Liquefaction & the Bulk Cargoes

►What is the problem:

- ✓ Cargoes at risk of liquefaction continue to be shipped.
- ✓ Liquefaction casualties cost the marine insurance industry over USD 100 million between 2010 and 2013.
- ✓ The IMSBC (International Maritime Solid Bulk Cargoes) Code started out as the BC Code, first issued in 1965, and became mandatory under SOLAS in January 2011.
- ✓ At the time of writing, the current version is the 2012 Edition of the IMSBC Code.
- ✓ The purpose of the IMSBC Code is to provide guidance on the procedures to be adopted when solid bulk cargoes are to be shipped.
- ✓ The Code ships greater than 500 gross tonnes when carrying bulk cargoes, regardless of whether or not they are called a 'bulk carrier'.
- ✓ The Code applies to all solid bulk cargoes, except grain.
- ✓ Compliance with the Code is mandatory.

The details of mineral cargoes are listed in Appendix 1 of the IMSBC Code, with advice on their properties, handling and carriage. This listing is not exhaustive, which means that not all types of cargo may be named specifically.
It is a requirement of SOLAS that each ship comply with the IMSBC Code. Therefore a copy should be kept on board and the master should ensure that he is familiar with its contents.

►Hazards of shipping bulk mineral cargoes:

The IMSBC Code draws attention to hazards associated with shipments of wet/damp solid bulk mineral cargoes, as follows:

1. Mineral cargoes are often high density. Therefore, their distribution in the holds must be considered as improper distribution of the cargo may lead to the ship being structurally damaged.
2. They are often loaded at a very fast pace; with the result that loading may stress the hold plating.
3. The loss of or reduction in, the stability of the ship during the voyage that may be due to: i. A shift of cargo due to inadequate trimming or improper distribution of the cargo. & ii. A wet cargo liquefying under the stimulus and vibration or motion of the ship, then sliding or flowing to one side of the cargo compartment.

►Shippers must supply correct documents:

All solid bulk cargoes should have a Bulk Cargo Shipping Name (BCSN) given by the shippers, and will have a schedule in Appendix 1 of the Code.

The schedules in the Code are not exhaustive and the properties are given for guidance only.

- ✓ It is essential that valid current information is obtained from the shipper before loading is started and that information shall be given as a declaration as set out in Section 4 of the Code, on a Cargo Information (or declaration) Form.
- ✓ If shippers are offering a solid bulk mineral cargo that is NOT LISTED in the Code, then the 'new' cargo must be assessed, at least by the competent authority of the port of loading (Section 1.3 in the Code).
- ✓ In this case, the shipper will provide details of the characteristics and properties of the proposed cargo and the competent authority will assess the acceptability of the cargo for safe shipment.
- ✓ If the cargo possesses hazards e.g. that it might liquefy, 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 will be authorised for carriage, by the competent authority, as Group C and in this case the competent authority will provide the Master with a certificate stating the characteristics of the cargo, its required conditions of carriage and handling requirements.

►Solid bulk cargo groups:

Once these procedures have been followed and completed satisfactorily, the cargo may be loaded.The characteristics of solid bulk cargoes have been divided into three groups; Group A, Group B and Group C.

Group A - cargoes which may liquefy if shipped with moisture content in excess of their transportable moisture limit.

Group B - cargoes which possess a chemical hazard and could cause a dangerous situation on the ship.

Group C - cargoes which are neither likely to liquefy (Group A) nor possess chemical hazards (Group B).

Some mineral cargoes can be both Group A and Group B, i.e., they may liquefy and have a chemical hazard.

Transportable Moisture Limit (TML) – the name says it all, it is the maximum moisture content, that is considered safe for carriage of Group A cargoes. It is given as a percentage.

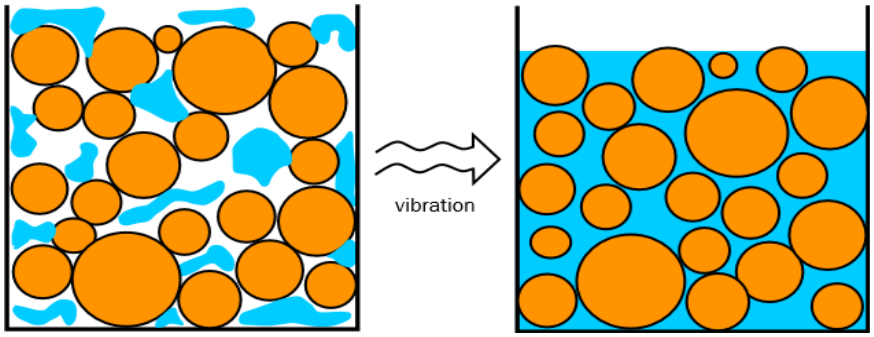
The moisture content (which may be referred to as 'MC') of the cargo, and also given as a percentage, must be established by the shipper within 7 days of loading.

Provided the moisture content is less than the TML, the cargo meets the carriage requirements of the Code.

If shippers report a Flow Moisture Point (FMP), the TML will be 90% of this value. It is always worth checking shipper's calculations on this matter.

►Testing methods:
Three test methods are used to determine TML in the current edition of the Code, only two produce an FMP, but all give a TML. Shippers should provide the test certificates stating what test method was used to determine the TML. If in doubt, seek advice.
'Can tests' are often used by Masters to provide further information (see Section 8 of the Code). It must be noted that the 'CAN TEST' is NOT a substitute for laboratory testing, and only provides a 'rough idea' on the state of the cargo.
If 'can tests' fail, then loading should be stopped and the Master should seek advice.

►How some cargoes liquefy:
The Code lists a number of mineral cargoes and their properties. Many mineral cargoes are fine-grained and loaded while wet/damp. They may be wet due to the industrial processing conducted by the shippers, or stockpiles that have been exposed to rain prior to loading.
-If the particles of the mineral cargo are in contact with each other, friction will hold them together.
-Large particles, commonly known as 'lumps', are big enough for contact between them to be maintained regardless of any vibrations and/or ship motion during the voyage. This contact allows water to drain. Therefore cargoes consisting of lumps often require the bilges to be pumped during a voyage and are Group C cargoes.
-Small particles, commonly known as 'fines' or 'concentrates' often do not drain as quickly as lumps, they may not drain at all. If these cargoes are loaded with a moisture contents above their TML, then they may settle, and become fully saturated. When this happens they may liquefy.
-When the particles are surrounded by water and lose contact with each other, the whole cargo can behave like a dense liquid and will flow. This is what makes them Group A.
-Some fine-particles cargoes that drain allow a 'wet base' to form. This information should be provided on the shippers' declaration.



►Danger of liquefaction for a ship:
Because most of the mineral cargoes are dense and likely to liquefy when the moisture content is above their TML, they can 'walk up the hold plating' when the vessel rolls, i.e., they flow towards the downside of the roll, but do not necessarily flow back. On each subsequent roll, the cargo might move further to the same side. This is unlike water and grain (which flow back), and can result in a large amount of heavy cargo resting against the hold side plating.

If a liquefied cargo moves during a voyage, the ship might suffer a loss of or reduction in stability due to the cargo shifting. There is a risk that the ship will list as a result of the cargo shifting. If the cargo continues to shift to one side, the ship will list more heavily to that side and, if the shift is excessive, there will be down-flooding of sea water into the ship's tanks and the ship might capsize and sink.
Group A cargoes should only be carried when the moisture content of the cargo is less than, or equal to, the Transportable Moisture Limit of the cargo. The Transportable Moisture Limit (TML) can be calculated as 90% of the Flow Moisture Point (FMP), depending on the test method used.

►Nature of some cargoes cause confusion:
Some people involved with shipping mineral cargoes may not understand the properties of Group A materials and may offer incorrect information. This may be because:

- ✓ Many mineral cargoes will 'look OK' even when they are wet – that does not mean they are safe for carriage. Visual appearance can be deceptive.
- ✓ Group A cargoes may not always liquefy if the voyage is calm and the ship's movement does not result in any significant energy transfer to the cargo.
- ✓ Shippers may use trade or commercial names for the cargo – a BCSN should always be provided for the cargo.
- ✓ The cargo may not be listed in the IMSBC Code – shippers should apply for Section 1.3 approval.
- ✓ Shippers may not have a copy of the IMSBC Code, they may not have read it and they may not understand it.
- ✓ Some shippers think that if a cargo is not listed; it is not controlled by the Code – this is NOT CORRECT. All solid bulk commodities that are put forward for shipment are controlled by the IMSBC Code.

The next edition of the Code will contain additional mineral cargo entries, including Iron Ore Fines and Nickel Ore.
Iron Ore Fines will be listed as Group A (but with exemptions for some grades), whereas Nickel Ore will always be Group A.
Until a new version of the Code is published, these two particular cargoes should be treated as Group A regardless of any shippers' declarations to the contrary.

►Safe loading:
While the voyage is being planned, the Master should refer to the procedures set out in the ship's Safety Management System. In addition, the Master and Chief Officer should consult the appropriate IMO publications, including the IMSBC Code, the BLU Code and recommendations on ballast water management.

►**Checklist for Masters and Officers to follow before loading:**

- ✓ Ensure that the identity of the cargo being carried is known and that the cargo's name is described by using the Bulk Cargo Shipping Name (BCSN), as detailed in the IMSBC Code. A trade name is not a BCSN.
- ✓ Ensure that the cargo holds are properly and appropriately cleaned, as well as being prepared for the cargo that is going to be loaded.
- ✓ Ensure that all necessary maintenance has been completed before loading starts.
- ✓ Plan the loading operation thoroughly, following all SMS and BLU Code requirements, as well as all the appropriate instructions.
- ✓ Ensure that the appropriate carriage instructions are obtained in advance.

►**Checklist of documents required before loading:**

A list of information can be focused in IMSBC Code subsection 4.2; shippers should give this to the Master for all solid bulk cargoes before loading. This should include:

- ✓ The Bulk Cargo Shipping Name (BCSN) when the cargo is listed in this Code. Trade or commercial names can be used in addition, but not as a substitution to the Bulk Cargo Shipping Name
- ✓ The cargo Group (A and B, A, B, or C)
- ✓ If listed as MHB (material hazardous only in bulk), information about the hazard should be included
- ✓ The total quantity of the cargo offered;
- ✓ The stowage factor
- ✓ The need for trimming and the necessary procedures
- ✓ The likelihood of shifting
- ✓ A certificate for the transportable moisture limit (TML). This can be tested up to six months before loading
- ✓ A certificate on the moisture content of the cargo dated within seven days of loading. If it rains after the certificate has been provided the shippers should give an updated moisture value
- ✓ Likelihood of a wet base forming (see sub-section 7.2.3 of the Code)
- ✓ Toxic or flammable gases that may be generated by the cargo
- ✓ Flammability, toxicity, corrosiveness and propensity to oxygen depletion of the cargo
- ✓ Self-heating properties of the cargo and if trimming is required
- ✓ Properties on the emission of flammable gases that may be in contact with water
- ✓ Radioactive properties
- ✓ MARPOL statement - ***Solid bulk cargoes should be classified and declared by the shipper as to whether or not they are harmful to the marine environment and only those declared as 'not harmful' may be discharged into the sea as detailed in the regulations of MARPOL Annex V***
- ✓ Any other information that is required by national authorities.

►**What should the Master/CO/OOW look out for during loading:**

- ✓ Is it or has it been raining?
- ✓ Have shippers provided all the required information on their declaration?
- ✓ How does the cargo behave when subjected to a 'can test'?

a. Is there any free water on the surface after the 'can test', i.e., does the surface appear shiny with free water?

b. Has the sample in the can changed form, i.e., does it flow and form a flat surface?

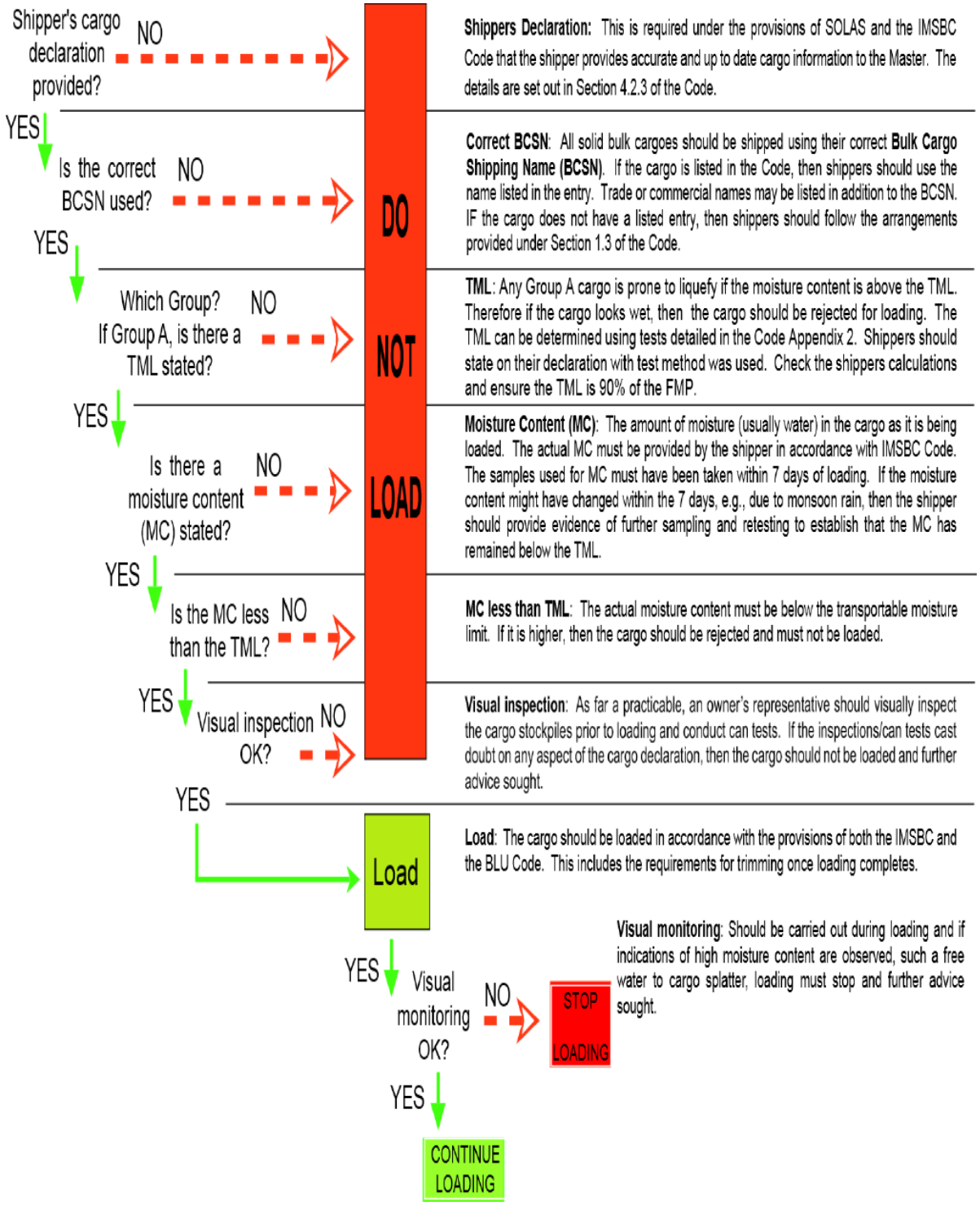
- ✓ If in doubt, seek advice.

►**What to look for during the voyage:**

- ✓ The cargo should be checked frequently, looking for signs of free water on the surface, flattening out of the surface, and fluid flow. When entering the holds, safe entry procedures must be used.
- ✓ If any of the above is seen, contact the vessel DPA immediately as per the company SMS and request expert technical assistance.

►***Best practice and seamanship:***
Points to be considered include:
If the cargo has shifted and the list is corrected by ballast operations, what happens if the cargo shifts again?
The cargo may act like a dense fluid when it flows around the hold(s), therefore ballasting operations may result in significant additional problems.
What are the prevailing weather conditions?
Is the vessel rolling? Can this be reduced or minimised by changing heading and/or speed?
It is recommended that if there is a shift, a reduction in speed will help to minimise the rolling, pitching and any engine/hull vibrations. In addition, sharp helm movements should be avoided.
Consider the distance to land (Port of Refuge) along with the current heading and prevailing weather conditions.
Avoid turning the vessel through the swell and/or wind waves, as this may cause rolling and additional shifting of the cargo.

A simple flowchart for loading group "A" bulk cargoes



►The legal requirements:

The Master will of course know that the vessel is under the charterers' employment orders and provided the orders are “lawful”, the Master should follow them.

*The most important factor, however, is the safety of the crew, followed by the vessel’s safety. The Master should use his discretion to take any decision which, in his professional judgment, is necessary for safety of life at sea: SOLAS Chapter V, Regulation 34-1. The Master can also refuse, for the security of the vessel, to load a cargo and grant access to his vessel: SOLAS Chapter XI-2 Regulation 8.

It is a legal requirement under the provisions of SOLAS Chapter VI, Regulation 2 and the IMSBC Code Section 4.2 for the shipper to provide the Master with accurate cargo information.

**Furthermore SOLAS Chapter VI, Regulation 6-2 and Regulation 7-7 provide that cargo must not be loaded if the actual moisture content exceeds the TML and that the Master has the right to suspend cargo operations if limits are exceeded.

Furthermore, where applicable, the Hague Visby Rules, Article IV Rule 6 provide that a Master can seek a Port of Refuge if the cargo on board becomes a danger to the vessel, even if the cargo was carried by consent and knowledge about its character.

Apart from general law, contractual law and international convention: a Master should always feel able to take steps he feels are necessary to ensure the safety of his crew and of the ship.

►**References:**

- ✓ International Maritime Solid Bulk Cargo Code (IMSBC) – current edition
- ✓ Nickel Ore: STOP, THINK, VERIFY. Intercargo Guide for the safe loading of Nickel Ore
- ✓ The BLU Code – The Code of Practice for the Safe Loading and Unloading of Bulk Carriers (including the BLU Manual)
- ✓ Thomas Stowage

►The IMSBC Code layout:

- ***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***
- ***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 – does not apply to mineral cargoes***
- ***Section 7 Cargoes that may liquefy – the dangers of liquefaction, conditions under which liquefaction may occur 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***
- ***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***