

# Carrying solid bulk cargoes safely

Guidance for crews on the International Maritime Solid Bulk Cargoes Code

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International Association of Dry Cargo Shipowners

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# Introduction

Carrying solid bulk cargoes involves serious risks, which must be managed carefully to safeguard the crew and the ship. These risks include reduced ship stability (and even capsizing) due to cargo liquefaction; fire or explosion due to chemical hazards; and damage to ship structures due to poor loading procedures.

The main legislation governing safe carriage of solid bulk cargoes is the International Maritime Solid Bulk Cargoes (IMSBC) Code, which became mandatory on January 1, 2011, under the SOLAS Convention<sup>1</sup>.

This pocket guide will help you understand the IMSBC Code's key requirements and give you greater confidence in managing the risks associated with the carriage of solid bulk cargoes. It outlines the precautions you should take before accepting cargoes for shipment and the procedures you should follow for safe loading and carriage, and details the primary hazards associated with the different types of solid bulk cargo.

It also contains a quick reference checklist and flowchart summarising the steps you need to follow.

**Note:** This guide is only an introduction to the IMSBC Code; you should always consult the full Code to check the requirements for each cargo you are carrying. It does not cover carriage of grain in bulk; this is covered by the International Grain Code.

**Look for “Consult the Code” headings within this publication, which refer you to specific sections of the Code for more information.**

<sup>1</sup>For a list of other IMO legislation and guidance relating to bulk cargoes, see Appendix 1.

# 1. General requirements for carrying solid bulk cargoes

No matter what solid bulk cargo you are carrying, the same general requirements apply for accepting them for shipment and loading them. Section 2 of this pocket guide covers the typical requirements for different types of cargo.

## Accepting cargoes for shipment

### Information required from the shipper

Before you can accept a cargo for shipment, the shipper must provide the Master with valid, up-to-date information about the cargo's physical and chemical properties. The exact information and documentation they must provide is listed in the Code under 'Assessment of acceptability of consignments for safe shipment; Provision of Information', and includes the correct Bulk Cargo Shipping Name<sup>2</sup> and a declaration that the cargo information is correct.

**Consult the Code – see Section 4**

### Checking the cargo schedule

Individual cargoes are listed in 'schedules' which are contained in Appendix 1 of the Code. These describe each cargo's properties and detail the requirements for handling, stowing and carrying it safely. You must always consult the relevant schedule in the Code to find out what hazards the cargo presents.

**Consult the Code – see Appendix 1**



Cargo being worked

<sup>2</sup>This is the cargo's official name used in the Code.

## Accepting cargoes not listed in the IMSBC Code

The list of individual cargoes contained in the Code is not exhaustive. If a cargo not listed in the Code is presented for shipment, the shipper and the appropriate competent authorities<sup>3</sup> must follow this process:

1. Before loading, the shipper must provide details of the characteristics and properties of the cargo to the competent authority of the port of loading.
2. Based on this information the competent authority of the port of loading will assess the acceptability of the cargo for shipment.
  - If the assessment defines the cargo as Group A or B<sup>4</sup>, the competent authorities<sup>3</sup> will set the preliminary suitable conditions for carriage.
  - If the cargo is Group C<sup>4</sup> then carriage can be authorised by the port of loading and the competent authorities of the unloading port and flag state will be informed of the authorisation.
3. In both cases, the competent authority of the port of loading will give the Master a certificate stating the characteristics of the cargo and the required conditions for carriage and handling. The competent authority of the port of loading will also provide the same information to the IMO.

### Consult the Code – see Section 1.3

## Exemptions

Under section 1.5 of the Code, a competent authority (or authorities) can grant an exemption which allows ships to carry a cargo outside the requirements specified in its schedule, provided that equivalent provisions have been put in place.

Agreement of all three competent authorities is required to ship a cargo under an exemption. Acceptance of an exemption by authorities not party to it is discretionary: i.e., if the loading port authority issues an exemption, the unloading port and flag state authorities can choose to accept it or reject it.

An exemption can be valid for up to five years and does not necessarily lead to the creation of a new or revised schedule.

### Consult the Code – see Section 1.5

<sup>3</sup>The competent authorities of the port of loading, the port of unloading and the flag state.

<sup>4</sup>The Code categorises cargo into three Groups – A, B and C. See page 7 for their definitions.

## Loading

### Inspecting and preparing cargo spaces

In general, before loading a cargo you must inspect and prepare the cargo spaces, checking that:

- bilge wells and strainer plates are prepared to facilitate drainage and prevent cargo entering the bilge system
- bilge lines, sounding pipes and other service lines are in good order
- cargo space fittings are protected from damage, and
- measures are in place to minimise dust entering living quarters or other interior spaces, or coming into contact with moving parts of deck machinery and external navigational aids.

### Distribution and stability

You must also make sure that cargoes are properly distributed throughout the ship's holds to provide adequate stability and ensure that the ship's structure is never overstressed. Information can be found in the ship's stability information booklet or you can use loading calculators if they are available. The Master will need to calculate the stability for the anticipated worst conditions during the voyage as well as for departure and demonstrate that the stability is adequate.

### Loading Plan

Before loading or unloading, the Master and the terminal representative must agree a Loading Plan to ensure that the permissible forces and moments on the ship are not exceeded. What this Plan should include is detailed in the Code of Practice for the Safe Loading and Unloading of Bulk Carriers (the BLU Code) and in the checklist on page 16.

## 2. The Code's three cargo groups

The IMSBC Code categorises cargoes into three groups:

**Group A** – cargoes which may liquefy if shipped at a moisture content exceeding their Transportable Moisture Limit (TML)<sup>5</sup>.

**Group B** – cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship.

**Group C** – cargoes which are neither liable to liquefy (Group A) nor possess chemical hazards (Group B). Cargoes in this group can still be hazardous.

You can find the Group for a particular cargo in its schedule.



Liquefied nickel ore (Image courtesy of MTD)

<sup>5</sup>The TML is the maximum moisture content considered safe for carriage. See page 9.

## Group A cargoes (cargoes which may liquefy)

### What is liquefaction and how does it affect cargo?

Liquefaction means that a cargo becomes fluid (liquefies). On ships, this happens when the cargo is compacted by the ship's motion. Cargoes which are prone to liquefaction contain a certain quantity of moisture and small particles, although they may look relatively dry and granular when loaded. Liquefaction can lead to cargo shift<sup>6</sup> and even to the capsize and total loss of the ship, and can occur even when cargoes are cohesive and trimmed level.

**Consult the Code – see Section 7**

### Examples of Group A cargoes

#### Mineral concentrates

Mineral concentrates are refined ores in which valuable components have been enriched by eliminating most waste materials. They include copper concentrate, iron concentrate, lead concentrate, nickel concentrate and zinc concentrate.

#### Nickel ore<sup>7</sup>

There are several types of nickel ore which vary in colour, particle size and moisture content. Some may contain clay-like ores.

#### Coal

Coal (bituminous and anthracite) is a natural, solid, combustible material consisting of amorphous carbon and hydrocarbons. It is best known as a Group B cargo due to its flammable and self-heating properties, but it can also be classed as Group A because it can liquefy if predominantly fine (i.e., if 75% is made up of particles less than 5mm in size). In these cases, it is classed as both Group A and B.



Coal being loaded. Coal is most commonly a Group B cargo, but can also be classed as both A and B.

<sup>6</sup>Cargo shift can be divided into two types: sliding failure or liquefaction consequence. Trimming the cargo can prevent sliding failure.

<sup>7</sup>Nickel ore is not to be confused with nickel concentrate.



## Typical requirements for accepting and loading Group A cargoes

### Information required from the shipper

To control the risks of liquefaction, Group A cargoes are tested to determine their Transportable Moisture Limit (TML) and their actual moisture content before they can be shipped. The TML is the maximum moisture content considered safe for carriage. The actual moisture content of the cargo must be below the TML.

The information supplied by the shipper to the master must include a signed certificate stating the TML, and a signed certificate or declaration of the cargo's actual moisture content.

### What you need to do

Follow these steps when carrying Group A cargoes to reduce the risk of liquefaction:

- Make sure the shipper has supplied the required information, including the TML and the actual moisture content.
- Only accept the cargo if the actual moisture content is less than its TML.
- Carry out visual monitoring during loading. If there are any indications of high moisture content, stop loading and seek further advice.
- Consider trimming the cargo to reduce the likelihood of cargo shift.
- Take measures to prevent water or other liquids entering the cargo space during loading and throughout the voyage.

Practical guidance on managing the risks of liquefaction is also available from the UK P&I Club at [www.ukpandi.com/loss-prevention](http://www.ukpandi.com/loss-prevention)



*Hui Long, a bulk carrier which sank in 2005. The cause was believed to be liquefaction, possibly due to the TML being exceeded.*

**Consult the Code – see Sections 7 and 8**

## Group B cargoes (cargoes with chemical hazards)

Group B cargoes are classified in two ways within the Code: 'Dangerous goods in solid form in bulk' (under the International Maritime Dangerous Goods (IMDG) Code); and 'Materials hazardous only in bulk' (MHB).

You will find this information in the "characteristics" section of the cargo's schedule. Cargoes classified as dangerous goods in solid form in bulk will also have a 'UN' number in the Bulk Cargoes Shipping Name.

**Consult the Code – see Section 9**

### Dangerous goods in solid form in bulk

In the Code these cargoes are classed as follows:

Class 4.1: Flammable solids

Class 4.2: Substances liable to spontaneous combustion

Class 4.3: Substances which, in contact with water, emit flammable gases

Class 5.1: Oxidizing substances

Class 6.1: Toxic substances

Class 7: Radioactive materials

Class 8: Corrosive substances

Class 9: Miscellaneous dangerous substances and articles.

### Materials hazardous only in bulk (MHB)

MHB cargoes are materials which possess chemical hazards when transported in bulk that do not meet the criteria for inclusion in the IMDG classes above. They present significant risks when carried in bulk and require special precautions. They are described as follows:

**Combustible solids:** materials which are readily combustible or easily ignitable

**Self-heating solids:** materials that self-heat

**Solids that evolve into flammable gas when wet:** materials that emit flammable gases when in contact with water

**Solids that evolve toxic gas when wet:** materials that emit toxic gases when in contact with water

**Toxic solids:** materials that are acutely toxic to humans if inhaled or brought into contact with skin

**Corrosive solids:** materials that are corrosive to skin, eyes, metals or respiratory sensitisers.

## Examples of Group B cargoes and the risks they present

The major risks associated with Group B cargoes are fire and explosion, release of toxic gas and corrosion.

### Coal

Coal may create flammable atmospheres, heat spontaneously, deplete oxygen concentration and corrode metal structures. Some types of coal can produce carbon monoxide or methane.

### Direct reduced iron (DRI)

DRI may react with water and air to produce hydrogen and heat. The heat produced may cause ignition. Oxygen in enclosed spaces may also be depleted.

### Metal sulphide concentrates

Some sulphide concentrates are prone to oxidation and may have a tendency to self-heat, leading to oxygen depletion and emission of toxic fumes. Some metal sulphide concentrates may present corrosion problems.

### Organic materials

#### Ammonium nitrate-based fertilisers

Ammonium nitrate-based fertilisers support combustion. If heated, contaminated or closely confined, they can explode or decompose to release toxic fumes and gases.

### Wood products transported in bulk<sup>8</sup>

Wood products transported in bulk are listed in a new schedule to the Code: Wood Products – General. They include logs, pulpwood, roundwood, saw logs and timber. These cargoes may cause oxygen depletion and increase carbon dioxide in the cargo space and adjacent spaces.



The damage caused by a DRI explosion (Image courtesy of Burgoynes)

<sup>8</sup>These are wood products loaded and discharged by methods such as elevators and grabs. They are distinct from wood products listed in other schedules.

## Typical requirements for accepting and loading Group B cargoes

### Information required on board ship for dangerous goods in solid form in bulk

To carry dangerous goods in solid form in bulk, your ship must have a Document of Compliance for the Carriage of Dangerous Goods, supplied by the ship's flag or classification society. The Master must have a special list, manifest or stowage plan identifying the cargo's location, and there must be instructions on board for emergency response.

### Segregation

Because of their potential hazards, many Group B cargoes are incompatible and must be segregated. When segregating cargoes, you should take into account any secondary risks they present.

**Consult the Code – see Section 9.3**



Coal on fire in a cargo hold

## Specific risk mitigation measures

The cargo's schedule and the information provided by the shipper will detail the precautions you must take when carrying Group B cargoes. The following are some of the common risk mitigation measures you will employ.

### Fire and explosion

Depending on the cargo, precautions against fire and explosion may include ventilating or inerting the cargo holds and the enclosed spaces adjacent to the holds: in some cases the ventilators will need to be explosion proof. The atmosphere in the cargo holds and the enclosed spaces adjacent to the holds may also need to be monitored with an appropriate gas detector.

### Toxic gas

Toxic gas risks will be mitigated using natural or forced mechanical ventilation. The choice of ventilation will depend on the type of cargo and the properties of the gas (i.e., whether it creates an explosive atmosphere). You may need to monitor the cargo hold atmosphere.

### Corrosion

Corrosion can be caused by some Group B cargoes and their residues. A coating or barrier may need to be applied to the cargo space structures before loading. Before loading and unloading corrosive cargoes, make sure the cargo space is clean and dry.



DRI which has self heated (Image courtesy of Burgoynes)

## **Group C cargoes (cargoes which are neither liable to liquefy nor possess chemical hazards)**

Although Group C cargoes do not present the dangers associated with Group A and B cargoes, they can still carry risks.

### **Examples of Group C cargoes, their risks and mitigation measures**

#### **Iron ore and high density cargoes**

These cargoes can be extremely dense and can overstress the tanktop. Make sure that their weight is evenly distributed during loading and during the voyage so that the tanktop is not overstressed, and also consider trimming the cargo. Loading rates of iron ore are normally very high and you should also consider the ship's ballasting operations and loading sequences.

#### **Sand and fine particle materials**

Fine particle materials can be abrasive. Silica dust is easily inhaled and can result in respiratory disease.

You should take appropriate precautions to protect machinery and accommodation spaces from the dust of sand and fine particle cargoes, and to prevent the cargo from getting into the bilge wells. People who may be exposed to cargo dust should wear goggles or other equivalent dust eye-protection, dust filter masks and protective clothing.

#### **Cement**

Cement may shift when aerated during loading. Dust can also be produced from this cargo. Follow the precautions for sand and fine particle materials (above).

### 3. Other hazards associated with carrying solid bulk cargoes

#### Entering enclosed spaces

Always follow the appropriate procedures before entering an enclosed space, taking into account IMO Resolution A.1050(27) – Revised Recommendations for Entering Enclosed Spaces Aboard Ships. Note: after a cargo space or tank has been tested and generally found to be safe for entry, small areas may exist where oxygen is deficient or toxic fumes are still present.

#### Pesticides

The risks of using pesticides include the accumulation of gas in spaces adjacent to the cargo holds being treated or, if it is essential to ventilate the cargo holds, accumulation of fumigant in accommodation and working areas.

Fumigants such as Phosphine and Methyl Bromide are poisonous to humans and if they are not handled correctly, they can also represent a fire risk. They should only be used by specialists and not by the ship's crew.

Carry out any fumigation in line with the IMO Circular, MSC.1/Circ.1264 – Recommendations on the Safe Use of Pesticides in Ships Applicable to the Fumigation of Cargo Holds. This is contained in the supplement to the Code.

The ship should carry gas-detection equipment, 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.

## 4. Checklist and flowchart for accepting and loading solid bulk cargoes

The checklist on the next two pages and the loading flowchart on page 18 bring together all the key procedures you must follow when accepting and loading any solid bulk cargo for shipment. Always consult the Code itself to ensure that all mandatory measures and specific advice have been implemented.

Download a large version of the flowchart at [www.lr.org/imsbc](http://www.lr.org/imsbc)

### Checklist

**Before accepting and loading a cargo, ask yourself the following questions:**

1. Has the shipper delivered the cargo information and documentation listed in the Code under 'Assessment of acceptability of consignments for safe shipment; Provision of Information', including the correct Bulk Cargo Shipping Name (BCSN), and provided a declaration that the cargo information is correct?
2. Have you consulted the relevant IMSBC Code schedule to find out the cargo's general and specific hazards?
3. If the cargo is listed as Group A, have you followed all procedures relating to the safe carriage of cargoes which may liquefy?
4. If the schedule indicates the cargo is Group B has the shipper provided a statement that the chemical characteristics of the cargo are, to the best of his knowledge, those present at the time of loading? 
  - a) If the cargo is classified as 'dangerous goods in solid form in bulk' does the Master have a special list, manifest or stowage plan identifying its location, are there instructions on board for emergency response, and does the ship have a Document of Compliance for the Carriage of Dangerous Goods?

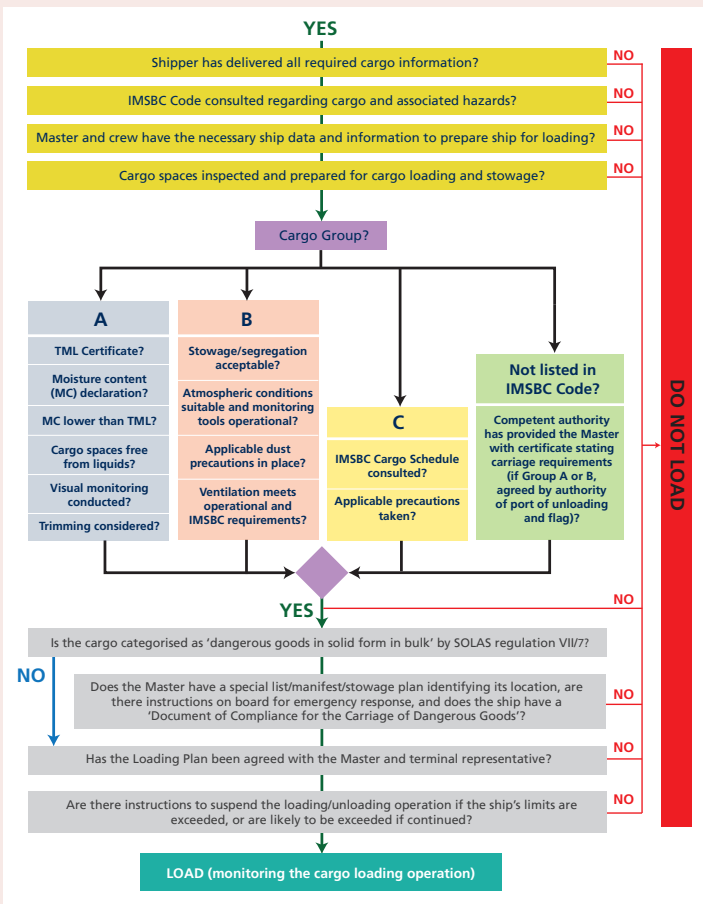
**(Continued on the next page)**



## Checklist (continued)

5. Whatever the cargo Group, have you taken the recommended precautions to remove or minimise the cargo's hazard, including:
  - a) preparing recommended safety equipment and procedures?
  - b) activating any cargo monitoring equipment ready for loading?
6. Have the Master and Terminal Representative agreed a Loading Plan to ensure that the permissible forces and moments on the ship are not exceeded during loading or unloading? This should include the sequence, quantity and rate of loading or unloading, the number of pours and the de-ballasting or ballasting capability of the ship.
7. Are there instructions to suspend the loading or unloading operation if the ship's limits are exceeded, or are likely to be exceeded if the operation continues?
8. Are you monitoring the cargo loading or unloading procedure, is the ship's draught being monitored and recorded in the logbook, and have any significant deviations been corrected?
9. Before sailing on the loaded passage, have you considered other factors, such as the ingress of water, which could affect the cargo during the passage?

## Loading flowchart – follow the steps to see if it is safe to load your cargo



# Appendix 1 – IMO regulations and guidance relating to the transport of solid bulk cargoes

## Mandatory regulations

### **International Convention for the Safety of Life at Sea (SOLAS)**

- Chapter VI: Carriage of cargoes
- Chapter VII: Carriage of dangerous goods
- Chapter XII: Additional safety measures for bulk carriers

**International Maritime Solid Bulk Cargoes (IMSBC) Code** – facilitates the safe stowage and shipment of solid bulk cargoes by providing information on the risks associated with their shipment, and the procedures to be adopted for carriage.

**International Code for the Safe Carriage of Grain in Bulk (International Grain Code)** – contains regulations and guidance for ships engaged in the carriage of grain in bulk.

**Code of Safe Practice for Ships Carrying Timber Deck Cargoes** – provides stowage, securing and other operational safety measures designed to ensure the safe transport of timber cargoes, primarily stowed on deck.

**MARPOL Annex V – Regulations for the Prevention of Pollution by Garbage from Ships** – includes requirements for discharge of dry bulk cargo residues and cargo hold wash-water containing cargo residues.

## Guidance

**Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code)** – assists those responsible for the safe loading or unloading of bulk carriers to carry out their functions and to promote the safety of bulk carriers.

### **Circulars and Resolutions**

- MSC.1/Circ.1160 – Manual on Loading and Unloading of Solid Bulk Cargoes for Terminal Representatives.
- MSC. 1/Circ.1357 – Additional Considerations for the Safe Loading of Bulk Carriers

## **Circulars and Resolutions (continued)**

- MSC. 1/Circ.908 – Uniform Method of Measurement of the Density of Bulk Cargoes
- MSC. 1/Circ.1395 – Lists 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
- Resolution A.1050(27) – Revised Recommendations for Entering Enclosed Spaces Aboard Ships
- MSC. 1/Circ.1264 – Recommendations on the Safe Use of Pesticides in Ships Applicable to the Fumigation of Cargo Holds
- BC. 1/Circ.69 – Contact Names and Addresses of the Offices of Designated National Competent Authorities Responsible for the Safe Carriage of Grain and Solid Bulk Cargoes.

## Appendix 2 – the Code section by section

**Section 1** – General provisions – including application, definitions, related SOLAS regulations

**Section 2** – General loading, carriage and unloading precautions – cargo distribution and loading/unloading procedures

**Section 3** – Safety of personnel and ship - poisoning, corrosive and asphyxiation hazards, dust hazards, flammability and ventilation

**Section 4** – Assessment of acceptability of consignments for safe shipment – identification of cargoes, and the tests and documentation required for their safe carriage

**Section 5** – Trimming procedures

**Section 6** – Methods of determining angle of repose

**Section 7** – Cargoes that may liquefy – the dangers of liquefaction, conditions under which liquefaction may take place and precautions to prevent it

**Section 8** – Test procedures for cargoes that may liquefy

**Section 9** – Materials possessing chemical hazards – classification of hazards, stowage and segregation requirements

**Section 10** – Carriage of solid bulk wastes – their classification, segregation and stowage

**Section 11** – Security provisions

**Section 12** – Stowage factor conversion tables

**Section 13** – References to related information and recommendations

### Appendices

**Appendix 1** – Individual schedules of solid bulk cargoes

**Appendix 2** – Laboratory test procedures, associated apparatus and standards

**Appendix 3** – Properties of solid bulk cargoes

**Appendix 4** – Index of solid bulk cargoes

**Supplement** – this contains supporting documents including the BLU Code and IMO circulars (see Appendix 1)

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The Club publishes loss prevention material through a wide range of media on topics such as hazardous cargo in containers, human error, personal injury and maritime security.

The full range of Club activities can be viewed at [www.ukpandi.com](http://www.ukpandi.com)

**UK P&I CLUB** 

### About Intercargo

Intercargo exists in order to present a unified voice for shipowners and operators in the dry bulk sector. Intercargo's primary objective is to link industry stakeholders in a commitment to a safe, efficient and environmentally friendly dry cargo maritime industry. For further details see [www.intercargo.org](http://www.intercargo.org)



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