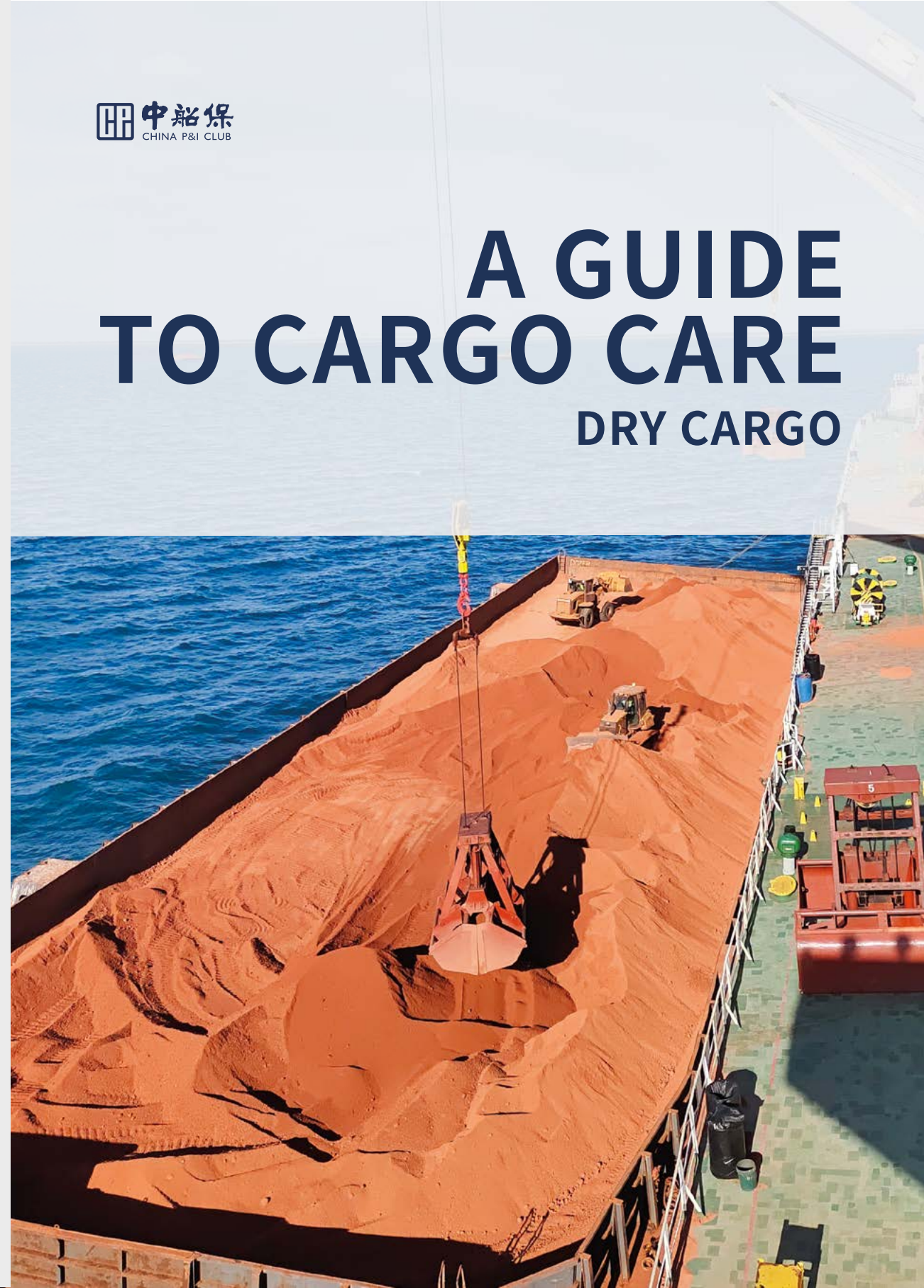


A GUIDE TO CARGO CARE

DRY CARGO



A Guide to Cargo Care - Dry Cargo

A GUIDE TO CARGO CARE

DRY CARGO



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A GUIDE TO CARGO CARE

DRY CARGO

Introduction

According to the statistics of the Association over the years, cargo claims account for almost 60% of the total number of newly registered claims and have always been among the top in both number and claim amount. Cargo risks are hence of great importance to the Association and its Members. This guide, by analysing some common and special forms of cargo risks and then promoting best practices, is written to help reduce cargo liability claims.

Damage or loss of cargo refers to the damage in quality or loss in quantity during the transportation, loading, unloading and storage of cargo, often in cases of wetting, shortage, physical damage, combustion, contamination, spoiling, infestation, falling overboard, etc. Apart from total loss caused by severe incidents like fire, collision, and grounding, damage or loss of cargo may also occur when the cargo itself is defective, or miscalculated, or scattered by pilferage. Other reasons include water ingress in cargo holds, improper stowage or lashing, and substandard hold cleaning. This guide, with a focus on ten primary cargo risks in shipping for dry cargo carriers and container ships, provides advice on how some special cargo should be handled and what preventive measures to be followed to avoid damages.

The intention of this guide is to provide guidance and information which is additional to existing conventions, regulations, and company safe cargo operation procedures. Ships are recommended to take into account the SOLAS Convention, IMO resolutions and codes (IMSBC, IMDG, Grain, BLU, CSS), classification society rules, national standards, industry knowledge and best practices (Thomas Stowage, Bulk Carrier Practice) as well as company procedures throughout the process of cargo operation.

Any suggestions to help us improve the content or form of this guide will be appreciated.

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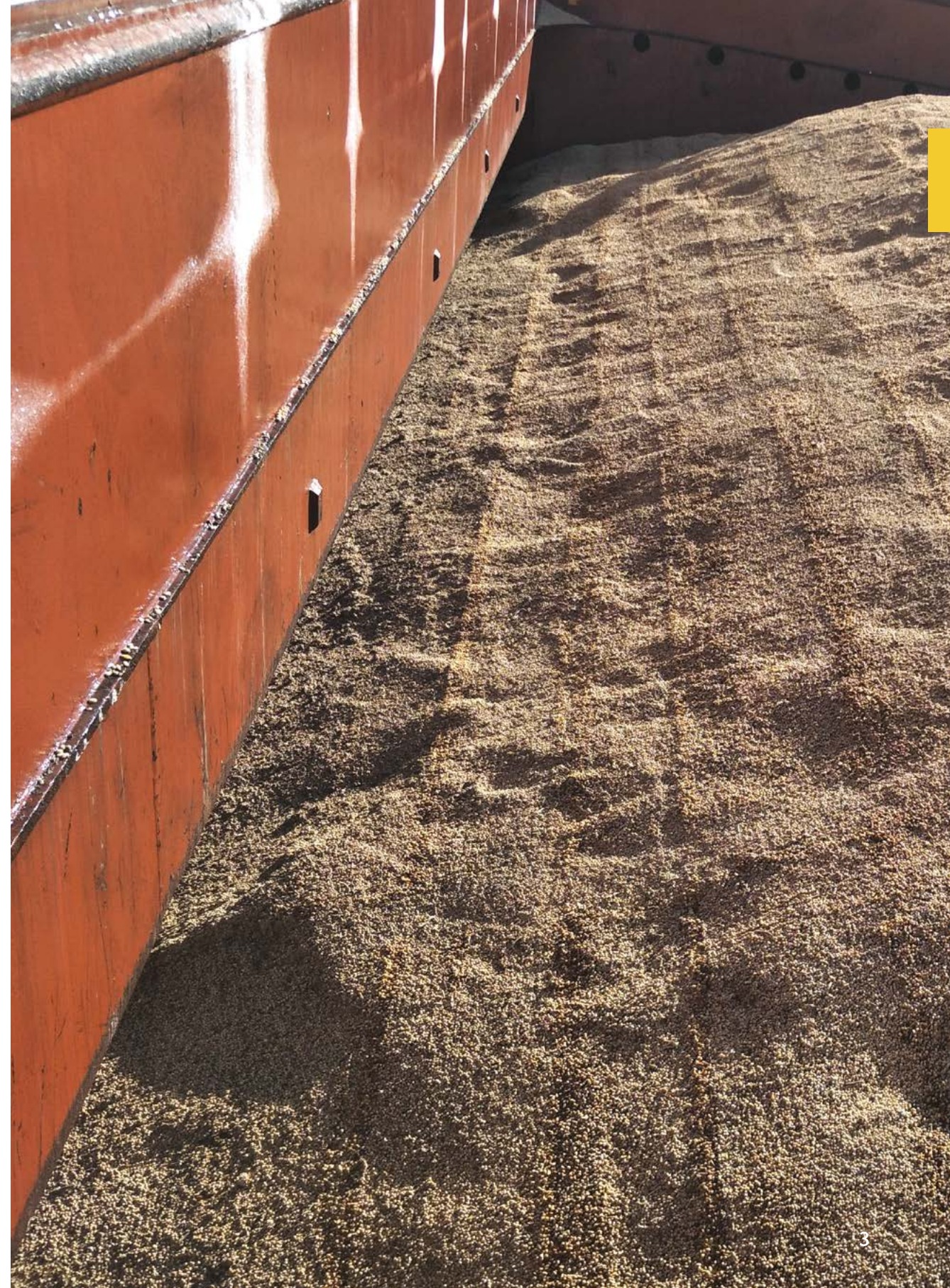
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1 Wet Damage by Sweat

As one of the primary types of cargo damage, wet damage by sweat mainly involves bagged/bulk agricultural products or steel cargoes. Claimants typically allege that the cargo went bad because the ship failed to ventilate correctly, causing the development of condensation in the holds, even the truth is that the cargo itself may be biologically unstable. Unfortunately, it's hard for carriers in many cases to sustain a defense to these allegations if no adequate documentary evidence or records can be provided.



01

Types of Sweat and Reasons for Wet Damage

Ship Sweat

It often occurs when a vessel loads in a warm climate and proceeds to a colder climate. As the seawater and external temperature cool, the steelwork may be eventually cooled beneath the dewpoint of the warm moist air in the hold, causing sweat on the hold surfaces. Additionally, ship sweat can be formed because of local heating or cooling events within the vessel. If the cargo contains natural moisture, e.g. grain, then any heating of the cargo by an external source such as a fuel oil tank or an engine can also result in the formation of condensation onto cold structures. Consequently, wet damage happens due to sweat dripping onto cargo from the underside of hatch covers and deck, or direct contact with the sweat attached to

hold bulkheads or accumulated at the bottom of the hold.

Ship sweat usually forms on the surface of steelwork which is in direct contact with outside environment:

- ◆ underneath of hatch cover with single skin;
- ◆ underneath of access hatch cover;
- ◆ single hull plate;
- ◆ underneath of cross deck;
- ◆ inner hatch coamings.



Ship Sweat



Up: Single Hull Plate More Vulnerable to Sweat
Bottom: Double Hull Plate Less vulnerable to sweat



Cross Deck Vulnerable to Sweat



Single Skin Hatch Cover More Vulnerable to Sweat



Double Skin Hatch Cover Less Vulnerable to Sweat

Cargo Sweat

Cargo sweat occurs when warm moist air is introduced into a hold and is cooled below its dewpoint by the cargo such that condensation forms. This could occur, for example, when a vessel is on passage from a cold climate to a warmer climate and the holds are ventilated with warm moist air being introduced into the holds. The warm moist air is cooled below its dewpoint by the colder cargo, causing condensation to form on the surface of the cargo. It is akin to the condensation forming on a can of cold drinks when taking it out of the fridge on a summer's day. Cargo sweat is most associated with incorrect ventilation, and it may be a more severe threat than ship sweat as all cargo whose surface is exposed to air will be damaged by sweat.



Cargo Sweat

02 Cargoes at Risk

Cargoes that are susceptible to damage caused by sweat are those that will deteriorate in some way when in contact with water. These cargoes may be either hygroscopic or non-hygroscopic.

Hygroscopic Products

Hygroscopic products have a natural moisture content and are mainly of plant origin. They may retain, absorb or release water vapour, and excessive amounts of inherent moisture may lead to significant self-heating and moisture migration within the cargo resulting in caking, mildew or rot. Hygroscopic cargoes include all agricultural crops and commodities: grain, rice, flour, sugar, oilseeds, animal feedstuffs, cotton, raw unrefined sugar, tobacco, cocoa, coffee, tea, paper and paper products etc.



Hygroscopic Products

Non-Hygroscopic Products

Non-hygroscopic cargoes are those that do not have an inherent moisture content, or at least not one which can interact with the air. One common example is steel products, that may react with the moisture to form rust. However, a hold containing steel or machinery may also contain substantial quantities of timber dunnage, which is hygroscopic, and others may be harmed if packaged using a hygroscopic material (e.g. wood, paper).



Non-Hygroscopic Products

The Source of Water/Vapour in Cargo Holds

- ◆ hygroscopic products
- ◆ fresh air from ambient
- ◆ hygroscopic dunnage or packing material
- ◆ water in bilge well
- ◆ water leakage: seawater, rainwater, ballast water

03 Proper Ventilation

Ventilation Rules

To eliminate/minimise the formation of sweat and the associated risk of cargo damage, the underlying principle is to keep the dewpoint of the air within the hold below the temperature of the hold structure and the cargo to stop the formation of ship and cargo sweat. The fundamental decision taken by the Master to ventilate the cargo space or not should be based on either the 'Dewpoint Rule' or the 'Three Degree Rule', or any instruction given by the fumigators or shippers, and should not be based on personal feelings, especially at night, foggy days, rainy days or shipping seas:

✂ **Dewpoint Rule:** VENTILATE if the dewpoint of the air inside the hold is higher than the dewpoint of the air outside the hold.

✂ **Three Degree Rule:** In many instances it is impracticable to measure hold dewpoint temperatures accurately, or at all. In such cases ventilation requirements may be estimated by comparing the average cargo temperature at the time of loading with the outside air temperature several times a day. VENTILATE if the dry bulb temperature of the outside air is at least 3°C cooler than the average cargo temperature at the time of loading.

(Note: in order to apply the Three Degree Rule, it will be necessary for the ship's staff to take a number of cargo temperature readings during loading.)

✂ **The instructions from the shippers or the fumigators, if there are any, should be followed first.**



Mechanical Ventilation



Natural Ventilation

Common Misunderstandings

// Suspension of Ventilation in Rain

It is usual to suspend ventilation when it is raining for fear that rainwater will be drawn into the ventilators and the cargo will become wetted. However, it is perfectly possible for it to be raining at a time when either comparison of dewpoints or the Three Degree Rule indicates it is appropriate to ventilate. In such cases, the cargo may be damaged by sweat if not ventilated, and by contrast may be damaged by rainwater ingress if ventilated. Therefore, Masters should be fully familiar with their vessel's ventilation arrangements and carefully assess the situation that how much water ingress can be expected by those vents (mushroom type is less risky while inlet on vertical side of hatch cover is of high risk). If there is any doubt, it would be prudent to suspend ventilation and record properly in the ventilation log, as it may be difficult to defend in the event of a claim for cargo damage by rainwater ingress.

// Suspension of Ventilation in Fog

Crew often simply shut off ventilation during foggy weather. The truth is that the presence of mist or fog has no bearing on the ventilation, and Masters should continue to apply either the Three Degree Rule or the Dewpoint Rule regardless of fog.

// Suspension of Ventilation When the Vessel Ships Seas or Spray

A master must be familiar with the vessel's ventilation arrangement and assess the risk of water ingress. If they believe there is a risk of water ingress, then ventilation should be stopped. By contrast, ventilation should be continued if Dewpoint and Three Degree Rule indicate it is appropriate, and relevant log entries should be made.

// Suspension of Ventilation at Night

It has been common practice for most crew to discontinue ventilation at night as they believe that night-time is associated with the formation of dew and the dew in the air could affect the cargo during the night-time. However, this is a misconception. Ambient temperatures are usually lower at night, and ship sweat is more likely to form during the dark hours, and therefore ventilation should be continued so long as Dewpoint and Three Degree Rule indicate it is appropriate.

Another reason for the crew to stop ventilation at night is that their ability to judge the severity of rainwater or shipping spray in the hours of darkness may be impaired. Furthermore, there may be insufficient crew available to assist with the closure of ventilation in a timely manner. Masters should then carefully assess if the ship's ventilation system can prevent ingress of rainwater and shipping spray, the availability of personnel and the possibility of sweat damage if ventilation stopped to show ventilation has been managed in a prudent manner.

// Good Weather Works for All

Ship's crew often deem that ventilation can be conducted whenever the weather was good. This is likely to be inappropriate since good weather are often those conditions associated with high temperatures and high moisture content. The fundamental decision taken by the Master to ventilate the cargo space or not should be still based on either the 'Dewpoint Rule' or the 'Three Degree Rule'.

Additional Ventilation Requirements and Precautions for Grain and Steel Cargoes

// Bulk Grain

For most hygroscopic agricultural cargoes – particularly where there are full or almost full holds – the cargo temperature everywhere except at the sides of the stow will change very little and often not at all during the voyage. In addition, crew access to cargo holds will be limited for various reasons such as fumigation, and therefore the 'Three Degree Rule' may apply more for carriage of grain cargoes.

It is important to note that most (but by no means all) hygroscopic cargoes are biologically 'alive', for instance sunflower seeds, which will sprout and grow if planted. Like all living things, these seeds are always respiring, and hence are producing heat and releasing water vapour. However, if grain and oilseed cargoes are dried prior to shipment and are effectively dormant, the heat and water vapour produced by respiration on board a ship is so small that it can be ignored. Meanwhile, the dewpoint temperature inside cargo hold may be decreased as the cargo may absorb moisture from the air inside the hold. Therefore, no ventilation is recommended while the ambient condition is rather stable during the whole voyage (such as north pacific voyage from west coast of US to China).

Some commodities may have inherent moisture levels which exceed acceptable limits at the time of loading, making them biologically unstable that no amount of ventilation will prevent damage. Ship should make every effort to conduct proper ventilation to minimise ship sweat, such as open hatch cover if weather, sea condition and safety permits, so that any potential claim becomes easier to defend if masters can demonstrate that they ventilated, to the capacity of their vessels' systems,

whenever it was appropriate for them to do so.

With a cargo such as grain, which will be stowed up into the coaming space of each hatch, the ventilation will reach even less of the cargo. This does not necessarily mean that masters should not ventilate a bulk cargo. While ventilation may have little or no effect on a bulk cargo, so long as the indications are correct it will not harm it in any way. If, at out-turn, there is a moisture-related problem with the cargo, masters will be in a position to demonstrate that they ventilated when they should have done.

It is not uncommon for grain cargoes to be fumigated on board the ship on completion of loading. Masters should follow the written instructions, either from their charterers or from the fumigators. Once the fumigation ends, the cargo condition should be confirmed, and if anything goes wrong, the shipper/charterer should be informed at first stage. Then proper ventilation should be conducted in subsequent sea passage. **In cases where the cargo has been fumigated, on no account should crewmembers and shore people enter the holds until these have been certified gas-free.**

Hygroscopic products may be damaged by heated bunker tanks and the cargo would further emit heat and moisture, increasing the risk of sweat. The bunkers used during the voyage should be drawn as far as possible from tanks situated well away from holds containing hygroscopic products. If impracticable, bunker tanks adjoining cargo spaces should be heated only when required, ensuring that the temperature does not rise above normal operational levels.

// Bagged Agricultural Cargoes

- ✓ Agricultural cargoes include crops and commodities such as wheat, rice, oilseeds and nuts. One of the largest exported agricultural cargoes shipped globally in bags is rice. Cargo claims for condensation damage to bagged cargoes are common, especially for carriage of bagged rice from Southeast Asia to West Africa, and are often based on allegations of inappropriate stowage, dunnaging, and/or ventilation. Cargoes in direct contact with the hull and those on top are subject to more damages in case of ship's sweat.
- ✓ The proper placement and combination of dunnage materials have been proven to be effective in reducing condensation damage on bagged rice caused by direct contact with ship's steel structure. In more recent times, it has become common in the bagged rice trade from Thailand for the traditional type of dunnage to be replaced by combinations of styrofoam, plastic/polythene sheet and kraft paper, but bamboo sticks/bamboo mats and kraft paper as the customary dunnage materials are still used in many ports. It should be noted that it is commonly found that bamboo is not free from moisture and can retain and bleed moisture during passage which may increase the risk of sweat. Meanwhile, bamboo mats tend to absorb the moisture and pass it on to adjacent bags that rest upon them when there is sweat on ship's hull.



Styrofoam, Plastic/Polythene Sheet for Bagged Rice



Bamboo Sticks/Mats as Dunnage

- ✓ Each country or port authority may have different rules as to the use of specific types of dunnage. Local agents should always be consulted in advance to determine if there are any local restrictions on the use of particular types of dunnage. It is noteworthy that Peru and Chile in South America do not allow cargo protected by bamboo mats and sticks to be discharged at their ports.
- ✓ While using styrofoam, plastic/polythene sheet and kraft paper as dunnage materials, caution should be taken using styrofoam near ventilation openings. The styrofoam should be carefully cut and fitted so as to not prohibit the flow of air through the ventilation openings. Meanwhile on completion of loading, the top layer of the bags will be usually covered with kraft paper so as to prevent any condensation from the hatch cover undersides from dripping over the cargo during the course of the voyage while inspection on the wet condition of kraft paper should be kept to avoid cargo damage.



Kraft Paper Covered on Bagged Cargoes

- ✓ There is some advice advocating the use of ventilation channels within the cargo stow. The main purpose of the channels is to increase the surface area of the stow to allow warm air to rise and then be removed during natural ventilation. However, there is little evidence to demonstrate the effectiveness of the channels. Meanwhile, there is a risk that the ventilation channels were not constructed properly and collapsed during the voyage, damaging

the cargo as a result. Expert opinion today is that biologically stable bagged hygroscopic cargoes do not require ventilation channels, unless specifically demanded by the IMDG Code (e.g. some types of seed cake). If shippers or charterers insist on the use of ventilation channels, then the Master should obtain written instructions to this effect.

- ✓ For voyages to colder climatic regions, natural ventilation is insufficient, and any ships engaged on carriage of bagged rice on longer voyages should be equipped with a proper functioning mechanical ventilation system, with a capacity of 15 to 25 air changes per hour (calculated on the basis of empty hold space). If the vessel is only fitted with natural ventilation, it's better to obtain the written acknowledgment from the shipper/charterers as notice of the vessel's ventilation limitations.

// Steel Products

- ✓ As we all know that steel is a non-hygroscopic material. However, steel products are normally transported using timber dunnage, which is a hygroscopic material. Moist timber dunnage will not only directly affect the cargo that rest on them but will also release moisture which may increase the risk of sweat. However, moisture proof of dunnage is usually neglected by stevedores and crew.
- ✓ While loading or discharging steel products which are not sensitive to rainwater, such as hot roll steel coils or steel billet etc., it's common that the shippers/charterers request ship to load or discharge in rain by Letter of Indemnity. In such case, special attention should be paid to the moisture-sensitive cargoes which are already loaded or to be loaded in the same hold in order to avoid direct wet damage or potential sweat damage.
- ✓ The moisture in a closed cargo hold with steel products is normally limited and will remain stable. The main risk is cargo damaged by

ship sweat which continuously occur in cycle: condensation under the weather/cross deck and hatch cover drop down onto the cargo, especially at region where the temperature varies greatly between day and night. Even proper ventilation can't prevent condensation of ship sweat in such cases. Where a ship has double skin of hull and hatch cover, the ship sweat will only occur under the cross deck. It's then a good idea to cover the cargoes under the cross deck to avoid sweat damage and save frequent ventilation.



Covering the Cargoes to Avoid Dribbling Sweat

- ✓ Steel products damage caused by cargo sweat is most associated with the incorrect ventilation of warm moist air into a hold with cold cargo. Another circumstance that should beware of is when a vessel loads a cargo in cool weather and the cargo is itself cool in temperature, and thereafter, the vessel transits into the second loading port where there is a warmer climate with higher humidity. It's then inevitable that sweat will condense on the surface of the relatively colder cargo as a result of the warmer humid air introduced into the cargo space. In case of such circumstances, the master shall report to the concerned parties for written instructions, such as change of port rotation. Prompt report and proper record shall be in place if any sweat damage occurred.

04 Proper Record-Keeping

During ship operation, there are numerous cases where owners lose their positive position in defending claims for cargo damage allegedly caused by improper or inadequate ventilation due to improper or lack of records. Therefore, while proper ventilation can effectively prevent cargo from sweat damage, proper and sufficient ventilation records are crucial to the interests of shipowners. In particular, in the event of sweat damage to cargo, evidence showing that the vessel ventilated correctly may be instrumental in defending any ensuing claims. Such evidence can be found usually in the Deck Log Book and the Cargo Temperature and Ventilation Log.

Deck Log Book

The Officer On Watch (OOW) is obliged to record all the events and abnormality (if any) occurred, including the prevailing weather condition, state of seas, etc. Hence, proper entry for cargo ventilation being carried out or otherwise at the material time should be made in order to safeguard the best interests of the owners/carriers in case such records are required to be disclosed as supporting documents at a later stage. Meanwhile, appropriate entries in the Deck Log Book should be written in most simple, clear and suitable wording to avoid incorrect interpretation by the claimants or unnecessary challenge or misunderstanding by the presiding judge.

Cargo Temperature and Ventilation Log

It is recommended that a separate ventilation log for each hold to be used to record all the required observations once per watch: dry & wet bulb temperature and

the dewpoint of ambient and cargo hold (only dry temperature of ambient required if Three Degree Rule used) , cargo loaded at average temperature (if Three Degree Rule used), oil tank temperature, seawater temperature, bilge sounding (at least two times every day), times of ventilation starts and stops, remarks and comments.

It is important to realize that even if the ventilation procedures are properly followed and applied, sweat may still unavoidably form as there are still limitations to how effective cargo ventilation can be due to various factors such as weather conditions, fumigation, cargo characteristic and stowage status etc. Therefore, in order to show ventilation has been managed in a prudent manner, it's essential to record all decisions and actions taken with regards to cargo ventilation during the voyage in remarks/comments column, especially reasons for stopping ventilation.

Other records

Cargo declaration and cargo quality certificate, log of weather conditions, written instructions on ventilation from the shipper/ charterer or the fumigator, records of sweat and evidence on relevant parties notified in a timely manner.

Hold No. — CARGO TEMPERSTURE & VENTILATION LOG

Name of Vessel		Cargo		Cargo Loaded at Average Temperature (°C)										Ventilation Rules		Remarks & Comments														
Name of Master		Total Quantity (MT)		Sea Temp °C		FOT Temp °C		Hold Temp (°C)		Ambient Temp (°C)		Bilge		Cargo Ventilation Times																
Name of Chief Officer		Cargo Loaded at Average Temperature (°C)		Port		Starboard		Start		Stop																				
15/ APR	Time (Lt)	Dry	Wet	Dew Point	Dry	Wet	Dew Point	FOT Temp °C	Sea Temp °C	Port	Starboard	Start	Stop	Ventilation Rules	Rule 1: Ventilate when Ambient “Dew Point” • Rule 2: Ventilate when Dry Ambient Temp is at least 3°C cooler than the average cargo temperature at the time of loading. • Rule 3: Shippers & Fumigators’ Instructions are of priority to be followed.															
																0400	30					35	28						Ventilation stopped during fumigation as per charterers/ fumigator’s instruction.	
																	0800	27					35	26	0	0	0800			Fumigation finished and start ventilation as per charterers/ fumigator’s instruction to remove fumigant after ending fumigation. Cargo in normal condition.
																	1200	23					35	22				1200		Stop ventilation as per Rule 2.
																	1600	21					35	22	0	0	1600			Start ventilation as per Rule 2.
																	2000	21					35	20				2000		Stop ventilation due to rain or seas may ingress into cargo hold via ventilation system.
2400	20					35	20						Stop ventilation during nighttime as high probability of rain or shipping seas in this area as per weather forecast.																	
16/ APR	Time (Lt)	Dry	Wet	Dew Point	Dry	Wet	Dew Point	FOT Temp °C	Sea Temp °C	Port	Starboard	Start	Stop	Ventilation Rules	Rule 1: Ventilate when Ambient “Dew Point” • Rule 2: Ventilate when Dry Ambient Temp is at least 3°C cooler than the average cargo temperature at the time of loading. • Rule 3: Shippers & Fumigators’ Instructions are of priority to be followed.															
																0400	20					35	20			0600			Start ventilation as per Rule 2.	
																	0800	20					35	20	0	0				Stop ventilation due to not safe for crew going to deck during rough weather.
																	1200													
																	1600													
																	2000													
2400																														

An Example of the Ventilation Log



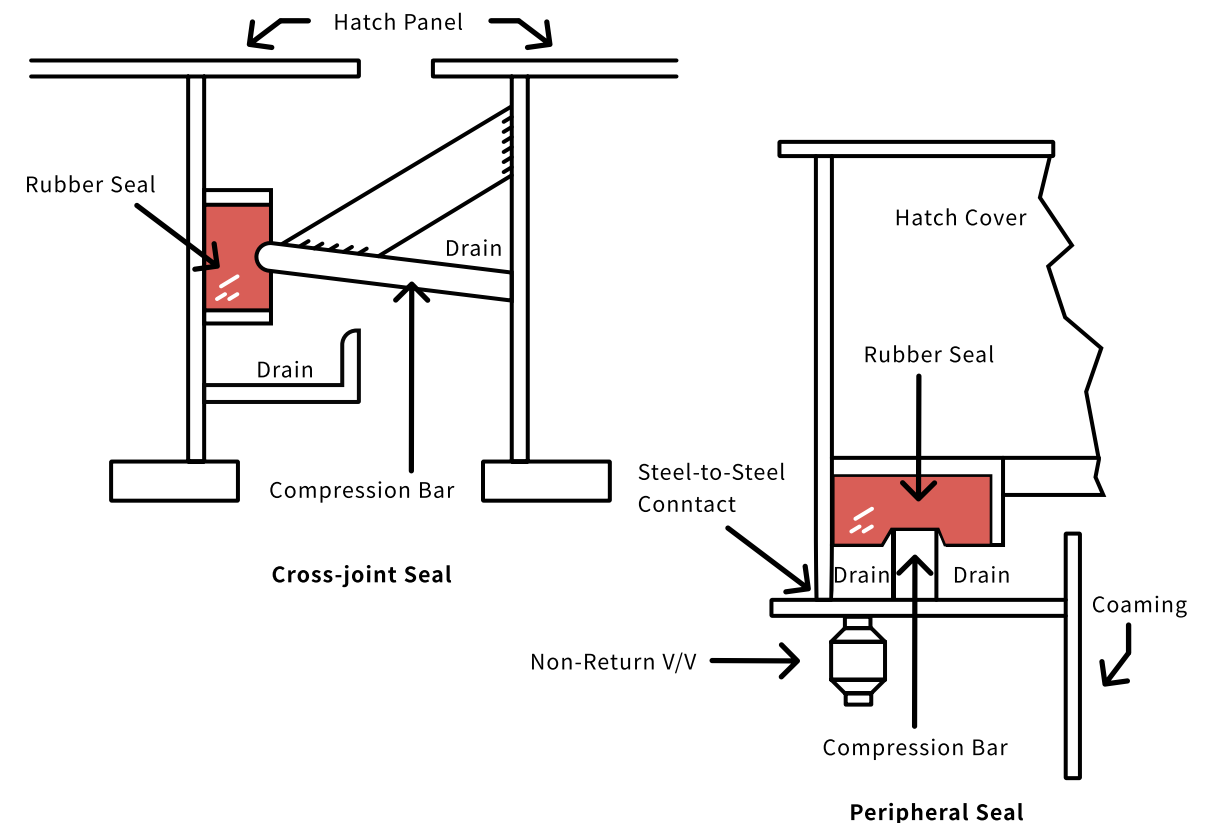
2 Wet Damage by Water Ingress

Apart from sweat and moisture, water ingress into cargo holds is another major cause of wet damage and a problem leading to substantial cargo claims. It happens mostly when the vessel is not maintained in proper condition or not properly operated. This chapter will focus on reasons for water ingress (as listed below) and preventive measures for wet damage in such cases.

- ◆ leaking hatch covers
- ◆ ventilation openings or access to cargo holds not secured
- ◆ bilge back-flow
- ◆ leaking manhole covers
- ◆ leaking air or sounding pipes
- ◆ damaged ballast tank or fuel tank
- ◆ heavy weather ballast tank valves and lines not secured
- ◆ damaged hull
- ◆ ballast water overflow to wet cargo on shore or on barge

01 Leaking Hatch Covers

Hatch covers and coamings in closed position are designed to prevent water ingress into cargo holds and protect the goods from being damped and damaged. Regardless of the various types of hatch covers fitted on ships (folding type, sliding type, lifting type, rolling type, drum stowing rolltite type), their watertightness relies heavily on the close contact between the rubber gasket and compression bar. Therefore, a leaking hatch cover can be the result of structure damages, or defective sealing systems such as distortion and missing of the gasket or lack of compression, which are mainly because of the abrasion or displacement of bearing pads and locators. Other hatch cover fittings and parts like compression bars, quick acting cleats, drainage channels, nonreturn drainage valves, if not properly maintained, might also affect watertight integrity.



Hatch Cover Sealing Arrangements

Reasons for Leaking Hatch Covers

- significant corrosion weakens strength of hatch covers and impairs the steel-to-steel contact, or rust holes on hatch covers can cause the leakage;
- gasket permanently distorted, cracked or missing is one of the primary reasons;



Gasket Permanently Distorted



Gasket Cracked



Gasket Partially Missing



Gasket and Compression Bar Distorted

- the compression of the gasket depends on the height of landing pads – zero contact between the rubber packing and the compression bar if too high, and if reduced in height because of corrosion or wear, the packing will be permanently distorted with the weight of the hatch covers completely on it;



Worn Landing Pads



Hatch Cover in Direct Contact with Coaming



Weight of Hatch Covers All on the Gasket



Inappropriate Repair of Landing Pads (Source: UKP&I)

🔧 worn wedges and locators affect compression of cross joint seal of hatch covers;



Worn Locators



Locators Well Maintained

🔧 water will spill into the cargo hold if the drainage channel is damaged or the drain valve is blocked;



Drainage Channel Damaged



Drainage Opening Blocked

🔧 corrosion, distortion, cracking and missing of cleats will affect hatch cover watertightness;



Cleat Removed



Cleat Badly Corroded



Cleat in Good Condition



Cleat in Good Condition

- ☞ water can enter the cargo hold through ventilators or access hatches which are not fully closed.



Rubber Seal on Hold Access Door
in Poor Condition

Preventive Measures

- ☞ Hatch covers and their fittings should be inspected and maintained in good condition in accordance with the PMS.
 - ✎ Maintain corrosion in an acceptable level and ensure there are no structural distortion, or cracks or holes. Immediate repairs and maintenance should be performed by the crew or shore professionals if there are any.
 - ✎ Rubber packing that is missing, damaged or aged should be renewed immediately. The minimum length of replaced packing should be one metre. Adjust the landing pad to its original design height before

replacing permanently distorted rubber packing, or it may distort again under great pressure. The design compression is normally 30% of the packing's thickness and rubber packing that is permanently impressed to 75% of its design compression should be completely replaced.

- ✎ Effective sealing also depends on the condition of compression bars. Those are distorted, damaged or corroded should be repaired or replaced. A chalk test may be carried out to check alignment.

- ✎ The height of landing pads should be checked on a regular basis and adjusted in accordance with the manufacturer's requirement. The pads, fitted to the top of the coaming and to the side of the hatch panel, is critical to the amount of rubber packing compression and the sealing of hatch covers. The gap between the coaming and the bottom plate of hatch panels should be around 10-15mm and any deviation is an indication of wear or distortion. Excessive gap (especially at lower ambient temperature) also indicates reduced height of landing pads.
- ✎ Examine the wedge-shaped locators regularly for wear and repair immediately if they are worn in case the hatch covers cannot be in the right place. Some locators are equipped with replaceable gasket for easy installation.
- ✎ Drainage channels function as the second line of defense for hatch cover watertightness. They might be damaged due to corrosion or collision during cargo operation. The integrity of drainage channels should be checked regularly, especially on ships with sealing arrangement using sliding rubbers and flat compression bars.
- ✎ Keep cleat and rubber packing in serviceable condition and correctly adjusted.

- ☞ Leak detection tests should be carried out regularly with proper record-keeping. Ultrasonic testing is preferred by P&I clubs because of its effectiveness and accuracy, compared with light testing, chalk testing and hose testing.

Light Testing: a simple method to determine potential position of leakage

by having man in a closed hold looking for light infiltration, though it may be affected by illuminance and the position of leakage.



Light Test
(Source: www.bulkcarrierguide.com)

Chalk Testing: where a chalk test is performed, the top edge of every compression bar is covered with chalk and then hatches are fully closed and reopened. The chalk mark on the rubber packing should run continuously and gaps will indicate lack of compression and need for further tests. The result merely indicates if hatch panels are aligned and compression achieved. It will not show whether compression is adequate and therefore it is not a test for weathertightness.



Chalk Test

Hose Test: the general procedure for hose test is to apply a powerful jet of water from a hose fitted with a 12mm diameter nozzle held at a distance of no more

than 1.5 metres from a hatch joint at a water pressure of not less than 200Kn/m², and have people check for leakage in the hold. Water hose test is a recognised method to determine weathertightness of hatch covers if performed correctly in accordance with the guidelines of the IACS. Limitations of hose test include: the hold needs to be empty; it cannot be performed in sub-zero conditions; care should be taken in complying with anti-pollution regulations.



Water Hose Test

Ultrasonic Test: as a viable alternative to the hose test without most of its drawbacks, ultrasonic test accurately locates potential points of leakage on hatch covers and manhole covers as well as the level of severity. However, the test cannot detect an excessive amount of compression or the penetration of the rubber packing by the compression bar, and therefore a visual check will be recommended after the test.



Ultrasonic Test

- 🔑 A detailed record of maintenance, inspection and test, carried out either by the crew or any third party, should be kept.
- 🔑 The crew should ensure, prior to departure of a laden voyage, that:
 - ✖ all hatch covers are weathertight;
 - ✖ all drainage channels and non-return valves are free of obstructions;
 - ✖ hatch covers including ventilators and access doors are closed and secured.

02 Bilge Back-Flow

Cargo bilge system is designed to remove fluid that have leaked or condensed into cargo holds or that have generated from cargo or tank cleaning. The system is often connected to bilge pump/GS pump/ballast pump and ejector pump and also to the system for ballast and firefighting, meaning that water may transfer from one space to another. To prevent possible leakage, a number of check valves and non-return valves are included in the system. However, incidents where cargo is wetted by bilge back-flow frequently happen, and some of the reasons are as follows.

- 🔑 Non-return valves are fitted on each bilge suction to prevent accidental flooding of seawater. They might not be effective if clogged by cargo residue, rust scale or rags. Aged or poorly maintained valves may not be fully closed.
- 🔑 Seawater is used to drive the eductor to discharge bilge water and opening the valve before vacuum is created could be expected to cause rapid back flooding of seawater through the bilge line.
- 🔑 Seawater may also flow back into cargo holds while operating ballast or firefighting system if any valve on the bilge line is unclosed or clogged, or if the sealing pack is worn.

Non-Return Valve Clogged
(Source: WOE)



Bilge Valve Clogged



Preventive Measures

- 🔑 The crew should be familiar with the bilge system, especially with the isolating valves and connections between the bilge system and other systems.
- 🔑 Inspection, maintenance and testing of non-return valves on the bilge lines should be included in the PMS. Check the non-return valves at regular intervals to ensure they are operating correctly and free of cargo residues/debris. Verify at the routine ballast tank inspection that if there is any significant corrosion of bilge pipes to prevent ballast water leakage into the bilge system.
- 🔑 Carefully and properly operate the bilge system to ensure not to open any valve on the bilge suction before vacuum is created.
- 🔑 Isolating valves should be closed immediately after discharge of bilge and a reminder posted next to the valves will be helpful.
- 🔑 To prevent cargo or debris in the bilge system affecting the non-return valve function, strum box of the bilge suction should be maintained in good condition. Also, remove all the cargo residue and debris in the bilge well after hold cleaning in a timely manner.
- 🔑 For carriage of cargo that is vulnerable to moisture but does not emit moisture, it is recommended to blank off the bilge lines from other systems.
- 🔑 Any debris in the sounding pipe should be removed in time so that a proper sounding can be taken. In case a cargo hold water ingress detection alarm is installed, regular tests should be carried out to ensure it is fully operational if water accumulates in the bilge well.

Inside a Bilge Well



03 Leaking Ballast Water

When the ship is in ballast condition, it is obvious to notice the leakage in cargo hold. Crewmembers may be off guard once they find no sign of leakage prior to loading. However, air and sounding pipes and bulkheads of cargo holds tend to be damaged during cargo operation without being detected, with ballast water pumped in to adjust the ship's draft, stability and stress while cargo is being unloaded, the remaining cargo may be wetted once the level of the ballast water is above the damaged area. In another case, air and sounding pipes and bulkheads of cargo holds, if significantly corroded, may break under pressure of the ballast and then cause a leakage.

Reasons for the leakage and where it can be:

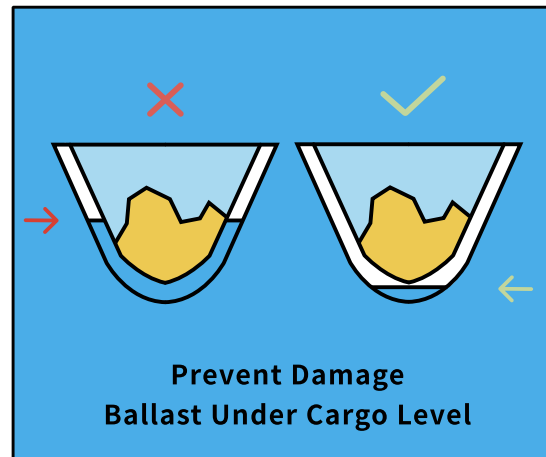
- 🔑 manhole cover not fully closed or damaged
- 🔑 ballast tank bulkhead cracked or damaged
- 🔑 sounding or air pipes damaged

Right Picture (from top to bottom)
Leaking Manhole Cover
Leaking Tanktop
Bunker Leaked into Cargo Hold Through Damaged Sounding Pipe
Sounding Pipe Leakage



Preventive Measures

- bulkheads, manhole covers, air and sounding pipes should be inspected in accordance with the PMS;
- pressure tests should be performed periodically or before commencement of loading;
- where a manhole cover has been opened, it should be examined by the chief officer for its condition and watertightness after restored;
- a good practice should be established – avoid ballast over the tanktop or the bottom of the cargo where there are cargoes in hold, and ballast again until the cargo is completely unloaded;
- Watertightness of the heavy weather ballast tank should also be checked after deballasting.



04 Other Leakage Problems

Cargo wetting may also result from hull damage, unsecured ballast system of the heavy weather ballast tank, or overflow ballast tanks. The following measures are recommended in preventing wet damage:

- ballast water overflow should be avoided at berth to prevent the cargoes on dock or on barge from wet damage.

- watch for fenders at the dock while berthing and be careful with potential hull damage if the fenders are in poor condition;
- crew should check the bilge at intervals for potential water ingress as hull damages may be less likely to be spotted with submerge of the ship and cargo loading;
- avoid hull damage from collision with the dock due to excessive speed or angle at berthing/unberthing;
- make sure the plates and valves are closed and secured after deballasting the heavy weather ballast tank;



Hull Plate Damaged



Cargo Damage by Heat

3

Cargoes that are most easily damaged by heat are heat-sensitive bulk or bagged grain products such as soya bean, soya bean meal, wheat, maize, and seed cake. They may be damaged by either external factors like heated fuel tanks or internal factors like self-heating.



01

Damage by Heat from Fuel Tanks or Engine Room

Vessels these days use high viscosity heavy fuel oil, which needs to be heated to be pumped from deep tanks to the settling tank. With the temperature rising, the tank plating conducts heat to the adjacent cargo, possibly causing the cargo to be discoloured, or scorched, or caked. The extent of damage depends on the temperature of the fuel, the length of time that the cargo has been exposed and the properties of the cargo concerned. In the case of seed cake, soya bean meal or other products that are liable to self-heat, any hot surface, even an uninsulated

engine room bulkhead, may promote self-heating and ultimately result in heat damage.

Although the heated fuel oil may only affect cargo within one metre, the damaged cargo is likely to be mingled with sound cargo during discharge, and as a result, the claims are usually in larger amount than the actual damage. Moreover, some ports may prohibit the discharge of damaged or rejected cargo, requiring the vessel to proceed elsewhere to dispose of the damaged product thereby incurring additional costs and delays.

Preventive Measures

Most of the serious heat damage occurs due to excessive heating of fuel oil. It also happens when the steam valves are leakage, and temperature of the fuel tank is not monitored. The following points should be considered to prevent such damages:

- ☀ establish a suitable stowage plan and a fuel oil management strategy to minimise the risk of heat damage;
- ☀ avoid using or heating the fuel tank that borders the cargo holds, and if it's necessary to do so, the oil should be heated to the minimum extent necessary to allow safe transfer;
- ☀ should the cargo deteriorate on passage due to inherent vice, cargo interests may allege that the damage was caused by excessively heated fuel tanks, and therefore, detailed records of the oil temperature should be maintained throughout the voyage;
- ☀ avoid pumping hot fuel oil to a tank which borders the cargo holds and watch out for unnecessary heating of fuel oil by accidental leakage of steam;

- ☀ the engine room bulkheads without A60 insulation should also be monitored for temperature changes in case cargo in the holds be damaged by heat;
- ☀ fuel oil heating arrangement, including temperature sensors in the tanks, should be included in the ship's PMS and undergo regular checks and tests;
- ☀ the IMSBC Code schedule for the cargo should be consulted for any particular requirements regarding stowage in way of heated fuel tanks and uninsulated engine room bulkheads.



The Temperature of Cargoes Close to Fuel Tank

02

Cargo Self-heating Due to Biochemical Instability or Excessive Content of Moisture



Grain cargoes, though biologically alive, are dormant and those with high moisture content may revive in warm condition. Their respiration process will result in further release of moisture and heat and also escalating temperature within the cargo stow. The environment in turn promotes respiration and growth of mould, yeast and germ, which can result in heat damage or deterioration of cargo.

The intensity of respiration is related to the moisture content of the grain cargo, the temperature and oxygen content at the place where the cargo is stowed, as well as the condition of the commodity itself, among which moisture content is a determining

factor, for grains with higher moisture content respire considerably faster at certain temperatures. This is why a moisture limit (normally 10-16%, and 13-14% in the case of soya bean) is set for the safe storage and transportation of each kind of grain cargo. The risk of heat damage or deterioration increases significantly if average moisture content exceeds the limit. In addition, allowable storage time can be determined for different grain cargoes depending on the moisture content and temperature. The same risk persists if the cargo shipped is stored on board for a period longer than allowable storage time and there have been claims where the cargo goes mouldy after staying at the discharge port for a prolonged period.

Preventive Measures

The risk of heat damage due to excessive moisture content of the cargo can hardly be controlled by the carrier, and to protect their interests, the following measures are recommended:

- ☀ Before loading, acquire from the shipper/charterer a cargo declaration and a quality certificate, which should provide at least the moisture content of the cargo, and requirements for ventilation, to ensure that the moisture content of the cargo does not exceed the relevant national standards and/or the contract.
- ☀ When presented for loading, the cargo should be carefully inspected and any products found to be mouldy or contaminated should be rejected. Members should notify the Association and consider appointing an experienced surveyor if they have any doubt about whether the cargo is transportable.
- ☀ The condition of the cargo should be monitored and photographed during loading. Meanwhile, the temperature of

cargo should also be monitored, and stop loading immediately if the temperature readings suggest occurrence of cargo self-heating. Comprehensive records are also importance evidence for the crew's due diligence in cargo care during loading.

- ☀ Keep monitoring the condition and temperature of cargo during the voyage (except during fumigation) and report immediately if there are any signs for cargo self-heating.
- ☀ Ensure proper ventilation and proper record keeping during the voyage to defend any potential allegations of poor ventilation.
- ☀ Keep on monitoring the condition of cargo at the discharge port, especially when the cargo has been on board for a period longer than its storage life.
- ☀ Where receivers alleging heat damages or masters suspecting such incidents, the Association should be notified immediately, and surveys will be arranged subsequently for handling of further claims.



03

Heat Damage in Soya Bean Cargoes

With increasing demand for soya beans in China, damage claims arising at domestic ports of discharge have been on the rise in terms of number and value. Cargoes loaded in South America, particularly Brazil and Argentina, have costed cargo insurers in China tens of millions annually in the past few years. The problem is related to elevated

Reasons for Self-Heating of Soya Beans

Soya beans are rich in proteins and fat and every bean is covered in dormant mould spores that can begin to grow and subsequently deteriorate a cargo under certain environment conditions. Requirements of moisture content and temperature for safe storage and carriage of soya beans are hence very different. At sufficiently elevated moisture content and temperature, the cargo is microbiologically unstable and prone to mould growth. As respiration accelerates, heat and moisture accumulated in the holds may cause the cargo to increase in temperature and ultimately to deteriorate. Also, excessive heat may produce blackened “bin-burned” beans due to its low thermal stability.

At a temperature of about 25°C, soya beans with a moisture content below 13% are generally regarded as safe for carriage (see table 1 for “Approximate” Allowable Storage Time), but the risk of deterioration increases at moisture contents above this limit. Because of the heterogeneity of soya bean cargoes, moisture content values reported on cargo quality certificates at load ports are usually an average for the entire shipment, which means that portions of a cargo are loaded above the stated contractual value. Furthermore, the contractual limits for moisture content of South American soya beans (e.g. 14% for Brazil and 13.5% for Argentina) are often above the recommended value for safe storage. In other words, many cargoes may be loaded

moisture content of the cargo and prolonged time of carriage on board, which can hardly be controlled by the carriers. In the event of any heat damage claims based on the Bill of Lading or the crew’s obligation for cargo care, carriers are often held liable if not supported by sufficient evidence.

within contract specifications but still be microbiologically unstable, with therefore a significant risk of self-heating during an about 6-week voyage to China.

In addition to elevated moisture content and cargo temperatures, other factors including age, storage history, presence of foreign matter and pre-shipment conditions can affect the propensity of soya beans to self-heat. Therefore, the rate of cargo spoilage can be accelerated by these additional factors, even when the cargo is loaded at a relatively low moisture content and cargo temperature. Prolonged storage periods prior to loading can drastically reduce the safe storage life of a cargo, allowing moulds/fungi to grow, albeit slowly during the storage period and then to accelerate their growth and proliferation when on board a vessel. Sales contracts often set forth detailed agreements on the quality of a cargo, and in some cases, a certain level of heat damage, crushing, discolouration and the presence of bean stalks or bean pods can be acceptable. However, these damaged portions of a cargo, emitting heat more intensely in faster respiration than sound cargoes, will further promote the growth of mould. The very existence of foreign matters will then prevent air flow during storage and transportation of soya beans and create room for the organisms to generate mould.

Table 1 "Approximate" Allowable Storage Time

Moisture Content (%)	Grain Temperature (°F) /(°C)				
	40/4.4	50/1.0	60/15.6	70/21.1	80/26.7
	Approximate Allowable Storage Time (Days)				
11	*	*	*	200	140
12	*	*	240	125	70
13	*	230	120	70	40
14	280	130	75	45	20
15	200	90	50	30	15
16	140	70	35	20	10
17	90	50	25	14	7

*Allowable storage time exceeds 300 days.

Allowable storage time is the storage period before quality loss is expected to affect grain quality.

Airflow through the grain permits maintaining the grain temperature but does not extend the allowable storage time beyond that listed in the table.

Allowable storage time is cumulative. If 16% moisture soy beans were stored for 35 days at 50°F, one-half of the storage life has been used. If the soy beans are cooled to 40 degrees, the allowable storage time at 40 degrees is only 70 days.

Source: North Dakota State University

Preventive Measures

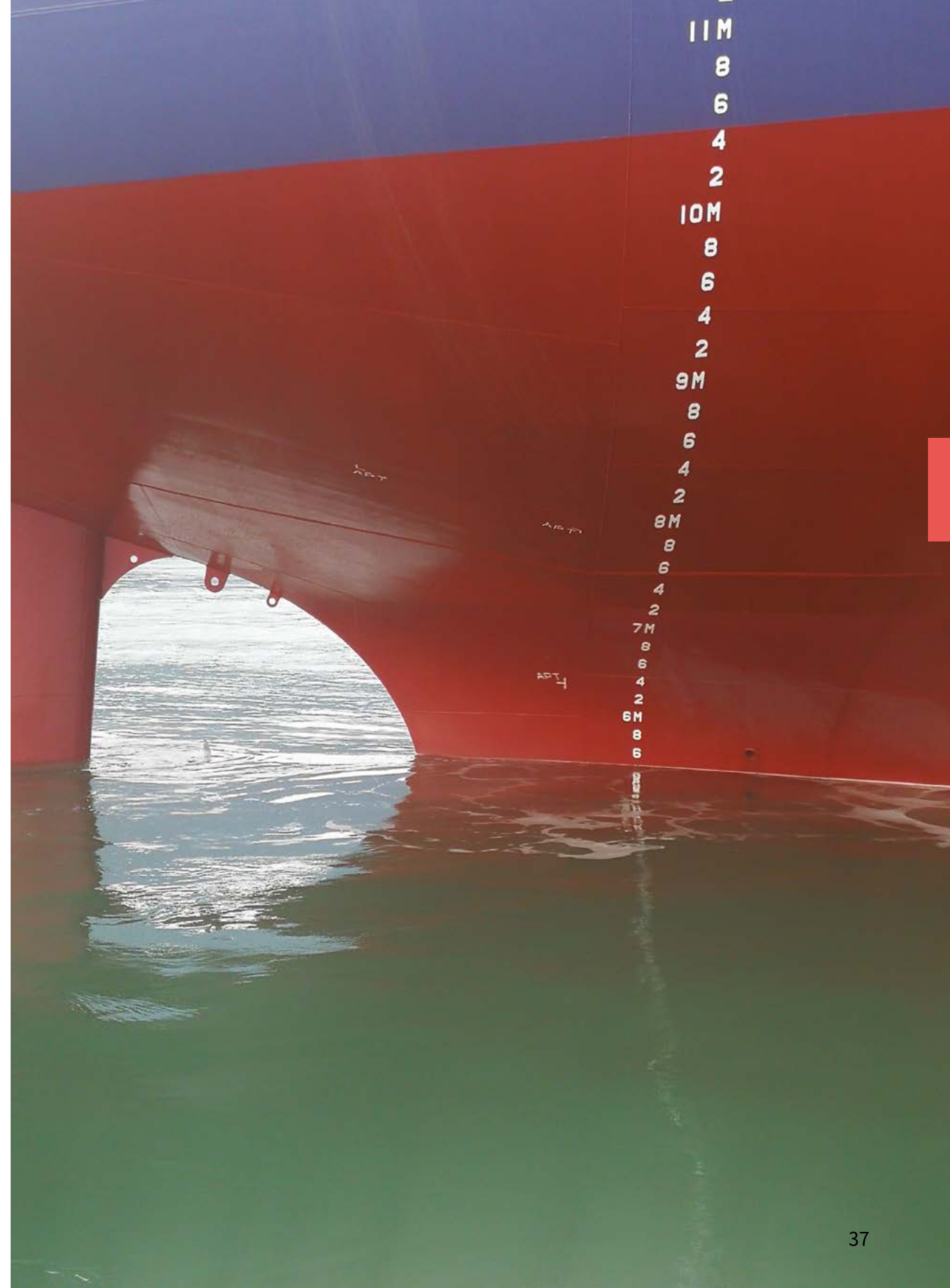
- During loading, the master should ensure that the cargo reflects the description in the Bill of Lading and is only responsible for the readily apparent condition of a cargo, such as abnormal presence of blackened beans, mouldy beans and foreign matter. Soya beans at either 12% or 15% moisture content appear visually the same and only a laboratory test can determine the exact moisture content. Therefore, with the exception of obviously wet parcels of cargo, the control of the moisture content is not a master's duty during loading.
- It is often difficult for the crew to maintain a continuous visual check during loading due to the presence of excessive dust, or excessive speed of loading or unavailability of representative samples, and it is therefore recommended to take videos or photographic evidence.
- Owners should not get involved in matters related to the quality of a cargo. If owners take samples during loading and find that the loaded cargo is within contractual specifications, it will be difficult for owners to defend their position if the cargo self-heats during the voyage. As explained above, even cargoes loaded at relatively low moisture content and temperature can self-heat during a sea voyage because of other factors such as age and storage history. Therefore, the general advice is not to routinely take samples of a cargo during loading.
- Ensure prior to loading that the holds are clean, and the hatch covers are weathertight.
- During loading, the crew should monitor the apparent condition of the cargo and cargo temperatures can be taken in several locations during temporary interruptions and at the completion of loading. The vessel should refuse to load once indication of excessive temperature or visibly wet beans are found during the process.
- Monitor the weather during loading and close hatch covers if rain is imminent.
- Although the ventilating air does not penetrate the cargo but only affects the top surface, and ventilation does not prevent ship's sweat in cases of a considerably strong self-heating cargo, ventilation should be carried out day and night, whenever permitted by the weather, and in accordance with rules introduced in Chapter 1 of this guide to show that the cargo is managed in a prudent manner.
- At the discharge port, where berthing or cargo operations cannot be carried out, have the crew closely monitor cargo conditions in the holds with written records maintained. The Association should be informed right away if there is any sign for heat damages or any reason to suspect such a situation.

4

Cargo Shortage

A carrier can face many claims arising from the short delivery of cargo. However, apart from “natural losses” occurred in transit due to condensation or evaporation, the cargo shortage in most cases is merely a paper shortage arising from different methods of measurement adopted at load/discharge port or inaccuracies in measurements. Common causes of a loss of cargo include:

- ◆ measurement errors in draft surveys;
- ◆ different methods of measurement for the shore figure and the draft survey figure;
- ◆ “natural loss” of the cargo due to evaporation of moisture content or migration of free water;
- ◆ spillage of the cargo during loading/discharging or theft.



01 The Draft Survey Figure

It is generally accepted that performing a draft survey is not an exact science. Much depends on the weather conditions at the time, the swell, the accuracy of the draft marks and the care which is taken in carrying out the required calculations. Nevertheless, the accuracy of a draft survey which has been properly performed is generally regarded as being up to more or less 0.5 percent of the final figure for dry bulk cargoes. Therefore, barring exceptional circumstances, such as a high swell during the survey, if the difference between the shore figure and the draft survey figure is greater than 0.5 percent, it may well represent a physical gain or loss, rather than being simply a "paper" difference.

Influencing Factors

Draft surveys as the only method to determine the amount of cargo on ships must be conducted meticulously. The principal sources of errors which may affect the survey results include:

- ✎ Draft marks reading: accuracy of draft mark readings can be affected by the presence of wind waves/swells, lighting, readability of draft marks, position and angle of view and others. An error of one centimetre in the draft could lead to an error in the cargo weight of dozens or even hundreds of tons.
- ✎ Seawater density: errors in density can be caused if the draft survey hydrometer is not calibrated or if the dock water sample is not representative. An error of 0.001 in density could lead to an error in the cargo weight of dozens or even hundreds of tons.
- ✎ Ballast and fuel oil soundings: a number of errors can occur in obtaining accurate soundings: the tank appearing to be falsely full under large trim, incorrect ballast water density, clogged sounding pipe and inappropriate methods of taking sounding. A tiny error in each compartment may add up to a huge one in final results.



Reading the Draft Mark
(Source: cfnet)



Testing the Seawater Density



Sounding the Tank

Considerations for an Accurate Draft Survey

- ✎ Keep the draft marks in a readable condition.
- ✎ In conditions where observation of the draft is affected by waves and swell, a remark regarding such a condition should be included in the draft survey report and a dedicated measuring device is recommended to improve accuracy in turbulence.
- ✎ Keep the vessel in an upright condition when taking measurements: no movement of ballast, hatches or cranes until it's done.
- ✎ The draft marks should be viewed from a horizontal angle and try observation at several angles to accurately determine the value if this has to be done from a wharf at a higher level.
- ✎ Choose the appropriate hydrometer: there are two types of hydrometers in use, the load line hydrometer and the draft survey hydrometer – both used to measure density but in different ways.
- ✎ Have the hydrometer calibrated in accordance with the manufacturer's requirement. The specific gravity of pure fresh water at 4°C is 1.000. This provides a standard for reference when examining the hydrometer used on ships or by surveyors.
- ✎ Take offside water samples at a depth of approximately half the existing amidship draft of the vessel, while the discharges should be avoided.
- ✎ Avoid overflow and/or false full when sounding the ballast tank.
- ✎ Each tank should be sampled for density as when and where the water was pumped in are different.
- ✎ If ships are to carry out joint draft surveys, for example with Chinese Customs, the crew shall cooperate with the officials to obtain an accurate result and arrange a third-party surveyor for assistance if it's necessary.



The Device Used to Improve Accuracy of Draft Measurement
(Source: alexpluss.com)

02

The Shore Scales Figure

It is a known fact that in countries like Argentina and Brazil that shippers and/or the Customs authorities would insist on the use of shore scales as the means of determining cargo quantity, pursuant to either the sales contract or local requirements. Unlike draft surveys which are carried out following a containable procedure, shore scale measurement is beyond the control of owners and the ship's crew. Problem then arises when shore figures are used to ascertain outturn quantities of cargoes.

Where the shore figure is used as the figure specified in the Bill of Lading and the number is greater than the draft survey figure, carriers are generally caught in a dilemma: either to accept the shore figure and face a shortage claim, or to deny the figure and face a detention of her ship by the Custom authority. What precautionary measures, then, should be taken by owners?

✍ Refusal to sign?

Under Article III Rule 3 of the Hague-Visby Rules, "...no carrier, master or agent of the carrier shall be bound to state or show in the bill of lading any marks, number, quantity, or weight which he has reasonable ground for suspecting not accurately to represent the goods actually received, or which he has had no reasonable means of checking." However, owners will have to resolve the dispute in court, which can cause considerable loss of time. An added difficulty with going to court is the legal uncertainty with regards to the local court's

outcomes. Furthermore, the receivers are likely to claim for the delay in cargo delivery. It is then difficult for owners to make the call under such great commercial pressure. There are no clear-cut guidelines to determine when, or if, a master can reasonably refuse to issue a Bill of Lading if he considers the quantity of cargo shown to be inaccurate. Therefore, as soon as a master is aware of a problem in this respect, it is vital that he contacts the Association or the Association's local correspondent for advice and guidance.

✍ Is it possible for carriers/owners to insert both ship and shore figures in the Bill of Lading?

Shippers will basically reject such bills of lading as to such bills of lading will be a problem for the letter of credit transaction or they are not acceptable to the buyers.

✍ Is it possible for carriers/owners to only insert the ship's figure into the bills of lading?

The best way to guarantee accuracy of the bill of lading figure is to insert only the ship's figure. However, this approach may lead to a dispute at the load port with the shippers, who are likely to appeal to the court to insert the shore figure. The ship's schedule will undoubtedly be delayed and who is then responsible for the delay? Where the owners have insisted on a ship's figure that is accurate, they may be able to claim the loss of time against the charterers, but if they have insisted on a wrong number, the risk of delay and off-hire is completely on owners. It is therefore important for the Master to take accurate measurements and, ideally, to cross check the same with an independent surveyor to be appointed by the owners as opposed to any other party in order to ensure the objectivity of his figures.

✍ "Weight, measure, quantity, quality, condition, contents and value unknown"



Shore Scale Measurement
(Source: Scalar Technology)

included in the Bill of Lading?

A master can in his authority include such an expression in the Bill of Lading if he has no reasonable means to check the cargo quantity or condition. The disclaimer, recognised in English law (not in many other jurisdictions), will mean that the bill of lading is not prima facie evidence of the quantity stated to have been shipped, nor the guarantee made by carriers on the quantity to be shipped. However, such a clause will not help when the figure inserted in a bill of lading is obviously wrong, even in English courts.

✍ Can a master/owner request a letter of indemnity (LOI)?

Generally, where there are disputes over the quantity of cargo to be loaded, charterers may offer a LOI holding the shipowner harmless if they agree not to state the actual figure in the Bill of Lading/Mate's receipt. The Hague-Visby Rules provides that "the shipper shall be deemed to have guaranteed to the carrier the accuracy at the time of shipment of the marks, number,

quantity and weight, and the shipper shall indemnify the carrier against all loss, damages and expenses arising or resulting from inaccuracies in such particulars". However, such LOI may be unenforceable if a fraud is intended or if the owner/master knows that the number inserted is clearly not true. Members should be aware that accepting such LOI may be risky unless the charterer is deemed reliable and financially capable of executing the LOI.

✍ Can a master accept the shore figure by issuing a letter of protest (LOP)?

It is a common practice for masters to use LOP as a compromise when there are discrepancies between ship and shore figures to protect owners' interests. Although there's no industry standard established for all cases, a discrepancy between 0.3% and 0.5%, varying according to the cargo and applicable jurisdiction, is generally considered as an acceptable margin. If the discrepancy is within an acceptable margin, then the owners would be in a position with lower risks. If the discrepancy does not fall within the

margin, owners and masters are advised to be prudent when considering use of a LOP, which may be used as evidence for a subsequent shortage claim at the discharging port by the receiver.

Preventive Measures

- ✎ Where the shore figure is used, a draft survey should still be carried out to verify its accuracy with proper record keeping:
 - ✓ The crew should ensure to take accurate measurements and not to write up the result to avoid paper shortages, which could lead to even more problems when the load port figure contradicts with the discharge port figure.
 - ✓ Apply the correct value of a ship's constant when calculating the amount of cargo loaded. If the constant appears to be exceptional compared with the readings from the previous three to five voyages, reasons for such a condition should be identified or the condition may not be acceptable to a third party in potential disputes.
 - ✓ An accurate draft survey is particularly important in ensuring the right amount of cargo to be loaded/discharged when the ship is calling at multiple ports.
 - ✓ If necessary, appoint an independent surveyor of repute at both ends to conduct the draft surveys to get an accurate and objective result.
- ✎ If the draft survey shows that the amount of cargo loaded is less than the inserted shore figure, the ship should immediately inform relevant parties and make up the quantity declared for shipment.
- ✎ If the cargo is still short in quantity and the

discrepancy is within an acceptable margin (less than 0.5%):

- ✓ Try to get the discrepancy shown on the Mate's receipt and make it clear in the master's letter of authority that the Bill of Lading should be issued strictly in accordance with the Mate's receipt.
- ✓ The master should issue a LOP and a statement of fact that there is a difference in cargo quantity.
- ✓ Where the Bill of Lading has to be signed to prevent delays, try to include a "weight, quality, quantity, etc., unknown" clause or similar phrases as an additional guarantee.

✎ If the cargo is still short in quantity and the discrepancy is beyond an acceptable margin (more than 0.5%):

- ✓ Give notice to the charterers by issuing a LOP and demand the charterers to communicate with the shipper to conduct another joint draft survey at the loading port, or to accept the ship's figure if possible.
- ✓ Inform the Association for assistance and guidance in safeguarding owners' interests.
- ✓ If the shipper/charterer refuses to accept the ship's figure and insists on issuing the bill of lading in accordance with the shipper's requirement, the owner should consider requesting a LOI (see previous paragraphs for detailed considerations).
- ✓ Try to include the "weight, quality, quantity, etc., unknown" clause.
- ✓ Inform the Association in advance to arrange a draft survey at discharge port by an independent surveyor, ideally calling for a joint survey with the shipper/charterer. Issue a LOP and a

statement of fact in the event of a shortage claim.

- ✎ Seal the hatch cover after loading, verify and record the fact the seals are intact before the start of discharge to indicate that no loss of cargo has occurred during the voyage.
- ✎ Obtain an empty hold certificate after discharge of cargo to confirm that the carrier has delivered all the cargo loaded at the loading port.
- ✎ The master should refuse to sign any cargo document if he suspects anything and if this is not practicable, sign it with "without prejudice, receipt only".
- ✎ Keep a detailed record to assist potential defense.

03 Further Considerations

- ✎ In the event of a cargo discrepancy arising from migration of moisture, accurate records of sounding and discharging cargo hold bilges should be kept and sent to the charterer through the daily noon report.
- ✎ In the event of a cargo discrepancy arising from evaporation of water, cargo certificate in relation to the moisture content at the loading and discharging port should be obtained, along with evidence showing that proper ventilation was carried out during the entire voyage.
- ✎ If cargoes are scattered at ports or severe pilferage is spotted, photographic evidence should be kept before appealing to the port authority and reporting to interested parties.

Right Picture (from top to bottom)
 Moisture Migration
 Moisture Evaporation
 Cargo Scattered
 Cargo Pilferage





Cargo Liquefaction 5

Solid bulk cargo liquefaction, especially liquefaction of nickel ore, has been of great concern to the shipping world with its potentially catastrophic consequences. Although ship sinking incidents have been drastically reduced in recent years, liquefaction continues to present a threat to the industry. It typically happens when the IMSBC Code provisions related thereto are compromised, for reasons including:

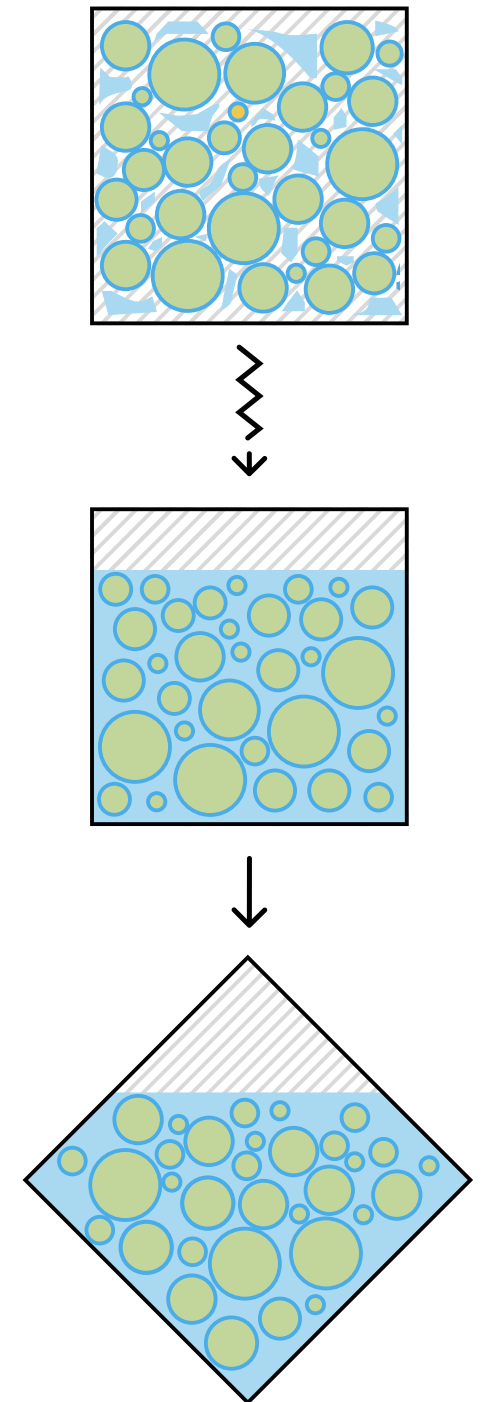
- ♦ inaccurate declarations and certificates from shippers;
- ♦ commercial pressures;
- ♦ negligence or inadequate monitoring of cargo conditions by the crew.

01 What is Liquefaction

Solid bulk cargoes which contain a degree of moisture within the particles tend to liquefy while subject to cyclic forces such as motion, slamming, rolling and pitching of the ship. The volume of spaces between the particles reduces, causing the pore water pressure to rise and the friction between the particles reduced. The cargo then develops a fluid state on the surface with loss of shear strength, undermining the ship's stability. With further rolling of the ship, the liquefied cargo tends to flow in one direction and does not completely return. The ship eventually develops an increasing list and loses its stability until capsizing.

IMSBC Regulation 1.7 – Definitions describes Group A cargoes as those “may liquefy if shipped at a moisture content in excess of their transportable moisture limit”, such as nickel ore, bauxite, mineral concentrates, and coal.

- ♦ Flow moisture point (FMP): the percentage moisture content at which a flow state develops.
- ♦ Transportable moisture limit (TML): the maximum moisture content for safe carriage of the cargo, often 90% of the FMP.
- ♦ Moisture content (MC): the percentage of water, ice, or other fluids in the wet weight of a representative sample. The MC data of a cargo which may liquefy should be obtained within seven days before loading and only when they are below the TML will the cargo be safe for stowage and shipment under the IMSBC Code.



02 Preventive Measures

Key Point

Identifying cargoes that may liquefy.

Members should be aware that any cargo with excessive amounts of moisture and fine particles are prone to liquefaction, even if not listed as Group A cargoes in the Code. For carriage of such cargoes, requirements of section 1.3 of the Code should be followed.

Basic Rule

Refuse to load when the cargo's actual MC has been in excess of the TML, unless the ship is specifically constructed or fitted in accordance with regulation 7.3.2 of the IMSBC Code with approval by the competent authority.

Before Loading

- The shipper should provide a cargo declaration in accordance with the latest requirements stipulated in section 4.2 of the IMSBC Code;
- The TML certificate should be issued within six months to the date of loading (IMSBC 4.5.1);
- The MC certificate should be issued within seven days prior to loading (IMSBC 4.5.2);
- If there has been significant rain or snow between the time of testing and loading, laboratory tests should be conducted to ensure that the MC of the cargo is still less than its TML.

During Loading

- Carry out visual monitoring and do not accept cargo with visibly high moisture content;
- Surface water in the holds or cargo splatter on bulkheads are indications of high MC;
- Where the cargo is exposed to rain on uncovered stockpiles or in open barges, stop loading until MC requirements are met and take photographic evidence;
- Conduct can tests at regular intervals as a primary method to determine the cargo's MC, stop loading and request an independent laboratory test in case of any doubt about the quality of cargo;
- The IMSBC Code suggests that even if the sample for can tests appears to be in a relatively dry state, the MC is likely to exceed its TML, and lab test results may not be reliable in some countries. Therefore, drying test by using of drying oven on board ships is recommended with proper record-keeping;
- Consider trimming the cargo upon completion of loading and make sure of hatch cover tightness.

Countering Commercial Pressures

Although a ship's master is offered an overriding authority to reject a cargo that does not comply with the IMSBC Code, it is often not the case in practice, especially for shipment of nickel ore from Southeast Asia countries like Indonesia and the Philippines.

The master's insistence on fitness of the cargo would mean extra costs and delays. Masters and owners may feel under great pressure from shippers or local port authorities. Tackling these pressures can be fundamental to the safe carriage of cargoes which may liquefy.

- Owners can ensure a contractual right provided for in the charterparty, for example by incorporating the BIMCO "Solid Bulk Cargo Which May Liquefy" clause to pinpoint the master's overriding authority over ship safety;
- Appoint a surveyor to assist with monitoring of cargo loading;
- Any document seeking confirmation that the cargo is safe to carry should not be signed by the master or his surveyor;
- Keep all records, photos and videos taken during monitoring of loading, especially photos showing cargo conditions, can test and drying test results.

During the Voyage

Evaluate weather and sea condition before sailing and make sound voyage plans.

Check the state of cargo every six hours within the first three days of the voyage, and then check the cargo twice a day as far as practicable in the event of heavy weather.

In addition, cargoes with different moisture content may sometimes appear to be dry on the surface and liquefy at the bottom and develop a wet base.

Avoid drastic motion or vibration of the ship and take measures to minimise the effect of wind if the weather gets rough.

If the cargo appears to be liquefying during the voyage, it is recommended to:

- Inform the owners and the P&I Club;
- Maneuver the ship along the coast or towards shallow waters;
- Take measures to reduce ship's vibration/motion, rolling in particular;
- Do not ballast to maintain stability if the ship has already started to list;
- Consider calling at the nearest port or place of refuge, or even beaching;
- Contact the nearest Coastal State Authority.

03 Carriage of Nickel Ore

Although there has been industry-wide recognition over the danger in carrying nickel ore, liquefaction of nickel ore still happens sporadically during sea passage. The main reason for this is that many practical circumstances prevent the Code from being strictly followed. Especially when loading nickel ore in ports of Southeast Asia

– Indonesia and the Philippines, there are still catastrophic incidents of ship listing or capsizing where nickel ore which contains excessive moisture content due to improper mining, storage and caring and loading is loaded on board out of commercial pressures. The Philippines is now the major exporter of nickel ore after Indonesia's export ban.

Concerns Regarding Loading Nickel Ore in the Philippines

- ☛ The cargo declaration and certificate provided by shippers can be inaccurate. It is said that some certificates are issued by local mines where the test on MC and FMP are not carried out following correct protocols under the IMSBC Code. The result, compared with analysis of independent surveyors, show a significant difference with errors of between 8% and 10% in MC and approximately 5% in FMP. This is a leading cause of liquefaction of the cargo.
- ☛ Local miners generally don't accept sampling taken by independent surveyors. Without shipper's facilitation, it is difficult to access stockpiles which are often in extremely remote areas. The limited number of independent local laboratories makes it even harder to get a third-party analysis.
- ☛ The cargo is often stockpiled on the shore in open cast mining and transferred to an anchorage for loading by barge. During the entire process, the cargo is seldom covered and are exposed to all weather conditions, and the MC is therefore increased notably especially during rainy seasons. Although under the IMSBC Code, check tests shall be conducted if there has been significant rain between the time of testing and loading to ensure that the MC of the cargo is still less than its TML, and the interval between sampling/testing and loading shall never be more than seven days, such procedures are seldom followed in practical terms.
- ☛ Loading at Southeast Asia ports often ends up with cargoes with excessive MC, due to the humid weather at high-rainfall equatorial regions and lack of protection to the cargo. Each mining area is typically known for a specific period of rainy season, for example November to March

of the following year for the Surigao area, and the duration of dry and rainy season is defined mostly based on historical meteorological data. However, with the effect of global climate change and occasional typhoons, rainfall at certain areas may appear to be exceptional at certain points.

- ☛ Cargoes not suitable for loading are often rejected by ships for various practical reasons, which would inevitably lead to a delay in schedule. Owners and crews may be pressured by the charterer, or even forced to load the cargo under threats or temptations from the shipper or sometimes the port authority.



Open Cast Mining (Source: SMM.CN)



Uncover Barge

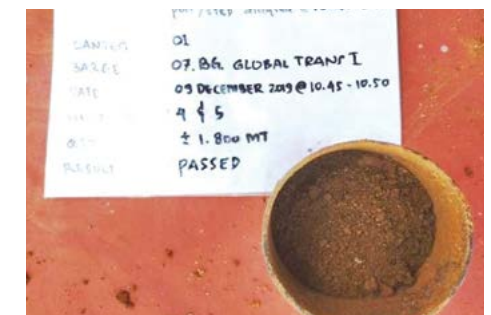
Preventive Measures

Apart from the general advice already mentioned for cargoes with a propensity to liquefy, here are some recommendations for the safe carriage of nickel ore:

- ☛ Members planning on trading in ports of Indonesia, New Caledonia or the Philippines for carriage of nickel ore should make sure to incorporate express clauses in the charterparty, COA or other forms of carriage contract to guarantee their rights. Additionally, Members can seek legal advice from the Association before the contracts are finalized.
- ☛ Members must notify the Association in time if they intend to load Group A cargoes from Indonesian or Philippine ports. The Association will then send corresponding advice to owners so that loss prevention precautions like appointing a qualified surveyor can be taken. Information to be provided by Members includes ship's name, ETA, laytime for loading, details regarding the charterer/shipper, the agent, cargo declaration and certificates.
- ☛ Since the climate and weather at loading ports have a direct influence on MC of the cargo to be shipped, it is recommended to pay continuous attention to local weather conditions and watch out for rainfalls so that strict control can be maintained over cargo humidity.
- ☛ With regard to concerns over reliability of the test certificates by local laboratories and accuracy of TML and MC data provided by the shipper, it is recommended to monitor cargo MC by carrying out can test and using hand grasping or drying method. Photos should be taken when taking such tests. If water or signs of liquefaction can be found at the end of a can test or a squeezing test, the cargo is then unsafe for carriage and

loading should be stopped immediately. The company and other interested parties should be informed so that subsequent arrangement can be made, for example seeking expert advice or appointing a surveyor to assist on board. Since sampling and testing at shore laboratories can be difficult, it would be better to equip drying/microwave ovens on ships to help determine the MC of the cargo.

Can Test: first, fill half of a cylindrical can or similar container (0.5-1L capacity) with a sample of the material. Take the can in one hand and strike it against a hard surface from a height of approximately 20cm. Repeat the action at least 25 times at one or two second intervals. Then check surface for moisture and fluid-like behaviour, and if free moisture appears, arrangements should be made to have additional laboratory tests conducted before it is accepted for loading.



A Normal Cargo



A Cargo Exceeding its TML

Hand Grasp Test: take a lump of the material and squeeze it firmly with one hand. Observe the sample between the fingers – if it is a thin strip without cracks, the cargo MC exceeds its TML and if there are cracks, the cargo MC is excessively high but not over the limit.



A Normal Cargo



A Cargo Exceeding its TML

Drying Method: take an appropriate amount of sample, have it dried at 105°C and weigh the sample successively with an interval until the mass remains constant. The length of the drying period depends upon many variables, such as the disposition of the material in the oven, the type of container used, the particle size, the rate of heat transfer, etc. Four to five hours may be sufficient in the case of nickel ore.



Drying Method

- Considering that a master may be pressured or threatened by the shipper to load a cargo before he sees any evidence showing that the cargo conforms with its loading criteria, or his right to take samples of the cargo may be denied, it is recommended that companies provide adequate support and legal assurance for the masters.
- Nickel ore cargo is often shipped to anchorages for loading by barge and the MC of each shipment can be different. In some cases, the cargo may appear to be dry on the top while those with high MC are in the bottom. When liquefaction happens in transit with the motion and vibration of the ship, a wet base is formed and top cargoes may move along with it. Crews should watch out for this when monitoring cargo conditions as this may not be noticeable.



Physical Damage

6

Physical damage is another type of cargo claims. Damaged cargoes can be broken, cracked, bent, dented, deformed, or curled up due to rough handling, or more importantly due to moving, dropping, or squashing of the cargo which resulted from bad stowage and securing. It can happen at any stage before loading, or in transit, or during discharging. Break bulk cargo especially steel cargo stands out in the cargo claim records of the Association. It is therefore important to ensure correct, sufficient and scientific stowing, lashing and securing for safe carriage of cargoes including break bulk cargo, steel, timber, heavy/project cargo, Ro/Ro cargo, and containers (on a non-cellular ship). Physical damage to cargoes on containerships is often caused by poor stowage which cannot be controlled by carriers and will be excluded from discussion in this Chapter.

01

Reasons for Physical Damage

Damaged Before Loading

A cargo can go through many steps from warehousing to transporting and handling before it is loaded on board. Some may be damaged before it is loaded, and the carrier may face damage claims from the receiver should such damages not be identified during loading.

Rough Handling

A cargo can be damaged when stevedores handle it roughly or incorrectly, and such damages are often hard to be detected by the crew during loading.

Improper Stowage and Lashing

Most physical damage claims for dry cargo are caused due to improper stowage and lashing. Poorly planned stowage and lashing can lead to cargo shifting or stress on the cargo during transit, or even impairing safe navigation.

Improper Packing

A cargo can also be damaged when it is not properly packed. Even correct stowage cannot prevent an insufficiently packed cargo from being damaged. High stows of break bulk cargo on a bulk carrier without a tween deck are particularly dangerous.



Damage Before or During Loading



Damage Due to Improper Stowage and Lashing



Damage Due to Improper Packing

02

Reasons for Improper Lashing and Stowing

The crew's lack of knowledge or over-reliance on shore personnel in lashing and stowing

Most seafarers gain their experience on cargo lashing and stowage from actual work and before the shipping containerization they have received proper training for it. However, with rapid development of the container fleets and with experienced seafarers retiring or leaving for shore jobs, seafarers today are not as good as their predecessors and heavily rely on the shore personnel to prepare stowage and lashing plan and to give professional advice when loading breakbulk cargoes. In addition, Port captains who compile stowage and lashing plan and assist loading at the terminal often represent charterers. Where charterers for their maximum interests may go against the rules, the crews often have insufficient experience and ability to monitor the operation and correct any error if they see one.

Insufficient technical requirements at certain ports

Insufficient or substandard technical requirements at some ports are also a big cause of incorrect cargo stowage and securing. Cargo lashing companies vary in size, manning and technical expertise and some cannot provide consistent quality services. Even when the crew point out anything wrong with their operation, proper actions are seldom taken.

CSM not adapted to specific conditions or not strictly followed

It is provided in Regulation 5 Stowage and securing, Chapter VI of the SOLAS Convention that a Cargo Securing Manual (CSM) is required on all types of ships engaged in the carriage of all cargoes other than solid and liquid bulk cargoes in accordance with MSC.1/Circ.1353 Revised Guidelines for the Preparation of the Cargo Securing Manual and the CSM shall be approved by the vessel's flag state administration or an authorized classification society. However, most CSMs these days are prepared in a standardized way and may not be able to provide an exhaustive information of the cargo to be loaded due to the variety in shapes, sizes, and types. Managers tend not to append the CSM for additional information and have the revised content approved, making the crews ignorant of how to handle special type of cargoes. Also, it is likely that cargoes are not loaded in accordance with the CSM when the crews are not familiar with it or when parties involved take short cuts to save cost or as an attempt to load more cargoes.

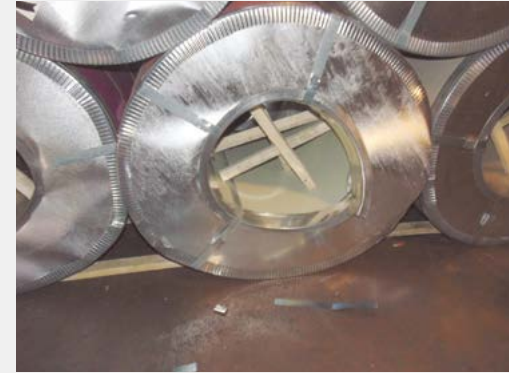
03 Examples of Bad Stowage and Poor Securing



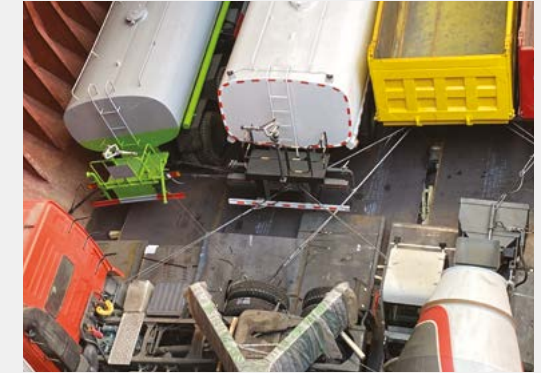
Insufficient Lashing, Inappropriate Size of Lashing Materials, and Incorrect Lashing Angles



Different Lashing Materials Used on a Single Cargo Unit



Cargoes Stacked in Excessive Tiers in Height



Cargo Units Lashed to Each Other



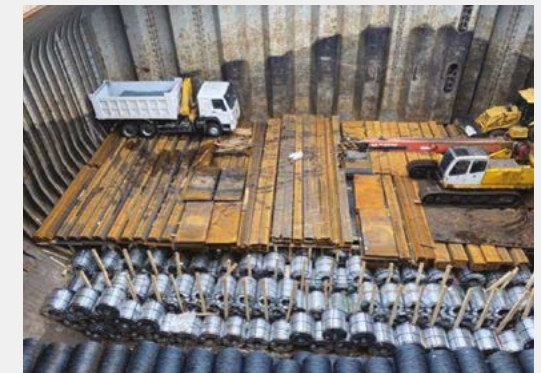
Securing Points on the Ship and/or on the Cargo are not of Adequate Strength



Multiple Lashings Attached to a Single Securing Point, Exceeding the SWL



Coiled Sheet Steel Stowed on Top of Other Cargoes



Other Cargoes Stowed on Top of Coiled Sheet Steel



Heavy Cargo Stowed on Top of Light or Fragile Cargo (Source: The America Club)



Inappropriate or Insufficient Dunnage Between the Cargoes



Dunnage for Steel Plates not Vertically Aligned



Wheel-Based Cargoes or Heavy Cargo Items Stowed on Top of Bagged Cargoes or Cargoes Without a Solid Base

04 Calculation Methods for Lashing and Securing

It is often hard for seafarers who don't have enough experience to tell whether the lashing and securing arrangement is appropriate or sufficient, especially for non-standardized cargoes. Methods (the rule-of-thumb method and the advanced calculation method) to assess the efficiency of securing arrangements for non-standardized and semi-standardized cargoes are provided in the CSS Code and the CSM. While the advanced calculation method is presented to assist qualified shore personnel, the rule-of-thumb method is more suitable for ship's staff as an evaluation when monitoring the loading operation.

Rule-of-Thumb Method

The total of the maximum securing load (MSL) values of the securing devices on each side of a cargo unit (port and starboard) should equal the weight of the unit. This method, which implies a transverse acceleration of 1g (9.81kN/s²), applies to nearly any size of ship, regardless of the location of stowage, stability and loading condition, season and area of operation. However, the method takes into account neither the adverse effects of lashing angles and non-homogeneous distribution of forces among the securing devices nor the favourable effect of friction. Transverse lashing angles to the deck should not be greater than 60° and it is important that adequate friction is provided by the use of suitable material. Additional lashings at angles of greater than 60° may be desirable to prevent tipping but are not to be counted in the number of lashings under the rule-of-thumb.

Advanced Calculation Method

Compared with rule-of-thumb method, the advanced calculation method is more accurate but uses a more complicated approach. Companies may consider providing a form or a computer software to assist the crew in calculation of lashing and securing arrangements, for example the LashCon IMO tool developed by DNV in accordance with Annex 13 of the CSS Code.

Determination of MSL From Breaking Strength

Material	MSL
Shackles, Rings, Deck Eyes, Turnbuckles of Mild Steel	50% of Breaking Strength
Fiber Ropes	33% of Breaking Strength
Wire Ropes (Single Use)	80% of Breaking Strength
Wire Ropes (Reusable)	30% of Breaking Strength
Steel Band (Single Use)	70% of Breaking Strength
Chains	50% of Breaking Strength

05 Preventive Measures

- whether or not the cargo is fragile and is not to be over-stowed;
- whether or not the cargo is suitable for carriage on deck;
- whether the cargo is a dangerous good, for which a declaration will be required in accordance with the IMDG Code.

General Recommendations

- The CSS Code provides general guidance concerning the proper stowage and securing of standardized and non-standardized cargoes, while the CSM details ship's information and guidance for carrying specific cargoes as well as cargo securing devices provided on board the ship. It is worth bearing in mind that the CSM will not cover every possible type of cargo which may be carried. If the intended cargo is not included in the CSM and there is insufficient guidance to allow its safe loading, stowage and securing, additional annex about safe stowage and securing of this cargo should be added and sought approval from Flag State or authorized Class.
- The ship's crew should be thoroughly familiar with the CSS Code and the CSM. It will be prudent to appoint an experienced inspector to assist loading if the master and the deck department know little about the breakbulk cargoes to be loaded, particularly in bulk carriers that are not designed for the carriage of such cargoes.
- Ask the shipper to provide detailed information on the intended cargo before loading to ensure effective stowage and securing, including any requirements or restrictions related thereto:
 - the precise size, gross mass and location of the center of gravity;
 - nature and strength of any packaging;
 - location of lifting and lashing points including any requirements for a specific type of lashing material;

- Develop appropriate stowage and lashing plan based on the detailed cargo information:
 - distribute cargo weight as evenly as practicable in each hold to ensure sufficient stability and strength of the ship;
 - determine stowage location and make sure there are sufficient spaces and devices for proper lashing;
 - determine the type(s) of lashing material to be used to get the MSL value, and determine the number of lashing based on the IMO rule-of-thumb method and/or the advanced calculation method;
 - determine the maximum load capacity of the hatch cover, the deck and the tank-top, and use timber or similar materials as dunnage to avoid overloading;
 - choose the suitable type of dunnage, such as timber, plywood and rubber mats, to increase friction and to protect cargo from direct contact with the ship's structure or with each other;
 - ensure the stowage and lashing of a cargo will not adversely affect another;
 - the stowage and lashing of a cargo should not prevent it from being inspected during the voyage;
 - take into account weather conditions

during voyage planning and adjust the stowage and lashing arrangements accordingly if heavy weather is expected during voyage.

- The master should prudently review the stowage and lashing arrangement if it is prepared with shore assistance and have the problems modified if there are any. Once confirmed with the master's signature, the arrangement will become the liability of the master/carrier.
- Communicate and confirm the stowage and lashing arrangement with the stevedores properly before loading.
- Make sure all lashing equipment are in good condition before loading.
- Monitor cargo conditions closely before loading. Obtain evidence in case of any cargo damage prior to loading, or demand replacement of the damaged cargo if practicable. Arranging a pre-loading survey can effectively help management of the cargo on ships with reduced manning.
- Insufficient packaging can cause physical damage of the cargo, but it is usually hard for the crew to confirm the adequacy of packaging during loading. Here are some examples:
 - ⚡ pallets are bent or broken when lifted;
 - ⚡ the cargo on the pallets is laterally greater than the surface area of the pallet platform which results in the cargo becoming torn or split on the pallet edges causing the load to be unstable;
 - ⚡ the load on the pallet is only secured with shrink-wrapped plastic sheeting, which leads to instability of the cargo;
 - ⚡ packages on pallets are not interlocked, potentially causing the cargo to slip off;
 - ⚡ wooden cases which have a strong base but with weak covers which lack rigidity

can result in the cases falling apart or the stow collapsing.

- All loading and lashing must be supervised by the ship's staff to ensure that the cargo is stowed in compliance with the approved loading and lashing plan.
- Watch for stevedore operations when they handle the cargo and take photographic evidence once any cargo damage is caused by incorrect or rough handling. A stevedore damage report form should be filled with a signature by the relevant party.
- Some appropriate adjustment can be inevitable during loading, but the requirements for stowage and lashing should always be fulfilled.
- Cargo stowage and securing should be done before departure in conformity with the requirements.
- If the master has a reason to believe that the stowage and securing arrangement has brought up concerns over ship safety and/or cargo integrity, he should call the charterer and/or his appointed surveyor and/or the supercargo to attention. If the issue concerned is not resolved, the master should inform the owner's protective surveyor on site in a timely manner. In absence of such a surveyor, the master should inform the owner and the P&I Club to arrange a surveyor as soon as possible.
- While in transit:
 - ⚡ inspect the cargo and lashing conditions regularly and make sure the cargoes are safely secured;
 - ⚡ if adverse sea and weather conditions are forecasted, take immediate actions such as increasing number of lashings, adjusting ballast, or avoiding areas of heavy weather by alteration of course or speed;

- ⚡ if the weather and sea conditions get rough without any signs, take immediate actions such as altering course or reducing speed to avoid excessive ship motion;
- ⚡ take actions to alter the course or speed to reduce ship motion once cargo has shifted. Restow or resecure the cargo if possible and if not, consider diversion to seek shelter;
- ⚡ if any damage is noted, the owners/managers, P&I and other relevant parties must be notified promptly.

Recommendations for Special Cargoes

➤ Stowage of wheel-based cargoes

Wheel-based cargoes are all cargoes which are provided with wheels or tracks, including those which are used for the stowage and transport of other cargoes, buses, military vehicles with or without tracks, tractors, earth-moving equipment, roll-trailers, etc. Such cargoes cannot be stowed under other types of cargo and are thereafter loaded on top in some bulk carriers without tween decks. This can be hazardous because:

- ⚡ wheel-based cargoes may shift with the lashings work loose when stowed on top of bagged cargoes which do not always provide a firm enough base and tend to move downwards during transit;
- ⚡ wheel-based cargoes cannot be effectively secured and are often lashed to each other, which can cause cargo shifting as long as one of the cargoes has moved, and pursuant to the CSS Code and the CSM, such cargoes should be secured to the ship instead of to the cargoes;
- ⚡ inadequate dunnage and wedges are



All Cargoes of Vehicles Lashed to Each Other



Loaded on Top of Other Cargoes Without Dunnage

provided during loading, resulting in movement of the vehicles and the cargoes beneath to be crushed;

- ⚡ fuel oil and batteries often come with wheel-based cargoes, and if not properly handled, can cause a risk of fire and pollution contamination of other cargo.

According to the CSS Code, in order to safely stow and secure wheel-based cargoes:

- ⚡ such cargoes should be secured to the ship by lashings like steel chains or wires;
- ⚡ such cargoes should be provided with adequate and clearly marked securing points or other equivalent means of sufficient strength to which lashings may be applied;
- ⚡ such cargoes which are not provided with rubber wheels or tracks with friction increasing lower surface should always be stowed on wooden dunnage or other friction increasing material such as soft boards, rubber mats, etc. When in stowage position, the brakes of a wheel-based unit, if so equipped should be set, and the wheels should be blocked to prevent shifting;

where possible, such cargoes, carried as part cargo, should be stowed close to the ship's side or in stowage positions which are provided with sufficient securing points of sufficient strength, or be block-stowed from side to side of the cargo space;

to prevent any lateral shifting of wheel-based cargoes not provided with adequate securing points, such cargoes should be stowed close to the ship's side and close to each other, or be blocked off by other suitable cargo units such as loaded containers, etc.;

to prevent the shift if wheel-based cargoes, it is preferable to stow those cargoes in a fore-and-aft direction rather than athwartships. If the cargoes are inevitably stowed athwartships, additional securing of sufficient strength may be necessary.

Other Considerations

it is preferable to load wheel-based cargoes on deck, or tween deck, or directly on the tank-top, instead of on other cargoes. If it is inevitable, a risk assessment should be carried out and sufficient dunnage and wedges should be provided for proper lashing and securing;

check the lashings regularly during the voyage and tighten the stow where necessary;

for carriage of gas-powered vehicles, the fuel cells should be removed and the batteries should be packed well to prevent short-circuit, or the cargoes should be declared as dangerous goods under UN3166, Class 9 of the IMDG Code;

for carriage of UN3166 vehicles, requirements under the IMDG Code should be complied with and ensure the ship's fitness for carriage.

Stowage of steel coils

Coils of steel sheeting are one of the most frequently shipped break bulk cargoes. There have been rather established standards and accumulated experience for stowage and lashing of the specific cargo. However, ships may encounter the following problems while loading coils at ports with lower technical standards.

Steel coils are often in various size and weight. They can range from several tons to as much as thirty tons in weight, and from 0.5 metre to 2 metres in width. With instructions on only 1-2 loading patterns are given in some vessel's Loading Manual, the maximum loading weight against the uniformly distributed loads of the tank-top is often determined by calculation of the shadow area of the coils. However, dunnage at some ports can be of insufficient length without connection to each other, or of insufficient thickness or just too soft, leading to point load and potential damages to the inner bottom structure.

Steel coils are loaded under other cargo units, causing damages to the bottom plates and deformation of the coils.

Steel coils are loaded on top of other cargo units, causing damages to the cargoes beneath or shifting/rolling of the coils when the cargoes beneath move downwards under pressure.



Dunnage Too Short



Dunnage Too Soft and Crushed
(Source: The America Club)

Preventive Measures

It is recommended to specify the maximum allowable load for coils of various weight and size, as well as the requirement for amount of dunnage in the class approved Loading Manual. A clear guidance is helpful in preventing future disputes for carriage of steel coil cargoes.

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Calculation Sheet of Maximum Allowable for Steel Coil Loading

Where Loading Manual does not provide instructions on stowage of steel coils of different sizes and weight, the following methods can be referred to.

Shadow Area Method: Maximum allowable load each row = inner bottom width x steel coil length x inner bottom uniformly distributed loads
Number of rows = inner bottom length / (steel coil length + 0.1m gap)
A 15% margin would be suggested considering excessive load due to negative factors affecting the bottom structure or improper stowage (such as improper use of dunnage).

Rule of thumb (knowing the tank-top strength): the weight on the tank-top in way of bottom tier coils does not exceed three times the maximum

permissible load of the tank-top plating. Thus, if the maximum permissible loading rate is, for example, 18 tonnes/m², 25-tonne coils could be stowed two tiers high and 15-tonne coils could be stowed three tiers high, and, if a range of weights of coils are to be carried, they may be stowed in two or three tiers so long as the maximum base coil load is no more than 54 tonnes.

Rule of thumb (not knowing the tank-top strength): this rule is to ensure that the weight exerted upon the tank-top in way of each of the bottom-tier coils does not exceed 30 tonnes. Thus, coils of up to 10 tonnes may be stowed 3 tiers, coils of more than 10 tonnes and up to 15 tonnes may be stowed 2 tiers, but coils of more than 15 tonnes should be stowed only 1 tier.

- ⚡ Steel coils are dunnaged to protect cargo from direct contact with the bottom structure, to increase coefficient of friction, to avoid damage of the cargo by uneven bottom plates and rust by sweat, and more importantly to distribute load from the cargo. The dunnage to be used should be:

- dry, free of oil, stout hardwood;
- no less than 5cm in thickness and 10cm in width;
- no less than 100cm in length and should be continuous without excessive gaps (the Association has noted that in some ports, wood dunnage of only 50cm are used with excessive gaps in between, making the cargo stowed on the bottom in a point load like way, for which the calculation of inner bottom uniform load does not apply);
- in at least 2 rows (the number and size of dunnage often depend on the steel coils' weight, size and tiers of stow).



Sufficient Dunnage
(Source: The standard Club)

- ⚡ Make clear on the use of dunnage prior to loading and request an immediate effort to modify the problem if the dunnage used are found during loading to be unsatisfying and photo evidence should be taken. It might be hard for the master to argue with the lashing company on their way of using dunnage at some ports with poor stowage practices, and therefore a surveyor should be sent for assistance at the site.
- ⚡ Prohibit loading of other cargoes on top of steel coils unless within the bottom plate strength limit - but use sufficient dunnage and be careful with the amount of pressure upon the steel coils in the bottom.
- ⚡ Steel coils without pallets should not be loaded on tween decks.
- ⚡ Steel coils should never be loaded on top of other cargoes.



Wooden Dunnage



(Source: The America Club)

7 Cargoes Possessing Chemical Hazards

Carriage of cargoes with chemical hazards at sea may involve a number of risk elements including fire, explosion, release of toxic gas, toxicity, corrosion, and radioactivity, among which the first two pose a severe threat to safety of cargoes and ships. Statistically, fire/explosion incidents occupy only a small percentage of cargo claim incidents, but often come at a big price – up to an average of millions of dollars for one incident and even an actual total loss in some cases. Proper measures taken for carriage of such cargoes and prevention of hazards are hence of great importance.

01

Reason for Safety Incidents

Non-Standard Loading

Cargoes are not loaded in strict accordance with the IMSBC Code and the IMDG Code:

- ⚠ cargoes not listed on the IMSBC Code fitness certificate or DG certificate are loaded
- ⚠ the vessel does not have the equipment or structure fit for carriage of the cargo
- ⚠ cargoes are not loaded, stowed, isolated, packed, or ventilated according to the carriage requirements or best practices

Cargoes Are not Properly Declared

- ⚠ mis-declaration may be provided by shippers on purpose
- ⚠ mis-declaration may be provided by shippers due to lack of knowledge or if the cargo is not yet included in the IMSBC Code or the IMDG code for its chemical hazards and the precautions to be taken

02

Chemical Hazards of Solid Cargoes

Cargoes with chemical hazards shipped at sea are classified in two ways: dangerous goods under the IMDG Code (IMDG) and the materials hazardous only in bulk (MHB). Some cargoes possess chemical hazards that meet both criteria.

Dangerous Goods in Solid Form in Bulk

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 cargoes are materials which possess chemical hazards when transported in bulk that do not meet the criteria for inclusion

03

Preventive Measures

Basic Rules for Safe Carriage

- ⚠ acquire detailed cargo information prior to loading
- ⚠ check the IMSBC and DG certificate of compliance for the ship's fitness for carriage
- ⚠ load, stow, segregate and transport the cargo in strict accordance with the IMSBC Code and the IMDG Code
- ⚠ plan and properly practice all the emergency measures

Guidance on Carriage of Specific Cargoes

Fire, explosion and other safety incidents happen when carrying dangerous goods mostly because of mis-declaration or because the cargo is not included in the IMSBC/IMDG Code. Guidance on carriage of some typical cargoes with chemical hazards is provided as follows.

in the IMDG classes above. They present significant risks when carried in bulk and require special precautions. They are described as follows:

Combustible solids (CB): materials which are readily combustible or easily ignitable and do not meet IMDG Class 4.1 criterion.

Self-heating solids (SH): materials that self-heat when transported in bulk and do not meet IMDG Class 4.2 criterion.

Solids that evolve into flammable gas when wet (WF): materials that emit flammable gases when in contact with water and do not meet IMDG Class 4.3 criterion.

Solids that evolve toxic gas when wet (WT): materials that emit toxic gases when in contact with water.

Toxic solids (TX): materials that are acutely toxic to humans if inhaled or brought into contact with skin and do not meet IMDG Class 6.1 criterion.

Corrosive solids (CR): materials that are corrosive to skin, eyes, metals or respiratory sensitisers and do not meet IMDG Class 8 criterion.



Self-Heating Coal on a Barge

Coal

Coal as the world's second largest dry bulk commodity has been transported by sea for ages. The chemical hazards and propensity to liquefaction associated with coal have been detailed in the IMSBC Code. However, some coals can produce methane and self-heat at the same time, which is extremely dangerous and hard to deal with yet sometimes overlooked by seafarers. Meanwhile advice on proper handling of the situation is not covered in the Code.

⚠ Case Study No.1

A vessel fully loaded with coal departed from Baltimore, USA for discharge in Fukuyama, Japan. In May 2018 while it is en route, an explosion of methane happened in the No.2 hold and the hatch cover was severely damaged. Some of the cargoes in the hold could not be discharged and had to be left on board. The owner overwhelmed with finding a solution suffered substantial loss and was not able to get all the cargo out until finally deviated to an Indian port.

Compression Bar
Deformed After
Methane Explosion



⚠ Case Study No.2

An incident involving self-heat of cargo happened on a vessel loading coal off Indonesia to China. The situation got under control after close of ventilation with sealing and boundary cooling of the affected holds. However, in subsequent gas monitoring, the methane readings exceeded its limit once oxygen concentration gets lower than 10%. According to expert advice, the master carried out limited ventilation to maintain methane concentration below the lower explosion limit (LEL) and to control self-heating of coal by preventing excess air ingress to the holds. Other measures taken include proper ventilation prior to arrival, prohibition of ignition sources on deck and early arrangement of discharging. With storage facilities unavailable and the typhoon approaching, cargo operation was interrupted for several times and the ship had to avoid the typhoon off the anchorage. Part of the coals were discharged while the remaining re-ignited with excessive oxygen in the holds. The discharge of cargo was eventually completed under extreme caution without causing actual hazards.

⚠ Why does coal emit methane?

Coal is an adsorption medium with developed pore and fissure structure, containing abundant methane which is generated during the process of coalification. With variation in conditions such as pressure and temperature after the coal is mined from underground, the methane adsorbed throughout processing and transportation will be released until a balance is reached. Factors that may affect methane emissions from coal include:

- ⚠ coals in deeper coal seams are more likely to emit methane;
- ⚠ coals with higher moisture content have reduced adsorption capacity and are more likely to emit methane;
- ⚠ the less time it takes for the coal to be mined, the more likely it is to emit methane during transportation;
- ⚠ coals with lower degree of coalification are more likely to emit methane – the ability to emit methane in descending order: peat > lignite > sub-bituminous coal > bituminous coal > anthracite;
- ⚠ self-heating coals with increased temperature are more likely to emit methane.

⚠ How to determine that the coal to be shipped has a tendency to emit methane?

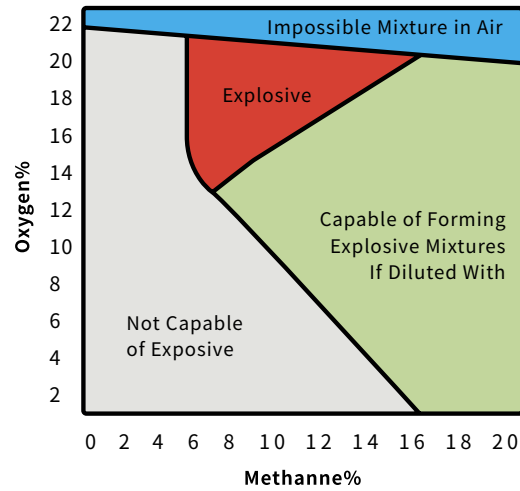
The IMSBC Code requires the shipper or his appointed agent to provide the master in writing with the characteristics of the cargo and recommendations for safe handling procedures for loading and transport of the cargo prior to loading. As a minimum, the cargo's contract specifications for moisture content, sulphur content and size shall be stated, and in particular whether the cargo may be liable to emit methane. However,

in some ports the cargo declaration provided by the shipper does not contain accurate information, like in case No.1 mentioned above, the cargo's tendency to emit methane is excluded in the declaration. To avoid similar incidents, the master should be careful to anticipate the possibility of methane emissions and accurately measure methane content to maintain it below 20% LEL.

⚠ How to properly measure methane concentration?

The IMSBC Code requires ships carrying coal to be suitably fitted with appropriate gas detectors for measuring concentration of oxygen, combustible gases and carbon monoxide and these instruments shall be regularly serviced and calibrated. To obtain correct readings, methane concentrations should be measured after ventilation has been turned off for at least 4 hours. Portable gas detectors used at sea are usually fitted with flammable gas catalytic sensors. If the level of oxygen falls to 10% or less, the readings produced by the catalytic sensor may not be accurate (a similar situation may exist in case No.2). The catalytic sensor may also produce false readings if the amount of methane in the hold atmosphere exceeds 100% of its upper explosive limit (UEL). To obtain accurate readings, it is recommended that dilution sampling be performed using dilution fittings applicable to a particular gas detector (the instrument's manufacturer should be contacted for further guidance). An infrared gas detector may be used to measure the amount of methane inside a cargo hold regardless of the oxygen level, as an alternative to using catalytic sensors and dilution fittings. Infrared gas detectors can also measure flammable gas concentrations above the UEL.

The Coward Explosive Triangle



⚠ How is the explosion limit of methane related to the concentration of oxygen?

In normal air, the LEL for methane is 5%-6%, the UEL is 15%-16%, and a methane concentration of 9.5% can produce the most damaging explosion. Where the oxygen concentration decreases, the LEL does not change much while the UEL is significantly reduced. When the oxygen concentration decreases to 12% or less, the methane-air mixture will not explode.

⚠ IMSBC Code special precautions for shipment of coals emitting methane

When the shipper has informed that the cargo is liable to emit methane or analysis of the atmosphere in the cargo spaces indicates the methane content in excess of 20% of the LEL, the following additional precautions should be followed as required in the Appendix to the coal schedule in the IMSBC Code.

☞ Adequate surface ventilation shall be maintained, except for an appropriate period for the purpose of gas monitoring.

☞ Care shall be taken to remove any accumulated gases before operation of the hatch covers or other openings for any reason, including discharging. Care shall be taken to operate hatch covers or other opening to avoid creating sparks. Smoking and the use of naked flames shall be prohibited.

☞ Personnel entering cargo spaces or enclosed adjacent spaces shall strictly follow the safety procedures for entry into enclosed spaces and special precautions shall be observed to ensure that no source of ignition is carried into the spaces.

☞ The ship's master shall ensure that enclosed working spaces such as storerooms, carpenter's shops, passageways, tunnels, etc., are regularly monitored for the presence of methane. Such spaces shall be adequately ventilated and, in the case of mechanical ventilation, only equipment safe for use in an explosive atmosphere shall be used.

⚠ Recommendations for shipment of coal that is liable to self-heat and to emit methane

In addition to the safety precautions provided in the IMSBC Code, the following recommendations are for Members' information.

☞ Notify the owner and the Association immediately if it appears that the coal loaded is emitting methane and exhibiting self-heating so that early arrangements can be made by relevant parties.

☞ Since ventilation requirements for self-

heating coal and methane emission are opposite, only a minimum amount of ventilation should be applied during the voyage to maintain methane levels below 20% LEL while maximum efforts should be made to avoid self-heating. Methane emissions generally decrease over the time as a certain amount of methane contained in the coal is released.

☞ As explained earlier, beware that the methane readings may not be reliable when oxygen concentration falls below 10%.

☞ Upon confirmation of the berthing plan, vigorous ventilation can be carried out to evacuate methane before berthing and discharging. Ignition sources adjacent to the cargo holds and the deck should be strictly controlled. Prior to opening hatch covers, the wheels and rails can be greased to avoid generation of sparks. No smoking or naked fire should be allowed on the deck or within the vicinity of the cargo holds while in port.

☞ A comprehensive cargo discharge plan should be prepared and try to coordinate with the terminal to complete discharge of each hold at one time to avoid self-heating and spontaneous combustion due to oxygen ingress to the hold during the period when the cargo is partially discharged.

☞ The situation may become complicated if the discharge is interrupted or the ship has no choice but to move to the anchorage to wait for discharge of cargo. It is then recommended to seek cargo expert advice and consider the following measures.

- With presence of abundant oxygen in the hold after discharging part of the coal, closing ventilation may not be a good way to control self-heating. In this case opening the hold for ventilation can instead prevent heat accumulation from self-heating, lower the coal temperature and at the same time reduce the methane concentration.

- Since the mixture will not explode if the level of oxygen in the hold is below 10%, controlled ventilation can be considered to prevent self-heating and to allow an appropriate concentration of methane.

- While self-combustion cannot be restricted even a minimum amount of ventilation is carried out to keep the methane concentration below the LEL, assistance from the port may be requested; or a small amount of fresh water may be used to cool down such areas; or a fixed CO₂ system may be used to extinguish the fire; or CO₂ may be used to dilute and replace the methane with spraying of water on the deck and around hatch coamings.



Fertilizer Burned Aboard (Source: Spanish Maritime Search and Rescue Society)

Ammonium Nitrate Based Fertilizer (ANBF)

There are three individual schedules for ANBF in the IMSBC Code, namely ANBF UN 2067, ANBF UN 2071 and ANBF (non-hazardous). The first two are identified as dangerous goods by the IMDG Code while the third one is defined as Group C cargo. However, ships have seen incidents of fire and explosion involving carriage of ANBF (nh) due to mis-declaration or misled by the term “non-hazardous”. Since the cargo is classified as Group C, most certificates issued by the authorized Class do not carry specific requirements for loading, which gives rise to potential hazards. In fact, precautions should be taken to stow this cargo out of direct contact with a medal engine-room boundary and away from any tank or double bottom containing fuel oil heated to more than 50°C.

⚠ Stowage Requirements for ANBF

📦 ANBF UN 2067 and ANBF UN 2071

“Separated by a complete compartment or hold from” combustible materials (particularly liquid), bromates, chlorates, chlorites, hypochlorites, nitrites, perchlorates, permanganates, powdered metals and vegetable fibres (e.g., cotton, jute, sisal, etc.).

“Separated from” all other goods.

“Separated from” sources of heat or ignition.

Not to be stowed immediately adjacent to

any tank or double bottom containing fuel oil heated to more than 50°C, unless with monitoring and controlling equipment to maintain the temperature. If the bulkhead between the cargo space and the engine-room is not insulated to class A-60 standard, this cargo shall be stowed “away from” the bulkhead.

📦 ANBF (nh)

The compatibility of ANBF (nh) with other materials which may be stowed in the same cargo space should be considered before loading. The cargo should be separated from sources of heat or ignition. It should not be stowed immediately adjacent to any tank or double bottom containing fuel oil heated to more than 50°C, unless with monitoring and controlling equipment to maintain the temperature. Fertilizers of this type should be stowed out of direct contact with a medal engine-room boundary. This may be done, for example, by using flame-retardant bags containing inert materials or by any equivalent barrier by the competent authority. This requirement need not apply to A-60 insulated bulkheads or short international voyages.

⚠ Hazards of ANBF

📦 ANBF UN 2067

Supports combustion. A major fire aboard a ship carrying these substances may involve a risk of explosion in the event of contamination or strong confinement.

An adjacent detonation may involve a risk of explosion. The cargo decomposes if heated strongly and there is a risk of toxic fumes and gases which support combustion in the cargo space and on deck. Fertilizer dust might be irritating to skin and mucous membranes.

📦 ANBF UN 2071

These mixtures may be subject to self-sustaining decomposition if heated. The temperature in such a reaction can reach 500°C. Decomposition, once initiated, may spread throughout the remainder, producing gases which are toxic. None of these mixtures is subject to the explosion hazard. Fertilizer dust might be irritating to skin and mucous membranes.

📦 ANBF (nh)

Even though the cargo is classified as non-hazardous, it will behave in the same way as the ANBF classified in class 9 under UN 2071 when heated strongly, by decomposing and giving off toxic gases. There will be a risk of toxic fumes in the cargo space and on deck. Signs of initial decomposition may be detected if regular monitoring of temperature is carried out. Fertilizer dust might be irritating to skin and mucous membranes. This cargo is non-combustible or with a low fire-risk.

⚠ Explosion Incidents Involving Shipment of ANBF

📦 In April 1947, a cargo ship docked at Texas City, USA caught fire, detonating 2,300 tons of ammonium nitrate on board. The explosion had caused another explosion at a nearby chemical plant. The ship SS High Flyer, in dock 200 metres away was also affected. Nearly 1,000 tons of ammonium nitrate and 1,800 tons of sulphur carried on board were ignited. The damage caused was incalculable to the country. The investigation later found that the ammonium nitrate had been stacked at the

dock for a long time, and there were signs of heating during stevedores’ handling. Back then, the terminal operators and ship managers do not know well about good practices for storage and transportation of ammonium nitrate fertilizer, or about its characteristics and hazards. Strict measures for transportation management and effective precautions for incidents were not in place.

📦 In the evening of August 4, 2020, 2,750 tons of ammonium nitrate stored in the port area of the Lebanese capital Beirut exploded violently and twice in quick succession, registering seismic waves equivalent to the magnitude of a 3.3 earthquake. The event destroyed a major part of the city with an estimate of hundreds of fatalities, over 5,000 injured, and hundreds of thousands of displaced individuals. The tragedy happened when welders were working on the door of a warehouse where the ammonium nitrate was stored there for six years without proper management.

⚠ Issues for Carriage of ANBF

📦 The cargo is shipped while such cargo is not included in the ship’s IMSBC certificate.

📦 The cargo is included in the certificate of fitness for carriage but requirements for carriage of the cargo are not complied with. For ships on which the bulkhead between the cargo space and the engine-room is not insulated to class A-60 standard, the cargo will be required to be stowed at least three metres away from the bulkhead, but it might be neglected by the crew during loading.

📦 The certificate of fitness for carriage of ANBF (nh) may not carry stowage and segregation requirements since the cargo is classified with Group C and therefore such requirements may not be complied with during loading.

⚠ Safety Precautions for Carriage of ANBF

☞ Acquire cargo information from the shipper and confirm the correct schedule to be applied. Also, check the ship's IMSBC and IMDG certificate for whether the ship is compliant so that precautions necessary to proper stowage and safe carriage of the cargo can be taken.

☞ The cargo should be carried in strict accordance with the arrangements as mentioned in the IMSBC Code schedule for ANBF.

☞ All three types of ANBF cargoes are required to be segregated from sources of heat or ignition. Such cargoes are not to be stowed adjacent to any tank or double bottom containing fuel oil heated to more than 50°C, unless with monitoring and controlling equipment to maintain the temperature. If the bulkhead between the cargo space and the engine-room is not insulated to class A-60 standard, this cargo shall be stowed away from the bulkhead.

- For ANBF UN 2067 and UN 2071, which are classified as Group B, segregation requirements are to be specifically carried in the class-issued certificate of compliance. Relevant precautions such as “stowed at least three metres away from the engine-room bulkhead”, “specialised blind plates are to be used to separate the fuel tank heating system” and “monitoring and control devices to be fitted to maintain temperature under 50°C” should be applied carefully.

- For ANBF (nh), which is classified as Group C, stowage and segregation requirements may not be carried in the class-issued certificate of compliance. The ship should otherwise confirm whether the cargo should be carried under Group B arrangements.

- Electrical equipment in the cargo

space, other than those approved and intrinsically safe, shall be disconnected by suitable means other than fuses at a location outside the space. This shall be maintained as long as the cargo remains on board.

☞ Control ignition sources strictly during handling of such cargoes. Rules of prohibiting smoking and use of naked fire should be followed not only by the crew but also by stevedores and visitors.

☞ Carry out crew training to get them familiar with the characteristics of the cargo and all emergency actions to be taken.

☞ It is recommended to have additional firefighting outfits and temperature measuring device fitted on ships so that early actions can be taken by the crew to effectively arrest any decomposition process.

☞ Temperature increases and oxygen depletion within the cargo hold are warning signs of possible decomposition, and therefore regularly monitoring of the temperature and oxygen level is vital to early detection of abnormal situations.

Calcium Hypochlorite (CH)

With provisions of the IMDG Code and all the measures taken by the industry on safe transportation of calcium hypochlorite, fire/explosion incidents (including many serious ones) continue to happen in container shipments, mostly due to mis-declaration or non-declaration. The cargo is often falsely declared as calcium chloride to avoid compliance with applicable requirements or under similar names such as bleaching powder, CCH, BK powder, disinfectant, and chlorinated lime. To ensure safe transportation, ships should strictly follow precautions as provided in the IMDG Code and the Version 3 Guidelines for the Carriage

of Calcium Hypochlorite in Containers by CINS and the International Group of P&I Clubs and be cautious with the issue of mis-declaration.

⚠ What is calcium hypochlorite?

Calcium hypochlorite is a white or yellowish solid that is soluble in water, commonly known as bleach. There are several chemical products manufactured as water purification and bleaching agents which contain CH as active ingredient. It is designated a Class 5.1 oxidiser in the IMDG Code. Some CH products and some mixtures thereof also meet the criteria for Class 8 corrosives. The IMDG Code currently has 6 entries for calcium hypochlorite:

☞ UN 1748 Calcium hypochlorite, dry or calcium hypochlorite mixture, dry with more than 39% available chlorine (8.8% available oxygen);

☞ UN 2880 Calcium hypochlorite, hydrated or calcium hypochlorite, hydrated mixture with not less than 5.5% but not more than 16% water;

☞ UN 2208 Calcium hypochlorite mixture, dry with more than 10% but not more than 39% available chlorine;

☞ UN 3485 Calcium hypochlorite, dry, corrosive or calcium hypochlorite mixture, dry, corrosive with more than 39% available chlorine (8.8% available oxygen);

☞ UN 3486 Calcium hypochlorite, dry, corrosive with more than 10% but not more than 39% available chlorine;

☞ UN 3487 Calcium hypochlorite, hydrated, corrosive or calcium hypochlorite, hydrated mixture, corrosive with not less than 5.5% but not more than 16% water.

⚠ Hazards of calcium hypochlorite

According to the IMDG Code, calcium hypochlorite is a strong oxidizing agent.



Fire Inside Container

Hazards related to the substance include: catching fire in contact with organic materials or ammonium; exothermic decomposition at elevated temperatures which may cause fire or explosion; and liable to heat slowly in reaction with acids, evolving chlorine, which is an irritating, corrosive and toxic gas. Also, when involved in a fire, it will decompose without burning and release oxygen to intensify the fire. If it is mixed with organic materials such as sawdust or oil, it can result in a fire without the need for an external ignition source. It is highly unstable and displays self-reactive characteristics. At normally encountered temperatures, CH decomposes very slowly and release heat, and if the heat is not able to escape from within the material, then its temperature increases, and the rate of decomposition increases until finally a violent fire or explosion.

⚠ Requirements for Carriage of CH in Containers

Effective precautions should be taken for safe carriage of CH pursuant to the IMDG Code and the guidelines by CINS and IG.

☞ Packaging

The maximum net weight of CH is 45 kg per package and no more than 14 tonnes per container. Drum packaging is recommended while bags, sacks, IBCs and bulk packaging are not allowed. Pallets, dunnage, drums and other packaging material must be clean, free from contaminants and in good condition.

☞ Preparation Prior to Carriage

The cargo should be declared three days

in advance to the competent authority in accordance with relevant requirements on transportation of dangerous goods and shall be loaded only with approval. During loading, the ship should carry out inspection on the cargo, including audit of documentation and examination on appearance of the containers. Loading of the cargo should be monitored to ensure that it is loaded in a position consistent with the stowage plan. The accuracy and integrity of dangerous goods labels and markings should be checked. Communicate with the cargo owner or agent immediately if there is any problem to keep clear of any safety hazards.

📦 Container Stowage

- The drums containing CH should be properly secured on pallets and within the container in accordance with the CTU Code. Any securing method should not restrict adequate air flow around the drums to reduce retained heat within the cargo.

- The cargo shall be transported in compliance with the stowage and segregation requirements set out in the IMDG Code, in which CH is subject to the provisions of stowage category D. It should therefore be carried only on cargo ships and stowed only on deck, not in the holds. Cargo transport units shall be shaded from direct sunlight and protected from sources of heat.

- To ensure easy access to the cargo, the container should be stowed on deck in the first or second tier. CH should be separated from ammonium compounds, acids, cyanides, peroxides and liquid organics, horizontally or vertically by a watertight bulkhead or a deck.

- Calcium hypochlorite is also listed as a marine pollutant and should hence be stowed on deck with proper protection. Considering that a fire hose is usually 20-25 metres long, it is advisable to stow the container at well-protected areas close to the ship's sides, not in the lateral center of the

ship, to ensure fast connection to the fire hydrant or convenient use of specialised tools to break in the container in case of any emergency.

- If CH is carried in reefer containers, the control temperature should be not higher than 10°C with ventilation at 40 cubic metres per hour and relative humidity at 50%. However, in the event of a mechanical failure or an extended interruption of the power supply, heat produced by CH decomposition may accumulate faster in a reefer than in a dry container, which may lead to an explosion soon if prompt steps are not taken to restore power or fix the failure. Another difficulty encountered with reefers has been the corrosive effect of CH on paint and metal work of the container. This damage has probably resulted from excess CH on the external surfaces of packaging becoming airborne when stirred up by a circulation fan. As such, if reefers are used then appropriate inspections of the cargo are necessary to avoid the problem.

📦 Management During the Voyage

Considering the complexity of sea environment during the voyage, ships should inspect dangerous goods cargoes in accordance with the SMS requirements and keep a proper record. Especially when reefer containers are used to transport CH, it is necessary to check the reefer settings and ensure the normal working condition. Declare to the authorities in time before arriving at the port of call or port of destination to avoid unnecessary problems.

⚠️ The Issue of Mis-Declaration

CH is often mis-declared as calcium chloride or under similar names such as bleaching powder, CCH, BK powder, disinfectant, and chlorinated lime to avoid compliance with applicable carriage requirements. In recent years, mis-declared dangerous cargo incidents have led to

significant losses in human lives and ship properties. According to CINS statistics, over 40% fire incidents on containerships involve dangerous goods fraudulently or by mistake declared as safe.

Carriers can hardly see what is actually loaded since the cargo is booked through the booking system, and the extremely small number of containers opened for inspection compared to the volume of freight, have all made it easier for shippers to commit fraud to export their dangerous goods. While many ship operators continue to reject carriage of CH or charging excessively for carrying it, the carriers are confronted with increased costs and potential delays and are further tempted to persistent frauds. It is indeed a great challenge for carriers to stop fraudulent misdeclaration by shippers.

⚠️ Emergency Procedures to CH Hazards

📦 Emergency Response to Fire

- In the event of a fire where exposed cargo may explode or its packaging may be damaged, the crew should assess the risk of explosion and take appropriate measures. Try to put out the fire from a distanced position with protection. An adequate emergency preparedness plan should be in place as sudden or instantaneous outbreak of fire/explosion may be devastating to the safety of a ship. If a deck container is on fire, cool it down with large amount of water, and where practicable and safe, pour water into the container after opening it with designated tools.

- Where practicable, remove or abandon packages that may catch fire. If the goods are exposed to fire, do not attempt to move the package that has been heated. If a package is not in direct contact with the fire, try to protect it from fire by using a water gun from afar. If it's safe and feasible, cargo exposed to the fire should be separated from cargo unexposed. Cargo that has been separated needs to be kept wet and monitored for signs

of burning at a safe distance.

- Firefighting crews should wear appropriate protective clothing and SCBA to ensure their own safety. While implementing emergency fire-fighting measures, be prepared for emergency procedures of abandoning ship. Once the situation gets out of control, the master should give the order to abandon ship to avoid further casualties.

- The current firefighting system of containerships is found to be rather ineffective in dealing with chemical fires onboard, mainly because 1) the smoke detection system will be activated only when the space is smoke filled, by which time the fire has already spread; 2) with oxygen in the container, the efficiency of carbon dioxide released is compromised; 3) it is almost impossible to stop the fire from spreading to the deck and cooling the deck with water is simply not practical. Therefore, industry associations including IUMI, BIMCO, CESA and IMO member states including the Bahamas and Germany have submitted a proposal to amend SOLAS Chapter II-2/2 to enhance provisions for early fire detection and effective control of fires in containerised cargo on deck.

📦 Emergency response to spillage

Separate the contaminated area, restrict access, and stop the spillage immediately if practicable. Personnel cleaning up the site should wear protective clothing and SCBA to ensure personal safety. Prohibit all ignition sources (e.g., naked flames, non-explosion-proof lamps, power hand tools, friction) and wear work clothes and soft-soled shoes that prevent static sparks. Do not come into direct contact with the spilled cargo, and do not mix it with any reducing agents, organic materials, flammable materials, or metal powders. When the cargo loaded on the deck surface spills, wash it off with large amount of water and remove the waste in time.



Sulphur

Sulphur can be highly corrosive to steel when in contact with water. To protect ships and seafarers from potential safety incidents, specific precautions should be followed in accordance with relevant rules for handling and carriage of bulk sulphur.

⚠ Case Study

A 2012-built bulk carrier loaded 40,000 tonnes wet sulphur which were declared as Group C cargo from a Russian port in September 2018. Hold steelwork was believed to be protected as per contract prior to loading. However, the sulphur cargo was not discharged until 65 days later due to port congestion and the holds have then been severely corroded. When the vessel went for dock repair in February 2019, the shipowner was demanded to replace a total of 600 tonnes of bottom plates by the classification society in accordance with the thickness measurement report. The Association later found out that protective product SLIP-COAT™ which works for dry cargoes was mistakenly applied instead of SLIP-COAT PLUS™ which should have been applied for the wet sulphur.

A similar case happened in October 2018 when a 2014-built bulk carrier shipped 30,000 tonnes of sulphur from the United States to Dakar. The owner was also demanded by the class to replace and reinforce the corroded steel plates. Part of the cargo holds was limewashed prior to loading, but not in a standard way,

according to the Association's investigation.

⚠ International Conventions and Domestic Regulations

📖 The IMSBC Code

Sulphur cargoes are divided into two categories based on their characteristics.

(i) Group C Sulphur: a co-product recovered from sour gas processing or oil refinery operations that has been subjected to a forming process that converts sulphur from a molten state into specific solid shapes (e.g. granules, pellets, pastilles or flakes); bright yellow in colour; odourless. This cargo is non-combustible or has a low fire risk. If involved in a fire, cargo may generate harmful gases. When handled and shipped in accordance with the provisions of the schedule, this cargo poses no corrosion or dust hazards for human tissue or vessel.

(ii) Group B Sulphur: crushed lump and coarse grained, a mineral substance found free in volcanic countries. Yellow in colour, brittle, insoluble in water, but readily fusible by heat. This cargo is flammable and has a liability to dust explosion. Fine grained sulphur shall not be transported in bulk.

📖 The IMDG Code

Sulphur (UN generic entry No.1350) is listed as Class 4.1 flammable solids, meaning readily combustible solids and solids which may cause fire through friction. According to IMDG Dangerous Goods List, sulphur

evolves toxic, very irritating and suffocating gas when involved in a fire. The dust forms an explosive mixture with air which may be ignited by static electricity, and forms explosive mixtures with oxidizing substances. It is corrosive to steel, in particular in the presence of moisture. May cause dermatitis by skin contact, and rashes in worse cases.

📖 Chinese National GB Standard

According to the No.1 Amendment of the Dangerous Goods List (GB12268-2005), sulphur in specific shapes (e.g. pellets, granules, prills, pastilles or flakes) can be shipped as ordinary goods.

⚠ Cargo Holds Protection

Dry sulphur does not react with bare steel, but when in contact with water it becomes wet sulphur which is potentially highly corrosive. It may take in moisture in the air when being stored or handled, and sometimes water is sprayed by the crew to keep down the dust. The hold steelwork should therefore be well protected, normally by one of the three methods as listed below, for the carriage of cargoes like sulphur, salt, petroleum coke and cement.

📖 LIMEWASH

It's a universal practice, and the only practice approved by some shippers, to apply limewash which is easily available at a low price as a protection to the holds. A single layer of limewash, if applied properly, can provide good protection to the steel for about 30-40 days. First, make sure a high concentration of the limewash and apply a thicker coating at the bottom and surrounding bulkheads until the original colour is fully covered. Second, spray the limewash from the front to the rear and from the top to the bottom. Sprays on the slopes can be evened with broomsticks. Third, the height at which the limewash is applied should be carefully calculated. Tank

cleaning will be a headache if the limewash is sprayed too high and steelwork will not be well protected if too low. The slope of pile of sulphur should be considered.

📖 SLIP-COAT

There are two kinds of slip-coat products - SLIP-COAT™ 25 LTR, which is non-water resistant and can be used when carrying dry cargoes like cement, and SLIP-COAT PLUS™ 25 LTR, which is water resistant and can be used when carrying cargoes like industrial salt, sulphur and even foodstuff. The slip-coat film will be completely dry in only 1-2 hours, ideal when difficult cargoes need to be loaded immediately after clean cargoes are discharged. The manufacturer also provides cleaning agents including Unitor™ Aquatuff™ and Unitor™ Aquatuff High Foam™.

📖 HOLDBLOCK

Two solutions are included in HOLDBLOCK products - HOLDBLOCK-AP, which is applied prior to loading to protect the holds, and HOLDWASHING-HD, which is used as a cleaner for HOLDBLOCK-AP and its residues. In practice, cargo holds are well protected by the HOLDBLOCK-AP coating without showing obvious signs of corrosion and changes in painting, but HOLDWASH-HD is not as effective. The HOLDBLOCK-AP residues and sulphur stains can't be removed easily unless washed repeatedly with high- pressure water (such as fire hose) and rubbed with brushes and sponges at the same time.

⚠ Precautions for Safe Carriage

📖 Prior to Loading

The master should confirm whether the sulphur cargo to be shipped is categorised as Group B or C in accordance with the IMSBC Code. If it is Group B Sulphur, first it should be confirmed that if the vessel is fit for carriage, that is to confirm whether

Group B Sulphur (UN1350) is included in the ship's IMSBC or IMDG Code certificate, and if the cargo is fine grained sulphur;

- check the cargo holds for water tightness;

- prepare the holds for the intended cargo as per requirements and make sure they are clean and dry without any loose rust scale or paint flakes;

- make sure the ballast water system is in good condition and the bilge well is clean and drained;

- evaluate the vessel's condition and choose a protection method accordingly, take photos for evidence afterwards.

⚠ During Loading

- officers on deck should wear personal protective equipment including respirators, gloves and goggles properly;

- stick to port regulations to prevent sulphur dust clouds;

- check the IMSBC Code certificate for restrictions to be complied with for carriage of Group B Sulphur and where the bulkheads adjoining to the engine room are not A60 fire-insulated, the cargo should be kept at least three metres away;

- wash down the sulphur scattered on the hatch track with fresh water after loading is completed;

- implement strict fire precautions, smoking and hot work are prohibited;

- cargo hold lights should be properly placed with net covers and removed in time.

⚠ During the Voyage

- ventilation is not a necessity during the voyage, and the vent should be covered with canvas to keep out sparks;

- avoid warming the fuel tank next to the holds as far as possible, and ask for permission from the master if it has to be done. Appoint crew members to monitor the heating and control the oil temperature below 50°C or adjust the temperature according to specific cargo conditions;

- make note of protest available on board in case of stormy weather.

⚠ During Discharging

- open the hatches in advance, weather permitting, and in a steady way to prevent sparks from contact of metals;

- let out sulphur emissions and spray fresh water on the surface of the cargo;

- strengthen fire prevention and strictly prohibit smoking during the discharge of sulphur; additional officers should be assigned for a 24-hour monitor;

- put out burning sulphur with fresh water and do not use sea water as the cargo will be damaged. Be cautious with hazards of burning gases to human when the fire is put out;

- extra cautions should be exercised when the cargo is about to be completely unloaded, as sulphur may be ignited by friction between the grabber and the floor.

⚠ Cargo Holds Cleaning

- After discharge of cargoes, it is recommended to wash out the holds with fresh water before sweeping as flying dust may cause harm to human and explosion incidents; no smoking during the cleaning;

- for bulkhead caked with sulphurous mud, apply high-pressure water plus high-pressure air;

- thoroughly wash the bilge system to prevent the residues from corroding the pipework.

8

Reefer Container Cargo Damage

The Association has been notified of an increase in the number and value of claims involving refrigerated containers with the growing share of reefer transportation in recent years. There are many reasons for cargo damage, mainly involving the following six aspects, but most claims against carriers arise when the set point temperatures are not maintained during the voyage. Since the transportation of a reefer container can go through many stages, some cargo damage may occur even before the container is accepted on board. In addition to exercising great care during the carrier's period of responsibility, it is also important to carefully check and record cargo conditions at the time of loading/discharging to clarify potential disputes.



01

Reasons for Cargo Damage

- refrigeration system failure
- extended period of power failure
- improper setting of temperature or atmosphere
- improper stowage preventing proper air circulation
- advanced and premature ripening of cargoes
- expected storage life exceeded

02

Limitations in Reefer Container Transportation

- Reefer containers are not designed to lower the temperature of warm cargo other than extremely slowly. If the cargo is not cooled to the prescribed temperature before loading, it may be damaged (especially from within) for not being maintained at an appropriate temperature.
- Correct stowage within a container is extremely important to the carriage of reefer cargo. Improper stowage can lead to inadequate air circulation, which means failure to reach the desired temperature and/or to remove product heat, carbon dioxide, ethylene (if present), moisture and other residual gases. However, this is seldom under the control of the carrier.
- During the many stages of a complete cold chain operation, there is a temporary period off-power between each stage and under different management. It's easy for cargo damage to occur without regular temperature monitoring, which is not always containable by the carrier, except during sea transportation when the cargo is cared by them.
- In the event of reefer container breakdowns at sea, cargo damage can be inevitable if the ship does not have adequate spares onboard or the relevant skills to carry out emergency repairs.

03 Types of Reefer Cargo and Stowage Requirements

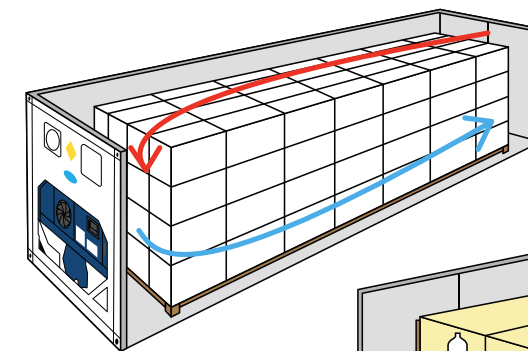
There are generally two types of refrigerated commodities – chilled and frozen.

- ✱ Chilled cargoes (mainly fresh fruit and vegetable cargoes), also known as perishable cargoes, are living organic that continue to metabolise and respire post harvest, inhaling oxygen and emitting carbon dioxide, water vapour and ethylene, etc. Such cargoes will inevitably produce respiratory heat during the process of energy consumption and the accumulation of heat is bound to affect the homogeneity of temperature distribution within the container, offsetting the coolness. Chilled cargoes are very sensitive to temperature and are hence a delicate commodity to transport for they are susceptible to deterioration in excessively high temperature or to freezer burn in excessively low temperature.
- ✱ Frozen cargoes are regarded as “inert” without metabolism or respiration and are normally stored below -10°C. Such cargoes are not susceptible to damage so long as the set temperature is maintained below the requirement. For instance, frozen beef is generally required to be stored at a temperature no higher than -22°C, so it won't be damaged even the set temperature is at -25°C during transit.
- ✱ Another type of cargo such as chemicals, dangerous goods, precise instruments also require controlled temperature.
- ✱ With frozen goods, it is important to circulate cold air around the edges of the cargo to reduce the possibility of temperature variations at the boundaries (e.g., walls, floor and roof). With chilled (live) goods (e.g., fruit, vegetables) the air flow should be allowed to permeate up and through the cargo stow, removing product heat, carbon dioxide, ethylene (if present), moisture and other residual gases.
- ✱ Goods should never be loaded above the red line marked inside the container. This space should always be kept clear to allow air to flow uninterrupted towards the front intake. The ideal stowage pattern should permit free movement of delivery air whilst restraining any movement of the cargo. Adequate space should also be left around the stow to allow free air circulation.
- ✱ Frozen products require a very simple stowage arrangement and should be loaded at the specified set point temperature. This can be achieved by a block stow. However, the cartons should not be packed together too tightly and there should be space between the cargo and the walls to allow heat passing through the sides of the container to be removed by circulating air. This is particularly important if the internal plating of the container is smooth. When carrying frozen goods, the fresh air ventilation ducts should always be closed.

Correct stowage within a container is extremely important to the carriage of reefer cargo.

- ✱ The cargo stow should cover the entire floor but not beyond the floor “T” bars in order to allow cooling of the door area and to facilitate an effective flow of return air. In larger containers, the height of the stow should be uniform if the volume of the cargo is less than the remaining free space.

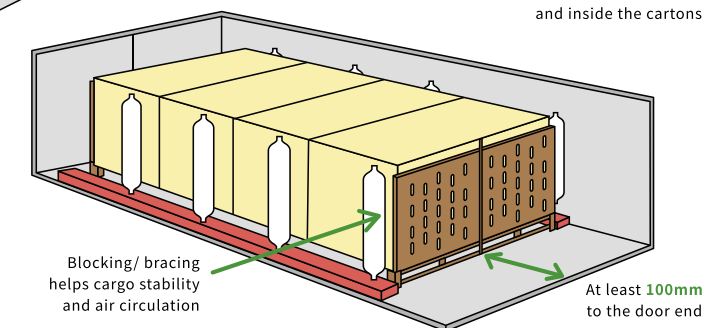
- ✱ Since stowage within the container plays an important part in maintaining the quality and security of the cargo during transit, expert advice should always be sought if any questions or doubts arise at the time of booking.



Pallets Stowage

Proper Pallet Stowage shall facilitate the airflow between and inside the cartons

Air Circulation Under Proper Stowage



04 Temperature Monitoring and Recording

Considering the numerous stages of reefer transportation, continuous monitoring and recording of temperature is of great significance in preventing cargo damage due to exceptional working conditions of the reefer container and in ascertaining causes and responsibilities in case of a cargo claim.

Temperature Controlling

A refrigerated container usually has a supply air sensor which is placed at the outtake at the lower end of the refrigeration unit to probe the temperature of supply air that comes from the evaporator and a return air sensor which is placed at the intake at the upper end of the

refrigeration unit to probe the temperature of return air that comes back to the evaporator. The supply air temperature is basically the lowest temperature in the reefer while the return air temperature can be regarded as the actual temperature in the reefer. For a reefer in normal operation, the return air, after being circulated in the container, is often 2-3°C higher in temperature than the supply air. For carriage of chilled cargoes which are susceptible to freezer burn in lower temperatures, temperature control is achieved through the supply airflow so that the actual temperature in the reefer will not be lower than the set temperature, and that is the chilled mode. For carriage of frozen cargoes, the temperature control is achieved through

the return air so that the actual temperature inside the reefer equals the set temperature, and that is the frozen mode.

The set temperature for carriage of refrigerated cargoes generally refers to temperature of the air delivered to cargoes, that is, the supply air temperature and in practice the set point of thermostat controller. The set point can be adjusted for a required supply air temperature within an acceptable deviation of $\pm 0.5^{\circ}\text{C}$. Therefore, refrigerated containers are simply an insulated transportation unit instead of a quick-freezing tool. If the cargoes are not pre-cooled and are loaded at an excessively high temperature, even if the settings are correct and the machinery functions properly, it may take days, or even weeks to reduce the cargo temperature to the appropriate level during which period the cargoes may have already been damaged.

Temperature Recording

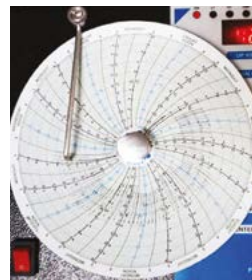
Partlow Chart Recorder

A common method of temperature recording is the Partlow chart recorder, which registers temperature on the chart by a clockwork mechanism that rotates over a 31-day period and a stylus that moves up and down as temperature variations. It usually consists of a temperature sensor, a power system, an indicator and a chart. It records data of temperature changes (usually for a month or an entire voyage, and the charts should be replaced before expiry if the voyage is expected to exceed 31 days) with the stylus (recording pen). It is also an important reference for determining whether the reefer functions normally in previous stages and the operating temperatures at certain points. The accuracy and reliability of the recorder may be affected by incidents during the transportation such as late installation

of the recorder, late replacement of charts, improper calibration or other human errors.

Data Logger

With the development of technology, temperature data of most reefer containers are now recorded by microprocessors which are more secure and reliable. The recorded data include the container's serial number and type, the refrigerating machine's number, name of the carrier, voyage number, date of loading/unloading, date and time of reports, humidity, supply air and return air temperature, warnings and PTI records – all these can be downloaded, printed, stored or accessed remotely. Memory of temperature variations can be kept for 2 consecutive years so that recent information can be tracked while earlier data are also well preserved. In case of substantial cargo damage, the preserved information can be used as evidence in claim handling.



Circular Chart Recorder



Data Logger

Temperature Monitoring

Monitoring and Recording by the Crew

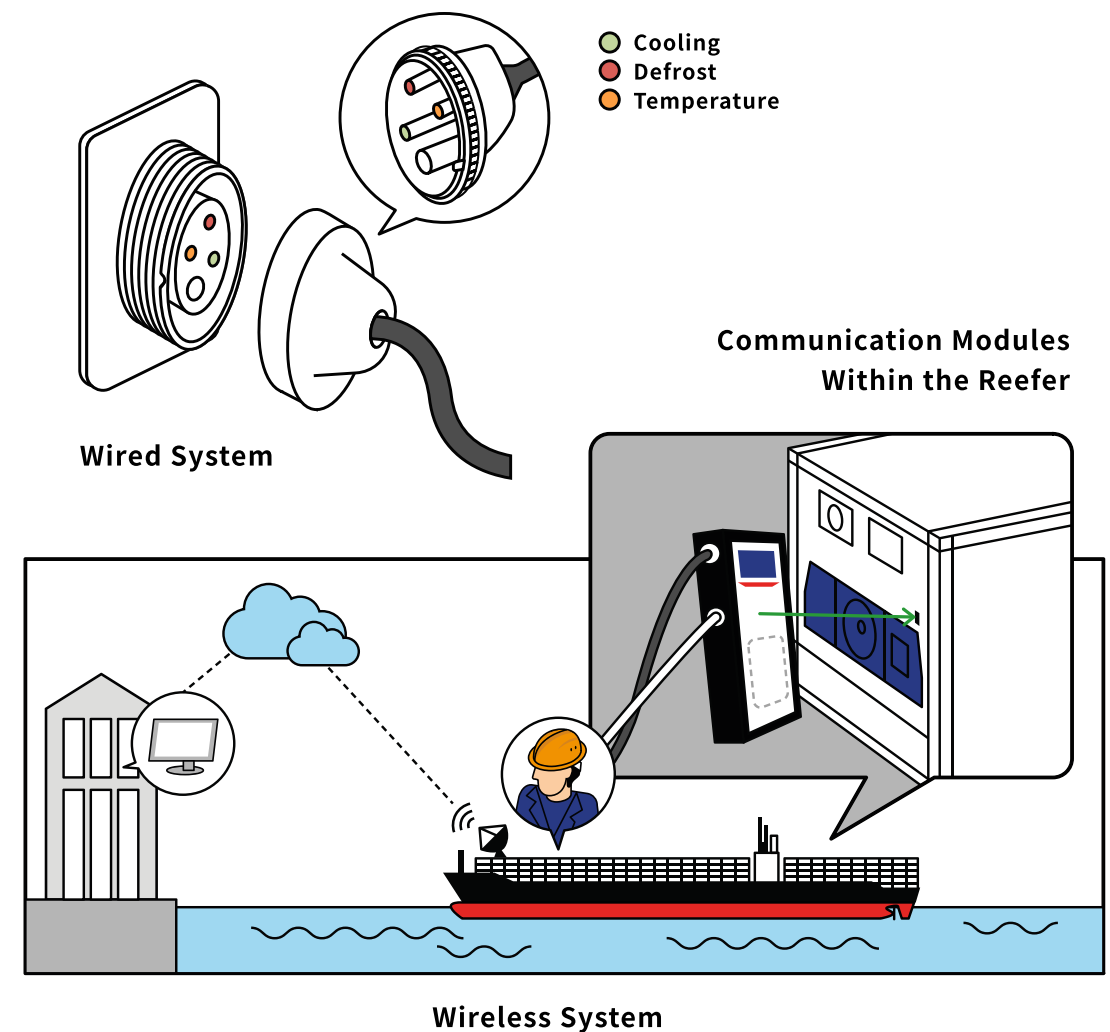
Where the weather and sea conditions permit during the voyage, the crew would routinely check and record the condition and temperature of the reefer containers twice a day. The records are evidence of the carrier's care of the cargo and have long been accepted by the industry.

Remote Monitoring

With the upsizing of containerships, the daily inspection of refrigerated containers on board a vessel takes a significant time. A number of companies have started to use systems that enable remote monitoring of the containers by crews, shore managers and even shippers. Since the crew can react to potential problems more quickly, the safety of cargoes and the seafarers are both assured. These systems could be either wired or wireless.

- Wired systems: data is transmitted to the loading computer on board via the power cable of the containers so that it is possible for the crew to monitor or operate (e.g., defrost) the containers from a remote location.

- Wireless systems: data including temperature, humidity and other working conditions is transmitted via WLAN or satellite network so that real-time monitoring is possible for crews, shore managers and shippers.



05

Pre-Trip Inspection (PTI)

Prior to delivery to a shipper, a reefer container should undergo a PTI arranged by the carrier or his local agent. This involves the refrigeration machinery being run and tested by a specialist engineer, usually within the port area. A PTI usually consists of two parts: a visual inspection regarding the structural integrity of the container and refrigeration machinery, and a series of electronic checks triggered by pressing the reefer machinery PTI button which results in a pass or fail. A fail may indicate that the unit is malfunctioning or that parts need to be replaced, requiring the attendance of a qualified refrigeration engineer. A record of the PTI is stored in the memory of the data logger.



A PTI Sticker

06

Preventive Measures

- ❏ Carry out a valid PTI before empty release to ensure the correct functioning of the refrigerated container, and records of PTIs and maintenances should be archived.
- ❏ The cargo should be pre-cooled to the required set temperature and stuffed properly to allow air around the stow to be circulated not blocking the vents or the T-bar floor.
- ❏ Prior to shipment, it is essential to obtain from the shippers detailed information

on all conditions of carriage including temperature, ventilation and humidity requirements. Confirm with the shippers in writing if there's any problem.

- ❏ Confirm that information, especially temperature settings, in the stowage plan is consistent with the manifest so that the reefers won't be mistaken as empty or dry containers.
- ❏ Distinguish reefer cargoes from non-reefer cargoes. A reefer container can be used 1) to carry refrigerated cargoes,

often with temperature requirements marked on shipping documents; 2) to carry non-refrigerated cargoes as a dry box, often with "Non-Operational Reefer" marked on shipping documents; 3) to carry special cargoes such as chemical materials, dangerous goods, chemical equipment, and instruments, often with special requirements (cooling, heating, etc.) marked on shipping documents; or 4) as empty container. Since containers for different uses all look alike, the chief officer should mark in detail the stowage position of different reefers and highlight those with special requirements.

- ❏ Before loading commences, confirm the conditions of the vessel's power supply system and power sockets. Make sure the power sockets are compatible with the reefer plugs and are sufficient in number. If necessary, a suitable quantity of plug adaptors should be obtained.
- ❏ Reefer container compressors should be loaded towards aft to prevent machinery damage in case of water on deck. Plug in the containers as soon as possible after they are loaded to check their working condition, temperature setting and actual temperature and to ensure that they have received a PTI with a "pass" sticker. Notify manager of the container yard for examination, repair, or other appropriate arrangement if there is anything exceptional.
- ❏ Be careful with the following conditions if the temperature is excessively high at the time of loading:
 - ☞ the reefer equipment breaks down, carry out trouble shooting and reduce the cargo to required temperature before accepting it on board;
 - ☞ or if the products are not pre-cooled to the required set temperature before stuffing, refuse to load or load them with guarantee issued by the cargo interests and "Cargo Not Pre-cooled" noted.

- ❏ Once a refrigerated container has been plugged in, the locking collar should be placed over the plug and socket. Checks should also be made to ensure that the reefer socket box is completely closed to prevent water ingress during the voyage.
- ❏ After a refrigerated container has been loaded, plugged in and the power has been switched on, a competently experienced crewmember should confirm that the unit is running and that the temperature is proceeding towards the set point. If a container will not run, some basic checks should be carried out. For example, the power switch on the control panel or the main breakers inside the control panel may have been switched off. If the container still refuses to start after it has been checked, shore assistance should be obtained. If this is also unsuccessful, the container should be sent back to the terminal.
- ❏ Many reefer container cargo claims have arisen due to confusion between the Fahrenheit and Celsius temperature scales, and also between positive and negative temperatures. Great care should be exercised to ensure that the set point temperature has been adjusted correctly as soon as the container has been placed on board. Any discrepancy between the actual temperature settings and cargo carriage instructions should be reported immediately.

- ❏ Confirm during loading that the reefer is not damaged and the seals are intact. Record any problems and report to parties concerned. Stop loading and arrange a surveyor to investigate the extent of the problem where necessary and ensure that actions are taken to minimise potential cargo loss.
- ❏ Any particular requirements in the charterparty addressing the carriage of reefer containers, for example, monitoring routines, repairs to be

attempted, parties to be notified in the event of a malfunction etc., should be complied with and appropriate instructions provided to the vessel in writing.

At sea, inspection on reefer containers should be carried out at least twice a day. The time of such inspections together with the supply and return air temperatures should be recorded on each occasion.

Details of any problems should be documented in a logbook if such inspections are not carried out for weather or other reasons. Where automatic logging systems are used on board, such systems should be checked for error messages on a regular basis. Where a chart recorder is used, make sure it makes accurate records and replace the chart timely if it runs out.

In the event of a reefer container malfunction, the ship should be equipped with sufficient spares and an operation manual and make sure it has the skills required to conduct emergency repairs.

Where there is any instability or malfunctioning of a refrigeration unit during the voyage and such fault cannot be resolved on board, the vessel should notify the office and the agents at the next port so that arrangements can be made to rectify the problem on arrival. In such circumstances, a surveyor should be appointed to provide details of the fault and assess the condition of the cargo inside the container.

To prevent loss of power or inadequate power supply, special care should be taken during high load operations such as berthing/unberthing and cargo operations with cranes.

If a reefer container is damaged at sea due to severe weather conditions or unforeseen circumstances, a sea protest should be submitted and notarized upon arrival at the next port of call.

In the event of a cargo damage claim, good accurate records and documentation can aid the strength of the defence while inaccurate ones are not helpful at all.

The following risks persist during transshipment when the reefers are discharged from a ship and loaded on another: 1) whether the reefers can be plugged in and cooled at the yard immediately after discharge from the previous ship; 2) whether the reefers can be effectively managed and monitored before loading; 3) whether the reefers can be loaded soon onto the next ship. To mitigate risks during the process, the company should notify local agent in advance to make early arrangement for the next ship.

Cargoes shipped in reefer containers are generally sensitive to temperature, which suggests that early delivery is more likely to ensure higher cargo quality and lower risks of claim. To this end, shipping agents should notify the consignees prior to the ship's arrival and assist them to take delivery of the cargo as soon as possible. Where the cargoes are not picked up in time, the agents should notify the shipper as soon as possible. Some consignees in reality have postponed receipt of the cargo on purpose to use the reefer as storage to save costs. To prevent extravagant electricity bills and management fees arising from it, consider a shortened period of free demurrage and a reasonably higher charge of demurrage when negotiating the contract with cargo owners.



(Source: MAIB)

9 Containers Lost Overboard

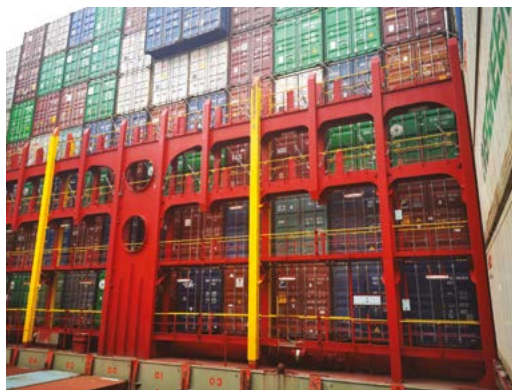
The World Shipping Council (WSC) estimates that there were on average a total of 1,382 containers lost at sea each year in the period between 2008 and 2019. Although causes for these incidents were not detailed in the WSC report, parametric rolling of ships in heavy weather conditions is known to be a predominant risk factor, according to industry analysis. Since 2020 as per public disclosure, there have been 9 incidents globally where a total of 3,067 containers were lost overboard. Not only substantial economic losses have been incurred, safety of crew and vessels as well as the marine environment are also at danger.

01 Reasons for Containers Falling Overboard

The shipping world has been studying the reasons for loss of containers at sea for many years. However, it never has a single cause but rather is a multifaced threat where stowage, lashing, navigation, weather and sea conditions should all be considered.

Improper Stowage As Per Ship's Cargo Securing Manual (CSM)

Failure to comply with limits for stack or tier weights or stack heights stipulated in the ship's CSM is a common cause of stack collapse. In some cases, the CSM itself has not catered for different stability conditions or the use of non-standard containers. Also, liner shipping companies generally have cargo stowage pre-planned by planners and then finalised on ship. However, since changes to the plan may affect warehousing, transportation, berthing and loading, masters may not be able to adjust the plan under commercial pressure or negligence.



Lashing and Stowage of Containers

Heavy Weather

Apart from container being lost overboard due to grounding, sinking or collision, heavy weather is often the most common factor resulting in stack collapse during voyages. Despite prompt and accurate forecasts these days, masters may not manage to avoid storms if they are too confident about their judgement or if they mis-judge the condition at all. It's also worth noting that although weather routing, which provides theoretically the optimal route, is used on most ships, it is likely that the weather information provided disagree with the actual observation on ships. Some masters choose not to deviate from the recommended route to avoid being pressured by charterers or owners, and as a result containers fell overboard in heavy storms.

Defective Lashing Equipment

Defective lashing equipment is also a major contributing factor.

Some poorly maintained or damaged equipment may be used for lashing. Most locking devices are used in the lashing of containers during transportation while only a small number of equipment such as lashing bars, turnbuckles and lashing eyes can be maintained by the crew at sea. Where other spare equipment is kept on deck is not easily accessible and therefore the crews can hardly maintain or repair those locking devices during the voyage.

The equipment used may have latent defects. With upsizing of containerships



Seriously Corroded Twistlock



Seriously Corroded Socket

and rise in scale of the lashing arrangements, some equipment that save time and effort for lashing and unlashng is used, for example fully-automatic twistlocks (FATs) which can release a container by rotating it around a central vertical axis. As a result of at least two serious incidents of container losses involving FATs, the industry has been concerned about whether they would unlock themselves during the ship's rolling and pitching in heavy weather.



Manual Twistlock



Semi-Automatic Twistlock



Light Fully-Automatic Twistlock



Heavy Fully-Automatic Twistlock

Lashing Issues Particularly Relevant to Large Containerships

On large container vessels that carry thousands or even over ten thousand TEUs, there are not enough trained professionals to execute cargo lashing and securing, and it's basically impractical to have the crew monitoring the placement and tightening of lashing materials and locking devices both ashore and on board. Even improper lashing or securing is found before departure, it's hard to demand correction by the stevedores and then masters are left with no choice but to set sail under the tight schedule.

There are also examples of cutting lashing arrangements due to missing or inadequate locking devices, like when stevedores leave the locks on the dock or on the gantry crane.

Loading of containers not in conformity with the pre-stowage plan may cause undue vertical weight distribution on an individual container stack or excessive lashing forces, of which masters and chief officers are unaware until they receive the final plan. At that time cargo loading is completed, the crane is removed, and stevedores have left, it takes tremendous work of coordination to adjust or even restow the loaded containers. Although the issue may be commonplace in ports that are not operated in a good standard, no perfect solution has yet been found even owners and charterers are both informed of the situation. By then, only good seamanship can be counted on to ensure safety at sea.

Misdeclaration of Weight

Container weight is important to the calculation of ship's stability and lashing strengths. Misdeclaration of weight by the shipper will certainly guarantee a compliant calculation result but may eventually end up with structural damage, improper stowage and/or inadequate lashings of containers.

02 Efforts to Improve Safety

Although containers lost overboard represent only a small portion of the 226 million containers currently shipped each year, the economic loss arising out of such incidents cannot be shared but to be borne by shipping companies and insurers. The liner shipping industry has hence been committed to enhancing container safety with its partners, including:

-  The SOLAS Convention was amended to make verification of container weights a legally binding condition for vessel loading. This can effectively prevent misdeclaration of container weights and further reduce loss of containers at sea.
-  The IMO, ILO and the United Nations Economic Commission for Europe (UNECE), with industry support, produced a code of practice for the packing of CTU. The code has outlined specific procedures to improve safety and was approved in late 2014.
-  In support of the IMO's efforts to enhance container safety, the ISO revised its standards regarding lashing equipment and corner castings and the new standards went into effect in 2015.

 WSC proposed to the IMO's Sub-Committee on Carriage of Cargoes and Containers (CCC) in September 2019 to align the Safe Container Convention's and ISO1496-1 container stacking strength requirements, noting that the existing discrepancy might have contributed to loss of containers at sea.

 WSC, together with the European Union, has submitted a proposal for a new output on the mandatory reporting of containers lost at sea to IMO's Maritime Safety Committee. The liner shipping industry supports such a mandatory reporting requirement and will continue to advocate for an early implementation of an effective and practical requirement.

 IMO revised its guidelines for the inspection programs for cargo transport unit and clarified that the selection criteria should be equally applied to CTUs carrying all types of cargoes. The revision has adequately referred to the IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units.

 For unusual stowage plans or loading conditions that may not be allowed for in the CSM, particular attention is required, and the cargo planner should discuss the stowage plan with the master to identify any potential problems.

 Unless permitted by the CSM and subject to forces being checked on the loading computer, avoid loading heavy containers above light containers, particularly in the upper tiers.

 Monitor the lashing process and carry out inspections to make sure the CSM is strictly followed.

 All fixed and portable lashing equipment should be properly maintained as per the PMS. Deficient items should be replaced or repaired in accordance with the manufacturer's instructions.

 Unless approved in the CSM, avoid using a combination of manual, semi-automatic and fully-automatic twistlocks in the same stowage.

 Improve training of the crew to get prepared for more complicated techniques of loading and lashing as containerships increase significantly in size.

 The master and chief officer may arrange inspections during the voyage, weather permitting, to tight or secure the sockets, turnbuckles, safety pins or lashing rods. If any automatic twistlock is found to be malfunctioning or dislocated, remove it for repair or replacement immediately after discharge of containers.

 Pay close attention to weather forecasts and take precautions including:

-  conduct regular inspections on lashing conditions;
-  alter course and reduce speed as

necessary to avoid heavy rolling and pitching;

 the master should be able to challenge weather routing when it conflicts with the actual conditions, and evidence such as photos, videos, logbooks, sea protest will be a strong proof in the event of any subsequent charterparty disputes;

 keep proper records of all inspections and actions taken to mitigate the effects of heavy weather.

 If a container is lost at sea:

 implement the correct emergency procedures to ensure the safety of crew, vessels and cargoes is not compromised and to minimise environmental impact;

 advise the company Designated Person Ashore (DPA) so that an emergency response can be initiated and request emergency assistance if required;

 alert the relevant Maritime Rescue and Coordination Centre (MRCC) and all vessels in the vicinity of the hazard to navigation;

 consider the planned voyage and whether a deviation to a safe port is required;

 maintain a detailed and accurate log of events and communications including the VDR;

 Ensure that all relevant cargo documentation is saved.

03 Preventive Measures

 Before loading, verify the stowage plan on the loading computer and make sure the container weight distribution and the vessel GM meet the requirement.

 The ship's GM should not exceed the maximum value in the CSM, or in violent rolling motion of the ship, containers may fall overboard when there are damages, failure of lashing or movement of cargoes.



Carriage of Containers on Bulk Carrier 10

For bulk carriers, which are not designed specifically for the purpose of carrying containerised cargoes, container lashing and securing devices are generally not fitted on ships. The crew may not be familiar with the procedures of handling containers, or the cargo operation practices at non-dedicated container terminals. Therefore, loading containers on bulk carriers as a transportation unit, no matter on deck or inside cargo holds, will inevitably give rise to some potential pitfalls in the ship's strength, stability and watertightness.

01 Risk Factors to Be Considered

Stability Calculation

With containerised cargoes loaded in bulk carrier cargo holds, the ship's transverse stability cannot be determined as per the standard when it's fully loaded with bulk cargoes. Instead, the volume centre of the stow can be roughly taken as the centre of gravity, provided that heavy units are evenly distributed in bottom tiers and light units on top, or the ship's stability should be calculated based on the weighted average of each container's volume centre.

Bulk carriers generally have sufficient stability as they are designed with a rather high block coefficient and a low superstructure. Stability is not necessarily the major concern when containers are stowed in cargo holds, except that an excess of stability may lead to stricter requirements on cargo securing and lashing, and when the containers are stowed on deck or hatch covers, the stability criteria may be affected due to increased heeling moments.

Pursuant to the freeboard computation in the Load Lines Convention, the permeability of cargo spaces and conditions of loading should be examined to ensure adequate buoyancy in the case of hull damage.

which the bottom plates are likely to be deformed. The IMO has hence recommended in the CSS Code that bottom-tier containers should be stowed on timber of sufficient thickness to transfer the load evenly onto the structure of the stowage area.

Where other cargoes and containers are both loaded in the cargo holds, the cargoes should be arranged in a way to withstand the longitudinal forces and prevent exceeded shear forces and bending moments. Containers stowed in the cargo holds could cause damage to the bulkheads or frames if they were to move and should therefore be secured by suitable lashings and dunnage. For containers stowed on the hatch cover, the hatch cover strength should be first checked, or structural deformation may seriously impact the vessel's watertightness.



Hatch Cover Dunnage

Structural Strength

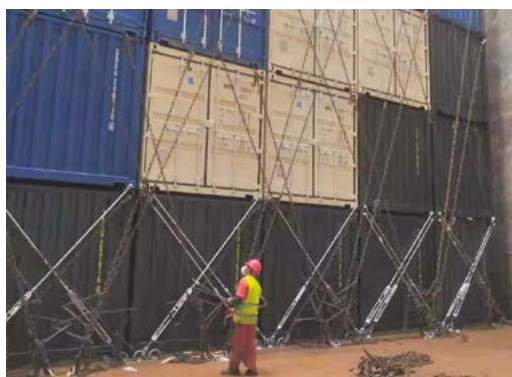
The main weight bearing components of a container are the four corner posts, and therefore the total weight of the cargoes is not evenly distributed over the bottom plate, but on the contact points with the corner posts. A strong pressure is then generated locally. Supporting structure like container sockets are usually not fitted on bulk carriers without

Cargo Securing

Most dry bulk carriers are not equipped with sufficient locking devices or lashing gears, which makes it extra important to adequately secure the containers to the ship through scientific and effective methods. Welded attachments should be aligned to decks and

bulkheads with stiffeners, away from fuel tanks and with consideration of the strength of the bottom plates, frames, bulkheads and hatch covers.

Specialised locking devices are indispensable in satisfying cargo securing requirements and welded angle iron may be necessary against sliding and tipping, or the violent rolling of the ship during the voyage will cause not only transverse and longitudinal sliding, but also collapse of containers as well as damages to the hull and the cargoes inside. Improper lashing has been proved to be one of the major reasons for container collapses on bulk carriers.



Stowage and Securing in Cargo Holds

Navigation Watchkeeping

The height and width of the container stack above the deck or hatch cover of bulk carriers is limited. This is because bulk carriers are not usually designed to load cargoes on the deck and the accommodation spaces are not positioned as high as that on a containership. The field of vision from the conning position, the main steering position and each bridge wing shall under all conditions of draught, trim and deck cargo conforms to the requirements as provided in regulation 22 of Chapter V of the SOLAS Convention and requirements on light sectors in Annex I/9 and Annex I/10 of COLREG 72.

Safe Access

According to requirements of the Cargo Securing Manual, safe access should be provided on containerships and on other ships specifically designed and fitted for the purpose of carrying containers on deck. Where containers are loaded on the deck or hatch cover of bulk carriers, safe access and safe places of work should be maintained for persons engaged in cargo securing operations. Convenience should be provided for the crew members to carry out routinary work in order to access sounding openings and examine or use any firefighting, lifesaving and oil spill facilities without obstructions.

Crew Training

Masters and crews traditionally work on dry bulk carriers are not necessarily familiar with the operations of container cargoes. Where the stowage, segregation, lashing and securing of cargoes are not effectively supervised or suitably cared by the master and crew, technical support from the company, the classification society or the terminal will be necessary for the operation on board.

02 Stability Documentation and the CSM

The SOLAS Convention has specifically provided that the master of the ship should be supplied with reliable stability information and the approved Cargo Securing Manual. With calculation during ship building and designing and also approval by recognised organizations, both can provide professional guidance as to the safety of ships, cargoes and personnel.

However, bulk carriers with approved stability documentation and CSM are not necessarily allowed to accept containers or other break bulk cargoes. It is necessary to confirm

whether a deck cargo (container) loading certificate is available or whether the loading condition and securing arrangements are to be verified by an appropriate standard. Where the loading condition is not acceptable or there are no effective securing arrangements included in the CSM, professional guidance from the classification society should be sought unless alternative measures are taken to satisfy the requirements of the authorities concerned, or the ship may be detained in accordance with the applicable conventions and regulations of the port state control.

03 Preventive Measures

- ❖ Prior to acceptance of containers on bulk carriers, check the Class approved CSM and stability documentation for typical loading conditions and stowage/lassing arrangements which should detail the stowage position, the approved securing devices and methods, or any alternatives for similar conditions. In absence of such information, contact the Classification Society for verification and approval on additional content.
- ❖ The installation, materials, tests and verification of newly added fixed devices provided by the company or the charterers should comply with requirements of the Administration and type approved by a Classification Society with relevant certificates.

- ❖ The ship should be supplied with sufficient lashing and locking devices for immediate replacement of damaged materials during the voyage.
- ❖ The wooden dunnage should be of adequate strength and fumigated with certificate, or it may be rejected by shore facilities or even violate the quarantine requirements at the port of discharge.
- ❖ Apart from the light over heavy principle, consider what negative impact a ship with excessive stability may have on equipment, cargo stacks and personnel in serious rolling during the voyage. Maintain the stability through adjustment of the stowage or ballast operation where necessary.
- ❖ Should any dangerous goods or reefer containers be loaded on ships, the master should check whether the fitness certificate for carriage of the goods is available or whether the power supply is in compliance, or such special units should not be accepted for shipment.
- ❖ The crew should check and clear all devices in the holds after the discharge of containers so that subsequent loading of bulk cargoes won't be affected.
- ❖ Consider appointing an independent surveyor for advice on the stowage and securing plan as well as the actual loading and lashing condition of containers.



Container Stacks Collapsed in Cargo Hold