The Swedish Club

Container focus

Refrigerated cargo analysis

2022

LOSS PREVENTION ESSENTIALS

Ensure you comply with the shippers' carriage instructions. If these are unclear, seek clarification.

When loaded, make sure that the container's set temperature complies with the carriage instructions.

Keep clear and accurate records of temperature, ventilation, and other relevant aspects. The records must cover each stage of the voyage, from loading to discharge.

It is important to maintain a continuous supply of power to reefer containers during the voyage.

Keep a record of all incidents regarding the vessel's diesel generators and reefer circuit breakers, and their associated alarm systems.

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1. Introduction

In this publication we focus on the most common causes of refrigerated cargo – 'reefer' – container claims, and provide analysis, case studies and loss prevention advice.

A younger relative of the original container, refrigerated containers have only been with us since the 1970s. Although the construction principles of a reefer are still fundamentally the same – a box with an integral refrigeration unit - new systems are in operation that make it possible to control the operation of the reefer both automatically and remotely. These include controlling the temperature, humidity, managing access and dealing with accidents.

This complex piece of engineering, has, over the years, become more reliable, and can be trusted to transport perishable goods vast distances, with little or no impact on quality.

It is easy to forget therefore, that the vessel crew still has an important part to play in ensuring that these fragile cargoes are delivered safely, and that the actions of those on board can make a significant difference to the claims experienced by an operator.

What we present are the most common causes that lead to claims, which are based on the Club's own statistics. We believe this gives a fair and representative picture of the issues and what areas to focus upon to avoid claims from happening.

The sister publication - ***Container focus: Preventing the loss of containers at sea***, discusses the issues which lead to containers being lost overboard, and can be downloaded from The Swedish Club's website at: https://www.swedishclub.com/films-and-publications/publications/loss-prevention-and-brochures/

If you have any questions, please contact **Joakim Enström**, the author of this publication, at joakim.enstrom@swedishclub.com

2. Statistics

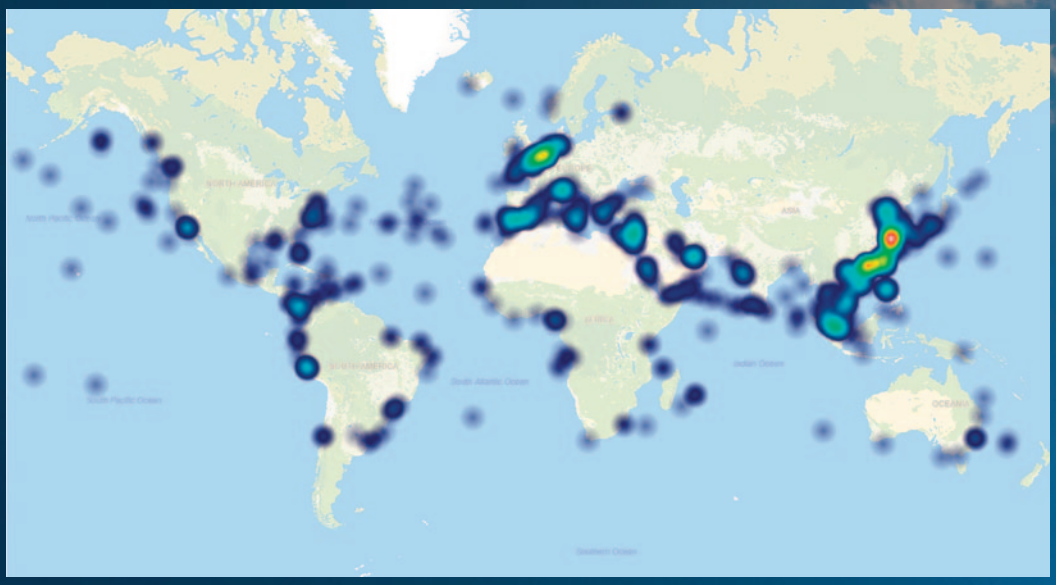
Introduction

For a cargo claim to be included in this report it must have generated a cost of at least USD 5,000 after the deductible. The average deductible for cargo is about USD 12,000 for this five-year period.

In this publication we examine almost 300 cargo claims on container vessels which have occurred between the years 2017 – 2021. About 100 of these are claims concerning reefer containers.

2.1 Geographical location of claims

GRAPH 1
Container cargo claims, 2017-2021
As per 05/07/2022



It can be seen that most incidents that lead to claims take place in China, ARA (Amsterdam, Rotterdam, Antwerp) and USA. Refrigerated container claims do not diverge from this pattern.

As these are centres for world trade, this is unsurprising. It should be noted that most of the incidents take place during the voyage.


CAUTION
9' – 6"
HIGH
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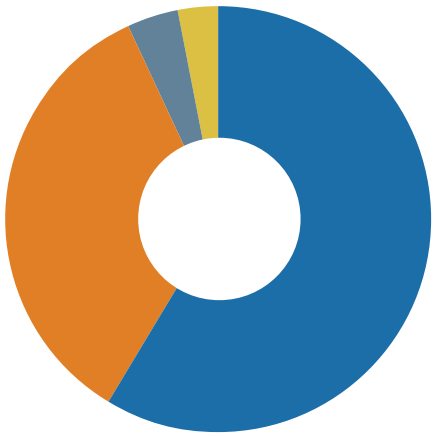
2.2 Point in the voyage when the incident took place

GRAPH 2a

Cargo: All container claims, 2017-2021
Claim cost: USD 5,000 – 3,000,000
As per 05/07/2022

During voyage	59%
Discharge port	34%
Loading port	4%
Outside period of responsibility	3%

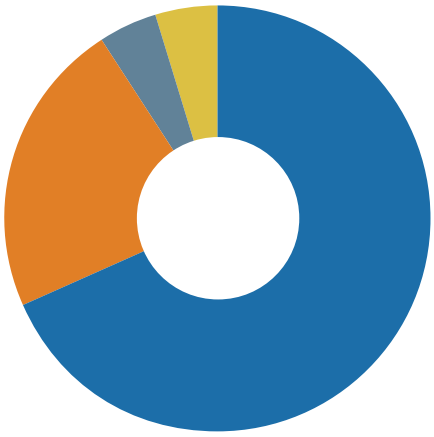


Considering the container sector as a whole, this chart shows exactly where the incident occurred that prompted the claim. Nearly 60% of incidents occurred during the voyage and 34% occurred at the discharge port.

GRAPH 2b

Cargo: Reefer container claims, 2017-2021
Claim cost: USD 5,000 – 3,000,000
As per 05/07/2022

During voyage	69%
Discharge port	22%
Loading port	5%
Outside period of responsibility	4%

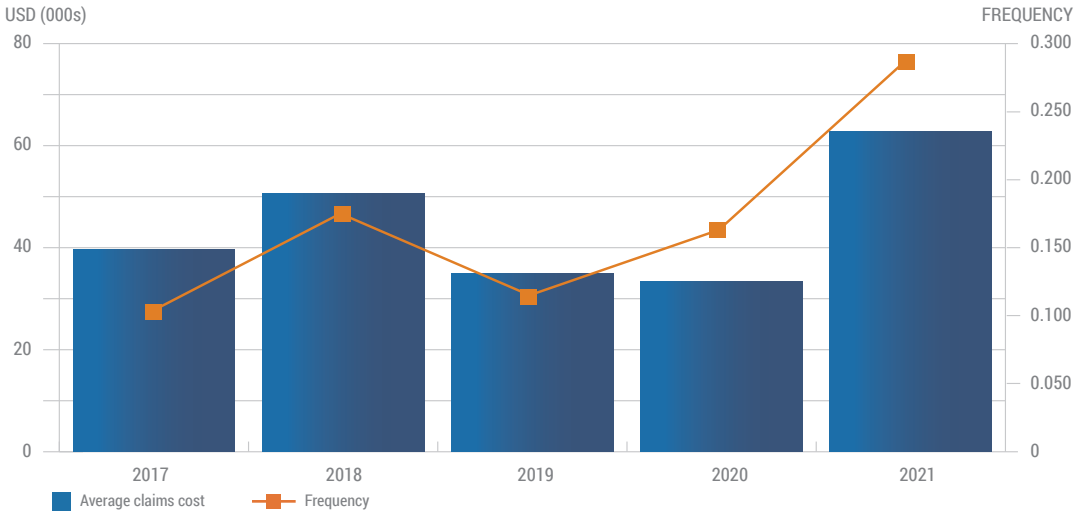


As can be seen from the chart, for reefer claims, a greater number of incidents (69%) occur during the voyage, when something takes place on the vessel which causes the reefer container to fail. Only 22% of incidents occur at the discharge port.

If you compare these results with Graph 3, it can be seen that 59% of incidents leading to container claims take place during the voyage, compared with 69% for reefer containers.

2.3 Average claims cost and frequency per year

GRAPH 3a
Cargo: All container claims, 2017-2021
Claim cost: USD 5,000 – 3,000,000
As per 05/07/2022



The average claim cost for the container vessel sector was USD 50,000.

The average frequency of claims for this five-year period is 0.16 which means that 16% of all insured container vessels have had a claim above USD 5,000.

We have seen an increase in both frequency and average claim cost between 2020 and 2021, since the beginning of the pandemic.

In 2021 over 80% of the cost was generated by containers being lost overboard.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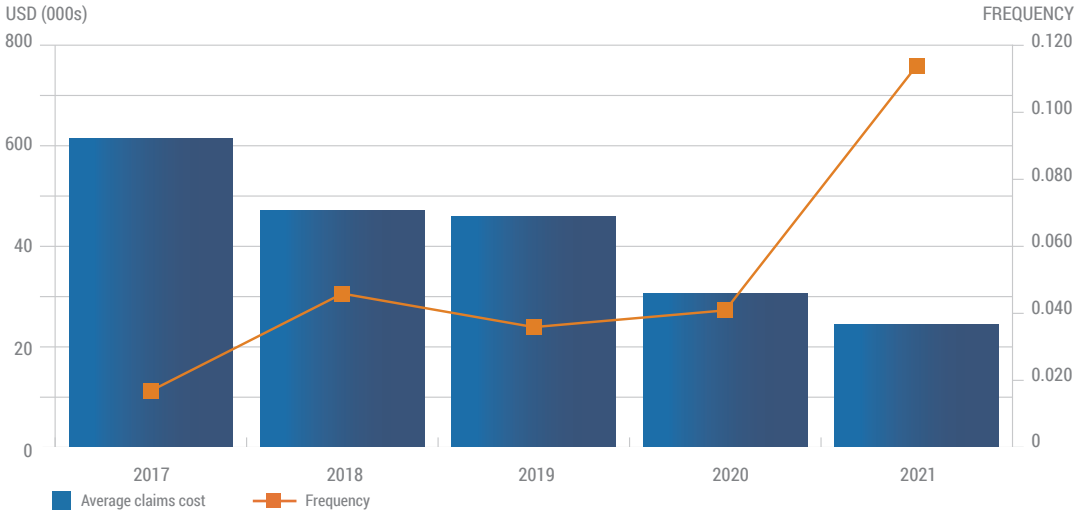
GRAPH 3b

Cargo: Reefer container claims, 2017-2021
Claim cost: USD 5,000 – 3,000,000
As per 05/07/2022



It can be seen that the frequency of reefer claims has varied over the last five years. The average frequency for this period is 0.045, i.e. 4.5% of all container vessels have had a reefer cargo claim.

The average cost has been going down over this five-year period and is on average about USD 38,000 after the deductible. There was, however, an increase of frequency from 0.041 in 2020 to 0.114 in 2021, as a direct result of supply chain disruption due to the pandemic.

In 2020 the most common immediate cause of a reefer cargo claim on container vessels was reefer mechanical failure at 36% followed by temperature variation at 29% of the claims.

In 2021 the most common cause of reefer cargo claim on container vessels was temperature variation at 65% and poor monitoring/maintenance of reefer units at 18% of the claims – a significant increase compared to previous years.

Investigation into the causes of this increase identifies the main cause as an increase in delays during the pandemic, the majority of which took place in China. Disruptions during the many regional lockdowns led to a high number of reefer containers being delayed either in port or during transportation to and from port via road or rail.

This clearly demonstrates that reefer containers are very sensitive to fluctuations in temperature, and this is explored further in this publication.

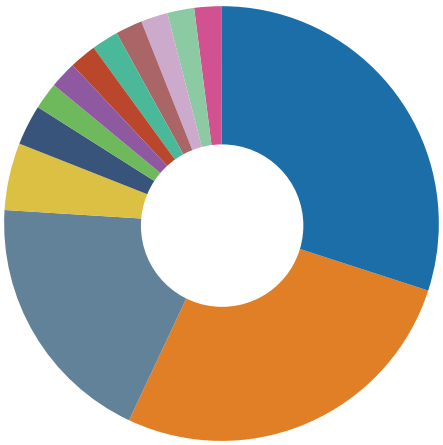
2.4 Overview of claims in the sector as a whole

GRAPH 4

Cargo: Type of claim
Number of claims
Claim cost: USD 5,000 – 3,000,000
All container vessels, 2017-2021

As per 05/07/2022

Temperature damage	30%	Leakage	2%
Wet damage	27%	Delay	2%
Physical damage	19%	Deterioration	2%
Unclaimed cargo	5%	Shortage	2%
Self ignition	3%	Theft	2%
Lost overboard	2%	Other	2%
Contamination	2%		



The most common claim category is for temperature damage to cargo. This cause accounts for 30% of all container claims, and is the main focus of this publication.

Wet damage accounts for 27% of all claims and is generally caused when the vessel sails through heavy weather and water enters through the cargo hatch covers. Other causes include water entering the cargo hold via a leaking pipe, errors in the ballast operation or bilges not maintained in a correct manner.

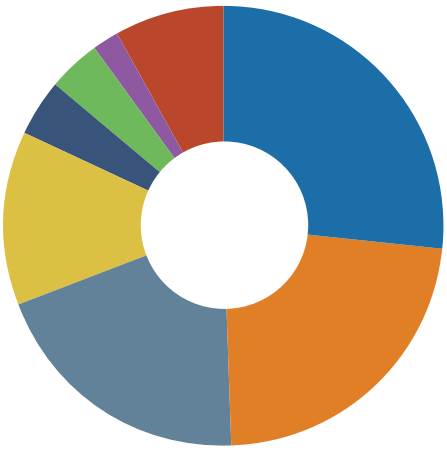
Physical damage accounts for 19% of claims, and is again mainly caused when the vessel sails through heavy weather and the cargo in the containers is damaged, or the container and its securing equipment is damaged; or alternatively when the container or its securing equipment is damaged somehow during cargo operation.

GRAPH 5

Cargo: Type of claim
Cost
Claim cost USD 5,000 – 3 000 000
All container vessels, 2017-2021

As per 05/07/2022

Lost overboard	27%
Temperature damage	23%
Wet damage	20%
Physical damage	13%
Contamination	4%
Unclaimed cargo	4%
Deterioration	2%
Self ignition	8%



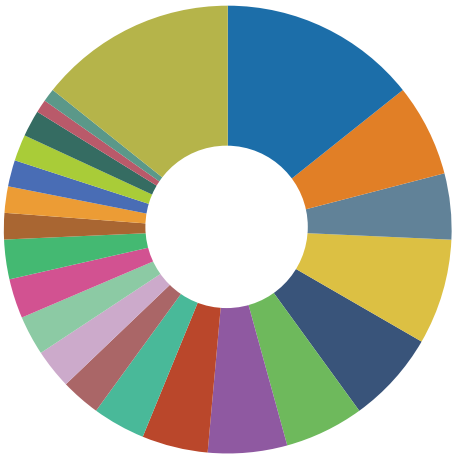
The most expensive claims category is that of containers being lost overboard at 27%, followed by temperature damage at 23% and wet damage at 20%.

GRAPH 6

Cargo: Cause of claims
Number of claims
Claim cost: USD 5,000 – 3,000,000
All container vessels, 2017-2021

As per 05/07/2022

Temperature variations during trip	**18%**	Insufficient lashing/securing by shipper	3%
Poor monitoring/maintenance of reefer unit	**7%**	Theft	3%
Reefer mechanical failure	**5%**	Inherent vice	2%
Flooding of hold	8%	Multiple	2%
Heavy weather	7%	Other leakage	2%
Improper cargo handling, ship side	6%	Damage prior loading	2%
Leaking container	6%	Poor stowage	2%
Unclaimed cargo	5%	Insufficient lashing/securing, ship side	1%
Improper cargo handling, shore side	4%	Leaking pipes	1%
Unknown	3%	Other	13%
Fire	3%		



The most common cause of container claims is variation of temperature during the trip (18%). This is followed by flooding of the hold (8%).

Heavy weather is the cause of 7% of claims, when the vessel loses containers overboard or containers cause damage to the vessel due to the weather. Although a relatively low percentage of claims volume, the consequences can be catastrophic, and in fact these are the most expensive type of claim.

However, if we re-examine the figures it can be seen that the causes which specifically relate to reefer containers make up a considerable element of the claims picture.

Temperature variation (18%), poor monitoring of the reefer unit (7%) and reefer mechanical failure (5%) in total contribute to 30% of the total claims, demonstrating that reefer failures are the main cause of container claims.

3. Loss prevention advice

Reefer containers carry a wide variety of refrigerated goods, of which fresh produce, frozen meat and fish, dairy products and pharmaceuticals are only a few. A single reefer container may carry a cargo value of several hundred thousand US dollars or more.

Each type of cargo varies in its requirements for carriage temperature, humidity, stowage arrangements and ventilation.

3.1 Temperature

Temperature abuse affects cargoes in different ways depending on the cargo. For fresh or frozen products this might include premature ripening, freezer burn, frosting and textural changes.

To prevent this the crew should check that the container set temperature complies with the shippers' specified carriage instructions. The external integrity of the reefer container should also be checked for damage with any defects noted and photographed. The shipper should be notified of any physical damage to the container.

Poor airflow/ventilation through the cargo can lead to temperature hotspots developing. This can be due to poor stowage or packaging of cargo preventing airflow through the cargo or over stowage of cargo preventing return air to the refrigeration unit.

3.2 Air

When carrying frozen cargo, the fresh air ventilation ducts should always be closed. In contrast, for chilled live cargoes such as fruit and vegetables the products should be stowed to allow air flow to circulate throughout the cargo stow, this will remove product heat, as well as moisture and gases such as carbon dioxide and ethylene. The exact ventilation requirements will depend on the type of product carried.

3.3 Loading

It is important to note that the reefer container is designed to maintain the cargo temperature rather than cool it. Ideally, all cargoes should be loaded at the intended carriage temperature to ensure product quality is maintained. The most important point for carriers is to ensure that the carriage instructions and set temperature are checked and adhered to at the time the reefer container is loaded.

3.4 Monitoring

Continuous supply of power to the reefer containers is also of utmost importance during the voyage. The vessel's crew should regularly monitor this and ensure that all incidents regarding the vessel's diesel generators and reefer circuit breakers and their associated alarm systems are meticulously recorded. Proper container monitoring and prompt action during a voyage will provide helpful information as to whether the carrier should appoint a surveyor to be present for opening of the container at the destination.

3.5 Record keeping

In the event of a claim, one of the most effective defences is the maintenance of clear and accurate records and documentation of each stage of the voyage from loading through to discharge.

For reefer containers, the crew can assist by maintaining detailed and accurate monitoring and maintenance logs as well as obtaining date stamped photographs of incidents which occur during the voyage.

However, the container's datalogger is the most accurate log available.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4. Case studies

4.1 Damage to various food products

The container vessel had loaded cargo in a European port, to be discharged in Asia. Several reefer containers with meat, fish and other food had been loaded. The containers had been filled with frozen food at a temperature of -20°C and the container temperature was set to freezing.

During the voyage an AB checked the containers twice a day and logged the temperature at between -19°C and -20°C.

One month later the vessel discharged the containers in Asia. When the cargo receivers inspected the meat, they found it to be thawing.

According to the container units' records, the temperature in the containers had increased over a couple of days after departure from -15°C to +5°C. All the alarms for the containers had been disabled.

The fresh air ventilation to the containers had been open. This allowed a continuous flow of warm air into the containers. Why this had been opened after departure is not known.

The cargo was fully rejected and destroyed by the cargo receivers.

The crew had not verified the correct temperature of the container but only written down what should have been the correct temperature in the log as the actual container's digital log showed +5°C and not -20°C as in the vessel's log.

4.2 Meat damaged due to wrong temperature settings

The container vessel had loaded cargo in a South American port, to be discharged in Europe. Several reefer containers with meat were also loaded. The containers had been filled with superior chilled meat at a cargo temperature of around 0°C. The containers were set to chilling mode with a set point temperature of -1.4°C.

For some reason one of the containers was switched to freezing mode with a set point of -18°C and remained at this setting throughout the entire month's voyage to Europe.

On the bill of lading it was stipulated that the container should be kept chilled at a temperature of -1.4°C. However, during the loading operation the agent supplied an initial reefer list which had two separate entries for this container - one stated that the container should be chilled and another stated that it should be frozen. This mistake was discovered by the crew, and the agent then updated the reefer list confirming the set point temperature as -1.4°C for the container.

One month later the vessel discharged the containers in Europe. When the cargo receiver inspected the meat, it found it to be frozen. The meat should have been chilled as it becomes damaged when it is frozen.

According to the container unit's records the temperature in the container fell a couple of days after departure. This caused the meat to freeze. Over a sufficiently long time, even a reefer container will achieve solid freezing of the entire cargo. In this case, there was clearly sufficient time.

Each piece of meat was packed in a heat-sealed vacuum plastic liner bag. When the cargo receiver inspected the meat it had turned dark red and slightly brownish and the vacuum bags contained a considerable quantity of blood.

The meat which was initially of superior quality could now only be used for lower end products and had to be sold for a loss.

4.3 Damage to seafood

A shipment of containerised boxed shrimps shipped from Argentina to China was found to be badly frosted. The shrimps inside the boxes were also beginning to blacken due to melanosis. Shrimps and crustacea undergo melanosis (an enzyme catalysed oxidation) when they are kept at incorrect temperatures and/or past their shelf life. Melanosis is also related to the freshness of the product at the time of freezing and whether it has been treated with any preservatives. While melanosis is not dangerous for consumption, it is a quality control indicator, and renders the shrimps unsightly and unsaleable.

The frosting is a second indicator that the product had suffered temperature abuse. Frosting appears when a product is thawed and then partially refrozen.

Usually, the boxes are tightly packed into the containers, restricting airflow through the cargo and effectively insulating the cartons inside the stow compared to the ones in the outside. The product on the inside of the stow would be insulated against the worst damage by the cargo around it. It is then expected to observe a gradient of damage as the condition of the cartons is poorest nearest the door and the external edges of the stow, with the damage lessening towards the rear of the container.

The cargo should always be kept below the load line of the container, away from the container walls and not beyond the 'T' bars to allow the refrigerated air to flow freely around the whole of the stow.

The container logs showed erratic temperature changes. Seven days after the start of the voyage, the temperature started to rise slowly but steadily from -25 °C to a range between -10 °C to -2 °C at arrival, which is indicative of a refrigeration system malfunction. These temperatures are sufficient for melanosis and frosting to occur.

The Master and the crew should have been warned of the malfunction and should have made an attempt to repair the container. However, the corresponding alarms were not relayed to the vessel, suggesting a secondary malfunction in the system.

4.4 Damage to fresh produce

A cargo of bagged white garlic was shipped from China to Central America. On arrival, it was noted that significant portions of the consignment showed signs of germination.

After curing (a process of drying after harvest), garlic can be stored at high temperatures (+25 °C) or low temperatures (-3 to 0 °C) to prevent germination of the bulbs and maintain the storage life of the product. Temperatures above 5 °C and below 20 °C are not appropriate for garlic storage and can cause dormancy break, advanced germination, and fungal/bacterial issues. It is common to see garlic transported in containers at low temperature (i.e., -3 °C to 0 °C). At these lower temperatures, the heat generated by respiration of the garlic bulbs is removed, helping to maintain a period of dormancy.

The temperature records indicated that it took several days for the temperature to reach +4 °C. Furthermore, the situation was exacerbated by the cargo being 'hot-loaded', meaning that the cargo was not pre-chilled before loading. The effect of these two factors was to prevent the cargo from meeting the required temperature range and thus, led to a significant portion of the cargo arriving with unacceptable levels of germination.

The crew should take care when checking, that set point temperatures, as outlined in the carriage instructions, are properly applied to the containers. A failure to do so can lead to the onset of germination and/or spoilage of cargo through bacterial or fungal infections.


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5. Conclusion

Key learnings from case studies

- It goes without saying that a continuous supply of power to reefer containers is of the utmost importance during the voyage. The vessel's crew should regularly monitor this and ensure that all incidents regarding the vessel's diesel generators and reefer circuit breakers, and their associated alarm systems, are meticulously recorded.
- The crew should check that the container set temperature complies with the shipper's specified carriage instructions.
- The external integrity of the reefer container should also be checked for damage with any defects noted and photographed.
- It is important to note that the reefer container is designed to maintain the cargo's temperature rather than cool it. Ideally, all cargoes should be loaded at the intended carriage temperature to ensure product quality is maintained.
- The crew should keep clear and accurate records. Document each stage of the voyage from loading through to discharge as well as obtaining date-stamped photographs of incidents which occur during the voyage.
- The owner should be aware that charterparties are often based on BOXTIME and, if not amended, any temperature damage to the cargo in reefer containers which is caused by crew negligence is 100% the responsibility of the owner.
- Ensure you comply with the shippers' carriage instructions. If these are unclear, seek clarification.
- When carrying frozen cargo, the fresh air ventilation ducts should always be closed.

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