Chapter 29 – Bagged Rice

Rice is a cereal grain and the staple food for many nations. It can be grown in anything from dry upland soils, to irrigated fields and along flooded river beds. There are over 85,000 varieties of rice in the research stocks of the International Rice Research Institute (IRRI), and over 120,000 cultivars are known to exist. The most common, Asian rice (*Oryza sativa*), is divided into Indica and Japonica varieties. Indica rice is longer and more slender, and generally remains separate when cooked. Japonica rice has shorter, rounder and more translucent grains, which quickly become slightly sticky when cooked.

When harvested, rice typically contains moisture in the range of 15 to 22% (US) or 19 to 25% (Asian) and must be dried to prevent spoilage (generally to between 12 and 14.5%). If well dried and protected, rice can be stored for many years.

After being dried and stored, rice undergoes a milling process to remove the tough outer husk and the inner layers of bran from the edible rice grain. Partial milling removes just the outer husk to produce brown rice. Complete milling also removes the bran layer and cereal germ to produce white rice.

Rice is traded as either paddy or milled rice, but most rice moving in world trade is fully milled and bagged in 20, 25 or 50 kg polypropylene bags. A description of the product is required in cargo documentation, ie paddy/ brown/milled/parboiled, along with the

grain type (long or short), origin and the percentage of broken rice (eg Thai white rice, long grain, 5% broken). Standards in most countries define the percentage of 'brokens' and other imperfections permitted in each grade of rice, and the basis on which such percentages are measured, which will have an impact on market value.

Traditionally, rice would have been carried as breakbulk on board general cargo ships designed to accommodate rice, with permanent wooden dunnage and spaces designed for proper ventilation to ensure the cargo arrived in the best condition possible. However, as global demand for staple foods has risen and the shipping industry has faced increasing pressure on freight rates, a large percentage of rice shipments are now transported in bagged form on board traditional bulk carriers, with smaller parcels carried more and more often as containerised cargo.

29.1 Hazards to the Cargo

The primary hazards to bagged rice are water damage, infestation, mishandling of cargo bags during loading, improper stowage in cargo holds and deficiencies in the ship's condition affecting the cargo holds.

Bagged rice needs to be kept dry and well ventilated. Therefore, it is important to inspect the ship's holds, hatch covers and ventilation system for potential defects as these will be critical to the safe carriage of the cargo on even short voyages.

The frequency and cost of claims associated with bagged rice is significant, with wet damage generally accounting for over one third of cargo claims and nearly half of the associated costs. Handling damages generally account for one fifth of the claims. It is also notable that cargo shortage, attributed to short-landings and pilferage, is one of the most costly types of claim.

Seawater ingress	Ingress through cargo hatch covers on passage, bilges, hull damage, pierced ballast tanks or sounding pipes in cargo holds.
Fresh water ingress	Rain ingress during loading or discharging operations, or through leakage on passage. Damaged pipework within cargo hold. Ship/cargo sweat due to variations in climate temperature and humidity.
Condensation	Fresh water condensation on the ship's structure or cargo caused by temperature differences between the air in the hold and the ship's steel structure (or cargo) from poorly managed ventilation.
Contamination	Cargo holds can be contaminated by prior cargoes carried in the hold (residual odours, staining), by general condition (rust, chipped paint) or from fuel leakage.
Infestation	Rice is particularly susceptible to infestation by storage pests if stored for over two months. Cargo can be exposed to granary and rice weevils; flour, drugstore and spider beetles; dried fruit and meal moths; rats and mice. The chewing damage caused by cereal pests also brings about increased heat and moisture, which in turn provides favourable conditions for mould and (potentially) bacterial growth.
Heat	As well as the danger of direct heating from halogen lamps that have not been isolated, heat may be generated from spaces adjacent to cargo holds, such as heated bunker tanks, the engine room or adjacent cargo.
Improper stowage	Damage to bagged rice can occur due to improper stowage, causing shifting or collapse of cargo stacks during transit.

Table 29.1: Possible causes of damage to shipments of rice.

Caking, wet rice and mould	Seawater/fresh water ingress or condensation can cause bagged rice to become wet and permanently damaged through 'caking' and can also result in mould development. Affected bags have almost no salvage value.
Odour contamination	Wet rice, particularly rice damaged by seawater, spreads a penetrating odour that is absorbed by the adjacent rice and may spread through the entire hold. Rice is highly odour-sensitive. Brown rice is particularly sensitive to the absorption of foreign odours. Affected cargo has almost no salvage value.
Torn bags	Bags used to carry rice are normally constructed from woven polypropylene, which is a relatively strong material but is still subject to tearing and damage during loading, transit or discharge. Rice from damaged bags can be restowed in spares, but this increases handling costs and can lead to shortage claims.
Stained bags	Bags can be stained due to contact with dirty surfaces, or other factors. If the rice is undamaged, it may be re-bagged, but it will face devaluation and incur additional costs for handling.

Table 29.2: Types of damage associated with shipment of rice.

29.2 Avoidance of Damage: Preparation

29.2.1 Cleaning

A number of factors can affect the condition of the cargo holds, making them unsuitable for carrying bagged rice. Proper precautions should be taken in preparing the cargo hold before loading.

If there is any sign of previous insect or rodent infestation, holds should be sealed and fumigated using an approved method or, if appropriate, sprayed locally with insecticide or rodent repellent.

This operation should only be performed by approved professionals, with due regard to the safety of the crew and contractors.

Rust and scale that might contaminate the cargo should be removed. Paint and lime wash may be applied to avoid contact of the scaled ship side with the bagged rice and also to provide a sound and hygienic space to carry cargo.

Cargo holds should be properly cleaned and prepared. All tank tops/decks and bulkheads (including all difficult to reach areas and areas where dirt and water may become trapped) should be cleaned, swept, washed, rinsed with fresh water, mopped, well ventilated and dried.

All residual odours from cleaning agents should be thoroughly ventilated from the space as they may taint the bagged rice.

The hold bilge wells should be clean and free from any cargo residue, bilge water or moisture. Hold bilge suctions and non-return arrangements should be tested and demonstrated as functional. Double burlap wrapping should be applied on the bilge cover plate and fixed with masking tape.

29.2.2 Hatches and Vents

Bagged rice needs to be kept dry and well ventilated. Therefore, it is important to inspect both the ship's cargo hatch cover systems and ventilators for potential defects as their performance will be critical to the safe carriage of the rice cargo. Attention should be paid to the following areas:

- Hatch cover operation should be reliable, safe and timely, and the hatches should be closed if there is rainfall during loading/discharge in order to protect the cargo. Hydraulics should be free from leaks that may taint cargo
- cargo hatches should be free from piercing damage or deformation, correctly aligned and meet adjoining covers and coamings squarely. To operate correctly, the compression bar, dogs, clamps and cleats must be in line and free from deformation. Dogs should be clear of damage and set for the correct tension when applied
- hatch cover packing should be in good condition (ie not imprinted by more than 25%, hardened, or with any sections missing). Replacement packing should be made in complete lengths only and preshaped corner sections used where necessary. Packing channels should be clear of corrosion and free from damage or deformation
- the full weight of the hatch cover should not be borne by the gaskets alone. Hatch cover landing pads should have minimal wear to avoid overcompression of the packings
- drainage channels should be clear of corrosion and free from damage or deformation and drain non-return valves should be checked and proven to be operational
- ventilator flaps should be inspected to ensure they are in good working condition and seal properly when closed
- the double-bottom ballast tanks and side tanks should be pressed up prior to loading to ensure their watertight integrity
- bilge suctions and tank top openings should be thoroughly examined, tested and proved fully operational and the strainer plate overcovered with burlap (as above). Any openings to the tank top should be examined and proven to be watertight and properly secured
- sounding pipes and other pipework should be examined and cleared of any debris. Any pipes within the holds, including ballast pipes or tank air pipes, should also be closely examined to ensure they are in good working condition. Sounding pipe closures should be checked to ensure they are watertight.

It is the shipowner's responsibility to maintain their cargo hatch covers in good operable condition and establish an adequate inspection/maintenance programme, so that due diligence may be proven in the event of any cargo claim. It is, therefore, also the shipowner's burden to prove that their cargo hatch covers are in good operable condition (see Chapter 55 Steel Hatch Covers).

Hatch covers should be proven to be watertight by hose test or, preferably, ultrasonic testing carried out independently and prior to loading of cargo. Holding valid Class and flag State certificates alone will be no defence against a water ingress claim.

It is important to note that, if charterers ask to use Ram-Nek tape (a brand/type of high adhesive plastic sealing tape) it does not relieve the shipowner from their duty under the charterparty to present their ship in seaworthy and cargoworthy condition.

29.2.3 Dunnage

To prevent damage from condensation, dunnage should be used on steel surfaces. Individual country or Port Authorities may have rules on the use of specific types of dunnage and local agents should be consulted in advance to determine whether there are any local restrictions. Generally, there are two primary types of dunnage used for bagged rice transported on bulk carriers – bamboo or timber – although combinations of Styrofoam, plastic/polythene sheet and kraft paper are also in use.

Bamboo dunnage
Dunnage usually consists of bamboo sticks laid in a crisscross fashion on the steel tank tops and side shells and then overlaid with bamboo mats.

While bamboo is lightweight, re-usable and relatively cheap and easy to access in load ports, it is commonly found that bamboo is not free from moisture and can retain and bleed moisture during passage. Bamboo sticks may appear dry on the outside but may have a moist pulpy interior. Bamboo mats overlaid with kraft paper should never be used as the fragile kraft paper will be destroyed and rendered useless.

When there is condensation or wetness on the tank top, bamboo mats tend to absorb the moisture and pass it on to adjacent bags that rest upon them. The greater the condensation, the more damage is transferred to more adjacent bags, so this method is not recommended.

It is noteworthy that Peru does not allow cargo protected by bamboo mats and sticks to be discharged at their ports. A similar restriction applies in Chile, where disposal of protection materials such as bamboo mats and sticks is not permitted.

Timber dunnage
Timber dunnage (thick planks) should be placed in two layers on the tank top of each hold, with the lowest layer in a fore-aft direction, to provide drain channels, and the second layer at 90°. This will prevent the lower tiers of bags coming into contact with the tank top and avoid wet damage to the cargo. Timber dunnage should be well cured and dried, and the use of fresh sawn timber should be avoided. Kraft/lining paper or corrugated cardboard should be placed on top of the timber dunnage to protect the bags.

In tall or partial loads, timber dunnage should also be used within the stow to avoid stow collapse.

Synthetic materials

For bagged rice, the proper placement and combination of plastic/Styrofoam dunnage materials has proven to be effective in reducing condensation damage caused by direct contact with the ship's steel structure.

In many ports, styrofoam is not easy to obtain and it can be expensive. In addition, plastic and styrofoam dunnage materials may be difficult to dispose of at some ports. Proper care is required to ensure that the stow does not become closed off by polythene sheeting material, reducing the ventilation capacity through the stow or blocking drainage of any condensation.

Caution is important when using Styrofoam near ventilation openings. It should be carefully cut and fitted so that it does not prohibit the flow of air through the ventilation openings.

Location	Plastic sheet	Styrofoam	Kraft paper	Optimal arrangement	Alternative arrangement
Side shell	X	X	X	Plastic and Styrofoam	Plastic and kraft paper
Forward bulkhead, cargo hold no. 1	X	X	X	Plastic and Styrofoam	Plastic and kraft paper
Aft bulkhead adjacent to engine room	X	X		Plastic and Styrofoam	Plastic and kraft paper
All other transverse bulkheads	X	X		Plastic and kraft paper	Kraft paper
Hopper tanks	X	X		Plastic and kraft paper	Plastic or kraft paper
Hatchways	X	X	X	Plastic and Styrofoam	Plastic and kraft paper
Hatch coamings	X	X		Plastic and Styrofoam	Plastic or Styrofoam
Tank tops and tank top sloping plates	X	X		Plastic and kraft paper	Plastic or kraft paper
On top of cargo			X	Kraft paper	

Table 29.3: Placement and combination of dunnage materials.

29.3 Avoidance of Damage: Stowage and Ventilation

Rice should not be stowed near any strong smelling cargo such as bagged cocoa, bulk copra or similar. The impact of any ventilation exhaust should also be considered.

Shipowners, in coordination with the ship's Master and chief officer, should be made aware of the charterer's stowage plan (in writing) in advance of cargo loading operations and all efforts must be made to ensure the cargo is stowed as per the agreed charterer's/shipper's instructions.

Construction of ventilation channels (ie a channel/reasonable gap between groups of bags) should be considered on a case-by-case basis, depending on the volume of cargo, dimensions and configuration of the cargo holds and the ventilation capabilities of the ship to allow the free flow of air. It is common practice that every five tiers of cargo being stowed should interlock and cross bags between adjacent stowage stacks. This practice allows for better stability of the stacks to prevent cargo stack slippage that could potentially block ventilation channels.

29.3.1 When to Ventilate

Bagged rice must be properly ventilated to prevent condensation during the voyage or at any point when the hatch covers are shut. The purpose of this is to remove the warm, moist air surrounding the cargo and replace it with drier air to minimise condensation on the colder steelwork in the hold (ship's sweat). To do this, the ventilation method must be effective and the environmental conditions must be right.

Ship sweat occurs when a ship loads in a warm, moist atmosphere and then sails into cooler climates. As the ship's steelwork cools below the dew point of the surrounding air, moisture will condense onto it.

Ship sweat appears as beads of moisture, typically on the sides of the hold when the sea temperature is low or on upper sides when the air temperature is cold.

If the dew point of the outside air (the air used for ventilation) is lower than that in the hold, it is appropriate to ventilate and, if not, ventilation should be withheld. However, it may be necessary to ventilate for other reasons, such as to comply with fumigators' instructions when the cargo has been fumigated on board. External factors, such as sea spray across the ventilator openings, must also be taken into account to ensure that water does not enter the hold.

While the ship is on passage, the dew point should be regularly monitored to determine whether ventilation of the cargo holds is necessary. Comparison of dew points is usually made by taking readings from wet and dry bulb thermometers on deck and in the hold. Obtaining the ambient readings is generally easy as most ships have a Stevenson screen fitted on each bridge wing. However, obtaining the same readings in a ship's hold can be problematic and during the voyage it may not be safe for crew to enter the hold to obtain temperature readings. If thermometers are simply lowered into the hold from outside, there will be difficulty obtaining sufficient airflow across the wet thermometer.

Where it is possible to safely enter cargo holds to obtain meaningful readings, it may be necessary to stop ventilation to allow the in-hold atmosphere to stabilise. If this is not done, the crew will be measuring the ventilating air rather than the true in-hold atmosphere. If a reading is taken, it should be properly recorded in the cargo ventilation record book.

Where access to the holds is impossible or undesirable, and provided there is no significant airflow, the hold dew point can be determined from traditional wet and dry bulb thermometers placed inside the trunking of an exhaust ventilator or similar pipework leading from the compartment. Again, if this is done, it should be properly noted in the cargo ventilation record book.

Where the cargo has been fumigated, on no account should crew members enter the cargo holds until they have been appropriately ventilated and certified gas-free.

29.3.2 Ventilation Systems

There are three systems of cargo ventilation in general use – mechanical (airflow assisted by fans), natural (without fans) and controlled atmosphere (controlling a space's temperature and carbon dioxide).

Most ships loading full cargoes of rice in the short sea trade in locations such as Thailand generally have only natural ventilation, sometimes assisted by portable fans. For voyages to colder climatic regions, natural ventilation is insufficient and any ships engaged on carriage of bagged rice on longer voyages should be equipped with a proper functioning mechanical ventilation system, with a capacity of 15 to 25 air changes per hour (calculated on the basis of empty hold space). All fans should be checked to ensure they run properly in the correct direction. The carriage of rice in a controlled atmosphere ship does not provide any advantage over a well-ventilated space.

29.4 Fumigation

Most rice cargoes are fumigated after completion of loading, which brings its own set of challenges as substances that kill insects may just as easily kill humans.

Due regard should be paid to the IMO's *Recommendations on the Safe Use of Pesticides in Ships Applicable to the Fumigation of Cargo Holds* (MSC.1/Circ.1264 and Amendments) (Reference 51).

The fumigation process starts with a survey by the fumigator prior to loading. The surveyor will inspect the cargo holds looking for any area that will allow a fumigant to penetrate into spaces that will be inhabited by the ship's crew. This is particularly important at the bulkheads between the accommodation spaces or machinery spaces and cargo holds. If any gaps are known or found, the surveyor will recommend that they are properly and effectively sealed off.

Before the fumigant is applied, the seals on the hatch covers and access trunkways must be marked with warning signs and sealed once completed.

The most common fumigant used is Phostoxin (aluminium phosphide), which creates phosphine gas when it reacts with moisture in the air. For it to activate, there has to be sufficient moisture in the air and the temperature of the cargo must be greater than 7°C.

Phostoxin tablets are often placed in sleeves that are laid across the surface of the cargo. The sleeves keep all of the Phostoxin in a sock-like tube so that the residual ash can easily be removed at the discharge port. If the sleeves are not properly applied, there may be an incomplete reaction, with an insufficient dose applied to the cargo and the danger of production of Phosphine gas when the sleeve is disturbed at the discharge port. A preferred (but more expensive) version is the prepack rope, which spreads the tablets out in a rope-like container across the top of the stow. This ensures greater exposure and thus better reactivity.

The recommended minimum dosage of Phostoxin is 33 g/1,000 ft^3 of space. An effective dose is normally 45 g/1,000 ft^3. In some instances, owners and/or P&I Clubs hire independent surveyors to witness the fumigation process.

For a charterer, fumigation is usually applied only because it is required in the sales contract and it can, therefore, be a temptation for the shipper to ask a fumigator for a 'full certificate' while only applying a cursory fumigation with less than the required dose for the size of hold. This should be monitored closely and the details of what is actually applied recorded.

29.5 Protection from Claims

Some damages can occur to bagged rice prior to arrival on board ship and it is important to recognise and document any pre-shipment irregularities prior to acceptance.

Cargo can be exposed to damage by wetting during any barge leg of a voyage. Water ingress may occur via the barge hull planking on older wooden barges, or via the deck/hatch cover arrangements on both steel and wooden barges. This is a particular problem during inclement weather and must be watched for. As well as the condition of the cargo, investigation of the condition of any barge should be well documented.

Bagged rice is normally brought on board ship from a barge, or loaded pre-bundled via crane from ashore. Bundles should be examined for any visible damage as much as possible before delivery into the hold and afterwards during stowage.

29.5.1 Cargo Quality and Moisture Content

The ship's Master and chief officer should ensure that the cargo is tested for moisture content as it arrives on board. The maximum moisture content for rice to be shipped is 14.5%. If the cargo moisture is found to be in excess of that amount, there is a significantly higher risk of damage resulting from condensation.

It is important to acquire cargo quality certificates from the shippers. However, this information should not be solely relied upon and the Master should approach the Club correspondent to assist if there are any concerns.

29.5.2 During Loading and Discharge

When the cargo hatch covers are open, the cargo holds are exposed to potential adverse weather conditions. The Master should ensure that during loading and discharge operations, there are crew members on station on the bridge who are constantly monitoring any changes in weather that may require closing of the cargo hatch covers. Monitoring should be informed by visual observation, radar and appropriate weather forecasts. Rain letters must not be accepted.

As well as ensuring hatch covers are in good working order, the crew should know the amount of time it takes to close each hatch cover prior to commencement of cargo operations. Adequately sized, placed and secured tarpaulins should be considered as an additional measure of cargo protection to cover closed or partially closed hatches in the event of adverse weather conditions.

While unlikely, the same applies if cargo hatches are opened during the voyage to ventilate the cargo.

29.5.3 Third Party Surveyors

To protect the ship from false claims, it might sometimes be useful to utilise qualified third party surveyors to properly corroborate and record the condition of the ship, cargo and conduct of the operations. The crew should regularly monitor and ensure that surveyors are performing their assigned survey tasks as required.

An inspection should be made to document the condition of the cargo holds prior to loading to ensure that they are dry and clean, that bilges are in satisfactory condition, ventilation systems are in working order and the hatch covers are in satisfactory weathertight condition. If possible, an ultrasonic hatch test should be witnessed and reported by the attending surveyor.

Where a draught survey is required (and allowed), surveyors representing the shipowner and the shipper's interests should jointly carry this out before and after loading to agree on the quantity of cargo loaded. It should be noted that the weight of cargo may decrease as a result of loss of moisture from the cargo during the voyage and so the moisture content of the rice should also be taken at load and discharge.

A tally surveyor should be positioned at each cargo hold to record the quantity of bags loaded and to liaise with tally clerks, representing the shipper's interests, to agree on the quantity that will ultimately be noted on the mate's receipt.

A cargo surveyor should monitor the cargo being loaded to ensure that it is properly stowed with due consideration to dunnaging and unobstructed ventilation, so that sufficient and proper ventilation channels are allowed for and a stable stow achieved. A cargo surveyor should also monitor the condition of the cargo as it comes on board and during its handling by stevedores, in order to reject on behalf of the shipowner any bags that are caked, mouldy, wet, torn, stained, discoloured or odour contaminated, and reject/remark entire lots that appear to be infested by vermin.

29.5.4 Stevedore Monitoring

During loading and discharge operations, the crew should be aware of the particular cargo damage risks associated with stevedores, which may include:

- Rough handling of cargo bags leading to tearing
- use of steel hooks for cargo handling (which should be strictly prohibited)
- careless loading of heavy slings of bagged rice. Damage may result if cargo is not properly lowered and lifted, and this may go undetected until discharge
- dragging cargo that is wedged in or overstowed by other cargo. This may be avoided by managing the load and discharge sequence
- improper stowage that prevents proper cargo ventilation
- theft/pilferage
- urination and defecation in cargo hold areas due to lack of sufficient sanitary facilities for stevedores while working on board the ship.

If cargo/tally surveyors are not available, as well as manning the gangway (and therefore monitoring any pilferage), the Master should consider stationing crew members above every cargo hold where cargo operations are underway to monitor the activities of all stevedores working in the cargo holds, and in any other locations where cargo is being brought on board or discharged from the ship.

29.5.5 Recording

In the event of damage or incident, the crew should:

- Notify the Master and/or officer on watch of any and all observed activities of concern by third parties on board the ship while loading or discharging cargo
- log the details of the specific incident in the ship's cargo logbook
- collect all possible relevant evidence (video, photographs, statements from witnesses and physical evidence of the incident, if applicable) to be kept as a record of the incident.

The mate's receipt should reflect details of the exact condition of the cargo, any pilferage/theft, receipt of damaged bagged rice upon loading (ie prior to arriving on board ship), improper stowage, etc. Any remarks concerning visual damage should be noted on the mate's receipt, for example 'two torn bags', 'five discoloured bags', 'three mouldy bags', 'evidence of infestation', etc.

29.6 Case Study

A small hold fire occurred on a ship with a cargo of bagged rice. Investigation showed that only empty rice bags had combusted. It was found that, as is customary, a few thousand empty polypropylene bags had been loaded on top of the cargo on completion of loading to allow for rice from split or broken bags to be repackaged during discharge.

From the available evidence, it was deduced that the person doing the fumigation had triggered the solid fumigant capsules and thrown them onto the cargo from the

hold access hatch. One or more of the capsules landed on top of the empty bags, which were determined to have been wet, and this additional moisture accelerated the chemical reaction, creating excess heat and causing the fire.

As the hold's fire/smoke detection systems had been isolated as required prior to fumigation, the ship's crew were unaware that there had been a fire in this hold for some days after departure.

To avoid a similar incident, empty bags should always be loaded in a clean and dry condition.

Carefully to Carry

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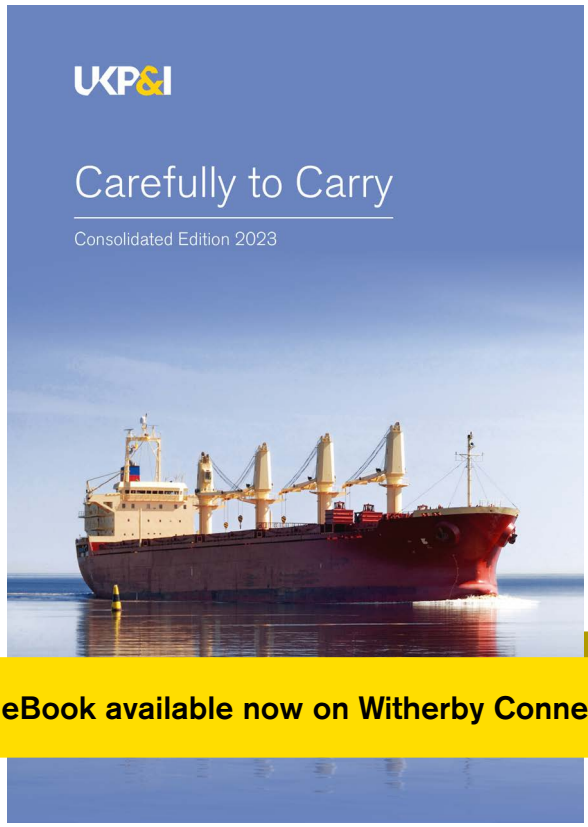

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