

Carefully to Carry

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Air changes

If the master follows the instructions to the letter, is the ship liable for the damage which arises to what otherwise would have been a sound cargo?

Ventilation of cargo compartments

The term 'air changes' can give rise to misleading carriage instructions from shippers to ships' masters, or otherwise correct carriage instructions can be misinterpreted by ships' officers. The object of this article is to provide support for those who know what they are doing, and to provide non-technical people with sufficient understanding to avoid the usual pitfalls.

Simple air changes

A general cargo vessel with a hold ventilation system which is not fan-assisted, can only change the air in the cargo compartments to the extent that the ventilator cowls, of whatever type, can be trimmed/opened to the external atmosphere. This will allow inward passage of outside air and outgoing exhaust of stale air. To all intents and purposes, therefore, this type of vessel tends to fall outside the groups to which this article applies and to which the term 'air changes' may refer.

Fan-assisted air changes

Three modes of air movement in ships' holds are considered:

- Open-circuit systems
- Closed-circuit systems
- Closed-circuit systems with fresh air input.

The term 'air changes per hour' refers to how many times the fans extract and replace the total volume of air in the empty cargo compartment in one hour. A fan-rating of '20 air changes per hour' for a hold of 1,300 cubic metres air capacity, means that, with the fans operating at full speed on full power, all the air in that hold could be continuously changed with fresh air 20 times in any one hour in an 'open' system - or that the original air could be re-circulated within the hold 20 times in any one-hour period in a 'closed' system. In other words the fans can generate an air throughput of 26,000 cubic metres per hour.



"The carrier shall properly and carefully load, handle, stow, carry, keep, care for and discharge the goods carried."

Hague Rules, Articles iii, Rule 2

Carefully to Carry Advisory Committee

This report was produced by the Carefully to Carry Committee – the UK P&I Club's advisory committee on cargo matters. The aim of the Carefully to Carry Committee is to reduce claims through contemporaneous advice to the Club's Members through the most efficient means available.

The committee was established in 1961 and has produced many articles on cargoes that cause claims and other cargo related issues such as hold washing, cargo securing, and ventilation.

The quality of advice given has established Carefully to Carry as a key source of guidance for shipowners and ships' officers. In addition, the articles have frequently been the source of expertise in negotiations over the settlement of claims and have also been relied on in court hearings.

In 2002 all articles were revised and published in book form as well as on disk. All articles are also available to Members on the Club website. Visit the Carefully to Carry section in the Loss Prevention area of the Club website www.ukpandi.com for more information, or contact the Loss Prevention Department.

It would seem to follow that, if there is cargo in that hold, the same fans operated in the same manner should be capable of changing, or recycling, the air surrounding the cargo at an increased rate because some of the hold's space is occupied by cargo; but it is not necessarily so. The degree to which that rate may be increased depends upon the nature of the cargo itself, the manner in which it is stowed, the direction(s) in which dunnage is laid, and the extent to which it is required for the moving air to pass through and around the cargo. Those same circumstances may equally decrease the rate of change due to the 'blockage' effect of the stowed cargo. And herein lies the first step towards misunderstanding.

A shipper and/or charterer may specify their need of a vessel having a '15 air change/hour fan capability' but the cargo, say, onions in crates and/or slatted bins, blocks most of the hold space to the extent that even operating the fans at full speed on full power will not achieve 15 complete air changes per hour. The master, however, may know from experience, that the very thing he should not do is to run the fans at full speed throughout the voyage, because to do so would cause the vegetables to dry-out and become unacceptable as sound cargo at the port of discharge. So the master runs the fans at speeds, and at times, in keeping with the nature of the cargo balanced against the day-to-day atmospheric conditions encountered during the voyage. But what if the cargo arrives 'spoiled' in any event?



When the dust has settled, the three-part question to be answered will be:

- If a shipper and/or charterer writes that fans must be operated at a given rate throughout the voyage, must the master follow that instruction even though he knows from experience that such continuous forced ventilation will damage the cargo - or lack of ventilation where instructions involve too little?
- If the master follows the instructions to the letter, is the ship liable for the damage which arises to what otherwise would have been a sound cargo?

- If he follows his own experience and operates the fans accordingly, is the ship liable for alleged damage to the cargo even if such damage was primarily due to the pre-shipment condition of the cargo itself?

Open-circuit systems

An open-circuit system is one in which external fresh air is drawn into the hold by fan induction and is exhausted from the hold by fan extraction; or, in which only induction or exhaust is created mechanically. Whatever the exact disposition of the fans, this is totally an 'external for internal air change' system, because there is no re-circulation of used air within the system. The rating will be expressed in the ship's documentation as somewhere within the range 10 air changes to 25 air changes, per hour, depending upon the type of ship and its individual ventilation arrangements.

Such systems are to be found in many general cargo ships, and in purpose-built vessels engaged in the carriage of perishable commodities which do not require artificial cooling, chilling or refrigeration. Such cargoes are often of the bagged kind, e.g. rice, potatoes, onions, and similar items. Many fresh vegetables often require some degree of artificial cooling, depending upon the location of harvest, the port of destination, and the intended length of the voyage.

Closed-circuit systems

Alternatively, an entirely closed-circuit system is required in purpose-built refrigerated vessels carrying deep-frozen products and in which there is the intention to retain the foodstuffs biochemically inert so that they are giving off no odour, gas or moisture. Low-level temperatures are the only consideration. Two methods may be employed to achieve this end result.

The most modern closed-circuit systems nearly always involve fan induction of air through low-level cooling machinery. In such instances, the fans will be rated as so many 'air changes per hour'. As explained earlier, in the deep-freeze context this may not refer to outside or fresh air. The phrase, as considered for deep-freeze compartments, relates to the ability of the fans to extract and re-circulate the volumetric air capacity of the compartment, when empty, through the cooling machinery, at so many times per hour. Such a system has to be entirely closed, otherwise the vessel's machinery would continuously be cooling fresh warm air from outside, instead of re-circulating the cold air already reduced to the required temperature level for the deep-freeze compartments.

In the alternative closed-circuit system, the deep-

freeze atmosphere is attained by, and maintained with, cooling coils fixed throughout the cargo compartment. In this system there is no air change or air movement at all: the atmosphere is entirely static without any circulation of re-used air, and without any input from outside air. In this type of vessel 'air changes per hour' has no meaning.

Closed-circuit systems with fresh air input

Where closed-circuit systems of the types outlined above are involved, there is little doubt in the minds of those most closely concerned as to what is required and what must be done to achieve it. The difficulties seem to arise in situations where, while the system itself is basically 'closed', some induction of fresh air is also required.

In vessels carrying vegetable cargoes which are required to be cooled, such as bananas, carrots, often potatoes and tomatoes - depending upon the port of shipment and the length of sea voyage involved - there may be a requirement both to reduce the temperature of the air within the cargo compartment artificially, and also to ensure that the natural gases and moisture given off from the vegetables/fruit by respiration will not attain levels likely to cause deterioration of the cargo itself. For instance, bananas will respire ethylene, which is used in the ripening process. If the ethylene content in a cargo compartment was allowed to accumulate, an exponential ripening process may result independent of the exactitude with which the carrying temperature is maintained.

So the requirement will be for a closed-circuit system, with the means of venting stale air and inputting a measure of fresh clean cooled air in a manner sufficiently controlled to remove unwanted gases, without giving the cooling machinery an impossible task and without loss of the required compartment carrying temperature. This may be done in one of three ways:

- By fitting trunkways with small slide panels, positioned so that the cooled air circulating fans themselves can draw fresh air down the ducts at a given rate, which should be specified as 'fresh air

changes per hour'. If such rating is given, it will probably be in the range 6/10 changes per hour and will relate to the fans' capacity to change the volume of air in the compartment that number of times through the fresh air system, whether or not the cooling machinery is in operation. With such a 'fresh air system' the slide panels can be adjusted to produce a continuous 'fresh air trickle' or, alternatively, opened fully at given times and closed at other times.

- There may be a separate small fan system, to induce fresh air and extract stale air through independent ducts - which may or may not be given a 'rating'.
- Less commonly nowadays, there may be just simple trunking to allow intake and exhaust served by small cowls, much on the principle of the old general cargo ventilators, and opened and closed at certain times of the day, only, weather conditions permitting.

There are many ships whose cooling arrangements are based on the fixed-coil system, in which the cooled atmosphere is more-or-less static, as indicated earlier. Where fruit and vegetables are being carried in cooled conditions however (as opposed to deep-frozen conditions), there remains the requirement to keep the compartment air 'fresh', which can only be achieved by venting stale air and replacing it with fresh air. Such 'freshening' may be effected by means of any of the three options referred to previously. And, of course, nothing excludes the use of refrigerated vessels for the carriage of some non-cooled cargoes.

Conclusion

When referring to fan-assisted cargo compartment 'ventilation', the speaker or writer should make clear the difference between 'open-circuit' and 'closed circuit' systems and the nature of the 'air changes'. If it is of the non-cooled general cargo type or of the circulated cooled type it should be stated as 'air changes per hour'. When it is inducted fresh air/exhaust of stale air in an otherwise closed-circuit system it should be stated as 'fresh air changes per hour' whenever the rate is known.