



Chapter 30 – Agricultural Products in Non-refrigerated Containers

When shipping agricultural products, such as coffee, in ventilated or standard containers, the shipper must ensure that the container, packaging and dunnage are appropriate for both cargo and voyage to ensure cargo arrives in prime condition to the receiver.

A wide variety of agricultural products are carried in non-refrigerated containers, either ventilated or standard dry boxes, including:

- Cocoa
- coffee
- tea
- tobacco
- dried fruit
- rice
- nuts
- oilseeds

- pulses
- spices.

Fresh fruit and vegetables are more commonly carried in refrigerated containers, although produce such as melons, oranges, potatoes, sweet potatoes, yams and onions are sometimes carried in ventilated or open containers.

Two frequent causes of major cargo damage are condensation and taint.

30.1 Condensation (Sweat)

Almost all agricultural products have a considerable intrinsic moisture content. They are hygroscopic cargoes which means they are in equilibrium with the air in the container and can emit as well as absorb moisture. The amount of water available within a container of such cargoes is much larger than for manufactured goods. Translocation of a comparatively small proportion of the total moisture available may cause substantial condensation problems.

Hygroscopic cargoes change temperature comparatively slowly. Therefore, when a container is shipped across climatic zones, the cargo adjusts to the changing ambient temperatures much more slowly than the container walls and the air. This delay can cause considerable temperature differences within the container and is the driving force for moisture translocation and condensation.

Ventilated containers

Ventilated containers include those with passive ventilation openings, open containers and mechanically ventilated containers. However, these are all comparatively rare and the vast majority of containers have no effective ventilation provision. Although the small air-expansion holes in the walls of standard dry boxes are sometimes called 'ventilation holes', the airflow through them is insufficient to provide significant protection against condensation.

The International Cocoa Organization recommends using ventilated containers for all containerised cocoa shipments. Some coffee and cocoa shippers use such containers, but this is not standard throughout the trade.

The air inside ventilated containers is largely common with the surrounding air, which may present additional problems, such as more ready transmission of taints. Therefore, the stowage location on board requires careful consideration.

Desiccants

During carriage of hygroscopic cargoes in non-ventilated containers, condensation can be prevented if the relative humidity of the air inside the container is kept sufficiently low that its dew point is always below the ambient temperature. This ideal situation is often unrealistic, but the dew point may be lowered, and the risk of condensation reduced accordingly, by using desiccants.

Desiccants (such as silica gel, Møler clay or certain polymers) are water absorbent and remove moisture from the surrounding air. They may be supplied in bags, specially-lined sheets or as polymer-based paint. Once the maximum absorption capacity of such

products is exhausted, they have no further beneficial effect, so their type and amount must be chosen carefully for the type of cargo and the voyage.

Because of their potential for significant moisture exchange with the air inside the container, hygroscopic cargoes place much greater demands on the capacity and sustained absorption rate of desiccants than non-hygroscopic cargoes. Desiccants alone are unlikely to prevent condensation in the event of rapid temperature changes of large magnitude.

Dunnage, sheets and linings

A basic precaution for cargoes sensitive to condensation damage is to apply suitable dunnage to separate the cargo from the container's walls and floors. This cannot prevent the formation of condensation, but can greatly reduce its commercial implications. It is often recommended to use kraft paper or similar material to line the walls and floors of containers or as protective sheets on top of the cargo. Since these quickly become saturated, they cannot afford significant protection against severe sweat, but they can absorb small amounts of condensation and, in some circumstances, prevent or reduce staining and similar damage.

Sheets placed on top of the cargo must be readily permeable to air; plastic is unsuitable for this purpose as condensation could form between sheets and cargo.

30.2 Taint

Many foodstuffs can absorb chemicals and foreign odours from the air. This, typically, affects their taste and severely affects their commercial value, even when there are no significant toxicological implications.

Coffee, tea and cocoa are particularly susceptible to taint. They are traded primarily on the basis of their delicate flavour balance, with sophisticated tastings of every consignment carried out at various stages. A comparatively minor off-flavour or odour causes commercial damage to these high-value cargoes.

Some basic considerations to protect against taint damage include:

- Prior to stuffing, inspect containers for odours, previous cargo residues and staining of floorboards. The container should be kept closed for some time until immediately before inspection
- containers that have recently been used for the carriage of odorous chemicals should not be used for foodstuffs, even if no detectable odour remains. More generally, operators should consider keeping separate pools of containers designated for chemicals and for foodstuffs
- stow containers containing foodstuffs away from strong odours on board. This is particularly relevant when using ventilated containers, where the air exchange rate, and so the potential for transmission of external taints, is much greater than for non-ventilated containers
- floorboards, pallets, crates, etc are often treated with fungicidal wood preservatives containing chlorophenols. These are also contained in mould inhibitors used on jute bags and in the adhesives in some fibreboard cartons. Chlorophenols are themselves a potential source of taint. Although the levels used are usually

insufficient to cause commercial problems, they can be converted to chloroanisoles by certain microorganisms, particularly in the presence of excessive moisture such as may result from condensation. Chloroanisoles are an extremely potent source of taint, causing a characteristic musty odour and flavour, even if present only in very minute proportions.

30.3 Production of Gases

Fresh produce continues to go through biological and chemical processes, including respiration, even when in storage. During this process, it will continue to generate heat when it absorbs oxygen (O_2) and releases carbon dioxide (CO_2) and ethylene (C_2H_4). The combination of heat and released gases can have an impact on the 'health' of the products being carried if the respiration process is not controlled.

The quantity of gases and associated heat produced varies between products. For example, pears and apples produce a significantly high quantity of ethylene, which can be controlled in two ways – by lowering the temperature or by increasing the CO_2 concentration combined with reduction of O_2 . The latter option, however, is not desirable as it will have a negative impact on the quality of the cargo. The lowering of temperature, therefore, remains the only option to prolong the shelf life and maintain the quality of fresh produce. The atmosphere changed in this way is known as 'Controlled Atmosphere (CA)' or 'Modified Atmosphere (MA)'.

Due to variations in the level of oxygen (O_2) absorption and release of carbon dioxide (CO_2) and ethylene (C_2H_4) even with the same produce, there cannot be any single best method of storage for a particular product. However, shippers may be able to provide some information for the required temperatures and levels of gases required on the basis of their experience. This information must always be complied with and specialist advice sought whenever there is any doubt.

30.4 Containerised Transport of Perishables without Refrigeration

Some perishable commodities are carried without refrigeration, possibly for very short duration journeys, or in ventilated equipment. In these cases, it is wise to consider which of the previous requirements may still apply.

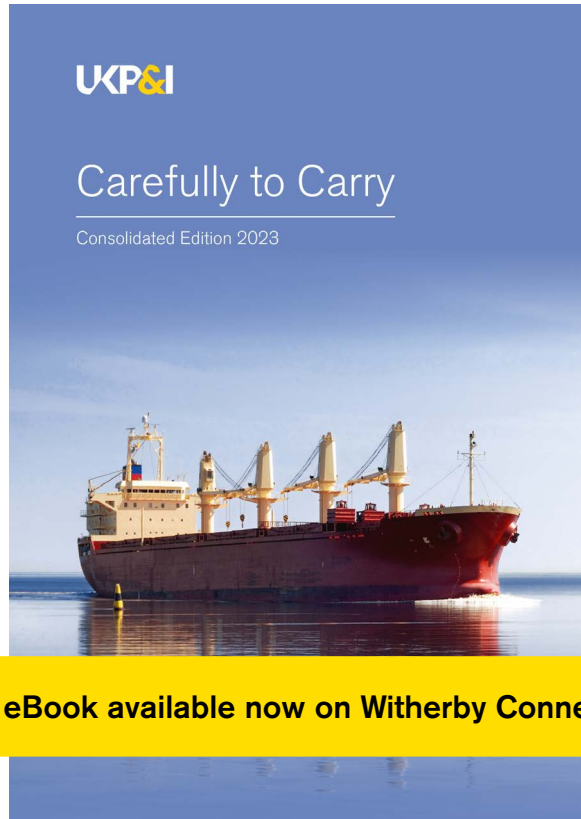
Products with limited temperature sensitivity may be carried under refrigeration for certain journeys only. The following guidelines suggest when this may be appropriate:

- For any goods requiring close temperature control, refrigeration is essential. If temperatures need to be maintained within a band of $2^\circ C$ or less, refrigeration should be virtually continuous
- at the other extreme, for less sensitive goods with a maximum temperature tolerance of $30^\circ C$ or above, refrigeration is only necessary for storage on land at high ambient temperatures. For containerised shipments at sea, a protected stow may be requested
- if the maximum permitted temperature is $25^\circ C$ or lower, refrigeration should be used for any journeys through the tropics and for any journeys anywhere in a summer season

- if cargo requirements are marginal, either in terms of temperature tolerance or in terms of possible delays at high ambient temperatures, the only safe option is to use refrigeration
- frozen foods may sometimes be carried without refrigeration for short journeys as long as the cargo is not subjected to more than the specified maximum temperature. This should only be done with the consent of the owner of the goods.



Price: £95



This comprehensive publication, compiled by the UK P&I Club, details best practice for the carriage, loading and storage requirements of a wide range of cargoes. It also contains essential information on draught surveys and preparing cargo plans.

Outlining and expanding on all major international cargo regulations and guidelines, it also includes detailed checklists, information on draught surveys and guides to preparing cargo plans. Cargoes covered include timber, gas, grain, steel and other metals, bulk goods and refrigerated goods.