The Swedish Club

# Container focus

## Preventing the loss of containers at sea

2020

LOSS PREVENTION
ESSENTIALS

Sailing through heavy weather is the most common immediate cause for containers being lost overboard. Using weather routeing will improve the situation. Reducing speed and altering course will also help.

When preparing a vessel for sea it is essential that the cargo is loaded as per the Cargo Securing Manual, which provides guidance on the stowage and securing of containers and non-standardised cargo.

In many of the cases that The Swedish Club has dealt with, an excessive GM has been one of the contributing factors. Particular attention must be paid to the vessel's GM when sailing through heavy weather.

There are also recurring issues with inadequate training.

Misdeclared cargo is a common cause of lost containers and can lead to major losses.

# Contents



# 1. Introduction

Established less than 70 years ago, the container industry is perceived by many as the modern face of shipping. Yet despite the sector being well regulated and highly regarded, containers are still lost overboard. In this publication we investigate this issue – we share statistics that the Club has carefully compiled over a number of years, provide an insight into specific cases, and with the help of experts, deliver some hands-on advice.

The most common factors associated with loss of containers overboard are misdeclared cargo weight, containers not stowed in accordance with the Cargo Securing Manual (CSM) and sailing through heavy weather.

Unfortunately, many of the issues raised in this publication occur time and time again in claims handled by The Swedish Club.

## Weight of containers

Of course, as it is the shipper's responsibility (as per the SOLAS Container Weight Verification Requirement, 1st July 2016) to declare the container's verified gross mass before it is loaded on board the vessel, it can be difficult for the shipowner to know the exact weight of every container stowed on their vessel.

However, Maritime & Coastguard Agency (MCA) guidance for the verified gross mass states: 'If a packed container is weighed at the port terminal facility, that is the gross mass that should be used for ship stow planning'[1]. In many of the cases that the Club has handled this guidance has, unfortunately, not been complied with.

## The Cargo Incident Notification System

Problems with incorrectly declared containers are costly for the shipping industry and have been an ongoing issue for many years. The Swedish Club supports the Cargo Incident Notification System (CINS), an important industry initiative which was launched in September 2011. The purpose of the CINS is to increase safety in the supply chain, reduce the number of cargo incidents on board vessels and publicise the risks caused by certain cargoes and/or packing failures.

*This publication has been written with input from SOLIS, Macgregor and SEC Bremen. We would especially like to thank Rosalind Blazejczyk - Managing Partner, Naval Architect from Solis Marine Consultants, Kari Tirkkonen - Senior Naval Architect from Macgregor and Hilko Dunkhorst - Managing Director from SEC Bremen.*

[1] *MCA MGN 534 (M+F) 8.2 Discrepancies in gross mass*

# 2. Statistics

## 2.1 Introduction

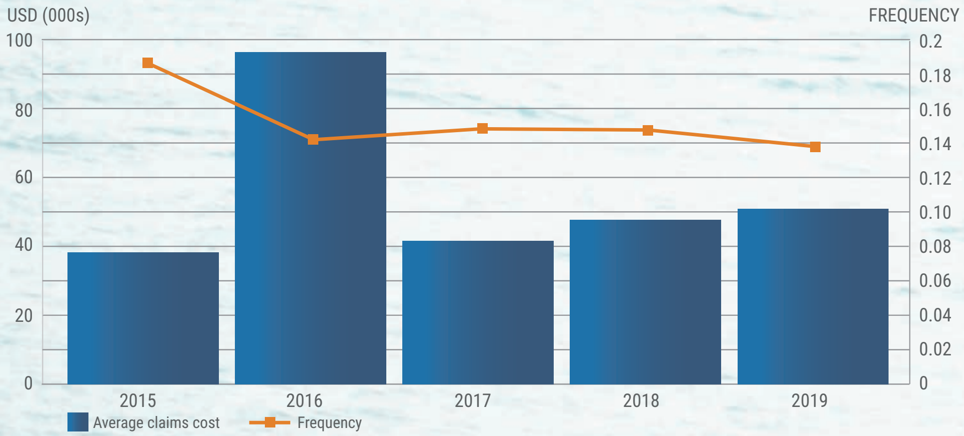
In this publication we consider container claims that have generated a cost of at least USD 5,000. This is to remove smaller claims which may only have incurred a survey cost, and instead focus on the claims which have generated a more substantial loss.

This publication focuses on 230 claims which the Club has experienced in the years 2015-2019.

GRAPH 1

### Average claims cost and frequency by year

*P&I cargo, container, 2015-2019*
*Cost =>USD 5,000 – uncapped*
*As per 14/8/2020*



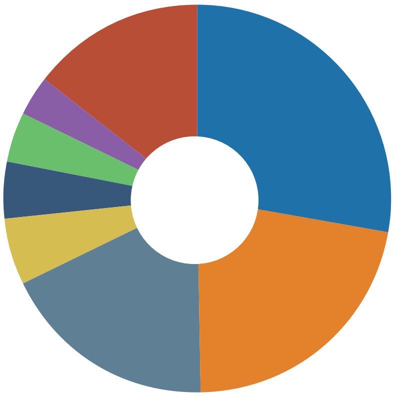

The graph shows a spike in frequency of cargo claims for 2018 as the Club experienced an unusual amount of wet damage claims caused by flooding in the cargo holds. The high cost for 2016 was caused by a complicated total loss claim.

For the chosen five-year period, the average container vessel cargo claim cost was USD 52,000.

GRAPH 2

## Type of claims by volume

*P&I cargo, container, 2015-2019*
*Cost =>USD 5,000 – uncapped*
*As per 14/8/2020*

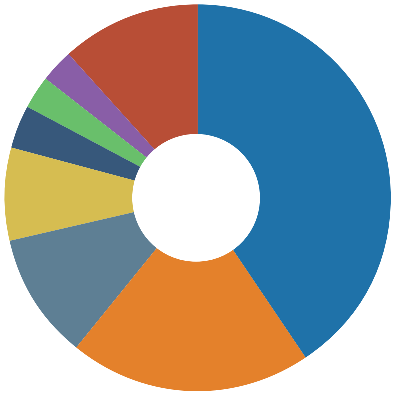


| | |
|---|---|
| Wet damage | 27.9% |
| Temperature damage | 21.9% |
| Physical damage | 18.1% |
| Unclaimed cargo | 5.6% |
| Off-spec | 4.7% |
| Lost overboard | 4.2% |
| Deterioration | 3.3% |
| Uncategorised | 14.3% |

GRAPH 3

## Type of claims by cost

*P&I cargo, container, 2015-2019*
*Cost =>USD 5,000 – uncapped*
*As per 14/8/2020*



| | |
|---|---|
| Wet damage | 40.6% |
| Temperature damage | 20.3% |
| Lost overboard | 10.6% |
| Physical damage | 7.7% |
| Deterioration | 3.8% |
| Unclaimed cargo | 2.8% |
| Off-spec | 2.8% |
| Other | 11.4% |

Whilst just over 4% of claims are for containers lost overboard, these account for over 10% of costs.

Claims caused by containers being lost overboard generate an average claims cost of more than USD 135,000 as compared with an average cost of claims from other causes of USD 52,000.

Importantly, these statistics cannot reflect the potential danger to shipping and the environment caused by containers lost at sea.

# 2.2 Immediate causes of container loss

Why are containers lost overboard? The Club's claims statistics show that the main reason is related to container vessels navigating in heavy weather combined with a failure of the crew to reduce speed and/or alter course to either avoid it or alleviate its effect.

Other common factors are;

- Containers not being correctly stuffed or declared by the shipper
- Containers not being loaded as per the stowage plan
- Containers not secured in accordance with the Cargo Securing Manual (CSM)
- Lashing strengths not checked against the loading computer's lashing module
- The vessel being too stiff with an excessive GM (Metacentric Height)

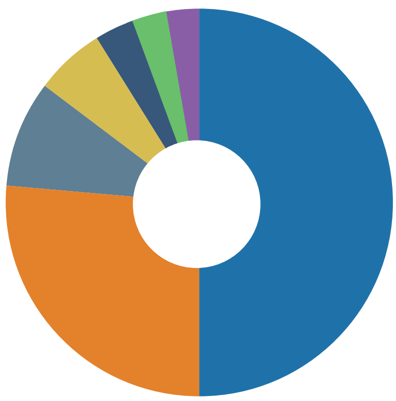
The costliest claims are related to container vessels navigating in heavy weather. Avoiding heavy weather and ensuring the cargo is properly secured is paramount. Exercising good seamanship when vessels navigate in or near areas of heavy weather will assist in preventing incidents and their associated high cost.

GRAPH 4

### Immediate causes of container loss – number of claims

*P&I cargo, container, 2015-2019*
*Cost =>USD 5,000 – uncapped*
*As per 14/8/2020*

| | |
|---|---|
| Heavy weather | 50.0% |
| Insufficient lashing/securing by shipper | 26.5% |
| Insufficient lashing/securing by stevedore | 8.8% |
| Insufficient lashing/securing, ship side | 5.9% |
| Poor tally | 3.0% |
| Loading heavy containers on top of light | 2.9% |
| Poor stowage | 2.9% |

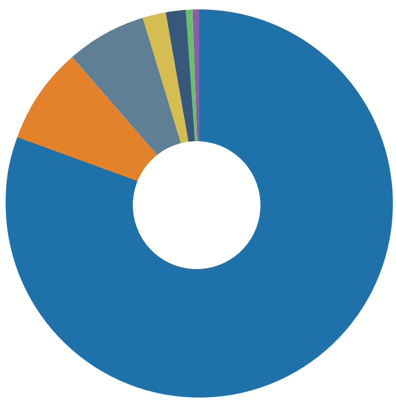


GRAPH 5

### Immediate causes of container loss – total cost

*P&I cargo, container, 2015-2019*
*Cost =>USD 5,000 – uncapped*
*As per 14/8/2020*

| | |
|---|---|
| Heavy weather | 80.8% |
| Insufficient lashing/securing by stevedore | 8.0% |
| Insufficient lashing/securing by shipper | 6.6% |
| Insufficient lashing/securing, ship side | 2.0% |
| Poor tally | 1.6% |
| Loading heavy containers on top of light | 0.5% |
| Poor stowage | 0.5% |

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TARE 3.860 KGS 8.510 LBS
NET 26.620 KGS 58.690 LBS
CU. CAP. 76.4 CU.M. 2.698 CU.FT.
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# 3. Planning, loading and stability

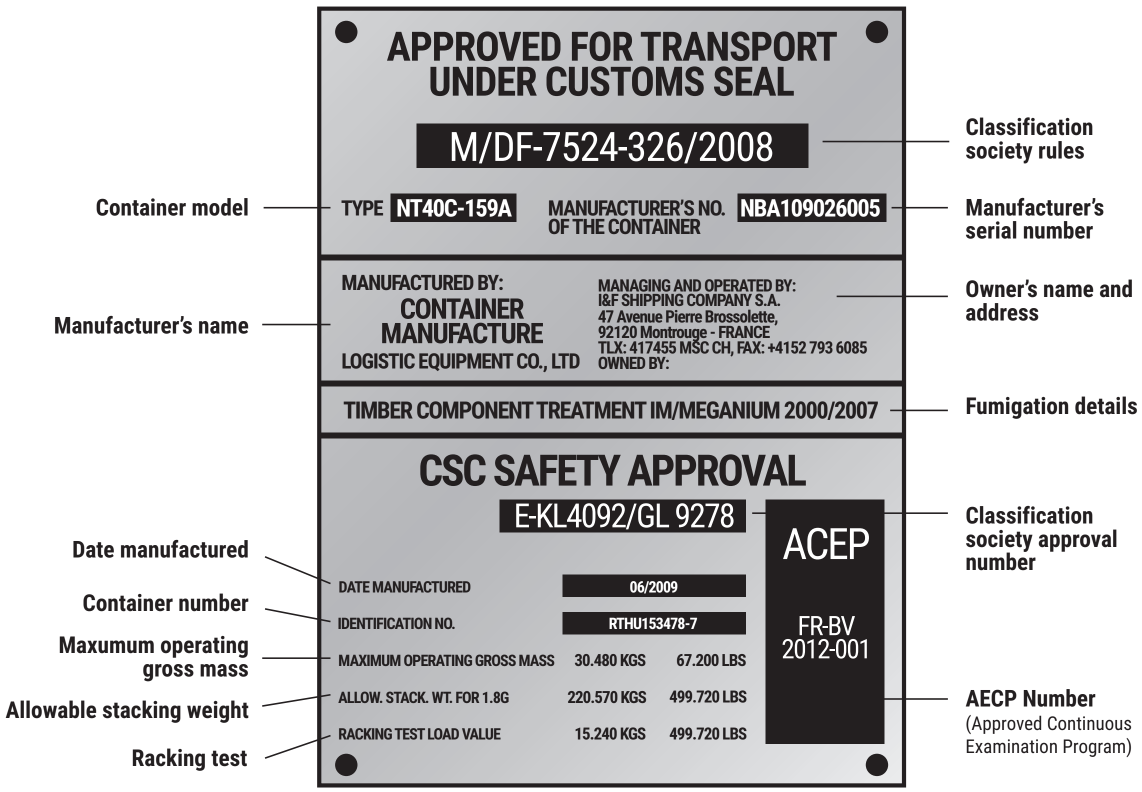
# 3.1 Considerations

## The stowage plan

Before loading, the Chief Officer receives a stowage plan from the cargo planner and this plan is entered into the onboard loading computer. The plan is verified against the vessel's CSM and, if fitted, against the lashing module of the loading computer.

The Master should not allow loading to commence until the stowage plan has been checked, including the verification of the stack weights. This is particularly important when loading non-ISO standard containers. If any irregularities are identified, these should be brought to the attention of the cargo planner so they can be rectified.

Container stacking limitations and other details will be shown on the Container Safety Convention (CSC) plate fixed to the container.




***Explanation of a Container Safety Convention (CSC) plate from Bureau International des Containers (BIC).*** *Courtesy: Macgregor*

## Securing containers

A container securing system typically consists of the permanent fittings such as cell guides, lashing bridges, twistlock sockets, shoes, lashing plates; and loose equipment such as twistlocks and lashing bars. A combination of all of this equipment should represent an overall container stowage solution.

## Dimensions

The most common container types are 20', 40' and 45', with heights of 8'6" or 9'6" and width of 8'. Other container sizes are rare and only some vessels are designed to carry them; non-ISO US intermodal 48' and 53' containers were not originally designed for sea transport.

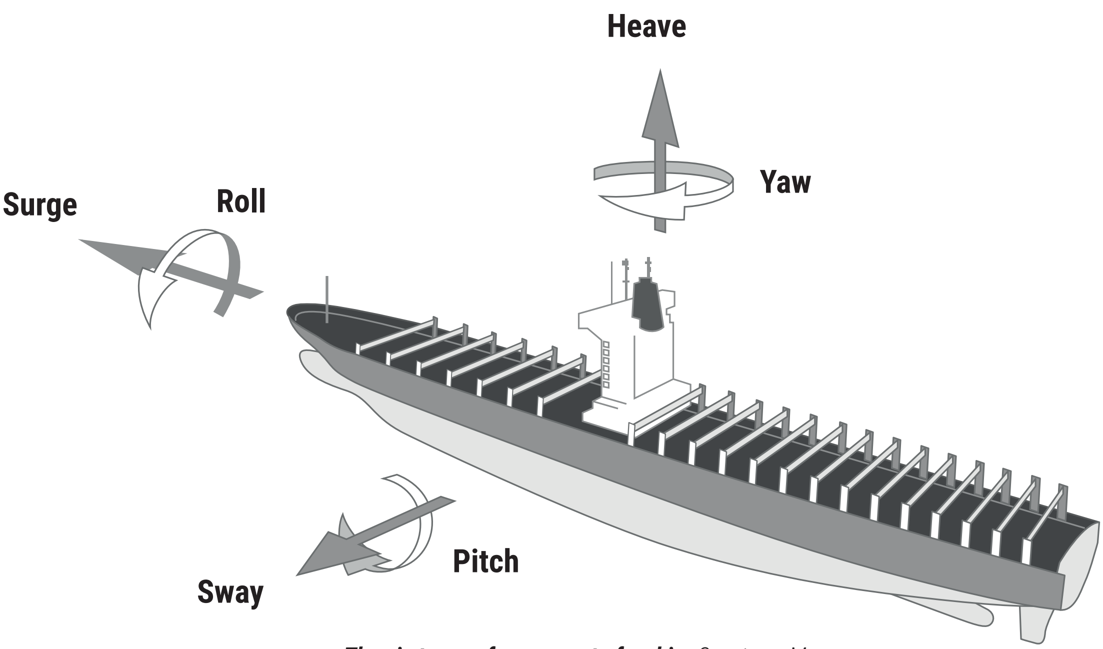
Particular care should be taken when mixing different-sized units within stacks, as this can make it difficult to apply lashings and lock and unlock twistlocks. If over-width non-standard containers are carried, then the stowage arrangement for these should be defined in the Cargo Securing Manual (CSM).

## Weights

If the weights of individual container stacks are exceeded beyond permissible limits, this can lead to failure of the containers in the lower tiers of the stack. Most ISO containers are designed to withstand stacking up to 13 high based on the allowable stacking weight *(see illustration 1)* but non-ISO containers tend to have a reduced capacity for stacking and their limits must be checked individually.

In accordance with 'The SOLAS Container Weight Verification Requirement', the responsibility of documenting the verified gross mass of a container lies with the shipper. The regulation states: 'A container should not be loaded unless the Master or his representative have obtained, in advance of vessel loading, the verified actual gross mass of the container'.

Furthermore, the container can be seen as a weak box loaded with heavy cargo. The mass of the cargo is accelerated by the six types of movement of a ship in response to sea conditions, and by additional forces from wind and green seas.




***The six types of movement of a ship.*** *Courtesy: Macgregor*

The mass of the cargo will be accelerated by the movement of the ship in response to sea conditions. The container is the weakest link in the lashing system. The CSM details how the container should be secured with turnbuckles, lashing bars, twistlocks and cell guides. The vessel's CSM is the core reference document governing how containers should be stowed and secured. In addition, the Master and deck officers should be familiarised with the manufacturer's instructions on the proper use and care of securing equipment.

## Loading and securing

The loading and securing of containers are usually performed by the port stevedores. A concern during loading is that stevedores secure containers with lashing equipment that has deteriorated. It is important that all lashing equipment is in good condition and that any items in poor condition are removed to prevent further use. The Master is responsible for the safe loading of the vessel in accordance with ISM and SOLAS regulations. Before departure, the crew should also verify that the cargo has been secured correctly.

## Stability

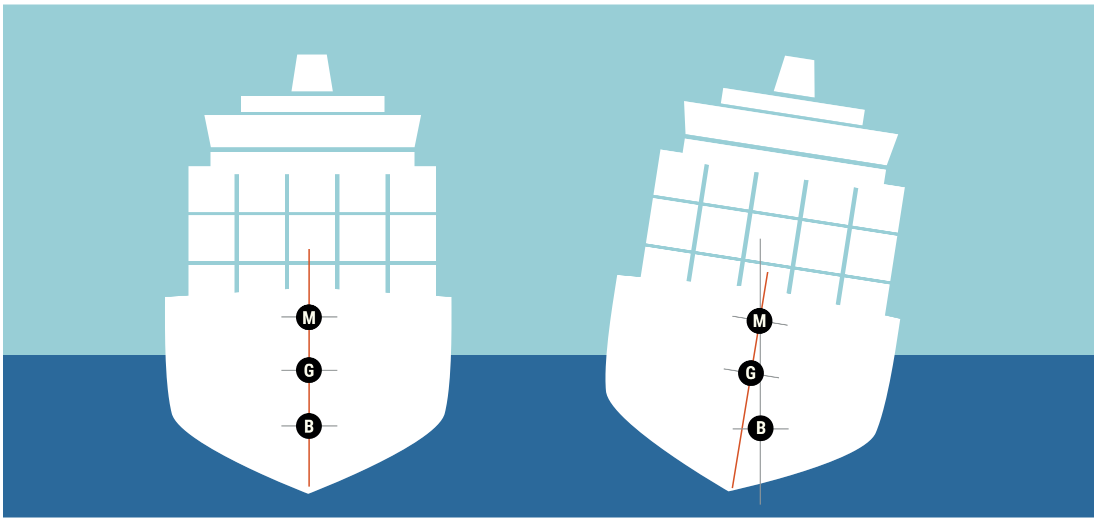
A vessel's stability is defined by its Metacentric Height (GM). It is calculated as a distance between the centre of gravity of the vessel and its metacentre. A large GM makes a vessel 'stiff'. The CSM is based upon a designed GM – for example if the designed GM is 2 metres but the actual GM is 12 metres, this could potentially exert enormous forces on the cargo lashings in excess of their design limits. The vessel has a minimum GM which it must comply with for stability reasons, however an excessive GM can lead to container losses.

The lashing module on the loading computer should alert the operator if the GM is excessive for the cargo lashings. The factored-in GM may be increased for modern vessels on account of their larger beam and improved lashing systems, allowing heavier cargo to be positioned in the upper tiers thus reducing the GM. It is usually not possible to reduce the GM by ballasting due to ballast tanks being positioned below the vessel's centre of gravity. However, deballasting could reduce the GM provided adequate stability is maintained.

Stability calculations from the shipyard are usually performed with a fixed container weight of i.e. 14 tonnes/TEU for the entire vessel, while the container weight distribution in the CSM is based on stratified container weights which is a more realistic application. Thus, there is no direct link between stability calculations from the yard and the CSM. The securing calculations should always be carried out with the maximum GM value calculated by the onboard stability software for the voyage and the actual container weights from the loading software.

The CSM will only present one loading scenario as an example. Only an onboard loading computer with integrated and approved lashing software can calculate the actual loading condition for each voyage. This software will indicate if there are any excessive forces.

***Metacentric Height***




***Ship stability diagram showing centre of gravity (G), centre of buoyancy (B), and metacentre (M) with ship upright and heeled over to one side. As long as the load of a ship remains stable, G is fixed. For small angles M can also be considered to be fixed, while B moves as the ship heels.***

## 3.2 Loss prevention advice

- The CSM should be approved by the vessel's Classification Society and/or the Flag State Administration.
- There should be procedures in place for calibrating the loading computer.
- The loading computer should include a lashing module. This is obligatory if Classification Society route specific lashing rules apply.
- The CSM is not accurate if the actual GM significantly exceeds the design GM. The CSM will specify a maximum GM for a vessel, which should not be exceeded.
- Sailing with an excessive GM i.e. in a 'stiff' condition, results in increased acceleration forces and more violent rolling motion.
- If the maximum GM is exceeded this could result in:
    - Higher transverse acceleration
    - Overstressing stowage and securing devices
    - Overstressing the ship's structure
    - Damaging containers
- Sailing with a very low GM should also be avoided to ensure positive stability is maintained throughout the voyage and during cargo operations.
- Before loading, the Master should ensure that the container weights are declared as per SOLAS requirements and that the maximum stack weight and height limits are not exceeded.
- Unusual stowage plans, loading conditions or voyages, that may not be allowed for in the CSM require particular attention and it is essential that the cargo planner discusses the stowage plan with the Master to identify any potential problems.
- Avoid loading heavy containers above light containers, particularly in the upper tiers, unless permitted by the CSM and subject to forces being checked on the loading computer.
- Lashing plans provided to stevedores should be checked against the CSM at each loading.
- Instructions relating to the correct application of the lashing arrangements should be available to the stevedores at every bay.
- It is important that the verified gross mass established for each container is applied to the vessel's loading plan.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4,000 KG
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26,480 KG
58,380 LBS
67.74 CU.M.
2,392 CU.FT.
M.G.W.
TARE
NET
CU.CAP.

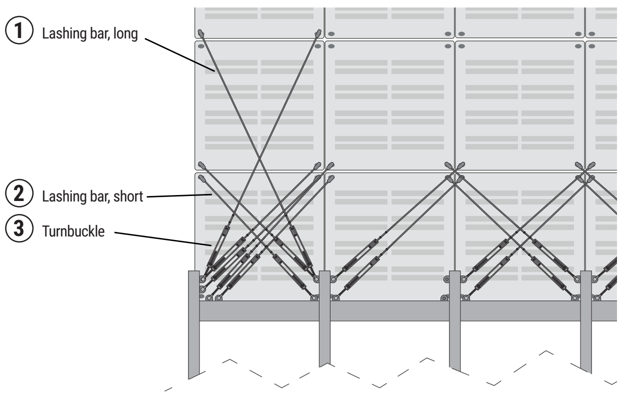
# 4. Lashings

# 4.1 Equipment

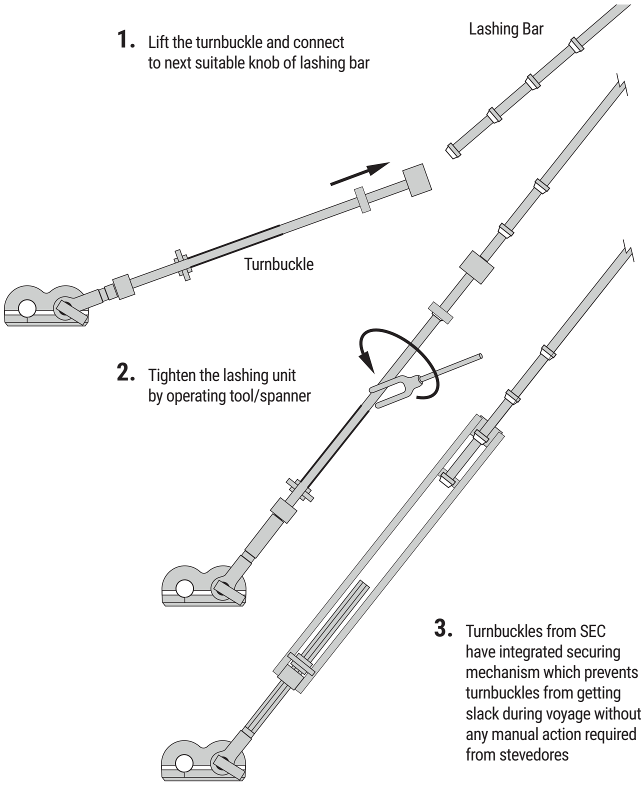
## Turnbuckles and lashing bars

Turnbuckles and lashing bars secure the containers when they are stowed on deck and not in cell guides. In accordance with ISO 1496 and Class rules, the lashings should be able to withstand the following forces: tension 250 kN, shear 210 kN, and compression 1200 kN.

The Container Securing Manual (CSM) provides information on how containers are to be stowed and secured on board.




***Paralash external system.*** *Courtesy: Macgregor*




***Correct securing of containers.*** *Courtesy: SEC Bremen*

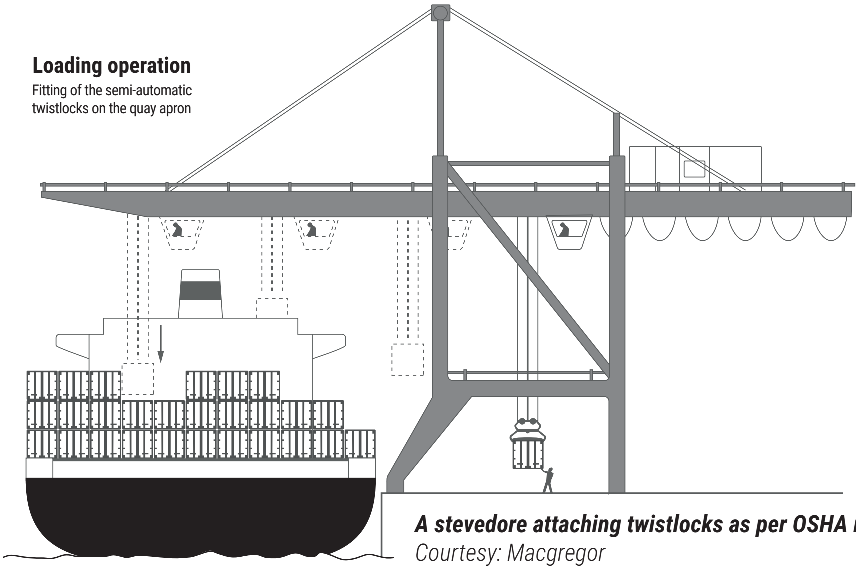
The turnbuckles, lashing bars and twistlocks form a system within which the lashing forces should be evenly distributed. If turnbuckles are applied too tightly, the twistlocks between the containers run the risk of not engaging properly and transferring all the lashing forces on to the turnbuckles and lashing bars.

Near the stern of the vessel, securing equipment will be more vulnerable to corrosion due to the combined effects of seawater and machinery exhaust fumes.  In order to extend the lifetime of the turnbuckles and lashing bars it is recommended that the location of the equipment is rotated between the aft and forward bays on a regular basis.

# Twistlocks

There are three types of twistlocks: manually operated twistlocks, semi-automatic twistlocks (SATs) and fully-automatic twistlocks (FATs).

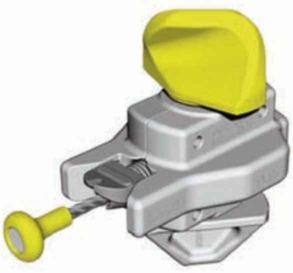
As the United States Occupational Safety and Health Administration (US OSHA) rules prohibit stevedore access on top of containers (unless in exceptional cases), manual twistlocks are used for securing only the bottom deck tiers in Europe, Asia and the US. From the second tier and upwards, or above the lashing bar container level, FATs or SATs are usually used.




***A stevedore attaching twistlocks as per OSHA rules.***
*Courtesy: Macgregor*

SATs lock automatically and require manually unlocking before unloading begins. FATs do not need any manual operation. All twistlocks have the same safe working load (SWL) of 25 tonnes but the more important figure is the pull-out force or holding power. This is tested by the classification societies. Heavy duty FATs can take higher loads, the safety factor between safe working load and minimum breaking load is four times instead of two times for a light FAT.

***Manual twistlock***
*Courtesy: Macgregor*



***Semi-automatic twistlock***
*Courtesy: Macgregor*

***Light fully-automatic twistlock with a pull-out force of 325kN***
*Courtesy: SEC Bremen*

***Heavy fully-automatic twistlock with a pull-out force of 486kN***
*Courtesy: SEC Bremen*

When locking and unlocking, manual and semi-automatic twistlocks require physical manual input whereas FATs can be operated remotely by crane operation without any physical handling. The FAT provides an automatic mechanism to both secure or unsecure the container when being loaded or discharged. This saves time and effort during loading and unloading.

Before loading any containers on board, the twistlocks are manually fitted by stevedores in each of the four bottom corner castings of the container. At the upper part, the twistlock has a metal pin which allows it to be locked in the bottom corner casting in one position only.

The container is then transferred on board and lowered on top of another container. A container secured with FATs can also be discharged from its position without additional handling or manual activity. Theoretically, a FAT should keep its locking function engaged during all anticipated sea conditions. The locking function is activated by rolling pressure force on one side of the container. This prevents the FAT on the opposite side to slip out of the corner casting and it locks when force occurs.

Before departure all bays must be checked to ensure that the operating position of semi-automatic or manual twistlocks is correct. Depending on the type of automatic twistlock it may have a handle or no handle. Broken handles or wire toggles are the most common problem with twistlocks. The crew should check that the bottom twistlocks and semi-automatic twistlocks are not locked during discharge.

## 4.2 Maintenance

The Master is responsible for the proper inspection and maintenance of both fixed and portable securing equipment on board. Particular attention should be paid to the following:

- A visual inspection of all components should be made at intervals not exceeding six months.
- Crew members and stevedores should report any defective components to the Chief Officer.
- The threads of turnbuckles and bearings of twistlocks should be regularly greased.
- Great care should be taken to ensure that twistlocks which have been taken ashore are returned immediately and are not replaced by other non-vessel specific twistlocks.
- Damage to fixed cargo securing devices must be repaired by an approved contractor in strict compliance with classification society requirements.
- The handling, maintenance and examination of equipment should be performed in accordance with the manufacturer’s instructions.
- Replacement equipment must be of identical type and quality as stipulated by the CSM.
- Damaged equipment must be replaced immediately with original spare parts.
- The equipment must be checked for fractures and any excessive corrosion and wear.
- When containers are identified with significant deficiencies to corner castings or corner posts, they should not be accepted for loading.

## 4.3 Loss prevention advice

- Lashings should be applied in accordance with the CSM.
- Loose lashings increase the risk of contact between the containers at the top of the stacks and greater racking force on the containers at the bottom of the stacks.
- The lashing force calculations should be performed by a Class-approved loading computer with a lashing module.
- Before departure, the Chief Officer should ensure that all manual twistlocks have been locked, that the wires of SATs are in the correct position and that all turnbuckles are tight. Do not over-tighten turnbuckles.
- Only use certified lashing equipment.
- The Chief Officer should ensure that both the fixed and the portable securing equipment are inspected regularly for signs of wear or damage and deficient items repaired or replaced as required.
- All required inspections and maintenance should be included in the Planned Maintenance System (PMS).
- Keep detailed records of maintenance, inspections and tests completed both by the crew and third parties.
- It is important that all lashing equipment is in good condition and that any defective equipment is removed to prevent it from being used.
- Avoid using a combination of manual, semi-automatic and fully-automatic twistlocks in the same stowage, unless this is approved in the CSM.
- Ensure that openings and hatches on deck are properly closed and secured before sailing.
- The stowage arrangements and lashing equipment should be in strict conformance with the CSM.
- The CSM should be written in a language understood by the crew and stevedores.
- Portable gear should be periodically inventoried to ensure the complement of the various components complies with the CSM.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# 5. Heavy weather

## 5.1 Introduction

When a container vessel encounters heavy weather, the container stacks will be subjected to high levels of stress, and damage to the hull and cargo is not uncommon. In circumstances where the containers' weights are mis-declared, permissible stack weights are exceeded or heavy containers are stacked on top of light containers, entire container stacks may collapse, damaging the vessel's structure and causing containers to fall overboard.

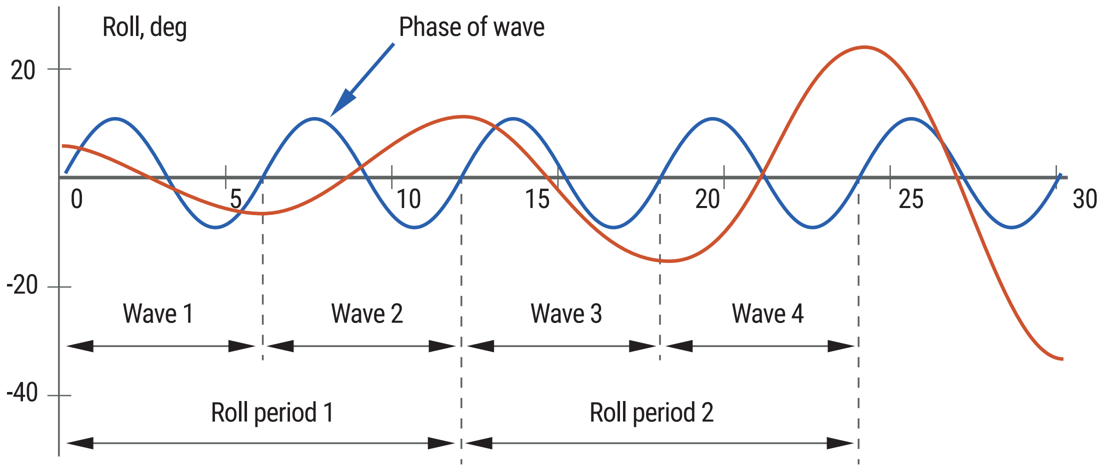
The wide beam of many container vessels can result in large metacentric height (GM) values and if only partly loaded, the GM may become excessive. This can become very problematic if a vessel experiences heavy weather, contributing to the failure of the cargo securing arrangements and loss of containers overboard. Weather conditions must be closely monitored during the entire voyage and the vessel routed to avoid forecast extremes of heavy weather. If the vessel cannot avoid heavy weather, it is essential to take early and effective action, such as reducing speed and altering the course as required.

## 5.2 Parametric rolling

Vessels such as container vessels, optimised to carry large volumes of cargo, have increased significantly in size. This increase of cargo space and transport efficiency could not have been achieved without developing sophisticated hulls. These hulls show a larger variation in stability during the passage of a wave compared to more traditional forms. This is usually not a problem because the average stability in waves is generally larger than in calm water. In certain conditions this variation might increase the risk of parametric rolling.

When a vessel passes the crest of a wave the waterplane area is reduced. This causes a reduction in GM from the still water value. Then as the vessel moves into a trough the flared sections, and the bow and stern become wetted which then increases the GM. This parametric rolling effect is most likely to occur in head, following, bow or quartering seas when there is little direct roll force from the waves. This makes the phenomenon difficult to predict.

The best prevention against parametric rolling is to have equipment installed that can detect when it occurs or when it is at risk of occurring and training crew to recognise when a vessel is at risk of parametric rolling and what actions to take in order to avoid it.




***Example of time series of parametric roll together with wave phase.*** *Courtesy: Bureau Veritas*

## 5.3 General loss prevention advice

- Weather routeing should be used to avoid the worst environmental conditions, but the Master should also use his/her own judgment to make course and speed adjustments during the voyage as necessary, to reduce the impact of the heavy weather.
- Conduct regular visual inspections on deck, particularly when heavy weather is expected, and tighten the lashings where necessary. Inspect and tighten again following heavy weather.
- If lashings are tightened when the vessel is rolling and pitching, there is a risk of over-tightening the turnbuckles.
- The crew should keep proper records of all inspections and action taken to mitigate the effects of heavy weather.
- When heavy weather is encountered, the OOW should reduce speed and alter course as early as possible to avoid heavy rolling.
- Address heavy weather issues (cargo stowage and ship handling) during seminars and in ship simulators.
- Distribute circular letters to vessels, ensuring that crews are aware of the problems associated with heavy weather.
- Complete a risk assessment for encountering heavy weather.
- If the vessel has an electronic motion monitoring, forecasting and decision support tool this could detect if the vessel is at risk of parametric rolling. It is imperative that the motion limits are set. It is important that all officers are trained and familiarised in the proper use of such systems.

## 5.4 What to do if a container is lost

All too often accidents do happen, and containers are lost overboard. In such a situation it is important to implement the correct emergency procedures to ensure that the situation is contained, that the correct measures are taken to minimise environmental impact, and that the safety of both crew and other vessels is not compromised.

- Respond to emergency situations, such as fire and hazardous chemical leaks, but do not place crew in unnecessary danger.
- Request emergency assistance if required.
- Establish what is inside the lost container(s) e.g. dangerous cargo.
- Alert the relevant Maritime Rescue and Coordination Centre (MRCC) and all vessels in the vicinity of the hazard to navigation.
- Advise the company Designated Person Ashore (DPA) so an emergency response can be initiated.
- Consider the planned voyage and whether a deviation to a safe port is required.
- Broadcast voice and text safety messages.
- Maintain a detailed and accurate log of events and communications.
- Save the Voyage Data Recorder (VDR).
- Ensure that all relevant cargo documentation is saved.
- Assess if there is any damage to the vessel and ensure safe access for crew.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# 6. Cases: Containers lost overboard

# 6.1 Vessel with large GM lost containers in heavy weather

A large container vessel was sailing on a SE course in the North Atlantic, bound for a European port. During the voyage, heavy weather was encountered from ENE at Beaufort force 9, with 7 metre waves. This meant that the wind was on the vessel's port side, causing heavy rolling. The maximum recorded roll angle was 30⁰.

During the morning watch, the OOW and the Master were on the bridge. Hearing a loud noise astern of the bridge they looked out of the window and could see that a number of containers had collapsed and some had fallen into empty bays. The collapsed containers were all 20' TEU and were stowed in four bays. The side containers on the starboard side had toppled inboard into an empty space and others had fallen overboard.

After the incident the Master broadcast a safety alert over the VHF. In response to the heavy weather, he then ordered a more easterly course of ESE and reduced speed from 16 knots to 7 knots.

## Cause

The Container Securing Manual (CSM) required that the bottom containers on deck were secured by manual twistlocks. However, the twistlocks in the container shoes were unlocked. In accordance with the vessel's procedures, the lashings were to be checked prior to every departure, which the Chief Officer stated he had done. At the loading port the Chief Officer had signed the lashing report without noting any deficiencies.

The vessel had a metacentric height (GM) of 11 metres which made it very 'stiff'. This means that the vessel would quickly return to the upright position after being inclined by an external force such as wind or waves.

## What can we learn?

- The base twistlocks had not been locked as they were found undamaged and still located in the shoe fittings. The combination of unlocked twistlocks and a very stiff vessel sailing through heavy weather led to the collapse of the container stacks.
- The Chief Officer should have ensured that the manual twistlocks were checked before departure.
- The officers should have reduced speed and altered course to ensure the effect of heavy weather was minimised. This was only carried out after the accident had happened.
- A GM of 11m was excessive for this vessel. A stiff vessel will affect the top and side containers the most. The top containers collapsed and fell onto other containers which then fell overboard. Principally, the main forces affecting the containers in the lower tiers consisted of:
  - The static weight of the upper containers in the stack.
  - Transverse/longitudinal/vertical acceleration forces on the top side containers when the vessel was rolling.
  - Transverse/longitudinal forces of wind pressure or seas impacting the vessel.
- When the vessel was rolling in heavy weather, the frames and corner posts for the lowest containers were affected by excessive racking forces. The larger the roll, the greater the racking force will be.
- Heavy rolling can impart enormous forces on the container structures and lashings.
- All of the above-mentioned loads will increase the compression and tension forces on the corner posts and to the intermediate twistlocks between them.

# 6.2 Misdeclared containers lost in heavy weather

A container vessel was outbound from a Mediterranean port. The forecast was for N wind Beaufort force 3–4, backing SW 4-5 sometimes 6 and NW waves 3-4 metres gradually decreasing to 2-3 metres.

After entering the Bay of Biscay, the vessel altered to a more NE course and encountered strong NW winds and a NW swell of 3 metres, causing it to roll heavily. The vessel then altered back to a NW course to reduce the rolling. However, the wind increased to NNW force 6 with a swell of 5 metres, causing the vessel to continue to roll heavily.

This resulted in the loss of several containers stowed in the same stack. It was not unusual on this vessel to have nine containers in a single stack.

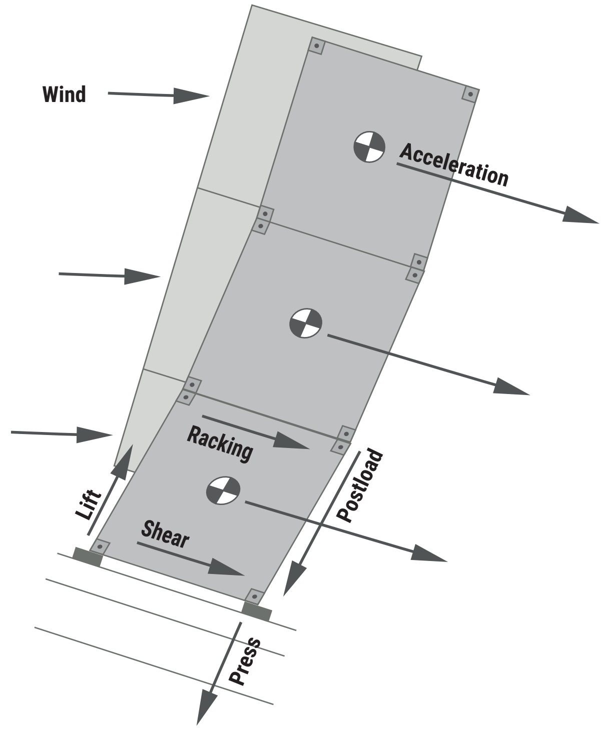
## Cause

When the Chief Officer received the stowage plan at the previous port, he was concerned about the weight of the upper containers in the stack. He informed the Master, who contacted the charterer and told them to only load empty containers in the three top tiers. When the Chief Officer double-checked the loading figures after departure, he discovered that the charterer had ignored the Master's requirement, and the containers in the top three tiers had three times the permitted weight.

The containers had been secured by the crew but were not secured as per the CSM. The lashing arrangement of the lost containers was as follows: from the tank top up to the hatch coaming, the containers were secured by cell guides, corresponding to five tiers of containers with only one metre of the cell guide remaining for the sixth tier container. The sixth, seventh and eighth tier containers were secured by twistlocks, lashing bars and turnbuckles.

## What can we learn?

- The small lateral and vertical movements of the stack's three top containers which were heavier than the permitted weight caused the lashings and turnbuckles to become slack, resulting in them becoming overloaded and to fail. When the lashing rods/turnbuckles failed, and the rolling acceleration increased for the sixth tier container it came off the cell guide and the containers fell overboard.
- Twistlocks were required to be fitted between tiers five and six on this type of vessel. The lashings should absorb additional tension forces from tier six. However, as the containers were heavier than permitted, extraordinary forces were imparted on the lashings.
- The stowage plan which is included in the CSM will specify where empty containers can be stowed. The stowage plan calculations are based upon one or several GMs.




***The mass of the containers will be accelerated by the movements of the ship as a response to the sea conditions.***
*Courtesy: Macgregor*

***Close up of the cell guide in the location of the lost containers.***
*The Swedish Club*

# 6.3 Containers damaged and lost overboard in heavy weather

A large container vessel was steering a course of 100° in the Indian Ocean. Prior to departure, the vessel's weather routeing service had informed the Master of a developing tropical depression. It was unknown how severe it would become. At departure the vessel had a GM of 3.7 metres and the stowage plan had been signed off by the Chief Officer.

The vessel was sailing initially at 14 knots and the wind was NNW at Beaufort force 4. The weather service updated the vessel, advising that the depression would probably develop NE winds of Beaufort force 7 the following day.

It was the normal routine to check the lashings of the containers every morning and no problems were recorded. The vessel had lashing bridges for securing the containers. The lashings were applied from the third tier. The outermost stacks, known as 'wind stacks', were lashed by a double set of cross lashings and a long internal wind lashing (diagonal lashing). There was also a short internal wind lashing fitted on the third tier. The lashings on board were in a fair condition, without excessive corrosion or wear and tear.

Early the following day, the vessel encountered heavy weather of NNE Beaufort force 7 and the Master ordered an alteration of course onto 090° with the wind on the port bow. The weather service suggested that the Master either sail through the weather or take a more northerly route and heave to. The Master chose to sail through the weather as he did not anticipate it getting worse as per the information he was given.

However, the wind started to increase with gusts up to 100 knots (Beaufort force 12) and a wave height of 7-9 metres. The vessel had eight tiers of containers on deck with a number of empty containers positioned on the top tiers. Suddenly 30 of the empty top side containers broke loose and became airborne. They either landed in other bays or were lost overboard. The vessel was rolling heavily, with the largest recorded rolling angle being 30°. The Master altered onto a ESE course and reduced the speed from 14 to 6 knots. A safety message was broadcast over the VHF warning of the lost containers. The wind had veered to ESE Beaufort force 10 with sea waves of 10-12 metres becoming hurricane strength Beaufort force 12. The Master ordered an NNW course to shelter the portside where the lost containers had been stowed.

About six hours later the weather abated to Beaufort force 5 and the Master ordered the course and speed to be resumed to destination.

## What can we learn?

- The bottom tier of containers on deck were secured to the hatch covers using manual base twistlocks. From the second tier upwards, FATs had been applied. The empty top containers which became airborne had been solely secured by FATs which were still intact and attached to the bottom corner sockets. It is possible that the twistlocks for the empty top containers had automatically disengaged during the voyage. FATs with a so-called 'wind-nose' at the lower cone should preferably be used to prevent accidental disengagement.

# 7. Conclusion

This publication is based upon statistics relating to frequency and cost of cargo claims experienced by the Club's members over a five-year period. In terms of the carriage of containers, heavy weather is by far the most common immediate cause of containers being lost overboard at sea. The reasons can often be attributed to a series of multiple failures, rather than a single cause but raising awareness of these issues to both ship and shore staff will serve to prevent accidents from happening. This will not only reduce costs but more importantly will enhance the safety of vessels and their crews.

We hope that highlighting the most common causes of containers being lost overboard will be beneficial for our members' own loss prevention initiatives.

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