Global service
built around you

North

Refrigerated Containers

Refrigerated Containers

CONTENTS

Introduction

The carriage of cargo in refrigerated containers, also known as 'reefer' containers, presents a number of challenges.

The carrier's responsibility may only be for the sea transit but increasingly combined and multimodal bills of lading are used and the carrier's responsibility is extended from the point of leaving the shipper's premises up to delivery to the consignee. Therefore this includes road or rail overland haulage and the periods of time the boxes are held at container terminals. Either way, these are critical links in the cold chain.

Reefer cargoes are of a sensitive nature. In addition to the requirements to maintain the correct temperature of the cargo, there is often the need to provide the correct atmosphere within the reefer by means of Controlled Atmosphere (CA) which presents further challenges.

This briefing will identify and address the common problems encountered which can lead to the damage of cargo and potential claims, as well as considering the basics of this type of carriage.

Figure 1: Integrated Reefer Continaer

Analysis of Cargo Damage

For the purposes of this briefing, data covering a five year period with regard to refrigerated container cargo claims was considered.

The type of reefer container cargo can be categorised as follows:

a) Living organic – fresh fruit and vegetable cargo kept refrigerated.

b) Non-living organic – such as frozen meat cargoes.

c) Inert – non-foodstuffs such as pharmaceuticals.

The analysis identified the breakdown of reefer container cargo claims by cargo type as shown in Figure 2.

It is perhaps not surprising that a large proportion related to the carriage of living organic cargoes, given the inherent sensitivities and unique challenges some of these cargoes present.

Furthermore, when all reefer container cargo claims were considered for the period under review, 96% were related to the claim category of 'cargo - damage'.

As most of the cargo damage type claims involved living organic cargoes as opposed to non-living organic and inert, these were further analysed in order to identify the actual nature of the damage to the cargo. This is shown in Figure 3.

It is apparent that in terms of number, a significant proportion of the claims relate to temperature deviation.

To analyse causation, claims data as reviewed by the Club's Loss Prevention Department over a representative period of time was considered.

Causative and contributory factors were identified in each case. Figure 4 shows the distribution of what were considered to be the causal factors.

The analysis identified two common issues:

1. Prolonged periods of time off-power – occurring at terminals, shipper/consignee's premises, overland haulage and onboard the carrying vessel.
2. The technical malfunction of the refrigeration unit and/or its control system and sensors. This included the Controlled Atmosphere unit.

Both of the above ultimately result in the deviation of temperature and/or atmosphere.

Refrigerated Containers (cont.)

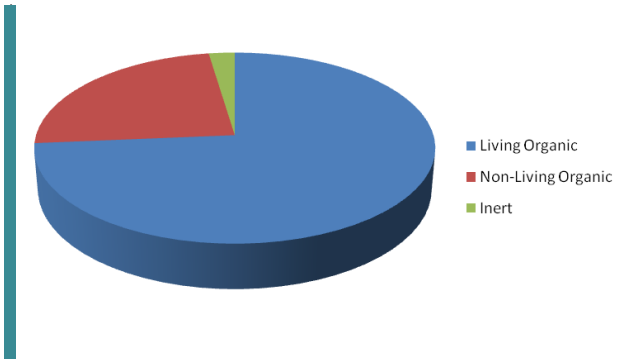


Figure 2: Reefer Containers - Number of Claims by Cargo Type

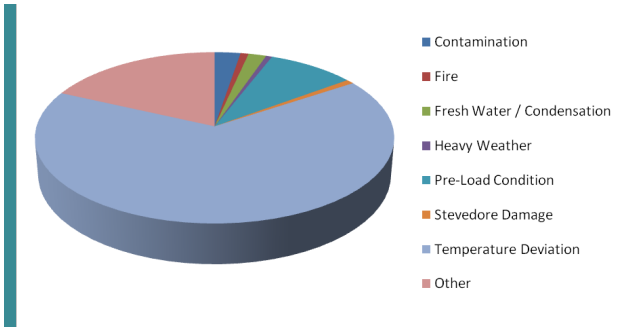


Figure 3: Living Organic Reefer Claims - Nature of Damage

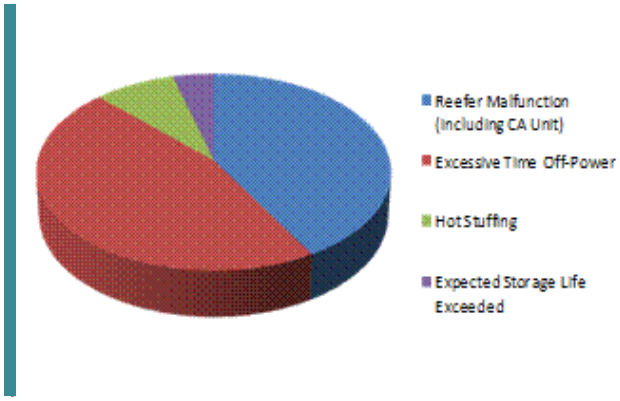


Figure 4: Reefer Cargo Claims Causation Analysis

Deviation of Temperature and Atmosphere

Temperature deviation of a reefer container can be caused by a number of factors.

Some of the common causes of temperature deviation, including Controlled Atmosphere (CA) deviation are listed below (and in no particular order):

a. Malfunction of the refrigerated system, controller or its components. This may include failure of a compressor, fan, probes or loss of refrigerant.

b. Malfunction of the CA system, controller or its components. This may also include CO2 gas leakage.

c. Prolonged periods of time off-power at any of the following locations:
   - Shipper's premises (post-stuffing)
   - Load port terminal or any intermediate ports
   - Onboard carrying vessel(s)
   - Discharge port terminal
   - Consignee's premises (prior to de-vanning)
   - During any road or rail transfer

d. Inappropriate stowage within the container. There should be no gaps of a magnitude that would allow short circuiting of the air flow. The T-bar floor should be clean and clear of any obstructions, and the maximum stowage height must not be exceeded.

e. Hot/Warm stuffing. Reefer containers are generally not designed to bring down the temperatures of warm cargoes to the desired level – they are designed to maintain temperature within the unit and cargo being loaded should already be at the desired temperature. The exception being some banana cargoes, where there is a common and accepted practice of stuffing the container with the fruit at ambient temperatures.

f. Advanced and premature ripening of climacteric cargoes. Such cargoes generate high levels of ethylene during their ripening process, and can emit a notable degree of heat energy. These cargoes may also be ethylene sensitive, so if one part of the cargo has ripened prematurely, the process will accelerate at a rapid rate to the surrounding cargo. Therefore fruit that has advanced maturity at time of stuffing can possibly lead to significant damage to the rest of the cargo.

g. Incorrectly set parameters such as temperature, or confusing °C/°F can lead to incorrect conditions. Freezing injury can cause just as significant damage as elevated temperatures. Incorrectly set ventilation can also lead to cargo damage and poor humidity control.

Figure 5: Premature Ripening & Spoiling

The Cold Chain

Each cargo, and in particular living organic cargo, has specific carriage requirements. To ensure the cargo reaches its final destination (such as a supermarket) in perfect order, the correct conditions must be maintained throughout shipment, i.e. from

Refrigerated Containers (cont.)

harvest to point of sale. This is effectively 'The Cold Chain'.

There is a responsibility on the shipper to provide the correct carriage instructions and a responsibility on other parties to ensure these conditions are maintained.

In the case of living organic cargo, there may be a requirement to pre-cool and initiate the cold chain immediately upon harvesting. The shipper should ensure that the cargo has already been cooled to the desired carriage temperature at the point of stuffing the container (in some cases bananas may be excepted, as explained earlier).

An essential part of maintaining the cold chain is to ensure the reefer containers remains plugged into a reliable power source and that times off-power are kept to a minimum.

Periods of time off-power are inevitable, such as when the container is transferred from the truck power supply; moving within the terminal; and loading/discharging onboard the carrying vessel. But it is essential that power is restored in a timely manner and that procedures are in place to ensure these are undertaken.

Checking and recording temperatures and ventilation settings at appropriate intervals is another important aspect of maintaining the cold chain. Agreements should be in place with the terminals and the carrying ship(s) to ensure regular inspections are carried out, operational logs are maintained, and that appropriate action will be taken in the event of a deviation from the desired conditions.

More detailed loss prevention advice relating to each link of the cold chain can be found further on in this briefing.

Figure 6: Monitoring of Reefer Temperatures

Maintenance of Refrigerated Containers

The safe condition and maintenance of the refrigerated container and its integral refrigeration equipment is the responsibility of the container owner.

There are recognised standards and appropriate regulation in place for the structural aspects of all containers used for sea transportation. These are laid down in the IMO International Convention for Safe Containers 1972 (as amended), often referred to as the CSC.

The CSC requires that the container must be structurally safe and be thoroughly examined visually at least every 30 months (or during the course of normal operations if subscribed to the continuous examination program ACEP). A compliant container will be fitted with a valid safety approval plate (also known as a 'CSC Plate').

Figure 7: Container CSC Plate

However, the CSC does not address the integral machinery of refrigerated and controlled atmosphere containers.

Classification Societies, in their procedures for type approval and initial certification, do detail the requirements for the refrigeration equipment. These standards state the minimum performance requirements of the refrigeration system as well as the thermal characteristics of the container and its insulation. However, these are aimed only at newly constructed reefer containers, and not enforced during the container's life.

It is therefore down to the owner of the container to maintain it and its equipment to a satisfactory standard, and carry out any maintenance in accordance with manufacturers' guidelines.

Service guides for the different makes and models of refrigeration containers are generally readily available. The scope of recommended maintenance differs between manufacturers; some are quite basic and others relatively comprehensive. Manufacturers also differ on maintenance intervals, with some calendar based and some working on the accumulated running hours of components.

The very nature of the container trade means that it is very difficult to determine the future movements of a unit. Unpredictable itineraries clearly make it difficult to monitor running hours and satisfy arranged planned maintenance schedules. Container owners are usually encouraged to enter into service agreements with reliable manufacturer approved companies with worldwide coverage.

Refrigerated Containers (cont.)

Each reefer container should have a log book which records all planned maintenance, overhauls and repairs. This log book may be kept with the container and found in a safe location such as inside the control panel.

It is apparent that there is a significant reliance on the pre-trip inspection (PTI) which should be carried out before each use. The scope of a PTI should consist of:

- Auto PTI – a self-diagnostic program carried out by the controller to check the status of components and probes.
- Visual inspection of the container and its refrigeration (and CA if applicable) system and components.
- Operational check of the container and its equipment (which be part of an expanded auto PTI, depending on type).

The PTI is often carried out by a local authorised service provider (ASP), and in some cases can be arranged by the container terminal.

On some models of reefer container, the details of the PTI may form part of the event data download.

Bills of Lading & Agreements

There are potentially a significant number of contracts and agreements in place between the various parties related to the carriage of containers. The flowchart on page 6 illustrates the typical agreements in use between shippers, liner operators, slot charterers etc.

BIMCO have a number of relevant charter parties and contract templates and some of these will be referred to in this briefing.

Two such important contracts that relate to the container and directly affect the care of the cargo are the Bill of Lading (B/L) and the Terminal Handling Agreement (THA).

Bills of lading & network liability clauses

Dependant on the B/L issued, the carrier's liability extends from either inside the ship's rail, or from point of collection from the shipper up to the point of delivery to the consignee.

The liabilities can be summarised as follows:

Port to Port

- Hague or Hague-Visby Rules should apply
- Carrier has no responsibility outside of the ship's rail

Door to Door

A Combined Bill of Lading (BIMCO COMBICON) or Multimodal Bill of Lading (MULTIDOC 95) is generally used. The liabilities are dependent on if the B/L covers from point of collection to point of delivery or is less onerous on the carrier, as well as if it is known where the loss or damage occurred.

Liability if the stage at which loss occurred is known:

- Onboard ship - Hague or Hague-Visby Rules
- Road Carriage - EU CMR 1956, UK RHA 1991 & relevant compulsory national laws

Liability if the stage at which loss occurred is not known:

- Assume onboard ship - Hague or Hague-Visby Rules

The B/L should include the carriage instructions and the carrier's obligation regarding these requirements.

There have been numerous instances where these instructions have not been sufficiently accurate. A common finding is that the ventilation settings have been stated in percentages rather than actual volumetric flow rates.

The instruction with regard to the carriage temperature should be limited to the carrier's obligation to maintain a specific air temperature set point as this is generally the only controllable temperature parameter.

The instructions may also include requirements for Controlled Atmosphere (stipulating CO2 and O2 levels) and relative humidity.

The shipper should consider this accordingly when advising of their carriage requirements.

It is also common for some operators to have their own liner bills of lading for this trade.

Terminal handling agreements

The liner operator will usually have agreed terms and conditions with the load, discharge and any intermediate container terminals. This may take the form of a Terminal Handling Agreement.

Under this agreement, the container terminals should ensure reefer containers are connected to an appropriate power source and that they are checked and temperatures logged at prescribed intervals.

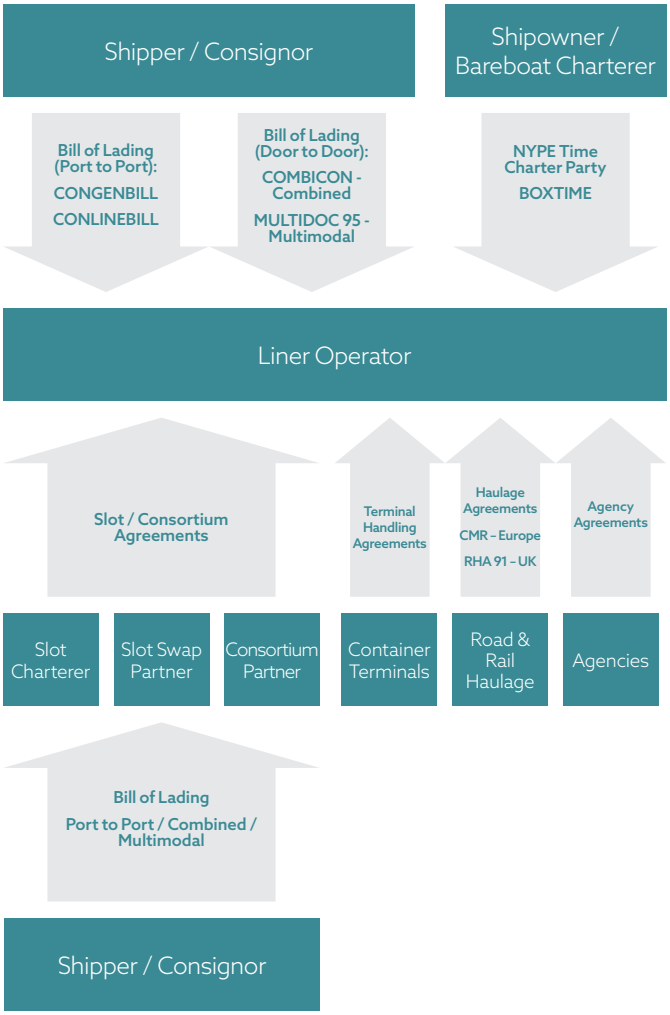
Agreements should be reviewed by the Club to confirm that Members are not prejudicing club cover by any terms contained in the agreement.

The liner operator, or the agency acting on behalf of the operator, must ensure that accurate information is given to the terminal planners in order for them to properly care for the cargo.

Container terminals can often arrange repairs and pre-trip inspections (PTIs) upon request.

Refrigerated Containers (cont.)

Typical Contracts & Agreements



Loss Prevention

The following includes some of the common issues identified with the carriage and care of reefer containers, and recommendations for carriers but which may also apply to other parties involved in the cold chain, from shipper to consignee.

It has already been identified that the main causal factors of reefer container cargo damage are:

i. Prolonged periods of time off-power

ii. The technical malfunction of the refrigeration unit

The aim of these suggestions is to:

1. Ensure the cargo is properly cared for at all stages of the cold chain.

   In particular:

   a. Prevent damage to reefer cargo caused by prolonged periods of time off-power.

   b. Prevent damage to reefer cargo caused by the breakdown or malfunction of the container and its machinery.

   c. Raise awareness of the need to understand the nature of the cargoes being transported and ensure that carriage instructions are suitable.

2. Assist in defending a claim resulting from reported damage to cargo.

Caring for the Cargo

Harvesting and Shipper's Premises

Living organic cargo can be vulnerable to damage at an early stage due to plant diseases, disorders, pests and infestation, as well as being influenced by the weather.

Mixing of harvests within the same packaging can lead to accelerated ripening of one batch due to the close proximity of an already maturing fruit. Ethylene sensitive and ethylene producing cargoes when close together can lead to the onset of premature ripening.

Each living organic cargo has different levels of ethylene sensitivity and ethylene production. For example, bananas have a moderate ethylene production rate and a high sensitivity to ethylene. Oranges have a very low ethylene production rate and a moderate sensitivity. Such characteristics determine the suitability of carrying different cargoes together or storing them in close proximity.

Figure 8: Premature Ripening of bananas of mixed harvests

Refrigerated Containers (cont.)

With consideration to the above, the shipper should exercise good stock management, segregation and control allocation of harvest/batch codes.

Many cargoes require rapid pre-cooling or freezing within a given time upon harvest and before shipment, although there is a common practice of loading bananas at ambient temperatures which may very well be over +25°C.

A good understanding of the cargo characteristics by all parties concerned will be of great benefit – utilise free services such as **www.cargohandbook.com** and **www.tis-gdv.de**

Empty Release & Stuffing

It is of great importance that the reefer container is fully operational and suitable for the intended cargo. This will require it to be clean and free from taint.

At time of empty release, pre-trip inspections should be carried out and properly documented.

The temperature and CA set points and the ventilation setting should be set correctly at time of empty release, unless otherwise agreed.

The stowage of the cargo within the reefer container would normally remain the responsibility of the shipper. They should be aware of the importance of correct stowage of the cargo when stuffing, ensuring the stow height does not restrict air flow, and avoid short circuiting.

It is also the shipper's responsibility to ensure the carriage instructions are accurate and unambiguous. Ventilation settings should be stated in flow rates (such as m^3/h and cbm/h) and not percentages. This is particularly important as the displayed percentages on the vent arrangement do not necessarily equate to the same corresponding actual flow rate from one type of container to another.

All parties should be aware of the fact that reefer containers are generally not designed to bring down the temperatures of warm cargoes to the desired level, and only maintain temperature within the unit. Therefore, (with the exception of some fruit cargoes such as bananas), the shipper must appreciate that the cargo must be pre-cooled to the required carriage temperature at point of stuffing.

As with all other stages of the carriage, ensure the electrical power supply to the container is connected in a timely manner and is reliable.

Overland Haulage

A common finding is the failure to provide a power supply during the road and/or rail legs of the transit. This is even more damaging when the reefer container has not been transferred expeditiously.

Always use trusted and reliable hauliers. They must be aware of the importance of maintaining a power supply to the reefer container they are transporting.

A good haulier will carry out checks on the unit accordingly and provide an important document trail.

Ports and Container Terminals

The review of claims data suggested that there numerous occasions where the reefer container remained off-power for excessive periods of time whilst at the container terminal.

Load, discharge and intermediate container terminals must ensure that a reliable power supply is connected in a timely manner upon arrival at or transfer within the port.

The location of the container whilst at the port may have an influence. Positioning reefer containers away from direct sunlight, heat and sources of taint should be considered.

Terminals should regularly monitor and record the temperatures and status of the reefers under their care.

An accurate document trail which records the movements of

Refrigerated Containers (cont.)

the reefer container is valuable in the event of a claim. Equipment Interchange Receipts (EIR) should be maintained.

The carrier or container owner should have a working relationship with an effective and trusted maintenance and repair service provider with a worldwide network who can attend at terminals on the fleet's trade routes.

The service provider can also carry out pre-trip inspections (PTIs) and auto-diagnostic programs. This will supplement the planned maintenance carried out as per the reefer manufacturer's guidelines and documented accordingly.

Sea Transit

As is the case with container terminals, it is essential that the electrical power supply should be established in a timely manner upon loading. The consequences of a premature disconnection of the power supply at the discharge port should also be recognised.

Another important factor is the reliability of ship's power supply. Ship's generators should be capable of operation to full design capacity and standby generators available in case of a need for unplanned maintenance during passage.

Effective onboard fuel treatment practices should be carried out to provide further levels of reliability and to prevent related mechanical breakdowns.

The ship's electrical distribution system and container supply sockets should be in good working order and undamaged.

Regular monitoring and recording of the temperatures of the reefer containers under their care should be carried out and properly documented. In the event of a claim these can be compared against the reefer unit download data and shipper's mobile temperature devices.

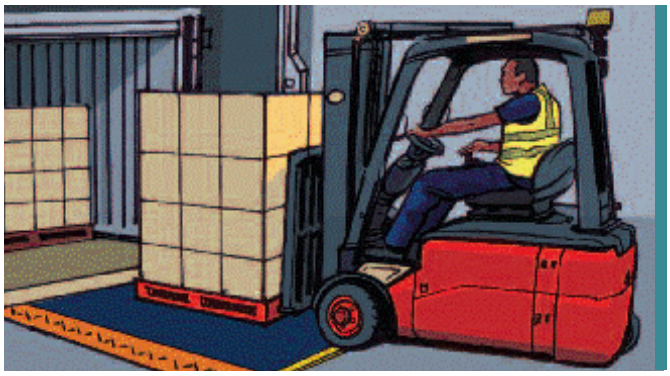
There have been instances where the values as recorded by the crew and entered onto the ship's own log have not correlated with the other recording devices. These were shown to be erroneous and suggested that the onboard record keeping has in some cases been inaccurate or falsified.

It should be recognised that repetitive tasks such as temperature monitoring of reefer containers can introduce complacency on the part of the crew. As such, the crew should be regularly reminded of the importance of accurate record keeping and how it is vital evidence in proving they properly cared for the cargo whilst in their custody. Random cross checking and verification of log taking practices can prevent such occurrences, not to mention the often underused practice of praising those who carry out their roles in effective and trustworthy manner.

In the event of reefer container breakdowns, ships should have adequate spares onboard and the relevant skills to carry out emergency repairs to the reefer onboard.

The ship should also give prompt notification of reefer problems or malfunctions that cannot be repaired onboard.

De-Vanning of Container



As with all other stages of the carriage, the consignee should ensure the electrical power supply is connected in a timely manner and is reliable for the period prior to de-vanning.

The consignee should check for any irregularities at time of delivery as prompt action may prevent or mitigate any cargo damage.

Defending a Claim and Mitigation of Damage

In the event of a cargo damage claim, the strength of the defence is aided by good accurate records and documentation.

The following documents and information are all helpful when investigating the cause of damage, and in particular when attempting to deduce if it is pre-shipment or a failure to care for the cargo in transit, and if the latter at what point of the cold chain this occurred:

- Data downloads from the reefer container – checking also that there has been no inappropriate alteration or manipulation of the data
- If fitted (and increasingly rare), Partlow charts
- Temperature record logs from the terminal and any holding areas
- Temperature record logs from the carrying vessel(s)
- PTI documentation
- Service reports and records of any repairs carried out
- EIR documentation and tracking data

Refrigerated Containers (cont.)

- Shipper's mobile temperature recording devices (Ryan recorder or TempTale for example); noting their position within or on top of the stow
- Bills of lading and carriage instructions

In some cases, the prompt appointment of a surveyor can be very beneficial, not least for their ability to provide contemporaneous independently verified evidence. This is most pertinent when the nature of the stowage of cargo within the container may be causative to the damage or a contributory factor and evidence of such is needed before de-vanning takes place.

If the affected cargo is of a living organic type, then the attending surveyor should be looking to record grower's/ harvest codes in order to identify any trends which may suggest damage was of pre-shipment origin.

The surveyor can also be effective in mitigating cargo damage as not all may be affected or in some cases the cargo may attract a salvage value. Separation, segregation and repackaging are salvage options to be explored.

An invaluable source of reference for the carriage conditions and characteristics of each type of reefer cargo can be found on the online database developed and maintained by BMT Surveys of Rotterdam:

www.cargohandbook.com

More in-depth information on fruit and vegetable cargoes can be found in Dr Anna Snowdon's A Colour Atlas of Post-harvest Diseases and Disorders - Volumes I and II.

Glossary

Controlled Atmosphere: This is a method of controlling the oxygen (O2), carbon dioxide (CO2) and nitrogen (N2) concentrations of the atmosphere within the reefer container. This is in addition to the standard temperature control. O2 levels are lowered by the admittance of N2 supplied from an integrated nitrogen generator. CO2 levels are raised by either the natural respiration of the cargo or by introduction from a separate CO2 bottle. Fresh air is admitted on demand though an air solenoid valve.

Climacteric: Produce fruit cargoes which continue to ripen after harvesting are classed as being climacteric. Examples of such are bananas and pears. Conversely, fruits that do not further ripen after harvest are termed non-climacteric such as oranges and grapes.

Ethylene: A hydrocarbon gas and natural hormone emitted by plants. It is closely associated with the speed and control of the ripening of fruits post-harvest.

Short Circuiting: The effect of the air flow choosing the path of least resistance and not passing though the cargo. If there are large gaps or chimneys within the stow, then the air is more likely to pass through these and not penetrate the cargo. This reduces the unit's capability to maintain the cargo at the desired temperature.

BIMCO: Baltic and International Maritime Council - A shipping association whose main objective is to facilitate the commercial operations of its membership by means of developing standard contracts and clauses, and providing quality information, advice, and education.

Disclaimer

Published July 2013.