

# Carriage of Containers

## Stowage and Securing

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### Introduction

When damage or loss to containers is caused by a problem relating to their stowage and securing, it is essential that the shipowner is able to demonstrate that it exercised due diligence to make the ship seaworthy and took all reasonable steps to properly care for the cargo.

The key document providing instructions on how to stow and secure cargo properly is the ship's individual Cargo Securing Manual. In the event of a cargo claim it is therefore essential to be able to show that an approved Cargo Securing Manual was in operation and that its requirements were complied with.

### Cargo Securing Manual

Correct stowage and securing is made more straightforward by having information provided in the form of an approved Cargo Securing Manual, prepared individually for each ship. This provides details of the container securing arrangements and devices on the vessel as well as information on container stowage.

A Cargo Securing Manual is a statutory requirement under the SOLAS Convention (Chapter VI Regulation 5) and must be approved by the administration of the contracting government (the ship's Flag State), and should be suitably endorsed to that effect.

However, Cargo Securing Manuals are often calculated and designed for a ship by a classification society, and sometimes the Flag State may delegate a recognised organisation such as a classification society to approve Cargo Securing Manuals on their behalf. This often leads

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to confusion about who actually issues and approves a Cargo Securing Manual.

The title is misleading as the Cargo Securing Manual gives just as much guidance about stowage as about securing. The relevant parts should be easy to understand and use in practice. It should comply with SOLAS Convention requirements and IMO guidelines.

## Shipowner's Obligations

Under the contract of carriage between the cargo owner and the carrier, the carrier should exercise due diligence to make the vessel seaworthy before and at the beginning of the voyage (Hague Visby Rules, Article III, Rule 1).

Examples of this seaworthiness requirement in the context of cargo stowage and securing include:

- The provision of an approved Cargo Securing Manual
- Ensuring that the vessel's fittings are adequate for the carriage of cargo
- Ensuring that the vessel's fittings and equipment are properly maintained
- Ensuring that containers are stowed and secured so they cannot shift and cause damage to the vessel's structure, or affect the vessel's stability, and thus endanger the seaworthiness of the vessel, or cause damage to other cargo on board.

The carrier also has an obligation under the contract of carriage to properly care for the cargo (Hague Visby Rules, Article III, Rule 2), which in the context of stowage and securing includes:

- Ensuring that containers are properly stowed
- Ensuring that containers are properly secured, checked and tended when appropriate throughout the voyage.

If cargo is lost or damaged, a claim is likely to be made against the carrier under the contract of carriage.

It is therefore important that the carrier can demonstrate that the loss or damage was not caused by a failure to exercise due diligence. When the cargo damage or loss claim results from a problem with stowage or securing of containers, there are two crucial questions that should be answered:

- Did the ship have a Cargo Securing Manual approved by its Flag State?
- Were the containers involved stowed and secured according to the approved Cargo Securing Manual?

## Container Loss or Damage

The common theme in container loss and damage incidents is a failure of lashing systems and container structure as a result of the forces acting on them, often, but not always, associated with heavy weather. Such failure may result in the collapse of a deck stow or loss overboard of part or all of the stow.

When containers are stowed on deck they must be stowed in accordance with the stack and tier weight limits set out in the Cargo Securing Manual. The forces imparted into the containers themselves and the securing equipments by the ship's rolling and pitching are greatest outboard and higher up in the stow. For this reason there are restrictions on the gross weight of containers outboard and higher up in each stack. The restrictions placed on individual container cells should be followed and not be ignored, even if all other units in the block are well below the limits, because the forces on a particular container in a particular slot are the same, irrespective of the weight of adjacent units. If the weights of any containers in a tier or stack exceed the limit given in the Cargo Securing Manual, there is a risk that the securing devices will become overloaded when the ship rolls and pitches heavily in the seaway, and the equipment will fail or there will be compression or racking damage to units lower down in stowage, or the stack might tip over, or a combination of these - many container losses have resulted from heavy units being stowed too high in stacks.

Although there may be a question about the age and condition of individual containers in some incidents, the general evidence suggests that poor container or lashing condition is not a common fault.

Therefore, even in heavy weather, it could be wrong to assume that container structural failure or lashing failure caused the damage or loss. The underlying cause is more likely to be incorrect stowage or securing.

For lashings and / or container structure to fail, the forces imposed on them must be greater than those intended by the designers of the stowage and securing system, and the container manufacturers. This can be caused by

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stowing the container incorrectly according to weight, size, or position:

## Weight

The total weight and the weight distribution within a container stow are critical factors. The total weight of a stack (vertical pile) of containers (stack weight) is limited according to the strength of the ships structure, including the hatch covers, and the capabilities of the lashing system. Exceeding the allowed stack weight will result in excessive loads on the ships structure and increased forces acting on the lashings and container structure.

The design of the lashing system will also impose a limitation on the weights of containers at different heights within a stack. What is referred to as an *upwards movement of weight concentration*. Exceeding the weight limit at any tier or loading heavier containers over lighter ones, will cause an increase in the forces acting on the lashings and individual container structures.

Loading an unauthorised extra tier of containers will have a similar effect.

## Size

Stowage and lashing systems are usually designed for a container height not exceeding 8'6" for both 20' and 40' containers. However, many manufacturers make 9'6" high containers, sometimes referred to as *high cube* containers. When these are stowed on deck the centre of gravity of the stack is moved higher, wind forces on the stacks are increased and the angles at which the lashings act are changed from their design specifications. These factors can cause an increase in the forces acting on the lashings and individual container structures.

## Position

The allowed positions for containers in the Cargo Securing Manual for an individual ship ensure that the calculated forces on the stacks are not exceeded and that there is sufficient visibility for safe navigation. Exceeding the design heights of a container stack will cause an increase in the wind forces acting on the stow and the centre of gravity of the stack to be moved higher. Both factors can cause an increase in the forces acting on the lashings and container structure.

Loss or damage may result when one or more of the above contributory causes results from incorrect stowage.

Consistently poor stowage that results in increased forces acting on the ships structure and lashing systems will also have a weakening effect that may result in a failure at later date.

Correct stowage and securing should take all the above factors into account. The approved Cargo Securing Manual should be prepared individually for each ship to take account of the arrangement and structural strength of the ship, visibility requirements and container lashing system. The manual should give the stowage and lashing requirements, with specific reference to size, weight, and position of containers as mentioned earlier.

## Metacentric Height (GM)

The ship's stability, primarily the initial GM, will depend upon the weight of the containers stowed on and under deck, and the forces acting on the containers stowed on deck will be partly dependent upon the ship's GM. There will always be a compromise between the weights of containers loaded on deck, any ballast and the initial GM, but the correct balance should be achieved to ensure that the ship's stability is within safe limits to ensure that the motions of the ship are not excessive.

A container ship's stowage and securing system is usually designed under the condition of a maximum GM, which will be noted in the ship's Cargo Securing Manual. If the vessel is operated at GM values exceeding those specified, the expected forces acting on the containers and lashings increase, the standard stowage and securing plans may not be used, and an appropriate reduction of stack weights, stack heights, or weight concentration to the lower tiers should be planned.

A UK Marine Accident Investigation Branch (MAIB) report - on a collapse of cargo containers on *Annabella* on 26 February 2007 - identified operation under an excessive GM as one of the factors leading to the incident. In its recommendations (Section 5) the MAIB report recommended that the shipping industry develops a best practice safety code to ensure that:

*The resultant increase in acceleration forces and consequent reduction in allowable stack weights when a vessel's GM is increased above the value quoted in the cargo securing manual is clearly understood by vessels' officers. The consequential effect on container stack weight, height and lashing arrangement for changes in the*

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*vessel's GM should be readily available and clearly displayed to ships' staff.*

## Non-ISO containers

According to ISO standard ISO 1496-1, fully loaded containers must be capable of nine high stacking. This is a stacking weight of 192,000kg on the bottom container, equivalent to eight containers – each of 24,000 kg and an acceleration force of 1.8G - stacked on top of the container.

However, there appears to be no requirement for container manufacturers to comply with the ISO standard.

The UK Marine Accident Investigation Branch (MAIB) report on *Annabella* identified the carriage of non-ISO containers as one of the factors leading to the incident. In its recommendations (Section 5) the MAIB report recommended that the shipping industry develops a best practice safety code to ensure that:

*Those involved in container operations are aware that containers with allowable stack weights below the ISO standard are in regular use and must be clearly identified at both the planning and loading stages to avoid the possibility of such containers being crushed.*

## Practical Considerations

In practice it will be up to the planners at the loading terminal and the ship's officers to ensure that both the stowage and securing requirements of the Cargo Securing Manual are complied with. The Cargo Securing Manual should provide planners and ships' staff with the information needed to ensure that both stowage and securing are carried out according to ensure that the forces acting on the ships structure, the container lashing system and the structure of an individual container do not exceed design limits.

The ship's master and officers have an obligation to exercise due diligence to make the ship seaworthy, which includes ensuring that containers are stowed and secured so as to prevent damage to the ship or to other containers, even if stowage and securing is the responsibility of the charterer under the charterparty.

Ships officers should not allow loading to commence until a stowage plan or equivalent information for the relevant under-deck or on-deck area (bay) has been provided,

even if a final stowage plan is not available. This will allow time for an inspection as to whether the stowage is correct and stack and tier weights are within the allowable limits. As loading continues, any changes made by the planners to the initial stowage plan should be notified to the ships officers, who should also note any changes to the actual stowage.

If any problems with the stowage plan are noticed, especially when stack or tier weights would be exceeded, the ship's officers should bring these to the attention of the stevedores and terminal planners so that the stowage can be rectified.

## Container weight and height

Specifically, requirements for weight limitation at different tier heights within a vertical stack of deck containers, and the distribution of containers by weight vertically within the stack, must be complied with. Compliance with this factor alone would probably result in a large decrease in the number of instances of damage and loss.

In summary, ship planners and ship's officers should ensure that:

- The total weight of each stack of containers does not exceed the permissible stack weight for the position and arrangement of units, this having been determined for the tank-top, deck or hatch cover.
- Tier weight distributions given in the Cargo Securing Manual are not exceeded.
- Container height parameters given in the Cargo Securing Manual are complied with.
- Metacentric height (GM) parameters given in the Cargo Securing Manual are complied with.

It is unusual for containers to collapse or lashings to break if the stowage and securing have been carried out correctly according to an approved Cargo Securing Manual, unless the weather conditions are exceptionally bad – bearing in mind that the stowage and securing systems are designed to cope with very heavy weather, and allow a margin of safety.

## Changes to a standard plan

If the ship has only a Cargo Securing Manual – when there is no loading software that includes a lashing forces module - then the specified maximum GM, maximum

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stack weights, and individual maximum tier weights must not be exceeded.

Any plan to alter the weight concentration in the stack downwards will depend on the ship being in a position to re-calculate the dynamic forces using the parameters container type (height), ship's actual GM, individual tier weights, and various combinations of lashings. There should be a page in the Cargo Securing Manual giving details of the data needed to re-calculate stowage patterns other than those shown in the Cargo Securing Manual.

In order to stow the ship if the maximum GM specified in the Cargo Securing Manual is exceeded and to give the ship's crew the possibility to calculate other special loading cases, it is generally recommended that ships and shore planning have an approved 'lashing module' software in addition to approved container planning and stowing computers and software. In such special loading cases there are generally six parameters to consider:

- 1 A reduction of stack weight.
- 2 A reduction of stack height (say from 5 high to 3 high).
- 3 Weight concentration to the lower tiers.
- 4 Increased or various combinations of lashings.
- 5 Treat each stack as an individual outer stack with corresponding lashings and weight reductions.
- 6 A combination of some or all the above.

The only practical way of doing these calculations is to use approved computer software including lashing module software.

## Evidence

To defend a claim properly, the shipowner with the assistance of their P&I club, should first determine that proper procedures were in place for stowing and securing the cargo, and then show that these requirements were followed in practice. The following should provide useful evidence. Pages copied from ship's Cargo Securing Manual

- Relevant page showing the approval stamp / endorsement of the Flag State – usually the front page.

- Relevant pages showing the approved stowage plans for the deck position ("bay") where the loss or damage occurred. These should include the allowed stowage weights
- Relevant pages showing the approved lashing plans for the deck position ("bay") where the loss or damage occurred
- Relevant pages giving details of parameters on which the stowage and securing calculations throughout the Manual are based, especially the container heights (usually 8'6") and stability (maximum GM).

## Copies of actual stowage plans

- Cargo loading plans ("bay plans") for the area where the damage or loss occurred, giving container numbers, heights and weights.

## Copies of ships records

- Ships stability – GM at time of damage or loss
- Maintenance records – statutory requirement for maintenance records to be kept under Cargo Securing Manual and ISM Code Section 10
- Record of lashings actually applied for the area where the damage or loss occurred
- Record of inspection and /or tightening of lashings before and during voyage.

## Record of checks

To establish that proper steps have been taken to stow and secure the cargo properly:

- Check the Cargo Securing Manual to ensure that it is approved.
- Check that GM was within range allowed by Cargo Securing Manual.
- Compare the relevant pages of the Cargo Securing Manual with the actual bay plans to ensure that the stowage was satisfactory.
- Compare the relevant pages of the Cargo Securing Manual with the actual lashing plan to ensure that the securing was satisfactory.
- Check securing records to ensure lashings were inspected and tightened (weather permitting).