REDUCING THE RISK OF DAMAGE TO OR LOSS OF NON-STANDARDIZED CARGO

Operational guidance for securing during transportation

The London P&I Club

TMC MARINE
A BUREAU VERITAS GROUP COMPANY

BUREAU VERITAS

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INTRODUCTION

The purpose of this booklet is to provide general guidance and practical advice to charterers primarily (who usually hold contractual responsibility for this aspect), but also ship's officers and ship owners/managers on the risks associated with stowage and securing of non-standardized cargo, and the precautions to reduce and prevent these risks.

It is not intended to replace official regulations and guidance notes or any document that forms part of a vessel's safety management system including the cargo securing manual.

A number of serious accidents have occurred as a result of inadequate securing arrangements on board and deficient stowage and securing of cargoes as well as causing injury and loss of life, not only at sea but also during loading and discharge. Only proper stowage and securing of cargo on adequately designed and properly equipped ships can prevent the occurrence of such accidents in the future.

The accelerations acting on a ship in a seaway result from a combination of longitudinal, vertical and predominantly transverse motions. The forces created by these accelerations give rise to the majority of securing problems. In addition, cargo carried on deck may be subjected to forces arising from the effects of wind and green seas. The hazards arising from these forces should be dealt with by taking measures both to ensure proper stowage and securing of cargoes on board and to reduce the amplitude and frequency of ship motions.

Charterers must ensure that the ship is suitable for its intended purpose. In addition, ship owners and operators should tender only suitable vessels for cargoes. Appropriate precautions shall be taken during loading and transport of heavy cargoes or cargoes with abnormal physical dimensions to ensure that no structural damage to the ship occurs and to maintain adequate stability throughout the voyage.

If a heavy cargo item has been dragged into position on greased skid boards or other means to reduce friction, the number of lashings used to prevent sliding should be increased accordingly. Where necessary, the securing arrangements for heavy cargo items should be verified by an appropriate calculation.

These types of cargo are generally a defined single operation, carrying out of gauge non-standardized cargo, often for a specific project. The cargo may be carried on deck or under deck.

Carriage of containers is excluded from the scope of this booklet as it is a topic on its own.

Cargoes which have proved to be a potential source of danger because of inadequate stowage or securing include:

- portable tanks
- portable receptacles
- cargoes on special wheel-based vehicles such as MAFI trailers or self-propelled modular trailers (SPMTs)
- wheeled heavy cargo items such as locomotives, mobile cranes, road construction or mining/quarrying equipment
- heavy machinery, transformers, etc.
- pre-assembled units (PAUs) for petro-chemical plant, offshore or factory installations
- wind farm components including towers, blades and turbine nacelle
- offshore mooring equipment including anchors, buoys and anchor chains

A ship in a seaway moves with six degrees of freedom, three translational and three rotational. All cargoes are subject to motion-induced forces and have to be secured to allow for sway, surge and heave (the translational motions) and roll, pitch and yaw (the rotational motions). The magnitude of the forces experienced by the cargo is obviously a function of the ship motions (itself a function of the weather conditions experienced and the characteristics of the ship) but is also dependent on the location of the cargo within the ship. The forces can be limited by careful management of the parameters over which the Master has control, such as the stowage position, the vessel stability, weather routeing and heavy weather vessel handling.

Whilst the technical issues with respect to transportation are all considered separately in the various sections below, the entire problem needs to be considered holistically since all the issues are co-dependent – suitability of the cargo and ship, physical space and cargo planning, stowage location, ship stability, weather anticipated and the ability to mitigate motions, the magnitude of the forces, local strength, strong points, lashing or seafastening arrangement and the practical arrangements for stowage and securing the cargo. Transportation of specialized heavy cargoes should be approached as a design spiral with each factor being considered in turn in increasing detail until a satisfactory solution is reached.

Due diligence is a fundamental foundation of all marine insurance cover and a commonly used expression is 'the conduct of the prudent uninsured'. This is, in the case of the subject covered in this document, the reasonable expectation of the level of preparation for the carriage of any cargo that the layman would expect of a party carrying the responsibility for the securing it. Essentially, this would be the act of conducting the operation as if uninsured and therefore without a sense of abandon with respect to risk of cargo loss and/or damage.

In many cases this would mean the vetting of CVs of potential Port Captains and Inspectors to ensure that they are suitable to take the proposed appointment and therefore fulfil the assured's efforts to perform their due diligence. In cases where an assured is not suitably experienced in the carriage of such goods, it is potentially a matter of due diligence to recognise this and make a suitable expert appointment to discharge their responsibility effectively.

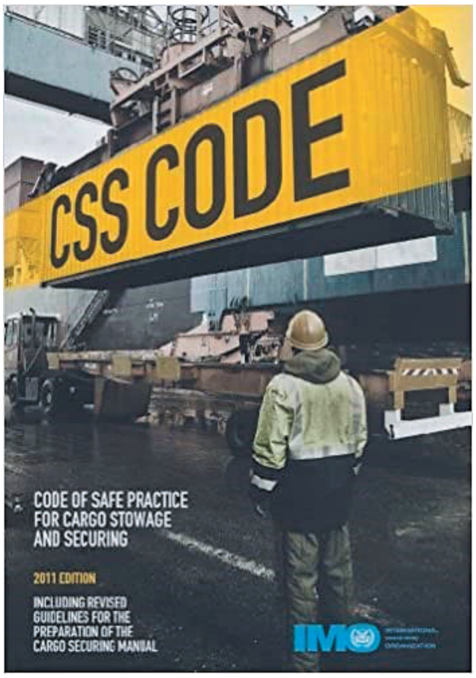
The performance of an independent cargo securing survey is a further example of a reasonable expectation and an act of due diligence. The benefit being that plans, prescribed/selected equipment and actual methods of installation have successfully combined to provide a suitable cargo securing solution.

GLOSSARY

CSD	Cargo Securing Devices used to secure and support cargo units
CSM	Cargo Securing Manual
CSS Code	Code of Safe Practice for Cargo Stowage and Securing
Flat	A platform or platform-based ISO container
MBL	Minimum Breaking Load, a term used to define the ultimate strength of a cargo securing device
GM	The vertical distance between the Centre of Gravity and the Metacentre (the metacentic height)
MSL	Maximum Securing Load is a term used to define the allowable load capacity for a device used to secure cargo to a ship
NDT	Non-Destructive Testing
Non-standardized cargo	Cargo which requires individual stowage and securing arrangements
Proof load	A term used to define the maximum test force to which a cargo securing device is subjected during production testing

STANDARDS

- Code of Safe Practice for Cargo Stowage and Securing (CSS Code) as amended
- BV Guidelines for the Preparation of the Cargo Securing Manual (NI429)
- BVLASH program (compliance with the CSS Code)
- Various Marine Warranty Codes



THE CONSEQUENCES OF **NOT CORRECTLY SECURING NON-STANDARDIZED CARGO**

- Claims
  - damage to/loss of cargo
  - fines
  - recovery costs
  - repair costs
- Loss of reputation
- Safety of ship and crew
- Lost cargo is potentially a "wreck" under the Nairobi International Convention on the Removal of Wrecks (which came into force on 14th April 2015)
  - "Wrecks", if not removed, may pose a hazard to navigation
  - Does the "wreck" pose a hazard to the environment?
  - Who is responsible? The onus to remove the "wreck" is on the registered owner
  - What measures can and are to be taken based on such a responsibility?
  - How can the responsibility be enforced?
- Cargo becomes a hazard (seaworthiness issue)
- Liability for re-stowage costs
- Liability for the value of the goods lost
- Liability to the owners of other cargo damaged by the unsecured movement of the goods in question
- Liability to the ship's hull for damage to the same
- Liability for potential damage caused by the goods lost overboard as flotsam
- Costs related to the location and removal of goods lost overboard

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THE CAUSES OF **NOT CORRECTLY SECURING NON-STANDARDIZED CARGO**

The securing of non-standardized cargo requires careful planning by experienced personnel. Shipping this type of cargo is frequently non-routine and the shipper (who may also be the charterer), as well as ship's crew, may have relatively little experience of securing different loads. Specialist carriers generally have dedicated departments of mariners and naval architects, but many general carriers do not and may lack competence in this area. Experience has shown that often the cargo has been packaged for transport by road but is not designed for securing and transporting on a ship. In addition to protective packaging, any supporting grillages/cradles may not be suitable for sea-going transportation and are not strong enough to support the changes in weight distribution of the cargo as the vessel pitches and rolls.

Initially, a plan of the cargo should be requested showing strong/securing points. These will need to match up to the securing arrangements on the ship. It may be necessary to employ a suitably qualified company to produce a lashing plan.

An appropriate ship which has suitable securing arrangements should be selected for the carriage of the non-standardized cargo. However, ships fit for non-standardized cargoes are becoming fewer with the increased use of containerisation. This makes the planning even more critical.

If a Port Captain is assigned to oversee the stowage, it is important to ensure he or she has experience in this type of work and are competent. This is particularly important if he or she is contracted in.

Once the planning is completed and a suitable ship has been selected, the lifting gear must be checked to ensure it is suitable for the cargo and is in good condition. This may require supplying dedicated lifting gear (possibly with spreaders) designed for the non-standardized cargo.

The cargo should be placed on good quality dunnage to increase friction. The cargo should not normally rest directly on a steel deck. The dunnage should reduce damage and prevent heavy or sharp pieces of cargo (if any) coming into contact with the ship's side plating.

If welded seafastenings are used, the welding must be of a good standard and preferably NDT checked. Finally, the lashing gear used must be suitable for the cargo and in good condition with proper certification. Items such as shackles/ratchet straps/bulldog clips must be used as designed and fitted properly.

AREAS OF **SPECIFIC FOCUS**

"WRECK" REMOVAL – RECOVERY OF THE LOST CARGO

There are examples where the Nairobi International Convention on the Removal of Wrecks would provide for the removal of property previously on board a ship. The most extreme is the total loss of the subject cargo overboard. In this case, there is the obvious cargo liability. In many circumstances, it may be deemed practicable by local authorities to force the responsible party to recover the lost cargo (particularly where the same can present an immediate or gradual risk to the environment).

The recovery element may include a lengthy 'search' process involving sonar searches and, in cases where recovery is not practicable, significant volumes of marine pollutants may have to be removed from the goods in situ. The costs of such operations are unpredictable, maybe vast, and will likely fall on the responsible party either directly or indirectly.

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PLANNING
Suitability of the cargo

It is unfortunately very often the case that large heavy equipment is presented for sea transportation where the equipment designer has no understanding of the forces that will be imposed upon the item when it is on a ship at sea. Ideally, a sea transportation load case would have been considered at the design stage and the cargo can be demonstrably proven to have sufficient integral strength to withstand the forces that will be imposed on it in a seaway and will be provided with adequate strong points to which lashings or seafastenings can be attached.

It is not always obvious how it is intended that project cargoes are secured on a ship. For example, pressure vessels may be clad in insulation with no attachment points for lashings, or shipped on cradles that are suitable for vertical static loads ashore but have not been designed for the rigours of sea transportation. Lifting lugs may be badly positioned or in the incorrect orientation for use as attachment points for lashings.

Special finishes or materials to which seafastenings cannot be welded or chain lashings attached may also be an issue. Heavy machinery may be protected by timber packing which covers up suitable lashing attachment points (and it is of little use securing the timber encasing the cargo if the heavy cargo moves within the packing).

If heavy cargo is presented for shipping on wheeled trailers, care must be taken to ensure that both the cargo and the trailers are secured. Do not assume that the cargo has been adequately secured to the trailer.

If it is not obvious how to go about securing the cargo, advice should be sought from the shippers. If the structural integrity of the cargo is dependent upon how it is supported and secured on board, then specialist assistance must always be sought, preferably before the cargo is even accepted for shipment.

Ship selection

The chartered ship must be suitable for the cargo to be transported with respect to the space requirement, structural strength and stability. These matters are all interdependent and should be considered together.

Whether stowed on deck or below, there needs to be sufficient space around all the cargo to fit the lashing or seafastenings. The ship's structural strength needs to be considered at an early stage to ensure that the ship is capable of carrying the cargo at all and that the location being considered has adequate local strength. Cargoes which are sensitive to environmental exposure may need to be stowed in the hold.

Cargoes stowed on deck should be located where they do not interfere with the normal operation of the ship or contravene the bridge visibility requirements. Special consideration will need to be given where the cargo is likely to be exposed to significant forces from green seas. Normally, cargoes should not be allowed to overhang the sides of a ship. Where this is necessary, special consideration will need to be given to both forces from green seas and possible uplift buoyancy forces if ship motions and passing wave crests are likely to result in partial immersion of the cargo. The location of the cargo will affect the ship stability and the ship stability will affect the forces on the cargo and possibly dictate a suitable stowage location.

Stowage planning

In planning the overall stow, the first consideration will always be cargo positioning to utilise space most efficiently along with the overall global strength of the tank top, deck or hatch on which the cargo is to be placed. Access, crane capacity and crane outreach or room to manoeuvre trailers will also be considered.

With heavy cargoes, it is usually not sufficient to rely solely upon the overall load bearing capacity of the tank top, deck or hatch (the permitted tonnes per square meter). The cargo must be positioned and supported over the strong points of the deck beneath the cargo. This will require consideration of the supporting points beneath the cargo, the ship's supporting structural members and the exact position the cargo will be located, whilst complying with any limitations imposed by the overall stow plan. The overall position of the cargo should provide sufficient space around the cargo (to adjacent cargo, ship's structure or a deck or hatch edge) to fit the proposed lashings or seafastenings. There needs to be room for the lashing/seafastening itself and room to install it. Unless new lashing points or seafastening are to be welded to the ship, the cargo must be positioned so that the existing lashing points are both sufficient in number and appropriately positioned for the proposed lashing arrangement.

It is, of course, preferable that full details of the cargo are known in advance to allow proper planning, although this is not always possible.

Calculation of the forces

As soon as the approximate location of the cargo is known, the forces on the cargo should be determined. These forces comprise the static weight of the cargo plus the dynamic forces from the six degrees of vessel motion discussed above. The forces are required in order to plan the lashings or seafastening arrangement and determine the vertical forces on the supporting ship's structure.

The forces on the cargo should be calculated in accordance with the CSS Code. Whilst the CSS Code remains the default methodology for determining forces on the cargo, other methods (usually based on more rigorous engineering principles) may be proposed by the shippers or their surveyors (based on classification society rules or a marine warranty code of practice, for example). The calculation will consider the characteristics of the ship, the location of the cargo within the ship and the mass of the cargo.

The calculated overall forces on the cargo must be applied at the centre of gravity of the cargo to determine the vertical forces on the support points, the lateral and transverse forces and overturning or tipping moment (if any) and the resultant forces at the lashings or seafastening. If the centre of gravity of the cargo is unknown, it must be estimated using conservative values.

Stowage location

Once the forces on the cargo have been calculated, the loads exerted on the ship's structure can be determined. The general positioning of the cargo can be verified with respect to the tank top, deck or hatch capacity and consideration then given to the exact location of the cargo and how the vertical forces from the cargo supports will be spread into the supporting ship's structure below.

The location of the supporting structural members can be determined from ship's drawings, observation (from beneath the deck or hatch) and detected by 'tapping' the deck with a hammer to identify the precise location of the transverse and longitudinal stiffeners beneath. The overall load-bearing capacity of the deck and permitted linear loads on longitudinal stiffeners and girders and transverse frames, or point loads at transverse/ longitudinal cruciform, may be annotated on the ship's drawings. If there is any doubt that the structure is sufficiently strong to support the cargo transportation loads, specialist naval architecture help will be required.

Heavy cargoes that have a small number of supports in fixed locations can present particular problems with respect to positioning over the supporting ship's structural members. For example, typically, pressure vessels or wind farm components may be supported on two or more cradles at fixed locations. PAU's or machinery skids may be supported on feet (which will be bolted onto concrete foundation supports when installed in the plant or factory to which they are being shipped). Whilst one cradle or foot may be positioned over the supporting ship's structure, the second or third support may not be coincident and will not align with the ship's structure beneath (unless by some unlikely coincidence they both have the same spacing). Adjustment of the cargo position may be necessary to get the cargo support points over the ship's structural members as intended. Ideally, transverse supports on the cargo should span longitudinal structure on the ship or vice versa.

If a compromise position, with the cargo supports substantially over the supporting ship's structure, cannot be achieved, it may be necessary to support a heavy cargo on a purpose-designed grillage. Unless this has been anticipated, properly designed and the appropriate materials and labour planned in advance, a satisfactory safe solution can be difficult to achieve at the time of loading.

Dunnage

Dunnage is traditionally used for the stowage of breakbulk cargoes to divide different cargoes or raise the cargo above the tank top. Its use for heavy cargoes should be for limited purposes only.

Dunnage can be used to prevent metal to metal contact (between the cargo and the ship or grillage or between the cargo and the face of seafastening stoppers). This increases friction between the cargo and the surface on which it is stowed and can protect the surface finish on the cargo. Dunnage can also be used to even out the contact between the cargo stowed on an uneven deck, ensuring that loads are transmitted into the ship's structure at the location intended.

Dunnage cannot be used as a construction material to support cargo, spanning between ship's structural members. This is the role of a properly designed grillage beam.

Generally thinner ply or dunnage timbers are preferable. Thicker sections of timber may crush under heavy cargoes which may then move causing lashings to go slack or seafastening stoppers to misalign from the cargo up against which they should be closely butted.

Lashings and seafastenings

Broadly, heavy cargoes can be secured by lashings (wires, chains or cargo straps) or seafastenings (purpose-designed steel members that are welded or otherwise rigidly fixed to the ship and may be welded or similarly rigidly fixed to the cargo). Lashings and seafastenings are considered separately below:

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Lashings

Lashings comprise all types of flexible securing arrangements, including all forms of binding chains, wires, cargo straps and the fittings required to secure and tighten them (senhouse slips, bulldog grips, cam buckles, ratchet mechanisms, bottle screws, shackles etc.). The MSL of the lashing is that of the weakest component. All fittings must be used correctly (e.g. shackles, padeyes and lashing points used in the correct direction of pull, bulldog grips orientated the correct way around and sufficient in number for the diameter of the wire, cargo straps used per the manufacturer's instructions etc.). Wires and cargo straps must not be led over sharp edges or around radii smaller than that appropriate for the wire diameter.

The number, orientation and MSL of the lashings must always be sufficient to restrain the cargo against the calculated forces within the constraints of the available lashing points on the cargo and the fittings on the ship. If sufficient lashing points on the ship or cargo are not available, either additional points should be provided (by welding new fittings in place if necessary) or the initial planning was incorrect and the cargo will need to be re-positioned.

Restraint forces in each principal direction – transverse, longitudinal and vertical (to prevent overturning or tipping) must be calculated considering the lashing angles. For efficiency, the lashings should be at a shallow compound angle from the direction of the required restraint, as required by the CSS Code.

It is important not to use more than one type of lashing in any one restraint direction. Using materials of different stiffness will result in the stiffest material carrying a greater load whilst the more elastic material will shirk load. For example, mixing chains and wires together will result in the stiff chain picking up load rapidly whilst the wire will stretch and carry less load. This risks the chain becoming overloaded and may result in the lashings breaking sequentially as the stiffer elements of the lashing become overloaded first.

Seafastenings

The term 'seafastenings' is usually reserved for steel components that are welded in place, although in some circumstances they may be bolted or clamped. They are usually designed specifically for the cargo and generally require more detailed planning and preparation before the cargo is loaded. Consideration will need to be given to 'no weld' areas both on the ship (in way of fuel tanks or insulated or coated bulkheads) and on the cargo itself.

The least sophisticated form of seafastenings comprise simple stoppers or clips welded to the deck. These butt up to the bottom of the cargo or clip over lower members of the cargo. They are generally not welded to the cargo itself and may require shimming with thin steel plate to ensure full contact with the cargo or packing with thin pieces of wood to protect the cargo from metal-to-metal contact. The advantages of stoppers and clips are that they are easy to design and install, they do not require welding to the cargo (and thus leave it undamaged), they can be designed to work mostly in shear (minimizing tensile, compressive and bending forces into the ship's structure) and they require minimal pre-planning. Clips or stoppers are also generally easy to repair or reinforce should any problems be encountered during the voyage.

More complex seafastening designs may comprise combinations of large brackets and braces welded to both the ship and the cargo, and will generally be bespoke designs. Complex seafastenings will be designed by a naval architect or structural engineer to an acceptable structural code to fit both the cargo and the structural arrangements of the ship.

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In general, all seafastenings should be aligned with the ship's structural members. If the forces are high, check calculations on the ship's structure in way of the seafastening (and/or grillages) will be required.

Welded seafastenings should not normally be mixed with lashings because of the extreme difference in stiffness between a 'rigid' welded seafastening and an 'elastic' lashing. This will result in the problem of a very uneven load sharing more extreme than that which occurs with the use of disparate lashing materials, as described above. This does not preclude welded stoppers to restrain transverse forces being used in combination with near vertical wires to restrain tipping moment.

All welded seafastenings should be constructed from traceable materials of known quality and fabricated by coded welders to an acceptable standard. Welds should all be free from visual defects and an agreed percentage of the welds should be inspected by an appropriate method of NDT (dye penetrant, MPI or UT).

Wood is occasionally used as a seafastening material, usually as shores between the cargo and a hold bulkhead. Generally, softwood is not suitable for heavy cargoes since it will crush and eventually work loose and become displaced. Greenheart high density constructional timbers are strongly preferred for this purpose. Substantial engineering timbers may sometimes be used in lieu of a steel grillage to spread a heavy load across a short span between ship's structural members.

Prior to the loading of any cargo, cargo transport unit or vehicle, the Master should ensure that:

1. The deck area for their stowage is, as far as practicable, clean, dry and free from oil and grease
2. The cargo, cargo transport unit or vehicle, appears to be in suitable condition for transport, and can be effectively secured
3. All necessary cargo securing equipment is on board and in good working condition
4. Cargo in or on cargo transport units and vehicles is, to the extent practicable, properly stowed and secured on to the unit or vehicle

INDEPENDENT CARGO SECURING SURVEY

Charterers primarily, but also ship owners, managers and operators should, where necessary, make use of relevant expertise when considering the shipment of a cargo with unusual characteristics.

This may require special attention to its location on board, taking into account the structural strength of the ship. The means of stowage and securing of the cargo should be checked, particularly bearing in mind the weather conditions expected during the intended voyage.

An independent cargo securing survey is not a marine warranty survey but would be carried out in compliance with general industry best practice, considering what is reasonable.

When selecting a suitable company to carry out a survey of this type, consideration should be given to experience, qualifications and the availability of suitable surveyors at the time and place of loading. The cargo surveyor will be fully aware of the details of the cargo, the stowage plan and the lashing plan if one has been produced.

Once on board, the cargo surveyor will liaise with the Master, Chief Officer and stevedores. They will agree the plan and inspect the lifting and lashing equipment. NDT testing will be arranged in advance if required.

Once the cargo has been secured in place, a full report with photographs should be produced.

MASTER'S RESPONSIBILITY FOR SAFETY

Whilst the loading operation is frequently overseen by the Chief Officer, the ultimate responsibility may be with charterers commercially, but always remains with the Master from a safety perspective. The Master is responsible for the safe conduct of the voyage and the safety of the ship, its crew and its cargo. This includes ensuring:

- Cargo is distributed so that the ship has a metacentric height in excess of the required minimum and, whenever practicable, within an acceptable upper limit to minimise the forces acting on the cargo
- All cargoes are stowed and secured in such a way that the ship and persons on board are not put at risk
- The safe stowage and securing of cargoes are properly planned, executed and supervised.
- Personnel commissioned to tasks of cargo stowage and securing are qualified and experienced
- Personnel planning and supervising the stowage and securing of cargo have a sound practical knowledge of the application and content of the Cargo Securing Manual

Prior to departure, the Master must consider the suitability of the passage plan, ships routing and in particular the anticipated weather conditions. It may be prudent to employ a weather routing service.

The CSM specifies the cargo securing arrangements of the ship and is guidance for the crew members with regards to cargo securing. In case of shipping of cargo not described in the approved CSM, it is advised that an addendum is prepared by the ship manager on a case-by-case basis and reviewed by the Flag Administration or by the classification society on behalf of the Flag Administration. This should contain specific securing plans consistent with the requirements of the vessel's trim & stability booklet and take into account ship characteristics, including GM, as well as actual loading cases.

Measures taken for stowage and securing cargo should be based on the most severe weather conditions which may be expected for the intended voyage. Ship-handling decisions taken by the Master, especially in bad weather conditions, should consider the type and stowage position of the cargo and the securing arrangements. The Master should ensure regular inspections and maintenance of cargo securing devices are carried out, and records of such inspections and work are maintained. The Master should only accept the cargo on board the ship if he/she is satisfied that it can be safely transported. The Master's responsibility as shown above cannot be overridden by any legal or contractual implications proposed by the shipper.

STABILITY ISSUES

Good stability is critical to the safe transport of heavy specialized cargos. Cargo and ballast should be distributed to ensure that throughout the entire voyage the stability of the ship remains within acceptable limits. Clearly, whilst the ship must comply with the statutory minimum stability requirements, the main hazard for heavy cargoes is usually high GM and an excessively stiff ship.

Most modern ship types carrying heavy specialist cargoes have hull forms predisposing them to a high GM. This can be compounded when heavy deadweight limiting cargoes such as steel products or heavy project cargoes are stowed below in the hold in combination with bulky, difficult shaped, project cargo stowed on deck. With a high GM and a stiff ship, the resultant short period roll motions can result in high transverse accelerations on deck. High GM should be reduced as far as possible by judicious arrangement of the ballast. If a high GM cannot be avoided, the resultant forces on deck will also be high and due caution must be exercised when designing the deck cargo securing arrangements.

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RECOMMENDATIONS

1. Use of external experts to provide advice and cargo securing survey

2. Pre planning

3. Prepare lashing plans, sketches, calculations and drawings. Keep a record of them

4. NDT

5. Employ specialist cargo superintendents and/or surveyors as appropriate

SUMMARY

The carriage of non-standardized cargo is an increased risk operation. It is imperative that prior planning is conducted by competent and experienced staff to ensure that the risk of loss of and damage to the cargo, ship and environment are minimized. It follows that such plans need to be applied in the correct manner with the quality of application well monitored.

It is a valuable and flexible feature of the shipping industry that such cargoes can be carried safely and efficiently. As stakeholders in the marine transport industry, we have a responsibility to maintain a high level of success and therefore reputation for the carriage of such goods. It is fundamentally important that the cargoes are carried on suitable vessels, that the cargoes themselves are suitable for carriage by sea and are prepared for the dynamic forces involved.

It is important that where parties involved in the carriage of non-standardized cargoes require support from suitably qualified marine experts, they are engaged so as to ensure that the risk of loss or damage is suitably controlled.

CASE STUDIES

CASE STUDY
"A SHIFT OF STOW"

A process heat exchanger was being transported by sea. The heat exchanger consisted of two steam drums, two reformed gas heat exchangers and various wooden cases of parts.

The steam drums and gas heat exchangers were secured on MAFI Roll/Cargo trailers. Securing arrangements were using ten tonne capacity tie-down chains. The gas heat exchangers weighed 65 tonnes and the steam drums 47 tonnes each.

Twenty chains had been used on either side of the steam drums for a total of 40 chains. The steam drums sat upright. Whilst the use of 40 chains would appear to be more than adequate, they were only secured vertically on the side to avoid tipping. There were no chains placed low down across the trailer to avoid sliding.

The IMO recommendations for securing cylinders are shown below.

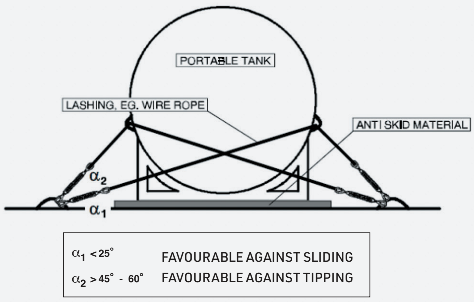
The vessel encountered heavy weather and suffered damage to a considerable amount of cargo. Most of the damage was caused by one large piece of cargo (a rock crusher) which was not properly secured and, once loose, destroyed a number of vehicles being carried in the same hold.

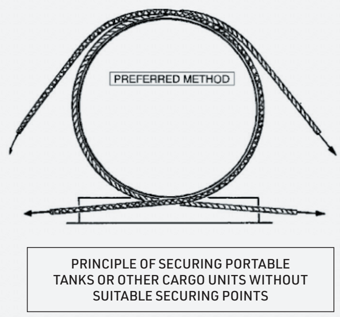
The steam drum started to slide and eventually the drum toppled over, rotating 80 degrees until it came to rest on a 40-foot container which was next to the original stowage space. The container was crushed and the contents damaged.

The steam drum was pressurised to 0.6 bar with nitrogen (to avoid possible corrosion during transit) so the operation to bring the drum upright and place it on another trailer was carried out under a carefully controlled procedure. The damage to the drum appeared relatively minor but, because it was a pressurised vessel, it had to be returned to the manufacturer for checking and re-certification.

Portable tanks should be stowed in the fore and aft direction on or under deck, permitting safe access for personnel in the necessary operation of the ship. At no time should the tank over stress the deck or hatches. Securing devices should be arranged so as to withstand transverse and longitudinal forces, which may give rise to sliding and tipping. As shown below the lashing angles against sliding should not be higher than 25° and against tipping not lower than 45° to 60°.

If under deck stowage is permitted, the stowage should be such that the portable non-standardized tank can be landed directly on its place and bedding.





CASE STUDY
"A CHANGE OF TRADE"

The charterers of a handy sized bulk carrier took the opportunity to take a project cargo on deck. The hired vessel was capable of carrying the cargo on her hatch covers and received her orders to proceed to the load port.

The project cargo to go on deck consisted of an offshore flare boom, crates of equipment and two diesel generators. The charterers had little experience of this kind of operation but sought no additional assistance in drawing up a lashing and securing plan. It was a further misfortune that the owners of the hired vessel were similarly inexperienced in such matters. In later expert analysis, it was determined that the lashing plan did not conform to the provisions of the CSS Code.

The securing plan was approved by owners and a local fabrication firm hired to weld in place sea lashings and lashing eyes to the hatch covers for the purpose of applying the requisite securing arrangements.

The welding firm was a cost-effective solution compared to other options in the region. However, they did not prepare the steel surface prior to welding and applied very poor quality welds during the fitment of the lashing eyes. Also, the added securing arrangements were not subjected to any form of NDT or expert visual inspection prior to sailing.

The vessel sailed for a two-week voyage but met with moderate to rough weather resulting in heavy rolling. Both diesel generators lost their securing arrangements and were lost overboard talking two boxes of equipment with them. This also caused significant damage to the flare boom.

The final insurance claim not only for the lost cargo, but damage to the remaining deck cargo and liability for damage to owner's vessel exceeded USD$1.25M.

Venturing into a new trade can be fraught with additional risk if there is not sufficient experience within an organisation to discharge the lashing and securing responsibilities assigned under the charter party. This risk can be offset greatly by the engagement of suitable marine experts to assist with planning and the assessment of the final application of the plan before sailing.

CASE STUDY
"YOUR TRAIN SERVICE WILL BE DELAYED"

A new tilting express trainset comprising power cars and carriages was being delivered to a customer by sea on a roro cargo vessel. The six-unit trainset was one of eight being supplied at a total contract cost of about 115 million euros. The train cars were secured to purpose- built trestle supports, two under each bogie, and about 1m in height. Each trestle comprised a pair of primary transverse beams with box beam legs on either side, with the train bogie wheels being supported by shallow cradles mounted across the transverse beams. Whilst some stowing and securing instructions were provided by the charterers, no experienced technical representative from the charterers attended the loading and no independent supercargo was appointed. The crew were required to undertake the securing of the cargo themselves.

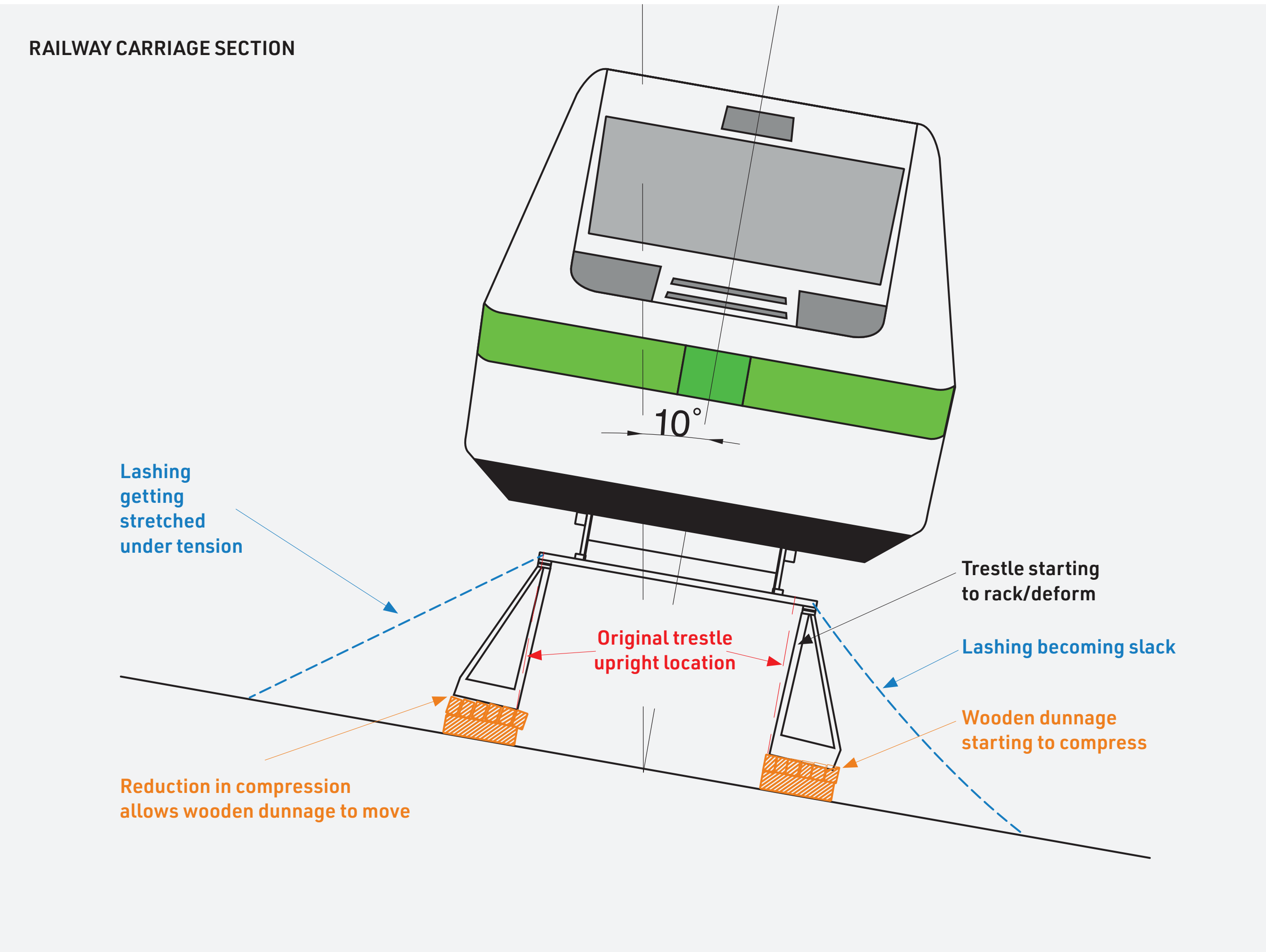
One set of six train units was to be stowed on the main deck. However, when presented for loading the carriages were found to be of different dimensions to that previously advised to the ship and the stowage plan for the main deck had to be hastily rearranged. The carriages, already secured to the supporting trestles, were loaded out on hydraulic trailers positioned under the transverse beams. Once in position on board, the trailers lowered the carriages so that they were supported by the trestles. To allow sufficient height for the trailers to be lowered and withdrawn from under the transverse beams, the trestle legs were set down on stacked wooden blocks placed on the deck. This dunnage stack comprised two layers of timber, each layer comprising individual pieces of wood, 100x100mm and about half a meter long, laid side by side with the two layers laid orthogonally to each other.

This stowage arrangement had been used for five previous similar shipments on other vessels, the purpose-designed trestles being returned to the port of departure to be re-used for each subsequent shipment of new trainsets. The design of the trestles was such that the legs were attached to the upper transverse beams by a fixing like a container twistlock. There were only small brackets in the transverse direction and none in the fore and aft direction. So the beam-to-leg connection was somewhat flexible and reliant on the lashing arrangement to resist racking forces. To facilitate this, at each end of the transverse beams were four holes for the attachment of lashings. The crew attached lashing chains to the upper trestle beams and led them at shallow horizontal angles to the ship's deck. No lashings were secured to the bottom of the legs or arranged to resist uplift.

In addition to the railway carriages, there were other cargo trailers and containers also stowed on the main deck, whilst there were further containers stowed on the weather deck. The lower hold was empty. Only loaded to about half the full deadweight capacity and with full ballast tanks, the vessel had a shallow draft and a higher than normal GM. It was not possible to reconfigure the loading arrangement to make a significant reduction in the GM.

On passage, the vessel encountered heavy weather and several items of cargo broke loose and started to shift, including the railway carriages and some of the containers. Notwithstanding the Master manoeuvring the ship to try and minimize the motions, and crew attempts to re-secure the cargo, the vessel continued to roll to angles of up to about 25°. As the situation deteriorated, a mayday was sent and with two vessels standing by, the crew prepared to abandon ship. Control of the situation was re-gained and the vessel was able to reach shelter under her own power. However, the train carriages were heavily damaged and had to be returned to the manufacturer for extensive repairs.

Investigations revealed that while no specific calculations had been carried out, the securing chains had a combined MSL that was adequate for the retrospectively calculated transverse and longitudinal lashing forces. However, the chains did not have sufficient stiffness to prevent movement of the trestle leg/transverse beam joint. Furthermore, as the vessel rolled, the 'high' side of the trestle was subject to uplift forces that could not be resisted by the lashing chains secured at a shallow angle. The stacked dunnage was not secured together or fixed to the trestle leg and became displaced when the leg lifted. As the trestle racked and the timber supports collapsed, the lashing chains became slack and the movement of the trestle was exacerbated until the trestles collapsed beneath the carriages and the lashing chains broke. It was not clear that the trestles or the carriages themselves had been verified for the forces they would be likely to experience on a ship.



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