and items, together with details of the extent of the damage to each, to be set out in the on-hire report.

Damages might include the following: heavy indentations to steel plating and structures; waving and distortion of rails, frames, access ladders and other fittings; and fractures in structures and fittings due to tearing of steel items.

The list of damages should not include fair wear and tear items such as minor scraping of paint coatings, the extent of rust, flaking rust, flaking paint and other similar items which must be dealt with during the ordinary maintenance of the ship; these are not items considered to be damages for the purposes of an on-hire or off-hire inspection. The surveyor should not make any comments, in the report, with regard to the condition of the cargo compartments in terms of their cleanliness or suitability for any particular cargo type.

At the end of the charter period the owner and charterer may agree that an off-hire inspection should be conducted during or after the offloading of the last cargo carried, in which case a surveyor should be instructed to carry out a normal off-hire inspection.

These instructions should include some background information about the ship, the charter period and the intended place where the survey is to be done. The surveyor should inspect the same areas as for an on-hire inspection, and should prepare a list of the damaged areas and items, together with details of the extent of damage to each, to be set out in the off-hire report. It might additionally be agreed between the owner and charterer that the surveyor appointed to carry out the off-hire inspection should be provided with a copy of the on-hire inspection report. A comparison can then be made between the on-hire inspection report and the surveyor's own findings to provide a list of damages sustained by the ship and its fixtures and fittings during the charter period.

The description given in the previous paragraphs is that of a normal on-hire and off-hire situation. If the owner and/or the charterer require the on-hire and/or the off-hire inspections to include additional items, there is no reason why the surveyor should not be instructed to carry out any additional inspections of any other items or areas on board, and to report the findings. However, as it is most likely that the additional items will relate to the general condition of the cargo compartments, a more appropriate course of action might be for the parties to give the surveyor a completely separate, additional, instruction to carry out a condition survey.

It is often the case that when an on-hire or an off-hire inspection is conducted, a bunker survey is also carried out. A bunker survey involves the sounding of all the fuel oil and diesel oil tanks and the determination of the quantity of bunkers on board at a particular time. Such a survey is carried out independently of any on-hire or off-hire inspection, although the findings of the bunker survey are usually included in the same on-hire or off-hire report.

Condition survey

When it is agreed, under a time charterparty, that a condition survey should be carried out in conjunction with an on-hire or off-hire inspection, the surveyor appointed should be instructed to carry out the additional inspections and to report the findings. The surveyor should be provided with information as for an on-hire or off-hire inspection, such as details of cargoes likely to be carried, but should also be given information from the charterparty about the required condition of the cargo compartments. For example, the charterparty might require the holds to be 'clean-swept' or 'grain clean', and might make reference to required levels of previous cargo residues, paint scale, rust scale and other factors. For the condition survey in conjunction with an off-hire inspection, the surveyor should be provided with information from the charterparty which relates to re-delivery.

The surveyor should inspect all of the internal structures of the cargo holds, including the tank top plating, bilges, ship's side structures, end bulkheads, plating of all tanks, under-deck structures, the inner hatch coaming plating and all fittings, and determine their condition and level of cleanliness to draw up a list of findings. The list of findings should include, for each area, the following.

Condition survey checklist

- The general condition of the steelwork.
- The general condition of the paint coating.
- The extent of any loose and flaking paint and any scratches or score markings.
- The extent of any hard rust and any loose and flaking rust.
- The extent of any previous cargo residues.
- Whether or not the surfaces are dry and, if appropriate, the extent of any wetting or water.
- Weather-deck hatch covers and the coamings and determine their condition.

From the findings the surveyor should set out in the report whether or not the condition of the cargo compartments is in accordance with the requirements of the charterparty.

If the owner and/or charterer requires the condition survey to include additional items, there is no reason why the surveyor should not be instructed accordingly. For example, there might be a need for the surveyor to inspect the ship's cargo handling equipment, hold ventilation equipment or other fittings and equipment on board.

The surveyor should also be given instructions with regard to reporting the findings, that is whether a single on-hire and condition report, or off-hire and condition report, is required, or whether two separate reports are required.

Pre-loading inspections

Pre-loading inspections are required with respect to a particular cargo to be loaded or a particular trade. The survey will involve the inspection of cargo compartments to determine their suitability for the carriage of the intended cargo. In addition, it might be necessary for the surveyor to inspect the weather-deck hatch cover arrangements to determine their condition and whether or not they are weathertight. Also, inspections of the cargo to be carried, both before and during the loading operation, to determine the apparent condition of that cargo, might be required.

Different cargoes require different standards of cleanliness. Therefore, before the surveyor is instructed, the instructing party should determine what standard of cleanliness is required and they should give to the surveyor full and detailed instructions (see section on 'Hold cleanliness, cleaning and maintenance' earlier in this Chapter).

When surveyors carry out inspections in the cargo compartments ahead of commencement of loading, they should determine whether or not the compartments are suitable in terms of their condition and cleanliness. They should inspect the hold bilges and the steelwork within the compartments, both generally and close up. For close up inspections they might use ladders or, under certain circumstances, they might require the use of cherry-pickers to carry out inspections of the underside of cross-decks and other high-up steel structures. They might use hand scrapers to determine whether paint and rust scale is loose. At the conclusion of their inspections they should advise masters of their findings, that is, which compartments have been passed as fit for loading and which, if any, have been failed, giving reasons for failure. Masters and ships' staff should co-operate fully with the requirements of surveyors and provide assistance as and where appropriate. If a compartment is failed, action should be taken to remedy the situation so, without too much delay, the compartment can be re-inspected and passed as fit for loading.

In addition to the basic cleanliness of the cargo compartments, a further consideration is often the possibility that insects, insect larvae or eggs might be present behind in-hold steel structures or behind loose paint or loose rust scale. If there is such infestation present, there is then the possibility that the cargo loaded will be infested during the ocean voyage. For this reason, the authorities of some importing countries require pre-loading inspections to be carried out at the loading port in accordance with their own requirements to ensure no infestation of the cargo will occur. Similarly, the authorities of some importing countries will not allow the offloading of cargo which is contaminated, to any extent, by certain other commodities and the surveyor carrying out the pre-loading inspection will ensure, following the requirements of the authority of the importing country, that there are no previous cargo residues in the cargo compartments before loading is allowed to begin. In these circumstances, pre-loading inspection surveyors might be instructed to conduct their examinations with a zero tolerance level of acceptance of the compartment with regard to the presence of infestation, loose rust scale, loose paint and previous cargo residues.

When a cargo which is water-sensitive is to be loaded, it is likely that the pre-loading inspection surveyor will be instructed to carry out a thorough inspection of the weather-deck hatch covers and to carry out a weathertightness test. As with other aspects of the inspections, ship's staff should co-operate with the surveyor and provide assistance as and where appropriate.

It is sometimes required by owner or voyage charterer that the cargo loaded is inspected to determine its condition upon shipment. This will normally form part of the pre-loading inspection during which the surveyor will have already carried out inspections on board. The surveyor should be instructed to examine the cargo ashore, so far as is possible, and while it is being loaded. The surveyor should determine the apparent condition of the cargo and whether or not it exhibits any damage or contamination by other material, and should discuss the findings with the master.

Following the completion of the required inspections, the surveyor should prepare the pre-loading inspection report in which the details of all findings, and discussions with other parties as appropriate, are set out.

Instructions regarding type of inspection

Before a surveyor is instructed to carry out an inspection, the instructing party should decide what type of inspections are necessary. If a basic on-hire or off-hire inspection or a basic pre-loading inspection is required, the surveyor should be instructed to carry out the required, basic survey. If it is decided that an on-hire or an off-hire inspection is required with a condition survey, the surveyor should be instructed to carry out both surveys. The surveyor should also be instructed with regard to reporting of the findings. A single report including all findings might be appropriate, or two separate reports (on/off hire report and condition report) might be required. Alternatively, two separate instructions can be given to the surveyor, to carry out an on-hire or off-hire inspection and to carry out a condition survey, or whatever is necessary, and to report accordingly.

The key advice here is that it should be known before the surveyor is instructed what information the surveyor is to obtain during the inspections on board, and to then instruct the surveyor to carry out the appropriate inspections.

Practical implications

When an on-hire, off-hire, condition or pre-loading inspection is planned and arranged, the master of the ship involved should be notified in advance with details of the surveyor involved, the type of the inspection to be carried out and the date on which the inspection is to be conducted.

When the surveyor attends on board, the master should obtain details of the identity of the surveyor and of the survey company, and of the party who gave the instruction for the survey to be conducted. The master should then discuss with the surveyor the instructions given and the type of inspection to be completed. The master should ensure the surveyor intends to carry out the type of inspection which is required, and for which instructions have been issued. If there is any doubt, that is to say if masters believe the requirements given to them are not the same as the requirements provided to the surveyor, masters should seek clarification from the party requesting the survey before the inspection is started. For example, if surveyors believe they have been instructed to carry out an on-hire survey that will involve establishing whether or not the cargo compartments are fit for loading in accordance with the charterparty (a condition survey), while the master has been advised there will only be an on-hire inspection, the master should require sight of the instructions given to the surveyors. If those instructions are not the same as the information given to the master, clarification should be requested.

When the master has confirmed that the surveyor will be carrying out the inspections as requested according to the master's instructions, the master should allow the inspections to be carried out. If thought appropriate, the inspections may be carried out while clarification is being obtained.

Throughout the inspection the master should ensure all the necessary co-operation of the appropriate crew members and duty deck officer is provided for the surveyor and all available equipment which is necessary for the inspections is provided to the surveyor. The officer and crew members accompanying the surveyor should wear the appropriate safety protective equipment and they should ensure the surveyor is similarly wearing appropriate safety protective equipment.

During an on-hire or off-hire inspection, or a condition survey, the surveyor will, under normal circumstances, carry out the inspections without the need for much assistance by the crew and will record the findings without comment. However, the surveyor might call upon the officers or crew members for assistance or to carry out any necessary tasks. During pre-loading inspections of the cargo compartments the surveyor will take down notes of the findings and might draw attention to areas which require remedial action, such as drying of tank top areas, before the compartment can be passed fit for loading. In these latter circumstances, ship's staff should provide all appropriate and necessary assistance. Following completion of the inspections, the master should discuss the findings of the inspection with the surveyor and take note of the findings, if appropriate. Finally, before the surveyor departs the ship, the master should ensure the surveyor has provided all the necessary information.

If the surveyor has been instructed to carry out inspections of the cargo to be loaded, these inspections will be conducted partly on board and partly ashore. When the surveyor is on board ship's staff should provide all the necessary co-operation. When the surveyor is carrying out inspections ashore, if possible and appropriate, a deck officer

should accompany the surveyor. The master should discuss with the findings with the surveyor and should take actions appropriate to those findings. If cargo is found to be damaged or contaminated, or in any way not fit for carriage, it might be appropriate for the master to take action as follows: suspend the loading operation; seek further advice and information with regard to the condition of the cargo; prepare a letter of protest; take steps to ensure the bills of lading are claused; or require further inspections and any appropriate testing of the cargo.

It should always be acceptable for there to be a short delay in the loading operation when there is a reasonable doubt about the condition of the cargo, even if that doubt turns out to be incorrect, whereas failure to stop loading when there is a reasonable doubt about the condition of the cargo may lead to catastrophic consequences.

During any inspections by a surveyor from ashore a record of the inspections carried out should be kept in the deck log book and photographs should be taken and retained for future reference to illustrate the findings of the surveyor and any other part of the ship or the cargo as appropriate in the circumstances.

SHIPS' CARGO GEAR, OPERATION AND MAINTENANCE

Cranes for the handling of cargo are fitted on board most handy-size bulk carriers, most general cargo ships and other ships such as mini-bulk carriers. Some, older, handy-size bulk carriers and general ships are fitted with derricks.

The cranes will be operated by electro-hydraulic or electric machinery and will be either of the gantry type which is capable of being moved forward and aft on rails fitted along the weather-deck, or pedestal type cranes fitted either on the centreline or to one side of the ship. The cranes might be designed for use with grabs and there might be on board grabs for the loading and offloading of bulk commodities.

In addition, some ships will be fitted with other lifting appliances such as one or more stores cranes fitted aft, a gantry crane in the engine room and/or a gantry crane on deck for the handling of piggy-back type hatch covers but not for the handling of cargo.

All such cranes comprise: a structure in the form of either a gantry together with a trolley or a crane body and jib arrangement; pieces of electrical and/or electro-hydraulic machinery; electrical control gear; a luffing wire (or luffing cylinders) or a trolley operation wire or wires, and a hoist wire.

Fig. 17. Ship's cranes topped up and turned away from the quay

The operation of a gantry crane is fairly simple. The crane is moved to the required working hatch and then secured into position. The gantry is extended over the quay and is locked into position. Within the gantry framework there will be a hoist wire winch to haul up or pay out the hoist wire and the cargo hook and a winch to haul in and pay out the wire, or a drive motor, which moves the trolley to port and to starboard.

Pedestal cranes are usually fitted as individual cranes on a single pedestal, although sometimes they are fitted in pairs on a single pedestal to operate either in tandem or individually. Each crane is fitted with: a winch to operate the hoist wire – to raise and lower the cargo hook; a winch to operate the luffing wire – to raise and lower the jib to decrease or increase the radius of operation; and slewing gear – to rotate the crane on its pedestal, usually through 360º with the ability to handle cargo at two adjacent holds. Luffing of the jib might, alternatively, be by means of one or two hydraulic cylinders.

Ship's cranes appear to be fairly robust units which will continue to work when only a minimum of maintenance is carried out. In fact, they are highly complex pieces of machinery which incorporate numerous components manufactured to very fine tolerances, all of which must function correctly throughout the operation for the crane, as a unit, to be operated as the manufacturer intended. The cranes should be properly maintained, and should be inspected at specified intervals to ensure they operate correctly and safely. Additionally, all other equipment used in association with a crane should, likewise, be properly maintained and should be inspected as appropriate. If the equipment is not in the appropriate good condition, failures are likely to occur during cargo operations, as follows.

Reasons for gear failure

Failure	Reasons
Machinery	Poor or inadequate maintenance of mechanical, hydraulic or electrical components.
Structures	Poor or inadequate maintenance of structures, including sheaves, machinery foundations, bearings and other incorporated elements.
Wires	Poor or inadequate maintenance of wires.
During operation	Operator error, inappropriate operation of the crane, overloading by an excessive weight being lifted, and limit switches being overridden.

A failure of any part of the crane will lead to delays in the cargo operations and possibly have other consequences. Additionally, the renewal of expensive parts or the carrying out of expensive repairs might be necessary. Set out here is guidance on good practice for the operation, inspection and maintenance of cargo handling cranes, although the same procedures, or very similar procedures, may be followed with respect to other cranes on board.

General guidance on inspections and maintenance

There should be on board every ship fitted with cranes a manual produced by the manufacturers of the cranes giving recommendations and guidance with regard to the

operation of the cranes and details of inspections and maintenance which should be carried out, as a minimum. Also, there should be on board a planned maintenance regime, which should include recommendations set out in the manufacturer's manual. Additionally, there should be a regime for the inspection of each crane and its machinery and structures, including details of who is responsible for conducting inspections within the safety management system procedures. All the required maintenance, and the appropriate inspections, should be carried out, and testing of each crane and all its various parts should be carried out at appropriate intervals, taking into account the frequency of use. Records should be kept of all maintenance and inspections, and the renewal of any parts, and these records should be held for future reference. More detailed comments, with regard to the various parts of a crane, are dealt with in the following sub-sections.

Cranes, and other lifting appliances and their loose gear, are required to be thoroughly inspected annually, with a further thorough inspection and a proof load test every five years. These inspections and tests should be in accordance with the ship's flag state requirements. The flag state may permit a classification society surveyor to carry out the required inspections and tests. Details of the surveys should be recorded in the ship's register of lifting appliances and cargo handling gear. Also, there should be an appropriate test certificate for all wire ropes on board, that is for all of those in use and for all spare wire ropes. The certificates should give the date of manufacture, the material strength, the construction of the rope and the breaking load test of a sample. There should be an inventory of all wire ropes on board and records of the dates of renewal of the wires in use on all cranes.

Wire ropes, motors, electrical control systems and other pieces of machinery and equipment wear out or might be damaged during the operation of a crane. It is therefore necessary for a number of spare parts to be maintained on board at all times. The trading pattern of the ship will, to an extent, dictate what type and what number of spares will be required. If the ship is trading in very hot or very cold areas, the hoist wires and winch motors might not last as long as if the ship is trading in less harsh environments. For example, even ignoring misuse, the hoist wire might be heavily worn with broken wires after only two years in use if self-loading and self-discharge is a routine procedure, whereas the hoist wire of a crane on a ship which is trading between terminals with on-shore loading and offloading facilities might require renewal at only five year intervals.

Maintenance and inspections of the cranes, their wire ropes and their various parts is essential to ensure the operation of the crane is safe, reliable and there is a minimum of wear and damage.

Crane machinery

The machinery of a crane includes all electrical control equipment and systems, all motors, hydraulic oil pumps, filters and coolers, and winches, together with winch brakes and control gear, all limit switches, cut-out switches and other pieces of equipment.

Routine maintenance of these various pieces of machinery is essential for their continuing correct operation. In accordance with the planned maintenance regime, inspections and testing of the various parts should be carried out, with renewal of items and so on, as necessary, as follows.

Crane machinery maintenance checklist

- Items such as filters should be cleaned or renewed at designated intervals and when indicated by increasing differential pressure.
- Gearbox oil and any hydraulic oil should be changed and kept to the required level in accordance with the manufacturers' specification. Additionally, when appropriate, the oil should be changed subject to shore-based analysis of samples, to include particle count to assess the internal wear of the machinery. This sampling and testing should be done at about three-month intervals, subject to the ongoing use of the cranes.
- All limit switches and cut-out switches should be inspected and tested at appropriate intervals to ensure their correct operation and any defective parts should be renewed.
- Electrical control equipment and systems should be inspected and tested at appropriate intervals and any defective parts should be renewed.
- All motors, pumps and winches, and their brake mechanisms, should be inspected and tested at appropriate intervals and renewal of any complete units or parts of these units should be carried out as required when defects are found. Defects might be identified by way of shore-based analysis of samples of oil, to include particle count to assess the internal wear of the machinery.

Records of all inspections, maintenance, repairs and renewals should be kept for future reference.

When there is an incident involving a crane, be it the result of improper operation of the crane, the malfunction of any part, a contact between any part of the crane and any other object, or any other cause, operation of the crane should be stopped and inspections of the machinery should be carried out to establish whether or not any damages have been sustained. If any damage is found, appropriate repairs should be carried out before the crane is taken back into use, if appropriate the classification society should be notified. All broken or damaged parts should be kept for future examination and photographs of them should be taken.

Crane structures

The structures of a pedestal crane includes: the pedestal upon which the crane is mounted, the housing of the crane including all strength structures within the housing, all sheaves, and their mountings, at the top and at any other location on the crane, the slewing ring at the base of the housing and its associated mechanisms, and the crane jib including the heel bearings, the strength structures of the jib itself and the sheaves, and their mountings, at the jib head and at any other location. Additionally, the foundation structures of the winches, motors, pumps and so on, also form part of the structures of a crane.

With regard to a gantry type crane, the structures include the travel wheels and their associated bogeys, the gantry itself, any extendable parts of the gantry and the trolley. Additionally, the horizontal part of the structure will include trackways for the trolley and mechanisms for the extension of the gantry. Sheaves will be fitted within the structure of the gantry and within the trolley, for the hoist wire and for the trolley wires, and these sheaves will be fitted within mountings. Additionally, the foundation structures of the winches, motors, pumps and so on also form part of the structure of the crane.

Routine maintenance of the various parts of the structures, and of the fittings and support structures, is essential for the continuing safe and correct operation of the

crane. In accordance with the planned maintenance regime, inspections and testing of the various parts should be carried out and the repair and any renewal of parts should be undertaken as follows.

Crane structure maintenance checklist

- The main structures of the crane should be inspected to establish if any damage has been sustained or if there are any defects in the form of fractures or corrosion of the steelwork. Repairs and/or renewals should be carried out as appropriate.
- All sheaves, bearings and other moving parts should be inspected to determine whether or not any wear or deformation of the parts is present. If parts are defective they should be removed and new spare parts should be fitted and then tested for correct operation. These moving parts should be lubricated using the appropriate grease in the correct manner.
- All foundation structures and mountings should be inspected to determine whether or not any defects or damages are present and, if any such defects or damages are present, appropriate repairs should be carried out.
- All trackways, rails and other associated parts of gantry cranes should be inspected to establish whether or not there are any defects or damages and, if any are found, appropriate repairs should be carried out.

Records of all inspections, maintenance, repairs and renewals should be kept for future reference.

When there is an incident involving a crane, be it the result of improper operation of the crane, the malfunction of any part, a contact between any part of the crane and any other object, or any other cause, operation of the crane should be stopped and inspections of the structure should be carried out to establish whether or not any damages have been sustained. If any damage is found, appropriate repairs should be carried out before the crane is taken back into use, and the classification society should be notified. All broken or damaged parts should be kept for future examination and photographs of them should be taken.

Wire ropes

Steel wire rope is constructed in a number of different arrangements, each arrangement of the outer strands and the core having different characteristics. These characteristics will provide resistance to one or more of the following.

Wire rope resistance characteristics

- Rotation – the torque or turning motion generated when a load is applied or is removed.
- Fatigue – deterioration as a result of working, bending and straightening around sheaves or a barrel when it is under load.
- Abrasive wear – which takes place between a wire rope and the sheaves it passes over, and between a rope and the barrel, or adjacent ropes on the barrel, as it is paid out or hauled in.
- Crushing – crushing of a wire rope will occur when there are multi layers of a rope on the barrel.
- Corrosion – a galvanised coating of the wires is normal for wires fitted to ships' cranes to minimise the effects of corrosion due to contact with sea water.

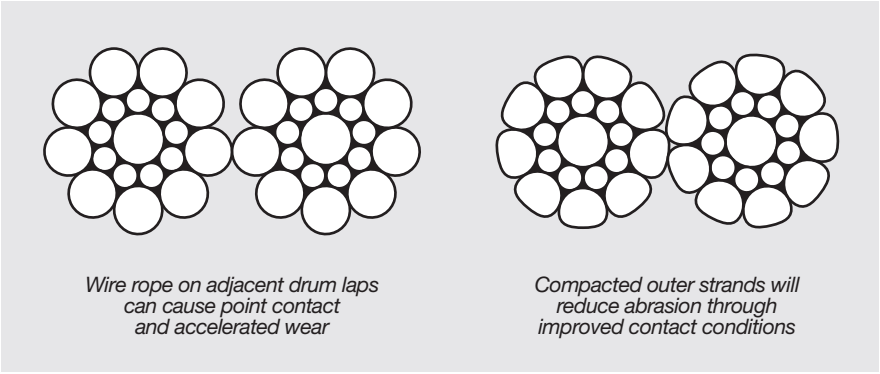

Fig. 18. Wire ropes are designed for different purposes and with different resistance capabilities

Wire ropes fitted to deck cranes should be designed for the purpose and should incorporate resistance to rotation, fatigue, corrosion and abrasive wear. Resistance to abrasive wear is achieved by the construction incorporating compacted outer strands. That is, the strands are made up with wires of a particular cross section, not circular, so as to produce a smooth outer surface to the strands which might look as if the wire is worn overall.

There should be on board an appropriate test certificate for all wire ropes and an inventory showing the date of fitting of all wires in use on all the cranes and the status of all spare ropes. The master and the chief officer, and appropriate crew members, should have full knowledge of the status of crane wires and of the construction of wires fitted to the deck cranes. The wire ropes in use should be of the correct diameter and construction, as specified by the crane manufacturer, because only the correct wires will run smoothly and correctly over sheaves and on the winch barrels. Wire ropes of incorrect diameter and/or construction will deteriorate rapidly when in use and may cause damage to other parts of the crane, and may have different safety ratings.

The period of safe use of a wire rope will depend to a large extent upon the manner in which it is maintained and cared for while it is in use. If the wire is regularly inspected and lubricated, and if the other parts of the crane are properly maintained, the wire will suffer less damage than if proper maintenance is not carried out.

The planned maintenance regime is likely to require that inspections of the wire ropes are carried out at set time intervals and/or after a specified number of uses, ensuring that the ropes are lubricated with appropriate grease at the same or at a different interval. During routine inspections and maintenance of the wire ropes they should be inspected over their full length and their fittings should also be inspected.

Wire ropes and their associated fittings should be examined for defects and damages and, if any damages or defects are found, repairs should be carried out as appropriate or the items should be removed from the crane and new items fitted. If the defect or damage is excessive, advice should be obtained. Inspections, maintenance and actions should be carried out as follows.

Wire rope and fittings inspection checklist

What to inspect

- Wire rope over its full length – inspections should be carried out to identify defects (as set out below) and the rope should be lubricated overall with particular attention to parts of the rope in way of sheaves when the crane is stowed for sea, end ferrules and end terminations.
- Swivels – these should be in sound condition without defects and should turn easily by hand, if not they should be dismantled, cleaned, re-built and greased.
- Ancillary equipment – including hooks, cargo blocks, shackles and other loose gear should be in sound condition without defects and all moving parts should be free and appropriately greased.

Wire rope defects and actions

- Number of broken wires – when broken wires are found, the number of broken wires within a part of the wire rope, for example, within a length equal to six diameters, should be assessed. If an excessive number of wires within that length are broken, the wire rope should be discarded (see ISO 4309 and below).
- Fractured strands – if a complete strand is fractured, the wire rope should be discarded.
- External and internal wear – if there is excessive wear, either internally or externally, the strength of the wire will be adversely affected and it may be appropriate to discard the wire rope; specialist advice should be sought.
- External and internal corrosion – if there is excessive corrosion, either internally or externally, the strength of the wire will be adversely affected and it may be appropriate to discard the wire rope; specialist advice should be sought.
- Decrease in elasticity – although this is difficult to detect by ship's staff, if the wire rope is found to have a reduced diameter or if there is elongation of the lay or the wire rope is found to be stiffer than expected, specialist advice should be sought.
- Kinks and other mechanical damages – if any kinks, distortions or other damages are found, their severity should be assessed and it might be appropriate to discard the wire rope; specialist advice should be sought.

The international standard ISO 4309, 'Cranes – Wire ropes – Care, maintenance, installation, examination and discard', sets out a comprehensive list of defects that affect wire ropes. Guidance with regard to how inspections should be carried out is shown, and what should be looked for is given, for example how to carry out an internal examination of a wire using specialised tools. Also, the discard criteria for wire ropes of different types are given, for example, the number of broken wires in a specified length of the wire rope, which would warrant discard.

Following completion of an inspection of a crane wire, the wire should be lubricated by the application of an appropriate grease or dressing. It might be necessary, if required by the age of the previous dressing or by the procedures of the lubricant manufacturer, for the wire to be cleaned to remove any old and de-natured dressing, in which case an appropriate cleaning product should be used. The lubricant should cover all parts of the rope and it might be necessary to work the dressing into the core of the rope to ensure the proper working of the lubricant.

Records of all inspections, maintenance and renewals of crane wires should be kept for future reference. Any damaged or failed wires should be kept for future examination, and photographs of them should be taken.

Operation of cranes

When ships' cranes are used for cargo operations, it is likely that they will be used over an extended period and also that stevedores' crane drivers will operate the cranes. However it is sometimes the case that members of the crew will operate the cranes during such operations. It is essential that the cranes are in good order and operating satisfactorily at the beginning of any cargo operations and the crane drivers are properly trained and experienced so incidents are avoided. If any incidents do occur, an investigation should be carried out and any appropriate inspections should be completed as discussed elsewhere in this section. The general procedures are set out in the following sub-sections.

There should be on board a planned maintenance regime for the inspection and care of the cranes; the requirements of that regime should be strictly followed. If all the required inspections and necessary maintenance of the cranes, that is of their machinery, their structures, and their wire ropes and other equipment, is completed, the cranes will be ready for use during cargo operations, or for other tasks, at any time. However, during an extended period of cargo operations the cranes, and their various components, will be subjected to loads and stresses which might lead to damages being sustained by some of the parts even though all the required inspections, maintenance, renewals and so on have been carried out. For this reason, inspections of the cranes should be carried out before a period of cargo operations, ongoing inspections should be carried out during these operations and a thorough examination of each crane should be carried out after the cargo work has been finished.

Before cargo operations

Before arrival at a cargo operations berth where the cranes are to be used or perhaps while the ship is at anchor waiting to go alongside, if safe to do so, a thorough examination should be carried out. Things to look for are as follows.

Crane pre-operation checklist

- All controls and the various limit switches and cut-outs are functioning correctly.
- All electrical components and gear are dry and operating correctly.
- All machinery and machinery housings are dry and operating correctly.
- All wire ropes are satisfactorily lubricated and all swivels move freely.
- All sheaves are satisfactorily greased and move freely.
- All power generating equipment needed to operate cranes is fully operational and capable of providing required power.

If any defects or problems are identified during the inspections, corrective action should be taken without delay. For example, if it is found that the cargo hook swivel is somewhat stiff it should be greased or, if necessary, dismantled, cleaned, re-built and greased to ensure it is completely free. Also, parts of any of the wire ropes which appear to be dry, for example in way of the sheaves when the crane is stowed for the voyage, should be additionally lubricated as necessary.

During cargo operations

During all cargo operations the duty deck officers and duty crew members should continually observe the operation of the cranes and the working of all their parts

and should keep records of their findings in the deck log book and/or an appropriate work book. If any part appears to be malfunctioning the crane should be stopped and corrective action should be taken. For example, if the machinery is not functioning correctly and smoothly the chief engineer should be notified and tests and examinations of the machinery should be carried out, following which any necessary repairs should be completed. Also, if any of the sheaves or any of the bearings are not functioning correctly or are making unusual noises, investigations should be carried out and any appropriate repairs or greasing put in hand.

Throughout cargo operations all limit switches must be operable and they must not be over-ridden. The over-riding or by-passing of a limit control must only be carried out in extreme circumstances and under the direct supervision of senior ship's staff and not during normal cargo operations. An example of when over-riding is acceptable is when the jib is being lowered onto its cradle in the rest position.

If it is found that the driver of a crane is not operating the crane correctly in any way, the cargo operations should be suspended, the qualification of the driver should be checked and an investigation should be conducted.

If the driver is a crew member, an internal, on-board assessment of that crew member should be conducted and either that crane driver should receive further instructions with regard to the operation of the crane or an alternative, fully and properly trained crew member should be directed to drive the crane during the cargo operations.

If the driver of the crane is a stevedores' employee, the master should prepare a note of protest and/or letter of complaint directed to the stevedores and other appropriate parties and should request details of the driver's experience and copies of any appropriate certificates of instruction. An investigation should then be conducted together with representatives of the stevedores to establish why the crane driver was mishandling the ship's crane. If appropriate, an alternative, sufficiently trained, crane driver should be directed to drive the crane before cargo operations are resumed. Records should be kept of all discussions held, to include the details of all parties taking part, of the discussions and of all decisions taken.

After cargo operations

Following completion of a period of cargo operations during which there have been no particular incidents of note, there should be a general, overall inspection of the cranes and their equipment to establish whether or not any damage has been sustained. A record of the inspection should be kept with details of any damages or defects found. If any damages or defects are found remedial work should be put in hand as appropriate. If structural repairs are carried out, or if work associated with load bearing systems is done, the crane should be re-tested with a proof load by a competent authority recognised by the flag state or other certifying authority on behalf of the flag state.

It should be borne in mind that a crane which is fully and properly maintained is less likely to suffer a failure or the development of a defect during its normal operation. If a defect does develop, records of all inspections, maintenance and any work carried out will assist with demonstrating that due diligence has been exercised to ensure, so far as possible, that the crane was apparently in normal working order before the defect was identified.

Incidents involving damage to a crane

When an incident of any kind involving one or more of the ship's cranes occurs during cargo operations, the crane(s) should be immediately stopped and an investigation and inspections of the crane(s) should be started.

Incidents might include failure of electrical or mechanical components, failure of a hoist or luffing wire or failure of any part of the structure of the crane, any bearings or sheaves. The incident might have been brought about by mishandling of the crane by the crane driver, by contact between the structure of the crane and another object – possibly the cargo being handled or another crane – or may be the result of an unforeseen failure of the maintenance and repair system on board. The investigation should establish: the extent of the failure and what parts of the crane(s) are involved; the reasons for the failure; the extent and nature of all repairs which are necessary.

Remedial action should then be started, without delay and the classification society should be notified. If structural repairs are carried out, or if work associated with load bearing systems is done, the crane should be re-tested with a proof load by a competent authority recognised by the flag state or other certifying authority on behalf of the flag state.

Records of all incidents should be kept, with details of all findings and remedial action taken. Additionally, a report, including full details, should be issued to the ship operator. All damaged and broken parts should be kept for future examination and photographs of them should be taken.

Grabs and their use

Bulk cargoes are handled either by some sort of conveyor system with either a spout for delivery or a suction or bucket leg for offloading, or by grabs. The grabs might be stevedores' equipment fitted to on-shore stevedores' cranes, stevedores' grabs fitted to ship's cranes or ship's grabs fitted to ship's cranes.

Although the grabs used by stevedores in conjunction with shore-side cranes might be any one of a number of types and designs, grabs used in conjunction with ship's cranes are usually of the clamshell type, connected to and lifted by the crane hook with the opening and closing mechanisms within the upper part of the grab. Usually, the opening and closing mechanism is by hydraulic cylinders powered by an electric pump, powered either from the ship via an umbilical cable plugged into the ship's electrical supply system or by a power pack incorporated into the machinery of the grab and operated via a radio control system. Occasionally, mechanical grabs with a wire and latch opening and closing system, sometimes known as dump grabs, are used.

Grabs from ashore

If grabs are provided from ashore, before they are taken into use with ship's cranes they should be fully inspected to establish whether or not they display any damages or defects. If any damages or defects are found, details of these should be recorded for future reference. The grabs provided must be of a suitable size and capacity for use with ship's cranes. The grabs should then be properly fitted to the crane hook or cargo block, as appropriate, and should then be fully tested to ensure the grabs function correctly. If a grab fails to function correctly, it should be removed from the crane's hoist wire and returned ashore. Only fully functioning grabs should be put into service.

Fig. 19. Discharge by grab to an on-shore hopper

Ship's grabs

With regard to ship's grabs, they should be the subject of part of the ship's planned maintenance regime and routine inspections and maintenance should be carried out. That routine maintenance and inspection regime should include the thorough inspection of all structures of the grabs and their mechanical parts, and of any associated equipment, including any umbilical cables and control systems to ensure, as follows.

Ship's grab inspection checklist

- All moving parts are free and well greased.
- All machinery and control systems are functioning correctly.
- Hydraulic oil reservoirs are filled to the appropriate level.
- All parts are without defect or damage.

If any defects or damages are found, corrective action should be taken without delay. A record of all inspections carried out and the findings of the inspections, of all maintenance done, and of any repairs or renewals, should be kept for future reference.

Before each ship's grab is taken into use for cargo operations, it should be rigged to the cargo hoist wire of the ship's crane and should be fully tested to demonstrate its fully functioning capability. A record of that testing should be kept.

Grab capacity and safe working load

The technical specification for a clamshell grab will include its capacity in cubic metres, its weight in tonnes, its dimensions in metres and details of its operation. The capacity might be a single figure, or might be two or more figures, if spill plates or moveable panels are fitted to the grab, which can be removed or put in place to alter the capacity of the grab when closed. The capacity of typical grabs used for the loading and discharging of bulk cargoes using ship's cranes ranges from about 4 m^3 to about 16 m^3. The weight of the grab might be about 2 tonnes or as much as 12 tonnes. This should be shown on the name plate attached to the grab.

The weight of cargo which can be lifted by a grab depends upon the capacity of the grab and the density, or the stowage factor, of the commodity. When calculating the weight of cargo lifted by a grab, it is likely the surface of the cargo in the grab will be slightly peaked or crowned, such that a greater weight than the volume of the grab might indicate will be lifted. An allowance of 25% for this should be included in any calculation.

For example, for a grab of capacity 10 m^3 and weight 4 tonnes, handling a cargo of density about 2.0 t/m^3 or stowage factor 0.5 m^3/t, the grab would lift 25 tonnes of the cargo (that is 20 tonnes plus the 25% allowance of 5 tonnes), such that the total lift taken by the crane wire would be 29 tonnes.

All ships' cranes are designed for particular operations and are certified to have a particular safe working load (SWL), dependent upon the strength of the structures of the crane and the strength of the wires which are fitted. That safe working load will be for hook operation, that is, for the loading and offloading of cargo lifted by slings attached to the cargo hook. For pedestal cranes the SWL is also only applicable between the maximum and minimum working radii.

If the crane is designed for both hook operation and for grab operation, it is likely to be given two different SWL ratings by the manufacturer, one for hook operations and one for grab operations. It is usual for the grab operation rating to be 20% less than the hook operation rating. For example, a crane having a safe working load of 30 tonnes for hook operation will be down rated by 20%, or by 6.0 tonnes, such that its SWL for grab operation would be 24.0 tonnes. It must be remembered that this SWL includes the mass of the loaded grab. The two SWL ratings should be stated on the crane jib.

The allowance given by the crane manufacturer is for a number of reasons, some of which are technical and some are operational. When a crane is used with a grab fitted to the hoist wire, the crane will lift and transfer a loaded grab in one direction and, after the load is released, it will lift and transfer an empty grab in the other direction, such that the crane will be transferring a load at all times when in operation, whereas in hook operation a load is transferred in only one direction. To compensate for these increased loadings on the structures and mechanisms of the crane, a down rating is applied. From the operational point of view, when a grab is closed to take a load from the pile alongside or in the hold, the grab will bite into the pile and become partly submerged.

When the hoist wire motor is engaged the wire will be tensioned as the weight of the grab and of cargo is taken and weight will be, effectively, greater than the weight of the grab and the weight of the cargo it can hold. Initially, there is likely to be some cargo on the shoulders of the grab, or in the grab, in addition to the 25% allowance, to increase the weight and, because there will be an amount of suction between the lower part of the grab and the cargo beneath the grab in the pile, there will be a further increase in

the weight being lifted. Additionally, there might be a very rapid take-up of weight by the hoist wire as the full grab is lifted or a rapid release of the load when the grab is opened, such that a snatch loading might be applied to the hoist wire, its structures and the mechanisms of the crane itself. These various factors are taken into account by the application of a small down rating of the safe working load of the crane for grab operation.

For a crane not specifically designed for grab operation, and which therefore is not given a grab operation safe working load, consideration should be given to applying an allowance when grabs are used for the loading or offloading of bulk commodities.

Working with cranes and grabs at anchor

When the ship is alongside and made fast to a berth it will be fairly static in the smooth water of the dock and not likely to roll or pitch. When cargo is loaded or offloaded by the ship's cranes at a berth, the ship will list and roll a little but that movement will last for only a short period and the movement will be small.

When a ship is at anchor, however, especially in exposed waters, it might roll and/or pitch to an extent that the movement might be large and prolonged, and such that the movement might affect the cargo operations, and damage might be sustained by the ship or its fittings, or personnel might be injured, if precautions are not taken. The movement of the ship may also subject cargo handling equipment to increased dynamic or shock loads

The factors to be taken into account while working at anchor are the motion of the ship, the motion of the grabs and the motion of the barges moored alongside. When a ship is at anchor and there are heavy seas or swell waves approaching, the ship's motion will depend upon the natural roll and natural pitch period of the ship at the particular draught, and the approach angle of the waves and their height and period.

If the waves are approaching from the beam and have a period about equal to the roll period of the ship, excessive rolling might result. If the period of the waves is not close to the rolling period or the waves are approaching from the quarter or the bow, rolling of the ship, irrespective of the height of the waves, might be minimal. The rolling period is dependent upon the beam, the GM and a coefficient which is similar to the block coefficient of the ship. This being the case, by changing how a ship sits in the water, for example by changing the amount of ballast water on board and by so doing changing the GM and the block coefficient, the roll period will change and so too will the ship's motions in any particular wave conditions. Bearing this in mind, the master may consider measures to reduce the rolling and/or pitching of the ship which might include, so far as is possible; increasing the amount of ballast water on board to put the ship more heavily into the water, reducing the amount of ballast water on board to reduce the draught or changing the arrangement of ballast water on board to change the GM without altering the draught.

If a grab fitted to the hoist wire of a ship's crane begins to swing as a result of the motion of the ship, a very dangerous situation may develop. If a grab starts to swing excessively during cargo operations, good seamanship practice dictates that the operation should be suspended without delay. The swinging of the grab may be the result of a combination of the roll period of the ship being close to the period of approach of waves and the period of the swing of the grab on the end of the hoist wire. A hoist wire with a grab attached will act like a pendulum and its period will be dependent only

upon the length of the hoist wire extending down from the head of the jib. Bearing this in mind, the master may consider measures to reduce the ship's motions by changes to the ballast situation which, in turn, may have a beneficial effect on the period of the crane hoist wire by increasing or decreasing the ship's freeboard.

If there are waves approaching the ship and there are barges alongside, it is likely that those barges will roll and pitch and generally move in the waves. In such circumstances, the fendering between the barges and the ship's side should be adequate to prevent damage being sustained by either the barges or the ship's side structures. The mooring arrangements should be adequate to retain the barges firmly in the required position alongside and against the fenders. If the fenders and/or the mooring arrangements are seen to be in any way inadequate before a barge is moored alongside, the barge should not be moored alongside or, for a barge already alongside, if these arrangements prove to be inadequate the barge should be let go and moved away from the ship.

If cargo operations, either loading or offloading, are continued with barges alongside which are moving in waves approaching the ship, and those barges are securely moored alongside adequate fenders, operations should be closely monitored to ensure the safety of the barges and of any crew members or other personnel on board the barges. If a grab starts to swing excessively or if a barge starts to move excessively such that there is the possibility of damage being sustained by either the barge or the ship, or of injury to any personnel, the operation should be suspended without delay and should not be resumed until it has been concluded that it is safe to do so.

Derricks

Some handy-size bulk carriers and some general cargo ships are fitted with masts and derricks. The derricks might be of the union purchase type or might be single swinging derricks. Each arrangement will include the derricks themselves, their masts, winches, hoist wires and various guy arrangements. The cargo handling equipment should be properly maintained and should be inspected at intervals to ensure all pieces or parts of the system operate correctly and safely. If the equipment is not in appropriate good condition, failures are likely to occur during cargo operations, as follows.

Reasons for derrick failure

Failure	Reasons
Machinery	Poor or inadequate maintenance of the mechanical and electrical components.
Derricks or masts	Poor or inadequate maintenance of the derricks or masts, including the various sheaves, blocks, heel structures, bearings and D-rings.
Wires	Poor or inadequate maintenance of these wires and their associated blocks, shackles and D-rings.
During operation	Operator error or inappropriate operation of the derricks.

Any failure of the derricks will lead to delays in the cargo operations and possibly to other consequences. Additionally, the renewal of expensive parts or expensive repairs might be necessary.

There should be on board a planned maintenance regime which should include requirements with regard to inspections and maintenance to be carried out routinely. Additionally, requirements should be set out within the safety management system procedures. All the required maintenance, the appropriate inspections and testing of each derrick and all its various parts should be carried out at appropriate intervals. Records should be kept of all maintenance and inspections, and of the renewal of any parts, and these records should be held for future reference.

The guidance notes set out in this section with regard to cranes, including details for crane machinery, crane structures, wire ropes and for the operation of cranes is entirely relevant for the operation, inspection and maintenance of the similar parts of derricks.

If the appropriate maintenance and inspections are carried out variously; in line with the planned maintenance regime on board, before cargo operations are begun, throughout cargo operations and at the end of a period of cargo operations, the likelihood of a problem being encountered will be reduced to a minimum.

It should be borne in mind that while a large proportion of the maintenance of cranes is carried out by engineers and/or electricians on board, with a small proportion being undertaken by the chief officer and the deck crew, the maintenance and ongoing care of derricks and their associated wires, blocks and other pieces of gear, is undertaken by the chief officer and the deck crew, with the engineers and electricians carrying out maintenance work and repairs to the winches and control systems.

Safety

The safety management system for the ship should include a manual in which there are all the various procedures to be adopted for safe working practices during cargo operations, and during maintenance and repair of the cranes or derricks on board. These procedures and any other or additional procedures should be followed. Maintenance of cargo handling equipment should be planned and work assessments should be completed, and all appropriate personal safety equipment and appropriate working equipment should be available and in good condition. Where appropriate, a permit to work should be issued. Before cargo operations are begun, discussions should be held to plan the operation and to identify any risks or problems which might arise.

Safety matters are dealt with in more detail in Chapter 3.

BALLAST, BILGE AND WASH WATER, AND CARGO RESIDUES

During most voyages consideration must be given to ballast water which is carried on board for the voyage towards the loading port and the pumping out of that water before and/or during loading. The cleaning of the holds before arrival at the loading berth and the disposal of cargo residues and wash water must also be considered, along with the water which may collect in the hold bilges during a loaded voyage and the pumping out of that water.

There are various international regulations and other local requirements for the disposal of the water, and cargo residues, which must be followed, and there are practical considerations which must be borne in mind during each voyage. There are three particular problems.

Water disposal problems	
Harmful aquatic organisms and pathogens	When ballast water is taken on board from the sea or from a river that water may contain, amongst other things, harmful aquatic organisms and pathogens which will survive in that ballast water, and in the sediments within the ballast tanks, for an extended period of time. These aquatic organisms and pathogens may create hazards to the marine environment where the ballast water is pumped overboard by threatening ecosystems, habitats or species which are indigenous to the area.
Substances which are harmful to the marine environment (HME)	Bilge water and wash water are likely to contain some cargo residues which might be HME. Also, wash water may contain chemical compounds of any barrier coat used before loading or any cleaning materials used after discharge, both of which might also be harmful to the marine environment. Cargo residues, bilge water and wash water would, if HME, endanger life in the sea area where discharge takes place.
Oil residues from cargo	If the cargo has a high oil content, bilge water, wash water and cargo residues will contain oil and an oily sheen may be produced on the water surface during any discharge or disposal overboard.

Regulations and other controls over the pumping overboard of ballast water, bilge water and wash water, and the disposal of cargo residues, have been introduced to try to eliminate, or at least minimise, pollution and contamination of sea water, especially in certain special areas, including the Mediterranean Sea and other enclosed or nearly enclosed seas, and in coastal waters. Regulations and requirements which must be complied with include the following.

Ballast water regulations

- International Convention for the Control and Management of Ships' Ballast Water and Sediments, known as the Ballast Water Management Convention (BWM Convention). The BWM Convention is published by the IMO, includes guidelines for its implementation and deals exclusively with ballast water.
- MARPOL, annex I, gives regulations for the prevention of pollution by oil and annex V gives regulations for the prevention of pollution by garbage from ships. These annexes deal with requirements relating to wash water, bilge water and cargo residues, and to other types of garbage which are not dealt with in this guide.
- Guidelines for the implementation of MARPOL annex V, as amended. This sets out an updated version of annex V which supersedes the annex V given in the 2011 consolidated edition of MARPOL, and gives guidance upon that new annex.
- Regulations and requirements issued by authorities of coastal states deal with ballast water as well as wash water, bilge water and cargo residues.
- Convention on the Prevention of Marine Pollution by Pumping of Wastes and Other Matter, 1972 (London Convention and 1996 Protocol) deals with the deliberate dumping of wastes and other materials that do not arise from the normal operations of the ship. This includes damaged cargo left behind after discharge has completed. Each dumping requires a permit from the country of origin of the waste.

During the normal operation of the ship there are a number of practical considerations which should be borne in mind with regard to the planning of ballasting and de-ballasting. These include the cleaning of the cargo compartments before loading and the washing down of

deck areas after loading; the pumping out of bilge water during a loaded voyage (if necessary); the maintenance of the various pipework and pumping systems; and the recording of soundings and operations which involve ballast, bilge water, wash water and cargo residues.

Ballast water

Under the BWM Convention the taking on board of ballast water in one coastal area and later pumping that water overboard in another coastal area is prohibited. The ballast water must either be discharged to a reception facility ashore (which would eliminate the need for it to be pumped overboard), or be circulated (exchanged) or treated on board when the ship is in an open sea water area before arrival at another coastal area where it is to be pumped overboard. The circulation and treatment of ballast water and the documents and records required, are discussed in the following sub-sections.

International Ballast Water Management Certificate

In accordance with regulation E-1 of the convention, every ship over 400 gross tons shall have on board an International Ballast Water Management Certificate to confirm that the ship complies with the requirements of the convention. As with other statutory certificates, it will be issued after an initial survey and will be renewed, as appropriate, after a survey at intervals not exceeding five years. Intermediate and annual surveys will be required during the period of validity of the certificate.

Ballast water management plan

Under regulation B-1 of the convention, it is required that each ship has a ballast water management plan. That plan must include procedures for the management of ballast water on board, that is, the taking of ballast water, the circulation or treatment of that ballast water while it is on board and the discharge of the ballast water to sea which will, so far as possible, eliminate or minimise the transfer of aquatic organisms and pathogens from one sea area to another.

Regulation B-1 sets out the requirements for a ballast water management plan as follows.

BWM Convention requirements for ballast water management plan

.1 detail safety procedures for the ship and the crew associated with ballast water management as required by this Convention;
.2 provide a detailed description of the actions to be taken to implement the ballast water management requirements and supplemental ballast water management practices as set forth in this Convention;
.3 detail the procedures for the disposal of sediments:
  .1 at sea; and
  .2 to shore;
.4 include the procedures for co-ordinating shipboard ballast water management that involves discharge to the sea with the authorities of the State into whose waters such discharge will take place;
.5 designate the officer on board in charge of ensuring that the plan is properly implemented;
.6 contain the reporting requirements for ships provided for under this Convention; and
.7 be written in the working language of the ship. If the language used is not English, French or Spanish, a translation into one of these languages shall be included.'

Ballast water record book

Under regulation B-2 of the convention it is required that each ship shall have on board a ballast water record book in which entries are to be kept of the various operations. Appendix II of the convention sets out requirements with regard to what should be recorded in the book, to include the following.

BWM Convention requirements for ballast water record book records

- When ballast water is taken on board.
- When ballast water is circulated or treated for ballast water management purposes.
- When ballast water is discharged into the sea.
- When ballast water is discharged to a reception facility.
- Accidental or exceptional uptake or discharge of ballast water.
- Additional operational procedure and general remarks.

In each section of the record book, details are to be kept of the date and time of the operation, the location of the ship at the time and the volume of water involved, together with any other appropriate information.

Soundings record book and ballast water reporting form

In addition, there should be on board a soundings record book in which all ballast tank soundings (as well as hold bilge soundings) are kept, together with the date and time when the soundings were taken. It is recommended that, to complement the ballast water record book, individual record sheets should be completed to record all ballast operations, one for each voyage with information as follows:

Recommended ballast water record for each voyage

- Ship information – basic information about the ship and its owner.
- Voyage information – previous port, load or discharge ports and date of arrival and departure, and next port.
- Ballast water on board and capacity – volumes and number of tanks involved.
- Ballast water management – ballast water management plan implemented or not, number of tanks involved with operations.
- Ballast water history – tables for; tanks, ballast water source, ballast water exchange and ballast water discharge, with dates and times of all individual operations.
- Signature.

Completed records can be provided for representatives of local authorities and others as evidence of ballast management operations during the previous voyage.

Ballast water treatment

The regulations in the BWM Convention allow the treatment of the ballast water, although such treatment technologies continue to be developed.

Ballast water exchange

The exchange of ballast water, sometimes described as circulation of ballast water, is a procedure where ballast water on board is sequentially replaced by new water from

the sea, such that at least 95% of the volume is exchanged. There are three accepted methods; the sequential method, the flow-through method and the dilution method. These methods are described in the guidelines, section G6, and the method to be used on board a particular ship will be set out in detail in the ballast water management plan.

It is a requirement under regulation B-4 of the convention that ballast water exchange is carried out in positions at least 200 nautical miles from the nearest land and in water of depth at least 200 m. However, if the ship is unable to comply with that requirement the exchange should take place as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water of depth at least 200m. There are additional requirements which should be complied with, including special requirements in certain areas.

In addition to the requirements set out in the convention, the authorities of coastal states will issue their own regulations and requirements with regard to the pumping overboard of ballast water. The regulations and requirements of the coastal state in whose waters the ship is sailing must be known by the master and must be complied with in full.

It is recommended that the ship's ballast water management plan is studied in detail, so all the required procedures are followed in full and so that the requirements of the convention are followed. Also, the BWM Convention and the guidelines for its implementation should be studied to gain an appreciation of the requirements and procedures set out in the ballast water management plan. It should also be remembered that, as with all IMO publications, the convention will be reviewed from time to time and it is likely that additional requirements will be issued or changes to the present requirements will be made in the future.

Bilge water, wash water and cargo residues

MARPOL sets out requirements with respect to the prevention of pollution from ships. Annex I deals with regulations for the prevention of pollution by oil and annex V deals with the regulations for the prevention of pollution by garbage from ships. Additionally, Guidelines for the implementation of MARPOL annex V have been published by IMO. Annex V sets out, amongst other things, the requirements with regard to the discharge of wash water from holds previously containing solid bulk cargoes classified as harmful to the marine environment and on-shore reception facilities for the receipt of that cargo hold wash water.

It is one of the particular problems that pollution of the sea might occur if any wash water or hold bilge water which contains any substances which are harmful to the marine environment (HME) is pumped overboard. As discussed elsewhere, it is a requirement under section 4 of the IMSBC Code that before cargo is loaded the shipper must provide a cargo declaration. Also, in accordance with paragraph 3.4 of the Guidelines for the implementation of MARPOL annex V, the shipper must state on the cargo declaration whether or not the cargo to be loaded is HME.

Under the full requirements of annex V it is prohibited for cargo residues which are HME, or any bilge water and wash water containing cargo residues which are HME to be discharged overboard anywhere and it is a requirement for the water and/or any cargo residues to be put ashore to a suitable reception facility.

All parties involved with the management and operation of ships should be aware that regulations and requirements are constantly being reviewed and revised, and new or supplementary requirements are issued on a regular basis.

MARPOL annex V, regulation 1 states the following.

MARPOL definitions of cargo residues, garbage and operational waste

- **Garbage** means all kinds of food wastes, domestic wastes and **operational wastes**, all plastics, **cargo residue**.
- **Operational wastes** means (amongst other things) all solid wastes (including slurries)… cleaning agent and additives contained in cargo hold and external wash water… does not include bilge water.
- **Cargo residues** means the remnants of any cargo which is not covered by other annexes to the present Convention and which remain on the deck or in the holds following loading or unloading, including loading and unloading excess or spillage, whether in wet or dry condition or entrained in wash water, but does not include cargo dust remaining on the deck after sweeping or dust on the external surfaces of the ship.

Chemical products are used routinely on board ship, variously as barrier coatings before loading and for cleaning purposes after discharge. The manufacturers of such products provide information about their products, either on the label attached to the container or as a separate Material Safety Data Sheet. That information should include a declaration as to whether or not the product is harmful to the marine environment. Alternatively, the manufacturer may provide a separate declaration in this regard. The products of most manufacturers are declared to be not harmful to the marine environment, although good practice requires that a check is made on each occasion that a different product is brought into use.

During voyages with cargoes which are loaded wet and are free-draining, for example some grades of coal, iron ore and petcoke, water will drain out of the cargo onto the tank top plating and will be collected in the bilge wells. It will often be necessary for that water to be pumped overboard to prevent too large a build-up of the water on the tank top. For the purposes of MARPOL annex V, it is suggested that such bilge water should be assumed to be in a category with wash water on the basis it will contain some very small residues of the cargo. There are additional comments later in this section with regard to petcoke.

Under Regulation 4 of MARPOL annex V, which deals with the discharge of garbage outside special areas, cargo residues (including wash water and water pumped from hold bilges) may be discharged while the ship is en route and as far as practicable from the nearest land but not less than 12 miles from the nearest land. However, if the cargo residues contain any substances classed as harmful to the marine environment (these substances being either within the cargo itself or from any cleaning or other chemicals used in the holds), under MARPOL annex V, these residues must not be pumped overboard.

Under Regulation 6 of MARPOL annex V, which deals with the discharge of garbage within special areas, cargo residues (including wash water and water pumped from hold bilges) may be discharged into the sea within special areas, when the ship is en route but only when all of the following conditions are satisfied.

MARPOL conditions for discharge of cargo residues

.1 cargo residues, cleaning agent or additives, contained in hold washing water do not include any substances classified as harmful to the marine environment, taking into account guidelines developed by the Organization;
.2 both the port of departure and the next port of destination are within the special area and the ship will not transit outside the special area between those ports;
.3 no adequate reception facilities are available at those ports taking into account guidelines developed by the Organization; and
.4 where the conditions of subparagraphs 2.1, 2.2 and 2.3 of this paragraph have been fulfilled, discharge of cargo hold washing water containing residues shall be made as far as practicable from the nearest land or the nearest ice-shelf and not less than 12 nautical miles from the nearest land or the nearest ice-shelf.

Under Regulation 10 of MARPOL annex V every ship of 400 GT and above shall have a garbage record book of the form specified in the appendix to annex V. In the garbage record book details are to be kept of each discharge into the sea, or to a reception facility, of any category of garbage; cargo residues are category G and operational wastes are category F. MARPOL annex I gives regulations for the prevention of pollution by oil under regulation 1.

MARPOL annex I definitions of oil and oily mixture

Definitions
For the purposes of this annex:
1 *Oil* means petroleum in any form including crude oil, fuel oil, sludge, oil refuse and refined products (other than those petrochemicals which are subject to the provisions of Annex II of the present Convention) and, without limiting the generality of the foregoing, includes the substances listed in appendix I to this Annex.
3 *Oily mixture* means a mixture with any oil content.

Regulation 15 of annex 1 deals with the control of operational discharge of oil from machinery spaces of all ships. These requirements can be used as guidance in this guide. Amongst other things, it is stated that the discharge of oil or oily mixture is prohibited, except when the ship is en route and the oily mixture is passed through an oil filtering equipment such that the oil content of the undiluted effluent does not exceed 15 ppm. The oil filtering equipment shall comply with Regulation 14. When visible traces of oil (that is in the form of a sheen) are observed on or below the surface of the water, an investigation must be carried out by the appropriate authority. Oily residues which cannot be discharged in compliance with the regulation shall be retained on board for subsequent discharge to reception facilities. Any discharge or disposal must be recorded in the oil record book part 1.

Practical implications

There are a large number of regulations concerning water and cargo residues on board. The best advice is to follow strictly the safety management system procedures, the ballast water management plan and any guidance given in the garbage record book, and to record all operations in the appropriate books. There are also a few additional advisory notes which can be given.

Ballast water

When ballast water is exchanged while the ship is at sea, the method and sequence set out in the ballast water management plan should be followed because various calculations and assessments will have been completed to draw up the plan. That is, it has been ensured that the stability of the ship will not be adversely affected and the shear forces and bending moments will not be excessive during each stage of the operation. Bearing this in mind, if there is likely to be a departure from the plan during a ballast exchange operation for any reason, calculations should be carried out without delay to determine the stability characteristics of the ship and the shear forces and bending moments caused by the operation. If an adverse, unwanted stress or characteristic has been produced, the operation should be stopped and/or action should be taken to rectify the situation without delay. Records of all operations should be kept.

When the ship is operating in very cold conditions there is always the possibility of ballast water freezing in the tanks and/or in pipework and vents. Before the ship enters an area where the ambient temperature is sub-zero there are a few precautionary measures which should be completed to minimise the possibility of ballast water freezing, as follows.

Measures to prevent ballast water freezing

- All ballast water on board should be sea water, any fresh or brackish water having been exchanged.
- All pipelines on deck should be drained.
- All air pipes and sounding pipes should be empty above deck level; this can be achieved and ensured by pumping a few tonnes of water out of each full ballast tank (the free surface effect of the slightly slack tanks should have no significant adverse effect upon the ship's stability but this should be checked and the operation monitored carefully).
- All valves in the ballast systems should be tested to ensure their satisfactory, free operation. If any maintenance is found to be necessary, it should, if possible, be completed.

When preparing the loading plan the de-ballasting sequence should be such that the top-side tanks, or upper side tanks, and the peak tanks (those above water level) are pumped out first, before lower hopper and double-bottom tanks. Consideration should be given to completely de-ballasting top-side tanks, or upper side tanks, before arrival at the loading berth. Other considerations will be the ship's stability condition, weather and sea conditions before arrival, air draught requirements and other requirements of the loading port. During de-ballasting operations each tank should be pumped out completely and then stripped in one continuous procedure to avoid the situation of there being a small amount of water in the tank for an extended period.

Wash water and cargo residues

During the final stages of unloading it should be ensured that the stevedores put ashore all accessible cargo, leaving only the absolute minimum of cargo residues in the holds. If the cargo remaining is at the minimum, the hold cleaning and the disposal of these cargo residues and the wash water will be made relatively easy.

The main problem is that either or both the cargo and the chemicals used for a barrier coat or for cleaning might be HME which, under the full requirements of MARPOL annex V, may not be discharged overboard anywhere and it will be necessary to land the residues and water to a reception facility. Bearing this in mind, the master should be guided as follows.

Wash water and cargo residue - HME or not?

- The cargo declaration must include a statement as to whether or not the cargo is HME.
- If the cargo is declared to be HME, liaise with the receiver, charterer and/or terminal representative and agent at the unloading port with regard to reception facilities for cargo residues and wash water after unloading, and confirm where water and residues are to be landed. If no information is forthcoming, request guidance from the ship operator's office.
- If the cargo is declared not to be HME, there are only limited restrictions on the disposal of cargo residues.
- Any chemicals for barrier coats and cleaning operations should be declared not to be HME on material safety data sheets or other declarations, and the status of the chemicals should be established before they are taken into use. Non-HME chemicals pose no problems with regard to disposal of wash water.
- If the chemicals used are declared to be HME, the provisions of annex V must be strictly followed.

The general rules for the disposal of wash water and cargo residues are as follows.

General rules for disposal of wash water and cargo residues

- The wash water (assuming no HME chemicals are involved) and cargo residues (assuming not to be HME) may be discharged overboard when the ship is more than 12 nautical miles from the nearest land outside special areas.
- The wash water (assuming no HME chemicals are involved) and cargo residues (assuming not to be HME) may be discharged overboard when the ship is more than 12 nautical miles from the nearest land when within a special area if the ship is en route between ports within the special area and there are no adequate reception facilities at these ports. If there is an available reception facility, the wash water and cargo residues must be discharged to that facility.
- If the cargo is stated to be HME on the cargo declaration and/or if any chemicals used are classified as HME, discharge of cargo residues and wash water overboard is prohibited, under the full requirements of MARPOL annex V, and wash water and cargo residues should be put ashore to a reception facility.

Bilge water

Some types of cargo are loaded wet and are free-draining, for example some grades of coal, iron ore and petcoke (petcoke is dealt with in the following sub-section), and water in the cargo will drain down onto the tank top plating and will collect in the hold bilge wells. During a voyage when the ship is carrying such a cargo, the amount of water in the hold bilges should be monitored and any significant amounts should be pumped out, as necessary.

The hold bilges should be sounded at least once during each day, more frequently if appropriate, throughout the voyage, and these soundings should be recorded in a soundings record book. If water in the bilges is pumped out, records of the pumping operations should be kept. If a significant amount of water is found to be draining out of the cargo and is filling the bilges so that frequent pumping-out of the hold bilges is required, additional records need to be kept.

Soundings should be taken and recorded before and after each pumping operation and the volume of water removed from each bilge should be calculated and also recorded. A table should then be produced giving the soundings, or the difference in soundings, and the amount of water pumped out of each bilge on each occasion, together

with a running total of the volume of water involved. Also, records should be kept in the garbage record book. The final total volume should be made available at the unloading port for use in draught surveys or other out-turn cargo weight measurement operations to avoid any claims for short delivery of cargo.

Petcoke

Petroleum coke (petcoke) is shipped in the form of black powder and small pieces, and is a residue of the petroleum refining industry. It is either calcined or uncalcined. Calcined petcoke has been heated to a very high temperature to remove volatile matter and moisture, whereas uncalcined petcoke (for example green delayed petcoke) is not heated and will retain an amount of hydrocarbon substances, or oil, possibly up to 15% (see also Chapter 7). Petcoke is a product derived from petroleum and therefore disposal of any cargo residues must be carried out in accordance with the requirements of MARPOL annex I, parts of which are as follows.

MARPOL annex I definitions of oil and oily mixture

Definitions
For the purposes of this annex:
1 *Oil* means petroleum in any form including crude oil, fuel oil, sludge, oil refuse and refined products (other than those petrochemicals which are subject to the provisions of Annex II of the present Convention) and, without limiting the generality of the foregoing, includes the substances listed in appendix I to this Annex.
2 *Oily mixture* means a mixture with any oil content.

As a consequence of the oil content the hold structures may become partly coated in oil during the voyage and the hold cleaning operation after offloading is sometimes difficult with the need for chemical cleaning products. During the hold cleaning operation the wash water is likely to contain oil residues, and also some petcoke solids, which, if discharged overboard, could produce a visible trace of oil, or a sheen, on the sea surface. Such a discharge of water could constitute a violation of MARPOL annex I, regulation 15. As the wash water cannot be passed directly through an oily water separator on board ships that carry dry bulk cargoes, any oily wash water should be discharged to an on-shore reception facility. The hold steel surfaces may have been sealed with a chemical barrier coating before loading and cleaning products may be used to remove any staining and residues after discharge, but the wash water will still comprise an oily mixture and therefore should be discharged to an on-shore reception facility.

It might be the case that the petcoke cargo is offloaded at a port where there are a no on-shore reception facilities and the ship must proceed to a nearby port for loading. It will then be necessary to remove the wash water to a holding tank for the loading of cargo and the discharge of the wash water at a later time. To avoid contamination of bilge lines, the wash water can be transferred by means of a portable pump, and suitable hoses, to one or more top-side tanks. The wash water can later be transferred to a suitable reception facility. Guidance to be borne in mind is as follows.

Guidance for transfer of petcoke wash water

- Transfer to the top-side tank(s) from the hold bilges and later from the top-side tank(s) to the shore facility should be by portable pump and suitable hoses which can be cleaned after use, or retained for that purpose.
- The top-side tanks used for holding the oily wash water will require cleaning to remove any oily residues after use.
- The wash water in the top-side tank(s) will produce a free-surface effect which will reduce the ship's stability.
- The weight of the wash water in the tank(s) will have the effect of reducing the ship's cargo carrying capacity, which might result in the ship's inability to uplift the total weight of the next intended cargo. This is dead-freight situation.
- The appropriate personnel in the ship operator's office and in the offices of charterer should be notified of all operations and their further guidance obtained and followed.
- The ship's classification society should be notified of all operations and their guidance obtained and followed.
- Details of all operations should be recorded in the garbage record book and in the oil record book, part 1, under code I.

Petcoke is sometimes wet when loaded as a result of spraying to reduce dust and for cooling purposes. During the voyage that water will drain to the hold bilges and it might become necessary to pump the bilge water out. The water which drains to the bilges is likely to contain oily residues, and uncontrolled discharge overboard of such oily residues is restricted under MARPOL annex 1. Guidance to be borne in mind is as follows.

Guidance for dealing with petcoke bilge water

- If the volume of water which is draining to the hold bilges is fairly small, it might be appropriate and acceptable to pump some of that water overboard. The oily residue will float on the surface of the water and it is normal practice to allow bilges to fill to near capacity before they are pumped out. If, when any of the bilges were nearly full, a maximum of half of the water was drawn out of the bilge well and pumped overboard, all of the oily residue would remain in the bilge well, on the surface of the remaining water. Such an operation should be closely monitored and might be appropriate if the water drainage is relatively small.
- If the volume of water drainage is large, the amount of oil residue might similarly be large, such that pumping overboard would produce a sheen on the sea surface. In such a situation, it might be appropriate and possible by means of pipework in the engine room to transfer the bilge water to the oily bilge water holding tank. There might then be a number of possibilities.
  - If the volume of water is not too large it might be appropriate and permissible to pump the water overboard via the oily water separator.
  - If the volume of water is not too large, it might, alternatively, be appropriate to retain, and slowly add to, the volume of water in the tank in the engine room and later discharge that water ashore to a reception facility, together with engine room bilge water, via the ship–shore discharge pipe.
  - If the hold bilge water is to be retained on board and if the volume is too great for the oily bilge water holding tank, it will be necessary to transfer water to another tank, preferably a top-side or upper wing tank, for storage. This operation will require, if it is possible, the pumping of the water via the ship–shore discharge line to the weather-deck and from there via suitable hoses to the tank via an air pipe or manhole. The oily water could later be pumped ashore to an appropriate reception facility by means of a portable pump placed in the ballast tank and suitable hoses.

- When oily bilge water is pumped through pipelines and is stored in ballast tanks, contamination by oil will occur and subsequent cleaning will be necessary. Therefore if any of the foregoing operations are carried out cleaning of bilge lines, engine room pumps, portable pumps and their hoses and ballast tanks will be required before use for any other purpose.
- The appropriate personnel in the ship operator's office and in the offices of charterer should be notified of all operations and their further guidance obtained and followed.
- The ship's classification society should be notified of all operations and their guidance obtained and followed.
- Details of all operations should be recorded in the garbage record book and in the oil record book, part 1, as appropriate.

If there are any doubts or concerns with regard to the disposal of bilge water or hold wash water, during or after the carriage of a petcoke, cargo the advice of an expert should be obtained.

General comments

To ensure all pumping operations progress as planned, be it pumping of ballast water, bilge water or wash water, the pipework system, the pumps and the various valves should be in satisfactory working order. Routine maintenance of all parts of the systems should be carried out as set out in the planned maintenance schedule and any additional work which is found to be necessary should be completed without delay. Appropriate records of all work done and of testing of the systems should be kept.

When ballast water, bilge water, wash water and cargo residues are handled on board all appropriate records should be kept.

In addition to the international regulations and requirements many coastal states have issued their own requirements. Wherever the ship is in the world, the master must be familiar with the international regulations and all local requirements, and must be guided accordingly. When assistance is required, the ship operator should be contacted for guidance.

Chapter 5

IDENTIFICATION, CARE AND CARRIAGE

IDENTIFICATION, CARE, APPARENT CONDITION AND TRIMMING OF CARGO

On every bill of lading issued in respect of cargo shipped there is a description of the cargo. The description should be correctly stated so that the cargo can be properly cared for during the voyage and then delivered to the consignee in the same good order and condition as it was at the time of loading. Furthermore, the master should establish the apparent condition of the cargo at the time of loading and whether or not any damages or defects are apparent so that, if necessary, the bill of lading can be clausedwith a description of any apparent defects or discrepancies found or the cargo can be rejected for shipment and not loaded. If the cargo is not in the same condition as given in the description on the bill of lading, and in any additional clauses, at the time of discharge, it is likely that the consignee will lodge a claim in respect of any alleged damage or discrepancies.

Before and at the time of loading the master, with the assistance of the ship's deck officers and others as appropriate, should follow a sequential process to ensure the master knows what cargo is to be loaded, that the ship is capable of carrying the cargo from both a design and a strength point of view, how the cargo can be cared for during the voyage, and the apparent condition of the cargo to be loaded. The process is as follows.

Loading procedure checklist

- The identity of the cargo should be established at an early stage so that further processes can be completed.
- Principally from the Document of Compliance for ships carrying dangerous goods, the certificate of compliance with the IMSBC Code (if on board) or the Grain Loading Manual, as appropriate, it should be ensured that the cargo being put forward for carriage is a cargo which can be safely carried on board.
- For cargoes other than grain, the shipper shall provide the bulk cargo shipping name (BCSN) in precisely the form given in the IMSBC Code.
- Carriage requirements should be established from the IMSBC Code, and from the shipper, or from other interested parties, so that the master can confirm that the ship can safely carry the cargo to destination in accordance with these instructions.
- Any hold cleanliness requirements should be established at an early stage so that cleaning of the cargo compartments can be carried out to the required standard for the particular cargo to be loaded.
- Hold preparation requirements, if any, should be established so that any re-painting or steelwork coating can be carried out.
- The apparent condition of the cargo should be established before and during loading and it should be ensured that the right cargo, as declared, is being loaded. With that knowledge it can be established whether or not the description on the bill of lading is accurate, if documents provided reflect the condition of the cargo, and whether or not the cargo appears to be damaged or defective such that clausing of the bill of lading is necessary or if rejection of the cargo is appropriate.

Some points to remember

The following table gives some basic points which should be remembered during the identification of a bulk cargo to be loaded and during inspections of that cargo before and during the loading operation.

Bulk cargo identification checklist

- From the IMSBC Code, solid bulk cargo means any cargo – other than liquid or gas – consisting of a combination of particles, granules or any large pieces of material generally uniform in composition which is loaded directly into the cargo space of a ship without any intermediate form of containment. Solid bulk cargoes include all cargoes listed in the IMSBC Code and all grain cargoes.
- Solid bulk cargoes are generally homogeneous in nature, that is, they are made up of granules, particles or larger pieces of material of a single size or within a relatively small range of sizes.
- Generally, solid bulk cargoes will flow and have a consistency such that they can be transported by conveyor and poured by means of a spout, or can be loaded by grab into a ship's holds. Some are free-flowing as grain is and are referred to as being non-cohesive, while others are cohesive, which means the particles or granules may stick together to some extent.
- Generally, solid bulk cargoes should not contain significant amounts of: foreign matter or foreign material, wet cargo, material of different colours, or material of different sizes. Also, solid bulk cargoes should not contain lumps of material or caked material. There are exceptions to the rule because coal and sulphur are sometimes loaded wet and grain cargoes are most likely to contain pieces of foreign matter such as pieces of stalk and other grains.
- Some cargoes may take oxygen from the atmosphere in the cargo compartments and adjacent spaces causing oxygen depletion.
- The master is not, and should not be expected to be, an expert with respect to the quality of a cargo being carried. The master can only examine the cargo as a prudent, reasonably experienced and reasonably competent master, and give judgement as to the apparent condition of the cargo as found.
- The full specification for a cargo to be loaded is very rarely available to the master and therefore the details of the composition of the cargo are not available to the master.
- Records should be kept and copies of all communications should be retained. Throughout the pre-loading preparations, records should be kept in the deck log book, port log book or a work book with regard to the various operations undertaken. Additionally, records should be kept of all discussions and instructions passed orally. Copies of all communications should be kept in a file. These records might be required following the offloading of cargo if a dispute arises.
- If the master has any doubts about any aspect of the loading or carriage of the cargo, the master should contact either the charterer or the ship operator, as appropriate, for clarification and any further advice. If appropriate, an independent marine consultant might be contacted to obtain further advice and recommendations.

Identification of cargo

All solid bulk cargoes are either grain, under the definition given in the International Grain Code which also gives details of how the grain should be carried, or are cargoes which are described in the IMSBC Code and should be carried in accordance with the

requirements set out in the IMSBC Code. Additionally, there are some cargoes included in the IMSBC Code which are non-cohesive cargoes and, in accordance with section 5 of the IMSBC Code, must be treated as if they are grain if their angle of repose is less than 30° and shall be stowed and carried in accordance with the provisions of the International Grain Code, as well as in accordance with the provisions of the IMSBC Code.

When cargo is declared to be a grain cargo, the provisions of the IMSBC Code do not apply as there is no entry for grain. The provisions of the International Grain Code shall be followed, as described in Chapter 3.

If the cargo is not a grain, the provisions of the IMSBC Code apply and the procedure should be as follows.

Non-grain cargo checklist

- A cargo declaration must be provided by the shipper and description must include the BCSN. This must be one of the names listed in all capitals in the index (appendix 1) of the IMSBC Code.
- The cargo description must include the group status of the cargo and must have a declaration as to whether or not the cargo is harmful to the marine environment (HME).
- If the cargo is declared to be a Group A cargo, the cargo documents must include certificates of TML and moisture content and these certificates must show that the moisture content is below the TML. Testing for TML must be not more than 6 months before loading and for moisture not more than 7 days before loading with additional testing after significant rainfall.
- If the cargo is declared to be a Group B cargo, the relevant properties or characteristics of the material should be declared and any appropriate certificates should be provided by the shipper.
- If the material is declared to be a Group C cargo, the shipper is not usually required to provide any additional certificates.
- The details given on the cargo declaration must match the information given in the IMSBC Code for the particular cargo type.

If the master is in any doubt about the identity of the cargo being put forward for shipment, or the validity or reliability of the certificates which accompany the cargo declaration, the master should contact the charterer and/or the ship operator to obtain clarification and further information with regard to the intended cargo. Before loading is allowed to begin the master should be satisfied that the cargo is properly identified and all the required certificates and information have been reliably provided. The IMSBC Code is discussed in Chapter 3.

Carriage requirements

A solid bulk cargo must be carried either in accordance with the IMSBC Code if it is not grain, or in accordance with the International Grain Code if it is grain or a non-cohesive bulk commodity with an angle of repose less than 30°. Non-cohesive cargoes are listed in appendix 3 of the IMSBC Code.

The International Grain Code sets out various requirements for the carriage of grain with respect to stability requirements and the stowage of the grain, with other parts dealing with methods and procedures which might be required for the safe carriage of the grain. If the ship is not provided with a Document of Authorisation to carry grain

and a Grain Loading Manual it cannot carry grain in accordance with the International Grain Code without extensive work to demonstrate compliance. During the planning of a voyage when a grain cargo is to be carried, the master should ensure all parts of the International Grain Code can be complied with. If they cannot, the master should advise the appropriate person in the ship operator's office and appropriate action should be taken to rectify the situation or the grain cargo as put forward for carriage should not be loaded.

If the cargo has an entry in the IMSBC Code under its BCSN, the requirements set out in the particular schedule should be noted and arrangements should be made for all the requirements to be followed. The ship's certificate of compliance with the IMSBC Code will show which cargo types can and which cargo types cannot be carried by the ship. If special precautions are necessary, arrangements for these precautions to be followed should be put in hand and if any special equipment is required for the monitoring of the cargo during the voyage it should be ensured that the required equipment is on board before loading is started. Requirements with regard to ventilation of the cargo should be noted and ventilation records should be made ready so ventilation of cargo compartments or the non-ventilation of cargo compartments can be recorded during the voyage, as appropriate.

Procedures in the safety management system manual might have details of carriage requirements for certain cargoes. Such requirements should not contradict others set out in the IMSBC Code or elsewhere they should be followed. Additionally, the charterparty might set out requirements for the carriage of particular cargoes or the charterer might provide the master with requirements for the carriage of a particular cargo. The master should consider all the information at hand and bear in mind that the requirements of the IMSBC Code are mandatory and shall take precedence over other instructions provided. If the master has any doubts about which particular carriage requirements should be followed, the master should contact the appropriate person in the ship operator's office, advise them of the situation and request clarification.

Many grain and seed cake cargoes require fumigation, sometimes at the loading port, more frequently during the voyage and occasionally at the offloading port before discharge. Instructions in this regard will be provided by the charterer, the shipper or the receiver of the cargo. This is a specialist operation that should be conducted by a recognised fumigation company and not the crew. When the master receives notification that the cargo is to be fumigated, the master should first ensure it is safe for the fumigation to be carried out as intended and the necessary equipment is on board. Then, if satisfied that the operation can be completed safely, the master should notify all parties concerned that the fumigation can go ahead. Fumigation of cargo is dealt with later in this Chapter.

Hold cleanliness requirements

Different types of cargo require a different level of cleanliness in the cargo compartments. It is important that the master establishes what level of cleanliness is required for the next cargo to be loaded because if not there may be delays and additional costs as a result. For example, if it is required that the holds should be cleaned to a standard above grain clean and they are below that standard, either there will be delays at the loading port while further cleaning is carried out, or the cargo carried might

be contaminated by residues remaining in the hold. Alternatively, if the cargo to be loaded is a dirty cargo and a high standard of cleanliness is not required, extra cleaning work in the preparation of the holds will have been done needlessly.

The standard of cleanliness for the cargo compartments before loading might be stated in the charterparty. Otherwise, the charterer and/or the shipper of the cargo may provide instructions before the loading of a particular cargo.

Before the loading of some commodities, for example grain cargoes loaded at many ports around the world and cargoes loaded for discharge at Australian ports, it is required by the authority of the loading port or of the offloading port that the cargo compartments are inspected to confirm that they have been cleaned to the required standard. The master should establish whether or not such inspections are required and should establish the standard to which the holds are to be cleaned so the holds will be passed fit for loading during the required inspections.

When the master has established what level of cleanliness is required, the master should ensure the cargo compartments are cleaned and prepared to that standard. If no precise instructions are provided, the master should make arrangements for cargo compartments to be prepared to the grain clean standard and should advise all appropriate parties of this intention. Hold cleanliness is dealt with in Chapter 4.

Hold preparation requirements

In addition to the cleaning of the cargo compartments to a required standard, it is sometimes required, because of the nature of the cargo to be loaded, for the steelwork in the cargo compartments to be provided with a chemical barrier coat or lime wash. These coatings are applied, dependent upon the cargo to be loaded, variously to protect the steelwork of the holds against corrosion, to protect the cargo against discoloration, or to assist with the cleaning of the cargo compartment after the offloading of the cargo.

After the master has established the identity of the cargo to be loaded, the master should establish whether or not any such protective coating is required before loading. The charterer and/or the shipper may give instructions for a coating to be applied, or will confirm that no coating is required. If, from experience, the master believes it is a normal procedure for a coating to be applied but no instructions have been received (for example for the loading of salt when, under the requirements of the IMSBC Code, the parts of the cargo space in contact with the cargo such as tank tops, hoppers, side plating and bulkheads should be lime washed or coated with paint to prevent corrosion), the master should seek further advice and follow any requirements set out in the IMSBC Code. Protective coatings are mandatory under the IMSBC Code for the carriage of sulphur and salt.

Condition of cargo

During the loading of a bulk cargo and, if possible, before loading is carried out, it is essential that the master, with the assistance of the ship's deck officers, establishes, first, that the cargo to be loaded is the cargo to be carried and, second, the apparent condition of the cargo.

If during inspections at any stage of the loading it is discovered that a different type of cargo is being loaded, the operation should immediately be stopped and an investigation should be carried out to discover why the incorrect cargo is being loaded.

The cargo which has been loaded incorrectly should then be discharged without delay and the correct cargo should be loaded, as intended.

What must be established by the master at the earliest possible opportunity and throughout loading is the apparent condition of the cargo. That is, what can be seen by the master when looking at the cargo being loaded into the cargo compartments of the ship and the characteristics which can be seen, if any, are not usual or are not expected. There are two reasons why the condition of the cargo being loaded must be determined. Firstly, the condition may warrant clausing of the bills of lading or rejection of the cargo to avoid the possibility of claims after the discharge of the cargo. Secondly, the condition may render the cargo not suitable or safe for carriage. In this case, the cargo must be rejected – clausing of bills of lading is not appropriate for unsafe cargoes.

Bulk commodities are generally homogeneous in nature and free-flowing, some are cohesive and some are non-cohesive, and they generally do not contain any significant amounts of foreign matter or foreign material, any wet cargo mixed in with dry material or any lumps or caked material. In addition, its temperature should be at an appropriate level at or a little above ambient temperature for grain and at or below any maximum temperature specified for cargoes with entries in the IMSBC Code. Finally, the cargo should not display characteristics which would suggest that some sort of reaction is taking place within the bulk of the cargo.

The visible characteristics should not be confused with the quality of the cargo, which is a matter for the shipper and the receiver of the cargo and which is given in cargo documents such as the specification, or load-port quality certificate. The quality of the cargo may be defined, for example by its chemical make-up if it is a mineral type cargo, or its protein content or oil content and so on if it is a grain or seed cake type cargo, and is typically determined by representative sampling carried out under the terms of the sales contract agreed between the buyer and seller of the cargo. The owner is not a party to that transaction and the master is usually unaware of the contractual arrangements for sampling.

Inclusion of foreign matter

The cargo should be inspected to determine whether or not any of the following are present within the bulk of the cargo: foreign matter or foreign material; lumps of material or caked material; material of a wide range of different sizes; and material of a wide range of different colours.

The inclusion of any of these may have no effect on the cargo itself and may not cause the cargo to deteriorate in any way during the voyage. However, amounts of any of these may lead to claims being brought by the consignee following discharge. Bearing this in mind, inspections of the cargo should be carried out while loading is underway to establish what level of any inclusions is present in the cargo. If possible, inspections of cargo should take place before it is loaded, in barges alongside or stockpiles on shore, or as it is brought to the quay in rail wagons or road vehicles.

If excessive amounts of foreign matter or other inclusions are present, the affected cargo should not be loaded or loading should be immediately stopped so discussions can be held with the shipper's representatives. It is not possible to give a definition of 'excessive' because different cargoes have different characteristics. The master should use experience and judgement and if in doubt should ask for expert assistance.

If clausing of the bills of lading is allowed, appropriate clauses should be prepared and agreement should be reached that these clauses can be inserted on the bill of lading. If clean bills of lading are required, or if agreement cannot be reached with regard to the wording of clauses, the master should refuse to allow loading of the affected material.

Wet cargo

Some commodities are loaded in a wet condition, and some of the water in the cargo may drain to the hold bilges during the voyage, such that pumping-out of the bilges will be required. In these circumstances, the weight of cargo landed at the discharge port will be slightly less than the loaded weight, as given on the bill of lading. This reduction in cargo weight may result in shortage allegations and possibly a claim. Throughout the voyage detailed records of hold bilge pumping operations should be kept; daily records of pumping operations and of holds involved should be kept together with bilge soundings, and a running total of the weight of water pumped out of each hold.

Group A cargoes have an inherent moisture content which must be below the TML before loading, and these commodities are dealt with in a following sub-section. Other commodities are carried in a dry condition, for example mineral sand and alumina, and any wetting will be considered to be damage by consignees. Grain cargoes have a particular inherent moisture content but they should not be visibly wetted because, if they are, deterioration of the grain will result.

The master should be aware of the dry or the wet nature of the cargo and inspections should be carried out before and during loading to establish that the material is dry as expected or that the amount of apparent moisture is not excessive. If wet material is presented for shipment when the cargo should be dry, that material should be refused for loading pending discussions with the shipper's representative with regard to clausing of bills of lading. As with the inclusion of foreign material and so on, if it is agreed that the bill of lading can be claused with regard to the inclusion of a proportion of wet material, a suitable remark should be made on the bill of lading. If the bill of lading is to be issued clean, no wet material should be loaded.

Wetting of cargo might occur because of precipitation during the loading operation, either ashore or on board. If wetting of cargo occurs before it is loaded, the procedure as described in the previous paragraph should take place. If cargo which has already been loaded is wetted by precipitation, that wetting has occurred while the cargo is in the care of the carrier and therefore the bill of lading cannot be claused. If possible, the wet cargo should be removed from the affected holds and replacement cargo should be loaded. With regard to the wet cargo itself, discussions should be held with the shipper of the cargo to resolve the situation as best possible.

High temperature

Some cargoes are produced at high temperature and are loaded while still hot, petcoke and cement being two examples. Although these materials are hot when loaded and will retain heat during the voyage, they are unlikely to heat up during the voyage to a higher temperature. Other commodities, such as some types of coal and swarf, are liable to spontaneously heat as a result of oxidation and this might occur, under certain circumstances, during the voyage. The entries for cargoes in the IMSBC Code give details, where applicable, of the likely temperature at time of loading if that temperature

is likely to be above ambient temperature and details of the likelihood of the commodity to heat spontaneously. When the identity of the cargo is known, these details in the IMSBC Code should be studied.

Grain and seed cake cargoes which are loaded with a high moisture content are likely to spontaneously heat during the voyage as a result of microbiological activity, which will be more extensive if the cargo is loaded at a high temperature. A record of the cargo temperature at the time of loading should be made for all cargoes of grain or seed cake.

During inspections of the cargo, both ashore or in barges alongside, if possible, before loading and during the loading operation when access to the cargo compartments is possible and safe for ship's staff, the temperature of the cargo should be obtained and monitored throughout the loading operation. If the temperature of the cargo is higher than expected, an investigation should be carried out to establish why the cargo is being loaded at such a temperature. There might be acceptable reasons, whereas it might be the case that the cargo is wet or that the manufacturing process was defective. If there appears to be a problem, loading should be stopped and advice should be obtained with regard to how to proceed.

Group A cargoes

Group A cargoes are those which are liable to liquefy if shipped with a moisture content in excess of their TML. When a Group A cargo, or any other damp or wet mineral type cargo which is seen to contain a proportion of small particles (even if listed as Group C in the IMSBC Code or declared as such by the shipper), is being loaded the material should be examined for its condition in terms of its consistency. If the material looks 'muddy' or 'clay-like' it might be that the amount of moisture in the cargo will render it liable to liquefy during the voyage.

If there is any doubt with regard to the liquefiable nature of the cargo, a 'can test' should be carried out as described in section 8 of the IMSBC Code. Samples should be drawn of the suspect material and the required amount of material should be placed into a can and the test carried out. If free moisture or a fluid (mud-like) condition appears on the surface of the tested sample, the cargo from which the sample was drawn should not be loaded.

Advice should be obtained with regard to the results of the can test and the condition of the cargo, and loading should proceed only in accordance with that advice. It must be remembered that a can test is not conclusive and while a failed can test shows that the portion of cargo from which the sample was drawn is not safe to carry, a can test which is not a fail does not show that the portion of cargo is in a condition safe to carry. See also Chapter 6.

If loading is underway and the material being loaded is in a 'muddy' or a 'clay-like' condition, or if splattering of the cargo occurs when it is dropped into the hold from the grab, loading should be stopped pending an investigation with regard to the condition of the cargo.

There are three methods for testing Group A cargoes for the determination of TML; the flow table test procedure, the penetration test procedure and the Proctor/Fagerberg test procedure. Additionally, for cargoes of iron ore fines only, there is a new test known as the Modified Proctor/Fagerberg test, which may also be referred to as the Proctor/Fagerberg test type D. The shipper's declaration should give details of which method was used.

To alter the characteristics of a Group A cargo, the shipper might mix in with the cargo a small proportion of polymer granules which absorb moisture and alter the TML of the cargo being loaded. The use of polymer granules is being introduced in shipments of iron ore fines and may become common with shipments of other Group A materials in the future.

More detailed guidance on testing procedures and the use of polymers can be found in Chapter 6.

Group B Cargoes

Group B cargoes are those which possess chemical hazards which could give rise to a dangerous situation on board ship. These materials include flammable solids, substances which are liable to spontaneous combustion, substances which emit flammable or toxic gases, and oxidizing, toxic, corrosive or radioactive substances. That is, they possess chemical hazards which might endanger the ship or its structures directly, or may endanger the crew if they come into contact with the materials themselves or gases emitted by the materials.

During inspections of the cargo before loading and while loading is underway, it should be established whether or not any reactions are going on within the cargo. That is, if possible, cargo should be inspected in stockpiles ashore, on the quay or in barges alongside before it is loaded on board and after the cargo has been stowed in the ship's holds. The master and the ship's deck officers should look for any unusual or unexpected conditions of the cargo such as steam or smoke rising from the cargo or any unexpected odours being given off by the material.

If the condition is observed before cargo is loaded, the affected cargo should not be loaded, whereas if cargo already on board displays an unexpected condition loading should be stopped and an investigation into the cause of the problem should be carried out without delay. Additionally, advice should be obtained with regard to the condition of the cargo and loading should only be carried out in accordance with the advice given.

Oxygen depletion

Many commodities will, as a natural process, draw oxygen from the atmosphere in the cargo compartments and in adjacent spaces to an extent that it would be dangerous for ship's staff and other personnel to enter these compartments without there having been adequate ventilation of the compartments. The oxidation process which takes the oxygen will be a chemical process and/or a microbiological process.

Mineral type commodities and metals in many forms are liable to oxidise by taking oxygen and combining with it to form an oxide. The process may accelerate if the mineral or metal is wet and warm.

Within organic commodities such as grain, seed cake and woodchips, and in any forest product, microbiological growth will occur naturally when there is sufficient moisture and warmth. The growth of fungi, bacteria and possibly other microscopic organisms, takes place in organic materials in warm and moist conditions and oxygen is drawn from the atmosphere during the proliferation of the micro-organisms. During these processes heat is also produced.

During the routine inspections of the cargo, and from any certificates and other documents produced, the master should establish the nature of the cargo in terms of its moisture content or the amount of water and other fluids which are entrapped within

the cargo when it is loaded. If the cargo is a mineral type commodity, metallic or organic, and if it has a significant moisture content, the master should bear in mind that there will be a high risk of oxygen depletion within the holds and adjacent spaces during the voyage. The master should set up a prohibition of entry into the holds and adjacent spaces without appropriate authority. Entry into the compartments should only be allowed after all 'entry into enclosed spaces' procedures have been followed.

Although certain cargo types are particularly likely to cause oxygen depletion, the master should always remember any compartment which has been closed and not fully ventilated should be considered to be a hazard for entry. Appropriate risk assessments, safety procedures, ventilation and atmosphere testing procedures should be completed before any personnel are allowed to enter the compartment at any time and for any reason.

Trimming

As a general rule, stowages should be trimmed reasonably level in a cargo compartment. The cargo should be spread as widely as practically possible to the sides of the ship, to port and to starboard, and to the end bulkheads, forward and aft. When cargo is trimmed reasonably level, there is less likelihood of a shift of cargo occurring during the voyage, and less air can enter the stowage, which could lead to spontaneous heating of cargo which is liable to self-heat.

For trimming purposes, solid bulk cargoes can be categorised as cohesive or non-cohesive. Appendix 3 of the IMSBC Code gives a list (although not exhaustive) of non-cohesive cargoes, and section 5 gives required trimming procedures. Additionally, there are supplementary requirements for particular solid bulk cargoes set out in the schedules of appendix 1. Grain is by nature non-cohesive and the International Grain Code sets out requirements for trimming and for dealing with the surface of the cargo in a slack hold.

Section 5 of the IMSBC Code states: 'The master has the right to require that the cargo be trimmed level, where there is any concern regarding stability based on the information available, taking into account the characteristics of the ship and the intended voyage.' Trimming requirements for non-cohesive solid bulk cargoes are based on their angle of repose. Prior to the completion of loading any non-cohesive cargo, the angle of repose of the material should be determined in accordance with one of the methods set out in section 6. When the angle of repose is established, the particular trimming requirements can be obtained from section 5. These requirements are under three headings.

General trimming requirements for non-cohesive bulk cargoes

- Angle of repose less than or equal to 30° – carriage and, therefore, trimming are to be in accordance with the International Grain Code.
- Angle of repose greater than 30° to 35° inclusive – the unevenness of the cargo surface measured as a vertical distance between the highest and the lowest levels of the cargo surface shall not exceed B/10, where B is the beam of the ship in metres, with a maximum allowable distance of 1.5 m. Alternatively, trimming must be by equipment approved by the competent authority.
- Angle of repose greater than 35° – the unevenness of the cargo surface measured as a vertical distance between the highest and the lowest levels of the cargo surface shall not exceed B/10, where B is the beam of the ship in metres, with a maximum allowable distance of 2.0 m. Alternatively, trimming must be by equipment approved by the competent authority.

For some IMSBC Code cargo types (an example group being MINERAL CONCENTRATES), there are additional specific requirements set out in the particular schedule. For MINERAL CONCENTRATES, trimming is to be done to ensure 'that the height difference between peaks and troughs does not exceed 5% of the ship's breadth and the cargo slopes uniformly from the hatch boundaries to the bulkheads and no shearing faces remain to collapse during the voyage.' This is understood to mean that:

- in way of the hatchway, the stowage is to be trimmed over the full breadth of the ship (from ship's side to port to ship's side to starboard) so that, on completion, the height difference between peak and trough is no more than 5% of the beam
- forward of the forward coaming and abaft the after coaming of the hatchway, the cargo surface must slope uniformly and with no shearing faces (with no steep slopes which might break away during the voyage) to the end bulkheads of the hold.

For grain cargoes, the International Grain Code requires (in section A 10) that free grain surfaces are trimmed level. There can be three situations in a cargo compartment, and these, and their trimming requirements, are as follows.

International Grain Code trimming requirements

- Filled compartments, trimmed – the grain should be trimmed level in the square of the hatchway, and in the under-deck spaces forward and aft, to fill these areas so far as possible.
- Filled compartments, untrimmed – the grain should be trimmed level in the square of the hatchway, but may be at the natural angle of repose forward of and abaft the hatchway.
- Partly filled compartments – the grain stowage should be trimmed level overall.

In Chapter 3, the various sections of the International Grain Code are discussed, with some guidance on good seamanship practice, and, in Chapter 7, some more practical guidance on the carriage of grain is given.

The primary concern when carrying grain is the possibility of a shift of cargo and the development of a large angle of list. To minimise the risk of a shift, the grain surfaces must be trimmed level. Also, so any list will be no more than 12º, the grain should be stowed so that the total grain heeling moment for the cargo is less than the maximum allowable grain heeling moment for the ship in the loaded condition. However, it is sometimes the case that there will be slack holds when all of the cargo is loaded, such that the total grain heeling moment is in excess of the maximum allowable. In this situation, trimming of the cargo surfaces is not sufficient and alternative arrangements are necessary.

To eliminate the grain heeling moment of one or more partly filled holds, to thereby reduce the total grain heeling moment to below the maximum allowable, the grain surfaces can be over-stowed, secured by strapping or lashing, or may be secured by wire mesh, as described in sections A 16, A 17 and A 18 of the code. The required arrangements, when properly fitted, prevent any movement of the grain during a normal voyage, such that the grain heeling moment for the compartment concerned may be considered to be zero.

In brief, over-stowing requires; first the free grain surface must be trimmed level, then that level surface must be covered with a separation cloth, or equivalent, or with a suitable platform and, lastly, bags of grain must be then tightly stowed over the whole surface to the required height. Alternatively, other suitable cargo must be tightly stowed over the grain surface.

In brief, the construction of strapping or lashing and of securing by wire mesh is as follows:

Preparing grain cargo for strapping and lashing

- The grain surface must be trimmed and levelled such that it is very slightly crowned, after which tarpaulins, or other equivalent sheets, are spread over the whole grain surface.
- Next, either timber planks are laid out over the grain surface and nailed together, or layers of wire reinforcing mesh are laid out and overlapped by at least 75 mm.
- When the layers of timber planks or wire mesh have been installed, holding-down lashings must put in place and set tight.
- The holding-down lashings must be inspected on a frequent basis throughout the voyage and adjusted as found necessary.

Group A cargoes (that is cargoes which may liquefy) must only be loaded when the moisture content is below the TML. It has, however, often been suggested that for a Group A cargo which has a moisture content in excess of the TML, similar arrangements to those given in the International Grain Code for a grain surface in a slack hold – that is over-stowing, securing by strapping or lashing, or securing by wire mesh – could be used to 'secure the cargo surface', and to thereby prevent movement and shifting of the stowage, so as to allow the over-moist cargo to be carried. Any such arrangements will not be sufficient to prevent shifting of all or part of a Group A cargo with a moisture content in excess of its TML if all or any part of that cargo liquefies during the voyage.

When a shift in a grain cargo occurs, as the carrying ship rolls heavily to one side, only the surface cargo shifts to the low side in the hold while the bulk of the stowage remains unmoved, and therefore over-stowing or securing of the surface prevents any movement taking place, whereas when part or all of a stowage of a Group A cargo which is over-moist liquefies the whole of the cargo which has liquefied will shift to the low side in the hold as the ship rolls. The mass of that shifting cargo may be many hundreds or thousands of tonnes and any arrangements set up in an attempt to 'secure the cargo surface' will be destroyed or pushed aside.

Before the loading of Group A cargo its moisture content must be below its TML. The only alternative is a specially designed ship. It must be remembered that, if the cargo surfaces are trimmed reasonably level, there will be a far smaller possibility of a shift of cargo during the voyage.

Ventilation

During each voyage there may be a need to ventilate the cargo or there may be good reasons for keeping the hold ventilators closed and secured. The main reasons for ventilating a ship's holds are as follows.

Reasons to ventilate cargo

- To ensure there is an adequate oxygen level for people to enter the holds.
- To remove poisonous, flammable or fumigant gases.
- To prevent, if possible, the formation of condensation, or sweat, when a voyage is from a hot place to a cold place.

The main reasons not to ventilate a ship's holds are as follows.

Reasons not to ventilate cargo

- To ensure fumigant gases remain in the compartments for the required period.
- To prevent, if possible, the formation of condensation, or sweat, when the voyage is from a cold place to a hot place.
- To prevent, if possible, the self-heating of cargo by maintaining gas concentrations when cargoes such as coal and DRI are being carried.

The prevention of sweat is probably the most common reason for ventilating cargo compartments. Any such ventilation should be done in such a way as to ensure the air going into the holds from the outside is drier than the air in the holds above the cargo; that is, the dew point of the outside air must be below that of the air in the hold. There are two simple rules for deciding if ventilation of a hold is appropriate:

Rules for deciding to ventilate	
Dew-point rule	Ventilate when the dew point temperature of the outside air is lower than the dew point temperature of the air in the hold.
Three-degree rule	Ventilate when the temperature of the outside air is at least 3°C below the temperature of the cargo, which was taken during loading.

When the cargo being carried is grain, seed cake or another cargo which has been fumigated, the holds should be kept closed without any ventilation for the full period of fumigation. More details on this topic are given in Chapter 5.

Appendix 1 of the IMSBC Code gives schedules for each cargo type, other than grain, and each schedule includes requirements for ventilation. In many cases it is simply stated that there are 'No special requirements'. For some cargoes it is required that the cargo spaces shall not be ventilated during the voyage, while for others continuous ventilation shall be carried out so long as it is safe to do so. With regard to other cargo types, there are very specific requirements as to when ventilation shall be carried out and when ventilation shall be ceased. The guidance set out in the schedule for the cargo being carried should be followed.

During each voyage records should be kept on a daily basis, in a ventilation log, of all temperatures taken, of dew point temperatures, of sea and weather conditions, of gas concentrations in the cargo holds, as appropriate, and of the times of starting and stopping ventilation.

North's loss prevention guide *Cargo Ventilation* should be consulted for additional information.

Practical implications

It is very important that the master, with the assistance of the ship's deck officers, establishes the apparent condition of the cargo at the time of loading. The condition may be something which will not cause any deterioration in the quality of the cargo and will not develop further during the voyage, or alternatively it might lead to a dangerous situation developing during the voyage which will endanger the crew and the ship. If the master has any doubts about the condition of the cargo the master should carry out an investigation into the characteristics identified, and should advise the charterer and/or the ship operator, as appropriate, of the findings. If appropriate, an independent marine consultant might be appointed to provide further advice and recommendations.

The master should bear in mind that, if there are any doubts about the condition of the cargo, it would be better for there to be a suspension in the loading operations for a short period rather than to ignore the condition of the cargo and allow the situation to get out of control, with dangerous consequences. During the suspension period the situation can be discussed and sorted out, appropriate changes can be made to the loading of cargo, or it may be established that there are no problems with the condition of the cargo to be loaded.

MEASUREMENT AND MONITORING OF CARGO WEIGHT

On every bill of lading issued in respect of cargo shipped there is a description of the cargo and description includes the weight of the cargo. The weight of the cargo should be accurately stated because if it is not it is likely that the receiver of the cargo at the offloading port will make a claim for any shortage. In addition, if the weight of cargo loaded and its distribution on board are not accurately known, the master will be unable to complete accurate trim, strength and stability calculations for the intended voyage.

The weight of cargo loaded may be measured either by on-shore weighing machines or by draught surveys. The method to be used may be specified by the shipper and/or the receiver of the cargo, or by the charterer. Each method of establishing a weight for the cargo is likely to be accurate only to within a certain tolerance, and each method will have a different level of accuracy. These inaccuracies with the measurement of weight might result in an apparent, or paper, loss of cargo weight. In addition, it is likely that there will be an actual loss of cargo weight variously during loading, the voyage and offloading of a dry bulk cargo which will produce a real loss of cargo weight. These losses, both paper and real, should be kept to a minimum by appropriate procedures to minimise the possibility of a claim for cargo shortage.

While the master cannot have any influence over the accuracy of any on-shore weighing machinery, the master is entitled to receive information from the terminal representative with regard to the quantity loaded or unloaded (in accordance with the BLU Code). The master can closely monitor the loading or unloading operation on board ship and can observe the ship's draughts to establish directly the weight of cargo loaded or offloaded. The various aspects of cargo weight measurement and likely weight losses are described in the following sub-sections.

Approximate errors for the different weight measurement methods are given. The errors given cannot be guaranteed and are for illustration purposes only.

On-shore weighing methods

There are a number of ways by which the weight of cargo being loaded or put ashore can be measured. The error of such methods ranges from around 0.1% of the weight at best to in excess of 0.5%. The various methods are described as follows.

Conveyor belt scales

Conveyor belt scales continuously weigh the cargo on a particular section of the conveyor belt and by applying the speed of the conveyor to that weight the total weight of cargo loaded over a given period is obtained. If properly maintained and calibrated, in accordance with the manufacturers' recommendations, the system should have an error of 0.1% or less.

Load cell or bin

Load cell or bin weighing machines are positioned within a conveyor belt system and weigh portions of the cargo as they are delivered into the cell or bin by the conveyor belt, after which the portion of the cargo is re-delivered to the conveyor belt system for delivery either to the loading ship or to the storage facility. A sum of the bin or cell weights gives the total weight of the cargo loaded or offloaded. If properly maintained and calibrated, in accordance with the manufacturers' recommendations, the system should have an error of 0.1% or less.

Weighbridges

Weighbridges are used when cargo is delivered to the export quay or from the import quay by road vehicles. Each vehicle should be weighed in its loaded condition and in its unloaded condition to establish the weight of cargo which is being carried. Alternatively, if the distance of the delivery cycle for each vehicle is only short, it is often accepted that a single tare weight, which is unloaded weight, measurement is recorded and then applied to all loaded weight measurements during the period of use. If the weighbridge is properly maintained and calibrated, and is used correctly, an error of 0.2%, or less, can be achieved. For that accuracy to be maintained, tare and loaded weights must be recorded for each round trip, or accurate allowances for fuel use must be taken into consideration, the weighbridge itself must at all times be kept clean and clear of all debris, water and any other extraneous matter, and the manufacturers' recommendations with respect to maintenance, and a testing, calibration and certification regime must be followed. If not, the error will be far greater and possibly in excess of 0.5%.

Grabs

Weighing of grabs is sometimes possible when the crane being used for a grab loading operation is fitted with a system for the weighing of the load on the hoist wire. The accuracy of such weighing machines is fairly good but the overall weight of cargo loaded will then depend upon an accurate tally of the weight of the grab loads loaded. Also, weather and operating conditions will affect the accuracy of the weighing machinery.

Weighing of bags

In some ports bags of cargo (particularly bags of seed cake or grain) are delivered alongside for loading. Gratings are positioned across the hatchway between the coamings, slings of bags are then lifted from the quay and are placed on the grating and the bags are cut open by the stevedores' labourers so that the cargo can be poured into the hold below through the grating. The empty bags are then returned ashore. The weight of the cargo loaded might be declared to be the average weight of the bags multiplied by the number of bags said to have been loaded, or truck-loads of bags might be weighed by use of a weighbridge, in both cases the weight of the bags is subtracted from the total weight. Different methods of assessing the cargo weight may be used. This way of assessing cargo weight is likely to have an error of at least 0.5% unless it is closely monitored.

Bagging plants

Bagging plants are sometimes used on the quay at discharge ports where each bag is weighed before being transferred to a road vehicle. The cargo is usually offloaded by grab and the grab loads of cargo are delivered to a hopper which feeds a bagging plant within which there are weighing machines. Such weighing machinery may have an error in excess of 0.5%.

The error tolerance of on-shore weighing machines might be, at best, about 0.1% and, at worst, in excess of 0.5%, or possibly more than 1%. The level of the inaccuracy will depend upon the method used and upon the condition of the machinery. Taking a cargo weight of 50,000 tonnes, being loaded into the holds of a handy-max type ship, 0.1% of the cargo is equivalent to 50 tonnes, whereas 1% of the cargo weight is 500 tonnes, the apparent loss of which is most likely to lead to a cargo shortage claim.

The master should be aware that different shore-based weighing machines and systems have different levels of accuracy and should arrange for the ship's duty deck officers to carry out draught surveys to check the weight of cargo being loaded, regardless of how the cargo weight given on the bill of lading is to be determined.

Draught surveys and draught readings

The weight of cargo on board can be calculated when accurate draught readings are taken in conjunction with accurate measurements of all liquids on board. For details of how a draught survey should be conducted see North's loss prevention guide on *Draught Surveys – a Guide to Good Practice*.

To accurately establish the weight of cargo loaded, draught surveys should be conducted before loading begins and after loading has been completed. During the initial draught survey accurate measurements of all liquids on board should be obtained to calculate the ship's constant, which is the weight of all other stuff which is on board, the weight of which cannot easily be measured. The weight of the constant includes the weight of all unaccounted for stores, the weight of paint coatings and rust on all the steel structures, the weight of any sludge and mud in ballast tanks and other compartments, and the weight of any other materials on board. During the final draught survey there should, so far as possible, be an absolute minimum of ballast water on board, such that when the constant is applied to the calculation an accurate cargo weight is obtained.

Fig. 20. Forward and aft draught marks

If it is not possible to carry out an initial draught survey prior to loading but a reasonably accurate figure for the ship's constant is available, a survey following completion of loading, referred to as a deadweight survey, can be carried out to calculate the cargo weight. That is, by using accurate draught readings, accurate measurements of all liquids on board and the known constant, the weight of the cargo can be obtained.

Similarly, at the time of offloading, before and after draught surveys can be carried out or a deadweight survey can be done following arrival, to calculate the weight of cargo offloaded.

At any stage during a loading or offloading operation, an intermediate draught survey can be carried out to determine the weight of cargo loaded or the weight of cargo offloaded up to that time. The draught of the ship is read, as normal, at six points, as for any draught survey, and soundings are taken to determine the weights for all liquids on board, and the resultant weight of cargo on board can be compared with the results of earlier draught surveys to determine the difference in weight. This method might be used to determine the weight of a part-load shipment of cargo or may be used to check on-shore produced weights.

An alternative method of calculating the weight of cargo loaded or discharged during a given period is by the use of the ship's draught, to be correct the mean-of-means draught, in conjunction with the tonnes per centimetre immersion (TPC). This method will give an approximate cargo weight which can be used during the monitoring of cargo operations by the master and deck officers but should not be used to determine the weight of cargo to be given on official documents. At the beginning of and at the end of the period of loading or discharging which is being monitored the draught of the ship should be read at six points, as normal, forward, mid-length and aft, both port and starboard, and the draughts as read should be corrected to produce draughts at the perpendiculars, so that a mean-of-means draught can be calculated. A mean-of-means draught is calculated as follows:

Mean-of-means draught calculation

$$\text{Mean-of-means draught} = \frac{\text{Mean forward draught} + 6 \times \text{Mean mid draught} + \text{Mean aft draught}}{8}$$

The TPC for the ship's draught at any time can be easily obtained from the ship's deadweight scale given on the capacity plan or the hydrostatic data in the stability booklet. The difference in deadweight is then easily calculated by taking the difference in draught in centimetres and multiplying that number by the TPC. For example, for a difference in draught of 120 cm on board a ship where the TPC is 60, the difference in deadweight is 7,200 tonnes. That difference in deadweight obtained must then be adjusted to take account of any differences in liquids on board, such as water ballast being pumped overboard or taken on board, to produce an approximate cargo weight loaded or offloaded during the period concerned.

It must be stressed that this TPC method should only be used during monitoring of cargo operations to give a rough estimate of the cargo weight involved and cannot replace full draught survey calculations, but it is a very useful tool during cargo operations.

With regard to the accuracy of a draught survey result, this will depend upon the accuracy of the draught readings, which in turn will depend upon: the sea and weather conditions at the time, including the height of the waves on the water; the clarity of the draught marks themselves and the light conditions prevailing; accurate determination of water density at various depths, and upon the accuracy of the measurement of the weight of liquids and other weights on board. If conditions are ideal and all readings and measurements are accurate, the cargo weight or the weight of the constant can be calculated accurately to within a few tonnes. If the measurement of liquids, and other weights on board, is very accurate but the reading of the draughts is good but not ideal, the calculated weight may be said to be within plus or minus the TPC of the ship at the particular draught. If the draught survey is carried out with reasonable accuracy in good conditions the calculated weight may be said to be within plus or minus 0.5% of the cargo weight. If the various measurements are not taken as accurately as possible, the weight produced by the calculations cannot be correct and should not be relied upon.

Cargo weight losses

Loss of weight of cargo loaded or unloaded can be divided into two categories, real losses and paper losses. Real losses occur during a voyage, variously during loading of the cargo, during the passage from the loading port to the offloading port and during offloading of cargo. Paper losses are not physical losses of cargo but are due to errors in the measurement of the weight of cargo.

Real losses

Small amounts of cargo are sometimes 'lost' and are not delivered to the receiver at the discharge port or moisture is 'lost' from the bulk of the cargo. Either type of loss will result in the actual weight of cargo delivered to the receiver being less than the weight of cargo delivered to the export quay by the shipper. The ways in which cargo is 'lost' include the following.

Real cargo losses	
Spillage during loading or unloading	Cargo may be spilled from conveyor belts or from grabs or may leak from grabs which do not close tightly. Those amounts of cargo will remain on the quay or adjacent areas, on the weather-deck of the ship or will fall into the dock or sea alongside, and will not be delivered either into the hold during loading or to the receiver following offloading. Additionally, spillage may occur from road vehicles during transit between the weighbridge and the ship's side during loading or the ship's side and the weighbridge during offloading operations.
Theft during loading or unloading	If the cargo is in bags before loading, some of the bags might be tallied more than once to show loading has taken place to give a greater weight of cargo on board for bill of lading purposes than is actually the case, or if the bulk cargo is bagged immediately after unloading some bags might not be tallied to give a smaller weight of cargo unloaded than is actually the case. Similarly, if the cargo is delivered to the quay or transit shed in road vehicles before loading, or is sent forward from the quay or transit shed in road vehicles after unloading, before loading some vehicles may be passed over a weighbridge, or otherwise counted, more than once to give a greater weight of cargo loaded or, alternatively, after unloading some vehicles may not be passed over a weighbridge, or otherwise not counted, to give a smaller weight of cargo unloaded than is the case and as given on the bill of lading.
Blown away	Wind-blown losses might occur during high wind conditions when relatively light cargoes such as grain, seed cake or light mineral cargoes, are being handled. Any wind-blown cargo will remain on the quay, on the weather-deck or over the side in the dock or sea, will remain unaccounted for.
Residues left on board	Residues which remain on board following completion of offloading might not be measured and therefore might not be included in the out-turn weight.
Water evaporation	During a voyage when a cargo with a high moisture content is carried, some of that moisture might evaporate into the air in the hold above the cargo surface. Any ventilation of the hold can then remove some of that evaporated moisture. During this process the weight of the cargo can reduce, although the loss of weight is likely to be very small. Losses from evaporation are almost always vastly smaller than from other sources, and evaporation alone cannot explain a significant apparent shortage at out-turn.
Water drainage	This occurs from some cargoes onto the tank top plating and then into the hold bilges occurs as a routine event. Cargoes such as some types of coal and sulphur loaded at some ports are wet when loaded and the water will naturally drain during the voyage. The water in the bilges is then pumped overboard which results in a loss of cargo weight. However, measurements of the amount of water pumped overboard can be taken and recorded and this is sometimes specifically required in the charterparty.

Dependent upon when and where the loss of cargo occurs and how the cargo weight is determined, the weight of that cargo may or may not be included in the weight declared on the bill of lading or in the declared out-turn weight. For example, the weight of wind-blown losses at the discharge port will be included in the bill of lading figure and will be included in the out-turn figure if the latter is determined by draught surveys, but they will not be included in any on-shore weight figures produced at the discharge port. The master should bear in mind how the cargo weight is determined and what losses are occurring and take appropriate action (see 'Practical implications' later in this section).

Paper losses

These are the result of inaccuracies or errors in the measurement of cargo weight by on-shore machinery or during measurements for draught survey calculations. Errors in measurement can occur in situations as follows.

Paper losses of cargo	
Weighing machinery calibration error	A weighing machine might be calibrated and tested in the correct manner such that the weighing machine may have an error of possibly 0.1%. Alternatively, if an incorrect method of calibration is used the error will be greater.
Weighing machinery maintenance error	This will, in all probability, produce cargo weights which are not within the normal tolerances expected for the type of machine and error in measurement may be unknown.
Draught survey error	Draught surveys involve a series of measurements which together, in the calculation, produce a cargo weight. If any of these measurements or calculations are in error, the resultant cargo weight will, likewise, be in error.
Bill of lading error	An incorrect weight on a bill of lading might be because of a clerical or typographical error, might be deliberate falsification of the weight or might be one or a combination of other factors.

Apparent losses can also occur as a result of the inappropriate comparison of different weights obtained by different methods. It is essential that like-with-like comparisons are carried out when possible. If the master is asked to sign mate's receipts and bills of lading containing a figure which the master does not believe to be accurate, the master should seek guidance and/or refer to North's loss prevention guide *Bills of Lading: A Guide to Good Practice*.

Normally acceptable allowance

It is recognised in some trades that there is likely to be a small loss of cargo weight during an ordinary voyage and that weighing machinery can only be accurate to within a small tolerance. Bearing this in mind, it is often accepted practice that the weight of cargo offloaded at the discharge port might be of weight up to 0.5% less than the weight of cargo loaded and as specified on the bill of lading. For example, for a cargo comprising 50,000 tonnes of grain, as given on the bill of lading, if there is a short landing of up to

a maximum of 250 tonnes, there may be no claim, depending on normal accepted trade allowance at that port, by the receiver for that apparent shortage of cargo on the basis that 250 tonnes is 0.5% of the total shipped weight.

Practical implications

When bulk cargo is carried it is important that the master is always aware of the weight of cargo on board and the weight of cargo to be loaded or to be offloaded. The master must be fully aware of the present situation and forthcoming events in order to carry out all appropriate calculations to ensure the safety of the ship, of the crew and of the cargo being carried. There is a sequence of events which must be followed to ensure the safety of the voyage. Central elements of that sequence of events are monitoring of the weight of the cargo and measurement of the weight of the cargo being loaded.

Cargo weight monitoring checklist

- At the beginning of any voyage the master will be advised of the weight of cargo to be loaded, either as an approximate weight with perhaps, '10% more or less at owner's option' written into the charterparty, or as a fixed weight of cargo for a particular shipment.
- The master must prepare a pre-stowage plan and strength and stability calculations to determine whether or not the intended cargo can be carried safely to the required discharge port.
- Next, in accordance with the requirements of the BLU Code, the master should prepare a loading plan, sometimes known as a loading schedule or sequence, in which the stages of the loading are defined by amounts of cargo loaded into each hold in sequence. The loading plan should also incorporate other information given for each stage of the loading operation, including ballast water to be pumped out, estimated draughts and shear forces and bending moments for the end of each stage. The preparation of such a loading plan requires strength and stability calculations to be carried out for the ship's condition for the end of each stage of the loading operation.
- During the loading operation the terminal representative should ensure the requirements of the loading plan are strictly followed with respect to the weight of cargo loaded into each hold in sequence, so that the correct weight of cargo is loaded as required.
- Also during loading the master and deck officers should monitor the loading of cargo to ensure the operation proceeds and is completed as required.

Prior to arrival at the offloading port the master should complete an unloading plan giving details of the sequence of unloading, together with ballasting requirements and details of draughts, bending moments and shear forces for each stage of the required unloading sequence. As with the loading of cargo, the terminal representative at the unloading port should ensure the offloading of cargo is carried out in accordance with the master's requirements and monitoring of the operation should be undertaken.

It can be seen that central to any loading or unloading operation is the requirement that the master is aware of cargo weights at all times.

The master has no control over the accuracy of any on-shore weighing machines or direct control over cargo handling operations ashore, or with regard to any losses of cargo which might occur. However, the master, with the assistance of the deck officers, should monitor cargo operations throughout loading and offloading and should issue letters of protest if the operation does not progress as intended.

It is a routine procedure for draught surveys to be carried out by an independent surveyor before and after loading, and before and after discharge of the cargo, to establish the weight of cargo carried for bill of lading and for out-turn purposes. Officers should accompany the surveyor during draught surveys to ensure consistent survey methods are used. If draught surveys are not carried out by an independent surveyor because the weight of cargo is to be determined by on-shore weigh scales, it is recommended that ship's staff should conduct such surveys as a check of the on-shore weigh scale measurement, with the results to be held on board for future reference.

To fully monitor a loading operation, to supplement the initial and final draught surveys and to keep a precise check on the weight of cargo being loaded and its distribution on board, it is recommended that the deck officers carry out checks as follows.

Cargo weight measurements checklist

- The forward, aft and mid-length draughts should be read at the end of each stage of the loading and de-ballasting operations to check against the loading plan that the required weight of cargo for each pour has been loaded on board.
- The weight of cargo loaded during each pour should be obtained from the terminal representative, again to check that the pour sequence is being followed on the loading plan.
- Draught surveys, with readings of all six draughts, should be completed at intervals of possibly two or three pour stages of the loading plan. Alternatively, TPC calculations can be carried out. These calculations will provide a cargo weight to be compared with the cargo weights given by the terminal representative.
- Before the final stages of loading, possibly before the final two pours of the loading plan sequence, a full draught survey should be carried out to establish precisely what weight of cargo has been loaded and the precise trim of the ship at that stage. Re-calculation of the final cargo loading pours may then be carried out if appropriate.
- A running total of all the on-shore cargo weights given by the terminal representative should be kept to ensure the requirements of the loading plan are being followed by the terminal staff.
- If any differences are found that affect the draught, trim, strength or stability of the ship, loading operations should be suspended and discussions should be held with the terminal representative to resolve the situation and to plan the loading of the balance of the cargo. If appropriate, a letter of protest may be submitted.
- Following completion of all the intended loading, a full and final draught survey should be carried out to calculate the weight of cargo loaded.

During the offloading of cargo similar checks should be carried out, including the checking of the ship's draught, the carrying out of draught surveys as appropriate, and the keeping of a running total of cargo weights given by the terminal representative. The final checks to be carried out will be in respect of the final cleaning of cargo compartments to remove all accessible cargo and to minimise what remains on board.

During cargo operations the duty officer should continuously monitor events and conditions, and record appropriate details. For example, if there is any spillage of cargo from conveyors, cargo handling grabs or road vehicles on the quay, details of these losses, when the losses occurred and how much loss of cargo was involved should be recorded. During draught surveys details of the weather conditions and the state of the water and height of any waves around the ship should be recorded. With regard to ballast water,

all operations of ballasting or de-ballasting should be kept in the appropriate form. If it is necessary to pump water from the hold bilges during loading or offloading operations, this also should be recorded, to include the time the pumping took place and the amount of water removed from the holds affected.

During the voyage records should be kept of all ventilation operations and of all hold bilge soundings and pumping operations, to include the time of pumping and the amount of water pumped out.

Following completion of offloading of cargo, the cargo compartments should be inspected and an estimation of the amount of cargo residues remaining in each cargo compartment should be done to obtain an overall weight of cargo remaining on board. A record of that figure should be kept.

If all of the records are maintained, any claims for a shortage of cargo following offloading can be addressed with meaningful answers with a view to countering such claims.

It is often required by shippers and/or receivers of cargo that the weather-deck hatches are sealed to prevent entry into the cargo compartments. When seals are fitted it should be ensured that they are fitted in such a way that the hatch covers cannot be opened and it should be ensured that the seals fitted are tamper-proof. If seals are not fitted properly or are not of a recognised tamper-proof type, complaints might be raised at the offloading port that the seals were ineffective and there is no evidence cargo compartments were not entered during the voyage.

As a safeguard, when there is any complaint about the weight of cargo shipped or any dispute involving the weight of cargo at the loading port, it is recommended that tamper-proof seals be fitted to all main weather-deck hatch covers and to all access hatch covers by a recognised survey company at the loading port. The surveyor should then issue a formal report giving details of the hatch cover sealing exercise and all seal numbers with their location. A record of the sealing exercise should be entered in the deck log book. The fitting of seals, when they are fitted properly and when the seal numbers are recorded properly, is an effective method of countering any claim for a shortage of cargo on out-turn.

DISTRIBUTION OF CARGO AND BALLAST – STRUCTURAL DAMAGE HAZARD

Over the years there have been many incidents of ships suffering structural damage as a result of the improper distribution of cargo, of ballast water, or of both. Some of these damages have involved only localised structures, for example damage to tank top plating and double-bottom internals due to excessive loading of the tank top, whereas many have involved large sections of the ship's structures, or the entire hull, leading to extensive fracturing and massive flooding, followed by the sinking of the ship.

These incidents were caused by the incorrect distribution of weights on board during a routine operation. However, they could have been prevented by proper planning of the operation, proper and complete calculations to establish the likely stresses which would be placed on the ship's structures and hull and proper monitoring to ensure the operation would be carried out and completed as planned. Such incidents can occur at any time during a loaded or ballast voyage; particularly during loading and unloading or during ballasting operations.

Different types of ship have different characteristics and are designed and constructed for the carriage of different types of cargo. Some are additionally strengthened to carry high-density solid bulk cargoes. Information with regard to the types and densities of cargoes which may be carried on board can be found variously in the ship's stability information booklet, the certificate of compliance with the IMSBC Code, the loading manual and other documents and plans. Some characteristics are as follows.

Ship cargo-carrying characteristics

- Some ships are designed for the carriage of grain in bulk, and therefore have been issued with a Document of Compliance with the International Grain Code and with a Grain Loading Manual; some ships are not designed for grain.
- Some ships are designed and constructed for the carriage of heavy bulk cargo, and some for heavy bulk cargo to be carried in alternate holds with the other holds empty for the voyage. A bulk carrier booklet, or additional information in the stability booklet, will be provided on board ships constructed for such heavy cargoes in accordance with the requirements of SOLAS, chapter XII. Some ships are not designed for heavy cargoes.
- Some ships have tank top loading rates which are high, while others have weaker tank top and double-bottom structures such that the maximum allowed loading rate is lower.
- Some ships have large ballast capacities, which may include one or more holds designed and fitted for ballast water, whereas other ships have relatively small ballast capacities.
- Some ships are equipped with large-capacity ballast pumps whereas other ships have small pumps.

These different characteristics affect the ways in which the loading and unloading of bulk commodities, and the ballasting operations, and any exchange of ballast water must be planned and carried out. At all times and during all operations the master must be sure, from the evidence of calculations and assessments, that the ship as a whole and all individual structures are not being over-stressed or overloaded by operations taking place.

Longitudinal strength of the ship's hull

Before a loading operation is contemplated the master must first establish that the cargo is of a type acceptable for carriage. When this has been established, calculations for the distribution of cargo on board and the ship's strength and stability must be completed for all stages of loading and de-ballasting and all stages of the voyage. The results of the various calculations can then be used to prepare the loading plan, as required by the BLU Code.

The strength calculations will produce figures for shear forces (SF) and bending moments (BM) at a number of positions along the length of the hull, primarily at transverse bulkhead locations and at some intermediate locations, usually set out in the form of tables and a graph. These tables of figures are calculated using the distribution of weights on board – cargo weights, the weight of liquids in tanks including fuel, ballast water and so on, and the weight of the ship's hull and machinery – the buoyancy of the hull, and the strength of the hull structures.

The master then needs to know if the shear forces and bending moments are acceptable or if they will cause structural damage to the ship.

For the production of the strength data in the loading manual the maximum

permissible shear forces and the maximum permissible bending moments are established from the construction details of the ship's hull, and each is given for two situations; the sea-going condition and the in-port or harbour condition. Additionally, these figures might be given for different situations, for example when the ship is loaded with iron ore and when it is in ballast.

The sea-going condition maximum figures are smaller than the harbour figures because when the ship is at sea the hull will be exposed to additional shear forces and bending moments caused by sea and swell waves as they pass the ship on its passage. When the ship is in a harbour, such that there are no additional forces to be taken into account, the in-port figures apply and the loading or unloading of cargo, and the de-ballasting or ballasting operations, can be carried out so long as the in-port maximum shear force and maximum bending moment are not exceeded at any part of the hull. When operations are completed and the ship is ready to proceed to sea, the largest shear force and the largest bending moment produced by calculations must not exceed the maximum permissible figures for the sea-going condition.

For each stage of any operation, strength calculations must be completed to ensure the hull will not be over-stressed at any time. When a loading and de-ballasting or an unloading and ballasting operation is being planned a loading or unloading plan must be completed and the calculated values of maximum SF and BM must be entered, in the appropriate columns, for the end of each stage of the operation (the end of each pour) and these figures should be expressed as a percentage of the maximum permitted in-port or at-sea figures, as appropriate.

As with all operations, loading and de-ballasting and unloading and ballasting operations must be closely monitored to ensure the plan is followed. If there is a deviation from the plan calculations must be completed to ensure the change can be safely undertaken; if it would be unsafe the operation must be stopped and a safe alternative found.

Some ships have large-capacity ballast pumps whereas others have small pumps, and different design ships have a larger or smaller ballast capacity. When the loading or unloading plan is being prepared the pump capacity and ballast capacity must be taken into account to ensure during each cargo operation pour the required de-ballasting or ballasting can be achieved in the required time periods, and in conjunction with the loading or unloading. Also, the loading or unloading rate and the number of loaders or unloaders must be entered into the calculations for the preparation of the plan.

If it is found during the cargo operations that de-ballasting or ballasting is not keeping pace with the loading or unloading, the cargo operations must be suspended for a period to allow the ballast water situation to catch up and to ensure, so far as possible, the calculated shear forces and bending moments are not exceeded. See also notes on the BLU Code in Chapter 3.

Strength of the tank top or 'tween deck

It is a requirement of paragraph 5.1.1 of the IMSBC Code that cargo shall be trimmed reasonably level. The trimming might be achieved during the actual loading of the cargo by grab or spout or, after loading, by a machine placed into the hold. There are a number of reasons why the cargo should be trimmed, as follows.

Reasons for trimming cargo

- Reduces the likelihood of cargo shifting.
- Minimises the air in the cargo.
- Minimising the air reduces any possibility of spontaneous heating.
- Minimises any localised loading of the tank top plating or 'tween deck.

Fig. 21 A bauxite stowage which has not been trimmed

Details of requirements are set out in section 5 of the IMSBC Code and in the individual schedules in appendix 1. This section look only at the localised loading aspect.

Tank top structures and 'tween decks are assigned a maximum permissible loading in terms of t/m^2. During the loading of any cargo the limit must not be exceeded, overall or in particular areas, because, if it is, localised damage to the ship's structures is likely to occur. Even if damage is not sustained immediately, while the ship is still in port, damage is likely to be sustained during the ocean voyage if the structures are overloaded.

Throughout any loading operation the weight of cargo being placed into each hold during each pour should be known; this is set out in the BLU Code. In addition, the deck officers supervising the loading must ensure the cargo being placed into each cargo compartment is spread out evenly over the tank top or deck area and is not loaded in large piles. This will ensure the loading, in terms of t/m^2, is as even as possible.

In some situations, where the loading equipment cannot be used to trim the cargo because it can only deliver the cargo in one particular area, it might be necessary to place one or more machines into the hold to carry out intermediate trimming.

Ballast operations – ship's strength implications

During a ballast voyage it is most likely that exchange of the ballast water will be required before arrival off the next loading port. The topic of ballast water is covered in Chapter 4. If the ballast water exchange, or any other ballast water movement, is not carried out in a properly planned sequence, excessive stresses may be placed on the ship's hull and structural damage might be sustained.

There will be a ballast water management plan as part of the ship's safety management system procedures and plan should be followed in its entirety. When the plan was drawn up various calculations and assessments will have been completed to ensure the stability of the ship will not be adversely affected and the shear forces and bending moments will not be excessive during each stage of the operation. If for any reason there is a departure from the plan during an exchange operation, calculations should be carried out without delay to determine the stability characteristics of the ship and the shear forces and bending moments caused by the operation. If an adverse or unwanted stress or characteristic has been produced the operation should be stopped and/or action should be taken to rectify the situation.

Alternatively, if partial ballasting, partial de-ballasting or partial exchange of ballast water is to be carried out, for whatever reason, a full assessment must be carried out by the master before the operation starts to ensure the safety of the ship. Calculations to determine the stability characteristics of the ship and the shear forces and bending moments caused by operations should be completed for the situation on board as follows.

Stability, shear force and bending moment calculation points

- At the beginning of the operation.
- At the end of each procedure and the beginning of the next procedure.
- During each procedure, at the point when the free surface moments are at a maximum.
- At the end of the overall operation.

If any of the results are unacceptable (too small or too large a GM or excessive shear forces or bending moments) the plan must be altered and new calculations must be carried out until an acceptable sequence is achieved so that a full ballasting plan can be drawn up. Only then may the movement of ballast water be started.

The master should be aware of the strengths and weaknesses of the ship and should ensure throughout all cargo operations and ballast operations; the stability of the ship is acceptable for the situation, the shear forces and bending moments are not excessive, with reference to the in-port or at-sea maxima as appropriate, and the tank top or 'tween deck maximum permissible loadings are not exceeded in any areas.

FUMIGATION

Many plant and animal products, including grain and seed cake, which are carried in bulk will nearly always have some insects living in them and possibly also larvae and eggs. These insects might move from one kind of product to another and may remain within a cargo compartment after discharge of that cargo causing infestation of a subsequent cargo. To control an insect population, fumigation is carried out. Fumigation of cargo

might be done before loading, in a silo or storage warehouse, or after loading in the holds of the ship. If carried out on board, it might be done entirely in port, being completed before departure from the loading port, or may be continued in-transit, that is, will continue during the voyage towards the destination port. Sometimes it is necessary for fumigation of cargo to be carried out at the discharge port, before offloading of the cargo. Fumigation of empty holds is also sometimes required.

Fumigant gas in general, the hazards and limitations involved and the effectiveness of the treatment when fumigation of cargo in the holds of a ship is carried out will be discussed first. Next the recommendations and procedures which are set out in the 'IMO Recommendations on the safe use of pesticides in ships applicable to the fumigation of cargo holds' will be discussed, drawing attention to sections of those recommendations and pointing out what is required and how procedures must be followed, under sub-headings disinfection of empty cargo holds, fumigation with aeration (ventilation) in port, and fumigation continued in transit.

Some of the requirements and other practical topics will be further discussed under the heading 'Practical implications' later in this section, including application of pellets or tablets, re-distribution of fumigant gas, fumigation during the voyage and after arrival, and fumigation of bagged cargoes.

As with all IMO recommendations and codes, it is suggested that the recommendations on the safe use of pesticides in ships should be read in full, with these notes to give further guidance. Because of the dangerous nature of fumigants, fumigation must be carried out by a professional fumigator. The master or crew should under no circumstances handle fumigation materials or carry out fumigation.

Fumigant gas

The fumigant most commonly used for cargo on board ships is the gas phosphine, which may penetrate through the stowage. In most cases, the fumigant is provided in the form of small pellets or tablets of the solid material aluminium or magnesium phosphide. These pellets or tablets are brought on board in sealed, airtight drums. In these drums there will usually be either bags, socks or other packages of the pellets or tablets. When the pellets or tablets have been distributed within the cargo to be fumigated, they react slowly with atmospheric moisture to produce the phosphine gas. It is the gas which will then slowly penetrate the stowage and, it is hoped, kill the insects. Phosphine also kills eggs and larvae but may take longer to do so. Phosphine may be used for fumigation in port or in-transit situations.

In addition to phosphine, other fumigants sometimes used include methyl bromide and, very rarely, carbon dioxide and nitrogen. These are applied in gas form. Methyl bromide is used in situations where rapid treatment is required and should only be used for in-port fumigation situations where the crew have been disembarked – it should not be used for in-transit fumigation. Other fumigant gases are being developed to replace methyl bromide as it is a greenhouse gas and therefore banned in many countries.

Hazards and limitations

With respect to the use of phosphine, there are three major problems with the fumigation of cargo in stowage on board, these being its toxicity, its potential for fire or explosion and its effectiveness.

The fumigant gas is toxic to insects but is also toxic to humans and other animals. This being the case, safety of the crew, the operatives carrying out the fumigating operation, and other personnel on board must be ensured by strictly following procedures.

After the pellets or tablets have been distributed within the cargo or cargo compartment, they will react with the atmospheric moisture to produce the fumigant gas. That chemical reaction will also produce heat. If the fumigant is not distributed correctly, for example, is placed in piles rather than being spread around a stow, the heat produced might cause heating of the adjacent cargo which may produce combustion and fire. Alternatively, in extreme cases, an explosion might be the result of spontaneous heating of the fumigant gas as phosphine gas is explosive at levels above 1.7% v/v in air. If the pellets or tablets become wet, for example by sea water ingress, rain or condensation, they can spontaneously ignite.

The fumigant tablets should be distributed correctly and in a sufficient number under all the correct conditions to maintain the required concentration of gas for the required exposure time to kill all insects. If not, the fumigation will not be effective.

Effectiveness of the treatment

There are number of factors which affect the effectiveness of a fumigation treatment. These include the penetration of the fumigant gas into the cargo stowage, the dosage of the fumigant, the time allowed for the fumigant to act and the temperature of the cargo. Decisions on these factors are for a professional fumigation company, not for the master.

Taking the penetration and the concentration or dosage first. There are a number of different methods by which the pellets or tablets, which subsequently produce the fumigant gas, are distributed on or within the cargo and some will allow greater penetration of the cargo than will others. Whichever method is used, the planned distribution should be adhered to. The concentration or dosage of the fumigant pellets or tablets must be calculated on the basis of the volume of the cargo compartment involved, and not with regard to the volume of the cargo within that cargo compartment. That dosage calculation is carried out on the basis there will be no leakage of the fumigant gas from the hold, and therefore on the basis that the hatch covers and all other openings, including access hatchways, ventilator openings and any other openings, can be made and can be maintained gas-tight throughout the period of fumigation.

Any leakage of the fumigant gas from the hold will result in there being insufficient fumigant gas for effective fumigation and may create a hazardous environment for personnel on board. Therefore the pellets or tablets should be distributed correctly and in a sufficient number so sufficient fumigant gas is produced and to have the desired effect on the infestation. If an insufficient quantity of pellets or tablets is used, or if the hold is not gas-tight, there can be no possibility of the fumigant killing all the insects. If the correct number of pellets or tablets is used but if then these pellets or tablets are not distributed correctly, the reaction and therefore the production of fumigant gas will be slower than planned and a longer period will have passed before the required gas level is reached. In this latter situation, there may be no problem with the ultimate effectiveness of the fumigant gas so long as the holds are gas tight, but if there are minor leakages the gas level in the hold may not be reached, which would affect the fumigation process.

The phosphine fumigant gas is released from the pellets or tablets slowly as they react with atmospheric moisture. This reaction is dependent on the temperature of

the cargo, such that at lower temperatures the reaction will be relatively slow, whereas at higher temperatures the reaction will be relatively fast. Manufacturers recommend that fumigation is not carried out if the ambient air temperature is less than 5^{O}C. The period of the exposure of the cargo compartment to the fumigant gas must therefore be calculated, taking the temperature into account, to ensure an effective treatment. Treatment periods are typically up to about two weeks, or possibly more, and will be determined by the fumigation company.

It should be noted that the exposure times given in manuals provided with the fumigant do not include the time required for the gas to penetrate the entire hold, and therefore the time must be increased substantially for effective fumigation to be achieved in ship's holds.

Recommendations and procedures

In view of the various hazards, the IMO has produced 'Recommendations on the safe use of pesticides in ships applicable to the fumigation of cargo holds' in the supplement to the IMSBC Code. The recommendations are arranged in five sections with three appendices.

The initial introduction and section 2 give guidance on the maintenance and sanitation of cargo holds and the main sites of infestation. The main part of the recommendations, section 3, gives detailed guidance on the chemical control of insect infestation. In sub-section 3.1 the methods of chemical disinfection are discussed and in sub-section 3.2 it is stated that the disinfection of empty cargo holds may be carried out. In sub-section 3.3, the disinfection of cargoes and surrounds, either in port or continued in-transit, is dealt with in great detail. Section 4 of the recommendations deals with regulations for the use of pesticides and section 5 gives guidance on safety precautions.

Before fumigation of cargo on board, or of empty cargo holds, is carried out the master should familiarise himself with the recommendations set out in the procedures given in the safety management system manuals and with the guidance set out in section 3 of the recommendations. In addition, some individual countries, for example the USA and Canada, have produced their own requirements which should be followed when fumigation is being carried out on board a ship within their territorial waters; the master should be familiar with these requirements if appropriate.

The fumigant will be supplied and distributed by a specialist fumigation company with a 'fumigator-in-charge' overseeing the operation, see sub-section 3.1.2. The fumigation company should, it is recommended, have an application manual in which operational guidelines are set out and these guidelines should incorporate the appropriate parts of the IMO recommendations.

Disinfestation of empty cargo holds

Fumigation of empty cargo holds is sometimes necessary, as set out in section 3.2 which directs the reader to section 3.3. When fumigation of empty holds is carried out by the use of methyl bromide gas, it should be undertaken in port with the crew disembarked, as discussed in the next sub-section. The crew should remain ashore until fumigation has been completed and a gas-free certificate has been issued by the fumigator-in-charge of the operation or by another authorised person. It can also be done using phosphine (produced by pellets or tablets) and continued in-transit, as with loaded holds.

Fumigation with aeration (ventilation) in port

When cargo on board is to be fumigated before the ship leaves the loading port, the crew should be disembarked and should remain ashore until the operation has been completed and a gas-free certificate has been issued by the fumigator-in-charge or another authorised person. That is, the fumigation operation should be carried out and the cargo spaces should be ventilated (that is full aeration of the cargo spaces), to remove all fumigant gas while the ship is alongside, or at anchor off the port. The crew should only be allowed to return on board when the ship has been declared to be gas-free, after which the voyage to the discharge port can be commenced. This is set out in sub-section 3.3.1.

Methyl bromide is only approved for fumigation in port and should never be used for fumigation continued in transit. The methyl bromide will be introduced into the cargo compartments as a gas and effective fumigation of the cargo is likely to be achieved within 24 hours to 48 hours. The methyl bromide gas is very toxic. Because of the manner in which it is applied to the cargo there is a significant risk of a relatively high concentration of the gas leaking from cargo compartments via the weather-deck hatchways and other openings, to cause a hazardous situation on the main deck.

Furthermore, there is the possibility that gas will enter other spaces and compartments, including the accommodation and storerooms. Bearing all this in mind, it is a requirement that the fumigation operation in full, including the ventilation, or aeration, of the cargo holds and other spaces on board to ensure no fumigant gas remains on board, is carried out in port. After that ventilation process has been completed and it has been established that no gas remains on board, a gas-free certificate can be issued.

The use of methyl bromide for fumigation purposes is being phased out although other fumigants for use during in-port fumigation are being developed. However, because of the delay to the ship and other expenses, this method is rarely used. Also, many countries and ports do not allow in-port fumigation.

Fumigation continued in transit

Fumigation of cargo which is continued during the voyage (that is in-transit), or fumigation which is carried out following arrival off the discharge port, is usually achieved using phosphine gas which is applied in the form of pellets or tablets, as described earlier. The production of the phosphine gas from the pellets or tablets is a fairly slow process. In the hours after the pellets or tablets have been distributed in the cargo they will start to break down and produce phosphine gas slowly. After the initial breakdown stage the pellets or tablets will produce gas more rapidly.

In view of the different method of application of the chemicals, fumigation by the use of phosphide pellets or tablets is allowed to be used for in-transit fumigation. That is, the fumigation process and the subsequent ventilation of the cargo may be continued during the voyage towards the discharge port, or may be carried out while the ship is off the discharge port, with the crew remaining on board. However, this option requires the ship to have gas monitoring equipment on board and for gas concentration checks to be carried out by crew members routinely throughout the voyage.

If it is proposed that methyl bromide is to be used for fumigation of cargo in-transit, the master should not allow the operation to be carried out. Before fumigation of the

cargo which is to be continued in-transit, the master should be fully aware of all the appropriate parts of section 3 of the IMO recommendations.

The in-transit fumigation operation should be carried out in stages, with the fumigator-in-charge of the operation having certain responsibilities and the master having other responsibilities. There should be inspections of the compartments before loading begins, there should be crew members who are trained with respect to the fumigation operation in general and with respect to the use of the test equipment and gas concentration checks in particular, there should be certain pieces of equipment on board and there should be various inspections and tests carried out after the fumigant has been applied and after the ship has sailed. The master and crew should co-operate with the fumigator-in-charge of the operation and should provide assistance as and when necessary.

When the master is notified that fumigation of the cargo is to be carried out, the master should ensure there is on board, in accordance with sub-section 3.3.2.7, the following.

On-board safety requirements for fumigation

- Gas detection equipment and adequate fresh supplies of service items for the fumigant used, together with instructions for their use and the occupational exposure limit values.
- Instructions on disposal of residual fumigant material.
- At least four sets of adequate respiratory protective equipment.
- A copy of the latest version of the *Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG)* and appropriate medicines and medical equipment.

When fumigators-in-charge of the operation attend on board, before loading they should discuss the operation with the master and should provide the master with certain pieces of information and documents. They should provide information with regard to what cargo is to be fumigated in which holds and what period of fumigation is required – a fumigation plan (sub-section 3.3.2.8).

The master should designate one officer and one other crew member who should be trained with regard to the use of the fumigant, the gas detection equipment and medical advice (sub-section 3.3.2.3). Those trained representatives should be provided with information with regard to the fumigant to be used, that is, a safety data sheet for the fumigant, instructions on its uses and first aid and medical treatment instructions (sub-section 3.3.2.6).

They should also be trained with regard to gas concentration checks which must be carried out before departure and during the voyage, where and when those checks must be done and what records must be kept to comply with other parts of the requirements. Those crew members will be the trained representatives of the master and they should brief the crew with regard to the fumigation of cargo before the fumigation is carried out and then inform the fumigator-in-charge that the crew have been briefed.

The fumigator-in-charge, together with a trained representative, should carry out inspections and/or tests of the cargo compartments to determine whether the holds to be treated can be made sufficiently gas-tight to prevent leakage of the fumigant from the holds into other compartments (sub-section 3.3.2.4).

Following such inspections, further discussions should be held between the master

and the fumigator-in-charge, and the fumigator-in-charge should provide the master with a signed document (sub-section 3.3.2.4) stating the following.

Pre-fumigation statement

- Details of inspections and tests conducted.
- Details of provisions and preparations for fumigation made.
- Confirmation that holds to be treated are or can be made satisfactorily gas-tight for the fumigation.

If any holds cannot be made sufficiently gas-tight, a signed statement to this effect should also be supplied to the master (sub-section 3.3.2.4). Also, the fumigator-in-charge should notify the master, in writing, which cargo spaces are to be fumigated (these cargo spaces would not include any that cannot be made sufficiently gas-tight) and which other spaces are considered to be unsafe, for example cofferdams, tanks, deck-houses and so on (sub-section 3.3.2.8).

Following completion of loading, the fumigant is applied by representatives of the fumigation company in accordance with the plan provided by the fumigator-in-charge. Crew members should assist as appropriate and, in particular, with the closing and battening down of the weather-deck hatch covers, and the doors and covers for other openings. The fumigator-in-charge, together with the trained representatives, should then make an initial check for any gas leaks, using the gas detection equipment, around the hatches and if any leaks are found they should be sealed using appropriate materials (sub-section 3.3.2.9). The fumigator-in-charge should post warning signs at all entrances to the holds under fumigation (sub-section 3.3.2.10).

After an appropriate period following completion of the application of the fumigant, the fumigator-in-charge, accompanied by a trained representative, should make checks for leaks of the fumigant variously on deck, in the accommodation, in the engine room and in other working spaces, to ensure they remain free of harmful concentrations of gas (sub-section 3.3.2.11). These checks should take place after gas levels have increased sufficiently, which for phosphine takes at least several hours. This will require the fumigators to remain on board for some hours after application of the fumigant and closing the hatch covers. In practice, the fumigators often leave immediately after the hatches are closed.

When fumigators-in-charge are satisfied that the application of the fumigant and the sealing of the hatches has been completed, they should formally hand over to the master in writing the responsibility for maintaining a safe condition on board in all occupied spaces (sub-section 3.3.2.12). The signed written statement should include the following.

Post-fumigation statement

- List of documents provided.
- Confirmation that all spaces adjacent to treated spaces have been found gas-free.
- Confirmation that trained representatives are fully conversant with the use of the gas detection equipment.
- Confirmation that gas detection equipment and the respiratory equipment is in full working order.
- Confirmation that adequate supplies of consumables are available on board.

In addition to the provision of the signed statement, the 'Model checklist for in-transit fumigation', attached as appendix 3 to the IMO recommendations, should be completed and should be signed by the fumigator-in-charge and by the master or one of the trained representatives (sub-section 3.3.2.9.1).

If the master is not satisfied that all the provisions of the recommendations have been met, the ship should be delayed in port or the fumigator-in-charge should remain on board and the procedures in sub-section 3.3.2.9.2 should be followed.

Following departure from the load-port, throughout the period of fumigation, and at intervals of no more than 8 hours, one of the trained representatives should make gas concentration measurements in all common working spaces, accommodation spaces and storerooms which are adjacent to the holds under fumigation. The findings should be recorded in the deck log book (sub-section 3.3.2.13). If any leakages are found, they should be sealed if possible and appropriate precautions to avoid any crew being exposed to harmful concentrations must be taken.

Following completion of the fumigation period, as stated by the fumigator-in-charge, ventilation of the cargo compartment(s) involved may be carried out. Careful monitoring of accommodation and working spaces should be carried out (sub-section 3.3.2.15).

Prior to arrival at the first discharge port, and not less than 24 hours in advance, the master should inform the appropriate authorities at the country of destination, and/or the port, that fumigation in-transit has been carried out on board (sub-section 3.3.2.16).

Following arrival at the discharge port, tests should be carried out in the cargo compartments to ensure the safety of personnel. Offloading of the cargo should be by mechanical means and all necessary safety precautions for personnel involved should be followed. Sub-sections 3.3.2.17 to 20 deal with matters at the discharge port.

Practical implications

To keep control of insect populations in cargoes, fumigation of the cargoes might be done while the cargo is on board. Fumigation is usually requested by either the shipper or the receiver of the cargo, or by both of them. Instruction with regard to the fumigation, the type of fumigation, who has requested the fumigation of the cargo and what company will carry out the operation, should be provided for the master. The master should check through the instruction and, if everything is in order and it is safe for the operation to be carried out, the fumigation of the cargo should be allowed to go ahead.

Although most grain and seed cake cargoes are routinely fumigated, there is a group of these commodities which are not, namely organically produced grains, which includes oil seeds. Organic grain is grown without the use of insecticides and for this reason fumigation may not be wanted or allowed. If the master knows that the cargo loaded into the holds of the ship was produced by organic methods and if instructions are received that the cargo is to be fumigated, the master should make further enquiries to ensure the instruction is correct, including advising the ship operator, before allowing the operation to begin. An organic grain may be considered to be no longer organic once it has been fumigated.

If the fumigation is to be continued in transit, the master should ensure all the required procedures of the IMO recommendations and those of the safety management system are followed. The master should ensure the fumigator-in-charge and the

operatives are fully trained and the ship has on board and/or obtains all the required equipment, spares, documents and certificates. The master and the ship's crew should co-operate with the fumigator-in-charge and should observe the deployment of the fumigant and the various inspections and tests should be carried out correctly to ensure the appropriate procedures are followed.

Application of pellets or tablets

The pellets or tablets which will produce the phosphine gas can be applied in a number of methods.

Options for applying fumigant pellets and tablets

- Scattering of pellets or tablets over the stowage surface.
- Placing socks, sleeves, or other packages containing the pellets or tablets at intervals over the stowage surface.
- Digging a trench or trenches in the stowage surface and applying the pellets or tablets in the bottom of the trench either loose or in retrievable socks, sleeves, or other packages, and then back-filling the trench(s).
- Using a short and/or a long probe to place loose pellets or tablets or retrievable socks, sleeves, or other packages containing pellets or tablets about a metre or more into the stowage.

During the application of the pellets or tablets, either loose or in packages, the crew should observe the application to ensure the fumigant is spread or placed in accordance with the fumigation plan and the calculations for the required concentration of gas. These observations by the crew should be carried out at a safe distance and by crew members wearing appropriate protective clothing. Notes should be taken of the methods of application and the number of pellets or tablets at each location in each hold fumigated. A plan should be drawn showing the disposition of the applied pellets or tablets. Photographs should be taken of the operation. It should be borne in mind that the chemical reaction which produces the phosphine gas also produces heat, and if there are piles of pellets or tablets in or on the cargo stowage the heat produced might cause heating of adjacent cargo, which might in turn cause a fire or explosion.

The master and crew should not, however, under any circumstances handle fumigant materials or carry out the application of the pellets or tablets themselves.

Redistribution of fumigant gas

One method for redistributing fumigant gas, after application, is the use of re-circulation fan and tubing; this is sometimes referred to as the 'J System'. Before loading of the hold, the fumigators set up a system of perforated tubing leading down from one of the access hatches to, and across, the tank top forming the shape of a 'J'. After completion of loading a fan is fitted to the top of the tubing in the access hatch and further tubing is fitted from the fan to the main hatchway. The fan is then connected to an electrical supply and is tested. During the period of fumigation the fan is run to draw fumigant gas from the coaming space and to circulate that fumigant into the stowage at lower levels, thereby increasing the effectiveness of the fumigant. If this method is used the master should ensure the safety of the electrical connections for the fan and

the safety of power cables, and should ensure the cover or door of the access hatchway is maintained weathertight throughout the voyage.

During the voyage

Because phosphine gas is highly toxic, any exposure may cause injury or death. For this reason, in accordance with the recommendations, at least two crew members are trained in the following.

Crew training requirements

- The use of gas-detection equipment.
- The instructions for the use of the fumigant, including methods of detection of the fumigant in air, its behaviour and hazardous properties, symptoms of poisoning, relevant first aid and special medical treatment and emergency procedures.
- The disposal of residual fumigant material.

In addition, those crew members should be trained with regard to the gas concentration checks which must be carried out during the voyage, when and where those checks are to be done and what records must be kept.

Throughout the voyage, at 8 hour intervals, or shorter intervals if it is thought appropriate, gas concentration checks to obtain gas concentration readings should be taken in all common working spaces, and in other locations where gas might accumulate, and the readings should be recorded in the deck log book. If any high readings are obtained which indicate leakage of the fumigant from a cargo hold the area concerned should be evacuated, closed off for entry and thoroughly ventilated. The cause of the gas concentration should then be located and sealed as appropriate or possible by crew members wearing appropriate safety and respiratory protection equipment. Only when the leakage has been sealed and the location has been ventilated to remove the gas concentration can the area be re-opened for use by the crew.

It is reported that phosphine gas can be detected because it has a smell of garlic. This is not a reliable method and the absence of a garlic smell does not mean the absence of phosphine gas. The only reliable method of detecting phosphine gas is by the use of the gas-detection equipment which is on board for the purpose.

During the fumigation operation, after the cargo has been loaded, the pellets or tablets are distributed by hand and the production of phosphine gas is slow to start with. This may tend to give a false sense of security, but do not be deceived; the build-up of phosphine gas will continue under the closed hatch covers and the gas concentration will increase. This means that even when no detectable levels of phosphine gas are found outside the holds using the gas detection equipment during the early part of the voyage there remains the possibility that there will be leakage of the gas later in the voyage. Leakage of gas might occur at any time and is why the gas concentration checks should be carried out throughout the voyage variously in the accommodation, the engine room, the navigation bridge and in other frequently visited working areas and stores.

When considering which spaces in the accommodation, which parts of the engine room, which storeroom and which other compartments should be monitored for gas concentration, thought should be given as to how fumigant leaks may occur. Gas may enter the engine room, accommodation spaces or storerooms via pipe tunnels, ducts, piping of any kind, including wiring ducts on or below deck, or dehumidifier systems

that may be connected to parts of the cargo holds and compartments in the engine room. Also, consideration should be given to potential leakage via bilge and other piping systems and their valve arrangements.

Ventilation procedures for the accommodation, the engine room and other spaces should be reviewed to avoid the possibility of drawing fumigant gas into those spaces by incorrect ventilation. Further, it should be verified that ventilation flaps and closing devices are correctly set before the fumigation is carried out and they should be maintained in the correct arrangement throughout the fumigation period. A review of the ventilation regime should be completed before any ventilation of the cargo compartments is started and any necessary changes to those arrangements should be made. Warning signs should be posted where necessary and appropriate.

There have been a number of incidents involving the injury or death of crew members due to exposure to fumigant gas following leakage from holds, and exposure was the result of a lack of appropriate gas concentration safety checks. If there is any doubt about the possibility of there being leakage of fumigant gas and the possibility of the gas accumulating in accommodation or working areas, all affected areas should be evacuated and emergency procedures should be followed.

With regard to the opening of holds sealed for fumigation in-transit, sub-section 3.3.2.14 of the IMO recommendations states as follows: 'Except in extreme emergency, cargo holds sealed for fumigation in transit should never be opened at sea or entered. If entry is imperative, at least two persons should enter, wearing adequate protection equipment and a safety harness and lifeline tended by a person outside the space, similarly equipped with protective, self-contained breathing apparatus.'

Throughout the fumigation period, as stated by the fumigator-in-charge, the hold or holds should be kept closed and sealed gas-tight. At the end of the fumigation period those compartments should be ventilated to remove as much of the fumigant gas as possible. The initial ventilation of the holds should be carried out when there is a strong cross-wind which will take the fumigant gas away from crew accommodation and working areas. A record should be kept in the deck log book or in a ventilation log of the status of each hold on a daily basis. The records should include when holds are not ventilated because they are under fumigation, when holds are ventilated and when holds are not ventilated (after the fumigation period) for another reason, with the reason being stated.

Before arrival at the first discharge port, and not less than 24 hours before arrival, the appropriate authority should be notified that cargo has been fumigated in-transit, with details of the fumigant and whether or not any ventilation of the cargo has been carried out. This should form part of the information exchange required under the BLU Code.

After arrival

Following the ship's arrival alongside after a voyage when the holds have been ventilated, the weather-deck hatch covers must be opened to allow the offloading of cargo. When the covers are opened there will be the release of some of the remaining fumigant gas. This being the case, during the opening operation the number of crew members on deck should be kept to the minimum necessary.

Before any stevedores or other personnel enter a fumigated hold, the atmosphere in the holds involved should be tested by a suitably trained and qualified person to ensure entry is safe. The readings obtained should be recorded in the deck log book. If entry

into any compartment is not safe because of gas concentrations, appropriate ventilation should be carried out, after which further testing should be done and only when the atmosphere is safe should entry by personnel be allowed. All readings should be recorded in the deck log book together with appropriate additional information.

The phosphide pellets or tablets react with the atmospheric moisture to produce phosphine gas. As this process takes place the pellets or tablets decay to form a light grey powder residue. If the pellets or tablets were loosely deployed on the stowage surface small piles of the light grey powder will be seen, but it will not be possible to remove much, if any, of that loose powder. If the pellets or tablets were deployed sub-surface the powder will not be visible. Fully-reacted powder residue is not harmful and is not a contaminant of the cargo.

If the pellets or tablets were deployed in recoverable socks, sleeves, or other packages, they should be retrieved from the stowages before offloading starts and they should be disposed of appropriately and in accordance with the instructions provided by the fumigator-in-charge. As there may be unreacted phosphide in the residues, such disposal should be carried out by qualified shore personnel rather than the crew. Unreacted residues may be a fire hazard and/or may emit toxic gas if stored in a confined space on board, for example a mast house. Residues shall therefore not be removed from the holds at sea.

As the offloading of cargo is progressed and before stevedores' labour enters the holds, monitoring of the atmosphere in the holds should be carried out by trained personnel wearing appropriate respiratory protection to ensure the holds are safe to enter. If appropriate, the stevedores' labourers should wear respiratory protection.

When offloading has been completed, further tests for fumigant gas should be carried out. When the ship is found to be free of fumigant, a gas-free certificate should be issued. The warning signs should then be removed and the gas-free status recorded in the deck log book.

Bagged cargoes

Products such as grain, particularly rice, and seed cake are often carried in bags and insects are likely to be present inside some of the bags, such that fumigant control might be necessary. The fumigation of bagged cargo is often carried out ashore in storage warehouses but it is also done on board, usually by the use of phosphine in accordance with the 'Fumigation continued in transit' requirements of section 3 of the IMO recommendations.

When a bagged cargo is to be loaded and fumigated in-transit the master should follow the requirement of the recommendations, any requirements in the safety management system manual and the guidance set out in this section. In addition, there are some further points for the master to bear in mind.

If the pellets or tablets are deployed loose, the powdery residue is likely to cause staining of the bags which cannot be removed easily and might lead to complaints from the stevedores and/or cargo interests. It is therefore recommended that the fumigant is deployed in retrievable socks, sleeves, and other packages and all are recovered before offloading starts.

The recommendations state that fumigated cargoes should only be discharged by mechanical means that do not require entry of stevedores into the holds. In practice,

bagged cargoes are generally offloaded by stevedores' labour in the holds, and therefore continuous monitoring of the working holds should be carried out throughout the operation.

The fumigation of bagged cargoes is not allowed on board ships at US ports, and therefore such cargoes loaded at US ports are likely to be fumigated at destination, before offloading.

VOYAGE PROCEDURES, PLANS AND RECORDS

In order for the loading of cargo, the carriage and care of that cargo and finally the offloading operations to be carried out correctly, smoothly and without problems arising, it is always necessary for various plans and procedures to be drawn up, followed and completed. The information required will be drawn from a number of sources and it must be ensured that the requirements of relevant IMO regulations and the local authorities at the ports of loading and unloading are complied with in their entirety.

The sequence for the completion of a successful voyage, from the initial preparation for the voyage through to completion and the final offloading of cargo, can be summarised as follows:

Bulk cargo voyage checklist

- The voyage charterparty, the charter recap and voyage instructions will provide information with regard to the cargo to be loaded and the ports involved.
- Communications will provide details of the cargo to be loaded and the load port, and likely dates and times involved.
- Ongoing maintenance will ensure the ship, and in particular the hatches and cargo compartments, are in satisfactory condition.
- Preparation of the holds to the required standard for the particular cargo to be loaded will be completed in good time.
- Pre-loading plans, strength and stability calculations and, if appropriate, grain stability calculations, will demonstrate that the cargo can be safely carried, after which the loading plan will be prepared.
- Pre-arrival exchanges will be completed to ensure the loading of cargo can be carried out as intended and without difficulties arising.
- During the loading period, monitoring of the ongoing operations and of the ship's draught will ensure cargo is loaded in accordance with the loading plan and, therefore, the strength and stability requirements.
- During the voyage the condition of the cargo will be monitored as appropriate for the particular cargo, ventilation of the cargo compartments will be carried out as required and any water which accumulates in the hold bilges will be monitored and pumped out as appropriate.
- For arrival at the discharge port an unloading plan will be drawn up and the pre-arrival exchanges will be completed to ensure the offloading operation progresses without problems arising.
- During the discharge of cargo, monitoring of operations will be carried out and checks of the ship's draught will be done to ensure the operation progresses as planned.

Throughout all of these operations the master and the ship's deck officers should progressively obtain information, carry out calculations, draw up plans and keep written records, while also obtaining various documents and certificates with respect to the cargo

loaded and requirements for its carriage to destination. These records should be kept for a minimum period, usually stated within the requirements of the safety management system procedures for the ship involved. As a guide to the records which should be kept or obtained and then retained on board, there are lists in chapter V. The lists given are general lists and are not exhaustive; they include many documents which are obvious to any experienced master and some which are not so obvious, although most would be useful in the event of a claim or problem arising. It should be pointed out, however, that not all of the documents listed will be relevant on all ships and during all voyages.

The sequence of a voyage includes topics such as the maintenance of the ship, hold cleanliness, the identification of the cargo to be loaded and the various monitoring and checking tasks which should be carried out (see Chapter 4 and Chapter 5). The procedures of the voyage are dealt with here, including the planning and associated calculations for loading and subsequent offloading of the cargo.

Cargo and port identification

From the voyage instructions and from subsequent communications, the master should obtain confirmation of the identity of the cargo to be loaded, the weight of the cargo to be loaded and the identity of the port or ports at which loading is to take place. Also, if possible, the identity of the discharge ports should be provided.

Following on from receipt of that information, the master should establish what limits will apply during the voyage; these might include a limiting air draught at one or more of the berths, a draught restriction at one of the ports or for transit of the Panama Canal, or a restriction under the International Convention on Load Lines, as amended, if the ship is to pass through a particular zone, for example, the winter North Atlantic zone. When the details of the voyage are known, the master can then, with the assistance of the chief engineer, plan the bunker requirements for the voyage and where bunkers are to be taken, if necessary.

Voyage – plans and calculations

When the master has gathered together the required preliminary information, the next step is to prepare a pre-stowage plan showing the distribution of the cargo to be loaded.

In conjunction, strength and stability calculations must be carried out for the ship in the fully loaded condition and for the various stages of the voyage to demonstrate compliance with the Intact Stability Code. Additionally, if the cargo is to be grain, grain stability calculations must be completed to demonstrate compliance with the International Grain Code. For these various calculations to be completed, the master should bear in mind a number of factors as follows.

Strength and stability calculations checklist

- The weight and distribution of miscellaneous items already on board, such as the amount of bunkers remaining at each of the various stages of the voyage, un-pumpable ballast water remaining in tanks, fresh water, the ship's constant and stores, and any other weights which are and will remain on board throughout the voyage. The total weight of these items will reduce the weight of cargo which can be safely uplifted.

- The weight of cargo which can be loaded may be restricted either by the volume of the cargo compartments if the cargo has a large stowage factor, or may be limited by tank top strengths and other requirements laid down in classification society rules. These aspects should be considered by the master when calculating the weight of cargo to be loaded into each of the ship's holds.
- The limiting draught for the voyage, together with the density of the water at that stage of the voyage, should then be taken into account. The limiting draught might be the ship's draught for a zone or seasonal area, as given in annex II of the International Convention on Load Lines, as amended, which might be transited during the voyage or an operational limit at a port or in a canal where a sufficient under keel clearance must be maintained. An example is a passage from South Africa to Europe during which a number of zones will be transited, another is the limiting draught in the Panama Canal. The limiting draught will limit the weight of cargo which can be carried.
- The hog or sag and the trim of the ship which will be produced by the stowage arrangement of the cargo when loaded. The maximum draught of the ship, be it aft when the ship is trimmed by the stern or at mid-length when the ship is sagged, must not exceed the limiting draught for the voyage. Also, if the mid-length load line for the particular zone or area is submerged – irrespective of the draughts forward and aft, and irrespective of whether the ship is heavily sagged such that the mean of the forward and after draughts is less than the draught required by the load line rules – the ship will be considered to be overloaded and in breach of the load line regulations.

Using the checklist, the master can conclude the required strength and stability calculations, including any necessary grain stability calculations, to demonstrate that the cargo can be safely carried to destination. On this topic, the arrangement of cargo when loaded, and the distribution of liquids on board, should be such that the shear forces and bending moments exerted upon the ship are not excessive at any stage of the intended voyage. These should, preferably, be less than 90% of the sea-going maximum allowed at all stages of the voyage at sea, that is, as opposed to the in-port maximum allowance.

The hog or sag of the ship is often overlooked or ignored because, it is assumed, if the shear forces and bending moments are acceptably low, any hog or sag will not affect the voyage as a whole. However, hog or sag will affect the voyage if there is a limiting draught at a stage during the voyage. If the ship is significantly sagged, the maximum draught may be the mid-length draught, rather than the after end draught, even when the ship is trimmed by the stern. If the ship is significantly hogged, the after end and/or forward end draughts may be in excess of the maximum required draught when the weight of cargo which was calculated to be acceptable for loading and carriage is loaded on board.

Strength and stability calculations rarely produce a figure for the likely hog or sag of the loaded ship. Bearing this in mind, the master should always take into account the likely hog or sag during initial calculations. A ship is likely to be hogged when one or more of the mid-length holds is left empty or slack and when forward and after end holds are fully loaded for cargo weight purposes, and a ship is likely to be sagged when mid-length holds are all fully loaded while end compartments are left slack for trimming purposes. The hog or sag might be only a couple of centimetres, which will have no significant effect upon the handling of the ship but if consideration is not given to the hog or sag of the ship during the early calculation stages, the hog or sag may become excessive, resulting in the ship being unable to sail or enter a discharge port.

Loading plan – the sequence of loading and de-ballasting

When the weight and distribution of cargo to be loaded has been decided upon, a loading plan should be drawn up in accordance with the requirements of the BLU Code. A copy of an example loading and unloading plan is given as appendix 2 of the BLU Code. The primary considerations when preparing the loading plan are as follows.

Loading plan considerations

- The arrangements at the port including the number of loaders and their range of movement, the least depth alongside and the air draught requirements.
- The loading sequence, including the number of pours per hold, where loading should begin and where the final trimming pours should be loaded.
- De-ballasting, including the timing of that operation to coincide with the loading sequence and the need for a substantial trim during stripping of the ballast tanks.
- The shear forces, bending moments and stability of the ship at all stages of the operation.
- Trimming pours and the final draught requirements.

The loading plan should normally, unless the ship is suitably strengthened for single pass loading, be drawn up on the basis there will be two or more pours per hold during the operation. The initial pours should be into holds at mid-length and aft to give the ship a good trim by the stern to assist with the de-ballasting operation. Successive pours should be in alternately forward and after holds or into appropriate pairs of compartments if there are two loaders at the terminal. The final stage of loading will be the trimming pours with, usually, the final quantity being loaded into one nearly full hold forward and one nearly full hold aft. Alternatively, if the ship is to be loaded to a required even keel draught with one or more mid-length holds slack, the final pours might be arranged such that the ship is brought to an even keel by loading into end holds after which the final tonnage can be placed into a slack mid-length hold to complete loading. There are many acceptable loading sequences and the master should rely on experience in this regard.

When the master has decided upon the overall sequence of loading and de-ballasting, a series of strength and stability calculations should be completed so it can be demonstrated that at each stage of the operation the ship's draughts forward and aft and the shear forces and bending moments are acceptable and well within maximum allowed limits. If the results of calculations are not acceptable, adjustments to the sequence must be made and re-calculation carried out to ensure the ship is not over-stressed at any stage of the loading operation. After that, the loading plan can be finalised.

For the de-ballasting operation to progress well, the ship should be trimmed by the stern during the early and mid-stages of the operation. As a guide, the trim required for satisfactory stripping of the tanks, which will be done when half to two thirds of the cargo has been loaded, should be at least 1% of the length of the ship, that is, for a handy-size ship the trim should be about 2 m, for a panamax ship the trim should be at least 2.5 m and for larger ships the trim should be well in excess of 3 m.

As discussed elsewhere in this guide, monitoring of operations is essential to ensure the required outcome is achieved. During the loading operation, the draughts of the ship should be monitored to ensure the loading plan is being followed. This is particularly important during the final stages of the loading operation to ensure the required final draughts are achieved with no, or an acceptable, hog or sag of the ship. Also, the ship

should be kept upright, or nearly upright, at all times during the loading operation and should be completely upright upon completion. Throughout the operation there should be exchanges of information between the terminal representative and other shore personnel and the master and the ship's deck officers and crew, including information about the weight of cargo loaded and the progress of the de-ballasting operation.

Following completion of loading, if the weight of cargo in any of the holds is different from what is set out in the loading plan, strength and stability calculations should be done again to establish whether or not the ship is in a satisfactory condition for the intended voyage. If the strength and stability requirements are not met, the ship cannot be taken to sea and arrangements must be made for the stowage of the cargo to be adjusted and put right. Discussions with regard to how best to rectify the situation should be held and agreement should be reached with regard to a plan of action. Appropriate arrangements should be made and preparations should be undertaken to adjust the stowage arrangement of cargo and to bring the ship into a safe condition for the intended voyage. Only after that operation has been completed can the ship proceed towards the discharge port.

Unloading plan – the sequence of unloading and ballasting

During the voyage, when the identity of the offloading port or ports is known, the master should draw up an unloading plan which, as for the loading plan, should be in a form similar to that which is included as appendix 2 to the BLU Code. For the preparation of the unloading plan the master should consider the following.

Unloading plan considerations

- The port arrangements, including the number of unloaders available and their range of movement, the maximum draught available and the minimum air draught available.
- The weight of cargo to be unloaded at the port or ports and its distribution on board.
- Ballasting, including the timing of that ballasting operation which should coincide with the unloading sequence and trim of the ship.
- The shear forces, bending moments and stability of the ship at all stages of the operation.
- Final draught requirements and air draught requirements.

The unloading plan should, preferably, be drawn up on the basis that there will be offloading from each hold in two stages, or more, as the loading of cargo was done, but in reverse. A sequence of ballasting should ensure that the trim of the ship is never excessive.

As with the preparation of the loading plan, when the overall sequence has been decided upon, the master should carry out a series of strength and stability calculations so it can be demonstrated that at each stage of the operation the ship's draughts forward and aft and the shear forces and bending moments are acceptable and well within maximum allowed limits. After that, the unloading plan can be finalised.

As with the loading and de-ballasting operations, unloading and ballasting should be monitored throughout to ensure that the unloading plan is being followed.

Changes to loading/unloading plan

It is often the case that the loading plan or the unloading plan will require some changes, ranging from minor modification through to massive alterations, variously at

the beginning of operations and as the work progresses. This might arise for a number of reasons as follows.

Reasons for changing loading/unloading plan

- Number of cranes or loaders/unloaders not as anticipated.
- Availability of cargo for loading/storage for cargo ashore not as anticipated.
- Mechanical problems ashore.
- Ballasting/de-ballasting problems on board.

During initial discussions between the master or chief officer and the terminal representative, the abilities and requirements of the terminal should be provided. Any necessary modifications to the initial stages of the loading/unloading plan should be made and agreed with as little delay as possible so that the operation can be started. Further modifications or alterations can be made subsequently as required.

When changes are made to the sequence, appropriate strength and stability calculations should be completed for each stage of the operation to demonstrate that the operations are safe. If, however, the results of calculations show that the shear forces or bending moments would be excessive, further adjustments to the loading/unloading plan must be made until a sequence is found which is acceptable and safe in terms of shear forces and bending moments. After this, agreement should be reached between the master or chief officer and the terminal representative that the new loading/unloading plan is to be followed.

Terminal representatives at both loading and offloading ports should be accustomed to the need for plans to be altered as the operation progresses, and the need for time to be spent on the necessary calculations. The master should not be forced into quick decisions or sequences which have not been fully assessed by shear force and bending moment calculations.

The object of the exercise is to load or offload the cargo without producing excessive stresses in the hull of the ship. If the wrong decision is made because there is insufficient information, the hull will be over-stressed, possibly with resultant structural damage.

During all stages of any loading or offloading operation, the master and deck officers should monitor the work to ensure the agreed plan is being followed. The master should maintain contact with the terminal representative and other shore personnel to exchange information about the progress of operations on board and ashore so as to avoid a situation in which a departure from the plan will be necessary before appropriate assessments can be made. By ongoing monitoring and exchange of information, the requirements of the BLU Code should be followed.

Records

In Chapter 9 of this guide there are lists of records which should be variously kept on board or obtained during a normal voyage and then retained. In brief, the basic records should include the following.

Records to be kept during voyage

- Charterparty, recap and voyage instructions.
- Communications relating to the cargo to be loaded, hold cleaning and any hold coating requirements.
- Communication with the loading terminal.
- Stability and strength calculations and cargo stowage calculations.
- Pre-stowage plan.
- Loading plan – signed.
- Ship–shore safety checklist – loading port – completed and signed.
- Terminal information book
- Deck log book with all relevant details.
- Port log (if used) with all relevant details.
- Work book in which details are kept of all discussions and agreements, loading operations, draught readings, inspections of cargo and findings, and of any other events.
- Cargo declaration, together with any associated certificates.
- Any altered loading plans – signed.
- De-ballasting records.
- Statement of facts – loading port.
- Fumigation plan and other associated documents and records (if appropriate).
- Ventilation records.
- Records of cargo and/or cargo hold atmosphere monitoring and any inspections of the cargo.
- Record of bilge soundings and any pumping operations, and associated records.
- Communications with discharge port or ports.
- Unloading plan – signed.
- Stability and strength, and cargo stowage calculations.
- Ship–shore safety checklist – unloading port – completed and signed.
- Terminal information book.
- Deck log book, with all relevant details.
- Port log (if used) with all relevant details.
- Work book in which details are kept of all; discussions and agreements, discharge operations, draught readings and of any other events.
- Any altered unloading plans – signed.
- Ballasting records.
- Statement of facts – unloading port.

Chapter 6

UNDERSTANDING THE HAZARDS

GENERAL COMMENTS AND GUIDANCE

This Chapter provides general notes and guidance on the hazards associated with particular types of cargo and on cargoes which present particular problems or difficulties. Further information and requirements that must be followed by the masters of ships carrying either grain or solid bulk cargoes, and others involved with their transportation by sea, can be found in SOLAS, the IMSBC Code, the International Grain Code, other codes, guidance notes and the ship's safety management system procedures.

All bulk commodities are either grain or sold bulk cargo and must be stowed accordingly.

Bulk Commodities	
Grain	Must be stowed and carried in accordance with the provisions of the International Grain Code.
Solid bulk cargo	Must be stowed and carried in accordance with the provisions of the IMSBC Code, and must have a BCSN.

There are only two exceptions. The first is solid bulk cargo commodities which are non-cohesive and have an angle of repose of less than or equal to 30° and the second is solid bulk cargo commodities which are not grain and are not listed in appendix 1 of the IMSBC Code.

Bulk Commodity Exceptions	
Non-cohesive solid bulk cargoes with an angle of repose of less than or equal to 30°	Must be stowed and carried in accordance with both the International Grain Code **and** the IMSBC Code.
Sold bulk cargo commodities which are not grain and are not listed in appendix 1 of the IMSBC Code	Cannot be carried unless and until the appropriate certificates have been issued under sub-section 1.3 of the IMSBC Code.

Before a ship can carry grain or other solid bulk cargo the ship must be assessed and appropriate documents must be provided and retained on board. For the carriage of any cargo, the ship must have on board all the appropriate statutory certificates as well as stability data and associated plans, including a stability booklet, probably a loading computer and an instructions manual.

For the carriage of grain in bulk the ship must have on board a Document of Authorisation to carry grain in bulk in accordance with the International Grain Code and a Grain Loading Manual incorporating grain loading stability data and associated plans. For the carriage of solid bulk cargoes the ship may have on board a Document

of Compliance for ships carrying dangerous goods, together with its appendices or attachments, and a certificate of compliance with the IMSBC Code together with its appendices or attachments.

All cargo ships of 2,000 GT and upwards shall have fitted a fire extinguishing system which can delivery either carbon dioxide or inert gas into the cargo spaces. If it is intended that the ship is to carry only cargoes which constitute a low fire risk the ship's flag state administration may grant an exemption if the ship is suitably fitted with steel hatch covers and other effective closing devices. If the ship is not fitted with a fire extinguishing system and has therefore been issued with an exemption, the carriage of cargoes which are not listed on the IMO list of cargoes which constitute a low fire risk is not permitted. This includes many cargoes listed as Group B in the IMSBC Code, and also some Group C cargoes, for example wood pellets.

If the ship is to carry dense cargoes, for example some types of iron ore, it must be designed and constructed with sufficient strength to withstand limited flooding in all loaded conditions. Details of what types of solid bulk cargo a ship may carry are set out in the ship's certificate of compliance with the IMSBC Code.

The IMSBC Code draws attention to there being three categories of hazard associated with shipments of solid bulk cargoes, as follows.

IMSBC Code hazard categories

1. Improper distribution of the cargo which may lead to structural damage to the ship.
2. The loss of, or reduction in, the stability of the ship during the voyage, which might result from:
   a) A shift of cargo due to inadequate trimming or improper distribution of the cargo.
   b) A wet cargo liquefying under the stimulus and vibration or motion of the ship, and then sliding or flowing to one side of the cargo compartment.
3. Chemical reactions within the cargo which may cause the emission of toxic or flammable gases, spontaneous combustion or severe corrosive effects.

To avoid the development of hazards, the characteristics of the cargo must be known prior to shipment, the loading operation and the discharge operation must be properly and adequately planned, and any procedures which must be carried out during the voyage must be planned beforehand to ensure the necessary equipment is on board. In addition, at all times, the safety of personnel must be taken into account.

It is recommended that the information and guidance as set out in the IMSBC Code and in the International Grain Code, as appropriate, is followed at all times. In Chapter 7 additional information is set out with regard to hazards associated with some types of solid bulk cargoes which are routinely carried. Also given for these types of cargo is some guidance on the requirements for hold cleanliness before loading and cleaning operations after unloading.

All cargo types carried, other than grain, are given a bulk cargo shipping name (BCSN) and this name must be given on the shipper's cargo declaration so that the master can establish from appendix 1 of the IMSBC Code, irrespective of what information is provided by the shipper, the group of the commodity (A, B, C or A and B), the likely hazards, details of other carriage requirements and precautions which must be

borne in mind and what information and certificates must be provided by the shipper in addition to the cargo declaration. Many types of cargo have a trade name or secondary name which is quite different from the BCSN but which will appear on all other cargo documents, including the bill of lading. This is because the contract of sale between seller and buyer is for the material described by the trade name and not necessarily as described by the simple BCSN.

For example, no.1 heavy melting steel (HMS No.1) is one of many types of steel scrap (see Chapter 7), and therefore what is given on the commercial documents will be so many tonnes of HMS No.1, or whatever, while on the shipper's cargo declaration it must be declared to be SCRAP METAL. Other examples are soya bean meal and citrus pulp pellets which are types of SEED CAKE and muriate of potash, which might be referred to as M.O.P, which has a BCSN of POTASSIUM CHLORIDE. With these factors in mind, the shipper must declare to the master the BCSN of the material to be loaded together with the commercial name which will be used on the trading documents.

If there is any doubt about the identity of the cargo to be loaded, additional questions should be directed at the shipper of the cargo prior to commencing loading.

FINE PARTICULATE MATERIALS – LIQUEFACTION HAZARD

Cargoes that are at risk of liquefaction are those containing at least some fine particles and some moisture. The cargoes most associated with this hazard have traditionally been mineral concentrates, although many other cargoes can also liquefy, such as fluorspar, certain grades of coal, pyrites, mill scale, sinter or pellet feed. In recent years, there has been particular industry attention on the liquefaction risks of certain unprocessed ores, particularly nickel ore and iron ore fines, following some high-profile casualties. Any damp or wet cargo containing at least a proportion of fine particles should be queried for potential liquefaction risk.

Cargoes which may liquefy are categorised as Group A in the IMSBC Code. Section 7 of the IMSBC Code gives guidance for cargoes that may liquefy and section 8 deals with test procedures for cargoes that may liquefy. Additionally, appendix 2 gives details of laboratory test procedures, associated apparatus and standards, and appendix 3 sets out properties of solid bulk cargoes including cargoes which may liquefy. In appendix 1 there are the individual schedules of solid bulk cargoes, each of which is given its group category. It is strongly recommended that the IMSBC Code should be studied.

In this section some additional guidance is provided with regard to the causes of liquefaction of solid bulk cargoes, the documentation which is required from the shipper of the cargo and the precautions which the master should bear in mind.

Liquefaction process

Although they often look dry in appearance at the time of loading, these cargoes contain moisture in between the particles. At the time of loading, the cargoes are usually in their solid state, where the particles are in direct contact with each other and therefore there is physical strength of resistance to shear strains. During ocean transport, cargoes are exposed to agitation in the form of engine vibrations, ship's motions and wave impact, resulting in compaction of the cargo.

The process of liquefaction occurs when the bulk cargo settles and compacts in the cargo compartment during the ocean voyage. Settlement and compaction of the cargo

during the ocean voyage is inevitable with any granular cargo because of the movement and vibration of the ship.

At the time of loading, these cargoes will usually be in a granular state and may look like sand or earth, possibly damp in appearance but not obviously wet. In that state, the individual particles making up the bulk material are in direct physical contact with each other, forming a stable matrix which is kept in a solid state by the friction between the particles along the contact surfaces. The spaces between the particles in the stowage, which might be called interstitial, or void, spaces, are occupied partly by air and partly by water. The wetter the cargo is, that is the higher the moisture content of the material, the greater the amount of water in the interstitial space.

The physical processes resulting in partial or full liquefaction are complex and cannot be predicted in detail for any specific cargo, but the principles can be understood in a somewhat simplified manner as follows.

Liquefaction process and consequences

- Throughout the voyage the cargo will be exposed to mechanical agitation caused by engine and propeller induced vibrations, wave impact and the motions of the ship in the seaway.
- The agitation results in a gradual settling and compaction of the cargo.
- This process inevitably leads to a reduction in the space between the particles and therefore a reduction in the space available for the air and the water.
- As water is incompressible, the volume of the water remains unchanged, and it remains around and between the particles of cargo within the stowage.
- As the settling and compaction of the cargo continues, a situation may be reached in which the volume of water within the cargo prevents further compaction and reduction of the space between the particles for that water to occupy. At this point the water pressure within the cargo increases significantly and the individual particles are forced apart by the interstitial water and they become surrounded by water and no longer in contact one with another.
- The friction is then reduced and the cargo turns into a viscous fluid, that is it has liquefied.
- In this liquefied state, the cargo may shift to one side of the cargo compartment, resulting in a list and, potentially, capsizing and sinking of the ship.

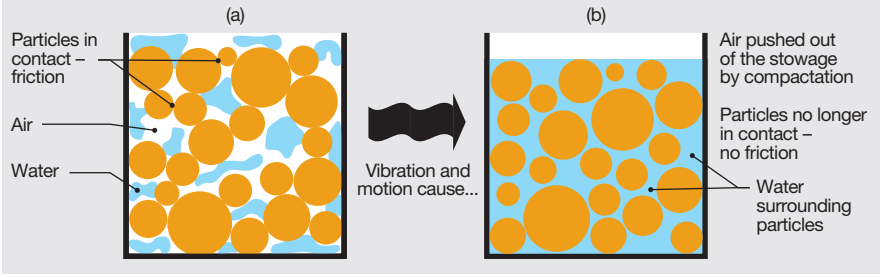

Fig. 22. (a) Particles in contact with each other and therefore friction holds the cargo together, (b) particles not in contact with each other but surrounded by water – resulting in liquefaction.

If the volume of the water is smaller than the interstitial volume within the bulk stowage, even at maximum compaction and when most of the air has been pushed out, the cargo will remain granular and the individual particles will remain in contact with

each other, such that no liquefaction will take place. That is, the moisture content is too low for liquefaction to occur.

Therefore if the cargo is sufficiently dry, liquefaction will not occur regardless of the degree of mechanical agitation and the extent of compaction or settling during the voyage, whereas if the moisture content is above a certain level, liquefaction may occur during the voyage.

The lowest moisture content at which liquefaction can occur under standardized test conditions is called the flow moisture point (FMP).

Flow moisture point (FMP) and moisture content

The FMP depends on the volume of void spaces between the particles of the cargo at maximum compaction. As the void volume depends on the size, shape and surface consistency of the individual particles making up a cargo, the numerical value of the FMP differs substantially between cargoes from different mining locations and/or processing facilities. Therefore, the FMP cannot be predicted but must be determined by laboratory testing in each instance. As the FMP is a property of the material itself, it does not change with time, or as a result of storage conditions.

Mineral concentrates are processed materials which are produced by a controlled industrial process such that during the production of many thousands of tonnes, the consistency of the cargo will be the same and therefore the FMP for that material will remain the same. This is not the case with materials such as nickel ore and most iron ore fines, which are not processed materials but are simply dug out of the ground, often in remote regions, and then presented for ocean transport. As a result of there being little or no processing, the consistency of the material can vary greatly between different parcels presented for shipment such that the FMP may vary between different parcels, and within a single parcel.

The moisture content of the cargo may well vary markedly within a shipment or between shipments. This might be because of one or more causes. The cargo may come from mining pits of different original moisture, or it may have been delivered from a large stockpile in which the upper level cargo is fairly dry while the material at lower levels in the stockpile is relatively wet due to downward draining of the water, or some cargo may have been wetted by rainfall while other parts of a stockpile remained relatively dry because they were covered during that rainfall. To make an assessment of the acceptability of the cargo for shipment, and to determine whether or not the cargo is likely to liquefy during the voyage, the moisture content of all parcels of cargo must be known for comparison with the FMP.

Moisture content is the proportion of a representative sample which is water expressed as a percentage of the total wet mass of that sample. The FMP and the transportable moisture limit (TML) are also expressed as a percentage so that direct comparisons can be made. The relationship and comparison between moisture content, FMP and TML are discussed in the following sub-section.

SOLAS and IMSBC Code requirements

SOLAS requires that the shipper of bulk cargoes provide the master of the carrying ship with information on the cargo sufficiently in advance of loading to enable the precautions which may be necessary for proper stowage and safe carriage to be put into effect. Such information shall be confirmed in writing and by appropriate shipping documents prior to loading of the cargo on the ship. That information is to be provided

primarily in the form of a cargo declaration on which the various pieces of information are set out and Declaration is to be accompanied by certificates of test. These requirements are set out in section 4 of the IMSBC Code.

For a cargo which is liable to liquefy, that is a Group A cargo, a certificate of moisture content and a certificate of transportable moisture limit must be provided. The FMP is effectively the lowest moisture content at which a cargo can liquefy when settlement and compaction takes place during a voyage. The TML is a moisture content less than the FMP figure, the difference being a safety factor, at which the cargo is considered to be safe for carriage. Whereas the FMP can be determined in a laboratory by two alternative IMO-approved test methods (the flow table and the penetration test procedures which are described in the following sub-section), the TML obtained by these test methods is a figure which is calculated, rather than being measured, and is defined as being 90% of the FMP (except in peat). Therefore, for a cargo with an FMP of, for example 10%, the TML for that cargo will be 9% and therefore only consignments with a moisture content below 9% may be shipped.

Fig. 23. Loading of chrome concentrate into the holds of a 'tween deck ship

Fig. 24. The same stowage of chrome concentrate in Fig. 23 after it liquefied

The safety margin of 10% is essential and should not be compromised, as there are a considerable number of potential sources of variability in both the FMP and the moisture content determination, in terms of sampling as well as in terms of laboratory testing.

A third IMO-approved test method, the Proctor/Fagerberg test procedure, determines the TML directly, rather than by calculation from the FMP (see following sub-section).

In principle, any damp or wet solid bulk cargo which contains at least some fine particles is at risk of liquefaction. The IMSBC Code specifies that all such cargoes should be submitted for laboratory testing to establish whether or not they possess flow properties. If such testing shows that the cargo possesses an FMP, the shipper must provide a certificate of moisture content and a Certificate of transportable moisture limit prior to commencement of loading.

Certificate of transportable moisture limit

TML is the fundamental safety parameter of Group A cargoes as cargoes should only be accepted for loading if the moisture content is below this maximum figure.

Samples, which fully represent the cargo being offered for shipment, should be drawn and these samples should be tested in a laboratory. There are several different alternative test methods for the determination of FMP and TML, three of which are described in full in appendix 2 of the IMSBC Code. In addition, the competent authority of the exporting country may approve additional test procedures.

Fig. 25. Stock piles are usually exposed to precipitation

The three methods are as follows:

a. Flow table test procedure.
b. Penetration test procedure.
c. Proctor/Fagerberg test procedure (including modified method for iron ore fines).

Although the test methods are not particularly difficult, the tests must be carried out by experienced analysts who are familiar with the equipment and the signs of liquefaction which are shown in the test. Following the testing of the sample, a certificate of transportable moisture limit should be issued by the laboratory.

The flow table and penetration methods involve determining the FMP experimentally by incrementally adding water until the sample liquefies, and then calculating the TML from that result. Therefore, test certificates for these methods are expected to list both the FMP and the TML, calculated as 90% of the FMP. The Proctor/Fagerberg method determines the TML directly and test certificates for this method show the TML but do not list the FMP.

A Modified Proctor/Fagerberg method has been developed and has been approved by IMO for cargoes of IRON ORE FINES; details are set out in IMO circular DSC.1/Circ.71.

The Modified Proctor/Fagerberg test procedure, may be referred to as the Proctor/Fagerberg test type D. It is still permissible to use any one of the other three methods for any Group A cargo, including IRON ORE FINES.

Tests have shown that the TML figures produced by using the original three

methods on a single sample of cargo will usually all be within a small percentage of each other, whereas a result obtained by the new modified test method might be significantly higher. This situation would mean that if a sample of an IRON ORE FINES cargo were to be tested using the Modified Proctor/Fagerberg method it could be shipped in compliance with the new requirements at a higher moisture content than was previously the case. Such a situation might, for a cargo of IRON ORE FINES, affect the interpretation of a can test result (see further comments under the heading 'Procedures before and during loading' later in this section).

Certificate of moisture content

The declaration of moisture content must contain a statement from the shipper that the figure is the average moisture content of the cargo at the time the declaration is handed to the master prior to the start of loading. To provide such a statement, sampling of the entire cargo and testing of the samples must be carried out before the declaration is prepared. One important consequence of this is that the entire cargo or shipment must be available for sampling prior to the start of loading, rather than cargo being delivered as loading progresses. The moisture content determination must be carried out on a truly representative test sample of the entire cargo or shipment. To obtain a truly representative sample full access is necessary and careful planning of a sampling exercise is required to obtain a truly average test sample for the determination of the average moisture content of the entire consignment.

Sampling for moisture content must not take place more than seven days prior to loading. Also, additional check tests should be conducted if there is significant rainfall between the sampling exercise and loading of the cargo.

The shipper must declare the moisture content for each cargo hold of the ship separately, unless sampling has shown the moisture content is uniform throughout the entire consignment. With concentrates, the moisture content is often sufficiently uniform for this but with unprocessed ores, such as iron ore fines and nickel ore, the moisture content might vary significantly throughout the consignment and therefore parcel-by-parcel certificates of moisture content should be provided.

If two distinct types of cargo are to be loaded, and are to be co-mingled in the same cargo hold, for example if loading is from a number of different stockpiles or from different sources of supply, the shipper must provide separate certificates for each type of cargo being loaded into each hold. Similarly, the shipper must carry out separate testing of samples for each substantial portion of material which appears to be different in characteristics or moisture content from the bulk of the consignment. The moisture content for each distinct parcel of cargo must be below the respective TML.

It follows that, if cargo is loaded from more than one source, it is not sufficient for the average moisture content of all the cargo in each hold to be below the TML of the cargo; the moisture content of each lot must be below the respective TML.

One important point to be remembered is that it is not possible or acceptable to compensate for the loading of a batch of excessively wet cargo by the later loading of drier cargo into the same cargo hold, on top of the wet material. If the moisture content at any location in a stowage is greater than the FMP that part of the stowage can liquefy.

Any parts of the cargo being delivered to the ship that are shown to have a moisture content which is above the TML must be rejected as unfit for shipment.

Using polymer granules to absorb moisture

To alter the characteristics of a Group A cargo, the shipper might mix in with the cargo a small proportion of polymer granules. At present this is being done with some cargoes of IRON ORE FINES, but the use of polymers may become more widespread, and may be used with other cargo types, in the future. Polymer granules absorb moisture and expand as they do so, but then do not release that moisture again at normal ambient temperatures. When mixed thoroughly throughout a shipment of IRON ORE FINES, or possibly another Group A cargo, the granules will effectively remove and lock away moisture which would otherwise fill the interstitial space in the bulk stowage as the cargo settles during the voyage, as described in the sub-section on the process of liquefaction above. This means there will be a reduced possibility of the cargo liquefying when polymer granules are added.

However, the actual moisture content of the cargo remains the same and there is always the requirement of the moisture content being below the TML before loading. There are two main effects of mixing polymer granules into a shipment of cargo and the absorption of moisture into these granules. First, the cargo becomes easier to manage during the pre-loading handling operations, for example on conveyor belts and in hoppers, because it acts as if it has a lower moisture content. Second, when samples are tested for TML, a higher figure is obtained than would be the case if no polymer granules had been admixed. If polymer granules are added to a shipment of cargo, it should be recorded by the shipper on the cargo declaration, in the Relevant Special Properties box of the form.

Likelihood of formation of a wet base

It is a requirement under section 4 of the IMSBC Code that the shipper declares the likelihood of the cargo forming a wet base during the voyage. In section 7, paragraph 7.2.3 it is stated that some cargoes are susceptible to moisture migration and may develop a dangerous wet base even if the average moisture content is less than the TML. Although the cargo surface may appear dry, undetected liquefaction may take place, resulting in shifting of the cargo.

The water in the bulk stowage may drain slowly during the voyage. This would result in the cargo at the surface drying out somewhat while the cargo lower down becomes wetter, thus forming a 'wet base'. The moisture content of that lower level cargo may eventually exceed the FMP of the cargo resulting in undetected liquefaction and potential shifting of the cargo. As this risk exists even if the cargo meets the IMSBC Code moisture and TML requirements, the only effective protection against wet base sliding failure is to ensure the cargo is trimmed flat overall, out to the sides and to the end bulkheads of the hold, following completion of loading.

It should be noted that the Schedule for MINERAL CONCENTRATES in appendix 1 of the IMSBC Code requires trimming to the extent that the height difference between the peaks and troughs of the cargo surface does not exceed 5% of the ship's breadth. Also, it is specified in section 5 that the master has the right to require that the cargo be trimmed level.

Procedures before and during loading

When the cargo to be loaded is a Group A cargo, the master should ensure, before loading begins, that a cargo declaration and certificates of TML and moisture content

have been provided for each shipment and for each type of cargo, as appropriate. The moisture content of each parcel must be below the TML of that shipment; if it is not the shipment must be rejected.

Examination of the cargo must be ongoing throughout loading. If there is any doubt about the dryness or wetness of any part of the cargo, 'can tests' should be carried out. If the result of a can test is that the surface of the sample in the can shows free moisture or a fluid condition (as stated in section 8 of the IMSBC Code) laboratory testing of samples should be arranged. In practice, loading should be suspended, the ship operator and any charterer should be notified, surveyors should be appointed and a proper regime of sampling of the shipment of cargo followed by laboratory testing of a representative sample should be arranged.

It must be remembered that a 'can test' is not conclusive and while a failed 'can test' shows that the portion of cargo from which the sample was drawn is not safe to carry, a 'can test' does not show that the portion of cargo is safe for carriage. This being the case, when it is thought necessary to carry out 'can tests', loading should be suspended, a series of tests should be carried out and the advice of a surveyor should be obtained and then taken into account.

Fig. 26. Nickel ore in solid state before a can test – particles are held together by their friction

Fig. 27. Nickel ore in liquid state after a can test – no friction between the particles

Only cargo which is known to have a moisture content below the TML should be loaded.

This section has described the three IMO-approved methods of testing for FMP and TML and it has been pointed out that there is a new test procedure, the Modified Proctor/Fagerberg method for the testing of samples of IRON ORE FINES. It has also been pointed out that the Modified Proctor/Fagerberg method tends to produce a higher figure for TML than do the original three test methods. While bearing in mind the method used to determine the TML, the master should always carry out examinations of the cargo and when thought appropriate 'can tests' should be done.

If the cargo being loaded is IRON ORE FINES and if the TML has been

determined using the Modified Proctor/Fagerberg method, and if the master obtains failed 'can test' results, the same procedure should be followed – as section 8.4.1 of the IMSBC Code requires – that is, additional laboratory testing of new samples drawn from the stockpiles to give new results, and, therefore, certificates for TML and moisture content. The new certificates should be compared with the old certificates and only cargo which is known to have a moisture content below the TML should be loaded. If this sequence is followed to demonstrate that the IRON ORE FINES cargo being loaded is acceptable under the requirements of the IMSBC Code, it might still be the case that 'can tests' of that IRON ORE FINES are failed. In this situation, if the new certificates are in all respects correct and acceptable, loading of cargo may be continued.

Finally, it must always be remembered that there is no safe way of carrying a cargo with a moisture content above its TML except in a specially constructed ship. Also, there are no safe weather conditions or safe routes for the carriage of a Group A cargo with a moisture content above its TML.

OTHER MATERIALS NOT LISTED – LIQUEFACTION HAZARD AND CHEMICAL HAZARD

The previous section discussed the liquefaction hazard and the cause of liquefaction in commodities which contain a large proportion of small particles when shipped with a high moisture content. For safe carriage, and as required by the IMSBC Code, the moisture content of the cargo should be below the transportable moisture limit (TML). Materials which may liquefy are categorised as Group A cargoes.

In appendix 1 of the IMSBC Code there are a number of commonly carried cargoes with schedules listing their BCSNs which are classified as Group A, the main group being the MINERAL CONCENTRATES.

As mentioned elsewhere in this guide, a cargo suitable for shipment in bulk must either have a bulk cargo shipping name (BCSN) under the IMSBC Code or be a grain cargo to be carried in accordance with the International Grain Code. However, other materials are required to be carried which are neither of the above; sometimes these materials are carried correctly and without problems arising although at other times there are disastrous results. This section discusses materials which have not yet been assigned a BCSN and safeguarding procedures which must be followed to avoid the loading of a cargo which might liquefy during the voyage and/or possess chemical hazards.

The IMSBC Code is now mandatory and therefore each bulk commodity must have a BCSN. The previous section mentioned IRON ORE FINES and NICKEL ORE. For example, there is an entry for NICKEL ORE in appendix 1 of the 2013 edition of the IMSBC Code but it did not exist in previous editions. IRON ORE FINES does not have an entry in the 2013 edition of the code, but a new schedule, set out in IMO circular DSC.1/Circ.71, becomes mandatory on 1 January 2017 and may be used on a voluntary basis before 2017 (see Chapter 7). This shows that the entries in appendix 1 of the code do not include all of the materials shipped and it is continuously being updated and extended.

There is a vast array of different types and grades of materials shipped worldwide. Some materials which are carried routinely have been grouped, where possible, under BCSNs – for example the various types of ferrous metal scrap have been grouped as SCRAP METAL, Group C or FERROUS METAL BORINGS, SHAVINGS, TURNINGS or CUTTINGS, Group B (see Chapter 7) whereas others have been given

a specific BCSN, for example ALUMINA. Because the list of materials in appendix 1 of the code cannot include new commodities, there is a system by which new cargo types can first be assessed for their acceptability for shipment, after which, if found acceptable, a certificate giving all the required information can be issued.

That procedural system is set out in sub-section 1.3 of the IMSBC Code, 'Cargoes not listed in the code'. Therefore if a shipper wishes to export a new type of cargo, for example a type of ore which has never been shipped before, the process set out in sub-section 1.3 must be followed. The procedure set out in sub-section 1.3 of the IMSBC Code is discussed in Chapter 3.

It may be noted that although this procedure is designed for new cargoes, there are also a number of long-established and/or high-volume cargoes that do not have a schedule in the IMSBC Code, an example being NICKEL ORE, which was not listed until the 2013 edition of the code was published. A certificate under sub-section 1.3 is required for any unlisted cargo, even if the shipper says it has shipped the cargo for many years without incident.

Unfortunately, cargoes are being carried without the proper process being followed and without the material being properly assessed by the competent authorities involved, such that hazards are not identified and therefore the ship carrying the cargo and the crew of that ship are at risk.

One group of materials which is causing great problems for ships is mineral and metal ores, which often have a liquefaction hazard.

These ores are non-homogeneous, consisting of a mix of very fine clay, sand or earth-like particles and larger rock-like particles, and are simply mined by digging the ore out of the ground. Some of the material is fairly loose, like soil, whereas other material is hard rock and must first be blasted to break it up. The material is then moved to stockpiles, may be screened to remove large pieces which may then be crushed, and is then stored in stockpiles to await shipment. There is likely to be no further processing of the ore and no drying to remove moisture, although there might be drying of surface material by the sun and some water may drain from the bottom of the stockpile.

Some of these unprocessed ores are from deposits of weathered soils, especially from South East Asia. Depending on the main metal that is commercially extracted from them, these weathered soils may be traded under various names including nickel ore, iron ore fines or bauxite, and depending on their particle size distribution and flow properties they may be Group A or – rarely -- Group C cargoes. They generally contain clay-like hydrates and hydroxides with water in a bound form that does not readily contribute to the liquefaction processes described earlier in of this Chapter. Therefore, these cargoes often have a much higher moisture content as well as a much higher TML than other Group A cargoes – moisture content above 30% is not uncommon in nickel ore.

A number of geological terms, such as 'laterite', 'saprolite', 'limonite' and 'goethite' are used to classify such weathered soils and may be encountered on cargo declarations. For shipping purposes, these terms are of little relevance with the exception of goethite, which is a specific type of iron oxide-hydroxide. Under the new schedule for IRON ORE FINES adopted by the IMO from 2015, as set out in IMO circular DSC.1/Circ.71, iron ore fines with 35% or more goethite is a Group C cargo.

Fig. 28. A stowage of iron ore which has a high moisture content – wave markings can be seen in the pile caused by cargo dropped onto the pile from a height

Another group of materials which is causing problems may be referred to as 'site residues'. These site residues come from clean-up operations at industrial areas which are being de-commissioned; for example so that there can be a change of use of the area. The residues may contain a high proportion of iron oxide and other minerals or metals. They are usually fine-grained materials which are damp or wet, such that there is likely to be a liquefaction hazard, that is these are most likely Group A cargoes.

There may also be other hazards, such as the emission of toxic or flammable gas, which would mean that the materials should be classed as Group B as well as Group A. Some shippers have in the past described such post-industrial residues using names listed in the IMSBC Code such as 'iron ore', 'iron ore fines' or 'iron oxide'. These are inappropriate names for site residues as their properties and origin are quite different from those of the cargoes described by those names in the IMSBC Code. In most circumstances, the appropriate procedure for shipping site residues in bulk is for the shipper to apply to the competent authority of the country of loading for a certificate under sub-section 1.3 of the IMSBC Code. The authority will then assess the properties and hazards of the proposed cargo and classify it accordingly.

A third group of problem materials is industrial residues from an ongoing production process. These residues are a by-product being produced constantly by the facility and must be removed at intervals to avoid too great a build-up. An example of this type of material is mill scale from steel mills. They are often fine-grained materials, but may contain larger pieces or lumps, and may be damp or wet. Such materials are likely to be Group A cargoes. In addition, the materials often comprise metallic and chemical

compounds and therefore may possess chemical hazards, such as the emission of toxic or flammable gas, as well as a liquefaction hazard. If so, the materials should be classed as Group B as well as Group A. Mill scale in particular is sometimes shipped in bulk declared inappropriately as 'iron ore fines'.

There are other materials which are not listed in the IMSBC Code. Some of these will be Group C cargoes when eventually listed while others will be Group A and/or Group B. Also there may be other materials which come into the market which have not been carried in bulk before and for which the procedure set out in sub-section 1.3 of the IMSBC Code should be followed. The master should be aware of this and take necessary precautions.

The vast majority of shippers diligently follow all of the requirements set out in the IMSBC Code. The cargoes they are shipping have the correct BCSN, they are properly sampled and tested and the certificates and the information given to the master are all correct and reliable. However, there are some shippers of cargo who, for a number of reasons, do not provide the master with the correct, reliable and complete information which relates to the cargo to be loaded on board the ship. The background and reasons for this may involve one or more of the following.

Reasons why not all bulk cargoes are correctly documented

- Some shippers are not aware of the IMSBC Code or that its requirements are mandatory worldwide and for all ships under SOLAS.
- Some shippers are familiar with the IMSBC Code but choose to ignore the requirements.
- Some materials are given an incorrect BCSN, which might mean that a material is said to be Group C rather than Group A and/or Group B if they were correctly identified.
- Sampling and testing is sometimes not carried out in accordance with the requirements such that the results are meaningless, and may incorrectly show that the cargo is safe for carriage when it is not.
- Certificates relating to a previously carried cargo may be presented to the master of a ship awaiting loading of cargo stockpiled ashore.
- Certificates presented to the master may have been produced by a laboratory (or in some cases an office) which is not a laboratory recognised by the competent authority of the loading port and/or may not be familiar with the required test methods.
- Certificates may be knowingly falsified to show the cargo to be safe when it is not safe for carriage.
- Certificates may not show the required information about the cargo to be shipped.

From the master's point of view, there is a series of observations and checks which should be undertaken and completed, before and during loading, to establish whether or not the cargo is safe for carriage with no risk of any or all of the cargo liquefying or creating a chemical hazard during the voyage. Some points to be borne in mind throughout the period from before arrival at the loading port to completion of loading are as follows.

Cargo pre-arrival and loading checklist

- The cargo must be assigned a bulk cargo shipping name (BCSN) by the shipper.
- The cargo may have a trade or commercial name in addition to the BCSN. The trade or commercial name might appear on the bill of lading and other commercial documents but that name must be another form of the BCSN; if it is not, further information is required.
- The shipper must give to the master a cargo declaration which must be in a recognisable format and must show all of the relevant characteristics and give all of the relevant information about the cargo to be loaded. Guidance on this is obtained from the schedule for the BCSN in appendix 1 of the IMSBC Code.
- Appropriate certificates must be provided by the shipper. These certificates should be issued by a laboratory which is recognised by the competent authority of the port of loading (although in practice not all authorities issue such recognitions to laboratories in their jurisdiction).
- Any required instruments for testing concentrations of gas and of oxygen in the cargo spaces must be on board.
- During loading, examinations of the cargo must be carried out. The cargo loaded on board must be consistent, in terms of its appearance and characteristics, with the information given on the cargo declaration and in the appendix 1 schedule. The cargo may look dry and sandy but this does not mean the cargo will not liquefy. All the cargo of any consignment should be roughly the same in terms of colour, consistency and general appearance. There should be no splattering of material or movement or wobbling of a stowage as cargo is dropped into the hold. There should be no free water on the cargo surface, on the tank top or in the bilges.
- If there is any doubt about the cargo 'can tests' (in accordance with section 8 of the IMSBC Code) must be carried out. If the tests fail, loading should be suspended and expert advice sought.
- The cargo must be trimmed reasonably level before the loading and stowage of the cargo can be considered to have been completed.

Additional information and guidance on actions to be taken is provided in Chapter 8.

If the master has any doubts with respect to the cargo declaration, or the information given on it, or with respect to the certificates which accompany the declaration, the master should not allow any loading of cargo and should seek advice from the ship operator. If the master has any doubts about the characteristics of the cargo being loaded, loading should be suspended and advice sought from the ship operator and any charterer.

As stated earlier in this Chapter, it must be remembered that there is no safe way of carrying a cargo with a moisture content above its TML – except in a specially designed ship. Also, there are no safe weather conditions or safe routes for the carriage of a Group A cargo with a moisture content above its TML.

VARIOUS MATERIALS – CHEMICAL AND OTHER HAZARDS

Some cargo types carried in bulk are innocuous and do not generally cause any form of chemical hazard or any other type of hazard. Examples are PEBBLES (sea) and STONE CHIPPINGS, both of which are Group C cargoes and so long as they are trimmed reasonably level they should cause no problems. However, many cargo types possess one or more hazards, details of which must be known before shipment. These various hazards and problems are as follows:

Cargo hazards

- May liquefy.
- May be of high density.
- May be non-cohesive or grain.
- May be dusty.
- May be toxic.
- May be affected by wetting.
- May oxidize.
- May produce gas.
- May spontaneously heat or ignite.
- May cause corrosion.

Under the IMSBC Code, cargoes which may liquefy are Group A cargoes, cargoes which may possess chemical hazards are Group B cargoes and cargoes which are neither liable to liquefy nor possess chemical hazards are Group C cargoes. However, that does not mean that the cargoes in any of the groups do not possess other hazards or problems. Also, grain may possess some of the hazards and problems listed.

Some materials are classified as dangerous goods under the IMDG Code and under the IMSBC Code. These have been assigned a hazard class and a UN number under the harmonized UN regulations, for example SODIUM NITRATE UN1498 which is Class 5.1: oxidizing substances. All other materials in Group B are materials hazardous only in bulk (MHB), for example PETROLEUM COKE (petcoke) which may be liable to heat and ignite spontaneously. With respect to cargoes other than grain, which come under the IMSBC Code, it is essential that the master obtains full, up-to-date and valid information about the physical and chemical properties of the cargo to be shipped in bulk prior to commencement of loading.

The shipper of the cargo shall provide the master (or representative) with appropriate information on the cargo to enable the master to establish from the Document of Compliance for Ships Carrying Dangerous Goods, if appropriate, from the certificate of compliance with the IMSBC Code, if one is on board, and from other documents on board, whether or not the material can be safely carried on board. The information should be set out in a cargo declaration provided by the shipper and that declaration must be accompanied by all associated certificates and data sheets.

If the cargo can be carried, any precautions which may be necessary for the proper stowage and safe carriage of the cargo on board the ship can then be put in place. When the master is in possession of the cargo declaration, and any other information about the cargo, the master can study that information in conjunction with the information in the appropriate schedule in appendix 1 of the IMSBC Code and the guidance with regard to chemical hazards set out in section 9 of the IMSBC Code. The master will then be able to make decisions with respect to the loading, stowage and carriage arrangements necessary for the safe handling of a particular cargo.

Set out in the following sub-sections are some guidance notes with respect to the various hazards and problems which the master should bear in mind when planning loading and unloading operations.

High density cargo

If the cargo is of high density, precautions must be taken as set out in the section on 'Distribution of cargo and ballast – structural damage hazard' in Chapter 5.

Non-cohesive or grain cargo

If the cargo is grain, the provisions of the International Grain Code must be followed.

If the cargo is non-cohesive, having an angle of repose of less than or equal to 30°, the provisions of the International Grain Code must be followed. In addition, the density of the cargo must be considered in conjunction with the maximum permissible weight of cargo for each hold.

Dusty cargo

If the cargo is dusty, ventilation systems should be shut down or screened and air conditioning systems placed on re-circulation to minimise the ingress of the dust. Covers should be put over deck machinery and external navigation aids as appropriate, or other precautions to minimise the effect of the dust should be put in hand. Personnel on deck during loading and unloading should wear masks and goggles and other protective equipment.

Following completion of loading all deck areas and the hatch cover and coaming arrangements should be swept clean and the cargo residues should be disposed of ashore. If the dust on deck constitutes an explosion hazard, hosing down rather than sweeping may be carried out.

Toxic cargo

If the cargo is toxic, or may emit toxic fumes, personnel on deck during loading and unloading should wear appropriate protective equipment. Entry into the cargo compartment should not be permitted until the space has been ventilated and the atmosphere tested for toxic gases and oxygen content.

Cargo affected by wetting

If the cargo may be affected by wetting, a close watch should be kept on the weather throughout loading and unloading and the cargo operations should be suspended and the hatch covers closed before the onset of precipitation. The hatches of non-working holds should be kept closed.

There are exceptions, for example if the amount of water which is likely to wet the cargo during a rain shower or during ongoing light drizzle will not cause actual damage to the cargo or will not affect in any significant way the condition of the cargo. Also, during unloading, the receiver may allow cargo operations to continue, in which circumstances during unloading the master must obtain a 'rain letter' from the receiver of the cargo, allowing the work to continue during precipitation.

Cargoes that may oxidise

If the cargo oxidizes it will take oxygen from the atmosphere in the hold and toxic or asphyxiating gases may be produced. Most materials will take oxygen from the atmosphere by some sort of mechanism, either directly like steel scrap which will oxidize to produce iron-oxide, or rust, or because of the presence of micro-organisms in the

cargo, such as in grain or seed cake, which respire and use the oxygen and produce carbon dioxide or, in extreme cases, carbon monoxide. In these circumstances, the atmosphere in the cargo compartment will become oxygen-depleted and appropriate precautions should be followed.

Cargoes that may produce gas

If the cargo may produce gas, which might be toxic or flammable, the appropriate instruments for measuring the concentrations of gas and oxygen in the cargo space shall be available on board. Additionally, the equipment must be calibrated and serviced regularly and ship's personnel must be trained in its use. Any spare parts which are necessary for its continued use throughout the voyage must also be on board. Also, if flammable gas or an explosive air mixture might be produced it should be ensured that all cables and electrical components in the holds and in adjacent spaces are free of defects, of spark-free design and/or isolated.

Cargoes that may spontaneously heat or ignite

If the cargo may spontaneously heat and/or ignite, monitoring of the cargo during loading and during the voyage must be carried out. The process of monitoring will depend upon the type of cargo being loaded and the manner in which the cargo is carried. For some cargoes thermo-couple temperature measuring equipment must be set up in the hold before and during loading so that monitoring during the voyage can be carried out. For other cargoes thermometers are then lowered down sounding pipes or specially fitted ducts. This method of temperature measurement is unlikely to be reliable, as at best it can record cargo temperatures at the periphery rather than the centre of the stow, and at worst it records effectively sea water temperatures rather than cargo temperatures.

Cargo that may cause corrosion

If the cargo may cause corrosion, ship's structures and fittings are at risk. The carriage of some cargoes, such as SALT and SULPHUR, might result in corrosion of exposed, unprotected steel structures and fittings in the cargo compartment. Bearing this in mind, before loading these cargoes a barrier coating of either lime wash or a chemical based compound is applied to the in-hold steelwork, including the tank top plating, to avoid any direct, corrosive contact. The carriage of other cargoes, such as COAL, might result in acidic water, present in the cargo at time of loading, draining down to the tank top and then to the bilge wells. That water must be pumped out during the voyage (see Chapter 4 with respect to bilge water and Chapter 7). For such a voyage, there should be on board an appropriate instrument for measuring the pH value of bilge water samples. The bilges should be pumped out frequently and samples should be taken and tested. If the results indicate that there is a risk of corrosion of the bilge pipelines and pump, the pump and engine room lines should be flushed out with sea water, so far as is possible, after each bilge pumping exercise.

The notes set out in this section provide some guidance with respect to actions and procedures which may be followed, in general. When the master has details of the cargo to be carried detailed guidance can be obtained from the various sections of the IMSBC Code and its appendices.

CLEAN CARGOES

Clean cargoes are those which require cargo compartments to be very clean before loading because they will be damaged by any form of contamination. The most frequently carried clean cargoes are as follows.

Most frequently carried clean cargoes

IMSBC Code BSCN	ALUMINA	Group C
	CHROMITE ORE*	Group C
	CLAY (kaolin)	Group C
	FLUORSPAR	Groups A and B
	ILMENITE SAND	Group A or C
	RUTILE SAND	Group C
	SAND	Group C
	SAND, HEAVY MINERAL†	Group A
	SODA ASH	Group C
	SODIUM NITRATE	Group B
	SODIUM NITRATE and POTASSIUM NITRATE MIXTURE	Group B
	ZIRCON SAND	Group C
International Grain Code	MILLED RICE	Grain

Notes
* CHROMITE ORE is given in the IMSBC Code as a Group C cargo. It is described as being concentrates or lumpy. If the shipper declares the cargo as a concentrate it should properly be included with the MINERAL CONCENTRATES and designated as Group A.
† SAND, HEAVY MINERAL has an entry in appendix 1 of the IMSBC Code. Whereas ZIRCON SAND and others, which are shipped as Group C cargoes, are dry and may be dusty, these sand cargoes are shipped wet and therefore as Group A. The sand might be zircon, rutile or ilmenite, or another type. Any sand cargoes, when shipped damp or wet, may need to be declared as Group A if they exhibit flow properties during pre-loading laboratory testing (see appendix 3 of the IMSBC Code).

These materials are all composed of fine grains or particles, having been processed. The Group B and Group C materials in the list are shipped very dry, while the Group A materials will contain moisture and the moisture content must be known, together with the TML, and certificates must be provided.

Hazards and problems

The IMSBC Code gives in appendix 1 the hazards to be aware of and the precautions to be followed for each individual material. These cargoes may be dusty and may be abrasive, such that other compartments should be kept closed and machinery protected against dust.

Hold preparation before loading

All of these materials require the cargo compartment to be at a standard cleaner than grain clean before loading, that is, there must be no previous cargo residues, no loose rust, no loose paint and no moisture. The materials contain no impurities and contamination by any paint flakes or rust is likely to result in a complaint being lodged. The hold bilges should be appropriately covered to prevent any cargo entering the bilge wells.

Safe carriage

These materials must not get wet and therefore loading should be suspended during precipitation and the hatch covers, ventilators and so on should be in good condition to prevent any ingress of water during the voyage.

Hold cleaning after unloading

These are clean and mostly dry materials and therefore the cleaning operation should be routine and relatively easy.

DIRTY CARGOES

Dirty cargoes are those which are unlikely to be affected by any small amounts of rust or paint from the steel structures within the hold. However, their carriage will make the holds very dirty and make the cleaning operation more difficult. The most frequently carried dirty cargoes are as follows:

Most frequently carried dirty cargoes

IMSBC Code BCSN	BAUXITE NICKEL ORE* PETROLEUM COKE COAL SCRAP METAL FERROUS METAL BORINGS, SHAVINGS, TURNINGS or CUTTINGS	Group C Group A Group B Group B (and A) Group C Group B

Note
* NICKEL ORE has an entry in appendix 1 of the IMSBC Code but reference should be made to comments in the IMSBC Code in Chapter 3.

As a result of their production processes, these materials may contain oily or muddy residues. Also, the materials are likely to contain impurities which are either of no concern with reference to further use, or will be removed during further processing.

Hazards and problems

The IMSBC Code gives, in appendix 1, the hazards to be aware of and the precautions to be followed for each individual material. The problem of concern here is the fact that the oily residues or muddy nature of the materials will lead to the steel structures of the cargo compartments becoming excessively dirty.

Hold preparation before loading

It is likely that no specific requirements with regard to the level of cleanliness will be given, in which case the cargo compartments should be grain clean if possible, although a lower, simply clean swept standard may be acceptable. Any very small amounts of loose rust, loose paint and previous cargo residues are unlikely to cause measurable contamination of the dirty cargo or lead to complaints being lodged. Alternatively, it might be a contractual requirement of either the owner or charterer that a chemical barrier coating is applied to the steel surfaces before loading to prevent adhesion of any oil or mud and to assist the cleaning operation to be carried out after unloading.

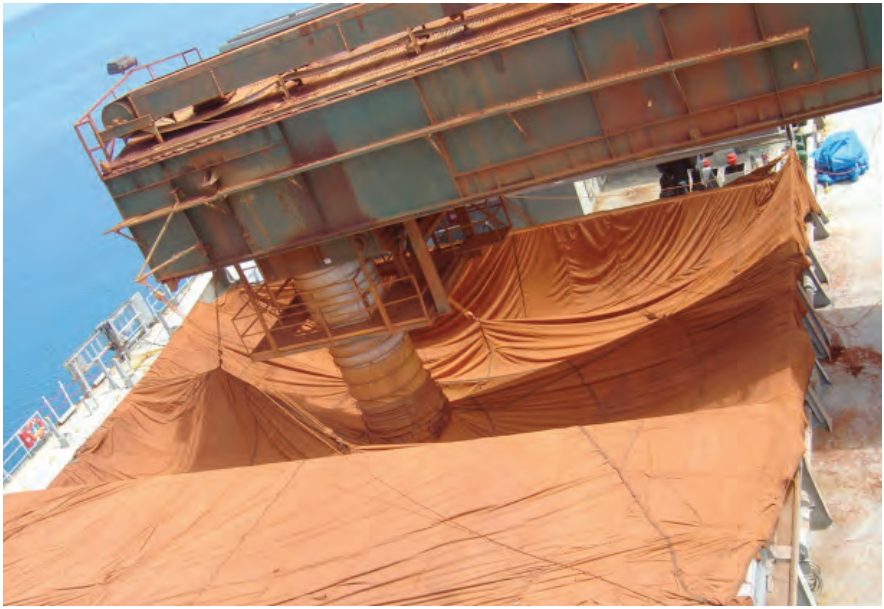

Fig. 29. Loading bauxite by conveyor from ashore with a tarpaulin cover over the hatchway to reduce the amount of dust

Safe carriage

With regard to the carriage of coal (see Chapter 7), the IMSBC Code sets out very specific requirements. With regard to oily residues, these may drain into the bilge wells and contaminate the bilge water. See elsewhere in this Chapter and Chapter 4.

Hold cleaning after unloading

If a chemical barrier coat is applied to the steelwork, that coat and any adhering oil or mud will be easily removed by the use of appropriate cleaning products, making the cleaning relatively easy and no more difficult than a routine cleaning operation after the carriage of a moderately clean to moderately dirty cargo.

If no barrier coat is applied the steel surfaces may be contaminated with oily or muddy residues which cannot easily be removed and the cleaning operation will be more difficult and more time consuming than a routine cleaning operation. There are cleaning

chemicals which can be used to break down the residues and pieces of equipment which will reduce the time taken for the operation. Chemical cleaning products should be sprayed over the affected areas and then left for an appropriate time to loosen and break down the deposits; the manufacturers' instructions in this regard must be followed and appropriate protective and safety equipment should be used. Prior to application, the compatibility of cleaning products with the paint coatings should be confirmed with the paint manufacturers. After the appropriate time has passed, hosing down should be carried out and disposal of the wash water.

The chemical products are, mostly, biodegradable and not harmful to the marine environment (HME), but before such chemicals are brought into use their characteristics should be established. The equipment brought into use may include cherry pickers, for close access if the ship is stationary alongside, and equipment including high pressure equipment, medium pressure equipment such as water cannon or fairly low pressure fire hoses. The more sophisticated the process, the more pieces of equipment brought into use and the greater the number of operatives, the shorter will be the period for the cleaning to achieve the required standard. It is often the case that a shore cleaning contractor is employed to use cherry pickers and high pressure equipment although some ships these days are provided with such equipment for use by the ship's crew. See also Chapter 4 with respect to hold cleaning.

Special cases

Cement, salt and sulphur are special cases and may be considered to be dirty cargoes for the purposes of hold cleaning after unloading. Also, they do not usually contain any impurities and are therefore moderately clean cargoes for loading purposes and they usually require additional preparation before loading, and will be contaminated by loose rust, loose paint and previous cargo residues. See Chapter 7.

Chapter 7

CARGO-SPECIFIC INFORMATION

This Chapter describes the specific problems associated with commonly carried cargoes. Further information and requirements that must be followed by the masters of ships carrying either grain or solid bulk cargoes, and others involved with their transportation by sea, can be found in SOLAS, the IMSBC Code, the International Grain Code, other codes, guidance notes and the ship's safety management system procedures.

CEMENT

Cement cargoes		
IMSBC Code	CEMENT	Group C
BCSN	CEMENT CLINKERS	Group C

Cement is produced by burning crushed limestone or chalk with clay. Initially rough lumps are produced, usually from the size of golf balls down to fine sand, which are cement clinkers. The cement clinkers are finely ground to produce cement and additives are included to produce cements of different characteristics.

Hazards and problems

CEMENT CLINKERS will set hard if it is wetted, and it is very dusty. It is usually loaded by conveyor and spout and sometimes by grab.

CEMENT will set hard if it is wetted and it is very dusty. There are additional problems associated with the loading and carriage of cement.

Cement characteristics

- Cement is produced at high temperature and will retain heat, such that it might be hot – up to a temperature of 80°C – when loaded. The high temperature may lead to problems with hold coatings and fuel tanks.
- Cement would be contaminated by any residues of previous cargoes, and therefore the cargo compartments should be cleaned to a high standard.
- Cement is usually loaded by conveyor and spout or by pneumatic loading equipment.
- For loading by pneumatic equipment, the cement is mixed with air and is blown into the hold via ducts. As a consequence of this, the cement will act like a fluid immediately after loading. It will then settle during a fairly short period after loading, as the air percolates out, by up to about 10% of the volume.
- Cement will set hard when wetted and there are many potential scenarios which can lead to wetting, including; loading or discharging during precipitation, allowing damp air into the cargo compartment, and allowing the in-hold steelwork to become cold such that ship sweat is produced, for example during ballasting or de-ballasting operations. Because of this problem, there is a high probability of hardened cement residues remaining on steel plating and structures in the holds after unloading.

Hold preparation before loading

Holds should be prepared to a high level of grain cleanliness and, if possible, should be rinsed with fresh water to remove salt residues. There should be no loose rust, no loose paint and no previous cargo residues. They should be dry throughout and, if appropriate, de-humidifiers may be used to dry the in-hold air. The bilges should be clean, dry and covered.

The weather-deck hatches and other openings should be in good condition and adequately weathertight. A hose-test or ultrasonic test to confirm the weathertight integrity of the hatches may be carried out before loading is started.

Because of the possibility that the hold structures will be affected by hard cement residues, it might be a contractual requirement of either the ship operator or the charterer that a chemical barrier coating is applied to the steel surfaces before loading. There is likely to be a cement loading paragraph in the cargo exclusions clause of the charterparty when cement is to be carried.

Safe carriage

Cement clinkers are loaded either via conveyors and a spout, or by use of grabs, into open hatchways. Cement is loaded by way of conveyors leading from the cement silos either via a spout into an open hatchway or via a closed pneumatic system which requires the hatches to be closed.

When cement is loaded via open hatches, and when cement clinkers are loaded, a large amount of dust will be produced. Some of that cement will collect on the hatch coamings, on hatch covers and on the weather-deck during the loading operation. Cleaning of the hatch coamings should be an ongoing task, always following safety precautions, so that the hatch covers may be closed when loading is moved to another hold or before the onset of precipitation. Following completion of loading, the hatches, coamings and all coaming drains should be thoroughly cleaned by brushing, and the application of compressed air if appropriate, to ensure the hatch covers can be closed and secured properly and weathertight. Also, deck areas should be swept and all residues should be collected together, for appropriate disposal, at regular intervals, with local regulations and requirements being followed at all times. This is necessary, in part, because if the residues get wet they will solidify. Loading must not be carried out during precipitation and non-working holds must be kept closed at all times.

For loading of cement via a closed pneumatic system there must be loading ports in the top plating of the hatch cover panels which are mostly, though not invariably, fitted on the centreline (Some ships have cement holes fitted on the outboard sides of the hatch covers). The bottom flange of the loading spout (which is flexible and able to move as the ship moves during loading) is secured to one open port and an extractor fan is secured to the other open port. The cement is aerated ashore and then blown via the loading pipe system into the hold. The extractor fan removes air from the top of the hold and filters out any cement dust in that air and maintains a low air pressure in the hold to assist the loading process. Using this method, only a relatively small amount of dust is produced on deck. After completion of loading the cargo will settle and the ship should not sail from the load-port until sufficient time has passed to allow settlement.

Fig. 30. Loading cement using pneumatic equipment via a cement port fitted in the hatch panel

During the voyage there should be no ventilation of the cargo spaces.

Unloading of the cement cargo or cement clinkers will be by means of grab or discharge elevator via open hatches. Operations must not be carried out during precipitation and non-working holds must be kept closed at all times. Dust and falling debris will collect on the hatches, coamings and the weather-deck during the unloading operation. Cleaning of the hatch coamings should be an ongoing task, always following safety precautions, so that the hatch covers may be closed when discharge is moved to another hold or before the onset of precipitation.

Hold cleaning after unloading

Cement and cement clinkers are dirty cargoes, from the hold cleaning point of view. It is recommended that all accessible dust and remaining cargo in the holds and on deck is collected together and removed before washing starts. During hold washing, so the bilge pipework and pumping system is not contaminated and possibly blocked with cement, a submersible or other portable pump should be used to pump the wash water out of the holds.

If the steelwork of the holds was coated with a chemical barrier before loading, the appropriate cleaning chemical should be used, first sprayed over the barrier coat and later washed off by water jet. These chemical products are, mostly, biodegradable and not harmful to the marine environment (HME) but before such chemicals are brought into use their characteristics should be established. Further information and guidance is given in Chapter 4. If no barrier was applied and hard residues of cement have accumulated as a result of ship's sweat or other wetting, removal of the residues can be achieved by the use of high pressure water lances or muriatic acid (dilute hydrochloric acid) applied by spray and washed off by water jet.

Fig. 31. The residues remaining after unloading cement

COAL

Coal cargoes		
IMSBC Code BCSN	COAL COAL SLURRY BROWN COAL BRIQUETTES	Group B (and A) Group A Group B

COAL, mainly bituminous and anthracite, but also sub-bituminous and lignite, is mined worldwide and is shipped worldwide. Lignite is otherwise known as brown coal. Bituminous coal is often referred to as soft coal whereas anthracite is referred to as hard, or stone, coal. Anthracite coal is normally very ancient and has been compressed for many millions of years while bituminous coal is less old and is therefore less hard. See also the comments on BROWN COAL BRIQUETTES and COAL SLURRY in the following sections.

Hazards and problems

Coal may possess one or more hazards, as follows.

Coal hazards

- May emit methane, a flammable gas, and create a flammable atmosphere in the hold.
- May heat spontaneously and the spontaneous heating may lead to combustion of the coal and the production of toxic gases, including carbon dioxide and carbon monoxide.
- May liquefy if the cargo consists predominantly of fines. Coal is classed as Group A if more than 75% of the cargo is of diameter less than 5mm.
- May react with water to produce acidic solutions.
- May oxidise, leading to oxygen depletion and an increase in the carbon dioxide and carbon monoxide concentrations in the cargo spaces.

In addition, some types of coal, particularly soft coals, may contain a significant amount of hydrocarbon coal tar. The tar on the coal adjacent to ship's structures is likely to stick to those structures during the voyage, leaving an oily residue after unloading.

Hold preparation before loading

It is likely that no special requirements with regard to the level of cleanliness will be given, in which case the compartments should be brought to the grain clean standard if possible, although a lower, simply clean swept standard may be acceptable.

Safe carriage

The shipper's declaration must provide fully detailed information about the characteristics of the cargo, including the following.

Shipper's declaration for coal cargo - checklist

- Recommend safe handling procedures for loading and transport.
- Specification details for moisture content, sulphur content and size, and whether or not it is liable to emit methane or to self-heat.
- Its group – as a Group B cargo or a Group A and Group B cargo.
- If it is a Group A cargo, and therefore liable to liquefy, the declaration must be accompanied by certificates giving moisture content and TML.

If the coal cargo is declared to be Group A, it should not be handled or loaded during precipitation and non-working hatches should be kept closed. That is, unless the moisture content is sufficiently less than the transportable moisture limit such that the small amount of additional wetting caused by the precipitation will not increase the moisture content to above the TML.

Throughout loading of all types of coal, in addition to the various other tasks which must be completed, the master should obtain detailed information with regard to the temperature of the cargo being loaded from the terminal representative or the appropriate person. Also, the master should monitor the temperature as best possible by the means provided on board. The temperature of the cargo during loading and during the voyage may be determined by a thermometer lowered down monitoring pipes fitted in the hold for the purpose. However, this method only gives the temperature of the cargo in way of the pipes. For temperature readings of coal in stock piles ashore and at all parts of the cargo surface throughout loading, a digital readout gun may be used taking care to read temperatures only from freshly exposed surfaces.

Coal should not be loaded if its temperature is above 55°C, regardless of whether or not the shipper has declared it as likely to self-heat. This is because any coal presented for loading above 55°C is likely to be already undergoing self-heating.

Fig. 32. Steam rising from coal in an on-shore stockpile which is wet from rainfall and heating up

Fig. 33. Coal on fire in a ship's hold

During any voyage with any type of coal the cargo may emit methane, it may heat up spontaneously, or it may do both. The production of methane may lead to a fire or an explosion in the hold when an ignition source is present and spontaneous heating may lead to an extensive fire in the cargo which is difficult to extinguish. Action must be taken before loading and monitoring of the cargo throughout the voyage must be done to minimise the possibility of a disaster occurring. The schedule for COAL in the IMSBC Code gives extensive guidance.

First, the possibility of an ignition source must be minimised by ensuring that all cables and electrical components in the holds or adjacent spaces are free of defects, are of spark-free design and/or are isolated.

Second, monitoring equipment must be provided. When methane is emitted and when self-heating occurs, the composition of the atmosphere in the head space of the hold will change and therefore if the composition of the air is monitored during the voyage any emissions of methane and any heating of the cargo can be detected. When emissions of methane and/or heating of the cargo are detected, action can be taken to minimise the effect.

The IMSBC Code provides extensive guidance in the appendix to the entry for COAL, which includes guidance on equipment and fittings to be provided and actions to be taken under certain circumstances. This should be carefully studied and followed before the start of loading. Some of the guidance in the code is identified as applying to self-heating coal and others as applying to coal that emits methane. Because shippers do not always identify hazards correctly, it is recommended that it should be assumed that any coal may possess both of these hazards, whether declared as such or not. Before loading, the following shall be provided.

Equipment to be provided before loading coal

- Sampling points fitted in the sides of the hatch cover or hatch coaming, one to port and one to starboard, at each hold.
- Instruments for measuring, via the sampling points, methane/flammable gas, oxygen and carbon monoxide concentrations in an oxygen-depleted atmosphere (note many gas meters do not read methane/flammable gas levels accurately at low oxygen levels).
- Equipment for measuring the pH value of cargo space bilge water samples.
- Means by which the temperature of the cargo in the range 0°C to 100°C can be measured without requiring entry into the cargo space. In practical terms, this actually means via sampling or temperature probing pipes, which unfortunately are unlikely to give reliable readings.

The equipment should be regularly serviced and calibrated, and ship's staff should be trained in its use.

Fig. 34. A sampling port in the side of a hatch cover with the gas sampling tube inserted

Fig. 35. Taking gas measurements

During the voyage measurements should be taken and recorded on a daily basis. Regular monitoring of hold atmosphere will ensure any changes in hold atmosphere are detected at an early stage. If changes in the in-hold atmosphere are detected, the appropriate action, as given in the appendix to the COAL entry in the IMSBC Code must be followed.

The main decision to be taken is whether to begin a ventilation regime or whether to keep the holds closed in view of the potential hazards – explosion and/or self-heating and possible fire. In brief, initial actions should be as follows.

When to ventilate coal cargoes

- If the methane level is in excess of 20% of the lower explosive limit (LEL) the cargo is likely to be emitting methane. A hold ventilation regime shall be started to reduce the methane content of the in-hold atmosphere and minimise the explosion risk, bearing in mind the carbon monoxide level.
- If the carbon monoxide concentration is increasing, the cargo is likely to be self-heating. The cargo space shall be completely closed and all ventilation ceased. This will reduce the oxygen level in the hold and minimise self-heating of the cargo, bearing in mind the methane level.
- If both the methane level and the carbon monoxide level are increasing at the same time, the explosion risk due to the presence of methane is the more serious and more imminent concern, and therefore takes precedence. Ventilation should be carried out to keep the methane level below 20% of the LEL.

In either case, the master must inform the ship operator, the shipper and other parties, including any charterer, of the situation on board, of all measurements taken and of all actions taken, and should obtain advice and guidance from an expert as to how to proceed.

Fig. 36. Coal on fire in a pile on the quay having been removed from the ship's hold

In addition to the possibility of self-heating and the production of methane, because coal cargoes are mostly self-draining and are usually loaded wet, water will drain to the hold bilges and should be pumped out. If a significant amount of water is pumped out of the hold bilges during the voyage, records should be kept of the soundings before and after each pumping operation and the volume of water removed should be calculated and recorded so as to produce a running total of the volume of water. The final total volume should be made available at the unloading port for use in draught surveys or other out-

turn cargo weight measurement operations to avoid any claims for short delivery of cargo. Also, records should be kept in the garbage record book.

Further, because of the sulphur content of the coal, that bilge water may be acidic and may cause corrosion of the tank top plating, bilge well structure and bilge piping systems. Testing of the pH value of the bilge water should be carried out regularly during the voyage as it is pumped out and if high readings are obtained, flushing out of pumps and pipework should be carried out as appropriate. Additionally, inspections of steel structures should be undertaken after unloading. It should also be noted that the coal may react with water to produce flammable and toxic gases, including hydrogen.

Coal may emit methane and may produce carbon dioxide or carbon monoxide and may deplete oxygen from the atmosphere. All of these may lead to asphyxiation of personnel. The cargo hold and adjacent spaces should be considered to be enclosed spaces with oxygen-depleted atmospheres which contain toxic gases and appropriate testing of the atmosphere, ventilation and safety precautions must be carried out before any personnel enter the spaces.

Hold cleaning after unloading

Most types of coal are moderately dirty cargoes. The steel surfaces will be contaminated with coal dust which is usually fairly easy to remove by brushing or by compressed air blowing. Following the removal of the cargo residues, a routine cleaning operation should be carried out.

Some types of bituminous coal are considered to be dirty cargoes because they will leave oily residues on the steel surfaces which are difficult to remove using water spray equipment only. There are cleaning chemicals which can be used to break down the residues and there are pieces of equipment which can be used to make the operation somewhat easier and to reduce the time taken. If no special equipment and no cleaning chemicals are available, the operation is likely to be relatively difficult and will take considerably more time to complete than a routine cleaning operation.

BROWN COAL BRIQUETTES

Anthracite coal is normally very ancient and/or heavily compressed over time, and is very hard. Bituminous coal is less old and/or is less heavily compressed over time and is relatively soft. Brown coal, or lignite, is less old again, is brown in colour and is fairly fibrous, not solid lumps. The fibrous coal is compressed to form hand-sized briquettes.

Hazards and problems

Brown coal is easily ignited, is liable to heat spontaneously, may ignite spontaneously and may deplete oxygen from the air in the cargo space. A cargo of briquettes is therefore a Group B cargo.

Hold preparation before loading

It is likely that no special requirements with regard to the level of cleanliness will be given, in which case the compartments should be brought to the grain clean standard if possible, although a lower, simply clean swept standard may be acceptable.

Safe carriage

The shipper's declaration must provide fully detailed information about the cargo to be carried and details of its liability to self-heat. It must be declared as a Group B cargo.

The requirements for the loading and carriage of the briquettes are very similar to those for coal which is liable to heat spontaneously. That is, cables and electrical components should be free of defects and/or isolated, and monitoring equipment must be provided and fitted. The IMSBC Code provides extensive guidance in the Appendix to the entry for the briquettes.

Hold cleaning after unloading

The briquettes are a moderately dirty cargo. All the remaining pieces of the brown coal should be collected together and removed before normal routine cleaning is carried out.

COAL SLURRY

This is fine particle coal mixed with water to form a slurry. As such, it is liable to liquefy during the voyage and is therefore a Group A cargo.

Hazards and problems

The slurry is liable to liquefy, it may emit methane and there is a possibility it may spontaneously combust if it dries out.

Hold preparation before loading

It is likely that no special requirements with regard to the level of cleanliness will be given, in which case the compartments should be brought to the grain clean standard if possible, although a lower, simply clean swept standard may be acceptable.

Safe carriage

The shipper's declaration must provide fully detailed information about the cargo to be carried and details of its liability to liquefy. It must be declared as a Group A cargo and certificates giving moisture content and TML must be provided.

The coal may emit methane. This being the case, gas monitoring equipment should be provided on board. It is recommended that sampling points should be fitted as required for the carriage of COAL. Monitoring of the atmosphere in each hold carrying the slurry should be carried out on a daily basis and if the methane level increases, as explained in special precautions for coals emitting methane, surface ventilation shall be carried out to remove the methane.

Hold cleaning after unloading

The slurry is a moderately dirty cargo. All the remaining pieces of the coal should be collected together and removed before normal routine cleaning is carried out.

DIRECT REDUCED IRON (DRI)

DRI cargoes		
IMSBC Code BCSN	DIRECT REDUCED IRON (A) (hot-moulded briquettes)	Group B
	DIRECT REDUCED IRON (B) (lumps, pellets, cold-moulded briquettes)	Group B
	DIRECT REDUCED IRON (C) (by-product fines)	Group B

DIRECT REDUCED IRON (DRI) is shipped in the form of briquettes (hot- or cold-moulded), lumps or pellets, or as fines (very small pieces of partially-oxidised iron) which are produced during the manufacture of the other forms of DRI. The briquettes, lumps and pellets are produced from iron ore, are black or metallic grey in colour, are nearly pure metallic iron, and are very porous.

DRI is produced from iron ore (which is primarily iron oxide) by first forming it into lumps or pellets and then heating these lumps or pellets by passing hydrogen or carbon monoxide which is at high temperature over them. The hot gas removes the oxygen from the iron ore, which is the reduction process, leaving lumps or pellets of nearly pure metallic iron. Briquettes are formed after the reduction process and are the size and shape of a large bar of soap. Fines are a by-product of both processes. The DRI produced has a very porous structure, which means that it has a very large exposed surface of metallic iron and is therefore extremely liable to re-oxidize when in contact with air and moisture.

DRI is mostly shipped in the form of lumps or pellets. To reduce the likelihood of re-oxidation, pellets are sometimes coated with a substance which is intended to protect the iron from contact with air and moisture; this process is called passivation. Some types of passivation coating are more effective than others, but no coating can render the DRI entirely safe.

Hot-moulded briquettes (DRI (A)), sometimes called hot-briquette iron (HBI), are produced by compressing pellets or lumps into briquettes at high temperature, above 650°C but below the melting point of iron (over 1500°C). The briquettes are sometimes passivated by the application of a coating and are not prone to breaking up during handling, as are the cold-moulded briquettes. Because of their nature, hot-moulded briquettes are one of the safer forms of DRI for carriage, although they are still liable to heat up and to produce hydrogen.

Cold-moulded briquettes (DRI (B)) are produced by compressing pellets of DRI into briquettes when they are relatively cold, with the intention of reducing the exposed surface area. The briquettes are sometimes passivated by the application of a coating and are fragile, such that they are liable to break up during handling.

By-product fines are produced during the reduction process, when briquettes are formed and during handling. They are not passivated and are therefore extremely liable to re-oxidize and are classed as DRI (C). Because of this propensity to re-oxidise, some cargoes of DRI fines will have already largely re-oxidised prior to loading and may only contain low residual levels of metallic iron. Such cargoes must nevertheless be declared as DRI (C) and be carried accordingly. Some shippers may describe such partially

re-oxidised cargoes as iron ore fines. Any such declarations are incorrect and should not be accepted.

The shipper may offer material for bulk shipment that is clearly a DRI by-product while claiming it is safe for carriage without certain precautions being followed. The descriptions for the materials may include HBI fines, metallic HBI fines, iron fines and iron remet fines. These commodities should be treated as DIRECT REDUCED IRON (C) (By-product fines) and the shipper's declaration should give that BCSN.

The shipper may offer material for bulk shipment that is in fact not DRI, although the name might suggest that it is, for example, direct reduction pellets, which is iron ore pellets destined for the direct reduction process, might be IRON ORE PELLETS.

If there is any doubt as to whether a cargo is or is not DRI, the percentage of metallic iron should be established: any cargo containing metallic iron, even if at very low levels, should be treated as DRI. Iron ore fines and pellets do not contain metallic iron, but only iron oxide.

Hazards and problems

DRI, because of its porous nature with exposed iron surfaces, will oxidize when in contact with air and moisture.

When in contact with oxygen in the air, the oxidation produces heat. The heating process is likely to progress and may lead to auto-oxidation or burning of the iron, in which case the stow becomes incandescent with a temperature of up to 1,000°C.

Fig. 37. DRI on fire in a ship's hold

When in contact with water, the oxygen is removed from the water and hydrogen gas is generated. Hydrogen is highly explosive and is readily ignited.

Hold preparation before loading

Holds should be prepared to a high level of grain cleanliness, and should be rinsed with fresh water to remove any salt residues. There should be no loose rust, no loose paint and no previous cargo residues or other debris, and they should be dry throughout. Bilges should be clean, dry and covered.

The weather-deck hatches and other openings should be in good condition and adequately weathertight. A hose test or ultrasonic test to confirm the weathertight integrity of the hatches may be carried out before loading is started.

Before loading, a temperature sensing system and a system for monitoring the hydrogen level and the oxygen level in the holds are set up. Also, equipment to detect temperature readings from the sensors and for measurements of hydrogen and oxygen in an oxygen-depleted and flammable atmosphere should be provided, so that measurements can be taken and recorded throughout the voyage. It is sometimes the case that a cargo superintendent will sail with the ship during the loaded voyage to carry out the cargo monitoring duties, and to advise the master of the findings.

Safe carriage

The cargo must be kept dry at all times and therefore there should be no loading or unloading during precipitation, and non-working holds should be kept closed.

DRI (A), DRI (B) and DRI (C) require different carriage arrangements, all of which are set out under the appropriate BCSN in appendix 1 of the IMSBC Code. These are detailed and involved, and need to be closely adhered to. Accordingly, the appropriate DRI schedule(s) should be carefully studied before loading. The shipper's declaration must provide fully detailed information about the characteristics of the cargo, including its Group listing.

DRI (A) must be below 1% moisture and DRI (B) and (C) below 0.3% moisture throughout the consignment. All types must be below 65°C at loading. The shipper must monitor moisture and temperature throughout loading and a log of the readings must be given to the master.

During the carriage of DRI (A) hydrogen is likely to be produced and oxygen will be depleted from the atmosphere. This must be borne in mind at the unloading port and all holds loaded with DRI should be considered to have a dangerous atmosphere. The cargo hold and adjacent spaces should be considered to be enclosed spaces with oxygen-depleted atmospheres which contain toxic gases and appropriate testing of the atmosphere, ventilation and safety precautions must be carried out before any personnel enter the spaces.

DRI (B) and DRI (C) must be carried in an inerted atmosphere, as described in the IMSBC Code. Some shippers may suggest that DRI (C) cargoes, that is fines, can be carried wet and under continuous ventilation; this is contrary to the IMSBC Code.

Hold cleaning after unloading

DRI is a moderately dirty cargo. It is recommended that all accessible dust and remaining cargo in the holds and on deck is collected together and removed before washing starts and washing by fresh water, not sea water, is carried out to remove any remaining cargo residues.

DRI residues can cause significant damage to the ship's paint coatings and any exposed steel work if allowed to remain for prolonged periods.

GRAIN

Grain must be stowed and carried in accordance with the requirements of the International Code for the Safe Carriage of Grain in Bulk, the International Grain Code, which is mandatory. Grain includes wheat, maize (corn), oats, rye, barley, rice, pulses and seeds and also soya beans, sorghum, sunflower seeds and so on, and certain processed forms of these seeds.

Also, non-cohesive bulk commodities having an angle of repose of less than or equal to 30° and, therefore, will flow like grain, must be stowed and carried in accordance with the International Grain Code. Those other bulk commodities may have hazards given in the IMSBC Code and will be assigned a BCSN.

Hazards and problems

If the ship is not provided with a Document of Authorisation and a Grain Loading Manual, it cannot carry grain in accordance with the International Grain Code without extensive work to demonstrate compliance with the code.

Grain is non-cohesive and will therefore flow or shift to the low side or end of cargo compartments when the carrying ship rolls or pitches in the seaway if there is available space in the cargo compartment for the cargo to move.

Under the requirements of the International Grain Code a grain cargo must be stowed on board in the cargo compartments in such a way that if there is a shift of grain that shift does not result in the ship listing to more than 12°.

Before any loading is undertaken it must be demonstrated that the intended cargo can be carried safely. First, calculations must be completed to decide upon a distribution of the cargo on board for the preparation of a pre-stowage plan.

Next, further calculations must be completed to determine whether or not that planned arrangement of cargo complies with the requirements of the code. If it does not, changes to the distribution must be made until it can be shown that, for the chosen distribution, any shift of cargo will be limited, such that the ship will not list to more than 12°. The data in the ship's Grain Loading Manual will be used in this process. When a satisfactory distribution has been drawn up and a pre-stowage plan has been prepared, a loading plan setting out the loading sequence and de-ballasting sequence can be completed.

A grain cargo is likely to contain small amounts of foreign matter or material, other grains, mouldy grains and possibly other matter, which are allowed for in the specification. It will also have a particular moisture content.

Hold preparation before loading

Holds should be prepared to the grain clean standard. That standard, as described in Chapter 4, may not be the same in the ports of different countries or for different types of grain. Guidance should be sought from agent at the loading port. If no requirements are given, a high level of grain cleanliness should be achieved, with no loose rust, no loose paint and no previous cargo residues present and the holds should be dry throughout. Bilges should be clean, dry and covered.

A surveyor acting for the government authority of the load port may attend on board to carry out an inspection of the cargo compartments to ensure they are at the required standard. A certificate of examination declaring the holds to be fit for loading must be issued by the surveyor before loading will be allowed to begin.

Safe carriage

A grain cargo must be stowed in accordance with the requirements of the International Grain Code and calculations must be completed before loading to show that the planned arrangement of cargo complies with the requirements of the code.

After arrival at the load-port and before loading begins, a surveyor acting for the government authority (for example the National Cargo Bureau, Inc. if the grain is to be loaded at a port in the USA) may attend on board to discuss with the master the planned loading and to examine the master's calculations to confirm that the requirements of the code will be met. Only after the surveyor is satisfied will loading be allowed to begin.

The surveyor will return on board upon completion of loading to determine whether or not the cargo has been stowed in the way the master had planned, and as set out in the pre-stowage plan and the loading plan. If the stowage of cargo has been completed in accordance with the original plans, no alterations in the grain stability calculation will be required.

If there have been significant changes, such that the grain heeling moment of the cargo on board is significantly different from the moment set out in the loading calculations, the surveyor will require a revised grain stability calculation to be completed to determine the angle of heel due to a shift of cargo in the as-loaded arrangement. The surveyor may also require further loading or shifting of cargo in extreme cases so that the total grain shifting moment for the cargo loaded is below the maximum allowed. When the surveyor is satisfied with the calculations, a certificate of loading is issued after which the ship may depart the loading port.

It is normal practice for the master to be given instructions to load a certain weight of grain of a given stowage factor for carriage to a particular country or discharge port. In addition, the master might be advised of a draught restriction, for example at the discharge port or for transit of the Panama Canal, for him to take into account. The master must then carry out a series of calculations; first to determine the weight of cargo to be stowed in each hold, next to determine if the planned stowage arrangement meets the requirements of the International Grain Code and then to produce a loading plan in accordance with the BLU Code.

The ship's grain stability loading program on the loading computer may be used for some of the calculations but some must be done by hand. For example, if loading is to be done at a port in the USA a grain stability calculation form must be completed. That form, which may be acceptable in some other countries, can be obtained from the website of the National Cargo Bureau, Inc. The four-page form includes sections for information about the ship and the cargo to be loaded, details of the distribution of grain and liquids on board – from which the draught and the stability can be determined – and then sections for the calculation of the heeling moment of the cargo and a stability summary in which the angle due to a shift of cargo can be determined. Other grain exporting countries have their own forms.

The starting point is the estimated weight of the grain cargo to be loaded, together with the stowage factor of the intended cargo which is provided by the shipper. To carry out the calculations, the data in the Grain Loading Manual will be required. The data set out in the manual will normally include the following.

Grain loading manual data

- Volumes for the holds when full and with the ends trimmed and also when full with untrimmed ends.
- Volumetric heeling moments for the holds when full and with trimmed ends, when full and with ends untrimmed and when slack with various ullages.

Modern bulk carriers have topside tanks for self-trimming at the sides but the under-deck areas forward and aft are usually not trimmed because of the expense or because it is often not practically possible. The untrimmed ends volume of each hold given in the Grain Loading Manual is calculated on the basis that the grain will have an angle of repose of 30°. Also, the presence of any bleeding holes in the end coamings of the hatchway is not taken into account.

However, in reality, the angle of repose of the grain may well be around 20° or less and this, together with the presence of any bleeding holes, will mean a larger part of the under-deck volume will be occupied by grain cargo than is estimated for the volume figures. Bearing this in mind, the authorities of most major grain exporting countries advocate the use of the full hold and with trimmed ends volumes for the determination of the weight of cargo to be loaded in each hold, for pre-loading planning purposes.

In the calculations it is better to have a greater safety factor than a smaller safety factor. The sequence is, therefore, as follows.

Grain loading calculations

- Using the stowage factor provided (and any ship experience factor if appropriate) and using the full hold volumes with trimmed ends determine the weight of cargo to be stowed in each full hold and then determine the weight of cargo to be stowed in each slack hold, if appropriate.
- Determine the ullage or sounding of each slack hold.
- Using the volumetric heeling moment data, determine the volumetric heeling moment for each hold, assuming each full hold has untrimmed ends and using the ullage or sounding for each slack hold.
- Apply the stowage factor to the volumetric heeling moments and obtain the total grain heeling moment.
- Complete stability calculations to determine the ship's fluid GM, the displacement and the draughts, and then determine from the data the maximum permissible grain heeling moment for the ship's loaded condition.
- Ensure the total grain heeling moment at each stage of the voyage is less than the corresponding maximum permissible grain heeling moment, sometimes referred to as the maximum allowable grain heeling moment.

If, during the loading of cargo, it is found that the stowage factor is larger than that used in the calculations, there might be a smaller weight of cargo in each full hold and a smaller amount of vacant space in any slack holds, which is a safer outcome. If the stowage factor is smaller than that used in the calculations there might, but might not, be a larger weight of cargo in each full hold and there might be a larger amount of vacant space in any slack holds but the grain heeling moment for the slack holds will not have increased in the same proportion because the stowage factor has been found to be smaller.

During loading close inspections of the cargo should be carried out, so far as is safely possible, to determine the condition of the cargo. If it is found that there are unidentified materials, lumps or caked material or wet grain being placed into stowage, loading should be suspended and an investigation should be carried out. For further guidance on this aspect see Chapter 3.

Fig. 38. Unloading grain by pneumatic suction pipe

Hold cleaning after unloading

Grain is a moderately clean cargo and therefore the cleaning operation should be routine and relatively easy.

IRON ORE

Iron ore cargoes		
IMSBC Code BCSN	IRON ORE	Group C
	IRON ORE PELLETS	Group C
	IRON ORE FINES*	Group A
	IRONSTONE	Group C
	IRON CONCENTRATE (pellet feed)	Group A
	IRON CONCENTRATE (sinter feed)	Group A

Note
* The IMO adopted amendments to the IMSBC Code from 2015 that included a new schedule for IRON ORE FINES. The requirements, as set out in IMO circular DSC.1/Circ.71, may be used on a voluntary basis until 1 January 2017, when they become mandatory. See also comments on the IMSBC Code in Chapter 3.

IRON ORE and IRONSTONE, the latter being a form of iron ore, is mined in many parts of the world and is shipped worldwide. It is dark grey to rusty red in colour and is dusty. IRON ORE PELLETS are produced by heating pellets of crushed iron ore combined with clay.

It is given in the characteristics in the entry in appendix 1 of the IMSBC Code that IRON ORE is of size 'Up to 250 mm'. The IMO adopted amendments to the IMSBC Code from 2015 that included a revised schedule for IRON ORE. The revised schedule gives the same size range but states that the provisions of the schedule shall apply to IRON ORE cargoes, as follows.

IMSBC Code re-classification of IRON ORE adopted from 2015

.1 containing either:
  .1 less than 10% of fine particles less than 1 mm (D_{10} > 1 mm); or
  .2 less than 50% of particles less than 10 mm (D_{50} > 10 mm); or
  .3 both; or
.2 iron ore fines where the total goethite content is 35% or more by mass, provided the master receives from the shipper a declaration of the goethite content of the cargo which has been determined according to internationally or nationally accepted standard practices.

This is a re-classification of IRON ORE in line with the new entry for IRON ORE FINES.

The provisions of the new schedule for IRON ORE FINES, adopted from 2015, shall apply to iron ore cargoes containing both:

IMSBC Code classification of IRON ORE FINES adopted from 2015

.1 10% or more of fine particles less than 1 mm (D_{10} ≤1 mm); and
.2 50% or more of particles less than 10 mm (D_{50} ≤10 mm).

Despite the re-classification iron ore fines where the total goethite content is 35% or more by mass may be carried in accordance with the individual schedule for 'IRON ORE', provided the master receives from the shipper a declaration of the goethite content of the cargo which has been determined according to internationally or nationally accepted standard procedures.

Until 1 January, 2017 cargoes of iron ore which contain a high proportion of fines should, on a voluntary basis, be classified as IRON ORE FINES, Group A (see IMO circular DSC.1/Circ.71).

IRON ORE FINES comprise fine material with a relatively high moisture content, such that a stowage is liable to liquefy and is therefore a Group A cargo. As set out in IMO circular DSC.1/Circ.71, a Modified Proctor/Fagerberg test for determining the transportable moisture limit (TML) has been developed for use on samples of IRON ORE FINES. The test may also be referred to as Proctor/Fagerberg test type D. It is still permissible for any one of the other three test methods, as described in appendix 2 of the IMSBC Code, to be used.

For the shipment of some cargoes, a small proportion of polymer granules is thoroughly mixed throughout the cargo to absorb moisture. That admixture of polymer should render the IRON ORE FINES in a condition safer for carriage. However, certificates for moisture content and for TML are always required for a Group A cargo. Further information on the Modified Proctor/Fagerberg test procedure and on polymer granules can be found in Chapter 6.

IRON CONCENTRATE, including both pellet feed and sinter feed, are refined forms of iron ore where the iron content of the material has been greatly increased, or concentrated, by the removal of other minerals and extraneous materials by chemical or physical processes.

Hazards and problems

All forms of iron ore and iron concentrate have a very high density and loading rates are high, such that the ship's structures could be damaged if loading and unloading is not carried out in a controlled manner.

Group A grades comprise fine material and a relatively high moisture content such that stowages are liable to liquefy.

Hold preparation before loading

It is likely that no special requirements with regard to the level of cleanliness will be given, in which case the compartments should be brought to the grain clean standard if possible, although a lower, simply clean swept standard may be acceptable.

Safe carriage

There is the possibility of damage being sustained by the ship's structures during loading, or unloading. Precautions for loading are as follows.

Precautions for loading iron ore cargoes

- During each pour from a conveyor, or loading period if by grab, the cargo should be evenly spread so far as possible over the tank top to distribute the weight of the cargo equally over the area and to avoid the build-up of piles of cargo.
- A loading plan should be drawn up by the master and the agreement of the terminal representative should be obtained that the plan should be followed, with any appropriate adjustments, in accordance with the BLU Code. The plan should include sequences for loading and de-ballasting.
- During loading, ship's staff should monitor the various operations to ensure the plan is followed.

Similar procedures should be followed during unloading to eliminate the possibility of over-stressing the ship's structures during that period.

The shipper's declaration must provide fully detailed information about the characteristics of the cargo, including the following.

Shipper's declaration for iron ore cargoes – checklist

- The BCSN for the cargo.
- The bulk density of the cargo.
- The group – as a Group A cargo or a Group C cargo.
- If it is a Group A cargo, and therefore liable to liquefy, the declaration must be accompanied by certificates for MC and TML.
- If the cargo is declared to be IRON ORE FINES with a total goethite content of 35% or more by mass, it may be carried as IRON ORE, Group C, but the shipper must provide a declaration of the goethite content of the cargo, as set out in DSC.1/Circ.71.

The bulk density of iron ore and associated cargoes can range from about 1,250 kg/m^3 to well in excess of 3,000 kg/m^3. For the carriage of these dense cargoes the ship must be designed and constructed with sufficient strength to withstand limited

flooding in all loaded conditions, as set out in SOLAS chapter XII. Reference should be made to the ship's valid IMSBC Code certificate of compliance and the loading manual to establish which density iron ore cargoes, if any, may be carried.

Cargoes of Group A should not be handled or loaded during precipitation and non-working hatches should be kept closed. The exception is when the moisture content is sufficiently less than the TML, such that the small amount of additional wetting caused by the precipitation will not increase the moisture content to above the TML.

See also the section in Chapter 6 on 'Fine particulate materials – liquefaction hazard'.

During the voyage the hold bilges should be sounded at appropriate intervals and any water in the bilges should be pumped out. If a significant amount of water is pumped out of the hold bilges during the voyage, records should be kept of the soundings before and after each pumping operation and the volume of water removed should be calculated and recorded so as to produce a running total of the volume of water. The final total volume should be made available at the unloading port for use in draught surveys or other out-turn cargo weight measurement operations to avoid any claims for short delivery of cargo. Also, records should be kept in the garbage record book.

Hold cleaning after unloading

Iron ore and associated cargoes are considered to be moderately dirty cargoes. The steel surfaces will be contaminated with iron ore dust which is usually fairly easy to remove by brushing or by compressed air blowing. Following the removal of the cargo residues a routine cleaning operation should be carried out.

PETCOKE

Petcoke cargo		
IMSBC Code BCSN	PETROLEUM COKE (calcined or uncalcined)	Group B

PETROLEUM COKE (petcoke) is a by-product of the oil industry and may be used as a low-cost fuel or as a source of carbon. Petcoke is black in colour and is in the form of small pieces to fine powder. It may have a high sulphur content, will have a fairly low moisture content and is often loaded at a high temperature.

There are basically two forms; calcined and uncalcined. Calcined petcoke has been heated to a very high temperature, in excess of 1,000°C, to remove volatile matter and moisture. Uncalcined petcoke is not heated specifically to remove volatile matter and moisture but will be hot as a result of the production process and will retain on the small pieces or particles an amount of hydrocarbon substances, or oil (up to 15%), and an amount of moisture. Trade names for uncalcined petcoke include green delayed petcoke, green fuel coke, needle coke and graphite petroleum coke.

Hazards and problems

Petcoke is usually hot when it is loaded. If the temperature is below 55°C there are no special requirements for loading. However, if the temperature is 55°C or higher, there are precautions to be followed as set out in the entry in appendix 1 of the IMSBC Code.

Petcoke, particularly uncalcined forms, may contain a significant amount of hydrocarbon oil and oil will stick to steel structures and fittings within the cargo

compartments during the voyage, leaving an oily residue after unloading.

During loading, to suppress airborne dust and to reduce the temperature of the material, petcoke is often sprayed with fresh water or a surfactant fluid, which will increase the moisture content of the cargo.

Hold preparation before loading

It is likely that no specific requirements with regard to the level of cleanliness will be given, in which case the cargo compartments should be brought to the grain clean standard. Because of the possibility that the hold structures will be affected by oily residues, it might be a requirement of either the owner or the charterer that a chemical barrier coating is applied to the steel surfaces before loading. There is likely to be a Petcoke Loading paragraph in the cargo exclusions clause of the charterparty when petcoke is to be carried.

Safe carriage

Petcoke might be affected by oil residues and might have a fairly high moisture content. The characteristics of petcoke are such that it is a free draining cargo and therefore it is likely that any oil residues and water present will drain to the tank top and then to the hold bilges. The bilge water should be pumped out of the hold bilges, but it might not be appropriate to pump the water overboard because of its possible oil content, and the requirements of MARPOL. See Chapter 4 for further guidance.

If a significant amount of water is pumped out of the hold bilges during the voyage, records should be kept of the soundings before and after each pumping operation and the volume of water removed should be calculated and recorded. Also, records should be kept in the garbage record book and in the oil record book, as appropriate.

Hold cleaning after unloading

If a chemical barrier coat is applied to the steelwork, that coat and any adhering oil will be easily removed by the use of appropriate cleaning products, making the cleaning relatively easy and no more difficult than a routine cleaning operation after the carriage of a moderately clean to moderately dirty cargo.

If no barrier coat is applied the steel surfaces will be contaminated with oily residues which cannot easily be removed and the cleaning operation will be more difficult and more time consuming than a routine cleaning operation. There are cleaning chemicals which can be used to break down the residues and pieces of equipment which will reduce the time taken for the operation. Chemical cleaning products should be sprayed over the affected areas and then left for an appropriate time to loosen and break down the deposits; the manufacturers' instructions in this regard must be followed and appropriate protective and safety equipment should be used. After the appropriate time has passed, hosing down should be carried out and disposal of the wash water (MARPOL annex 1).

The chemical products are, mostly, biodegradable and not harmful to the marine environment (HME), but before such chemicals are brought into use their characteristics should be established.

The equipment brought into use may include cherry pickers, for close access if the ship is stationary alongside, and equipment including high pressure equipment, medium pressure equipment such as water cannon or fairly low pressure fire hoses. The

more sophisticated the process, the more pieces of equipment brought into use and the greater the number of operatives, the shorter will be the period for the cleaning to achieve the required standard. It is often the case that a shore cleaning contractor is employed to use cherry pickers and high pressure equipment although some ships these days are provided with such equipment for use by the ship's crew.

SALT

Salt cargoes		
IMSBC Code BCSN	SALT	Group C
	SALT CAKE	Group C
	SALT ROCK	Group C

SALT is sodium chloride, normally in the form of fine white grains, and having a moisture content of up to 5.5% usually. SALT ROCK is also sodium chloride in dry form with a very low moisture content of 0.02%. SALT CAKE is impure sodium sulphate, and is different from salt.

Hazards and problems

There are no particular hazards or problems with cargoes of rock salt or salt cake, although the stowages should be trimmed. Salt might shift if it becomes wet, it is likely to cause corrosion of unprotected steel and it can become contaminated.

Salt can be shipped with a moisture content of up to 5.5% and is highly soluble. Because it is soluble it will dissolve if it gets wet, either by precipitation during loading or by ingress of sea water during the voyage. This being the case, as it says in the IMSBC Code, salt must not be loaded during precipitation and non-working hatches must be kept closed. Weather-deck hatch covers must be in good condition to minimise the possibility of ingress during the voyage. If ingress occurs salt will dissolve, which is likely to change the stability of the ship and may cause a loss of stability, and might lead to the formation of a wet base resulting in shifting of the cargo.

Salt is shipped in bulk in the form of fine white grains. If the cargo is contaminated with anything, the contaminant will be easily seen and a claim is likely to be lodged by receiver after unloading. Contamination might occur because the cargo compartment is not clean enough, with loose rust scale, loose paint flakes, previous cargo residues and so on present. If the tank top plating, or any other steel structures and fittings, are unprotected bare steel, corrosion of the steel in contact with the salt will take place leading, in turn, to the discoloration of the salt by rust.

Hold preparation before loading

The holds should be prepared to a high level of grain clean, with no loose rust, no loose paint and no previous cargo residues, and should be dry throughout.

The steelwork of the holds to a height above the top of the intended stowage, including the whole of the tank top plating, must be either lime washed or treated with a chemical barrier coating to prevent corrosion of the steel and discoloration of the salt. Although it is given in the IMSBC Code that a paint coating is sufficient to protect against corrosion, it is recommended that lime wash or a barrier coat is applied. This

recommendation is given because, first, the tank top plating is usually not paint coated (and therefore would need to be painted anyway) and, second, it has been found by experience that even a good paint coating is not sufficient to prevent corrosion.

Safe carriage

The hatches and ventilators should be kept closed throughout the voyage because ventilation is not required.

Fig. 39. Loading salt by conveyor and a spout with a directional head

Hold cleaning after unloading

If a lime wash has been applied, that coating should be removed; this is described in Chapter 4. If there is no lime wash, a barrier coating should have been applied, and the removal of that coating is likely to require the application of a suitable and compatible chemical cleaning product. After the removal of the lime wash or barrier coat, routine cleaning is required, dependent upon the next intended cargo.

Fig. 40. Unloading salt by pneumatic suction pipe and with a front-end loader to trim the cargo to the pipe. Note the discoloured salt on the tank top plating

SCRAP

Scrap cargoes		
IMSBC Code BCSN	SCRAP METAL	Group C
	FERROUS METAL BORINGS, SHAVINGS OR CUTTINGS	Group B

SCRAP METAL includes a large range of types of iron or steel scrap ranging from motor blocks and heavy steel sections to finely cut small pieces, all types of which have a low fire risk.

FERROUS METAL BORINGS, SHAVINGS, TURNINGS OR CUTTINGS include swarf and all the small borings and so on, which are wet and contaminated with cutting oil, oily rags and/or other combustible material, such that the material is liable to self-heat and ignite spontaneously.

Guidelines for Ferrous Scrap, published by the Institute of Scrap Recycling Industries, Inc., gives the commonly used names or terms for the different types of scrap. For example, there is 'No.1 heavy melting steel' and 'No.2 heavy melting steel' (referred to as HMS No.1 and HMS No.2), each of which might include different size material. Also, there are bundles of sheet scrap or clippings and there are different types of turnings, borings and so on. The products might be loose or might be in the form of compressed bundles if the constituent pieces are small and light. Although the shipper's cargo declaration must show the cargo to be SCRAP METAL for all these products, the commercial documents, including the bill of lading, are likely to describe the cargo in accordance with the name given in *Guidelines for Ferrous Scrap*, for example HMS No.1.

If the cargo to be loaded is in the form of swarf, for example fine turning and so on, which is wet, oily and/or contains combustible material, it should be declared by the shipper to be FERROUS METAL BORINGS, SHAVINGS OR CUTTINGS, Group B.

If the cargo to be loaded is in the form of fine turnings and so on, but the shipper has submitted a declaration that the material has no self-heating properties, the cargo will have been mis-declared, probably as SCRAP METAL, Group C.

Hazards and problems

The hazard with respect to FERROUS METAL BORINGS, SHAVINGS, TURNINGS OR CUTTINGS is the fact that it is liable to spontaneously heat and ignite. This commodity should not be loaded if it is above a temperature of 55°C and the entry in appendix 1 of the IMSBC Code gives further information and guidance.

These scrap commodities are likely to contain oily residues and are therefore considered to be dirty cargoes. Also, damage to the ship's structures and fittings might be sustained if loading and unloading is not carried out carefully. There is likely to be a scrap loading paragraph in the cargo exclusions clause of the charterparty when scrap is to be carried.

Scrap is usually loaded by use of grabs, magnets or some form of large tray or flat container, or is sometimes, in some light forms, loaded by conveyor and chute. If dropped from a height onto the deck or onto the tank top during loading or unloading, medium sized and larger pieces of scrap will cause damage to the tank top plating,

weather-deck plating and other ship's structures and fittings. For this reason, there are two recommendations which must be followed.

Recommendations for loading scrap cargoes

- Before loading or unloading starts, the weather-deck area and associated structures and fittings should be protected by sheets of plywood and other dunnage.
- At the beginning of loading into any hold, the first cargo loaded should either: (a) be soft loaded by lowering the grab, magnet or tray close to the tank top before release, or (b) be light material, such as shredded scrap or chippings. The first cargo should be loaded carefully to produce a pile in the centre of the hold to cushion the fall of material loaded on top.

Throughout the loading of a scrap cargo the operation should be monitored to identify any damages caused and, when damage is sustained, action should be taken to inspect the area and to arrange for appropriate repairs.

During the loading operation and after completion, the stowages should be compacted and trimmed, as appropriate, normally by use of a bulldozer. The trimming should be done to ensure the wings and ends of the hold are fully loaded with cargo so as to prevent cargo from shifting and to eliminate the possibility of pieces of scrap rolling outboard or into the ends of the compartment and then causing damage to ship's structures during the voyage.

Hold preparation before loading

It is likely that no specific requirements with regard to the level of cleanliness will be given, in which case the cargo compartments should be grain clean if possible, although a lower, simply clean swept standard may be acceptable. Any very small amounts of loose rust, loose paint and previous cargo residues are unlikely to cause measurable contamination of the scrap cargo or lead to complaints being lodged.

Safe carriage

The iron or steel scrap may be liable to self-heat and may consume oxygen as a result. Also, all scrap cargoes contain some dirt and debris, and oily or wet material, and there will be exposed metal surfaces, such that oxygen will be absorbed during the voyage. Bearing this in mind, all holds loaded with scrap should be considered to have an atmosphere which is depleted of oxygen, and appropriate safety precautions should be exercised prior to entry being made into any cargo compartments or adjacent spaces.

Oily residues may drain to the hold bilge wells and contaminate the bilge water; see Chapter 4 in this regard.

Hold cleaning after unloading

As a result of the dirty nature of a scrap cargo, it is likely that the hold will be contaminated with oil and dirty residues. There are cleaning chemicals which can be used to break down the residues and there are pieces of equipment which can be used to make the operation somewhat easier and to reduce the time taken. If no special equipment and no cleaning chemicals are available, the operation is likely to be relatively difficult and will take considerably more time to complete than a routine cleaning operation.

During the final stages of unloading and during the cleaning operation, thorough inspections of all steel structures, and testing of all adjacent tanks, if possible, should be carried out to establish whether or not any damages have been sustained. When damages are found, action should be taken to report the details of the damage and to arrange for appropriate repairs to be carried out.

SEED CAKE

Seed cake cargoes		
IMSBC Code BCSN	SEED CAKE, containing vegetable oil UN 1386 (a) mechanically expelled seeds, containing more than 10% of oil or more than 20% of oil and moisture combined.	Group B
	SEED CAKE, containing vegetable oil UN 1386 (b) solvent extractions and expelled seeds, containing not more than 10% of oil and when the amount of moisture is higher than 10%, not more than 20% of oil and moisture combined.	Group B
	SEED CAKE UN 2217 with not more than 1.5% oil and not more than 11% moisture	Group B
	SEED CAKE (non-hazardous)	Group C

SEED CAKE is the residue remaining after oil has been extracted or expelled from oil bearing seeds, or cargoes with similar properties and hazards to such residues.

The oil removal process involves, first, the seeds (or coconut flesh or citrus fruit peel) being crushed or ground to produce a meal and then the meal being processed either by using a liquid solvent or by squeezing mechanically to extract the oil. The resultant residue meal may be further processed to produce cakes or pellets. The cargo to be shipped may be in the form of pulp, meal, cake or pellets and will contain a proportion of oil remaining after the oil removal process and a proportion of moisture. The cargo is often referred to simply as extraction, expellers or meal.

The various entries in appendix 1 of the IMSBC Code give lists of the seeds, cereals and so on which are used to produce seed cake. Some of the cargoes included in this list do not match the general description of seed cake as to the residue remaining after oil extraction but are included as they present similar hazards. Examples are brewers' grain pellets or wheat bran pellets.

The oil which is produced by the processes, for example soya oil, palm oil and linseed oil, will be used in food preparation and industrial processes.

Hazards and problems

SEED CAKE is liable to self-heat slowly during the voyage and possibly, under certain conditions, ignite spontaneously. The heating occurs as a result of the growth and respiration of micro-organisms within the cargo when the moisture content, the oil content and the temperature of the cargo are all sufficiently high. If the heating by the

microbial growth leads to temperatures in excess of about 55°C, chemical oxidation of the oil occurs which creates more heat and a further increase in the temperature of the cargo, in some cases resulting in a cargo fire.

Oxidisation of the oil and the growth of micro-organisms will cause a reduction of oxygen in the in-hold atmosphere, and carbon dioxide, or carbon monoxide in extreme conditions, may be produced in the oxygen-depleted atmosphere.

Hold preparation before loading

Holds should be prepared to the grain clean standard. Bilges should be clean, dry and covered.

Safe carriage

The cargo must be kept dry at all times and therefore there should be no loading, and preferably no unloading, during precipitation, and non-working holds should be kept closed.

There are particular requirements for each type of seed cake and therefore full details of the cargo, or cargoes, to be carried must be obtained before loading is started. For example SEED CAKE UN 1386 (a) may be carried in bulk only with special permission from the competent authority, although the competent authority may allow the cargo to be carried as SEED CAKE (b) if the results of tests are acceptable; appropriate certificates must be provided.

Particular types of seed cake, even though their oil and moisture content are in the ranges specified for SEED CAKE UN 1386 (b) and SEED CAKE UN 2217, are considered to be non-hazardous and are designated as Group C – details are given in the entries in appendix 1 of the IMSBC Code. For solvent-extracted SEED CAKE other than the non-hazardous types, if the engine room bulkhead is not insulated to A60 standard, the stowage must be '*away from*' the bulkhead, which means there must be a gap of 3m between the bulkhead and the cargo stowage.

The shipper's declaration for seedcake cargoes must include the following.

Shipper's declaration for seedcake cargoes - checklist

- BCSN for the cargo.
- A full description of the cargo including the type of seed cake.
- Its oil content and moisture content
- Appropriate details of its specification and its chemical properties.

The declaration must be accompanied by certificates, as appropriate, which may include an exemption certificate, weathering or age certificate, oil and moisture content certificates, and a certificate stating that the material is substantially free of flammable solvents.

Seed cake cargoes should not be loaded at cargo temperatures above 55°C. While this is not explicitly stated in the IMSBC Code, it says that ventilation should cease and/or inert gas be introduced if the cargo heats beyond that temperature during the voyage. A situation where such emergency measures are already necessary at the time of loading should be avoided.

The temperature of the cargo should be monitored during the voyage. It is not the usual practice to set up a system of thermo-couple temperature sensors within the

stowage during loading and therefore the only way to take temperatures during the voyage is by lowering thermometers down bilge sounding pipes.

Detailed guidance is given under the appropriate BCSN in appendix 1 of the IMSBC Code.

Seed cake is liable to self-heat and to consume oxygen, and may produce carbon dioxide and carbon monoxide as a result. Bearing this in mind, all holds loaded with seed cake should be considered to have an atmosphere which is depleted of oxygen and appropriate safety precautions should be exercised.

Hold cleaning after unloading

Seed cake is a moderately clean cargo and therefore the cleaning operation should be routine and relatively easy.

Fig. 41. Seed cake cargo being trimmed out from under the wing by back-hoes during unloading

SULPHUR

Sulphur cargo		
IMSBC Code BCSN	SULPHUR (formed, solid) SULPHUR UN 1350 (crushed lump or course grained)	Group C Group B

SULPHUR occurs as a by-product of the oil and gas industries. It is yellow in colour, is odourless and is shipped in the form of prills, granules, pellets and so on. To suppress airborne dust which is produced during loading, and the possibility of fire because of the dust, sulphur is often sprayed with fresh water or a surfactant fluid when being loaded.

As a result of the spraying, the cargo is damp or wet when on board.

Fine-grained sulphur (flowers of sulphur) – effectively powdered sulphur – should not be transported in bulk.

Hazards and problems

SULPHUR UN 1350 is flammable and dust explosions may occur if the spraying is insufficient. Both types of sulphur cargoes are liable to produce acidified water which will cause corrosion of bare steel and wet sulphur in direct contact with bare steel will cause corrosion by electrolytic reaction. A protective coating, therefore, must be applied to all steelwork in the hold.

Fig. 42. A stockpile of bulk sulphur

Hold preparation before loading

Holds should be prepared to a high level of grain cleanliness, using fresh water for final washing, and with no loose rust, no loose paint and no previous cargo residues present. The paint coating on all steelwork should be in good condition.

The steelwork in the holds to a height above the intended stowage level, including the whole tank top plating, must either be lime washed or treated with an appropriate chemical barrier coating.

The sulphur and its inherent moisture are liable to produce acidified water. That acidified water will dissolve the lime wash during the voyage and will slowly reduce its thickness. It is therefore necessary to apply lime wash to a thickness such that the underlying steel structure is no longer visible.

It is normal for voyages to be such that the sulphur is on board for a maximum of 40 days; if the lime wash satisfactorily covers and obscures all the steel structures it should be sufficient for an ordinary voyage. Over the course of the voyage, the lime wash is gradually consumed and beyond 40 days may no longer afford effective protection against corrosion.

If a corrosion reaction between the sulphur and steel does occur, this results in the formation of a black compound (iron sulphide). Any such corrosion may result in deep pitting of the steel structures and an inspection of the affected area may be necessary. There may also be a cargo claim for contamination. This problem is not encountered with chemical barrier coatings. There is likely to be a sulphur loading paragraph in the cargo exclusions clause of the charterparty when sulphur is to be carried.

Safe carriage

Water in the cargo will drain to the hold bilge wells during the voyage and water should be pumped out. The soundings of the bilges should be recorded before and after each pumping operation and the volume of water removed should be calculated and recorded so as to produce a running total of the volume of water. The final total volume should be made available at the unloading port for use in draught surveys or other out-turn cargo weight measurement operations to avoid any claims for short delivery of cargo. Also, records should be kept in the garbage record book.

Hold cleaning after unloading

If a lime wash has been applied, that coating should be removed by the use of high pressure water lances or muriatic acid (dilute hydrochloric acid) applied by spray and washed off by water jet. If a chemical barrier coating has been applied, the appropriate cleaning chemical should be used, first sprayed over the barrier coat and later washed off by water jet. These chemical products are, mostly, biodegradable and not harmful to the marine environment (HME) but before such chemicals are brought into their characteristics should be established. Further information and guidance is given in Chapter 4.

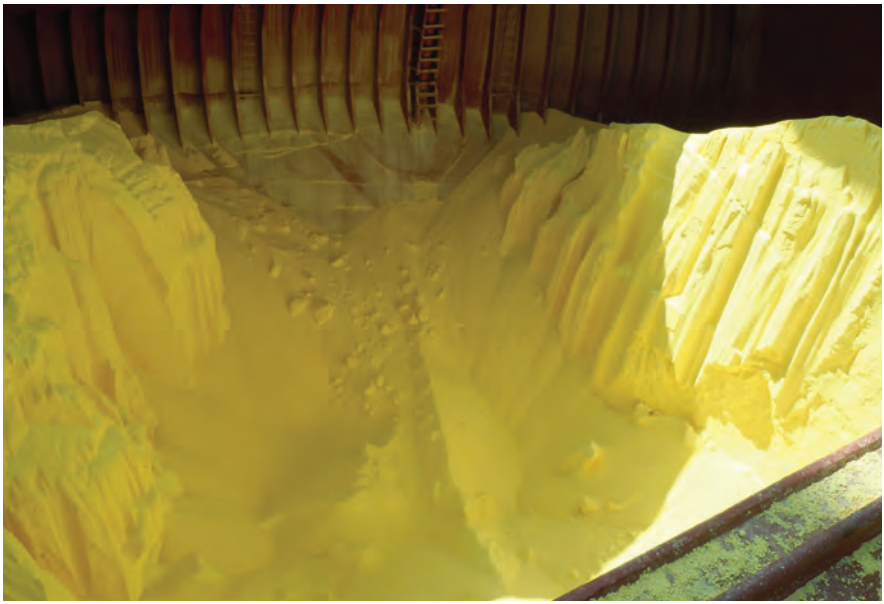

Fig. 43. Part way through the unloading of bulk sulphur – the steelwork of the hold was treated with a chemical barrier coat before loading

Chapter 8

THE VOYAGE

GENERAL PRINCIPLES

This chapter draws together the key points for successful carriage of solid bulk cargoes and grain cargoes, highlighting the procedures that should be followed on each and every voyage.

The general principles to follow on all voyages are as follows.

General principles for voyages with bulk cargoes

- The ship should be in a thoroughly efficient condition and suitable in all respects to carry the cargo safely to destination.
- The identity of the cargo should be known in advance, either a grain or a cargo under the IMSBC Code with a bulk cargo shipping name (BCSN)
- Calculations should be completed for the distribution of the cargo on board and for the strength and stability of the ship at all stages of the loading, the voyage and the unloading, and all results should be satisfactory.
- Cargo compartments should be prepared for the intended cargo in terms of cleanliness and any required coating on the steelwork.
- Cargo operations should be closely monitored to ensure the operation progresses in compliance with the loading or unloading plan. If it does not, the operation should be stopped and discussions should be held with the terminal representative and agreement should be obtained before work is resumed.
- All appropriate carriage instructions should be followed as well as any requirements set out in the IMSBC Code for monitoring of the cargo during the voyage.
- If there are any departures from normal or routine procedures, or if there are any unusual or unforeseen events, seek advice without delay.
- The ship operator, any charterer, shipper and any other interested party should be kept fully advised of the various aspects of the loading operation, the voyage and the unloading operation throughout their progress.

In each of the following sections there are guidance notes, with references to associated sections in earlier chapters, for the various stages and operations of a normal voyage. Attention is directed to principles of good practice and good procedures, and to the requirements of SOLAS, applicable IMO codes, regulations and other appropriate recommendations.

Within each section there are also examples of the losses likely to occur in the event of good practice and procedures not being followed, together with the key loss prevention points to remember. Failure to follow these points can result in problems or difficulties which, if allowed to develop, may lead to a delay in the voyage, damage to or loss of cargo, damage to the ship, personnel injury or fatality or, ultimately, the loss of the ship.

SAFETY MANAGEMENT SYSTEM REQUIREMENTS

(See Chapter 3.)

Hold preparation

The holds should be cleaned and prepared as required by the nature of the cargo, but also as instructed by the charterer and/or the shipper. Keep all completed checklists.

Loading operations

Loading operations should be in accordance with the requirements of, and should follow, the loading plan. Keep appropriate records.

Ballast operations

De-ballasting operations should be in accordance with the requirements of, and should follow, the loading plan. Keep appropriate records.

Care of the cargo

Care of the cargo might be included in the safety management system procedures. Also obtain the requirements, if any, from the charterer and/or the shipper. Keep any documents provided which relate to the care of the cargo.

Discharge operations

Discharge operations should be in accordance with the requirements of, and should follow, the unloading plan. Keep appropriate records.

Ballast operations

Ballasting operations should be in accordance with the requirements of, and should follow, the unloading plan. Keep appropriate records.

Losses caused by not following safety management system procedures

If during operations on board, the appropriate safety management system procedures are not followed, this may lead to non-conformities occurring, to major non-conformities occurring, to failure to comply with the requirements of the ISM Code, and to the safety management certificate and the Document of Compliance being withdrawn.

Possible consequences include: delays and additional costs; and cancellation of the voyage or charter.

Loss prevention action

All appropriate safety management system procedures should be followed at all times.

WEATHER-DECK ARRANGEMENTS

(See Chapter 4.)

Inspect hatch covers

The weather-deck hatch covers must be weathertight. Inspections should be carried out at least once each voyage to establish their condition. Items to be inspected should include the steel structures, securing arrangements (cleats, wedges, draw-bolts

and other devices), the sealing arrangements (packing rubber and compression bars), drainage channels and non-return arrangements, hinges, wheels and rollers, and opening and closing arrangements.

Record in a work book all details of inspections and tests carried out and the results of tests. Record details of inspections and findings in the maintenance and inspection records.

If any defects are found, record details, advise the ship operator, make arrangements for repairs to be completed.

Record in a work book details of all repairs and maintenance carried out.

Losses caused by not maintaining hatch covers

If the weather-deck hatch covers are not in good, weathertight, condition, the load line survey may be failed, pre-loading inspections may be failed, seawater or rainwater may enter the holds causing wetting damage to cargo.

Possible consequences include: delays and additional costs; cancellation of voyage or charter; and cargo claims.

Loss prevention action

Maintain the weather-deck hatch covers and all weather-deck closing devices in weathertight condition in accordance with safety management system procedures.

Test hatch covers

The weather-deck hatch covers should be capable of passing a weathertightness test either by hose or by ultrasonic equipment. Hose testing or ultrasonic testing should be carried out before the loading of a water-sensitive cargo, either by the ship's crew or by shore personnel.

Record in the deck log book when a hose test or ultrasonic test is carried out, the hatches tested, and the results.

Record in a work book all details of all testing of weather-deck hatch covers, and details of all findings.

Losses caused by not testing hatch covers

If a hose test or ultrasonic test of the hatch covers is not successfully carried out and properly recorded before loading, the hatch covers might not be weathertight, it will not be possible to demonstrate that the hatch covers were, in fact, weathertight.

Possible consequences include: pre-loading inspection may be failed; and claims for water damage to cargo lodged after discharge may be difficult to defend.

Loss prevention action

Carry out testing of the hatch covers when possible before loading and record details.

Inspect weather doors, access covers and ventilators

The weather-deck arrangements include all weather doors on the main deck leading into cargo compartments and other spaces, hold access covers and ventilators. Inspections should be carried out regularly to establish their condition. When hose or ultrasonic testing is carried out on hatch covers, these doors and covers should also be tested.

The doors, covers and vents should be maintained in good working order. All hinges, seals and securing devices should be operational, vent covers should be operational, and fans and other machinery should be fully operational. Record in a work book all details of inspections and tests carried out.

Record details of inspections and findings in maintenance and inspection records. If any defects are found, record details, advise the ship operator, make arrangements for repairs to be completed.

Record in a work book details of all repairs and maintenance carried out.

Open and close hatch covers correctly

The weather-deck hatch covers should always be opened and closed in accordance with the correct procedures.

Before opening or closing the hatches ensure the correct crew members are assigned to the operation, all securing devices are removed and trackways are clear. All other personnel should be kept clear.

During the operation, observe that the hatch panels move correctly; if any defects or deficiencies are found, record details. Arrangements for repairs or rectification, as appropriate, should be made without delay.

Losses caused by misusing hatch covers

If the weather-deck hatch covers are not opened and closed in accordance with the correct procedures throughout the hatch panels may not open or close in the correct sequence, the hatch panels may come off or be displaced from trackways, the hatch panels may become jammed or locked out of position, and crew members or shore personnel may approach or be in way of the moving hatch panels.

Possible consequences include: damage to hatch panels resulting in an inability to close or open the hatch covers; delays and additional costs; and injury or fatality to crew members or shore personnel.

Loss prevention action

On every occasion of opening and closing the weather-deck hatch covers the correct procedures should be followed in full.

CARGO GEAR

(See Chapter 4.)

Maintain cargo gear

The cargo gear (by which is meant cranes or derricks) should be fully operational and properly maintained.

Inspections and tests should be carried out in accordance with the planned maintenance regime to establish the condition of all cranes and derricks. Items to be inspected should include:

- electrical control systems and equipment
- motors, hydraulic pumps, filters and coolers, and winches, and their brake mechanisms

- limit switches and cut-out switches
- structures, foundations and mountings
- sheaves, bearings, blocks and other moving parts
- wires, including terminations, swivels, lifting hooks and ancillary equipment
- means of access to operator cabins and so on.

Bear in mind the guidance in International Standard ISO 4309.

Record in a work book all details of inspections and tests carried out, the results of tests and details of any maintenance completed. Record details of inspections and tests in the maintenance and inspection record.

If any maintenance work or repairs and renewals are found necessary, advise the ship operator and make arrangements for the work to be carried out. If major defects are found, advise the ship operator and make arrangements for repairs to be carried out. Advise classification society if appropriate.

Record in a work book details of all repairs and maintenance carried out.

Inspect lifting gear

Lifting appliances and their loose gear are required to be thoroughly inspected annually, with a further inspection and proof load test every 5 years.

Arrangements should be made, in conjunction with the flag state or classification society for the annual and 5-yearly inspections to be carried out.

Details of the inspections and tests will be recorded in the register of lifting appliances and cargo handling gear by the surveyor.

Record in the deck log book details of the inspections and tests and their results. Record in the maintenance or inspection record details of the inspection and tests and their results.

Record in a work book details of any repairs and maintenance carried out.

Check cargo gear before, during and after operation

The cargo gear should be in good order and in satisfactory operational condition at the beginning of and throughout cargo operations.

Before cargo operations the cargo gear should be thoroughly examined and tested; any maintenance should be completed.

During cargo operations the operation of the cargo gear and all working parts should be continually monitored; if defects or deficiencies are found, work should be stopped and corrective actions should be taken.

During cargo operations the driver of the cargo gear should be monitored; if the cargo gear is not operated correctly, work should be stopped and an investigation should be conducted. Only appropriately trained drivers should operate the cargo gear.

During all cargo operations the duty deck officer should monitor the cargo being lifted by the cargo gear and should ensure the safe working load limit is never exceeded.

After cargo operations the cargo gear should be inspected overall to identify any defects or damages. Record in a work book details of all inspections, and of any maintenance carried out. If any incidents occur, an investigation should be conducted.

Record in the deck log book details of investigations and the results. Advise the ship operator.

Maintain grabs

Ship's grabs should be fully operational and properly maintained.

Inspections and tests of ship's grabs should be carried out in accordance with the planned maintenance regime to establish their condition.

Before being taken into use for cargo operations, grabs should be thoroughly inspected and tested.

During cargo operations the operation of the grabs should be monitored; if any defects or deficiencies are found, work should be stopped and corrective action should be taken. Advise the ship operator.

Record in a work book all details of inspections and tests carried out, the results of tests and of any maintenance completed.

Losses caused by not maintaining cargo gear

If the cargo gear is not maintained in good operating condition, annual or five-year surveys may be failed, machinery and associated parts may fail, and wires may fail.

Possible consequences include: delays and additional costs; possible cancellation of voyage or charter; damage to parts of the cargo gear; damage to cargo; and personnel injury or fatality.

Loss prevention action

Maintain all cargo gear in good operational condition, carry out all appropriate tests and inspections, and do not use any cargo gear which is not in good operational condition.

HOLD LIGHTING

(See Chapter 4.)

Maintain hold lighting

Hold lighting systems should be fully operational and properly maintained.

During hold cleaning and maintenance operations, inspections and tests of hold lighting systems should be carried out and any necessary maintenance, repairs and renewals should be completed. Items include main circuit breakers, local switches, light fittings, their bulbs or tubes, fixings and supports and their surroundings, and cable trays and their fixings and supports.

If any items are found to be dirty or partly or wholly covered in dirt, debris or cargo residues, they should be cleaned to allow full access for inspections and to allow proper function of the lighting system.

Losses caused by not maintaining hold lighting

If the hold lighting fittings are not properly maintained, failure of the systems may occur and cargo operations may not be possible.

Possible consequences include delays and additional costs.

Loss prevention action

Maintain the hold lighting fittings in good operating condition and carry out all appropriate tests and inspections.

Hold lighting during cargo operations

Hold lighting should be kept switched off throughout cargo operations unless required for safety reasons or light levels.

During loading and discharging hold lighting should be switched off locally throughout daylight hours and should only be switched on in working holds when it is required at night or at other times because of low light levels. When the hold lighting is not required it should be switched off. Hold lighting or hold access lighting can start a fire if switched on while submerged in bulk cargo.

Following completion of loading or discharging in any hold the lighting should be switched off locally or it should be confirmed that it is switched to off. Following completion of all loading or discharging at the port all hold lighting should be switched off locally and/or it should be confirmed that all lighting is switched off.

Hold lighting during the voyage

Hold lighting should be kept switched off throughout the voyage, unless required for inspections, maintenance and so on.

When the ship is secured for sea it should be confirmed that all hold lighting is switched off locally and the lighting circuits should be isolated at the circuit breaker. A notice should then be put in place stating that the hold lighting is not to be reconnected without appropriate permission, that is, from a duty deck officer or senior deck officer.

If inspections or work are to be carried out in one or more of the holds appropriate permission should be obtained after which only the required lighting should be switched on. Following completion the lighting should be switched off locally and the circuits should be isolated at the circuit breaker, and the notice should be reinstated. Be aware that other lights for other compartments might be on the same circuit and might be inadvertently switched on.

If shore personnel attend on board to carry out inspections, including inspections in the holds, the appropriate lighting should be switched on. Following completion of the inspections the lighting should be switched off locally and the circuits should be isolated at the circuit breaker and the notice should be reinstated.

Losses caused by misusing hold lighting

If the hold lighting is found to be switched on when it should be switched off, there has been a failure of procedures, unauthorised entry of a cargo compartments may have occurred, heating or ignition of cargo in way of light fittings may have occurred.

Possible consequences include: injury or fatality of unauthorised persons; cargo damage leading to a claim; and fire.

Loss prevention action

Carry out an investigation to establish who switched the lighting on and why, and carry out a search, using all appropriate safety equipment and following all appropriate safety procedures, to establish whether or not there are any unauthorised persons in the cargo compartments and whether or not there have been any injuries and, so far as possible, whether or not there is any heating damage to cargo.

Appropriate action should be taken thereafter. Also maintain a notice at the lighting circuit breaker stating that the hold lighting is not to be reconnected without appropriate permission when the lighting is not in use and is switched off and isolated.

IDENTIFICATION OF THE CARGO

(See Chapter 5.)

Establish cargo name

Establish the proper name of the cargo.

If the cargo is a grain cargo, the provisions of the International Grain Code should be followed. If the cargo is a solid bulk cargo which is not grain, it is covered by the IMSBC Code and the provisions of the IMSBC Code should be followed. A solid bulk cargo is either grain or is a cargo covered by the IMSBC Code.

Bulk Commodities	
Grain	Must be stowed and carried in accordance with the provisions of the International Grain Code.
Solid bulk cargo	Must be stowed and carried in accordance with the provisions of the IMSBC Code, and must have a BCSN.

However there are some IMSBC Code cargoes – called non-cohesive cargoes – that must also be treated as if they are grain for stowage and stability purposes (see paragraph 1 of appendix 3 and section 5 of the IMSBC Code) if the angle of repose is less than or equal to 30°.

From the Document of Compliance for ships carrying dangerous goods, the certificate of compliance with the IMSBC Code or the Grain Loading Manual, as appropriate, ensure the cargo being put forward is a cargo which can be safely carried on board.

If it is an IMSBC Code cargo, the cargo declaration provided by the shipper must state the bulk cargo shipping name (BCSN). The shipping declaration might also include trade or commercial names.

If the name is not listed in all capitals in the index of the IMSBC Code (appendix 1), revert to the ship operator or charterer for more information. Appropriate authorisation from the government of the country of loading may be required (see IMSBC Code, section 1.3).

Keep a record of all discussions and communications.

Establish shipper name

Establish the identity of the shipper. The name of the shipper should be on the cargo documents. Ensure the name is the same on all cargo documents.

Keep copies of the documents.

Check other sources

Consult *Thomas' Stowage* and other publications for additional information and guidance. However, publications might give a recognisable name, but that does not mean that that is the cargo to be loaded. If in doubt, keep checking.

Keep a note of references in publications.

Confirm cargo with ship operator

Confirm the identity of the cargo with the ship operator's office. If there is doubt about the identity of the cargo, discuss and communicate with shore personnel and, if appropriate, with an independent marine consultant.

When the identity of the cargo is known, be aware of all the requirements for its safe carriage and ensure all requirements are rigorously followed.

Keep copies of all communications and notes of discussions.

When cargo is grain

When it has been established that the cargo is grain, the provisions of the International Grain Code should be followed.

When cargo is not grain

When it has been established that the cargo is not grain, the provisions of the IMSBC Code apply and the group status, A, B or C, must be established.

Using the cargo documents, establish if the cargo description or name matches an entry in the IMSBC Code, which is the BCSN, which identifies the group listing. If there is a Group declared on the cargo documents, ensure the group is the same as the entry in the IMSBC Code. If not, revert to the ship operator or charterer for more information.

If there is a listing in the IMSBC Code but no group given on the cargo documents, revert to the ship operator or charterer for more information. If the cargo is listed in the IMSBC Code, be aware of all the requirements in the code for its safe carriage and ensure all requirements are rigorously followed. If the cargo is not listed in the IMSBC Code, it should not be loaded. Refer to section 1.3 of the IMSBC Code.

If the cargo is declared as Group A, the cargo documents must include certificates for TML and moisture content, and these levels must be such that the moisture content is below the TML.

If no certificate is provided (as set out in section 4 of the IMSBC Code), revert to the ship operator or charterer for clarification. If in doubt about the reliability of the TML or moisture content declaration, a 'can test' should be carried out as a check test of the possible condition of the cargo, as given in section 8 of the IMSBC Code. However, a can test can never replace a valid TML or moisture content certificates.

If the cargo is declared as Group B, carefully review the procedures in the IMSBC Code relating to the hazard classification declared for the cargo. Ensure all necessary safety and monitoring equipment is on board and in good working order, and the crew are fully trained in its use. Keep copies of any safety data sheets.

For Group B cargoes which possess a chemical hazard and may emit hazardous gases or may self-heat, such as coal, review the IMSBC Code procedures relating to appropriate times to employ hold sealing, and hold ventilation. If the shipper provides instructions for hold sealing and ventilation which differs from IMSBC Code procedures, revert to the ship operator or charterer for clarification.

Keep copies of any instructions. If the cargo is declared as Group C but a TML and/or a moisture content certificate is provided, the cargo group may be mis-declared. Revert to the ship operator or charterer for clarification.

If the cargo has been declared as Group C, but is wet or damp and contains a

proportion of fine particles, seek advice from the ship operator or charterer as to whether testing for flow properties has taken place (see appendix 3 of the IMSBC Code).

If the cargo is harmful to the marine environment (HME) the declarations must show this to be the case.

If in any doubt, revert to the ship operator or charterer for clarification and, if appropriate, with an independent marine consultant. Keep copies of all communications. Keep notes of discussions.

Losses caused by incomplete declaration for IMSBC Code cargo

If, for an IMSBC Code cargo, a cargo declaration is not provided or if the declaration is incomplete, the cargo may possess characteristics and hazards which are not known.

As a consequence the cargo may liquefy, may shift, or may produce a chemical or other hazard during the voyage which would endanger the crew and the ship.

Loss prevention action

Do not allow an IMSBC Code cargo to be loaded without a complete cargo declaration.

Losses caused by not knowing moisture content and/or limit of Group A cargo

If, for an IMSBC Code cargo which is declared to be a Group A liquefiable cargo; (a) a TML certificate and/or a moisture content certificate is not provided, (b) certificates are provided but you have suspicions with regard to the validity and/or the reliability of the certificates or (c) the moisture content is above the TML, the cargo may be likely to liquefy.

As a consequence the cargo may liquefy during the voyage which would endanger the crew and the ship.

Loss prevention action

Do not allow a Group A liquefiable cargo to be loaded without reliable TML and/or moisture content certificates or if the moisture content is above the TML.

Losses caused by not being able to monitor Group B cargo

If the cargo is declared to be a Group B chemical hazard cargo under the IMSBC Code and the necessary safety and monitoring equipment is not on board, it will not be possible to carry out the necessary monitoring of the cargo and the atmosphere in the cargo compartments properly.

As a consequence the cargo may develop or produce a hazardous situation which cannot be controlled, and which would endanger the crew and the ship.

Loss prevention action

Do not allow a Group B chemical hazard cargo to be loaded until all the necessary safety and monitoring equipment is on board.

Losses caused by unidentifiable cargo

If the cargo cannot be identified either as a grain cargo or with a BCSN under the IMSBC Code, the cargo may have characteristics which are not known.

As a consequence the cargo may liquefy, may shift or may produce a chemical or other hazard during the voyage which would endanger the crew and the ship.

Loss prevention action

Do not allow a cargo to be loaded that cannot be identified as grain or with a BSCN under the IMSBC Code.

CARE AND CARRIAGE REQUIREMENTS

(See Chapter 3 and Chapter 5.)

Follow IMSBC Code for non-grain cargoes

Care and carriage requirements for bulk cargoes other than grain are set out in the IMSBC Code.

If the cargo is not grain it should have an entry in the IMSBC Code. The various requirements are set out in the Code and these requirements must be followed. The requirements in the code, which are given in individual schedules in appendix 1, are divided into a sequential list including; stowage and segregation, hold cleanliness, trimming and so on, through to clean up.

If the material does not have an entry in the IMSBC Code it cannot be carried until the procedure set out in section 1.3 of the IMSBC Code is completed, see Chapter 3.

Losses caused by not following IMSBC cargo care requirements

If the care and carriage requirements for an IMSBC cargo are not fully followed and put into effect; the structures of the hold and ship may be overloaded; dust or gas may enter the accommodation, the engine room and other spaces; the cargo stowages may not be trimmed adequately or properly, leading to other hazards; the cargo may be wetted, leading to other hazards or problems; the cargo may not be ventilated or ventilated as required, leading to other hazards or problems; and the cargo may spontaneously heat and may catch fire.

Possible consequences include structural damage to the ship and damage to the cargo.

Loss prevention action

Be fully aware of all the requirements in the IMSBC Code, and elsewhere, and always follow them completely.

If all the procedures are not followed at the loading port – do not sail until the situation is corrected.

Follow International Grain Code for grain cargoes

Care and carriage requirements for bulk grain are set out in the International Grain Code.

If the cargo is grain or is considered to be grain, those parts of the International Grain Code dealing with the voyage must be followed.

Losses caused by not following grain cargo care requirements

If the care and carriage requirements for a grain cargo are not followed and put into effect, the compartments may not be filled as required and the stowages may not be trimmed as required.

Possible consequences include structural damage to the ship and the ship listing to an excessive angle and possibly capsizing.

Loss prevention action

Be fully aware of all the requirements in the International Grain Code, and elsewhere, and always follow them completely. If all the procedures are not followed at the loading port – do not sail until the situation is corrected.

Check published requirements

Other information may be found in the safety management system procedures and in publications.

Care of cargoes might be included in the safety management system procedures; the guidance should be followed.

Publications such as *Thomas' Stowage* might give some general guidance and might suggest other publications. If in any doubt, revert to the ship operator or charterer for clarification and, if appropriate, contact an independent marine consultant.

Keep a note of references in publications.

Check charterer and shipper requirements

For some cargoes the charterer and/or the shipper might provide their own requirements.

Cross-check any requirements with those in publications. If there is a difference, revert to the charterer for clarification. Discuss and communicate with the ship operator and, if appropriate, with an independent marine consultant.

Keep copies of all communications. Keep notes of discussions.

For some cargoes the charterer, shipper or receiver might require fumigation of the cargo (see section on 'Fumigation requirements' in this Chapter).

HOLD CLEANLINESS REQUIREMENTS

(See Chapter 4.)

Follow charterer and shipper requirements

The hold cleanliness requirements should be stated by the charterer and/or the shipper.

When the identity of the cargo is confirmed, establish from the charterer and/or the shipper what their requirements for hold cleanliness are. Establish, if possible, that the standard of cleanliness is accepted by the receiver of the cargo or country of destination.

Keep copies of all communications.

Losses caused by not establishing hold cleanliness level

If it is not established what level of hold cleanliness is required, it will not be possible correctly to instruct the crew with regard to the cleaning operations.

Possible consequences include: an unnecessary amount of time may be spent cleaning when it is not required because a dirty cargo is to be loaded; and an insufficient amount of time may be spent cleaning when a high standard of cleanliness is required for a clean cargo.

Loss prevention action

Establish exactly what level of cleanliness of the holds is required for the cargo which is to be loaded next.

Check published requirements

Requirements are given in some publications.

Consult publications such as *Thomas' Stowage* which might give advice. Keep a note of references in publications.

Check exporting country requirements

For some cargoes, the authority of the exporting country sets standards and carries out inspections. Establish whether or not the authority requires a certain standard of hold cleanliness.

Obtain details of the standard and arrange cleaning accordingly.

Keep a record of the required standard or reference to the standard.

Losses caused by not cleaning holds to required standard

If the holds are not cleaned to the required standard, the holds will be found to be not in a condition suitable for loading during a pre-loading inspection.

Possible consequences include: the ship may be rejected as not suitable for loading; the charter might be cancelled; and there will be delays during additional cleaning operations and plus additional costs and other consequences.

Loss prevention action

When it has been established what level of cleanliness is required, ensure the holds are cleaned to that standard, or better.

Confirm requirements with ship operator

Confirm the requirements with the ship operator's office. If in doubt, discuss and communicate with shore personnel to confirm the required standard of cleanliness for the cargo and, if appropriate, with an independent marine consultant.

Keep copies of all communications. Keep notes of all discussions.

Losses caused because holds not cleaned to required standard

If cargo is loaded into holds which have not been cleaned to the required standard, cargo may become contaminated by debris remaining in the holds, and cargo may become wetted by water remaining in the holds.

Possible consequences include: cargo which is contaminated and/or damaged may be rejected during the unloading operation; delays in the unloading operation while segregation of affected cargo is carried out; additional costs and other consequences.

Loss prevention action

Always ensure the holds are cleaned and prepared to the standard required for the particular cargo before loading is commenced.

HOLD PREPARATION

(See Chapter 4.)

Cleaning by crew

When the required standard of cleanliness is known, arrangements should be made for the crew to carry out the cleaning.

The crew should be instructed to carry out the cleaning and preparation of the holds as required using the appropriate equipment and materials.

Record in the deck log book when work starts and when work finishes in each hold during each day of the operation. Record in a work book, for each day of the operation, which crew members are working in which hold, the methods of cleaning employed, and details of the equipment and materials used, including the quantities of detergents, seawater and fresh water. Also record which, if any, hatch covers are open and how far they are open. Also ensure weather and sea conditions are recorded.

Inspect during cleaning

During the operation, the master or chief officer should carry out inspections to ensure the cleaning is being carried out correctly and by use of the correct materials and equipment. Inspections should be carried out at least once during each day by the master or chief officer, in company with the bosun, to establish how the operation is progressing.

Items to be inspected should include the inside of the hatchway, the under-deck areas, the end bulkheads and side structures, the tank top and the bilges. Record in the deck log book when the inspections are carried out and by whom. Record in a work book when the inspections are carried out and by whom, and details of findings with regard to cleanliness and condition of structures. If the course and/or speed of the ship are adjusted to facilitate the operation, details should be recorded in the deck log book.

Safe procedures for opening and closing hatch covers at sea should be followed. If the hold cleaning is not possible because of adverse weather, this should be recorded in the deck log book. Take photographs of the cleaning operations.

Inspect after cleaning

Following completion of the cleaning operation, a final inspection should be carried out to confirm that the holds have been cleaned and prepared to the required standard.

The final inspection should be carried out, when all cleaning and all preparations have been completed, by the master or chief officer, in company with the bosun, to establish that the holds are in a suitable condition for the loading of the designated cargo.

Record in the deck log book when the inspection is carried out and by whom. Record in a work book when the inspection is carried out and by whom, and details of findings with regard to the cleanliness and the condition of the structures. Take photographs of the holds.

Test hold bilges

Following completion of cleaning of the holds, the hold bilges should be tested, and the structures and fittings should be tested or inspected.

The chief officer, in conjunction with the duty engineer, should test the pumping suction of bilges and then test the non-return function of the bilge system valves to ensure no flow-back will occur. Hold bilge high level alarms should be tested and proved operational where fitted. The chief officer should inspect the steelwork of all ballast tanks and all fuel tanks, all air pipes and all sounding pipes, to ensure there are no fractures or areas of wastage where leakage might occur.

The chief officer should inspect all manhole covers and other fittings to ensure proper securing of the covers has been completed and no leakage should occur. If any deficiencies are found, appropriate rectification measures should be carried out.

Record in the deck log book when inspections are carried out. Record in a work book when inspections are carried out, details of findings, and details of all work done.

Advise on cleaning progress

During the operation the master should advise the ship operator, the charterer and any other appropriate party of the progress of the cleaning operation.

Information on the progress of the operation should include, as appropriate to the circumstances, one or more of the following:

- whether or not the holds can be cleaned as required and the expected time and date of completion
- whether or not difficulties are likely to be encountered because of adverse weather conditions, a lack of time available, a lack of equipment available, an excessive amount of previous cargo residues or inaccessible previous cargo residues
- whether or not there will be a need for hold washing water to be disposed of ashore
- whether or not shore cleaners and/or equipment will be needed for completion of the operation.

Updating information should be provided as the operation progresses. Keep copies of all communications.

Cleaning by contractor

If shore cleaning gangs are involved with the cleaning operation, discussions should be held with their supervisor to establish exactly what work will be done by them and using what equipment or materials.

The supervisor of the cleaning company should be advised by the master or chief

officer of the construction of the ship and of safety procedures, as appropriate, and of the previous cargo. Agreement should be reached with regard to what is to be cleaned, the required level of cleanliness and how.

Ensure contracted cleaning company has adequate insurance cover in place for all employees on board. Keep notes of all discussions and of all agreements made. Keep copies of all written communications.

Record in the deck log book on each day of the operation when the cleaning gangs attend on board, the number of personnel, and when they leave. Record in a work book for each day of the operation what shore personnel are working in which hold, the methods of cleaning employed, and details of the equipment and materials used on board and where, including the quantities of detergent, sea water and fresh water.

The ship's crew should ensure shore labour are always using appropriate PPE and employing safe work practices. If non-compliance is noted then work should be stopped and the problem(s) brought to the attention of the cleaning company supervisor. Work should not be resumed until the problem(s) have been satisfactorily resolved. Take photographs of the cleaning operation.

Losses caused by not cleaning holds to required standard

Holds may not be cleaned to the required standard because of failure to establish what level of cleanliness is required, incorrect instructions being given to the crew, incorrect instructions being given to shore labour, or inadequate monitoring of cleaning operations. An insufficient number of crew members or shore labour personnel may have been assigned to the cleaning operation, an insufficient amount of time may have been spent cleaning when a high standard of cleanliness is required for a clean cargo, or inappropriate or an inadequate amount of equipment and materials may have been used.

Possible consequence include: the ship might be rejected as not suitable for loading; the charter might be cancelled; and there may be delays during additional cleaning operations plus additional costs and other consequences.

Loss prevention action

When it has been established what level of cleanliness is required, ensure the holds are cleaned to that standard, or better.

Coating requirement

Establish whether or not a hold coating is required and, if so, what type (e.g. lime wash).

Obtain confirmation that a coating is to be applied and establish the type of coating. Confirm that the coating is compatible with the coating on the ship's structures and the cargo to be loaded. Establish who is to apply the coating, where, and when. Keep notes of all discussions and of all agreements made, and keep copies of all written communications.

Record in the deck log book when the coating is applied and where. Record in a work book when the work is carried out, what personnel are involved in each hold, what equipment is used, and to what surfaces the coating is applied.

Monitor the operation to ensure the coating is applied correctly and as required. Record in a work book details of the coating, to include the type of coating, the supplier and the quantities used. Take photographs of coated holds.

Losses caused by not coating hold steelwork when required

If it is not established that a coating is required on the steelwork of the holds when one is required, the holds may be found to be not ready for loading during a pre-loading inspection, and cargo might be loaded into holds with unprotected steelwork.

Possible consequences include: the ship might be rejected as not suitable for loading; and there might be delays during the operation of applying the required coating plus additional costs and consequences. Contact between cargo and bare steelwork may also lead to corrosion and wastage of the steelwork and/or contamination of cargo and consequential claims.

Loss prevention action

When it has been established what cargo is to be loaded next, establish whether or not any form of coating on the hold steelwork is required.

Inspect hold structures and test ballast tanks

Carry out inspections of the steel structures of the holds, and of ballast tanks if appropriate. Also, test ballast tanks if possible. Inspections should be carried out by competent senior officers, to establish that all structures are in satisfactory condition.

Record details of inspections of the steel structures, and the findings, in the maintenance and inspection records. Record details of all testing of ballast tanks, and the findings, in the maintenance and inspection records.

If any defects are found, record details, advise the ship operator, and request arrangements be made for rectification of defects. Notify classification society if appropriate.

Losses caused by not inspecting holds and testing ballast tanks

If proper inspections of the steel structures in the holds and appropriate tests are not carried out, there might be a failure to identify wastage and weakness in the structures and defects in piping systems.

Possible consequences include: rejection of the ship for loading by local authority inspectors; failure to comply with the safety management system; wetting of cargo during the voyage by a flow-back of water into the holds via the bilge pumping system and consequential claims; and wetting of cargo during the voyage by flow of water from ballast tanks or their piping systems into the holds via defects and consequential claims.

Loss prevention action

During hold preparation operations, carry out thorough inspections of steel structures and piping systems and carry out appropriate tests.

Local authority inspection

Establish whether or not it is a requirement that a local authority inspector must inspect the holds before loading is allowed to begin.

If such an inspection is required, all necessary arrangements should be made for the inspection to be completed as required and without delay.

Record in the deck log book when the inspection is carried out, by whom, and what is inspected. Record in the deck log book the results of the inspection. Record in a work book details of the inspection, the results of the inspection, and any discussions with regard to the inspections, the findings, and any additional work to be carried out.

Retain copies of all certificates issued.

CALCULATIONS AND PLANS – LOADING

(See Chapter 5.)

Clear loading instructions should be received

Instructions for the loading of cargo received by the master should be clear.

Establish what mass of cargo is to be loaded, its stowage factor, and any draught restrictions which apply at any stage of the voyage. Carry out calculations to determine the required mass in each hold.

Carry out trim, strength and stability calculations to ensure there are adequate margins of safety at all stages of the voyage. Advise the ship operator, the charterer and any other appropriate party of the findings.

Keep copies of all calculations. Keep copies of all communications.

Losses caused by inaccurate cargo weight calculation

If the weight of cargo to be loaded into each compartment is not calculated accurately, errors might be introduced into other calculations, the loading plan will not be prepared correctly and incorrect instructions for loading will be given to the stevedores.

Possible consequences include: the ship might be incorrectly and dangerously loaded; structural damage to the ship; incorrect draughts and/or trims upon completion; and the ship might be placed off-hire.

Loss prevention action

When it has been established what cargo is to be carried next, carry out all the necessary and required calculations accurately.

Work out loading sequence

A loading sequence should be worked out.

Establish how many loaders or cranes will be used during loading. Work out a loading sequence giving the weight of cargo per pour per hold. Work out a de ballasting sequence to be undertaken during loading.

Carry out trim, strength and stability calculations for each stage of the operation to ensure the ship's safety at all times. Complete a loading plan giving all the details, and forward a copy of the plan as appropriate.

Keep copies of calculations and of the loading plan.

Losses caused by not completing pre-loading calculations

If the required pre-loading calculations are not completed, it will not be possible to demonstrate that the ship will have a safe margin of stability at all stages of the voyage.

Possible consequences include: contravention of SOLAS and the International Code on Intact Stability; delays at the load port and other costs and consequences; and shifting of cargo at sea.

Loss prevention action

Always satisfactorily complete all the required calculations.

Establish if cargo is grain

Establish whether or not the cargo is grain or is considered to be grain.

If the cargo is grain, carry out appropriate grain stability calculations as required by the International Grain Code. Complete calculations required by the authority for the loading port (e.g. the National Cargo Bureau, Inc.).

Bear in mind that some prilled or granular cargoes (e.g. fertiliser) are non-cohesive and have an angle of repose of less than or equal to 30° and must therefore be considered to be grain for the purpose of loading and stowage (see section 5 of the IMSBC Code). Carry out all the necessary calculations.

Also bear in mind the possibility of overloading of the tank top plating in the holds. Carry out all the necessary calculations.

Advise the ship operator, the charterer and any other appropriate party of the findings. Keep copies of all calculations and communications.

If required, obtain the advice of an independent marine consultant.

Losses caused by not completing grain cargo plans and calculations

If the required plans and calculations for a grain cargo are not completed, it will not be possible to demonstrate that the ship will comply with the requirements of the International Grain Code at all stages of the voyage.

Possible consequences include: contravention of SOLAS and the International Grain Code; delays at the load port and other costs and consequences; and shifting of cargo at sea.

Loss prevention action

Always satisfactorily complete all the required plans and calculations.

THE BLU CODE – LOADING

(See Chapter 3.)

Establish loading port or berth

Establish details of the port or berth at which loading will take place.

Ensure the ship is suitable for loading at the nominated terminal. Ensure all the pre-arrival information is provided. Ensure the terminal provides all the necessary information. Carry out checks and request confirmation of information, or more information, as appropriate.

Keep copies of all communications.

Complete loading plan

A loading plan should be completed.

Ensure the loading plan is properly prepared after all the necessary calculations have been satisfactorily completed (see appendix 2 of the BLU Code).

Forward a copy of the loading plan as appropriate. Keep copies of calculations and of the loading plan.

If the requirements of the BLU Code are not complied with there would be a contravention of SOLAS.

Exchange information with terminal

When alongside, there should be full exchange of information between the ship and the terminal. Complete the ship–shore safety checklist with the terminal representative, and both parties should sign the checklist (see appendix 3 of the BLU Code).

A copy of the loading plan should be passed to the terminal representative, and both parties should sign the plan. Obtain the agreement of the terminal representative with regard to the sequence of loading.

Record in the deck log book that the loading plan has been agreed and the ship–shore safety checklist has been completed. Keep copies of all documents.

Losses caused by inadequate communication during loading

If there is no or no adequate and appropriate exchange of information and communication between ship's personnel and the terminal representative and other terminal staff, there might be a misunderstanding of information; and the cargo might not be loaded correctly and as planned.

Possible consequences include: the ship might be overloaded and/or overstressed; there might be delays while re-distribution of the cargo is carried out with additional costs and other consequences; incorrect draughts and/or trim upon completion; and the ship might be placed off-hire.

If the requirements of the BLU Code are not complied with there would be a contravention of SOLAS.

Loss prevention action

Always maintain full co-operation between ship's staff and the terminal representatives throughout the loading operation.

Cooperate with terminal

During the loading operation there should be full cooperation between the ship and terminal to ensure the operation is safe and efficient.

Fully discuss the loading operation and its progress with the terminal representative as the operation is ongoing. Point out any difficulties on the ship's side. Enquire about any difficulties on the terminal's side. Keep a record of communication.

Monitor the loading operation and ensure it is proceeding in accordance with the loading plan. Carry out de-ballasting in accordance with the loading plan, and keep the terminal representative notified of the progress and situation. Maintain contact with the terminal representative at all times. Keep a record of all discussions and communications.

If loading and/or de-ballasting are not progressing in accordance with the loading plan, discuss the situation with the terminal representative and reach agreement with regard to any appropriate changes to the plan.

If appropriate, loading should be suspended while discussions are underway.

Keep a record of these communications, discussions and agreements.

Losses caused by not loading as planned

If the loading operation is not progressing as planned, cargo will not be loaded correctly and as required by the pre-loading calculations.

Possible consequences include: the ship might be overloaded and/or overstressed; there might be delays while re-distribution of the cargo is carried out with additional costs and other consequences; incorrect draughts and/or trim upon completion; and the ship might be placed off-hire.

Loss prevention action

Stop loading. It would be far better to suspend loading for a short period while the situation is discussed and any appropriate changes to the loading plan are made than to allow the situation to get out of control, with dangerous consequences.

LOADING OPERATIONS

(See Chapter 5.)

Load according to loading plan schedule

The loading operation should follow the schedule set out in the loading plan.

A deck officer should be on duty on deck at all times when loading of cargo is underway, to monitor operations.

Record in the deck log book when loading starts and when loading finishes in each hold during each day of the operation. Keep the ship operator, the charterer and any other appropriate party advised of operations throughout the process. Also record details of all delays and the reasons for those delays in a work book.

Ensure correct weights in holds

Ensure the correct weight of cargo is loaded into each hold.

The duty officer should obtain from the terminal representative the loading rate and the weight of cargo loaded during each pour. These weights should be recorded in a work book, and running totals for the ship and each hold should be kept in the work book.

The ship's draught should be frequently monitored to ensure the loading plan is being followed. Record all draught readings in a work book and as appropriate on the loading plan. Draught surveys should be carried out by ship's staff as appropriate to establish the weight of cargo on board. Additionally, official joint draught surveys might be carried out.

Keep copies of all draught survey calculations (see also next sub-section.)

Ensure required draught achieved

Ensure the loading is carried out to achieve the required draught. The ship's draught should be frequently monitored to ensure the loading plan is being followed. Record all draught readings in a work book.

Draught surveys should be carried out during the final stages of loading by ship's staff so that calculations can be carried out to establish if there is any hog or sag of the ship, what weight of cargo is required to be loaded to achieve the required draught and what distribution of that cargo is required for trimming of the ship. A sufficient quantity

of cargo should be kept in-hand for final 'trimming' pours. Typical tonnages allowed for trimming could be 5,000 tonnes for a cape-size, 2,500 tonnes for a panamax or 1,000 tonnes for a handy-size.

Draught readings forward, aft and at mid-length should be monitored to ensure; the loading of the final weight of cargo is as required, the required draught is achieved and not exceeded, and the ship is not loaded to a draught deeper than the appropriate load line requirements during the voyage.

It should be borne in mind that fully loaded bulk carriers have a tendency to sag, sometimes considerably.

Keep copies of all draught survey calculations. Record all draught readings in the deck log book or in a work book as appropriate.

De-ballast according to loading plan schedule

De-ballasting operations should follow the schedule set out in the loading plan. The duty deck officer should liaise with the duty engineer, or whoever is responsible for the pumping of ballast water, to ensure the required de-ballasting is carried out when required.

Soundings of the tanks involved should be taken before, during and after each de-ballasting operation to ensure the required operation is completed.

All soundings taken during de-ballasting operations should be recorded in a work book, together with the date and time taken. Morning soundings and afternoon soundings, if appropriate, of all tanks should be recorded in a soundings record book.

Record in the ballast water record book all details of all de-ballasting operations, and complete the ballast water reporting form.

Losses caused by not monitoring loading

If loading operations are not carefully and properly monitored throughout, cargo might not be loaded correctly and as planned.

Possible consequences include: the ship might be overloaded and/or overstressed; there might be delays while re-distribution of the cargo is carried out with additional costs and other consequences; incorrect draughts and/or trim upon completion; and the ship might be placed off-hire.

Loss prevention action

Always closely monitor the loading of cargo throughout the operation. If cargo is not loaded correctly and as planned, stop loading and investigate the reason for the error, discuss the loading with the terminal representatives and make appropriate changes to the loading plan.

Monitor cargo type and apparent condition

Ensure the cargo is the declared cargo and establish its apparent condition.

Inspections of the cargo should be carried out on an ongoing basis. The cargo in the holds and ashore, so far as possible, should be inspected, and the temperature of the cargo should be measured. Inspections during the loading of a dusty cargo may be difficult to achieve, in which case inspections during breaks in the operation should be done.

Establish, if possible, what inspections of the cargo were or are carried out and what testing of samples has been done and by whom and for what purpose. Record details in a work book. Record in a work book details of the apparent condition of the cargo,

the details to include: temperature, colour and colour range, dryness or dampness, free-flowing or not free-flowing, lumps present and their size and quantity, foreign matter and its type and quantity, and anything else seen.

If the cargo is grain or seed cake, record the cargo temperature at loading to assist in ventilation strategy (e.g. three-degree rule) and to monitor any changes in temperature at out-turn. Seed cake cargoes should not be loaded above 55°C. If the cargo is a mineral-type material and comprises a significant proportion of fine particles, particular attention should be given to its consistency and moisture content.

If the cargo is 'muddy' or 'clay-like', samples should be drawn and a complementary test, that is the 'can test', should be carried out as given in section 8 of the IMSBC Code. For mineral cargoes appearing 'muddy' or 'clay-like', photograph or video cargo dropping from height, that is onto the tank top or previously-loaded cargo, and, when carrying out a 'can test', photograph the cargo in the can before the test and after the test.

Discuss findings with shore personnel and the ship operator, and an independent marine consultant. Local P&I club correspondents can be a useful source of help and advice if difficulties are encountered. If in doubt, proper sampling and laboratory testing should be carried out, independently of the shipper.

Testing should be conducted before cargo is accepted for loading.

Clause the mates receipts and bills of lading as or if appropriate.

Keep notes of all discussions and keep copies of all communications. Take photographs of the cargo and of any apparent conditions found. Keep samples if possible.

Losses caused by not monitoring condition of cargo during loading

If loading operations are not carefully and properly monitored throughout, the apparent condition of the cargo cannot be established.

Possible consequences include: failure to see defects, damages or condition of the cargo; failure to clause the bills of lading appropriately; and cargo displaying pre-shipment damage being discharged against clean bills of lading, leading to delays, claims and additional costs and other consequences.

Loss prevention action

Always closely monitor the loading and the apparent condition of the cargo. If the cargo is seen to display anything which is not expected and appears to affect its condition (for example wetting, discoloration, lumpiness, inclusion of foreign matter) clause the bill of lading appropriately.

Losses caused by loading a Group A cargo which looks muddy or clay-like

If the cargo being loaded is Group A under the IMSBC Code and it looks 'muddy' or 'clay-like', or splatters when dropped into the hold, its moisture content might be in excess of its TML.

Possible consequences include that the cargo may liquefy during the voyage, which could then endanger the crew and the ship.

Loss prevention action

Do not allow loading of the cargo.

Carry out one or more 'can tests' on samples of the cargo.

Seek advice with regard to the results of the 'can tests' and act accordingly.

Losses caused by loading a Group B cargo which displays a chemical hazard or looks too hot

If the cargo being loaded is Group B under the IMSBC Code and it appears to display a chemical hazard, or is hotter than the maximum temperature that may be specified in the IMSBC Code (e.g. coal, DRI or seed cake), the cargo might not be in a condition suitable for carriage.

Possible consequences include that the cargo may develop or produce a hazardous situation which cannot be controlled during the voyage and would endanger the crew and the ship.

Loss prevention action

Stop loading. Carry out an investigation into the cause of the problem. Seek advice, and act accordingly.

Losses caused by loading any cargo which displays a hazardous condition

If cargo being loaded is from any Group, A, B, C or a combination, and it appears to display a 'muddy' or 'clay-like' appearance, a chemical hazard or any other condition which appears to be hazardous, such as splattering when it is dropped into the hold, the cargo may have an inherent dangerous condition.

Possible consequences include that the cargo may further develop or produce a dangerous situation during the voyage, which would endanger the crew and the ship.

Loss prevention action

Stop loading. Carry out an investigation into the cause of the problem. Seek advice and act accordingly.

Monitor loading operations

Monitor loading operations alongside, so far as possible. Inspections of the loading equipment ashore should be carried out so far as is possible and is allowed, and so far as safety considerations will allow when alongside.

Inspections of cargo on barges should be carried out when loading while at anchor.

Record in a work book details of the shore equipment in use, the details to include: conveyors, cranes, grabs, bulldozers, pay-loaders and other equipment. Take photographs of the equipment.

Monitor cargo delivery

Monitor delivery of the cargo alongside, so far as possible. Inspections of the delivery equipment ashore, and of storage facilities, should be carried out so far as is possible and is allowed, and so far as safety considerations will allow when ship is alongside.

Inspections of barges should be carried out when loading while at anchor.

Record in a work book details of the delivery equipment in use: road trucks (open or covered), rail trucks (open or covered), conveyors (open or covered, barges. Also details of stowage facilities, stockpiles (open or covered), sheds, silos, or whatever, if possible. Take photographs of the equipment and the storage facilities.

Monitor weather conditions

Monitor the weather conditions. The duty deck officer should at all times monitor the weather conditions to be constantly aware of the likelihood of precipitation.

The radar should be used if appropriate and if allowed by shore authorities. Record in the deck log book at the end of each watch, and at other times as appropriate, the ambient temperature, dew point, visibility, air pressure, and details of all precipitation.

If the cargo is Group A under the IMSBC Code, and if it is being stored in uncovered stockpiles or is delivered in open transport vehicles, and if there is significant precipitation, the added water might affect the moisture content and raise it above the TML. Therefore, monitor the precipitation and, if appropriate, request re sampling and new tests for moisture content.

The duty officer should discuss weather conditions with the stevedores or terminal representative, and when loading should and should not be stopped because of the intensity of precipitation, and agreements should be reached.

Records of discussions should be kept in the deck log book. Keep copies of all communications. Letters of protest should be written if the stevedores do not follow the master's instructions. Also record in the deck log book details of all delays for precipitation, together with times of closing and opening of the hatches. Take photographs of the precipitation, and of the closing and opening of the hatches.

Losses caused by rain on water-sensitive cargo prior to loading

If cargo which is water sensitive and should be kept dry is wetted by precipitation, problems will be encountered during loading, during discharge or during both.

Possible consequences include: delays, additional costs and other consequences during loading; and delays, claims, additional costs and other consequences during discharge.

Loss prevention action

If water sensitive cargo is seen to be wet before it is loaded, the wet cargo should not be loaded. An investigation into its acceptability can then be carried out.

If water sensitive cargo which has been wetted before loading is seen to have been loaded, either that affected cargo should be removed from the hold(s) concerned or the appropriate bill of lading should be claused accordingly.

If water sensitive cargo is wetted by precipitation after loading into the hold(s): loading should be suspended immediately; the hatches should be closed while the precipitation is falling; an inspection should be carried out and the affected cargo should be removed from the affected holds. Changes to the loading plan should be made as necessary.

Montor stevedore damage

Monitor operations to establish details of any stevedore damage. Establish from the relevant clause(s) of any charterparty who is responsible for damages caused by stevedores and the rectification of any and all such damages.

The duty officer should monitor the loading operation to ensure all items of damage to the ship's structure and fittings caused by the stevedores are identified.

A written notification of stevedores' damages should be presented to the terminal representative as soon as possible after the incident. Additionally, as appropriate, the master should notify the charterer and/or its agent of the damage caused by the stevedores in writing within the specified time in the charterparty.

If appropriate, notify the ship operator and the classification society and arrange a survey. Joint inspections, with the terminal representative, and with surveyors appointed on behalf of the ship operator, charterer or stevedores as appropriate, should be carried out, and agreement should be reached regarding the cause, nature and extent of the damage.

The master should issue a letter of protest to the stevedores, charterer or agent, as appropriate, and the master, or the ship operator should seek to obtain a letter from the stevedore or charterer, as appropriate, confirming responsibility and liability for any and all damages caused. Record in the deck log book details of the incident and the damage. Discuss with the terminal representative and, as appropriate, with surveyors appointed on behalf of the ship operator, charterer or stevedores, and with the classification society surveyor, any necessary repairs; reach agreement with regard to the nature and extent of repairs and the time-frame for the repairs.

The duty officer should also monitor loading operations to ensure any damage to cargo by the stevedores is identified. When such damage to cargo is found a similar sequence as for damage to ship's structures and fittings should be followed. Notifications and letters of protest should be issued, inspections by appropriate representatives should be conducted to establish the nature, cause and extent of the damage and appropriate action should be taken to rectify the situation. Keep notes of all discussions and agreements and keep copies of all communications.

Losses caused by not monitoring stevedores during loading

If loading operations are not carefully and properly monitored throughout, damage may be done to the ship by the stevedores without it being seen by ship's staff.

Possible consequences include: the ship might be unseaworthy; sea water or oil fuel bunkers might enter the holds and cause damage to cargo; there might be delays while repairs are carried out with additional costs and other consequences; and the ship might be placed off-hire.

Loss prevention action

Always closely monitor operations being carried out by the stevedores to ensure any damage caused by them or their equipment is noted and properly dealt with.

Trim stowages as required

Ensure all stowages are trimmed as required. The master should, at an early stage in the loading, discuss cargo trimming with the terminal representative, and agreement should be reached with respect to the method and end result of trimming of stowage surfaces. Trimming is required under the IMSBC Code and/or the International Grain Code.

The duty officer should monitor the final stages of loading with respect to the stowage surfaces and ensure the required and agreed method of trimming is carried out and the required and agreed result is achieved. Record details of the communications. Record in the deck log book details of surface trimming.

It would be far better to suspend loading for a short period while the situation is discussed and any appropriate changes to the loading of cargo are made than to allow the situation to get out of control, with dangerous consequences.

FUMIGATION REQUIREMENTS

(See Chapter 5.)

Follow IMO procedures

The fumigation operation should follow the procedures set out in the IMO Recommendations for the Safe Use of Pesticides in Ships, as amended, applicable to the fumigation of cargo holds.

Ensure the fumigator-in-charge and the operatives are fully trained, certified and capable of carrying out the required work. Obtain full details of the fumigation company, the fumigator-in-charge and the operatives.

The chief officer should accompany the fumigator-in-charge during an inspection of the ship and cargo compartments. Obtain from the fumigator-in-charge written details of the cargo compartments to be fumigated, of the fumigant to be applied, of the period of the fumigation and of spaces on board which will be unsafe. If methyl bromide fumigant is to be used then crew must disembark the ship.

The chief officer should provide all crew members with details of the fumigation operation and restrictions imposed. Ensure all necessary safety and gas monitoring equipment is on board, in good working order, and crew members are fully trained in its use. The chief officer should monitor the fumigation operation, and together with the deck crew should assist the operatives as necessary. They should not, however, handle fumigant materials or assist in applying them.

The chief officer should pay particular attention to how the fumigant is distributed, that is spread evenly or piled in a number of small single locations. Heavy concentrations of fumigant can be a combustion risk. If there is concern, discuss with the fumigator-in-charge and, if appropriate, with an independent marine consultant. If a re-circulation system is installed, including pipework and a fan, all electrical equipment should be tested for its safe operation and all wiring should be carefully checked.

Record on a plan or sketch, for each hold fumigated, showing precisely where on the cargo surface the fumigant is applied and the amount of fumigant or number of piles of tablets applied at each location. Record in the deck log book details of the fumigation operation. Advise the ship operator, the charterer and any other relevant parties as appropriate throughout. Take photographs of the fumigation operations of any equipment installed, and of the fumigants being applied in the holds.

Record in a work book details of the fumigation operation, including the name of the fumigator-in-charge, the number of operatives on board, the time of starting and finishing the fumigation, the identity of which holds were fumigated, the identity of the fumigant, how much was applied in each hold, and how and where it was applied, and all gas readings obtained by the fumigator-in-charge during the inspections. Record cargo temperature.

The master should complete a 'Model checklist for in-transit fumigation' (obtainable from the IMSBC Code supplement), together with the fumigator-in-charge, at every stage of the operation, and both the master and the fumigator in charge should sign the checklist.

Obtain a certificate of fumigation and a formal written hand-over of responsibility for maintaining safe conditions on board.

Losses caused by not fumigating holds properly

If fumigation of the holds is not carried out correctly, there might be undiscovered routes for the gas to escape; the fumigant gas might not penetrate through the cargo; the fumigant pellets or tablets might not be distributed correctly; and the fumigant pellets or tablets may become wetted by sea water, rain or condensation.

Possible consequences include: toxic fumigant gas escaping from the holds and causing a hazardous situation for the crew and possible fatalities; failure of the fumigant gas to deal with the infestation, leading to a requirement for further fumigation and associated delays and additional costs, or rejection of the cargo; in way of incorrectly distributed pellets or tablets, heat might be produced which might cause a fire or an explosion; and wetted pellets or tablets may ignite and cause a fire or explosion.

Loss prevention action

Always follow the procedures set out in the IMO Recommendations. If the fumigator-in-charge is not following the procedures; stop the operation, do not sail, seek advice and proceed accordingly.

Fumigation in transit

The fumigation of the cargo during transit should follow the procedures set out in the IMO recommendations for the safe use of pesticides in ships applicable to the fumigation of cargo holds.

Ensure the gas concentration safety checks are carried out throughout the voyage at least at 8 hour intervals, or more frequently if appropriate. The safety checks should be carried out by trained crew members in the accommodation, engine room, navigation spaces, storerooms and other frequently visited spaces, using the appropriate gas detection equipment.

Record in the deck log book all readings obtained and details of the spaces tested.

Ventilation after fumigation

Ventilation of the cargo holds at the end of the fumigation period should be carried out safely and the operation should be monitored. Ensure the fumigation of the cargo holds is continued for the full period determined and required by the fumigator-in-charge and provided in writing.

During this period all ventilators must remain tightly closed and all hatches sealed. During ventilation of fumigated holds, other compartments of the ship, including the accommodation, engine room, navigation spaces, stores and other frequently visited spaces, should be checked for the presence of fumigant using the appropriate equipment.

The hatch covers should not be opened at sea for the purpose of gas-freeing except in an emergency. Record in the deck log book on each day as appropriate:

- when holds are not ventilated because they are under fumigation
- when holds are, or are not, ventilated after completion of fumigation period, and the reason for not ventilating
- the gas concentration readings obtained
- details of spaces visited when checks are made during ventilation of holds.

If gas concentrations are found to be excessive, the spaces should be evacuated and the holds should be closed down and re-sealed. Cargo holds should only be entered

during an extreme emergency. If required, entry should only be by at least two fully trained crew members wearing the appropriate protective equipment with harnesses and safety lines, and these lines should be tended by similarly equipped crew members.

Losses caused by improper fumigation during voyage

If during the voyage the required fumigation procedures are not carried out correctly, fumigant gas might accumulate in spaces outside the holds and remain undetected; the holds might not be ventilated as required and as appropriate; and the required pre-arrival procedures might not be followed.

Possible consequences include: a hazardous situation might develop leading to injury to crew members or stevedores, or to fatalities; delays in the berthing of the ship and delays in offloading cargo while ventilation of the holds and additional testing is carried out with additional costs and other consequences; cargo rejection; and fire or explosion.

Loss prevention action

Always follow the procedures set out in the IMO recommendations.

Pre-arrival procedures

Prior to arrival and at the beginning of cargo operations, the required procedures should be followed. Not less than 24 hours before arrival at the discharge port the appropriate authority should be notified that holds have been fumigated in-transit, and details of the fumigant, the period, the holds involved and whether or not ventilation has been carried should be provided.

Removal and disposal of removable fumigant containing sacks and so on must be done by qualified shore personnel, not by crew members.

Before entry into the holds the atmosphere in the holds should be tested by a suitably trained and qualified person and the values should be recorded in the deck log book. When personnel enter the holds monitoring of the atmosphere should be carried out to ensure the safety of personnel. The cargo hold and adjacent spaces should be considered to be enclosed spaces with oxygen-depleted atmospheres which contain toxic gases and appropriate testing of the atmosphere, ventilation and safety precautions must be carried out before any personnel enter the spaces.

VENTILATION REQUIREMENTS

(See Chapter 5 and North's *Cargo Ventilation* guide.)

Establish ventilation requirements at time of loading

Ventilation requirements should be established at the time of loading. If the cargo has an entry in the IMSBC Code, the ventilation requirements set out in the code must be followed.

Care of the cargo, including ventilation procedures, might be included in the safety management system procedures; the guidance should be followed. Publications such as *Thomas' Stowage* might give some general guidance and might suggest other publications.

If in doubt, revert to the ship operator, the charterer and any other appropriate parties for clarification and, if appropriate, contact an independent marine consultant. Keep a note of references in publications.

IMSBC Code ventilation requirements

Ventilation requirements for IMSBC Code cargoes are set out in the code entry. Follow the ventilation and atmosphere testing requirements in the IMSBC Code given in appendix 1, in the schedule for the specific cargo.

Record in the deck log book details of all atmosphere test results and all times of when ventilation was carried out and when ventilation was not carried out, with reasons for actions.

Holds which contain cargo that has been fumigated might require ventilation later in the voyage – see previous section on 'Fumigation requirements'.

Ordinary ventilation procedure

For some cargoes ordinary ventilation might be required.

Ventilation of the surface cargo and the head space in the holds can be carried out by the use of one of two rules:

- dew-point rule – ventilate when the dew point temperature of the outside air is lower than the dew point temperature of the air in the hold.
- three-degree rule – ventilate when the temperature of the outside air is at least 3°C below the temperature of the cargo, which was taken during loading.

Ventilation should only be carried out when conditions allow, that is, for example, ventilation should be suspended when heavy spray is being shipped or when heavy rain is falling and spray or rain water is likely to enter the holds via the ventilators.

If ventilation is required and conditions allow, it should be carried out 24 hours a day, including during night-time hours.

Temperature readings of the atmosphere in the holds may be by use of thermometers lowered into the holds on a rope lanyard or by thermometers fitted permanently in each of the holds. If permanent thermometers are used, entry into the holds will be necessary and for this the appropriate 'entry into enclosed spaces' procedures and atmosphere testing should be completed before entry by a crew member. Reliable dew-point measurement in the holds may be difficult or impossible to obtain. In this case, the three-degree rule may be appropriate.

Record in the ventilation log details of all temperatures taken, dew point temperatures, sea and weather conditions and times of starting and stopping ventilation. If in doubt, discuss or communicate with the ship operator and, if appropriate, with an independent marine consultant.

North's loss prevention guide *Cargo Ventilation* should be consulted for detailed information.

Losses caused by inadequate ventilation

If ventilation of the holds is not carried out when it should be, there will be no exchange of air when it is required.

Possible consequences include: formation of ship's sweat followed by wetting of cargo, with consequent damage to cargo; the build-up of explosive gases, leading to an explosion; and the build-up of toxic gases, leading to death or injury of personnel.

Loss prevention action

Always carry out ventilation when required and when it is appropriate to do so.

Losses caused by excess ventilation

If ventilation of the holds is carried out when it should not be, there will be an exchange of air when it is required that there should be no exchange.

Possible consequences include: formation of cargo sweat with consequent damage to cargo; the self-heating and possible ignition of the cargo; and the failure of the fumigation of the cargo.

Loss prevention action

Always carry out ventilation only when it is required and if it is required that no ventilation is carried the covers of the ventilators should be closed.

BILGE AND BALLAST WATER

(See Chapter 4.)

Take bilge and ballast water soundings throughout voyage

Throughout the voyage soundings should be taken to establish the amount of water in the bilges and tanks.

Soundings should be taken at least once during each day to establish the amount of water present and if there have been any changes in the levels. All soundings should be kept in a soundings record book.

If it is not possible to take any or all of the soundings because of adverse weather, this should be recorded in the soundings record book.

If there are changes in the soundings from one day to the next which cannot be accounted for, an investigation should be carried out to discover, if possible, the reason for the change. Record details of the investigation in a work book.

If in any doubt, revert to the ship operator for advice and, if appropriate, contact an independent marine consultant.

Losses caused by inadequate bilge and ballast water soundings

If soundings are not taken and recorded of all bilges and ballast tanks on a regular basis, the amount of water accumulating or being held in these spaces would not be known.

Possible consequences include: strength and stability calculations will be incorrect; and draughts will be unknown.

Loss prevention action

Always ensure soundings are taken and recorded on a regular basis.

Monitor drainage of water from cargo into bilges

Water runs out of some cargoes progressively during the voyage and into the bilges. If water naturally runs out of the cargo during the voyage, careful monitoring of the bilge levels should be carried out; soundings should be taken twice, or more often, each day. All soundings should be kept in a soundings record book.

Water in the bilges should be pumped out in a controlled manner with soundings being taken before and after each pumping operation.

Record in a work book details of the soundings, the times of starting and stopping the pumping and a calculation of the amount of water pumped out from each bilge well. Also record details in the garbage record book, and in the oil record book if appropriate.

If appropriate because of the nature of the cargo, take samples of the bilge water and carry out tests to determine its acidity and other characteristics. Record in the work book details of the samples taken, the dates and times taken and the results of tests carried out.

Details of soundings, pumping operations, amount of water pumped out and sample testing, as appropriate, should be communicated to the ship operator and/or technical superintendents.

If the amount of water is unexpected, communicate or discuss with the ship operator and, if appropriate, with an independent marine consultant.

Keep copies of all communications and keep notes of all discussions.

Losses caused by not properly monitoring bilge water

If bilge soundings, the acidity of the bilge water and the amount of water being pumped out are not monitored when a wet cargo is being carried the amount of water running into the bilges will not be known; the acidity of the bilge water will not be known; and the weight of water which has run out of the cargo during the voyage will not be known.

Possible consequences include: there might be a short-landed weight of cargo and claims for the shortage; and there might be corrosion of the bilge system pipework as a result of the acidity of the bilge water.

Loss prevention action

Always ensure soundings are taken, pH values sampled and recorded on a regular basis and records of bilge pumping and the amount pumped out are kept.

Follow ballast water management plan and local requirements

Ballast water on board should be exchanged or treated in accordance with the ballast water management plan and local requirements.

If there is any ballast on board at the time of departure from the loading port, or is taken on board during a loaded voyage, that water should be exchanged or treated before arrival at the discharge port.

During a ballast voyage all ballast water on board should be exchanged or treated before arrival at the next port.

Record in the ballast water record book all details of ballast pumping operations or ballast treatment operations, and complete the ballast water reporting form. Keep a record of all soundings in the soundings record book.

Losses caused by improper ballast water operations

If any ballast water exchanges or treatments are not properly monitored, carried out and recorded, there will be no way of knowing whether or not operations were carried out as required.

Possible consequences include: detention by the local authority and/or a fine; delay; and the ship might be placed off-hire.

Loss prevention action

Always ensure exchanges of treatments of ballast water are properly carried out, monitored and recorded.

CALCULATIONS AND PLANS – DISCHARGE

(See Chapter 5.)

Clear instructions for discharge should be given

Instructions for the discharge of cargo given to the master should be clear.

Establish what weight of cargo is to be discharged at each port and any draught restrictions which apply at any stage.

Carry out trim, strength and stability calculations to ensure there are adequate margins of safety at all stages of the discharge operation. Advise the ship operator, the charterer and any other appropriate party of the findings.

Keep copies of all calculations and communications.

Work out unloading sequence

An unloading sequence should be worked out. Establish how many un-loaders or cranes will be used during the unloading operation.

Work out a ballasting sequence to be undertaken during unloading. Carry out trim, strength and stability calculations for each stage of the operation to ensure the ship's safety at all times.

Complete an unloading plan giving all the details, and forward a copy of the plan as appropriate. Keep copies of calculations and of the unloading plan.

Losses caused by not completing unloading plans and calculations

If the required plans and calculations for the unloading of cargo are not completed, the unloading plan will not be prepared correctly and incorrect instructions for unloading will be given to the stevedores.

Possible consequences include: the ship might be incorrectly and dangerously unloaded; structural damage to the ship; incorrect draughts and/or trim at an intermediate port; and the ship might be placed off-hire.

Loss prevention action

When the unloading rotation or port has been established, carry out all the necessary and required calculations accurately.

Losses caused by not doing strength and stability calculations for intermediate voyage

If there is an intermediate voyage between discharge ports and if the required strength and stability calculations for that voyage are not completed, it will not be possible to demonstrate that the ship will have a safe margin of stability during the intermediate, part-loaded voyage.

Possible consequences include: contravention of SOLAS and the International Code on Intact Stability; contravention of the International Grain Code if the cargo is grain; delays at the discharge port and other costs and consequences; and unsafe cargo configuration on voyages between multiple discharge ports, over-stressing of ship or shift of cargo.

Loss prevention action

Always satisfactorily complete all the required calculations.

THE BLU CODE – DISCHARGE

(See Chapter 3.)

Establish unloading port or berth

Establish details of the port or berth at which unloading will take place. Ensure the ship is suitable for unloading at the nominated terminal, ensure all the pre-arrival information is provided and ensure the terminal provides all the necessary information.

Carry out checks and request confirmation of information, or more information, as appropriate.

Keep copies of all communications.

Complete unloading plan

An unloading plan should be completed. Ensure the unloading plan is properly prepared after all the necessary calculations have been satisfactorily completed (see appendix 2 of the BLU Code). Forward a copy of the unloading plan as appropriate.

Keep copies of calculations and of the unloading plan.

If the requirements of the BLU Code are not complied with there will be a contravention of SOLAS.

Communicate with terminal when alongside

When alongside, there should be full exchange of information between the ship and the terminal. Complete the ship–shore safety checklist with the terminal representative, and both parties should sign the checklist (see appendix 3 of the BLU Code).

A copy of the unloading plan should be passed to the terminal representative, and both parties should sign the plan. Obtain the agreement of the terminal representative with regard to the sequence of discharge.

Record in the deck log book that the unloading plan has been agreed and the ship–shore safety checklist has been completed. Keep copies of all documents.

Co-operate with terminal during unloading

During the unloading operation there should be full co-operation between the ship and terminal to ensure the operation is safe and efficient.

Fully discuss the unloading operation and its progress with the terminal representative as the operation is ongoing. Point out any difficulties on the ship's side, and enquire about any difficulties on the terminal's side.

Monitor the unloading operation and ensure it is proceeding in accordance with the unloading plan. Carry out ballasting in accordance with the unloading plan, and keep the terminal representative notified of the progress and situation. Maintain contact with the terminal representative at all times.

If unloading and/or ballasting are not progressing in accordance with the unloading plan, discuss the situation with the terminal representative and reach agreement with regard to any appropriate changes to the plan. If appropriate, unloading should be suspended while discussions are underway.

Keep a record of these communications, discussions and agreements.

Losses caused by poor communication during unloading

If there is no or no adequate and appropriate exchange of information and communication between ship's personnel and the terminal representative and other terminal staff, there might be a misunderstanding of information and the cargo might not be unloaded correctly and as planned.

Possible consequences include: the ship might be overstressed; there might be delays while re-distribution of the cargo is carried out with additional costs and other consequences; incorrect draughts and/or trim upon completion; the ship might be placed off-hire.

If the requirements of the BLU Code are not complied with there will be a contravention of SOLAS.

Loss prevention action

Always maintain full co-operation between ship's staff and the terminal representatives throughout the unloading operation.

Losses caused by not unloading as planned

If the unloading operation is not progressing as planned, cargo will not be unloaded correctly and as required by the pre-unloading calculations.

Possible consequences include: the ship might be overstressed; there might be delays while re-distribution of the cargo is carried out with additional costs and other consequences; incorrect draughts and/or trim upon completion; and the ship might be placed off-hire.

Loss prevention action

Stop unloading. It would be far better to suspend unloading for a short period while the situation is discussed and any appropriate changes to the unloading plan are made than to allow the situation to get out of control, with dangerous consequences.

DISCHARGE OPERATIONS

(See Chapter 5.)

Follow enclosed space procedures

Cargo compartments and adjacent spaces should be considered to be enclosed spaces. Before any personnel, ship's staff or from ashore, are allowed to enter the holds and adjacent spaces, ventilation should be carried out and appropriate 'entry into enclosed spaces' procedures and atmosphere tests should be completed. Gas-freeing of fumigated holds should be carried out.

The cargo hold and adjacent spaces should be considered to be enclosed spaces with oxygen-depleted atmospheres which contain toxic gases and appropriate testing of the atmosphere, ventilation and safety precautions must be carried out before any personnel enter the spaces.

Instructions for the removal and disposal of fumigation residues should be followed.

Record in the deck log book what safety procedures are carried out, when and where.

Unloading to follow unloading plan schedule

The discharge operation should follow the schedule set out in the unloading plan. A deck officer should be on duty on deck at all times when discharge of cargo is underway, to monitor operations.

Record in the deck log book when discharge starts and when discharge finishes in each hold during each day of the operation. Keep the ship operator, the charterer and any other appropriate parties advised of operations throughout the process. Also record details of all delays and the reasons for these delays in a work book.

Ensure correct weight taken from each hold

Ensure the correct weight of cargo is discharged from each hold.

The duty officer should obtain from the terminal representative the discharge rate and the weight of cargo discharged during each period. These weights should be recorded in a work book, and running totals for the ship and each hold should be kept in the work book.

The ship's draught should be frequently monitored to ensure the unloading plan is being followed. Record all draught readings in a work book and as appropriate on the unloading plan.

Draught surveys should be carried out by ship's staff as appropriate to establish the weight of cargo on board. Additionally, official joint draught surveys might be carried out. Keep copies of all draught survey calculations.

Ballasting to follow unloading plan schedule

Ballasting operations should follow the schedule set out in the unloading plan. The duty deck officer should liaise with the duty engineer, or whoever is responsible for the pumping of ballast water, to ensure the required ballasting is carried out when required.

Soundings of the tanks involved should be taken before, during and after each ballasting operation to ensure the required operation is completed.

All soundings taken during ballasting operations should be recorded in a work book, together with the date and time taken. Morning soundings and afternoon soundings, if appropriate, of all tanks should be recorded in a soundings record book. Record in the ballast water record book all details of all ballasting operations, and complete the ballast water reporting form.

Losses caused by not monitoring sequence of unloading

If unloading operations are not carefully and properly monitored throughout, cargo might not be unloaded correctly and as planned.

Possible consequences include: the ship might be overstressed; there might be delays while re-distribution of the cargo is carried out with additional costs and other consequences; incorrect draughts and/or trim upon completion; and the ship might be placed off-hire.

Loss prevention action

Always closely monitor the unloading of cargo throughout the operation. If cargo is not unloaded correctly and as planned, stop unloading and investigate the reason for the error, discuss the unloading with the terminal representatives and make appropriate changes to the unloading plan.

Monitor cargo condition

Establish the apparent condition of the cargo on out-turn. Inspections of the cargo should be carried out on an ongoing basis as discharge is ongoing.

Record in a work book details of the apparent condition of the cargo, the details to include: colour or colour range, dryness or dampness, free-flowing or not free-flowing, lumps present and their size and quantity, foreign matter and its type and/or quantity, and anything else seen.

If anything unusual or unexpected is found, discuss findings with the ship operator and, if appropriate, an independent marine consultant.

Keep notes of all discussions and keep copies of all communications. Take photographs of the cargo and of any unusual or unexpected conditions found. Take cargo temperatures and keep samples if possible. Keep records of precisely how, where and by whom samples were taken.

Monitor weather conditions

Monitor the weather conditions. The duty deck officer should at all times monitor the weather conditions to be constantly aware of the likelihood of precipitation.

The radar should be used if appropriate and if allowed by shore authorities.

Record in the deck log book at the end of each watch, and at other times as appropriate, the ambient temperature, dew point, visibility, air pressure, and details of all precipitation.

The duty officer should discuss weather conditions with the stevedores or terminal representative, and when discharge should and should not be stopped because of the intensity of precipitation, and agreements should be reached. A 'rain letter' should be obtained from receiver when appropriate, and instructions should be obtained as appropriate from the ship operator, charterer or cargo interests.

Records of discussions should be kept in the deck log book. Keep copies of all communications. Letters of protest should be written if the stevedores do not follow the master's instructions. Also record in the deck log book details of all delays for precipitation, together with times of closing and opening of the hatches. Take photographs of the precipitation, and of the closing and opening of the hatches.

Losses caused by rain on water-sensitive cargo prior to unloading

If cargo which is water sensitive and should be kept dry is wetted by precipitation while still in the holds, problems will be encountered during the unloading.

Possible consequences include delays, claims, additional costs and other consequences.

Loss prevention action

Unloading should be suspended immediately; the hatches should be kept closed while the precipitation is falling, an investigation should be carried out and, when the precipitation has stopped and the hatches can be opened, the affected cargo should be removed from the affected holds and segregated as appropriate. Changes to the unloading plan should be made as necessary.

Monitor stevedore damage

Monitor operations to establish details of any stevedores' damage. Establish from the relevant clause(s) of any charterparty who is responsible for damages caused by stevedores and the rectification of any and all such damages.

The duty officer should monitor the discharge operation to ensure all items of damage to the ship's structure and fittings caused by the stevedores are identified.

A written notification of stevedores' damages should be presented to the terminal representative as soon as possible after the incident. Additionally, as appropriate, the master should notify the charterer and/or its agent of the damage caused by the stevedores in writing within the specified time in the charterparty.

If appropriate, notify the ship operator and the classification society and arrange a survey. Joint inspections, with the terminal representative, and with surveyors appointed on behalf of the ship operator, charterer or stevedores as appropriate, should be carried out, and agreement should be reached regarding the cause, nature and extent of the damage.

The master should issue a letter of protest to the stevedores, charterer or agent, as appropriate, and the master, or the ship operator, should seek to obtain a letter from the stevedores or charterer, as appropriate, confirming responsibility and liability for any and all damages caused. Record in the deck log book details of the incident and the damage.

Discuss with the terminal representative and, as appropriate, with surveyors appointed on behalf of the ship operator or charterer or stevedores, and with the classification society surveyor, any necessary repairs; reach agreement with regard to the nature and extent of repairs and the time-frame for the repairs.

The duty officer should also monitor discharge operations to ensure any damage to cargo by the stevedores is identified. When such damage to cargo is found a similar sequence as for damage to ship's structures and fittings should be followed. Notifications and letters of protest should be issued, inspections by appropriate representatives should be conducted to establish the nature, cause and extent of the damage and appropriate action should be taken to rectify the situation.

Keep notes of all discussions and agreements, and keep copies of all communications. It would be far better to suspend unloading for a short period while the situation is discussed and any appropriate changes to the unloading of cargo are made than to allow the situation to get out of control, with dangerous consequences.

Losses caused by not monitoring stevedores during unloading

If stevedores unloading operations are not carefully and properly monitored throughout, damage may be done to the ship by the stevedores without it being seen by ship's staff.

Possible consequences include: the ship might be unseaworthy; sea water or oil fuel bunkers might enter the holds and cause damage to cargo; there might be delays while repairs are carried out with additional costs and other consequences; and the ship might be placed off-hire.

Loss prevention action

Always closely monitor operations being carried out by the stevedores to ensure any damage caused by them or their equipment is noted and properly dealt with.

Chapter 9

GUIDE TO BASIC RECORDS

Set out in this Chapter are lists of records which the master of a vessel carrying bulk cargo might collect during the course of a voyage. The lists include documents and certificates which must, during any voyage, be retained on board, log books and records which are completed as a routine procedure and communications exchanges which are necessary for the efficient operation of a ship. In addition, the lists include guidance on notes which might be recorded in a work book and photographs which might be taken as evidence of situations and events. All the items listed will not be relevant or appropriate for every voyage and the lists cannot be considered to be exhaustive because unusual situations may arise.

GENERAL

General records
Ship's particulars.
Time charterparty.
Charter re-cap.
Dry-docking reports and classification society documents.
Statutory certificates.
Maintenance, inspection and repair reports required by the safety management system including those for: • hatch cover arrangements • hold steelwork and structures • ballast tanks and pipework • cranes and other cargo equipment • lighting systems • fire detection and extinguishing system • hold bilge pumping systems and bilge high level alarms • gas, temperature and other monitoring equipment as appropriate.
Deck log book.
Port log book.
Bilge and ballast soundings record.
Communications.

PREPARATION PERIOD

Records for preparation period
Voyage charterparty.
Charter re-cap.
Voyage instructions.
Communications with regard to and clarification and confirmation of: • the identity of the cargo or cargoes to be loaded • the weight and stowage factor of the cargo or cargoes to be loaded • the hold cleanliness requirements • any hold steelwork coating requirement • any fumigation requirements • any carriage or care requirements • bunkering and bunker requirements.
Pre-stowage plan and any associated communications.
Strength and stability calculations for all stages of the voyage.
Grain stability calculations for all stages of the voyage, if appropriate.
Loading plan.
Records, in an appropriate work book, of details of preparations: • hold cleaning activities by the crew – times and dates, holds cleaned, crew members employed, equipment and materials used, and methods used • hold cleaning activities by shore labour, if appropriate – times and dates, holds cleaned, shore labour employed, equipment and materials used, methods used, and exchanges and agreements • hatch cover arrangements, cleaning and maintenance undertaken – times and dates, hatches involved, equipment and materials used, and methods used • hatch cover arrangements, weather-tightness testing – times and dates, tests carried out, hatches involved, results and maintenance carried out • hold coating application – times and dates, type of coating applied, where applied, equipment used, quantity used and personnel involved (ship's crew or shore labour) • inspections of holds, hatches, tanks and other compartments, and associated testing – times and dates, personnel involved, compartments and areas involved, findings, results of tests and any maintenance carried out.
Photographs of cleaning operations and of prepared holds.
Records, in the deck log book, of preparation work done, on each day of the operation: • holds and hatches involved • time starting and stopping • inspections carried out, by whom and results • if course and/or speeds are adjusted to facilitate operations • if preparations are not possible because of adverse weather.
Communications with regard to hold preparation and relating to: • standard of cleanliness required • progress of cleaning operations • expected times and dates of completion, and whether or not problems are encountered • whether or not any shore cleaners and/or items of equipment are required • whether or not hold washing water needs to be disposed of ashore • completion of the cleaning operations • whether or not a coating needs to be applied • application of coating, times and dates of application • any additional instructions or requests.

PRE-ARRIVAL PERIOD – LOADING

Records for pre-arrival period – loading
Pre-arrival communications with the terminal and/or agent relating to: • layout of the berth or anchorage and equipment and facilities available • requirements for arrival, draught, air draught and so on • loading rate and other appropriate information • provision of the loading plan and any associated exchanges • instructions for berthing or anchoring and loading date and time.
Records of ballasting during the voyage and exchange or treatment of ballast water: • ballast tank sounding record • ballast water record book, with details of exchange operations or treatment including times and dates for each tank and ship's position • ballast water reporting form, with details of operations.

PERIOD ALONGSIDE – LOADING

Records for period alongside – loading
Terminal information book.
Ship–shore safety checklist signed by a terminal representative and by the master or the chief officer.
Loading plan signed by a terminal representative and by the master or the chief officer.
Records, in an appropriate work book, of details of preparations for loading: • that the loading plan is agreed or that changes should be made, details of those changes and a new loading plan is agreed • details of working arrangements if not the same as provided in pre-arrival exchanges • any other appropriate information provided • details of inspections of holds and hatches carried out by on-shore inspector; name and company of inspector, holds inspected, times and dates, results and any work required • details of draught surveys carried out – draughts, shore surveyors involved (names and companies), times and dates, and results.
Any revised loading plans, signed by a terminal representative and by the master or the chief officer.
Hold inspections reports.
Draught survey reports – initial.
Cargo declaration provided by the shipper and all associated certificates, data sheets and carriage instructions.

Records, in the deck log book, of loading preparation:

- ship–shore safety checklist completed and loading plan agreed
- attendance of shipper's or charterer's representatives or cargo and loading superintendents
- attendance of hold inspectors
- attendance of draught surveyors
- provision of cargo declaration and other documents.

Records, in the port log or deck log book, of details of loading operations:

- starting and stopping of work at each hold, times and dates
- tonnages loaded per pour into each hold and a running total loaded
- weather conditions at intervals, maybe 6 hours
- use of ship's cranes, if appropriate
- movement of shore cranes, loaders or floating cranes alongside
- movement of barges alongside and of floating cranes or loaders if ship is at anchor
- opening and closing of hatches
- periods of precipitation
- draught readings
- any delays caused on board
- any delays caused ashore
- any surveyors attending on board with reason for attendance
- any stevedores' damage to ship's structures and/or fittings
- cargo temperature (in particular for grain, seed cake and coal).

Records, in an appropriate work book, of details of inspections of cargo and findings, and associated investigations:

- notes of references in publications used for identification of cargo, its likely condition and other characteristics
- inspections of cargo ashore or in barges brought alongside – times and dates, personnel involved, location of inspections, samples taken, any other parties present and findings
- inspections of cargo on board – times and dates, personnel involved, location of inspections, samples taken, any other parties present and findings
- how cargo is delivered alongside and how it is loaded
- apparent condition of cargo on a continuous basis – temperature, colour, colour range, dryness, dampness, free-flowing, not free-flowing, lumps present, size, quantity, foreign matter, type, quantity and anything else seen
- with respect to crane operations – limit-switch settings, overload settings, and condition of crane and wires before loading and after completion
- can tests carried out – times and dates, location from where samples drawn, personnel involved, any other parties present and results
- all draught readings and results of cargo weight calculations on a continuous basis.

Records, in an appropriate work book, of discussions: • with shore personnel regarding the condition of the cargo, loading of cargo and any related issue • relating to can testing – times and dates, and details of personnel involved • regarding rejection of any cargo and, or clausing of bills of lading – times and dates, and details of personnel involved • relating to precipitation and loading operations – times and dates, and details of personnel involved • relating to the progress of loading and any necessary changes to the loading plan – times and dates, all agreements reached and personnel involved • relating to stevedores' damage to structures and, or fittings – times and dates, details of damages found, personnel involved, action to be taken and any agreements.
Photographs during the loading operation: • the stockpiles ashore, or cargo being delivered to the export quay or alongside in barges • cargo handling equipment – conveyors, cranes, grabs, bulldozers and so on • cargo in the holds during loading • trimming procedures • cargo in any condition not acceptable • can tests • personnel involved in discussions, if appropriate.
De-ballasting records. • ballast tank sounding records • ballast water record book • ballast water reporting form, with details of operations.
Letters of protest relating to loading operations, condition of cargo, cargo documents, stevedores' damage and so on.
Draught survey calculations by ship's staff.
Draught survey reports – final.
Stowage plan.
Any re-worked stability and strength calculations.
Any re-worked grain stability calculations.
Manifest.
Bills of lading.
Any mate's receipts.
Any certificates for the cargo, as appropriate.
Statement of facts of load port.

FUMIGATION OF CARGO

Records for fumigation of cargo
Communications relating to fumigation.
Details of fumigation company, fumigator-in-charge and operations.
Fumigation plan.
In the deck log book record details of the operation.
In a work book record details of the operation including: • details of the fumigator-in-charge and operatives • times of starting and finishing • holds involved • identity of the fumigant, application level and where and how applied • all gas readings with locations of testing.
Photographs of the fumigation operation.
Plan or sketch for each hold fumigated showing where the fumigant was applied and the amount of fumigant at each location.
Model checklist for in-transit fumigation signed by the master and the fumigator-in-charge.
Certificate of fumigation.
Formal written handover of responsibility.

THE VOYAGE

Records for the voyage
Communications with regard to the voyage and discharge ports, including: • fumigation of the cargo and testing for the presence of gas concentrations • ventilation of the cargo • testing of the atmosphere in cargo compartments or the monitoring of cargo, the results obtained and any action taken • identity of the discharge port or ports and any special requirements.
Strength and stability calculations for the latter stages of the voyage.
Grain stability calculations for the latter stages of the voyage, if appropriate.
Records of bilge soundings and pumping operations: • bilge sounding record • times and dates of bilge pumping • amounts of water pumped out of each bilge well during each pumping • soundings before and after each pumping.

Records of ballasting and de-ballasting during the voyage and exchange or treatment of ballast water:
- ballast tank sounding record
- ballast water record book, with details of exchange operations or treatment
- ballast water reporting form, with details of operations.

Records of ventilation on each day for each hold:
- all temperatures taken and dew points calculated
- whether or not ventilation carried out
- reasons for not ventilating
- weather and sea conditions
- ventilation rule applied (e.g. three-degree rule or dew point rule).

Records relating to the fumigation for each day:
- gas concentration readings obtained and location at which each reading taken
- time readings taken
- any action necessary because of high readings
- results of actions taken
- details of ventilation of holds after fumigation period.

Records relating to monitoring of cargo or hold atmosphere for each day (e.g. for coal or silicomanganese):
- results of readings taken at each hold, with time readings taken
- any action necessary because of readings obtained and the results of action taken
- findings during inspections of cargo in each hold, with time inspections carried out
- any action necessary because of findings and the results of action taken.

Records, in the deck log book, of details of cargo care and monitoring activities:
- monitoring of the fumigation and gas concentration safety checks
- ventilation of cargo compartments
- monitoring of cargo or hold atmosphere.

PRE-ARRIVAL PERIOD – DISCHARGE

Records for pre-arrival period – discharge

Pre-arrival communications with the terminal and/or agent relating to:
- layout of the berth or anchorage and equipment and facilities available
- requirements for arrival, draught, air draught and so on
- unloading rate and other appropriate information
- provision of the unloading plan and any associated exchanges
- instructions for berthing or anchoring and unloading date and time.

PERIOD ALONGSIDE – DISCHARGE

Records for period alongside – discharge
Terminal information book.
Ship–shore safety checklist signed by a terminal representative and by the master or the chief officer.
Unloading plan signed by a terminal representative and by the master or the chief officer.
Records, in an appropriate work book, of details of preparations for unloading: • that the unloading plan is agreed or that changes should be made, details of those changes and a new unloading plan is agreed • details of working arrangements if not the same as provided in pre-arrival exchanges • any other appropriate information provided • details of inspections of cargo carried out by on-shore inspector – name and company of inspector, holds inspected, times and dates, results, any action required • details of draught surveys carried out – draughts, shore surveyors involved (names and companies), times and dates, and results.
Any revised unloading plans, signed by a terminal representative and by the master or the chief officer.
Cargo inspections reports.
Draught survey reports – initial.
Rain letter, if appropriate.
Records, in the deck log book, of discharge preparation: • ship–shore safety checklist completed and unloading plan agreed • attendance of receiver's or charterer's representative or cargo discharge superintendent • attendance of cargo inspectors • attendance of draught surveyors.
Records, in the port log or deck log book, of details of discharge operations: • starting and stopping of work at each hold, times and dates • tonnages offloaded per shift from each hold and a running total offloaded • weather conditions at intervals, maybe 6 hours • use of ship's cranes, if appropriate • movement of shore cranes, unloaders or floating cranes alongside • movement of barges alongside and of floating cranes, unloaders if ship is at anchor • opening and closing of hatches • periods of precipitations • draught readings • any delays caused on board • any delays caused ashore • any surveyors attending on board with reason for attendance • any stevedores' damage to ship's structures and, or fittings.

Records, in an appropriate work book, of details of inspections of cargo and findings, and associated investigations:
- inspections of the cargo on board – times and dates, personnel involved, location of inspections, samples taken, any other parties present and findings
- details of discharge methods – grabs, cranes, elevators, conveyors, hoppers, road vehicles, barges and so on
- apparent condition of the cargo on a continuous basis – temperature, colour, colour range, dryness, dampness, free-flowing, not free-flowing, lumps present, size, quantity, foreign matter, type, quantity and anything else seen
- action taken with regard to any cargo rejected – alternative discharge, segregation of cargo, cargo placed on weather deck, cargo left in holds and so on
- all draught readings and results of cargo weight calculations on a continuous basis
- with respect to crane operations – limit-switch settings, overload settings, and condition of crane and wires before unloading and after completion.

Records, in an appropriate work book, of discussions:
- with shore personnel regarding the condition of the cargo, discharge of cargo and any related issue
- regarding rejection of any cargo – times and dates, and details of personnel involved
- relating to precipitation and discharge operations – times and dates, and details of personnel involved
- relating to the progress of discharge and any necessary changes to the unloading plan – times and dates, all agreements reached and personnel involved
- relating to stevedores' damage to structures and, or fittings – times and dates, details of damages found, personnel involved, action to be taken and any agreements

Photographs during the discharge operation:
- cargo in the holds as discharge progresses
- cargo handling equipment – conveyors, cranes, grabs, bulldozers and so on
- cargo in any condition not acceptable
- personnel involved in discussions, if appropriate.

Ballasting records.
- ballast tank sounding records
- ballast water record book
- ballast water reporting form, with details of operations.

Letters of protest relating to discharge operations, condition of cargo, cargo documents, stevedores' damage and so on.

Draught survey calculations by ship's staff.

Draught survey reports – final.

Stowage plan for part cargo for on-carriage.

Any re-worked stability and strength calculations.

Any re-worked grain stability calculations.

Statement of facts of unloading port.

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This guide explains basic rules to be remembered on every occasion during loading, carriage and unloading of bulk cargoes. It describes where various regulations, recommendations and general guidance can be found, and discusses procedures, preparations and good seamanship practice for appropriate and safe carriage of cargoes in bulk. It also describes the problems and recommended procedures associated with particular types of bulk cargo, and gives guidance on points to be remembered during passage planning and the voyage itself. The guide aims to answer all the questions most often encountered by masters of ships carrying bulk commodities.

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