Circular

Ventilation

We frequently handle cargo claims that are the result of moisture damage. As moisture damage to a cargo is caused by ship's sweat or cargo sweat, proper ventilation plays a key role in preventing this problem.

The cargo ventilation system should be used to:

- prevent cargo sweat and ship's sweat
- supply fresh air to the cargo
- prevent poisonous gasses from accumulating
- remove the odour of previous cargo
- disperse the heat and moisture generated by some types of cargo

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This circular is a practical guide that explains how cargo sweat and ship's sweat occur, and how these phenomena can be prevented by using the ventilation system correctly. Furthermore, we have included several practical tips and two simplified flow charts. These charts provide practical guidance on when to ventilate the cargo.

Ventilation

In terms of ventilation, we divide cargoes into two different groups.

1) Hygroscopic cargoes, such as agricultural products (grain, rice, flour, sugar, cotton, tobacco, cocoa, coffee and tea). They contain an inherent quantity of moisture that can interact with the air.

2) Non-hygroscopic cargoes, such as steel products. They do not contain an inherent quantity of moisture that can interact with the air.

As discussed in the introduction, ventilation is essential to avoid cargo becoming damaged by cargo sweat or ship's sweat. The ventilation system must always be used until the cargo has been discharged, and ventilation should not be stopped while the vessel is waiting to berth.

Maintaining accurate ventilation records on the vessel is essential to defend shipowners against cargo claims. It is important to record periods of ventilation as well as periods when ventilation is not possible or necessary.

Cargo Sweat

Cargo sweat occurs when warm moist air comes into contact with the surface of a **cold** cargo. This happens if a bulk hygroscopic cargo is loaded in a cold region for transport to a **warm** region. As the vessel heads towards the warm region, the temperature of its structure will gradually increase in line with the seawater temperature and air temperature.

Hygroscopic cargoes warm up more slowly, because they have a lower thermal conductivity than a non-hygroscopic cargo such as steel. Consequently, the temperature of these cargoes is lower than the temperature of the external air during the voyage. If the dew point of the external air is higher than the temperature of the air in the hold and the cargo is ventilated, warm moist air could enter the hold and condense onto the cooler surface of the cargo, forming cargo sweat.

Several non-hygroscopic cargoes (steel products, machinery, earthenware and canned goods) may also be at risk of sweat damage because these cargoes may interact with the moisture, which can cause rust.

To prevent cargo sweat, the general principle is that cargo ventilation should not be used when entering a **warm** climate from a relatively **cold** climate. It is only safe to ventilate when the temperature of the cargo is higher than or equal to that of the external air, or if the dew point of the external air is lower than that of the air in the hold.

Ship's sweat

Ship's sweat occurs when **warm** moist air comes into contact with a **cold** ship's steel structure inside the cargo hold. For instance, if cargo in bulk is loaded in a warm region for transport to a relatively cool region, the seawater and air temperatures begin to fall as the vessel enters the colder climate. The ship's steel outer hull is a good thermal conductor and in direct contact with the seawater and air, so it is rapidly cooled. This cooling is gradually transferred from the outer hull to the hold structure.

The cargo is a poor thermal conductor, so it cools more slowly while tending to maintain its higher loading temperature, especially toward the insulated center of the cargo. Warm moist air then rises from within the cargo to the underside of the hatch covers, as well as to the sides of the hold due to convection. If this air encounters any parts of the ship's steel structure at a temperature below the dew point of the cargo hold air, then moisture will condense on the structure. This is commonly known as ship's sweat.

Ship's sweat can also occur because of local heating or cooling events within the vessel. If the cargo contains natural moisture, then any heating of the cargo by an external source such as a fuel oil tank or an engine can also result in condensation forming on cold structural parts. Another possible cause of condensation could occur if refrigerating units cool the ship's steel structure below the dew point of the air in the hold, leading to condensation on the cold steel.

The most effective way to prevent ship's sweat is to ensure that the cargo is sufficiently dried before loading.

Case Study

A bulk carrier vessel with five hatches and gear onboard transported a shipment of bagged rice from Myanmar to Ivory Coast. The cargo was loaded by the terminal stevedores on slings (20 bags x 5 = 100 bags) with the ship's gear. During discharge, partly moldy bags of rice were found and a surveyor was instructed to investigate the cause and extent of the damage.
According to the surveyor, the root cause of the mold damage was excessive moisture in the rice. During the sea passage, the excessive moisture content was released and condensed on the cold steel parts of the holds. The vessel was sailing in a temperate climate (outside air temperature

of 19 °C and sea temperature of 17 °C). It ultimately caused sweating of the ship's hull which resulted in moldy cargo.

In this particular case, there were also aggravating factors that caused mold to form in the cargo. The surveyor noted that the cargo holds were naturally ventilated. If the cargo holds had been ventilated mechanically, there would have been less damage to the cargo due to more air circulation inside the cargo hold.
Furthermore, no ventilation was allowed after departure from the port of loading. During a period of 12 days, the holds had to be kept tightly closed for fumigation reasons. During the voyage, ventilation of the holds was stopped during rain and bad weather. This led to start of moulding of the cargo.

Practical Tips

We recommend always calculating whether ventilation is necessary on the basis of the outdoor and cargoes dew point and the relative humidity. Nevertheless, the following rules of thumb can be followed when it comes to ventilation:

1. The Dew Point Rule

The Dew Point Rule states that a cargo hold should be ventilated when the dew point of the outside air is lower than the dew point of the air inside the hold.

2. The Three Degree Rule

The Three Degree Rule states that a cargo hold should be ventilated when the dry bulb temperature of the outside air is at least 3 °C lower than the temperature of the cargo.

In addition, bear in mind the following:

- Cold seawater may cause sweat locally
- Bunker tanks should be heated up until the fuel is just pumpable
- Temperatures inside and outside should preferably be measured 1.5 hours after sunrise, at 14:00 local time, and 1.5 hours after sunset
- Records need to be maintained daily, and parties must state the justification if ventilation is not applied (for example bad weather)

This information is intended for guidance only.
Should you require more information or assistance, please feel free to contact our Loss Prevention Services at LPS@msigspecialtymarine.com

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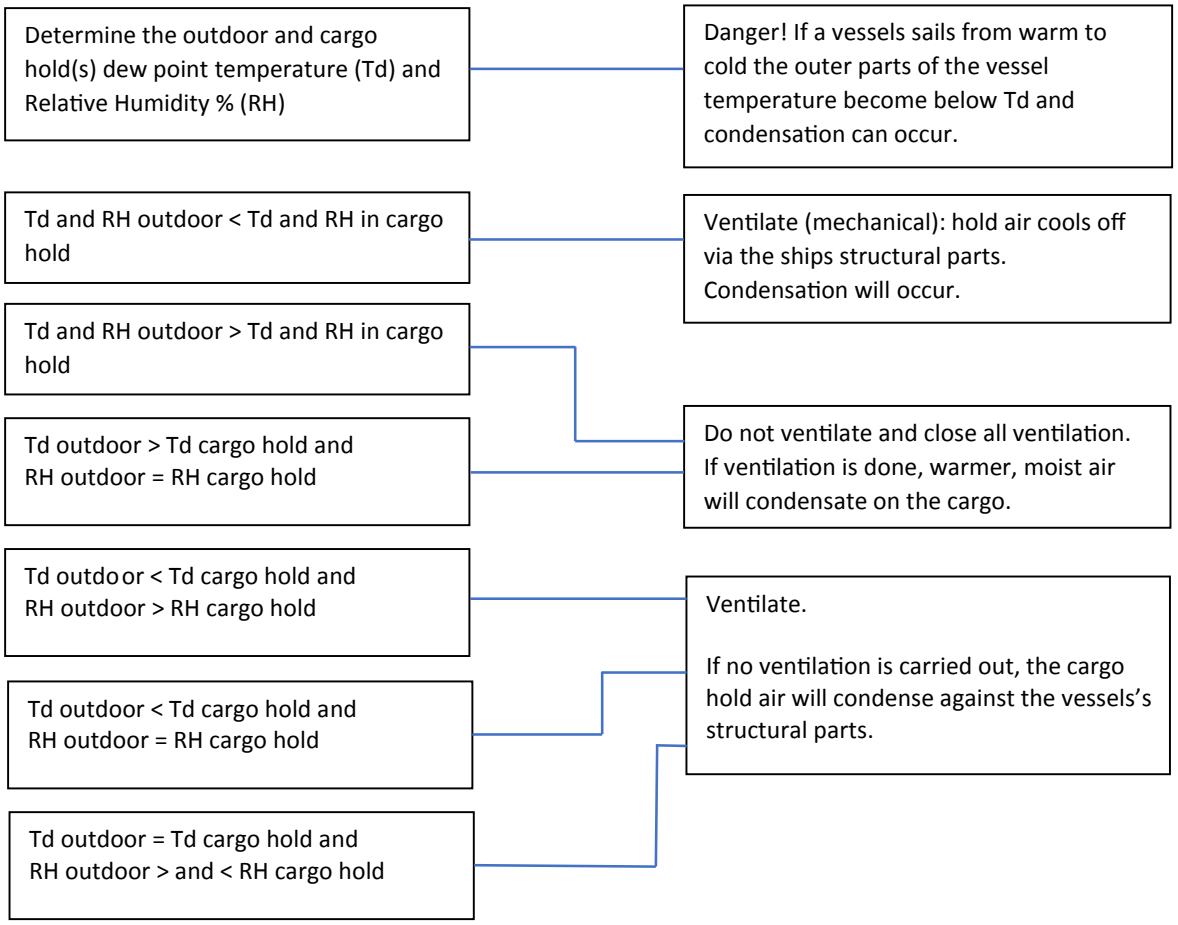
Ventilation of hygroscopic products – *When to ventilate?*



If condensation is noted on the hold particulars or cargo and the outside air does not allow for ventilation, recirculation by means of mechanical vents should be opted.

A clear logbook must be kept stating the following:

Outside temperature	Outside dew point temperature	Relative Humidity %	Cargo hold temperature	Cargo hold dew point temperature	Relative Humidity %	Ventilation start stop time

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Ventilation of non-hygroscopic products (e.g., steel products) – *when to ventilate?*

Determine the outdoor and cargo hold(s) dew point temperature (Td) and Relative Humidity % (RH)	Important! The below table is based on the presumption that the steel products have the same temperature as the outside air.
Td and RH outdoor < Td and RH in cargo hold	Ventilate. If no ventilation is done, the cargo hold air will condense against the ships structural parts.
Td and RH outdoor > Td and RH in cargo hold	Do not ventilate. If ventilation is done, warmer, moist air will condensate on the cargo.
Td outdoor < Td cargo hold and RH outdoor > RH cargo hold	Ventilate. If no ventilation is done, the cargo hold air will condense against the ships structural parts.
Td outdoor < Td cargo hold and RH outdoor = RH cargo hold	
Td outdoor > Td cargo hold and RH outdoor = RH cargo hold	Do not ventilate. If ventilation is done, warmer, moist air will condensate on the cargo.
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