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# DNV REPORT

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## INTRODUCTION

Extracts from the International Convention for the Safety of Life at Sea, 1974 (SOLAS) chapter VI Regulation 5 Stowage and securing, and chapter VII Regulation 5, paragraph 6, are quoted below. Requirements to CSM apply to all ships except those that carry only liquid or dry bulk cargoes. The requirements were implemented 1 January 1998. Ships below 500 GRT are also to carry an approved CSM on board, although the flag state may modify this requirement for protected coastal trade.

Passenger ships also engaged in the carriage of cargo must be provided with a manual, as should specialised vessels such as pipe and cable layers, and offshore supply vessels. Bulk carriers that may carry other cargoes than pure dry bulk cargoes are required to carry approved CSM. Various examples of potential problem cargoes (extracts from CSS) are given under chapter 3 of this model manual.

Timber deck cargoes are to be stowed in accordance with the IMO Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 1991 or in the case of ships having timber load lines the International Convention on Load Lines 1966. Under deck stowage of timber is covered in chapter 3 of this model manual.

Solid bulk cargoes are to be stowed in accordance with the IMO Code of Safe Practice for Solid Bulk Cargoes.

## SOLAS CHAPTER VI CARRIAGE OF CARGOES

### Regulation 1 - Application

This chapter applies to the carriage of cargoes (except liquids in bulk, gases in bulk and those aspects of carriage covered by other chapters) which, owing to their particular hazards to ships or persons on board, may require special precautions in all ships to which the present regulations apply, and in cargo ships of less than 500 tons gross tonnage. However, for cargo ships of less than 500 tons gross tonnage, the Administration, if it considers that the sheltered nature and conditions of voyage are such as to render the application of any specific requirements of part A or B of this chapter unreasonable or unnecessary, may take other effective measures to ensure the required safety for these ships.

### Regulation 5 - Stowage and securing

- 1 Cargo and cargo units carried on or under deck shall be so loaded, stowed and secured as to prevent as far as is practicable, throughout the voyage, damaged or hazard to the ship and the persons on board, and loss of cargo overboard.
- 2 Cargo carried in a cargo unit shall be so packed and secured within the units as to prevent, throughout the voyage, damage or hazard to the ship and the persons on board.
- 3 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.
- 4 Appropriate precautions shall be taken during loading and transport of cargo units on board ro-ro ships, especially with regard to the securing arrangements on board such ships and on the cargo units and with regard to the strength of the securing points and lashing.
- 5 Containers shall not be loaded to more than the maximum gross weight indicated on the Safety Approval Plate under International Convention for Safe Containers (CSC).
- 6 Cargo units, including containers, shall be loaded, stowed and secured throughout the voyage in accordance with the Cargo Securing Manual approved by the Administration. In ships with ro-



ro cargo spaces, as defined in regulation II-2/3.14, all securing of such cargoes, in accordance with the Cargo Securing Manual shall be completed before the ship leaves the berth. The Cargo Securing Manual shall be drawn up to a standard at least equivalent to the guidelines developed by the Organization.

## **SOLAS CHAPTER VII CARRIAGE OF DANGEROUS CARGOES**

### **Regulation 5 – Stowage and Securing**

- 6 Cargo transport units, including freight containers, shall be loaded, stowed and secured throughout the voyage in accordance with the Cargo Securing Manual approved by the Administration. The Cargo Securing Manual shall be drawn up to a standard at least equivalent to the guidelines developed by the Organization.

## GENERAL

It is agreed that save as provided below Det Norske Veritas, its subsidiaries, bodies, officers, directors, employees and agents shall have no liability for any loss, damage or expense allegedly caused directly or indirectly by their mistake or negligence, breach of warranty, or any other act, omission or error by them, including gross negligence or wilful misconduct by any such person with the exception of gross negligence or wilful misconduct by the governing bodies or senior executive officers of Det Norske Veritas. This applies regardless of whether the loss, damage or expense has affected anyone with whom Det Norske Veritas has a contract or a third party who has acted or relied on decisions made or information given by or on behalf of Det Norske Veritas. \* However, if any person uses the services of Det Norske Veritas or its subsidiaries or relies on any decision made or information given by or on behalf of them and in consequence suffers a loss, damage or expense proved to be due to their negligence, omission or default, then Det Norske Veritas will pay by way of compensation to such person a sum representing his proved loss. \* In the event Det Norske Veritas or its subsidiaries may be held liable in accordance with the sections above, the amount of compensation shall under no circumstances exceed the amount of the fee, if any, charged for that particular service, decision, advice or information. \* Under no circumstances whatsoever shall the individual or individuals who have personally caused the loss, damage or expense be held liable. \* In the event that any provision in this section shall be invalid under the law of any jurisdiction, the validity of the remaining provisions shall not in any way be affected.

This manual has been prepared according to the International Convention for the Safety of Life at Sea, 1974 (SOLAS) chapters VI and VII, Guidelines for the Preparation of the Cargo Securing Manual (IMO MSC.1/Circ.1353), Amendments to the Code of Safe Practice for Cargo Stowage and Securing (IMO MSC/Circ. 1026) and the Rules of Det Norske Veritas. The latest amendments from MSC87 (May 2010) has been incorporated as far as applicable.

This model manual should be used as a guide and example for the preparation of Cargo Securing Manual according to the Guidelines for the Preparation of the Cargo Securing Manual (IMO MSC.1/Circ.1353). The guidelines should be followed closely, as we have tried to do in this model, but still allow for cargo specific and/or company specific procedures and information to be included. The manual is to be ship specific and include obligatory general information as outlined in the Guidelines for the Preparation of the Cargo Securing Manual (IMO MSC.1/Circ.1353) and included in the text below.

Extracts from codes such as the Code of Safe Practice for Cargo Stowage and Securing (CSS with 1994/95 amendments, Annex 1-13), are included in this model manual where appropriate. Examples of various information to be included are given. A separate calculation tool, LASHCON™, may be used to provide some of the ship specific information needed, such as tables and diagrams of accelerations to be included in Ch. 3.

**Not all chapters or all information is applicable to all ships.** Owners or managers need to consider the ship you operate and the cargoes they may carry. Version 1.0 of the Model Manual (April 1996) used a RO-RO ship as an example. This version includes the material from the first version and is generalised to include all ship types.

The following notation has been used in the model manual:

1. **Bold type is used for text to be included in all Cargo Securing Manuals (compulsory)**
2. Normal type is used for text that represents example wording which may be used (voluntary)
3. *Italics type is used for guidance notes for the preparation of the manual, and text quoted directly from Guidelines for the Preparation of the Cargo Securing Manual (IMO MSC.1/Circ.1353) and Amendments to the Code of Safe Practice for Cargo Stowage and Securing (IMO MSC/Circ. 1026)*

Experience by the crew and ship operator specific to the ship, trade or cargoes should be included in the CSM. General information of this type might be included in the end of chapter 1.



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# GUIDANCE TO CARGO SECURING MANUAL

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BY

DET NORSKE VERITAS

This is a guidance for the preparation of Cargo Securing Manual according to “Guidelines for the Preparation of the Cargo Securing Manual” (IMO MSC.1/Circ.1353) and the “Amendments to the Code of Safe Practice for Cargo Stowage and Securing (IMO MSC/Circ.1026). It may be used for all types of ship required to carry approved Cargo Securing Manuals on board.

The latest amendments as per the end of May 2010 are covered by this guidance.

Version: 1  
Date: 04-01-01

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## 2 General

### 2.1 Ship Data

#### General Data

Ship Name:	M/S Model Ship
DNV Id No:	12345
IMO No:	67890123
Flag	Flag
Class Notation	✱1A1 General Cargo/ Container Carrier

#### Ship dimensions

Length, L	155.6 m
Beam, B	21.0 m
Depth moulded, D	12.1 m
Draft, T	7.0 m
Speed, V	17.0 kn
GM, range of values	0.5 - 2.5 m

#### Reference documents

Document/Manual	Issue date	Approval date
Loading Manual	96.04.19	96.04.20
Trim & Stability Booklet	96.04.21	96.04.22

#### **FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*The ship dimensions are needed for calculation of accelerations and lashing forces (Ref. chapter 4.1.5 of this manual). A typical range of GM values should be given in accordance with values from the Trim and Stability Booklet.*

*Reference to appropriate cargo information documents should be given in this table. Other references than those quoted could be to the Certificate of Compliance for Dangerous Goods, Grain Loading Manual, Container Plan, etc.*

*The owner/ship manager or shipyard should make sure that all information quoted in this manual is in accordance with other relevant documents, such as the Loading Manual and Trim and Stability Booklet referred to above.*



## 2.2 Definitions

“Cargo Securing Devices” are all fixed and portable devices used to secure and support cargo units.

“Maximum Securing Load” (MSL) is a term used to define the allowable load capacity for a device used to secure cargo to a ship. “Safe Working Load” (SWL) may be substituted for MSL for securing purposes, provided this is equal to or exceeds the strength defined by MSL.

“Standardized Cargo” means cargo for which the ship is provided with an approved securing system based upon cargo units of specific types.

“Semi-standardized Cargo” means cargo for which the ship is provided with a securing system capable of accommodating a limited variety of cargo units, such as vehicles, trailers, etc.

“Non-standardized Cargo” means cargo which requires individual stowage and securing arrangements.

“Cargo transport unit” means a road freight vehicle, a railway freight wagon, a freight container, a road tank vehicle, a railway tank wagon or a portable tank.

***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*The above definitions are general ones quoted from IMO MSC.1/Circ.1353. Any other definitions describing ship specific, cargo specific or company specific terms should be included in this subchapter.*

*The following definitions are applicable for RO-RO ships:*

“Semi-trailer” means a trailer which is designed to be coupled to a towing vehicle and used on roads. Includes box type, curtainsider, flatbed, etc.

“Roll trailer” means 20’, 30’ or 40’ wheeled platform handled by terminal trucks.

“Flat” means 20’ or 40’ platform or platform based ISO container.

“Mobile” means vehicle with wheels or caterpillar threads, e.g. dumpers, excavators, etc.

“Fixed Securing Devices” means securing points and supports either integral, i.e. welded into the hull structure, or non-integral, i.e. welded onto the hull structure.

“Portable Securing Devices” means portable devices used for lashing, securing or support of cargo units.

## 2.3 General Information

- 1 The guidance given herein should by no means rule out the principles of good seamanship, neither can they replace experience in stowage and securing practice.

- 2 The information and requirements set forth in this Manual are consistent with the requirements of the vessel's trim and stability booklet, International Load Line Certificate (1966), the hull strength loading manual (if provided) and with the requirements of the International Maritime Dangerous Goods (IMDG) Code (if applicable).
- 3 This Cargo Securing Manual specifies arrangements and cargo securing devices provided on board the ship for the correct application to and the securing of cargo units, containers, vehicles and other entities, based on transverse, longitudinal and vertical forces which may arise during adverse weather and sea conditions.
- 4 It is imperative to the safety of the ship and the protection of the cargo and personnel that the securing of the cargo is carried out properly and that only appropriate securing points or fittings should be used for cargo securing.
- 5 The cargo securing devices mentioned in this manual should be applied so as to be suitable and adapted to the quantity, type of packaging, and physical properties of the cargo to be carried. When new or alternative types of cargo securing devices are introduced, the Cargo Securing Manual should be revised accordingly. Alternative cargo securing devices introduced should not have less strength than the equipment which it replaces.
- 6 There should be a sufficient quantity of reserve cargo securing devices on board the ship.
- 7 Information on the strength and instructions for the use and maintenance of each specific type of cargo securing device, where applicable, is provided in this manual. The cargo securing devices should be maintained in a satisfactory condition. Items worn or damaged to such an extent that their quality is impaired should be replaced.
- 8 The Cargo Safe Access Plan (CSAP) is intended to provide detailed information for persons engaged in work connected with cargo stowage and securing. Safe access should be provided and maintained in accordance with this plan (applicability and enter into force date are given in the Note on annex 14 of the CSS Code).

## 2.4 Principal sources of danger

### ***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*This subchapter is not required by the MSC.1/Circ.1353, but is an example of safety information that the owner should consider to include in the manual.*

*The following text is applicable for RO-RO ships, but this sub-chapter should be considered included for other ship types as well.*

Some important sources of danger which can affect the safety of roll on/roll off ships and of persons on them include:

1. Cargo badly stowed or inadequately secured inside or on cargo units.
2. Free surface effects in tank vehicles, tank containers or other bulk units which are slack.
3. Poorly maintained ramps, lifts and stern doors.



4. Poorly maintained or inadequately illuminated decks.
5. Wet decks.
6. Failure to apply brakes correctly.
7. Insufficient or incorrectly applied lashings or the use of lashing equipment of the wrong type or of inadequate strength with respect to mass and centre of gravity of the cargo unit and the weather conditions likely to be encountered during the voyage.
8. Free play in the suspension of vehicles.
9. Failure to comply with the stowage, segregation and marking requirements for vehicles carrying dangerous goods.

### 3 Securing Devices and Arrangements

When securing devices are replaced, the inventory lists should, as far as practicable, be updated and relevant certificates inserted in an appropriate place in the manual.

#### 3.1 Specification of Fixed Cargo Securing Devices.

##### **FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*All fixed securing devices, for new vessels and existing vessels, as well for replaced securing devices should be provided with certification as far as practicable. In general, for new vessels, all fixed securing devices and associated hull supporting structure are normally considered during the ship plan approval process.*

*For all vessels, new and existing, carrying semi-standardized (e.g. RO-RO ships) or standardized cargo (e.g. container ships), all fixed securing devices to be provided with certification according to the Class Societies Rules.*

*For securing of hazardous cargo only certified devices should be used.*

*Owners may operate a computer based inventory system. The system should be able to provide updated inventory lists with relevant information of all securing devices. If this is found suitable, the inventory list may be combined with a list of inspection and maintenance.*

No other attachments to the ship hull structure than those listed below shall be made without the Masters special permission.

Any lashing arrangements imposing loads exceeding the maximum securing loads listed in the inventory list may cause serious structural damage.

##### **Fixed securing devices:**

Type	Manufacturer	Type designation	Quantity <sup>1)</sup>	MSL [kN] <sup>1) 2)</sup>	Sketch
D-ring	NN Inc.	ZA-3	350	T = 245	see page ? <sup>3)</sup>
Lashing plate	Yard Supply	-	250	S = 75	see page ? <sup>3)</sup>

T = Tension, S = Shear

##### **FOR GUIDANCE TO THE TABLE ONLY:**

*The above table shows an example of how the equipment may be listed and information sorted, **Type**, **MSL** and **Quantity** are a minimum of information needed.*

*1) Further reference may be given to a stowage plan, if applicable.*

*2) If the MSL is unknown, it may be obtained by the simplified expression given in **Appendix I**.*

3) *Sketches or descriptions of the various items may be enclosed on a separate page or annex.*

*It should be noted that the scantling of existing ship structures does not normally allow for additional cargo securing loads and the structure in way of fixed securing devices may require additional local stiffening.*

### 3.2 Specification of Portable Cargo Securing Devices.

#### **FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*Generally, all portable cargo securing devices supplied onboard shall be certified in accordance with relevant national or international standards.*

*For securing of hazardous cargo only certified fittings are to be used.*

As a general rule-of-thumb, if doubt about determining the MSL, portable equipment should not be subject to loads exceeding what have been customary usage in the past.

#### **Portable securing devices:**

Type	Manufacturer	Type designation	Quantity <sup>1)</sup>	MSL [kN] <sup>1) 2)</sup>	Sketch
Lashing Bar	NN Inc.	LB-2	350	T = 245	see page ? <sup>3)</sup>
Lashing Wire	NN Inc.	SEL-K1	220	T = 176	see page ? <sup>3)</sup>
Turnbuckle	NN Inc.	CTB-1-HH	350	T = 98	see page ? <sup>3)</sup>
Lashing Chain	NN Inc.	K-HS-11	175	T = 73	see page ? <sup>3)</sup>

T = Tension, S = Shear

#### **FOR GUIDANCE TO THE TABLE ONLY:**

*The above table shows an example of how the equipment may be listed and information sorted, **Type, MSL and Quantity** are a minimum of information needed.*

- 1) *Further reference may be given to a stowage plan, if applicable.*
- 2) *If the MSL is unknown, it may be obtained by the simplified expression given in **Appendix I**.*
- 3) *Sketches or descriptions of the various items may be enclosed on a separate page or annex.*

*Portable cargo securing equipment is often difficult to control and may be mixed with fittings from various sources. Mandatory survey of portable fittings will not generally be pursued and inspection and replacement should be the responsibility of the operators. The practical operation of new equipment provided, should, as far as practicable, be the same as for the equipment already onboard.*

### 3.3 Inspection and Maintenance Schemes

***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*This sub-chapter should describe the inspection and maintenance schemes for the cargo securing devices on board the ship.*

Regular inspections and maintenance are carried out under the responsibility of the Master.

Cargo securing device inspections should as a minimum include:

1. Routine visual examinations of components being utilised:
  - Before using any cargo securing device, whether fixed or portable, the equipment must be visually inspected to ensure that there are no defects and that when appropriate, all moving parts have been greased and are operating correctly.
  - After use, and before going into storage, each device should be visually inspected to ensure that the device has not sustained damage, is still in good condition and does not require repair or replacement. Especially after heavy weather voyages the lashing equipment should be carefully examined. Defective portable lashing equipment should be put aside into a suitable separate location, i.e. bins marked “BAD“, and any necessary repairs and testing must be carried out prior to re-use. If beyond repair the equipment is to be scrapped.
  - Discarded parts of equipment should be replaced by equivalent parts. Cargo Securing Equipment is only to be renewed by certified equipment.
  - All portable securing devices shall be visually examined and greased as necessary at intervals not exceeding 3 months.
  - Portable equipment not in use should be collected and stored in bins.
  -

***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*If a system is in use today, this should be described, and relevant information such as instructions, forms etc. should be included. If this makes the Manual too bulky, these instructions may be placed in the record book, and a short reference put in the manual.*

*The inspection and maintenance system may be part of the inventory lists.*

*If the manufacturer has any requirements regarding maintenance of the lashing equipment, this should be included in this section.*

2. Periodic examinations/re-testing as required by the Administration. When required, the cargo securing devices concerned should be subjected to inspections by DNV.
  - The welds connecting the fixed cargo securing equipment to the ship's structure should be inspected regularly and any fractures or tearing should be gouged out and rewelded. Welding of the device to the structure should be carried out by approved personnel in accordance with recognised welding practice.

- If the underlying structure of the deck, tank top, hatch covers, bulkheads or side structure is deformed to such an extent that an uneven stow would result, the structure should be repaired by the most appropriate method. Any significant deformation of the ship's structure in way of securing points is to be reported to DNV at the earliest opportunity.
- Cargo securing equipment used several times, both loose and fixed, should be re-tested regularly. The equipment to be tested should be selected by random selection, for instance 1 of 50 pieces of each type of equipment. These tests should be to proof strength load.

The following procedures should be followed for accepting, maintaining, repairing or rejecting cargo securing devices, and should be carried out by the ship's crew:

Cargo Sec. Device	Inspection Check if/for:	Maintenance	Actions To be:
Elephant foot pots	deformed		repaired or replaced
	corroded		replaced if top plate is less than 75 % of original
Turnbuckle	bent	* see below	renewed
	pins damaged or missing		renewed
	hook damaged		renewed
	destructive, thread		scrapped
Lashing chain w/tensioner	link is deformed		replace if any link is deformed
Wire rope lashings	permanent kinks flattening corrosion drying out of the fibre core protrusion of the fibre core		replaced if any of the listed defects are found
Shackles	bolt damaged or missing		renewed
	bent		scrapped
	wear and tear		scrapped
Twistlock	handle damaged/missing	* see below	straightened/renewed
	spring/ball/bolts and nuts damaged		renewed
	amount of small cracks		scrapped
Bridgefitting	nuts damaged or missing	* see below	renewed
	bent		straightened
	destructive; thread		scrapped

\* Threads of turnbuckles, twistlocks and bridgefittings should be greased regularly, at least every 3 months.

Inspections and adjustments of securing arrangements during the voyage:

1. The securing devices should be regularly inspected to ensure that the cargo remains safely secured throughout the voyage.
2. The securing arrangement should be adjusted, if found necessary after inspection, during the voyage. Adjustment of securing devices includes re-tightening of lashings or remaking the lashing. If necessary additional lashings should be fitted, and if possible the friction could be increased. This is particular important when heavy weather or swell is expected. Moreover, when heavy weather has passed.

Particular attention should also be paid to lashings which may become slack due to the cargo deforming or compacting during the voyage. Lashings may also become slack when cargoes are loaded and secured in conditions of low ambient temperature and the vessel then proceeds to areas of significantly higher ambient temperature.

3. If adjustment to the cargo securing arrangement has to be carried out at sea under adverse weather and sea conditions adequate precautions have to be taken to avoid dangerous situations for the crew. Good seamanship is necessary.
4. During a voyage, partial discharge may result in an exposed cargo face. This should preferably be secured while loading to avoid hazards while discharging other cargo.
5. Sufficient reserve securing devices should be carried to deal with unexpected circumstances.
6. Entries of all examinations and adjustments to lashings should be made in the ship's record book.

Inspections and maintenance carried out are to be entered into the "Log for Maintenance of Cargo Securing Equipment", see Appendix II.

***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*The system must allow for record keeping of equipment being brought on or off the vessel, as well as new acquisition.*

*A computerised system may be used, and this may be integrated with other computerised systems already in use on board. Printouts from the computerised system should be included in the Manual.*

*The record book should contain the following information as a minimum.*

- *Date of inspection*
- *Signature of person conducting examination*
- *Name and identification of items examined*
- *Results of examination/inspection and maintenance/repair undertaken, if any.*



## 4 Stowage and Securing of cargo

### 4.1 Handling and safety instructions

#### ***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*This subchapter should contain:*

- *Instructions on the proper handling of the securing devices*
- *Safety instructions related to handling of securing devices and to securing operations by ship or offshore personnel.*

*For ships certified for the carriage of dangerous goods, reference should be given to the IMDG Code.*

*Note that only certified fittings are to be used.*

*The following text is an example on general instructions that can be included. Note that general remarks regarding specific cargo units, cargo transport units and vehicles should be included in this text.*

#### **4.1.1 General principles of cargo securing**

1. Cargo shall be secured according to recognised principles, taking into account the dynamic forces that may occur during sea transport and the most severe weather condition expected. Ship handling decisions should take into account the type of cargo and stowage position of the cargo and the securing arrangements.
    - Care should be taken to distribute the forces as evenly as possible.
    - If in doubt the lashing arrangement should be verified using an acceptable calculation method.
    - The securing gear should be adapted to the cargo to be carried.
    - Lashings are to be kept as short as possible.
  2. Prior to loading cargo, the following should be checked:
    - Relevant deck areas are, as far as practicable, to be clean, dry and free from oil and grease.
    - Cargo, cargo transport unit or vehicle to be suitable for transport.
    - Necessary securing equipment is to be found onboard.
    - See item 5.
  3. The securing equipment should be:
    - available in sufficient quantity including reserves
    - suitable for the purpose\*\*
    - of adequate strength\*
    - practical and maintained\*\*
- \* The required strength, which depends on the lashing forces, can be calculated based on methods for evaluating forces as outlined in this manual.

\*\* Specific handling and safety instructions are provided in sub-chapter 4.1.2 along with instructions to suitable areas, while the maintenance is dealt with in chapter 3.3.

4. Securing operations shall be completed before the ship leaves the berth and the securing should be based on proper planning, execution and supervision. Relevant personnel should be properly qualified and experienced and should have a sound practical knowledge of the application and content of this Cargo Securing Manual.
  - The master shall take care in planning and supervising the stowage and securing of cargoes based on information about the cargo.
  - The cargo is to be distributed with attention to the ship stability so that the hazards of excessive accelerations are reduced as far as practicable.
  - Due attention to the ship's structural strength should be taken.

Excessive accelerations are expected to occur in the far forward and aft part of the ship, but can also occur in general as a result of a high GM value.

5. Where practicable, cargo units shall be provided with a Cargo Stowage and Securing Declaration, stating that the cargo has been properly stowed and secured, taking into account the IMO/ILO Guidelines for Packing Cargo in Freight Containers or Vehicles. In general, cargo carried in containers, road vehicles, ship borne barges, railway wagons and other transport units should be properly packed and secured within these units. Relevant expertise should be called for, if found necessary, when considering the shipment of a cargo with unusual characteristics, i.e. cargo which may require special attention to location, stowage/securing and weather conditions.
  - Different commodities should be compatible with each other or suitable separated
  - Cargo must be suitable for the ship and vice versa
6. If the duty officer considers that a cargo is not safely secured to a cargo unit, measures shall be taken to avoid shifting of the cargo. If adequate measures are not possible, due to the nature of the cargo or lack of securing points, the cargo unit shall not be taken on board. Reference in this respect is made to TfK Report 1990:6E "Loading and Securing Cargo on Load Carriers, Advice and instructions".
7. The securing arrangements shall be adequate to ensure that there will be no movement which will endanger the ship. Slackening of the securing gear due to cargoes which have a tendency to deform or to compact during voyage shall be avoided. Cargoes with low friction coefficient should also be tightly stowed across the ship to avoid sliding. Suitable material such as soft boards or dunnage should be used to increase friction, ref. paragraph 7.2.1 of the CSS Code.
8. Cargo units containing hanging loads (e.g. chilled meat, floated glass) and very high cargo units are, because of the relatively high position of the centre of gravity, particularly prone to tipping. Whenever possible they should be located in positions of least movement i.e. on the centre line, towards amidships and on a deck near the waterline.
9. Safe means of access to securing arrangements, safety equipment, and operational controls shall be provided and properly maintained. Stairways and escape routes from spaces below the vehicle deck shall be kept clear. The cargo spaces should be, as far as practicable, regularly inspected during voyage.

10. Lashings shall not be released for unloading before the ship is secured at the berth, without the Masters express permission.
11. Cargo shall not obstruct the operating controls of stern doors, entrances to accommodation and/or fire fighting equipment.
12. The ship may only carry dangerous goods according to the Certificate of Compliance for Dangerous Goods.
13. Dangerous goods shall be segregated, stowed and secured according to the IMDG code and valid instructions for this ship.

***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*The following items are applicable for RO-RO ships.*

14. Uncoupled semi-trailers shall be supported by trestles or similar devices placed in the immediate area of the drawplates so that the connection of the fifth-wheel to the kingpin is not restricted. Trailer brakes should not be released prior to coupling.  
  
In this respect it must be remembered that designs of tugmasters vary from port to port, and the trestle should not be placed so that restriction occurs at the discharge port. The trestles should also be placed so that it is under a flat area of the semi-trailer, and not inclined to tipping down.
15. Road vehicles and semi-trailers shall be stowed so that the chassis are kept as static as possible by not allowing free play in the suspension. This can be done by securing the vehicle to the deck as tightly as the lashing tensioning device will permit, and in the case of compresses air suspension systems, by first releasing the air pressure where this facility is provided.
16. Lashings shall not be attached to lamp brackets, side guards or bumpers except those specially designed for this purpose.
17. Lashings on a road vehicle, semi-trailer or roll trailer shall be under equal tension.
18. Only one lashing shall be attached to any one aperture, loop or lashing ring at each vehicle securing point.
19. Where practicable, the arrangement of lashings on both sides of a vehicle should be the same, and angled to provide some fore and aft restraint with an equal number pulling forward as are pulling aft.
20. The front ends of roll trailers shall always be placed on softboards or rubber mats.
21. Caterpillar treaded vehicles such as bulldozers and cranes are prone to sliding when parked on bare steel decks owing to the low degree of frictional resistance between the threads and the deck. Such vehicles shall be stowed on dunnage or soft boards before being secured.
22. Parking brakes, where provided, of each vehicle or each element of a combination of vehicles shall be applied.

#### **4.1.2 Safe handling of cargo securing devices**

# **FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*This subchapter should contain clear and specific handling and safety instructions for all the cargo securing devices used on board. The instructions should be based on the manufacturer's guidance literature. Please note that a reference to such literature is not deemed sufficient.*

*In order to be effective and simple to use, the instructions should be visualized by means of sketches, figures or photos. The instructions should provide information regarding which areas the gear is to be used to ensure suitability.*

*It is important that the instructions are clear and precise. Below are examples showing a specific instruction and non-specific instruction:*

## *Example of specific instructions:*

*Twistlocks shall be inserted in a way that emergency opening devices are accessible for opening.*

*Lashing bars shall be handled with care and under no circumstances dropped to the deck or hatch cover. Indents, notches or any other damage to the lashing bar may reduce the securing load significantly.*

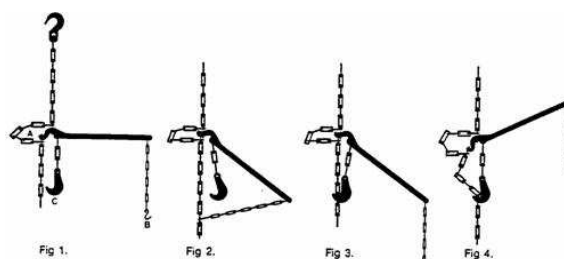
*Mounting of containers by use of ladders or other non-approved means is prohibited.*

## *Example of non-specific instructions:*

*All cargoes should be stowed and secured in such a way that the ship and persons onboard are not put to risk.*

*In all cases, improper stowage and securing of cargo will be potentially hazardous to the securing of other cargoes and the ship itself.*

## *Example of instructions for Chain Lashing – Lever/Hook – Up Pin, which might be given.*



1. *Insert hook tip A of lever into two links of the lashing chain placed opposite each other. (fig. 1)*
2. *Pull lever handle down for tension (fig.1)*
3. *Secure lever handle in position by locking in place securing chain B in main lashing chain (fig.2)*

## *For continuous take-up and tightening*

4. *Ensure chain is tensioned as much as possible (as in fig.2).*
5. *Loosen chain B and hook-up lever adjustment hook C in the appropriate link (fig.3).*
6. *Remove hook tip A of lever from early position (fig.1) and take up slack in the chain.*
7. *Repeat operations (fig. 1- 4) by moving hook C to the next link along the chain.*
8. *These operations to be repeated until the required tension is achieved.*
9. *The lashing is then tightened and locked in position (as in fig.2).*

### 4.1.3 Evaluation of forces acting on cargo units

***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*The following is required in this sub-chapter according to Guidelines for the Preparation of the Cargo Securing Manual (IMO MSC.1/Circ.1353):*

- *tables /diagrams giving a broad outline of the accelerations which can be expected in various positions on board the ship in adverse sea conditions and with a range of applicable metacentric height (GM) values;*
- *examples of forces acting on typical cargo unit when subjected to the accelerations referred to in the paragraph above and angles of roll and metacentric height (GM) values which the forces acting on the cargo unit exceed the permissible limit for the specified securing arrangements far as practical;*
- *examples of how to calculate number and strength of portable securing devices required to counteract the forces referred to in 4.1.5 as well as safety factors to be used for different types of portable cargo securing devices. Calculations may be carried out according to Annex 13 to the CSS Code or methods accepted by the Administration;*
- *it is recommended that the designer of a Cargo Securing Manual converts the calculation method used into a form suiting the particular ship, its securing devices and the cargo carried. This form may consist of applicable diagrams, tables or calculated examples; and*
- *other operational arrangements such as electronic data processing (EDP) or use of a loading computer may be accepted as alternatives to the requirements or the above paragraphs, providing that this system contain the same information.*

*Computer programs will not generally be approved unless specifically requested to be so, in which case they will be dealt with separately to the approval of the Cargo Securing Manual.*

Lashing forces are derived from accelerations of the cargo due to ship motions. The largest accelerations, and therefore the most severe forces, can be expected in the furthest forward, the furthest aft and the highest stowage positions on each side of the ship. Special consideration should be given to the securing of vehicles stowed in these positions. Generally the forces which have to be taken by the securing devices are composed of components acting relative to the axes of the ship, i.e. longitudinal, transverse and vertical direction. The two first are the most important to consider with respect to lashing since the main function of lashings are to prevent cargo units from tipping and/or sliding, in the transverse or longitudinal direction.

The transverse accelerations increase directly with the GM value, and care should be taken when stowing and distributing cargo to avoid excessive accelerations, ref. sub-chapter 4.1.1 “General principles of cargo securing”.

If cargo is stowed in positions where loads from wind pressure and/or sea sloshing may be expected, this shall be taken into consideration when securing the cargo.

Due to uncertainties as to the actual weights and locations of the centre of gravity of cargo units, the lashing forces may vary considerably. It is not possible to specify exactly the maximum forces which may be exerted in the most severe conditions. A general rule is that an adequate number of lashings of sufficient strength to meet the worst weather that could be encountered during the voyage should

always be fitted. If very heavy weather is expected, appropriate operational measures, such as delaying sailing or altering course or speed, should be taken to minimise the forces.

Due to the difficulty in predicting dynamic accelerations and the complexity of dynamic calculations, the lashing forces apply to rigid and unsprung cargo. Additional lashings will be required to resist dynamic forces due to sprung or non-rigid cargoes.

The lashings are in general most effective on a cargo unit when they make an angle with the deck of between 30° and 60°. When these optimum angles cannot be achieved, additional lashings may be required.

The forces can be estimated based on the calculation methods outlined in this Cargo Securing Manual. The effect of anti roll devices should not be taken into account when planning the stowage and securing of cargoes.

#### 4.1.4 Forces acting on typical cargo units

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

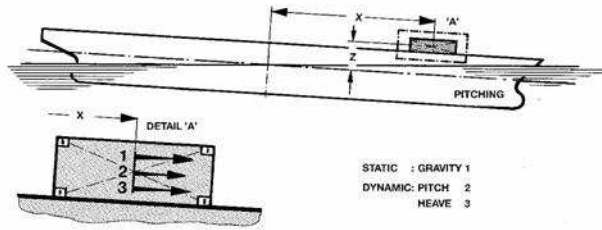
*According to Guidelines for the Preparation of the Cargo Securing Manual (MSC.1/Circ.1353) this sub-chapter should contain:*

*Examples of the forces acting on typical cargo units when subjected to the accelerations referred to above and angles of roll and metacentric height (GM) values above which the forces acting on the cargo units exceed the permissible limit for the specified securing arrangements as far as practicable.*

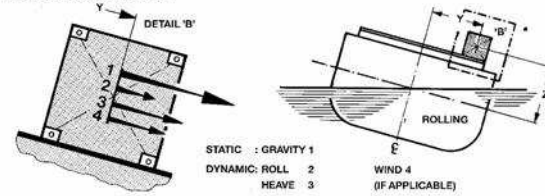
*The figure below will provide example of the forces acting on a typical cargo unit when subjected to the ship's accelerations. In addition to this, examples of unsatisfactorily lashing arrangements should, as far as practicable, be presented, for all the GM values given above.*

Cargo units/cargo transport units on a ship will in principles be subjected to the forces given on the drawing below.

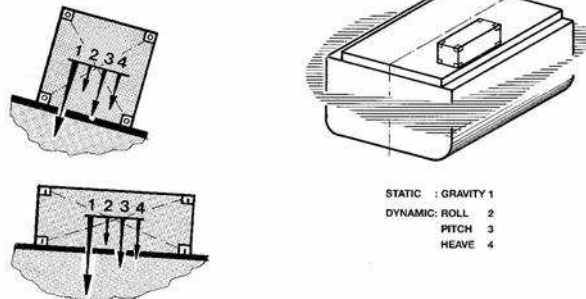
LONGITUDINAL SLIDING



TRANSVERSAL SLIDING



VERTICAL PRESSURE



Source: Mac Gregor Conver

#### 4.1.5 Procedures for calculation of forces in semi- and non-standardised lashing arrangements

##### **FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*This sub chapter provides the methods described in Annex 13 and the “Amendments to the Code of Safe Practice for Cargo Stowage and Securing (IMO MSC/Circ.1026).*

*Alternative calculation methods may be developed. These should at least consist of the same balance calculations as presented in the advanced calculation method, i.e. transverse and longitudinal sliding and transverse tipping. For long and narrow cargoes stowed transversely, it may also be relevant to include longitudinal tipping in the balance calculation.*

*The GM values selected shall be based on actual loading conditions as given in the loading- and stability-manual.*

*There is no clear-cut borderline between safety and non-safety. If in doubt, improve the arrangement.*

*This method must not be applied to standardised cargoes.*

*The text below is quoted directly from Annex 13 and the “Amendments to the Code of Safe Practice for Cargo Stowage and Securing (IMO MSC/Circ.1026), and the same chapter numbering is applied.*

##### **Scope of Application**

*The methods described in this annex should be applied to non-standardised cargoes, but not to containers on containerhips.*

*Very heavy units as carried under the provisions of chapter 1.8 of the Code of Safe Practice for Cargo Stowage and Securing (CSS Code) and those items for which exhaustive advice on stowage and securing is given in the annexes to the Code should be excluded.*

*Nothing in this annex should be read to exclude the use of computer software, provided the output achieves design parameters which meet the minimum safety factors applied in this sub-chapter.*

*The application of the methods described in this section is supplementary to the principles of good seamanship and shall not replace experience in stowage and securing practice.*

##### **Purpose of the methods**

*The methods should:*

- *provide guidance for the preparation of this Cargo Securing Manual and the examples herein;*
- *assist ship's staff in assessing the securing of cargo units not covered by this CSM;*
- *assist qualified shore personnel in assessing the securing of cargo units not covered by this CSM;*
- *serve as a reference for maritime and port-related education and training.*

##### **Alternative to hand calculation**

*LASHCON<sup>TM</sup> IMO is a DNV developed MS EXCEL based program for evaluation of forces in semi- and non-standardised securing arrangements. The program uses the accelerations and the calculation*



*methods specified in Annex 13 to the CSS code for calculation of forces in securing arrangements and the "Amendments to the Code of Safe Practice for Cargo Stowage and Securing (IMO MSC/Circ.1026)".*

*Using LASHCON™ IMO or a similar computer program, the designer of the Cargo Securing Manual can very easy and clear manner present acceleration values at different positions for various GM values. This will make the Cargo Securing Manual more user-friendly. Presenting the results this way using an applicable programme is therefore strongly recommended.*

*If other similar computer programs are to be used on board the ship, independent approval of the program should be obtained.*

*For more information about LASHCON™ see LASHCON™ User Manual in Appendix VI.*

#### 4.1.5.1 MSLs for different securing devices

MSLs for different securing devices are given in table 1 if not given else where.

The MSL of timber should be taken as 0.3 kN/cm<sup>2</sup> normal to the grain.

Material	MSL
Shackles, deckeyes, twistlocks, lashing rods, D-rings, stackers, bridge fittings, turnbuckles of mild steel	50% of breaking strength
Fibre rope	33% of breaking strength
Wire rope (single use)	80% of breaking strength
Wire rope (re-useable)	30% of breaking strength
Steel band (single use)	70% of breaking strength
Chains	50% of breaking strength
Web lashings	50% of breaking strength

Table 1 - Determination of MSL from breaking strength

For particular securing devices (e.g. fibre straps with tensioners or special equipment for securing containers), a permissible working load may be prescribed and marked by authority. This should be taken as the MSL.

When the components of a lashing device are connected in series (for example, a wire to a shackle to a deckeye), the minimum MSL in the series shall apply to that device.

#### 4.1.5.2 Safety factor

When using balance calculation methods for assessing the strength of the securing devices, a safety factor is used to take account of the possibility of uneven distribution of forces among the devices or reduced capability due to the improper assembly of the devices or other reasons. This safety factor is used in the formula to derive the calculated strength (CS) from the MSL and shown in the relevant method used.

$$CS = MSL / \text{safety factor}$$

Notwithstanding the introduction of such a safety factor, care should be taken to use securing elements of similar material and length in order to provide a uniform elastic behaviour within the arrangement.

#### 4.1.5.3 Simplified method – Rule of thumb

***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*Simplified method for evaluation of required lashing strength for safe securing of a cargo unit. The method does, by no means, optimise any arrangement, but may be used as a first approach to define the arrangement. A later control with the advanced calculation method is advisable.*

The total of the MSL values of the securing devices on each side of a unit of cargo (port as well as starboard) should equal the weight of the unit. (The weight of the unit should be taken in kN).

This method, which implies a transverse acceleration of 1g (9.81 m/s<sup>2</sup>), applies to nearly any size of ship, regardless of the location of stowage, stability and loading condition, season and area of operation. The method, however, takes into account neither the adverse effects of lashing angles and non-homogeneous distribution of forces among the securing devices nor the favourable effect friction.

Transverse lashing angles to the deck should not be greater than 60° and it is important that adequate friction is provided by the use of suitable material. Additional lashings at angles of greater than 60° may be desirable to prevent tipping but are not to be counted in the number of lashings under the rule-of-thumb.



For ships of a length other than 100 m and a service speed other than 15 knots, the acceleration figures should be corrected by a factor given in table 3.

Length [m] Speed [kN]	30	40	50	60	70	80	90	100	120	140	160	180	200	250	300
9	1,37	1,31	1,20	1,09	1,00	0,92	0,85	0,79	0,70	0,63	0,57	0,53	0,49	0,41	0,36
12	1,56	1,47	1,34	1,22	1,12	1,03	0,96	0,90	0,79	0,72	0,65	0,60	0,56	0,48	0,42
15	1,75	1,64	1,49	1,36	1,24	1,15	1,07	1,00	0,89	0,80	0,73	0,68	0,63	0,55	0,48
18	1,94	1,80	1,64	1,49	1,37	1,27	1,18	1,10	0,98	0,89	0,82	0,76	0,71	0,61	0,54
21	2,13	1,96	1,78	1,62	1,49	1,38	1,29	1,21	1,08	0,98	0,90	0,83	0,78	0,68	0,60
24	2,32	2,13	1,93	1,76	1,62	1,50	1,40	1,31	1,17	1,07	0,98	0,91	0,85	0,74	0,66

Table 3 – Correction factors for length and speed

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*It should be noted that the values in Table 3 for ships with length outside the range 50 - 200 metres are found by extrapolation and should be used with some care and criticism. The extended table is included in LASHCON™.*

For length/speed combinations not directly tabulated, the following formula may be used to obtain the correction factor with v = speed in knots and L = length between perpendiculars in metres:

$$\text{correction factor} = \left( 0.345 \cdot \frac{v}{\sqrt{L}} \right) + \frac{(58.62 \cdot L - 1034.5)}{L^2}$$

This formula shall not be used for ship lengths less than 50 m or more than 300 m.

In addition, for ships with B/GM less than 13, only the transverse acceleration figures should be corrected by a factor given in Table 4.

B / GM	4	5	6	7	8	9	10	11	12	13 →
on deck, high	2,30	1,96	1,72	1,56	1,40	1,27	1,19	1,11	1,05	1,00
on deck, low	1,92	1,70	1,53	1,42	1,30	1,21	1,14	1,09	1,04	1,00
Tween-deck	1,54	1,42	1,33	1,26	1,19	1,14	1,09	1,06	1,03	1,00
lower hold	1,31	1,24	1,19	1,15	1,12	1,09	1,06	1,04	1,02	1,00

Table 4 - Correction factors for B/GM < 13

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*It should be noted that values in Table 4 for ships with B/GM < 7 are found by extrapolation and should be used with some care and criticism. The extended table is included in LASHCON™.*

The following cautions should be observed:

In the case of marked roll resonance with amplitudes above + 30°, the given figures of transverse acceleration may be exceeded. Effective measures should be taken to avoid this condition.

In the case of heading into the seas at high speed with marked slamming shocks, the given figures of longitudinal and vertical acceleration may be exceeded. An appropriate reduction of speed should be considered.

In the case of running before large stern or quartering seas with a stability which does not amply exceed the accepted minimum requirements, large roll amplitudes must be expected with transverse accelerations greater than the figures given. An appropriate change of heading should be considered.

Forces by wind and sea to cargo units above the weather deck should be accounted for by simple approach:

force by wind pressure = 1 kN/m<sup>2</sup>  
force by sea sloshing = 1 kN/m<sup>2</sup>

Sloshing by sea can induce forces much greater than the figure given above. This figure should be considered as remaining unavoidable after adequate measures to prevent overcoming seas.

Sea sloshing forces need only be applied to height of deck cargo up to 2m above the weather deck or hatch top.

For voyages in a restricted area, sea sloshing forces may be neglected.

#### 4.1.5.5 Balance of forces – Advanced method

Friction contributes towards prevention of sliding the following friction coefficients ( $\mu$ ) should be applied.

Materials in contact	Friction coefficient, ( $\mu$ )
timber-timber, wet or dry	0,4
steel-timber or steel-rubber	0,3
steel-steel, dry	0,1
steel-steel, wet	0,0

Table 5 – Friction coefficients

The balance calculation should preferably be carried out for:

- transverse sliding in port and starboard directions;
- transverse tipping in port and starboard directions;
- longitudinal sliding under conditions of reduced friction in forward and aft directions

In the case of symmetrical securing arrangements, one appropriate calculation is sufficient.

## 1. Transverse sliding

The balance calculation should meet the following condition (see also figure 1):

$$F_y \leq \mu m g + CS_1 f_1 + CS_2 f_2 + \dots + CS_n f_n$$

where

$n$  is the number of lashings being calculated

$F_y$  is transverse force from load assumption (kN)

$\mu$  is friction coefficient

$m$  is mass of the cargo unit (t)

$g$  is gravity acceleration of earth = 9.81 m/s<sup>2</sup>

$CS$  is calculated strength of transverse securing devices (kN)

$$CS = \frac{MSL}{1,5}$$

$f$  is a function of  $\mu$  and the vertical securing angle  $\alpha$  (see table 6).

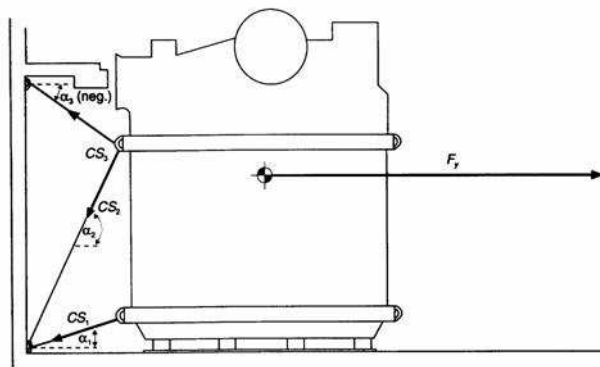


Figure 1 - Balance of transverse forces

A vertical securing angle  $\alpha$  greater than 60° will reduce the effectiveness of this particular securing device in respect to sliding of the unit. Disregarding of such devices from the balance of forces should be considered, unless the necessary load is gained by the imminent tendency to tipping or by a reliable pre-tensioning of the securing device and maintaining the pre-tension throughout the voyage.

Any horizontal securing angle, i.e. deviation from the transverse direction, should not exceed 30°, otherwise an exclusion of this securing device from the transverse sliding balance should be considered.

$\alpha$ $\mu$	-30°	-20°	-10°	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
0,3	0,72	0,84	0,93	1,00	1,04	1,04	1,02	0,96	0,87	0,76	0,62	0,47	0,30
0,1	0,82	0,91	0,97	1,00	1,00	0,97	0,92	0,83	0,72	0,59	0,44	0,27	0,10
0,0	0,87	0,94	0,98	1,00	0,98	0,94	0,87	0,77	0,64	0,50	0,34	0,17	0,00

Table 6 -  $f$ -Values as a function of  $\alpha$  and  $\mu$

Remark:  $f = \mu \sin \alpha + \cos \alpha$

## 2. Transverse tipping

This balance calculation should meet the following condition (see also figure 2):

$$F_y a \leq b m g + CS_1 c_1 + CS_2 c_2 + \dots + CS_n c_n$$

Where

$F_y$ ,  $m$ ,  $g$ ,  $CS$ ,  $n$  are as explained under 1, Transverse sliding

$a$  is lever-arm of tipping (m) (see figure 2)

$b$  is lever-arm of stability (m) (see figure 2)

$c$  is lever-arm of securing force (m) (see figure 2)

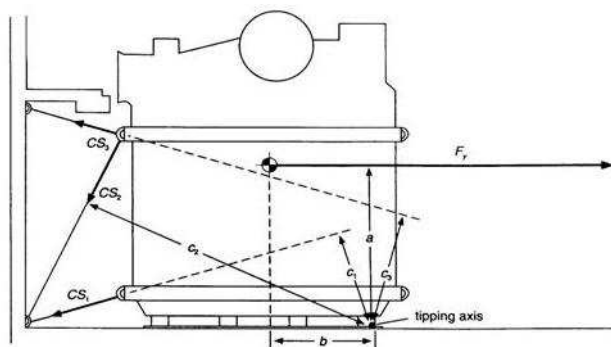


Figure 2 - Balance of transverse moments

## 3. Longitudinal sliding

Under normal conditions the transverse securing devices provide sufficient longitudinal components to prevent longitudinal sliding. If in doubt, a balance calculation should meet the following condition:

$$F_x \leq \mu (m g - F_z) + CS_1 f_1 + CS_2 f_2 + \dots + CS_n f_n$$

where

$F_x$  is longitudinal force from load assumption (kN)

$\mu$ ,  $m$ ,  $g$ ,  $f$ ,  $n$  are as explained under 1, Transverse sliding

$F_z$  is vertical force from load assumption (kN)

$CS$  is calculated strength of longitudinal securing devices (kN)

$$CS = \frac{MSL}{1,5}$$

Remark: Longitudinal components of transverse securing devices should not be assumed greater than 0.5  $CS$ .

#### 4.1.5.6 Balance of forces – Alternative Method

This alternative method allows a more precise consideration of horizontal securing angles.

Securing devices usually do not have a pure longitudinal or transverse direction in practice but have an angle  $\beta$  in the horizontal plane. This horizontal securing angle  $\beta$  is defined in this annex as the angle of deviation from the transverse direction. The angle  $\beta$  is to be scaled in the quadrant mode, i.e. between  $0^\circ$  and  $90^\circ$ .

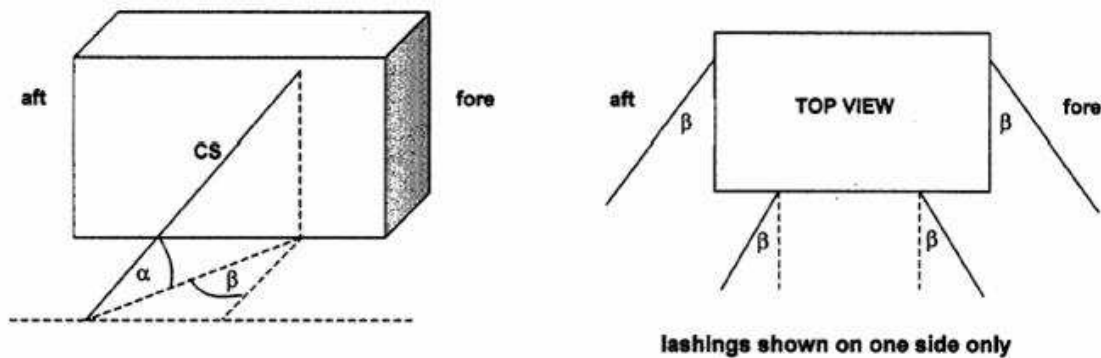


Figure 3 – Definition of the vertical and horizontal securing angles  $\alpha$  and  $\beta$

A securing device with an angle  $\beta$  develops securing effects both in longitudinal and transverse direction, which can be expressed by multiplying the calculated strength CS with the appropriate values of  $f_x$  or  $f_y$ . The values of  $f_x$  and  $f_y$  can be obtained from Table 7.

Table 7 consists of five sets of figures, one each for the friction coefficients  $\mu = 0.4, 0.3, 0.2, 0.1$  and  $0$ . Each set of figures is obtained by using the vertical angle  $\alpha$  and horizontal angle  $\beta$ . The value of  $f_x$  is obtained when entering the table with  $\beta$  from the right while  $f_y$  is obtained when entering with  $\beta$  from the left, using the nearest tabular value for  $\alpha$  and  $\beta$ . Interpolation is not required but may be used.

The balance calculations are made in accordance with the following formulae:

$$\text{Transverse sliding} : Fy \leq \mu \cdot m \cdot g + fy_1 \cdot CS_1 + \dots + fy_n \cdot CS_n$$

$$\text{Longitudinal sliding} : Fx \leq \mu \cdot (m \cdot g - Fz) + fx_1 \cdot CS_1 + \dots + fx_n \cdot CS_n$$

$$\text{Transverse tipping} : Fy \cdot a \leq b \cdot m \cdot g + 0,9(CS_1 \cdot c_1 + CS_2 \cdot c_2 + \dots + CS_n \cdot c_n)$$

#### Caution:

Securing devices, which have a vertical angle  $\alpha$  of less than  $45^\circ$  in combination with horizontal angle  $\beta$  greater than  $45^\circ$ , should not be used in the balance of transverse tipping in the above formula.

All symbols used in these formulae have the same meaning as defined in 4.1.5.5 except  $f_x$  and  $f_y$ , obtained from Table 7, and CS is as follows:

$$CS = \frac{MSL}{1,35}$$



Table 7.1 for  $\mu = 0.4$ 

$\beta$ for fy	$\alpha$														$\beta$ for fx
	-30	-20	-10	0	10	20	30	40	45	50	60	70	80	90	
0	0.67	0.80	0.92	1.00	1.05	1.08	1.07	1.02	0.99	0.95	0.85	0.72	0.57	0.40	90
10	0.65	0.79	0.90	0.98	1.04	1.06	1.05	1.01	0.98	0.94	0.84	0.71	0.56	0.40	80
20	0.61	0.75	0.86	0.94	0.99	1.02	1.01	0.98	0.95	0.91	0.82	0.70	0.56	0.40	70
30	0.55	0.68	0.78	0.87	0.92	0.95	0.95	0.92	0.90	0.86	0.78	0.67	0.54	0.40	60
40	0.46	0.58	0.68	0.77	0.82	0.86	0.86	0.84	0.82	0.80	0.73	0.64	0.53	0.40	50
50	0.36	0.47	0.56	0.64	0.70	0.74	0.76	0.75	0.74	0.72	0.67	0.60	0.51	0.40	40
60	0.23	0.33	0.42	0.50	0.56	0.61	0.63	0.64	0.64	0.63	0.60	0.55	0.48	0.40	30
70	0.10	0.18	0.27	0.34	0.41	0.46	0.50	0.52	0.52	0.53	0.52	0.49	0.45	0.40	20
80	-0.05	0.03	0.10	0.17	0.24	0.30	0.35	0.39	0.41	0.42	0.43	0.44	0.42	0.40	10
90	-0.20	-0.14	-0.07	0.00	0.07	0.14	0.20	0.26	0.28	0.31	0.35	0.38	0.39	0.40	0

Table 7.2 for  $\mu = 0.3$ 

$\beta$ for fy	$\alpha$														$\beta$ for fx
	-30	-20	-10	0	10	20	30	40	45	50	60	70	80	90	
0	0.72	0.84	0.93	1.00	1.04	1.04	1.02	0.96	0.92	0.87	0.76	0.62	0.47	0.30	90
10	0.70	0.82	0.92	0.98	1.02	1.03	1.00	0.95	0.91	0.86	0.75	0.62	0.47	0.30	80
20	0.66	0.78	0.87	0.94	0.98	0.99	0.96	0.91	0.88	0.83	0.73	0.60	0.46	0.30	70
30	0.60	0.71	0.80	0.87	0.90	0.92	0.90	0.86	0.82	0.79	0.69	0.58	0.45	0.30	60
40	0.51	0.62	0.70	0.77	0.81	0.82	0.81	0.78	0.75	0.72	0.64	0.54	0.43	0.30	50
50	0.41	0.50	0.58	0.64	0.69	0.71	0.71	0.69	0.67	0.64	0.58	0.50	0.41	0.30	40
60	0.28	0.37	0.44	0.50	0.54	0.57	0.58	0.58	0.57	0.55	0.51	0.45	0.38	0.30	30
70	0.15	0.22	0.28	0.34	0.39	0.42	0.45	0.45	0.45	0.45	0.43	0.40	0.35	0.30	20
80	0.00	0.06	0.12	0.17	0.22	0.27	0.30	0.33	0.33	0.34	0.35	0.34	0.33	0.30	10
90	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.19	0.21	0.23	0.26	0.28	0.30	0.30	0

Table 7.3 for  $\mu = 0.2$ 

$\beta$ for fy	$\alpha$														$\beta$ for fx
	-30	-20	-10	0	10	20	30	40	45	50	60	70	80	90	
0	0.77	0.87	0.95	1.00	1.02	1.01	0.97	0.89	0.85	0.80	0.67	0.53	0.37	0.20	90
10	0.75	0.86	0.94	0.98	1.00	0.99	0.95	0.88	0.84	0.79	0.67	0.52	0.37	0.20	80
20	0.71	0.81	0.89	0.94	0.96	0.95	0.91	0.85	0.81	0.76	0.64	0.51	0.36	0.20	70
30	0.65	0.75	0.82	0.87	0.89	0.88	0.85	0.79	0.75	0.71	0.61	0.48	0.35	0.20	60
40	0.56	0.65	0.72	0.77	0.79	0.79	0.76	0.72	0.68	0.65	0.56	0.45	0.33	0.20	50
50	0.46	0.54	0.60	0.64	0.67	0.67	0.66	0.62	0.60	0.57	0.49	0.41	0.31	0.20	40
60	0.33	0.40	0.46	0.50	0.53	0.54	0.53	0.51	0.49	0.47	0.42	0.36	0.28	0.20	30
70	0.20	0.25	0.30	0.34	0.37	0.39	0.40	0.39	0.38	0.37	0.34	0.30	0.26	0.20	20
80	0.05	0.09	0.14	0.17	0.21	0.23	0.25	0.26	0.26	0.26	0.26	0.25	0.23	0.20	10
90	-0.10	-0.07	-0.03	0.00	0.03	0.07	0.10	0.13	0.14	0.15	0.17	0.19	0.20	0.20	0

Table 7.4 for  $\mu = 0.1$ 

$\beta$ for $f_y$	$\alpha$														$\beta$ for $f_x$
	-30	-20	-10	0	10	20	30	40	45	50	60	70	80	90	
0	0.82	0.91	0.97	1.00	1.00	0.97	0.92	0.83	0.78	0.72	0.59	0.44	0.27	0.10	90
10	0.80	0.89	0.95	0.98	0.99	0.96	0.90	0.82	0.77	0.71	0.58	0.43	0.27	0.10	80
20	0.76	0.85	0.91	0.94	0.94	0.92	0.86	0.78	0.74	0.68	0.56	0.42	0.26	0.10	70
30	0.70	0.78	0.84	0.87	0.87	0.85	0.80	0.73	0.68	0.63	0.52	0.39	0.25	0.10	60
40	0.61	0.69	0.74	0.77	0.77	0.75	0.71	0.65	0.61	0.57	0.47	0.36	0.23	0.10	50
50	0.51	0.57	0.62	0.64	0.65	0.64	0.61	0.56	0.53	0.49	0.41	0.31	0.21	0.10	40
60	0.38	0.44	0.48	0.50	0.51	0.50	0.48	0.45	0.42	0.40	0.34	0.26	0.19	0.10	30
70	0.25	0.29	0.32	0.34	0.35	0.36	0.35	0.33	0.31	0.30	0.26	0.21	0.16	0.10	20
80	0.10	0.13	0.15	0.17	0.19	0.20	0.20	0.20	0.19	0.19	0.17	0.15	0.13	0.10	10
90	-0.05	-0.03	-0.02	0.00	0.02	0.03	0.05	0.06	0.07	0.08	0.09	0.09	0.10	0.10	0

Table 7.5 for  $\mu = 0.0$ 

$\beta$ for $f_y$	$\alpha$														$\beta$ for $f_x$
	-30	-20	-10	0	10	20	30	40	45	50	60	70	80	90	
0	0.87	0.94	0.98	1.00	0.98	0.94	0.87	0.77	0.71	0.64	0.50	0.34	0.17	0.00	90
10	0.85	0.93	0.97	0.98	0.97	0.93	0.85	0.75	0.70	0.63	0.49	0.34	0.17	0.00	80
20	0.81	0.88	0.93	0.94	0.93	0.88	0.81	0.72	0.66	0.60	0.47	0.32	0.16	0.00	70
30	0.75	0.81	0.85	0.87	0.85	0.81	0.75	0.66	0.61	0.56	0.43	0.30	0.15	0.00	60
40	0.66	0.72	0.75	0.77	0.75	0.72	0.66	0.59	0.54	0.49	0.38	0.26	0.13	0.00	50
50	0.56	0.60	0.63	0.64	0.63	0.60	0.56	0.49	0.45	0.41	0.32	0.22	0.11	0.00	40
60	0.43	0.47	0.49	0.50	0.49	0.47	0.43	0.38	0.35	0.32	0.25	0.17	0.09	0.00	30
70	0.30	0.32	0.34	0.34	0.34	0.32	0.30	0.26	0.24	0.22	0.17	0.12	0.06	0.00	20
80	0.15	0.16	0.17	0.17	0.17	0.16	0.15	0.13	0.12	0.11	0.09	0.06	0.03	0.00	10
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Remark:  $f_x = \cos \alpha \cdot \sin \beta + \mu \cdot \sin \alpha$   $f_y = \cos \alpha \cdot \cos \beta + \mu \cdot \sin \alpha$

#### 4.1.5.7 Calculated example 1

(Reference is made to paragraph 4.1.5.5 - Balance of forces – Advanced method)

Ship:  $L = 120 \text{ m}$  ;  $B = 20 \text{ m}$  ;  $GM = 1,4 \text{ m}$  ; Speed = 15 knots

Cargo:  $m = 62 \text{ t}$ ; dimensions =  $6 \times 4 \times 4 \text{ m}$   
Stowage at  $0,7L$  on deck, low

Lever arm of tipping:  $a = 1.8 \text{ m}$

Lever arm of stableness:  $b = 2.0 \text{ m}$

Lever arm of securing force:  $c_1 = 1.0 \text{ m}$

$c_2 = 2.8 \text{ m}$

Force by wind pressure:

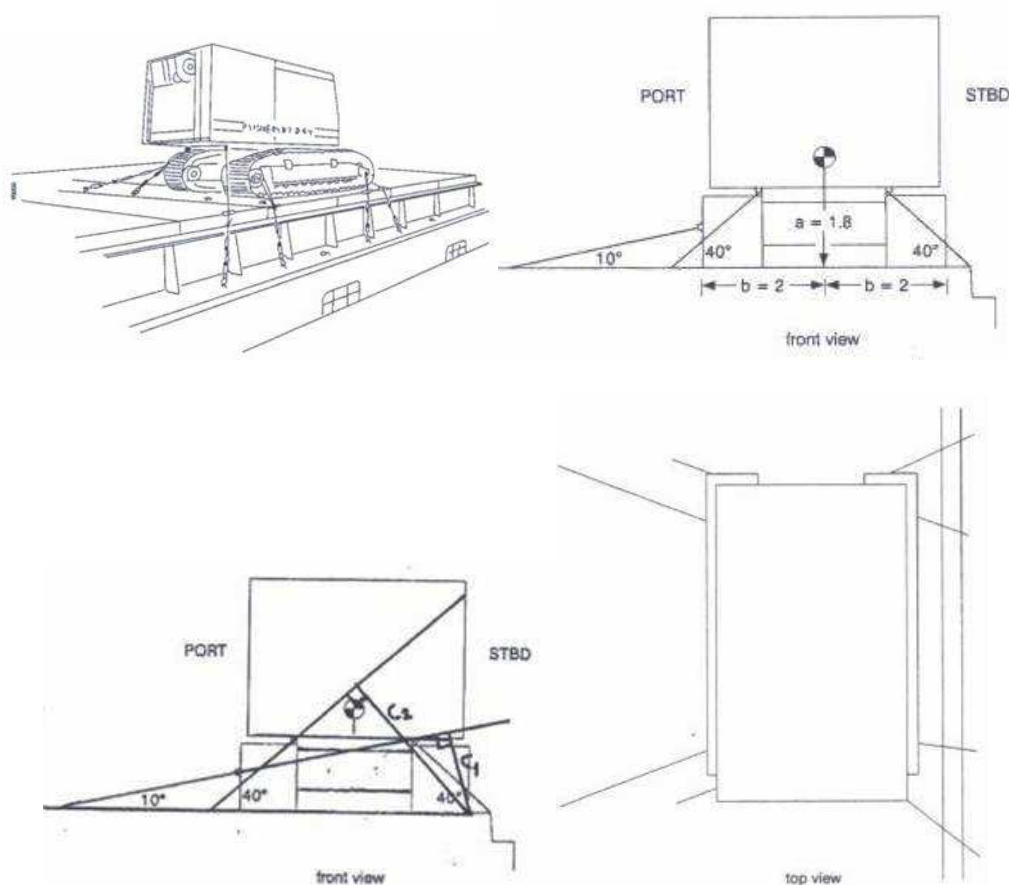
Longitudinal direction =  $F_W = 4 \text{ m} \times 4 \text{ m} \times 1 \text{ kN/m}^2 = 16 \text{ kN}$

Transverse direction =  $F_W = 6 \times 4 = 24 \text{ kN}$

Force by sea pressure:

Longitudinal direction =  $F_S = 4 \times 2 = 8 \text{ kN}$

Transverse direction =  $F_S = 6 \times 2 = 12 \text{ kN}$



### Securing material:

Wire rope:	breaking strength = 125 kN MSL = 100 kN
Shackles, turnbuckles, deck rings:	breaking strength = 180 kN MSL = 90 kN
Stowage on dunnage boards:	$\mu=0.3$ (Steel – timber)
Calculated strength (using lowest MSL):	CS = $90/1.5 = 60$ kN

### Securing Arrangement:

SIDE	n	CS	$\alpha$	f*	c
STBD	4	60 kN	40°	0.96	2.8
PORT	2	60 kN	40°	0.96	2.8
PORT	2	60 kN	10°	1.04	1.0

\*) Where f is taken from Table 6

### External forces:

$$F_x = \text{mass} \times \text{long. acc.} \times \text{correction factor from table 3} + \text{long. force by wind} + \text{long. force by sea}$$

$$= 62 \times 2.9 \times 0.89 + 16 + 8 = 184 \text{ kN}$$

$$F_y = \text{mass} \times \text{trans. acc.} \times \text{correction factor from table 3} + \text{trans. force by wind} + \text{trans. force by sea}$$

$$= 62 \times 6.3 \times 0.89 + 24 + 12 = 384 \text{ kN}$$

$$F_z = \text{mass} \times \text{vertical acc.} \times \text{correction factor from table 3}$$

$$= 62 \times 6.2 \times 0.89 = 342 \text{ kN}$$

### Balance of forces (STBD arrangement):

$$F_y < \mu \times m \times g + n \times \text{CS} \times f = \text{Friction force} + \text{Lashing force}$$

$$384 < 0.3 \times 62 \times 9.81 + 4 \times 60 \times 0.96$$

$$384 < 412 \quad \text{This is OK!}$$

### Balance of forces (PORT arrangement):

$$F_y < \mu \times m \times g + n \times \text{CS} \times f + n \times \text{CS} \times f = \text{Friction force} + \text{Lashing force}$$

$$384 < 0.3 \times 62 \times 9.81 + 2 \times 60 \times 0.96 + 2 \times 60 \times 1.04$$

$$384 < 422 \quad \text{This is OK!}$$

### Transverse tipping (STBD arrangement):

$$F_y \times a < b \times m \times g + n \times \text{CS} \times c = \text{Tipping moment} + \text{Lashing force}$$

$$384 \times 1.8 < 2 \times 62 \times 9.81 + 4 \times 60 \times 2.8$$

$$691 < 1216 + 672$$

$$691 < 1888 \quad \text{No tipping, even without lashings!}$$



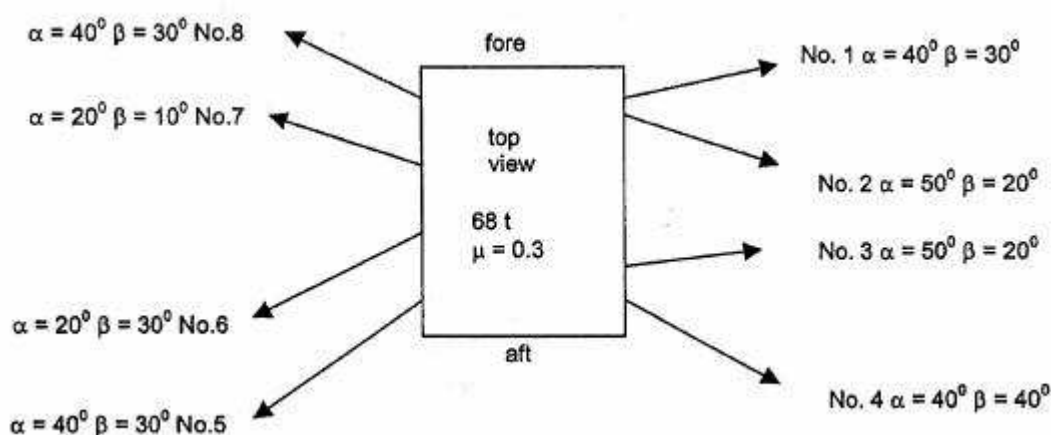
#### 4.1.5.8 Calculated example 2

(Reference is made to paragraph 4.1.5.6, Balance of forces – Alternative Method)

A cargo unit of 68 t mass is stowed on timber ( $\mu = 0.3$ ) in the tween deck at 0.7 L of a vessel.  $L = 160$  m,  $B = 24$  m,  $v = 18$  kn and  $GM = 1.5$  m. Dimensions of the cargo unit are height = 2.4 m and width = 1.8 m.

The external forces are:  $F_x = 112$  kN  
 $F_y = 312$  kN  
 $F_z = 346$  kN

The top view shows the overall securing arrangement with eight lashings.



#### Calculation of balance of forces:

No.	MSL (kN)	CS (kN)	$\alpha$	$\beta$	$f_y$	$C_s \times f_y$	$f_x$	$C_s \times f_x$
1	108	80	40° stbd	30° fwd	0.86	68.8 stbd	0.58	46.4 fwd
2	90	67	50° stbd	20° aft	0.83	55.6 stbd	0.45	30.2 aft
3	90	67	50° stbd	20° fwd	0.83	55.6 stbd	0.45	30.2 fwd
4	108	80	40° stbd	40° aft	0.78	62.4 stbd	0.69	55.2 aft
5	108	80	40° port	30° aft	0.86	68.8 port	0.58	46.4 aft
6	90	67	20° port	30° aft	0.92	61.6 port	0.57	38.2 aft
7	90	67	20° port	10° fwd	1.03	69.0 port	0.27	18.1 fwd
8	108	80	40° port	30° fwd	0.86	68.8 port	0.58	46.4 fwd

#### Transverse balance of forces (STBD arrangement) Nos. 1, 2, 3 and 4:

$F_y < \mu \times m \times g + CS_1 \times f_{y1} + CS_2 \times f_{y2} + CS_3 \times f_{y3} + CS_4 \times f_{y4} = \text{Friction force} + \text{Lashing force}$   
 $312 < 0.3 \times 68 \times 9.81 + 68.8 + 55.6 + 55.6 + 62.4$   
 $312 < 443$  this is OK!

### Transverse balance of forces (PORT arrangement) Nos. 5, 6, 7 and 8:

$$F_y < \mu \times m \times g + CS_5 \times f_{y5} + CS_6 \times f_{y6} + CS_7 \times f_{y7} + CS_8 \times f_{y8} = \text{Friction force} + \text{Lashing force}$$

$$312 < 0.3 \times 68 \times 9.81 + 68.8 + 61.6 + 69.0 + 68.8$$

$$312 < 468 \quad \text{this is OK!}$$

### Longitudinal balance of forces (FWD arrangement) Nos. 1, 3, 7, 8:

$$F_x < \mu \times (m \times g - F_z) + CS_1 \times f_{x1} + CS_2 \times f_{x2} + CS_3 \times f_{x3} + CS_4 \times f_{x4} = \text{Friction force} + \text{Lashing force}$$

$$112 < 0.3 (68 \times 9.81 - 346) + 46.4 + 30.2 + 18.1 + 46.4$$

$$112 < 237 \quad \text{this is OK!}$$

### Longitudinal balance of forces (AFT arrangement) Nos. 2, 4, 5, 6:

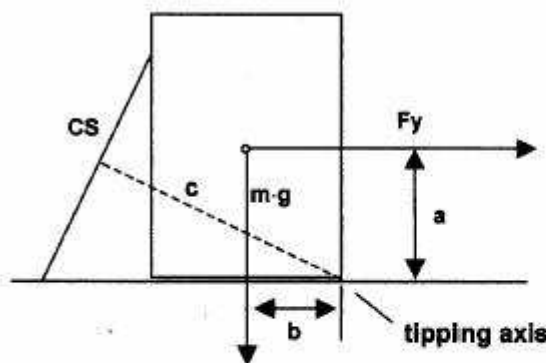
$$F_x < \mu \times (m \times g - F_z) + CS_5 \times f_{x5} + CS_6 \times f_{x6} + CS_7 \times f_{x7} + CS_8 \times f_{x8} = \text{Friction force} + \text{Lashing force}$$

$$112 < 0.3 (68 \times 9.81 - 346) + 30.2 + 55.2 + 46.4 + 38.2$$

$$112 < 266 \quad \text{this is OK!}$$

### Transverse Tipping

Unless specific information is provided, the vertical centre of gravity of the cargo unit can be assumed to be at one half the height and the transverse centre of gravity at one half the width. Also, if the lashing is connected as shown in the sketch, instead of measuring c, the length of the lever from the tipping axis to the lashing CS, it is conservative to assume that it is equal to the width of the cargo unit.



$$F_y \cdot a \leq b \cdot m \cdot g + 0.9 \cdot (CS_1 \cdot c_1 + CS_2 \cdot c_2 + CS_3 \cdot c_3 + CS_4 \cdot c_4)$$

$$312 \cdot 2.4/2 < 1.8/2 \cdot 68 \cdot 9.81 + 0.9 \cdot 1.8 \cdot (80 + 67 + 67 + 80)$$

$$374 < 600 + 476$$

$$374 < 1076 \quad \text{this is OK!}$$

### FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:

*Explanations and interpretation of "Procedure for calculation of forces in semi- and non-standardised lashing arrangements"*

- The exclusion of very heavy units as carried under the provisions of chapter 1.8 of the Code from the scope of application of the methods should be understood to accommodate the possibility of adapting the stowage and securing of such units to specifically determined*

*weather conditions and sea conditions during transport. The exclusion should not be understood as being a restriction of the methods to units up to a certain mass or dimension.*

2. *The acceleration figures given in table 2, in combination with the correction factors, represent peak values on a 25-day voyage. This does not imply that peak values in x, y and z directions occur simultaneously with the same probability. It can be generally assumed that peak values in the transverse direction will appear in combination with less than 60% of the peak values in longitudinal and vertical directions.*

*Peak values in longitudinal and vertical directions may be associated more closely because they both arise from pitching and heaving.*

3. *The advanced calculation method uses the “worst case approach”. That is expressed clearly by the transverse acceleration figures, which increase to forward and aft in the ship and thereby show the influence of transverse components of simultaneous vertical accelerations. Consequently there is no need to consider vertical accelerations separately in the balances of transverse forces and moments. These simultaneously acting vertical accelerations create an apparent increase of weight of the unit and thus increase the effect of the friction in the balance of forces and the moment of stableness in the balance of moments. For this reason there is no reduction of the force  $mg$  normal to the deck due to the presence of an angle of heel.*

*The situation is different for the longitudinal sliding balance. The worst case would be a peak value of the longitudinal force  $F_x$  accompanied by an extreme reduction of weight through the vertical force  $F_z$ .*

4. *The friction coefficients shown in the methods are somewhat reduced against appropriate figures in other publications. The reason for this should be seen in various influences which may appear in practical shipping, as: moisture, grease, oil, dust and other residues, and vibration of the ship.*

*There are certain stowage materials available which are said to increase friction considerably. Extended experience with these materials may bring additional coefficients into practical use.*

5. *The principal way of calculating forces within the securing elements of a complex securing arrangement should necessarily include the consideration of:*

- load-elongation behaviour (elasticity),*
- geometrical arrangement (angles, length),*
- pre-tension of each individual securing element.*

*This approach would require a large volume of information and a complex, iterative calculation. The results would still be doubtful due to uncertain parameters.*

*Therefore a simplified approach has been chosen with the assumption that the elements take an even load of CS (calculated strength) which is reduced against the MSL (maximum securing load) by the safety factor 1.5.*

6. *When employing the advanced calculation method, the way of collecting data should be followed as shown in the calculated example. It is acceptable to estimate securing angles, to*

*take average angles for a set of lashings and similarly to arrive at reasonable figures of the levers a, b and c for the balance of moments.*

*It should be borne in mind that meeting or missing the balance calculation just by a tiny change of one or the other parameters indicates to be near the goal anyway. There is no clear-cut borderline between safety and non-safety. If in doubt, the arrangement should be improved*

## 4.2 Application of portable securing devices

### **FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*Subchapter 4.1.2 provides handling and safety instructions for the various securing gear to be used on board, while this chapter should provide information about correct application of portable securing devices as described in the guidance for the various chapters.*

*This sub-chapter should draw the master's attention to the correct application of portable securing devices, taking into account the following factors, taken from Guidelines for the Preparation of the Cargo Securing Manual (MSC.1/Circ.1353):*

- .1 duration of the voyage;
- .2 geographical area of the voyage with particular regard to the minimum safe operational temperature of the portable securing devices;
- .3 sea conditions which may be expected;
- .4 dimensions, design and characteristics of the ship;
- .5 expected static and dynamic forces during the voyage;
- .6 type and packaging of cargo units including vehicles;
- .7 intended stowage pattern of the cargo units including vehicles; and
- .8 mass and dimensions of the cargo units and vehicles.



## 5 Supplementary Requirements for different types of vessels

### 5.1 RO-RO Vessels

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*This sub-chapter is applicable to all new and existing RO-RO vessels. Guidance may be utilised from IMO Assembly resolutions A.533(13) and A.581(14), appendix 3 and 4 to the CSS Code, respectively.*

*Extracts from the IMO Assembly Resolution A.533(13) is given in Appendix III.*

#### 5.1.1 Longitudinal and transverse distances between fixed Cargo Securing Devices

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*This subchapter is expected to provide similar information as presented in chapter 3.1. Additionally, longitudinal and transverse distances between securing points should also be shown. This may be provided by an arrangement drawing.*

#### 5.1.2 Cargo securing arrangements for RO-RO ships exposed to angle of heel after damage or flooding or other considerations relevant to the effectiveness of the cargo securing arrangement.

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*This subchapter is intended to specify cargo securing arrangements for RO-RO ships exposed to angle of heel after damage or flooding or other considerations relevant to the effectiveness of the cargo securing arrangement.*

*A group of IACS (International Association of Classification Societies) members has investigated the effect on securing arrangements due to angle of heel after damage. It was concluded that provided resolution A.581(14) and annex 13 to the CSS Code are complied with, the securing arrangements of vehicles and other cargoes should prove adequate on RO-RO ships in damaged and heeled condition.*

#### 5.1.3 Number of lashings and lashings angles

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*The following is taken from Guidelines for the Preparation of the Cargo Securing Manual (MSC.1/Circ.1353):*

*This sub-chapter should describe the application of portable cargo securing devices as to number of lashings and allowable lashing angles.*

*Due to frequent on- and off loading should RO-RO vessels be equipped with a converted calculation method presented as diagram or handling procedures for various cargoes. The following is typical text applicable for RO-RO ships. Note that diagrams as those presented below are subject to a set of assumptions that should be clearly stated in the manual as boundaries within which the curves should be operated.*

The diagrams are based on the calculation method described in Annex 13, and presented as a function of the period of roll ( $T_R$ ). The relation between  $T_R$  and GM is according to DNV rules Pt.3 Ch.1 Sec.4B402:

$$T_R = \frac{2k_r}{\sqrt{GM}} (s)$$

$k_r$  = roll radius of gyration in m

GM = metacentric height in m

The values of  $k_r$  and GM to be used are to give the minimum realistic value of  $T_R$  for the load considered. In case  $k_r$  has not been calculated for such condition, the following approximation design values may be used:

$k_r$  = 0,39 B for ships with even transverse distribution of mass

= 0,35 B for tankers in ballast

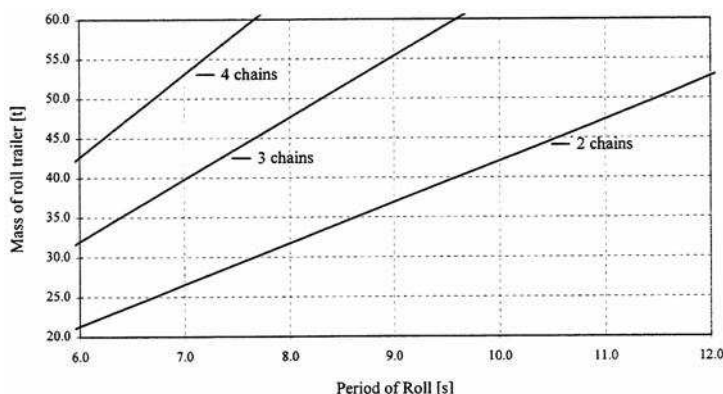
= 0,25 B for ships loaded with ore between longitudinal bulkheads

## DOUBLE STACKED ROLL TRAILERS

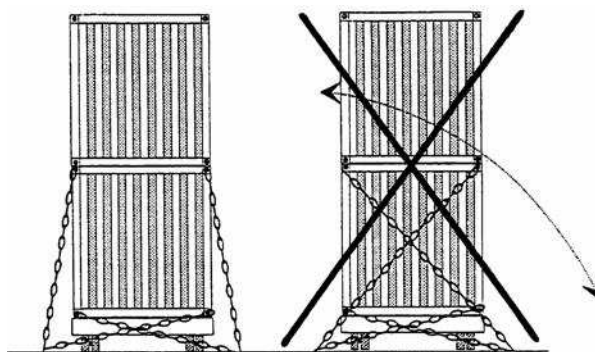
The diagram below gives the minimum number of crossed or side lashing chains on each side of a roll trailer.

Note!

A coefficient of friction of 0.3 has been applied in the derivation of the curves. If the deck is very slippery due to grease, oil spill, water or ice, the friction may be reduced to 0 and extra lashings shall be considered.



In order to prevent tipping, double stacked roll trailers shall always be secured by two additional lashings on each side, passing from the bottom corners of the upper container to the deck securing points on the same side of the unit. If the center of gravity is assumed to be situated in the upper half of the unit, an extra set of lashings on each side may be necessary. The top container shall also be secured to the lower container by twistlocks at all 4 corners. The principal lashing arrangement is shown below:

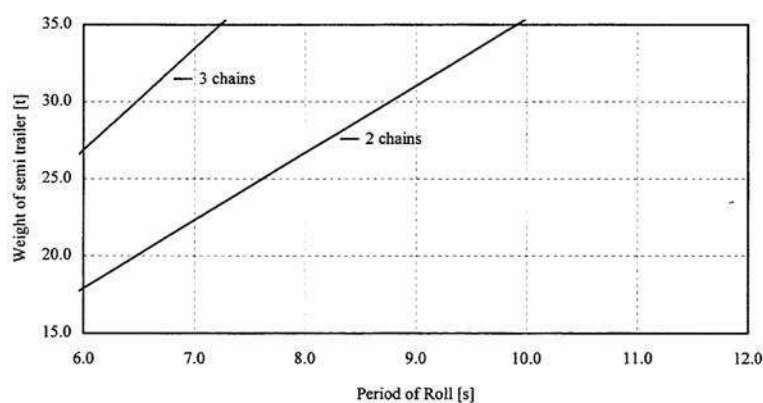


## SEMI TRAILERS

The diagram below gives the minimum number of lashing chains on each side of a semi-trailer.

### Note!

A coefficient of friction of 0.3 has been applied in the derivation of the curves. If the deck is very slippery due to grease, oil spill, water or ice, the friction may be reduced to 0 and extra lashings shall be considered.



The required number of lashings derived from the diagram is assumed to act with an angle of 45° both in the transverse, longitudinal and vertical direction. If the lashing arrangement deviates significantly from this assumption, extra lashings should be considered.

## 5.2 Bulk Carriers

### ***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*Bulk carriers will often carry cargoes that fall within the scope of chapter VI/5 and chapter VII/5 of the SOLAS Convention and are therefore normally required to carry an approved CSM on board. Annexes 1-12 of the CSS cover many of such cargoes, and they may be used for this ship type.*

*Annex 1-12 is given in Appendix V.*

### 5.2.1 Timber Deck Cargoes

#### ***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*If vessels are to carry Timber Deck Cargoes, reference should be made to the IMO “Code of Safe Practice for Ships carrying Timber Deck Cargoes”, 1991.*

*Extracts from:*

- *the IMO “Code of Safe Practice for Ships carrying Timber Deck Cargoes”, 1991*
- *the International Conference on Loadlines, 1966*
- *DNVs interpretation of regulation 44 in order to harmonise this Regulation with the Code of Safe Practice for Ships Carrying Timber Deck Cargoes (Resolution A.287(VIII))*

*is given in Appendix IV.*

## 5.3 Container Carriers

### 5.3.1 Handling and Safety Instructions

1. Instructions on the proper handling of the securing devices on containers (and other standardized cargo):
  - All loose securing elements have to be applied according to this Cargo Securing Manual.
  - It is recommended to have only one type of twistlock on board. If more than one type of twistlocks, the different types should be clearly identified.
  - All twistlocks in use have to be locked.
  - Twistlocks must be inserted so that opening devices are accessible for opening.
  - Adjustable pressure- or tension / compression elements have to be set with a minimum clearance to the longitudinal bulkhead in order to reduce the movement within the container block.
  - Damaged containers are not allowed to be loaded.
  - Cargo carried within the standardized cargo units should be packed and secured within these units. The same principles to stowage and securing of cargo inside the containers should be applied as the same cargo being stowed conventionally onboard.
  - The skirts of the bottom rails of the container should not be allowed to come in contact with the underlying dunnage. These structures are not strength members, and will buckle and give way if placed on dunnage.
2. Safety instructions related to handling of securing devices and to securing and unsecuring of containers (or other standardized cargo by ship or shore personnel):
  - People working in the cargo area are always to wear a protective helmet and protective shoes.
  - Any securing or unsecuring of containers must be carried out during the ship's stay at berth or safe anchorage.
  - Dropping of container fittings from above is forbidden.
  - Work on top of container stacks is generally to be avoided. If work on top of containers is not avoidable, an approved fall protection system must be used. Access to the top of a container stack for inserting, locking, unlocking or collecting securing devices is only allowable by means of an approved lashing cage.
  - A fall hazard shall exist whenever employees are working within 0.9 meters of the unprotected edge of a work surface and 0.3 meters or more, horizontally, from the adjacent surface. Weather conditions may impair vision or sound footing of workers on top of containers.

- Fall protection systems must be inspected and maintained prior to each day's use.
- Each fall protection system shall be rigged to minimize the free-fall distance.

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*Detailed handling and safety instructions, for instance from the manufacturers guidance literature, should be provided for all securing devices used onboard.*

*The ship may only carry dangerous goods according to the Certificate of Compliance for Dangerous Goods. If the ship is certified for dangerous goods, these goods shall be segregated, stowed, handled and secured according to the IMDG Code. Reference is also made to the DNV Rules Pt.5 Ch.11 and to MSC/Circ. 675 "Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas".*

*For the securing of hazardous or dangerous cargoes, only certified fittings are to be used.*

### 5.3.2 Stowage and Securing Instructions

#### 5.3.2.1 Stowage and securing principle on deck and under deck

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*For calculations of the forces acting on the containers, and required lashing, DNV Classification Notes 32.2 can be used.*

*This sub-chapter should support the interpretation of the stowage and securing plan, ref Chapter 5.3.2.2, highlighting:*

1. *the use of the specified devices;*
  - *In designing and calculating the individual securing systems for each stack not only the strength of securing devices but also the strength capacities of the containers have been taken into account.*
  - *Diagonal lashings are generally required to support the container frame where transverse racking forces would exceed the permissible limit without such lashings. Such diagonal lashings are generally necessary for stacks exposed to wind. Alternatively, the masses in the stacks that are wind exposed can be reduced.*
  - *When different stack heights result in "step stacks" these should be considered as outer stacks ( wind exposed ).*
2. *any guiding or limiting parameters.*

*The securing arrangements are designed so that the forces on the containers do not exceed the following limits, ref DNV Classification Notes 32.2:*

<b>Standard ISO</b>	<b>20'</b>	<b>40'</b>
- Racking force door end	150 kN	150 kN
- Racking force doorless end	150 kN	150 kN
- Racking force side walls	75 (150*) kN	75 (150*) kN
- Corner post compression	864 kN	864 kN

- Vertical tension in top corner (from locking device)	250 kN	250 kN
- Vertical tension in bottom corner (from locking device)	250 kN	250 kN
- Lashing loads in corner casting (in plane of cont. wall)		
Horizontal	150 kN	150 kN
Vertical	300 kN	300 kN
- Horizontal shoring forces on corners (perp. to cont. wall)		
Lower corner, tension	200 kN	250 kN
Lower corner, compression	300 kN	350 kN
Upper corner, tension	200 kN	250 kN
Upper corner, compression	200 kN	250 kN

*\* For closed box containers*

*Lifting forces may become critical in stacks of more than 2 containers high. Such forces will normally be absorbed by twistlocks. Maximum lifting forces are generally found between deck or hatch top and the bottom container. In some cases additional vertical lashings have to be used to support the twistlocks of the bottom container.*

*The mass distribution of the containers as stated in this manual is the optimum distribution under the given circumstances. Any changes in this distribution will have an effect on the magnitude and distribution of forces in containers and securing devices. When other distributions than given in this manual are chosen the following principles should be followed:*

- *maximum stack masses or maximum stack heights must not be exceeded*
- *shifting mass from top and downwards is acceptable*
- *shifting mass from bottom and upwards is not allowed*
- *when mass is reduced in the bottom of the stack, the masses in the containers above are to be reduced accordingly.*

*Standard wind forces on ISO containers:*

*ISO wind force per tier of exposed containers:*

- *20' Containers – 18,5 kN*
- *40' Containers – 37,0 kN*

*In case of outer stacks on weather deck not being filled with containers, allowances should be made for the increased force on the inner stack being exposed to wind.*

Possible consequences from misuse of securing devices or misinterpretation of instructions given might result in the following:

- Exceeding the maximum stack mass may result in:
  - overstressing hatch cover construction
  - overstressing stowage and securing devices
  - damaging containers or loss of containers overboard

- When twistlocks are not locked properly this may result in:
  - overstressing stowage and securing devices
  - damaging containers or loss of containers overboard
- When lashings are not applied in the relevant places this may result in:
  - overstressing of twistlocks
  - damaging containers or loss of containers overboard
- When the weight distribution in the stack is not like prescribed in this manual this may result in:
  - overstressing stowage and securing devices
  - damaging containers or loss of containers overboard
- If the maximum GM - value in the stowage plan is exceeded this may result in:
  - higher transverse accelerations
  - overstressing stowage and securing devices
  - overstressing the ship structure
  - damaging containers

#### 5.3.2.2 Stowage and Securing Plan

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*This sub-chapter should consist of a comprehensive and understandable plan or set of plans providing the necessary overview on:*

1. *under deck and on deck stowage and locations of containers;*
2. *alternative stowage patterns for containers of different dimensions;*
3. *maximum stack masses, sequence of masses in stacks, stacks affected by wind load, height of stacks;*
4. *maximum stack heights with respect to approved sight lines;*
5. *lashing/securing arrangements.*

*For vessels with class notation **Container Carrier** or **Container**, in addition to other notations, the securing arrangement is to be approved by the Society. The Stowage and Securing Plan can be a separate booklet, Container Stowage/Securing Manual, or it can be a part of the Cargo Securing Manual.*

#### 5.3.3 Other allowable stowage patterns

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*This sub-chapter should provide the necessary information for the master to deal with cargo stowage situations deviating from the general instructions addressed to under sub-chapter 5.3.2.*



### EXAMPLE:

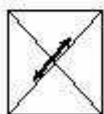
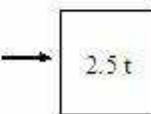

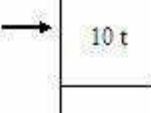
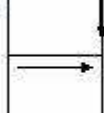
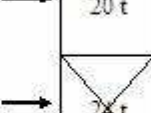
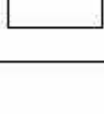
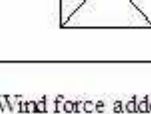
1. alternative vertical sequence of masses in stacks;
2. stacks affected by wind load in the absence of outer stacks;

The effect of wind on a stack is indicated in the table below\*.

3. alternative stowage of containers with various dimensions;
4. permissible reduction of securing effort with regard to lower stacks masses, lesser stack heights or other reasons.
5. the influence of missing lashing rods

The effect of missing lashing rods, when the stack mass is not changed, is indicated in the table below\*.

To give an indication of the effect of shifting mass upwards, an example where the 20 t container in the 2nd tier is shifted to the top tier is shown in the table below\*.

Loadcase	1	2	Incr. in %	3	Incr. in %	4	Incr. in %
Lashing force	108,9	108,9	0,0	142,6	30,9		
Lift force	339,0	433,6	27,9	422,5	24,6	343,3	1,3
Compression in post	247,7	342,3	38,2	325,9	31,6	252,0	1,7
Racking force	53,7	53,7	0,0	70,3	30,9	104,8	95,2
Lashing force		2.5 t	20 t		2.5 t	2.5 t	
Lift force		10 t	10 t		10 t	10 t	
Compression in post		20 t	2.5 t		20 t	20 t	
Racking force		2 t	2 t		2 t	24 t	
Loadcase	1. Basis	2. Shift of masses		3. Wind force added		4. Lashings missing	

\* The forces are calculated for a specific ship with 20' containers and a GM - value equal to 2.17 m. For other ships and for other stacks the results will not be exactly the same, but show the same tendencies.

***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*Applicability and enter into force date of this sub-chapter is given in the Note on annex 14 of the CSS Code.*

**5.3.4 Cargo safe access plan (CSAP)**

5.3.4.1 Ships which are specifically designed and fitted for the purpose of carrying containers should be provided with a cargo Safe Access Plan (CSAP) in order to demonstrate that personnel will have safe access for container securing operations. This plan should detail arrangements necessary for the conducting of cargo stowage and securing in a safe manner.

It should include the following for all areas to be worked by personnel:

- .1 hand rails;
- .2 platforms;
- .3 walkways;
- .4 ladders;
- .5 access covers;
- .6 location in equipment storage facilities;
- .7 lighting fixtures;
- .8 container alignment on hatch covers/pedestals;
- .9 fitting for specialized containers, such as reefer plugs/receptacles;
- .10 first aid stations and emergency access/egress;
- .11 gangways; and
- .12 any other arrangements necessary for the provision of safe access.

5.3.4.2 Guidelines for specific requirements are contained in annex 14 to the CSS Code.

## APPENDIX I – VI

## Appendix I – Assessment of MSL for uncertified cargo securing devices

### **FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*The determination of maximum securing load (MSL) is normally based on a certification process including a break load test and approval of drawings. If, for any reason, certificates are not available, the MSL for most cargo securing equipment may probably be obtained directly from the suppliers or the manufacturers of such equipment. A simplified calculation method for assessment of the MSL is provided below for use in cases where this is not possible.*

*The simplified calculation method is general and conservative. It accounts, however, for possible strength reducing effects as indents, notches or other minor damages to the equipment. It should be noted that such damages may reduce the strength significantly.*

### 1. Assessment of MSL for existing uncertified fixed cargo securing devices

#### Lashing Plates:

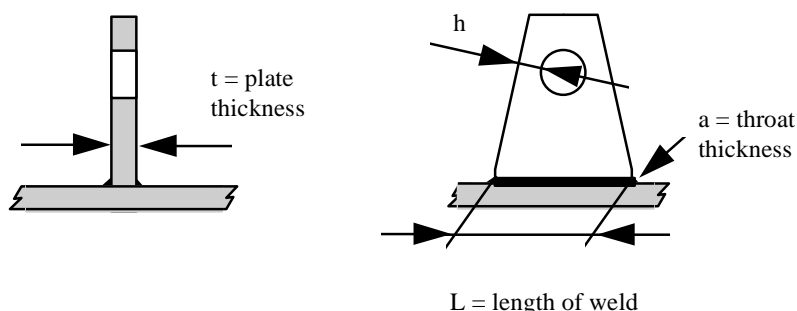


Figure 2.1

If the Maximum Securing Load, MSL, is unknown, the following simplified expression may be used to determine the MSL in kilo Newton, kN, for existing lashing plates:  $MSL = 0.12 \cdot h \cdot t$ , where  $h$  and  $t$  are in millimetres.

If the lashing plate is of single-use type, new and with smooth edges without any kind of fractures, indents or other damages, the following expression may be used:  $MSL = 0.18 \cdot h \cdot t$ .

The expressions are valid under the assumption that the material yield strength,  $\sigma_y \geq 235 \text{ N/mm}^2$ , and that the supporting structure (deck, tanktop, frame, etc.) is of sufficient strength.

Where it is documented that the material is of high strength steel, the right side of the expression may be multiplied by the material factor,  $f_1 = (\sigma_y/235)^{0.75}$ , where  $\sigma_y$  is the actual yield strength.

For determination of necessary throat thickness [mm] for the welded connection to supporting structure, the following expression may be used:  $a = MSL / 0.12 \cdot (L+t)$ .

MSL must be in kN and  $L$  and  $t$  in millimetres. See figure 2.1 for explanation of variables. The throat thickness must not, under no circumstances be less than 3.5 mm.

In order to achieve the necessary hull structural support, the following main principles for attachment of lashing plates should be considered:

1. Lashing plates, or any other securing point are never to be welded on unstiffened platefields.
2. Lashing plates are preferably to be attached in line with girder webs or bulkheads as shown on figure 2.2, alternatively supported by brackets as shown on figure 2.3.

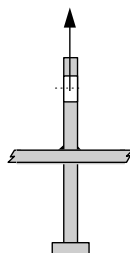
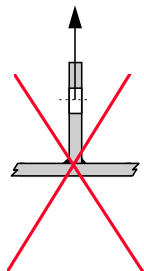


Figure 2.2

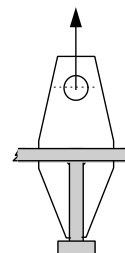


Figure 2.3

3. Lashing plates are to be fitted parallel to direction of attack for lashing force. See figure 2.4.

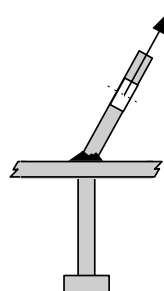
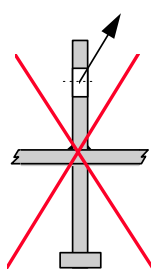


Figure 2.4

4. Welding of lashing plates to doublers should be avoided. In cases where a doubler for some reason is deemed necessary, this should be of substantial thickness to avoid local deflections of the doubler.
5. Attachment of lashing plates directly to side longitudinals at sheer strake or strength deck longitudinals in midship area should in general be avoided. However, if this, for some reason, is deemed necessary, intercoastals between longitudinals are to be fitted for distribution of forces. Thickness of intercoastals to be at least as for longitudinals. See figure 2.5.

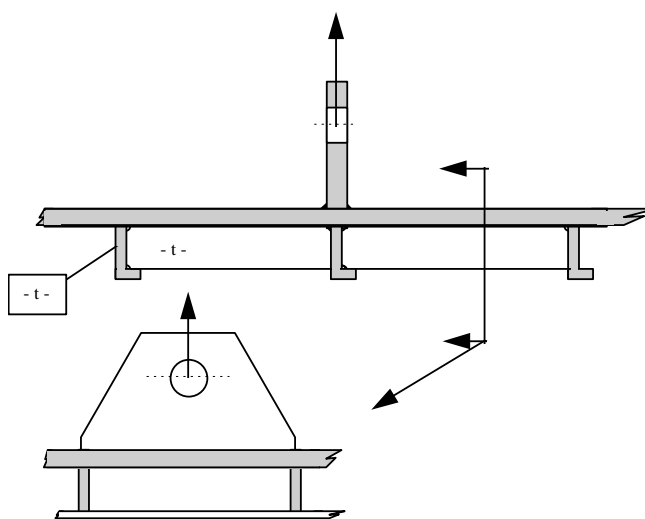


Figure 2.5

### D-rings:

For uncertified, existing D-rings the MSL [kN] may be calculated by the following simplified expression:  $MSL = 0.094 \cdot D^2$ , where D is the minimum measured ring diameter in millimetres.

If the D-ring is new, without any kind of fractures, indents or other damages, the following expression may be used:  $MSL = 0.141 \cdot D^2$ .

The expressions are valid under the assumptions that the material yield strength,  $\sigma_y \geq 235 \text{ N/mm}^2$ , and the supporting structure (deck, tanktop, frame, etc.) is of sufficient strength. Furthermore, welded seams and saddle plate must have at least the same cross-section as the ring and not be impaired by corrosion.

Where it is documented that the material is of high strength steel, the right side of the expression may be multiplied by the material factor,  $f_1 = (\sigma_y/235)^{0.75}$ .

For determination of necessary throat thickness [mm] for the welded connection to supporting structure, the following expression may be used:  $a = MSL / 0.12 \cdot L$ , where L is saddle length.

MSL must be in kN and L in millimetres. The throat thickness must not, under no circumstances be less than 3.5 mm. For sufficient hull structural support of D-rings, the principles for attachment outlined for lashing plates above are to be followed as far as practicable.

## **2. Assessment of MSL for existing uncertified portable cargo securing devices**

### Lashing Bars:

For uncertified, existing lashing bars the MSL [kN] may be calculated by the following simplified expression:  $MSL = 0.084 \cdot D^2$ , where D is the lashing bar diameter in millimetres.

If the lashing bar is new, without any kind of fractures, indents or other damages, the following expression may be used:  $MSL = 0.126 \cdot D^2$ .

The expressions are valid under the assumptions that the material yield strength,  $\sigma_y \geq 235 \text{ N/mm}^2$ .

Where it is documented that the material is of high strength steel, the right side of the expression may be multiplied by the material factor,  $f_1 = (\sigma_y/235)^{0.75}$ , where  $\sigma_y$  is the actual yield strength.

#### Turnbuckles:

- always use a turnbuckle with the tension force acting in one straight line.
- never allow a turnbuckle to become the fulcrum of angled forces no matter how slight.
- make sure the screws are at adequate extension when the securing of the cargo is finalised, thereby providing scope for further tightening if this should prove necessary during the voyage as the cargo and lashing arrangements settle down.
- below deck, and where high torque upon a main lashing is involved, the eyes of the turnbuckle should be seized/stopped against its own body to prevent the screws working back under load during the course of the voyage. It may not prove possible to check and/or re-tension below-deck lashings once cargo loading has completed and hatches are secured.

The maximum securing loads for bottle-screws and turnbuckles listed below should only be used for guidance. There are types of special-purpose turnbuckles with special fittings and modifications with deviating strength than those given below. Again, the manufacturers' literature should be consulted if such equipment is to be brought into use.

Bottle Screws		Wire Turnbuckles		
Screw diameter mm	MSL kN	Eye Diameter mm	Bow Diameter mm	MSL kN
16	7.5	16	16	147
19	11.3	19	18	186
22	16.3	22	25	275
25	21.2			
29	27.5			
32	37.5			
38	51.1			

#### Lashing Chains:

The table below gives some data relevant to the strengths and sizes likely to be met with for deck cargo lashing purposes if lashing chain is to be used.

Diameter [mm]	Link Type	MSL [kN]
9	Long	29
11	Long	49
13	Long	69
10	Short	42
13	Short	69
16	Short	105

The table should only be used for guidance purposes. As for most securing equipment the maximum securing load will depend very much on material quality used in the lashing chain. Manufacturers should be consulted for more detailed information on the equipment.

For existing, uncertified lashing chains the following simplified expression may be used for determination of the MSL [kN]:  $MSL = 0.275 \cdot D^2$ , where D is the minimum diameter in millimetres of the bar forming the link.

### Lashing Wires:

When assembling and applying conventional wire lashings the following principles should be observed:

- Ends of cut off lengths of wire rope must be secured by suitable adhesive tape.
- The size of wire clips must match the diameter of the wire rope.
- The number of wire clips should be at least four per wire loop.
- The U-bolt of the wire clips should preferably be applied to the dead end of the wire rope.
- Wire clips should be spaced at intervals not exceeding six times the wire diameter. Threads of wire clips must be greased and nuts tightened until the dead end of the wire rope is visibly dented. Without greasing a sufficient tightening will be impossible.
- Turn sticks may be used for wires of 12 mm diameter or less. They should be secured against reverse turning after tightening the lashing. After the first tightening of the lashing the nuts of wire clips should be re-tightened. Wire lashings must be applied in a way that chafing at sharp corners is avoided.
- Doubling of the wire rope is not providing a doubling of MSL, due to a loss of strength at the bend on the top side. However, MSL will be doubled if the top bend has a radius of at least three times the wire diameter.

### Web Lashings:

Web lashings made of synthetic fibres are extensively used onboard ships for securing of cargo. Such web lashings certainly elongate considerably more than steel chains. However, chain lashings often become slack after some time, due to the motions of the ship and cargo, and slack chains with low elasticity will give jerking forces on securing points, cargo and lashings. The more elastic web lashings, with proper pre-tensioning, will largely avoid this problem. Modern web lashings have improved resistance to ripping and chafing compared to those available only few years ago.

Web lashings should be used and handled with great care, and it should be borne in mind that the maximum securing load decreases considerably if the synthetic fibre strap is ripped.

### **3. Summary of simplified MSL-expressions.**

The table below gives a summary of the simplified expressions presented in this chapter. They may be used for an approximate calculation of MSL for existing, uncertified cargo securing equipment. However, if possible, manufacturers of such equipment should always be consulted to obtain the most accurate values.

MSL	Throat	MSL [kN]		Material factor, $f_1$	
		"Existing" <sup>2)</sup>	"New" <sup>3)</sup>	$\sigma_y = 235$	$\sigma_y > 235$
Assessment	thickness [mm] <sup>1)</sup>				
Lashing plates	$MSL / 0.12 \cdot (L+t)$	$0.12 \cdot h \cdot t \cdot f_1$	$0.18 \cdot h \cdot t \cdot f_1$		
D-rings	$MSL / 0.12 \cdot L$	$0.094 \cdot D^2 \cdot f_1$	$0.141 \cdot D^2 \cdot f_1$	1.0	$(\sigma_y/235)^{0.75}$
Lashing Bars		$0.084 \cdot D^2 \cdot f_1$	$0.126 \cdot D^2 \cdot f_1$		
Chains		$0.275 \cdot D^2$	Table ch. 2.2.3		



- 1) The table shows required throat thickness in millimetres for connections of lashing plates or D-ring saddle plates to decks, side or bulkheads. The throat thickness is under no circumstances to be less than 3.5 millimetres.
- 2) “Existing” means uncertified securing devices that have been in use some time. These may be affected by corrosion, notches, indents or other minor damages that may reduce the strength.
- 3) “New” means uncertified securing devices that, for some reason, need to be inserted on an single-use basis. It is assumed that these are free of any kind of damages or corrosion.





- *Date of inspection*
- *Signature of person conducting examination*
- *Name and identification of items examined*
- *Results of examination/inspection and maintenance/repair undertaken, if any.*

LOG FOR MAINTENANCE OF CARGO SECURING EQUIPMENT

[illegible]

[illegible]

## Appendix III – Extracts from the IMO Assembly Resolution A.533(13)

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*The following text is quoted from IMO Assembly Resolution A.533(13). The numbering is the same as in the resolution text:*

### 2 GENERAL ELEMENTS

#### 2.1 It is of the utmost importance to ensure that:

- .1 cargo units including vehicles intended for the carriage of cargo in sea transport are in sound structural condition and have an adequate number of securing points of sufficient strength so that they can be satisfactorily secured to the ship. Vehicles should, in addition, be provided with an effective braking system; and
- .2 cargo units and vehicles are provided with an adequate number of securing points to enable the cargo to be adequately secured on the cargo unit or vehicle so as to withstand the forces, in particular the transverse forces, which may arise during the sea transport.

### 3 ELEMENTS TO BE CONSIDERED BY THE SHIPOWNER AND SHIPBUILDER

#### 3.1 The ship should be provided with an adequate number of securing points of sufficient strength, a sufficient number of items of cargo securing gear of sufficient strength and a Cargo Securing Manual. In considering the number and strength of the securing points and items of cargo securing gear to be used, the following elements should be taken into account:

- .1 duration of the voyage;
- .2 geographical area of the voyage;
- .3 sea conditions which may be expected;
- .4 size, design and characteristics of the ship;
- .5 dynamic forces under adverse weather conditions;
- .6 types of cargo units and vehicles to be carried;
- .7 intended stowage pattern of the cargo units and vehicles;
- .8 weight of cargo units and vehicles; and
- .9 safe access, safe place of work, illumination and working conditions for persons engaged in work connected with cargo stowage and securing.

#### 3.2 The Cargo Securing Manual should provide information on the characteristics of cargo securing items and their correct application.

#### 3.3 Ship's mobile cargo handling equipment not fixed to the ship should be provided with adequate securing points.

#### 3.4 Ships which are specifically designed and fitted for the purpose of carrying containers should be provided with a cargo Safe Access Plan (CSAP) in order to demonstrate that personnel will have safe access for container securing operations.

### 4 ELEMENTS TO BE CONSIDERED BY THE MASTER

#### 4.1 When accepting cargo units or vehicles for shipment and having taken into account the elements listed in paragraph 3.4.3.1 above, the master should be satisfied that:

- .1 all decks intended for the stowage of cargo units including vehicles are so far as is practicable free from oil and grease;

- .2 cargo units including vehicles are in an apparent good order and condition suitable for sea transport particularly with a view to their being secured;
  - .3 the ship has on board an adequate supply of cargo securing gear which is maintained in sound working condition;
  - .4 cargo units including vehicles are adequately stowed on and secured to the cargo unit or vehicle;
  - .5 where practicable, cargoes are adequately stored on and secured to the cargo unit and vehicle; and
  - .6 where applicable, safe access to be provided in accordance with the CSAP and maintained throughout cargo operations.
- 4.2 In addition, cargo spaces should be regularly inspected to ensure that the cargo, cargo units and vehicles remain safely secured throughout the voyage.

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*The following text is quoted from IMO Assembly Resolution A.581(14). The numbering is the same as in the resolution text:*

## 6 LASHINGS

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*This text was amended by DSC/14 in September, 2009.*

- 6.1 The maximum securing load, MSL, of lashings should not be less than 100 kN, and they should be made of material having suitable elongation characteristics. However, for vehicles not exceeding 15 tonnes (GVM), lashing with lower MSL values may be used. The required number and MSL of lashings may be calculated according to annex 13 to the code of Safe Practice for cargo Stowage and Securing (CSS Code), taking into consideration the criteria mentioned in paragraph 1.5.1 of the Code.
- 6.2 Lashings should be so designed and attached that, provided there is safe access, it is possible to tighten them if they become slack. Where practicable and necessary, the lashings should be examined at regular intervals during the voyage and tightened as necessary.
- 6.3 Lashings should be attached to the securing points with hooks or other devices so designed that they cannot disengage from the aperture of the securing point if the lashing slackens during the voyage.
- 6.4 Only one lashing should be attached to any one aperture of the securing point on the vehicle.
- 6.5 Lashings should only be attached to the securing points provided for that purpose.
- 6.6 Lashings should be attached to the securing points on the vehicle in such a way that the angle between the lashing and the horizontal and vertical planes lies preferably between 30° and 60°.
- 6.7 Bearing in mind the characteristics of the ship and the weather conditions expected on the intended voyage, the master should decide on the number of securing points and lashings to be used for each voyage.
- 6.8 Where there is doubt that a road vehicle complies with the accepted criteria for number and strength of securing points, the master may, at his discretion, load the vehicle on board or reject

it for carriage, taking into account the apparent condition of the vehicle, the weather and sea conditions expected on the intended voyage and all other circumstances.

## 7 STOWAGE

- 7.1 Depending on the area of operation, the predominant weather conditions and the characteristics of the ship, road vehicles should be stowed so that the chassis are kept as static as possible by not allowing free play in the suspension of the vehicles. This can be done, for example, by compressing the springs by tightly securing the vehicle to the deck, by jacking up the chassis prior to securing the vehicle or by releasing the air pressure on compressed air suspension systems.
- 7.2 Taking into account the condition referred to in 7.1 and the fact that compressed air suspension systems may lose air, the air pressure should be released on every vehicle fitted with such a system if the voyage is of more than 24 hours duration. If practicable, the air pressure should be released also on voyages of a shorter duration. If the air pressure is not released, the vehicle should be jacked up to prevent any slackening of the lashings resulting from any air leakage from the system during the voyage.
- 7.3 Where jacks are used on a vehicle, the chassis should be strengthened in way of the jacking-up points and the position of the jacking-up points should be clearly marked.
- 7.4 Special consideration should be given to the securing of road vehicles stowed in positions where they may be exposed to additional forces. Where vehicles are stowed athwartship, special consideration should be given to the forces which may arise from such stowage. Vehicles should, so far as possible, be aligned in a fore and aft direction.
- 7.5 Wheels should be checked to provide additional security in adverse conditions. When freight vehicles are being stowed on an inclined deck, the wheels must be chocked before lashing commences.
- 7.6 Vehicles with diesel engines should not be left in gear during the voyage.
- 7.7 Vehicles designed to transport loads likely to have an adverse effect on their stability, such as hanging meat, should have integrated in their design a means of neutralizing the suspension system.
- 7.8 Stowage should be arranged in accordance with the following:
  - .1 The parking brakes of each vehicle or of each element of a combination of vehicles should be applied and locked.
  - .2 Semi-trailers by the nature of their design, should not be supported on their landing legs during sea transport unless the landing legs are specially designed for that purpose and so marked. An uncoupled semi-trailer should be supported by a trestle or similar device placed in the immediate area of the drawplate so that the connection of the fifth-wheel to the kingpin is not restricted. Semi-trailers should not be supported on their landing legs during sea transportation unless the deck plating has adequate strength for the point loadings. Semi-trailer designers should consider the space and the reinforcements required and the selected areas should be clearly marked.

## Appendix IV – Extracts from various Timber Deck Codes

### **FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*The following text is quoted from the “Code of Safe Practice for Ships carrying Timber Deck Cargoes”, 1991, chapter 2.1-6.4. The original numbering in the Code is maintained.*

#### CHAPTER 2 - STABILITY

- 2.1 The ship should be supplied with comprehensive stability information which takes into account timber deck cargo. Such information should enable the master, rapidly and simply, to obtain accurate guidance as to the stability of the ship under varying conditions of service. Comprehensive rolling period tables or diagrams have proved to be a very useful aid in verifying the actual stability conditions.
- 2.2 The stability of the ship at all times, including during the process of loading and unloading timber deck cargo, should be positive and to a standard acceptable to the Administration. It should be calculated having regard to:
  - .1 the increased weight of the timber deck cargo due to:
    - .1.1 absorption of water in dried or seasoned timber, and
    - .1.2 ice accretion, if applicable;
  - .2 consumables;
  - .3 the free surface effect of liquid in tanks; and
  - .4 the weight of water trapped in broken spaces within the timber deck cargo and especially logs.
- 2.3 The master should:
  - .1 cease all loading operations if a list develops for which there is no satisfactory explanation and it would be imprudent to continue loading;
  - .2 before proceeding to sea, ensure that:
    - .2.1 the ship is upright;
    - .2.2 the ship has an adequate metacentric height in both departure and arrival conditions; and
    - .2.3 the ship meets the required stability criteria.
- 2.4 Ships carrying timber deck cargoes should operate, as far as possible, with a safe margin of stability and with a metacentric height which is consistent with safety requirements but such metacentric height should not be allowed to fall below the recommended minimum.
- 2.5 However, excessive initial stability should be avoided as it will result in rapid and violent motion in heavy seas which will impose large sliding and racking forces on the cargo causing high stresses on the lashings. Operational experience indicates that metacentric height should preferably not exceed 3% of the breadth in order to prevent excessive accelerations in rolling provided that the relevant stability criteria are satisfied. This recommendation may not apply to all ships and the master should take into consideration the stability information obtained from the ship's stability manual.

## CHAPTER 3 - STOWAGE

### 3.1 General

#### 3.1.1 Before timber deck cargo is loaded on any area of the weather deck:

- .1 hatch covers and other openings to spaces below that area should be securely closed and battened down;
- .2 air pipes and ventilators should be efficiently protected and check-valves or similar devices should be examined to ascertain their effectiveness against the entry of water;
- .3 accumulations of ice and snow on such area should be removed; and
- .4 it is normally preferable to have all deck lashings, uprights, etc., in position before loading on that specific area. This will be necessary should a preloading examination of securing equipment be required in the loading port.

#### 3.1.2 The timber deck cargo should be so stowed that:

- .1 safe and satisfactory access to the crew's quarters, pilot boarding access, machinery spaces and all other areas regularly used in the necessary working of the ship is provided at all times;
- .2 where relevant, openings that give access to the areas described in 3.1.1.1 can be properly closed and secured against the entry of water;
- .3 safety equipment, devices for remote operation of valves and sounding pipes are left accessible; and
- .4 it is compact and will not interfere in any way with the navigation and necessary working of the ship.

#### 3.1.3 During loading, the timber deck cargo should be kept free of any accumulations of ice and snow.

#### 3.1.4 Upon completion of loading, and before sailing, a thorough inspection of the ship should be carried out. Soundings should also be taken to verify that no structural damage has occurred causing an ingress of water.

### 3.2 Height and extent of timber deck cargo

#### 3.2.1 Subject to 3.2.2, the height of the timber deck cargo above the weather deck on a ship within a seasonal winter zone in winter should not exceed one third of the extreme breadth of the ship.

#### 3.2.2 The height of the timber deck cargo should be restricted so that:

- .1 adequate visibility is assured;
- .2 a safe margin of stability is maintained at all stages of the voyage;
- .3 any forward-facing profile does not present overhanging shoulders to a head sea; and
- .4 the weight of the timber deck cargo does not exceed the designed maximum permissible load on the weather deck and hatches.

#### 3.2.3 On ships provided with, and making use of, their timber loadline, the timber deck cargo should be stowed so as to extend:

- .1 over the entire available length of the well or wells between superstructures and as close as practicable to end bulkheads;

- .2 at least to the after end of the aftermost hatchway in the case where there is no limiting superstructure at the after end;
  - .3 athwartships as close as possible to the ship's sides, after making due allowance for obstructions such as guardrails, bulwark stays, uprights, pilot boarding access, etc., provided any area of broken stowage thus created at the side of the ship does not exceed a mean of 4% of the breadth; and
  - .4 to at least the standard height of a superstructure other than a raised quarterdeck.
- 3.2.4 The basic principle for the safe carriage of any timber deck cargo is a solid stowage during all stages of the deck loading. This can only be achieved by constant supervision by shipboard personnel during the loading process.
- 3.2.5 Appendix A provides general advice on stowage practices which have proved to be effective for various types of timber deck cargoes.

## CHAPTER 4 - SECURING

### 4.1 General

- 4.1.1 Every lashing should pass over the timber deck cargo and be shackled to eyeplates suitable and adequate for the intended purpose and efficiently attached to the deck stringer plate or other strengthened points. Such arrangements will be specially considered by class. They should be installed in such a manner as to be, as far as practicable, in contact with the timber deck cargo throughout its full height.
- 4.1.2 All lashings and components used for securing should:
- .1 possess a breaking strength of not less than 133 kN;
  - .2 after initial stressing, show an elongation of not more than 5% at 80% of their breaking strength; and
  - .3 show no permanent deformation after having been subjected to a proof load of not less than 40% of their original breaking strength.
- 4.1.3 Every lashing should be provided with a tightening device or system so placed that it can safely and efficiently operate when required. The load to be produced by the tightening device or system should not be less than:
- .1 27 kN in the horizontal part; and
  - .2 16 kN in the vertical part.
- 4.1.4 Upon completion and after the initial securing, the tightening device or system should be left with not less than half the threaded length of screw or of tightening capacity available for future use.
- 4.1.5 Every lashing should be provided with a device or an installation to permit the length of the lashing to be adjusted.
- 4.1.6 The spacing of the lashings should be such that the two lashings at each end of each length of continuous deck stow are positioned as close as practicable to the extreme end of the timber deck cargo.



4.1.7 If wire rope clips are used to make a joint in a wire lashing, the following conditions should be observed to avoid a significant reduction in strength:

- .1 the number and size of rope clips utilized should be in proportion to the diameter of the wire rope and should not be less than four, each spaced at intervals of not less than 15 cm;
- .2 the saddle portion of the clip should be applied to the live load segment and the U-bolt to the dead or shortened end segment;
- .3 rope clips should be initially tightened so that they visibly penetrate into the wire rope and subsequently be re-tightened after the lashing has been stressed.

4.1.8 Greasing the threads of grips, clips, shackles and turnbuckles increases their holding capacity and prevents corrosion.

## 4.2 Uprights

4.2.1 Uprights should be fitted when required by the nature, height or character of the timber deck cargo.

4.2.2 When uprights are fitted, they should:

- .1 be made of steel or other suitable material of adequate strength, taking into account the breadth of the deck cargo;
- .2 be spaced at intervals not exceeding 3 m;
- .3 be fixed to the deck by angles, metal sockets or equally efficient means; and
- .4 if deemed necessary, be further secured by a metal bracket to a strengthened point, i.e. bulwark, hatch coaming.

## 4.3 Loose or packaged sawn timber

4.3.1 The timber deck cargo should be secured throughout its length by independent lashings.

4.3.2 Subject to 4.3.3, the maximum spacing of the lashings referred to above should be determined by the maximum height of the timber deck cargo in the vicinity of the lashings:

- .1 for a height of 4 m and below, the spacing should be 3m;
- .2 for heights of above 4 m, the spacing should be 1.5m.

4.3.3 The packages stowed at the upper outboard edge of the stow should be secured by at least two lashings each.

4.3.4 When the outboard stow of the timber deck cargo is in lengths of less than 3.6 m, the spacing of the lashings should be reduced as necessary or other suitable provisions made to suit the length of timber.

4.3.5 Rounded angle pieces of suitable material and design should be used along the upper outboard edge of the stow to bear the stress and permit free reeving of the lashings.

## 4.4 Logs, poles, cants or similar cargo

4.4.1 The timber deck cargo should be secured throughout its length by independent lashings spaced not more than 3 m apart.

- 4.4.2 If the timber deck cargo is stowed over the hatches and higher, it should, in addition to being secured by the lashings recommended in 3.4.1, be further secured by:
- .1 a system of athwartship lashings (hog lashings) joining each port and starboard pair of uprights near the top of the stow and at other appropriate levels as appropriate for the height of the stow; and
  - .2 a lashing system to tighten the stow whereby a dual continuous wire rope (wiggly wire) is passed from side to side over the cargo and held continuously through a series of snatch blocks or other suitable device, held in place by foot wires.

4.4.3 The dual continuous wire rope, referred to in 3.4.2.2, should be led to a winch or other tensioning device to facilitate further tightening.

4.4.4 The recommendation of 4.4.2.2 should apply to a timber deck cargo of cants.

#### 4.5 Testing, examination and certification

4.5.1 All lashing and components used for the securing of the timber deck cargo should be tested, marked and certified according to national regulations or an appropriate standard of an internationally recognized standards institute. Copies of the appropriate certificate should be kept on board.

4.5.2 No treatments which could hide defects or reduce mechanical properties or strength should be applied after testing.

4.5.3 A visual examination of lashings and components should be made at intervals not exceeding 12 months.

4.5.4 A visual examination of all securing points on the ship, including those on the uprights, if fitted, should be performed before loading the timber deck cargo. Any damage should be satisfactorily repaired.

#### 4.6 Lashing plans

One or more lashing plans complying with the recommendations of this Code should be provided and maintained with this Cargo Securing Manual for carrying timber deck cargo.

### CHAPTER 6 ACTION TO BE TAKEN DURING THE VOYAGE

#### 6.1 Tightening of lashings

6.1.1 It is of paramount importance that all lashings be carefully examined and tightened at the beginning of the voyage as the vibration and working of the ship will cause the cargo to settle and compact. They should be further examined at regular intervals during the voyage and tightened as necessary.

6.1.2 Entries of all examinations and adjustments to lashings should be made in the ship's log-book.

#### 6.2 Voyage planning and ship handling

- 6.2.1 The master should plan the voyage so as to avoid potential severe weather and sea conditions. To this effect, weather reports, weather facsimiles or weather routing agencies should be consulted.
- 6.2.2 In cases where severe weather and sea conditions are unavoidable, masters should be conscious of the need to reduce speed and/or alter course at an early stage in order to minimize the forces imposed on the cargo, structure and lashings. The lashings are not designed to provide a means of securing against imprudent ship handling in heavy weather. There can be no substitute for good seamanship.

### 6.3 Listing during voyage

If a list occurs that is not caused by normal use of consumables (water and fuel), such a list can probably be attributed to one of three causes, or possibly a combination of same.

#### *Cargo shift*

- 6.3.1 A major shift of deck cargo will obviously be immediately apparent. Deck cargo may however have shifted imperceptibly or there may have been a shift of cargo below decks. An immediate examination should determine whether or not cargo has shifted and if this is the case the master will have several remedies available to him depending upon the exact circumstances.
- 6.3.2 The ballasting and transferring of ballast or fuel to reduce or correct a list caused by a shifted cargo should, however, be carefully considered since this action would, in all probability, result in a far greater list if the cargo should subsequently shift to the other side.
- 6.3.3 As any cargo shift will in most cases occur in adverse weather conditions, sending crew to release or tighten the lashings on a moving or shifted cargo may well represent a greater hazard than retaining an overhanging load. A moving or shifted timber deck cargo should only be jettisoned after careful consideration; jettisoning is unlikely to improve the situation as the whole cargo stack would probably not fall at once. Severe damage may also be sustained by the propeller if it is still turning when timber is jettisoned.

#### *Water ingress*

- 6.3.4 The possibility of water ingress should immediately be determined by sounding throughout the ship. In the event that unexplained water is detected, all available pumps should be used to bring the situation under control. Subsequent actions will obviously depend upon whether or not such ingress of water can be controlled by use of pumps.

#### *Angle of roll*

- 6.3.5 If the rolling of the ship prior to the detection of the list has been exceptionally slow and the ship has returned to the upright position in a sluggish manner, this will indicate that the ship has little or no metacentric height remaining. The list is therefore due to the ship lolling to one side and having no righting arm to return it to the upright position. This situation may be rectified by either adding weight to the low part of the ship (ballasting double bottom tanks) or removing weight from the high part (deck cargo). Of the two options, ballasting is usually preferable and if empty divided double bottom space is available, the tank on the lower side should be ballasted first in order to immediately provide additional metacentric height-after which the tank on the high side should also be ballasted. However, special care should be taken in ballasting and deballasting to rectify the situation since this may cause a far greater list to the other side.

**FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*The following is quoted from the "Code of Safe Practice for Ships carrying Timber Deck Cargoes" 1991, Appendix A. The original numbering in the Code is maintained.*

## Code of Safe Practice for Ships carrying Timber Deck Cargoes 1991, Appendix A

## Advice on stowage practices

## 1 GENERAL

- 1.1 The stowage practices described in this appendix have been found to achieve satisfactory results, provided that account is taken of the recommendations of chapters 1-6. Although specific conditions may dictate a departure from these guidelines, the basic principles as detailed in 1.2 should nevertheless be adhered to.
- 1.2 The basic principle for the safe carriage of timber deck cargo is, as indicated earlier, to make the stow as solid and compact as practicable. The purpose of this is to:
  - .1 prevent slack in the stow which could cause the lashings to slacken;
  - .2 produce a binding effect within the stow; and
  - .3 reduce to a minimum the permeability of the stow.
- 1.3 Lashings prevent deck cargo from shifting by increasing the friction due to pre-stress forces and counteracting forces on the stow in the direction of possible shifting. The lashings should meet the following criteria:
  - .1 the strength of all lashing elements should be at least equal to that recommended in the Code; and
  - .2 the necessary tension should be maintained during the whole voyage.
- 1.4 The shifting of timber deck cargo is due mainly to the following causes which may occur singly or together:
  - .1 lashings becoming slack due to compaction of the cargo during the voyage, unsuitable devices for tightening the lashing systems and/or inadequate strength of the lashings;
  - .2 movement of the cargo across the hatch covers due to insufficient friction, particularly in ice and snow;
  - .3 inadequate strength of the uprights due to poor material properties and/or excessive forces;
  - .4 heavy rolling or pitching of the ship;
  - .5 impact from heavy seas.
- 1.5 Great care should be taken to keep the ship in an upright condition during loading as even a slight list will impose a considerable load on the retaining uprights. The necessity for prudent ship handling during the voyage cannot be overstressed; imprudent ship handling can nullify even the best of stowages.
- 1.6 The lashings should be in accordance with chapter 4 of the Code and may comprise the following types:

- .1 Hog lashings are normally used over the second and third tiers and may be set "hand tight" between stanchions. The weight of the upper tiers when loaded on top of these wires will further tighten them (see figure 1).
- .2 Wire rope lashings which are used in addition to chain lashings. Each of these may pass over the stow from side to side and loop completely around the uppermost tier. Turnbuckles are fitted in each lashing to provide means for tightening the lashing at sea (see figure 2).
- .3 Wiggle wires which are fitted in the manner of a shoelace to tighten the stow. These wires are passed over the stow and continuously through a series of snatch blocks, held in place by foot wires. Turnbuckles are fitted from the top of the footwire into the wiggle wire in order to keep the lashings tight at sea (see figures 3 and 4).
- .4 Chain lashings which are passed over the top of the stow and secured to substantial padeyes or other securing points at the outboard extremities of the cargo. Turnbuckles are fitted in each lashing to provide means for tightening the lashing at sea (see figure 5)

1.7 Systems for securing timber deck cargoes are shown in figures 3, 4, 5, 6, and 7

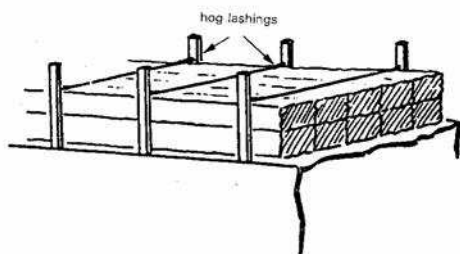


Figure 1

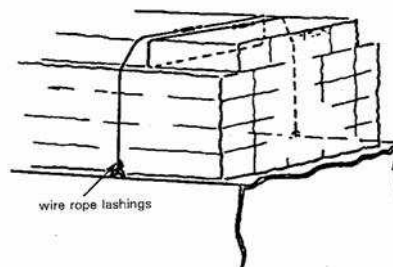


Figure 2

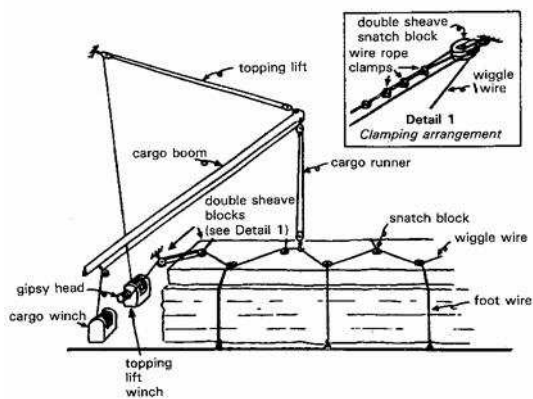


Figure 3

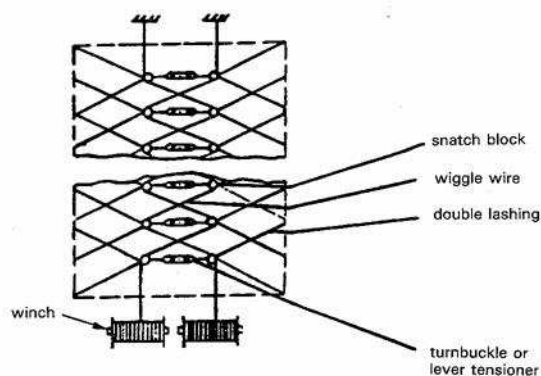


Figure 4

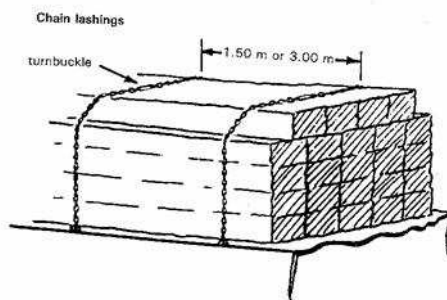


Figure 5

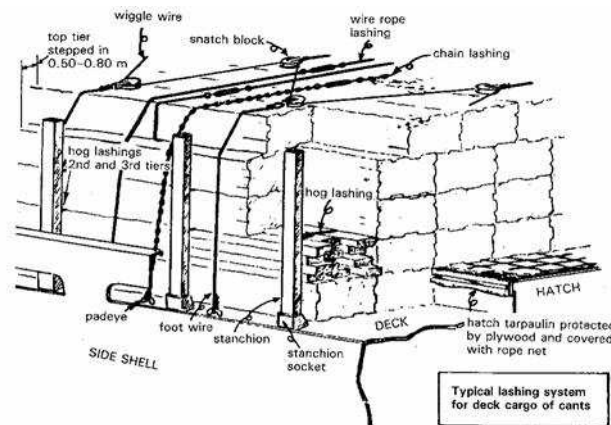


Figure 6

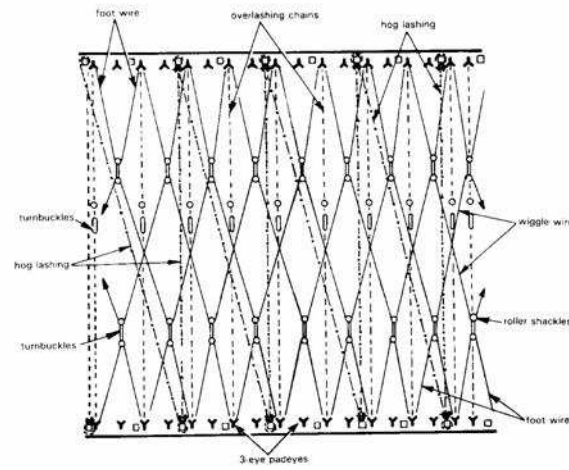


Figure 7

## 2 PACKAGED TIMBER AND CANTS

- 2.1 Timber packages are usually bundled by bandings fastened mechanically (hard bundled) or by hand (soft bundled). The packages may not have standard dimensions and they are not always flush at both ends. The stowage problem is compounded by differences in the lengths of packaged timber when the packages are stowed on board the ship. Moreover, the master of the ship often has no influence on the order in which the packages are delivered.
- 2.2 Packages which contain random lengths likely to disrupt the compaction of the stow should not be loaded on deck. Other packages of random lengths capable of compact stowage may be loaded on deck in a fore-and-aft direction but not on exposed surfaces or in the stowage outboard of the hatch coamings (see figures 8 and 9).



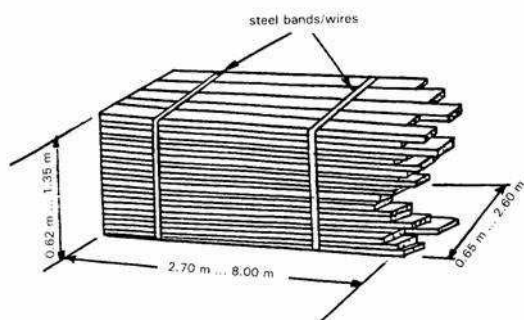


Figure 8

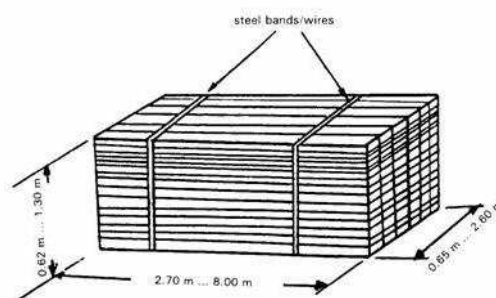


Figure 9

- 2.3 Packages for deck stowage should be solidly made up. They should have bands adequate to prevent slackening or disintegration of the package during the voyage, which could cause a loosening of the stow as a whole. Slack bands on the top surface of the deck cargo are dangerous foot traps.
- 2.4 Cants are usually bundled by banding, but the irregularities caused by varying thicknesses and curved sides make compact bundling very difficult to achieve. Because of these factors, considerable broken stowage is encountered as well. The tendency is for the packages to assume a rounded cross-section within the bands due to the curved sides of the individual pieces (see figure 10).

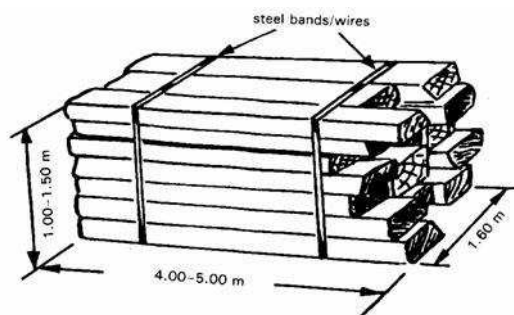


Figure 10

- 2.5 A solid stow of packaged timber is not always possible as the packages of timber have different measurements, may be partially soft bundles, and gaps may exist between the packages. It is essential, however, that the upper tier and outboard packages be stowed as compactly as possible and the upper tiers chocked as necessary.
- 2.6 The methods used to stow cargoes of loose timber for transport cannot always be applied to the transport of packaged timber as:
- .1 packaged timber cannot be stowed to give a compactness as tight as that achieved with loose timber, and lashings may therefore be less effective;
  - .2 packaged timber cannot be stowed between the uprights as densely and with so few gaps as loose timber. The uprights may consequently have to sustain greater loads when packaged timber is being carried and may absorb the forces generated by the cargo when it is moving.
- 2.7 Before commencing to load on the deck or hatches, a firm and level stowage surface should be prepared. Dunnage, where used, should be of rough lumber and should be placed in the direction which will spread the load across the ship's underdeck structure and assist in draining.

- 2.8 Due to the system of athwartship lashing, the stowage of packages should generally be in the fore-and-aft direction; the wings of the upper two tiers should always be in the fore-and-aft direction. It is advisable to have one or more non-adjacent tiers stowed athwartships when above the level of the hatches in order to produce a binding effect within the cargo. Also, athwartship packages should be carried above the hatches to interlock the load. If packages with great differences in length are to be loaded, the longest packages should be stowed fore and aft outboard. Short packages should be confined to the inner portions of the stowage. Only packages flush at both ends can be stowed athwartships (see figures 11,12 and 13).

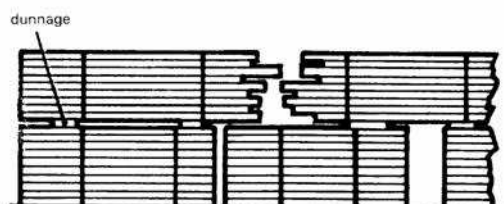


Figure 11

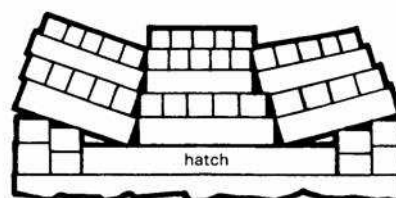


Figure 12

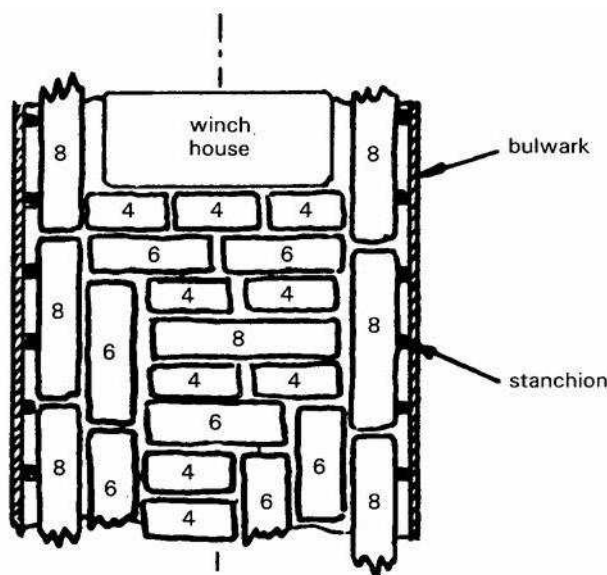


Figure 13

- 2.9 The timber should be loaded to produce a compact stow with a surface as level as practicable. Throughout the loading, a level and firm stowage surface should be prepared on each working tier. Rough dunnage, if used, should be spread over at least three adjacent packages to produce a binding effect within the stow, particularly in the wings.
- 2.10 Any gaps occurring around packages in which the cargo may work at sea, such as in the vicinity of hatch coamings and deck obstructions, should be filled with loose timber, efficiently chocked off or effectively bridged over. For this purpose a supply of timber chocking material should be made available to the ship.
- 2.11 Packages at the outboard edges of the stow should be positioned so that they do not extend over the padeyes and obstruct the vertical load of the athwartship lashings. The end of each deck stow should be flush in order to minimize overhangs to resist the influence of green seas and to avoid the ingress of water.



- 2.12 Large heavy boards and squares of timber, when loaded on deck in combination with packages, should preferably be stowed separately. When placed in upper tiers, heavy pieces of timber tend to work loose at sea and cause some breaking of packages. In the event that boards and squares are stowed on top of packages they should be efficiently restrained from movement.
- 2.13 When the final tier is loaded on a large number of tiers, it may be stepped in from the outer edge of the stow about 0.5-0.8 m (a half package).

### 3 LOGS

- 3.1 If logs are loaded on deck together with packaged timber, the two types of timber should not be intermixed.
- 3.2 Logs should generally be stowed in a fore-and-aft direction to give a slightly crowned top surface such that each log is adequately restrained from movement when the system of securing is in place and set up taut.
- 3.3 In order to achieve a compact stow, the butt of each log or sling of logs should not be in the same athwartship plane as those adjacent to it.
- 3.4 In order to achieve a more secure stowage of logs when stowed on deck, a continuous wire (hog wire) should be utilized at each hatch meeting the specifications of chapter 4 of the Code. Such hog wire should be installed in the following manner:
- .1 At approximately three quarters of the height of the uprights, the hog wire should be rove through a padeye attached to the uprights at this level so as to run transversely, connecting the respective port and starboard uprights. The hog lashing wire should not be too tight when laid so that it becomes taut when overstowed with other logs.
  - .2 A second hog wire may be applied in a similar manner if the height of the hatch cover is less than 2m. Such second hog wire should be installed approximately 1 m above the hatch covers.
  - .3 The aim of having the hog wires applied in this manner is to assist in obtaining as even a tension as possible throughout, thus producing an inboard pull on the respective uprights.

### 4 PULP WOOD AND PIT-PROPS

- 4.1 When these items are stowed in the manner described below, good compaction of the deck cargo can be obtained.
- .1 In the deck area clear of the line of hatches, the cargo should be stowed in the athwartship direction, canted inboard by some cargo laid fore and aft in the scuppers.
  - .2 At the centre of the stow, along the line of hatches, the cargo should be laid in the fore-and-aft direction when the wing cargo has reached hatch height.
  - .3 At the completion of loading, the cargo should have a level surface with a slight crown towards the centre.
- 4.2 To prevent the cargo from being washed out from below its lashings, it is recommended that nets or tarpaulins be used as follows:
- .1 the ends of each continuous section of deck cargo, if not stowed flush with the superstructure bulkhead, may be fitted with a net or tarpaulin stretched and secured over the athwart-ship vertical surface;

- .2 over the forward end of each continuous section of deck cargo and in the waist of the ship the top surface may be fitted with a net or tarpaulin stretched and secured across the breadth of the cargo and brought down the outboard vertical sides to securing points at deck level.

***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*The following text is quoted from the International Conference on Loadlines 1966.*

Annex I - Regulations for determining loadlines.

Regulation 44

Stowage  
General

- (1) Openings in the weather deck over which cargo is stowed shall be securely closed and battened down. The ventilators shall be efficiently protected.
- (2) Timber deck cargo shall extend over at least the entire available length which is the total length of the well or wells between superstructures. Where there is no limiting superstructure at the after end, the timber shall extend at least to the after end of the aftermost hatchway. The timber shall be stowed as solidly as possible to at least the standard height of the superstructure.
- (3) On a ship within a seasonal winter zone in winter, the height of the deck cargo above the weather deck shall not exceed one-third of the extreme breadth of the ship.
- (4) The timber deck cargo shall be compactly stowed, lashed and secured. It shall not interfere in any way with the navigation and necessary work of the ship.

Uprights

- (5) Uprights, when required by the nature of the timber, shall be of adequate strength considering the breadth of the ship; the spacing shall be suitable for the length and character of timber carried, but shall not exceed 3 metres (9.8 feet). Strong angles or metal sockets or equally efficient means shall be provided for securing the uprights.

Lashings

- (6) Timber deck cargo shall be efficiently secured throughout its length by independent over-all lashings spaced not more than 3 metres (9.8 feet) apart. Eye plates for these lashings shall be efficiently attached to the sheer strake or to the deck stringer plate at intervals of not more than 3 metres (9.8 feet). The distance from an end bulkhead of a superstructure to the first eye plate shall be not more than 2 metres (6.6 feet). Eye plates and lashings shall be provided 0.6 metres (23 inches) and 1.5 metres (4.9 feet) from the ends of timber deck cargoes where there is no bulkhead.
- (7) Lashings shall be not less than 19 millimetres (1 inch) close link chain or flexible wire rope of equivalent strength, fitted with sliphooks and turnbuckles, which shall be accessible at all times. Wire rope lashings shall have a short length of long link chain to permit the length of lashings to be regulated.

- (8) When timber is in lengths less than 3.6 metres (11.8 feet) the spacing of the lashings shall be reduced or other suitable provisions made to suit the length of timber.
- (9) All fittings required for securing the lashings shall be of strength corresponding to the strength of the lashings.

#### Stability

- (10) Provision shall be made for a safe margin of stability at all stages of the voyage, regard being given to additions of weight, such as those due to absorption of water and icing and to losses of weight such as those due to consumption of fuel and stores.

#### Protection of Crew, Access to Machinery Spaces, etc.

- (11) In addition to the requirements of Regulation 25 (5) of this Annex guard rails or life lines spaced not more than 330 millimetres (13 inches) apart vertically shall be provided on each side of the deck cargo to a height of at least 1 metre (39 inches) above the cargo.

#### Steering Arrangements

- (12) Steering arrangements shall be effectively protected from damage by cargo and, as far as practicable, shall be accessible. Efficient provision shall be made for steering in the event of a breakdown in the main steering arrangements.

#### **FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:**

*The following text should be regarded as DNV's interpretation of Regulation 44 in order to harmonise this Regulation with the Code of Safe Practice for Ships Carrying Timber Deck Cargoes (Resolution A.287 (VIII)).*

#### Stowage

##### General

Openings in the weather deck over which cargo is stowed should be securely closed and battened down. The ventilators and air pipes should be efficiently protected. Timber deck cargoes should extend over at least the entire available length which is the total length of the well or wells between superstructures. Where there is no limiting superstructure at the after end, the timber should extend at least to the after end of the aftermost hatchway. The timber deck cargo should extend athwartships as close as possible to the ship side due allowance being given for obstructions such as guard-rails, bulwark stays, uprights, etc. provided any gap thus created at the side of the ship does not exceed 4 per cent of the breadth (b). The timber should be stowed as solidly as possible to at least the standard height of a superstructure other than a raised quarter deck. On a ship within a seasonal winter zone in winter, the height of the deck cargo above the weather deck should not exceed one-third of the extreme breadth of the ship. The timber deck cargo should be compactly stowed, lashed and secured. It should not interfere in any way with the navigation and necessary work of the ship.

##### Uprights

Uprights, when required by the nature of the timber, should be of adequate strength considering the breadth of the ship; the strength of the uprights should not exceed the strength of the bulwark and the spacing should be suitable for the length and character of timber carried, but should not exceed 3 metres. Strong angles or metal sockets or equally efficient means should be provided for securing the uprights. Lashings for timber deck cargo should be efficiently secured throughout its length by

independent overall lashings. The spacing of the lashings should be determined by the maximum height of the cargo above the weather deck in the vicinity of the lashing:

- 1) for a height of 4 metres and below the spacing should be not more than 3 metres;
- 2) for a height of 6 metres and above the spacing should be not be more than 1.5 metres;
- 3) at intermediate heights the average spacing should be obtained by linear interpolation.

Where the height of timber deck cargo exceeds 6 metres the strength of the lashings should be to the satisfaction of the Society. Eye plates for these lashings should be efficiently attached to the sheer strake or to the deck stringer plate. The distance from an end bulkhead of a superstructure to the first eye plate should not be more than 2 metres. Eye plates and lashings should be provided 0.6 metre and 1.5 metres from the ends of timber deck cargoes where there is no bulkhead. The lashings should be capable of withstanding an ultimate load of not less than 13,600 kg. They should be fitted with sliphooks and turnbuckles, which should be accessible at all times. Wire rope lashings should have a short length of long link chain to permit the length of lashings to be regulated. When timber is in lengths of less than 3.6 metres, the spacing should be reduced or other suitable provisions made to suit the length of timber. Shackles, stretching devices and all other ancillary components incorporated into a chain or wire rope lashing and its securings should have a minimum ultimate load of 14,100 kg. Each component should be proof loaded to 5,600 kg. No part should be damaged or permanently deformed after proof loading.

#### Stability

Provision should be made for a safe margin of stability at all stages of the voyage, regard being given to additions of weight, such as those due to absorption of water and icing and to losses of weight such as those due to consumption of fuel and stores.

#### Protection of Crew, Access to Machinery Spaces, etc.

In addition to the requirements of Regulation 25(5) (Ch.1 Sec.10 E) of this Annex, guard rails or lifelines not more than 330 millimetres apart vertically should be provided on each side of the cargo deck to a height of at least 1 metre above the cargo. In addition a lifeline, preferably wire rope, set up taut with a stretching screw, should be provided as near as practicable to the centre line of the ship. The stanchion supports to all guard-rails and lifelines should be spaced so as to prevent undue sagging. Where the cargo is uneven, a safe walking surface of not less than 600 millimetres in width should be fitted over the cargo and effectively secured beneath or adjacent to a lifeline.

#### Steering Arrangements

Steering arrangements should be effectively protected from damage by cargo and, as far as practicable, should be accessible. Efficient provision should be made for steering in the event of a breakdown in the main steering arrangements.

## Appendix V – Annex 1-12 to the CSS Code

***FOR GUIDANCE ONLY NOT TO BE INCLUDED IN THE MANUAL:***

*The following text is quoted directly from the Code, but not all Annex's or all the information is applicable to all ships. Additional text, not given in the Code, which can be given in the Cargo Securing Manual for closer explanation, is in the following recognised by paragraph-numbering.*

**ANNEX 1      Safe stowage and securing of containers on deck of ships which are not specially designed and fitted for the purpose of carrying containers.****1      Stowage**

- 1.1 Containers carried on deck or on hatches of such ships should preferably be stowed in the fore-and-aft direction.
- 1.2 Containers should not extend over the ship's sides. Adequate supports should be provided when containers overhang hatches or deck structures.
- 1.3 Containers should be stowed and secured so as to permit safe access for personnel in the necessary operation of the ship.
- 1.4 Containers should at no time overstress the deck or hatches on which they are stowed.
- 1.5 Bottom-tier containers, when not resting on stacking devices, should be stowed on timber of sufficient thickness, arranged in such a way as to transfer the stack load evenly on to the structure of the stowage area.
- 1.6 When stacking containers, use should be made of locking devices, cones, or similar stacking aids, as appropriate, between them
- 1.7 When stowing containers on deck or hatches, the position and strength of the securing points should be taken into consideration.

If the individual gross weights of the containers are not known all 20ft units and all 40ft units should be assumed to have a gross weight of 20 and 26 tonnes respectively with the centre of gravity at the geometrical centre.

Care should be taken to ensure that the safe weight load of each individual container is not exceeded and that the gross and tare weights are accurately recorded and declared.

Stowing containers in cargo holds requires securing in solid blocks. The containers should be keyed to the tanktop and adequate inter-locking of units should be provided. The resulting block must be secured to the ship structure using common sense.

## 2. Securing

- 2.1 All containers should be effectively secured in such a way as to protect them from sliding and tipping. Hatch covers carrying containers should be adequately secured to the ship.
- 2.2 Containers should be secured using one of the three methods recommended in figure 1 or methods equivalent thereto.
- 2.3 Lashings should preferably consist of wire ropes or chains or material with equivalent strength and elongation characteristics.
- 2.4 Timber shoring should not exceed 2 m in length.
- 2.5 Wire clips should be adequately greased and tightened so that the dead end of the wire is visibly compressed (figure 2).
- 2.6 Lashings should be kept, when possible, under equal tension.

Care should be taken when:

- It is required to mix general break-bulk cargo with containers.
- Loading general cargo on top of containers.

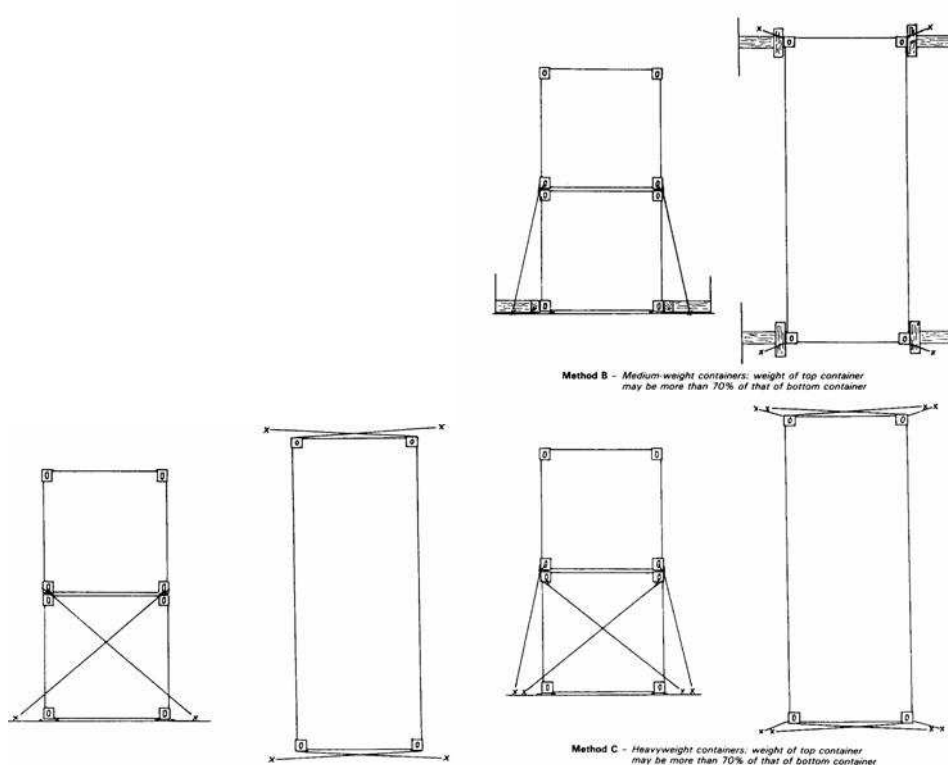
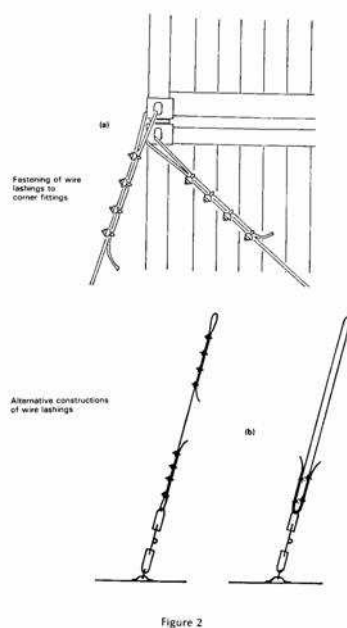


Figure 1 - Recommended methods of non-standardized securing of containers

Figure 1 (cont.) - Recommended methods of non-standardized securing of containers



## ANNEX 2 Safe stowage and securing of portable tanks.

### 1 Introduction

- 1.1 The provisions of this annex apply to a portable tank, which in the context of this annex, means a tank which is not permanently secured on board the vessel and has a capacity of more than 450 l and a shell fitted with external stabilising members and items of service equipment and structural equipment necessary for the transport of liquids, solids or gases.
- 1.2 These provisions do not apply to tanks intended for the transport of liquids, solids or gases having a capacity of 450 l or less.

Note: The capacity for portable tanks for gases is 1000 l or more.

### 2 General Provisions for Portable Tanks

- 2.1 Portable tanks should be capable of being loaded and discharged without the need of removal of their structural equipment and be capable of being lifted onto and off the ship when loaded.
- 2.2 The applicable requirements of the International Convention for Safe Containers, 1972, as amended, should be fulfilled by any tankcontainer which meets the definition of a container within the terms of that Convention. Additionally, the provisions of section 13 of the General Introduction to the IMDG Code should be met when the tank will be used for the transport of dangerous goods.
- 2.3 Portable tanks should not be offered for shipment in an ullage condition liable to produce an unacceptable hydraulic force due to surge within the tank.
- 2.4 Portable tanks for the transport of dangerous goods should be certified in accordance with the provisions of the IMDG Code by the competent approval authority or a body authorised by that authority.

### 3 Portable Tank Arrangements

3.1 The external stabilising members of a portable tank may consist of skids or cradles and, in addition, the tank may be secured to a platform-based container. Alternatively, a tank may be fixed within a framework of ISO or non-ISO frame dimensions.

3.2 Portable tank arrangements should include fittings for lifting and securing onboard.

Note: All types of the aforementioned portable tanks may be carried on multipurpose ships but need special attention for lashing and securing onboard.

### 4. Cargo Information

4.1 The master should be provided with at least the following information:

- .1 dimensions of the portable tank and commodity if non-dangerous and, if dangerous, the information required in accordance with the IMDG Code;
- .2 the gross mass of the portable tank; and
- .3 whether the portable tank is permanently secured onto a platform-based container or in a frame and whether securing points are provided.

### 5. Stowage

5.1 The typical distribution of accelerations of the ship should be borne in mind in deciding whether the portable tank will be stowed on or under deck.

5.2 Tanks should be stowed in the fore-and-aft direction on or under deck.

5.3 Tanks should be stowed so that they do not extend over the ship's side.

5.4 Tanks should be stowed so as to permit safe access for personnel in the necessary operation of the ship.

5.5 At no time should the tanks overstress the deck or hatches; the hatchcovers should be so secured to the ship that tipping of the entire hatchcover is prevented.

### 6. Securing against Sliding and Tipping

#### 6.1 Non-standardized portable tanks

6.1.1 The securing devices on non-standardized portable tanks and on the ship should be arranged in such a way as to withstand the transverse and longitudinal forces, which may give rise to sliding and tipping. The lashing angles against sliding should not be higher than 25° and against tipping not lower than 45° to 60° (figure 1).



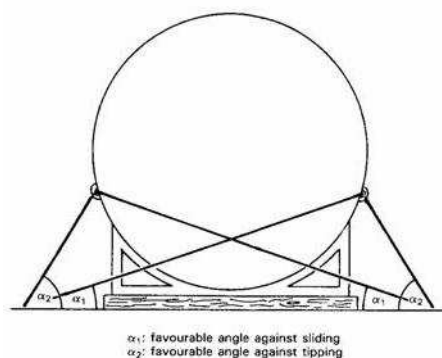


Figure 1 – Securing of portable tanks with favourable lashing angles

- 6.1.2 Whenever necessary, timber should be used between the deck surface and the bottom structure of the portable tank in order to increase friction. This does not apply to tanks on wooden units or with similar bottom material having a high coefficient of friction.
- 6.1.3 If stowage under deck is permitted, the stowage should be such that the portable non-standardized tank can be landed directly on its place and bedding.
- 6.1.4 Securing points on the tank should be of adequate strength and clearly marked.

Note: Securing points designed for road and rail transport may not be suitable for transport by sea.

- 6.1.5 lashings attached to tanks without securing points should pass around the tank and both ends of the lashing should be secured to the same side of the tank (figure 2).

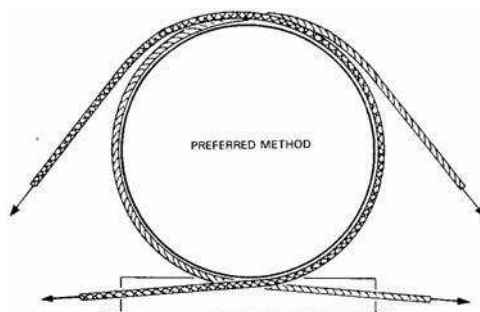


Figure 2 – Securing of portable tanks having no securing points

- 6.1.6 Sufficient securing devices should be arranged in such a way that each device takes its share of the load with an adequate factor of safety.
- 6.1.7 The structural strength of the deck or hatch components should be taken into consideration when tanks are carried thereon and when locating and affixing the securing devices.
- 6.1.8 Portable tanks should be secured in such a manner that no load is imposed on the tank or fittings in excess of those for which they have been designed.
- 6.2 Standardized portable tanks (tank-containers)
  - 6.2.1 Standardized portable tanks with ISO frame dimensions should be secured according to the system of lashing with which the ship is equipped, taking into consideration the height of the tank above the deck and the ullage in the tank.

- 7. Maintenance of securing arrangements
  - 7.1 The integrity of the securing arrangements should be maintained throughout the voyage.
  - 7.2 Particular attention should be paid to the need for tight lashings, grips and clips to prevent weakening through chafing.
  - 7.3 Lashings should be regularly checked and retightened.

### **ANNEX 3      Safe stowage and securing of portable receptacles.**

- 1 Introduction
  - 1.1 A portable receptacle, in the context of these guidelines means a receptacle not being a portable tank, which is not permanently secured on board the ship and has a capacity of 1,000 l or less and has different dimensions in length, width, height and shape and which is used for the transport of gases or liquids.
- 2 Portable receptacles can be divided into:
  - .1 cylinders of different dimensions without securing points and having a capacity not exceeding 150 l;
  - .2 receptacles of different dimensions with the exception of cylinders in conformity with 2.1 having a capacity of not less than 100 l and not more than 1,000 l and whether or not fitted with hoisting devices of sufficient strength; and
  - .3 assemblies, known as "frames", of cylinders in conformity with 2.1, the cylinders being interconnected by a manifold within the frame and held firmly together by metal fittings. The frames are equipped with securing and handling devices of sufficient strength (e.g. cylindrical receptacles are equipped with rolling hoops and receptacles are secured on skids).
- 3 Cargo Information
  - 3.1 The master should be provided with at least the following information:
    - .1 dimensions of the receptacle and commodity if non-dangerous and, if dangerous, the information as required in accordance with the IMDG Code;
    - .2 gross mass of the receptacles; and
    - .3 whether or not the receptacles are equipped with hoisting devices of sufficient strength.

Note: Where in this annex the term receptacle is used, it is meant to include both receptacles and cylinders.
- 4 Stowage
  - 4.1 The typical distribution of accelerations of the ship should be borne in mind in deciding whether the receptacles should be stowed on or under deck.
  - 4.2 The receptacles should preferably be stowed in the fore-and-aft direction on or under deck.

- 4.3 Receptacles should be dunnaged to prevent their resting directly on a steel deck. They should be stowed and chocked as necessary to prevent movement unless mounted in a frame as a unit. Receptacles for liquefied gases should be stowed in an upright position.
- 4.4 When the receptacles are stowed in an upright position, they should be stowed in a block, cribbed or boxed in with suitable and sound timber. The box or crib should be dunnaged underneath to provide clearance from a steel deck. The receptacles in a box or crib should be braced to prevent movement. The box or crib should be securely chocked and lashed to prevent movement in any direction.

## 5 Securing Against Sliding And Shifting

### 5.1 Cylinders

Cylinders should be stowed fore-and-aft on athwart ships dunnage. Where practicable, the stow should be secured by using two or more wires, laid athwart ships prior to loading, and passed around the stow to securing points on opposite sides. The wires are tightened to make a compact stow by using appropriate tightening devices. During loading, wedges may be necessary to prevent cylinders rolling.

### 5.2 Cylinders in containers

Cylinders should, whenever practicable, be stowed upright with their valves on top and with their protective caps firmly in place. Cylinders should be adequately secured, so as to withstand the rigours of the intended voyage, by means of steel strapping or equivalent means led to lashing points on the container floor. When cylinders cannot be stowed upright in a closed container, they should be carried in an open top or a platform-based container.

### 5.3 Receptacles

Securing of receptacles stowed on or under deck should be as follows:

- .1 lashings should be positioned as shown in figure 1;
- .2 where possible, the hoisting devices on receptacles should be used to lash them; and
- .3 at regular times the lashings should be checked and re-tightened.

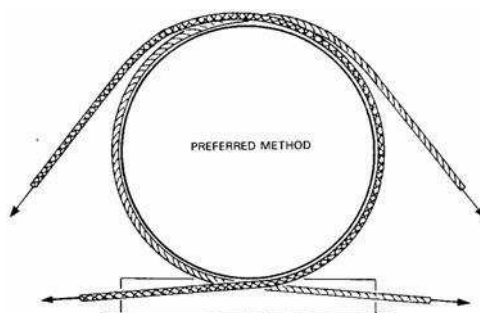


Figure 1 – Securing of receptacles having no securing points

**ANNEX 4      Safe stowage and securing of wheel-based (rolling) cargoes****1      Introduction**

Wheel-based cargoes, in the context of these guidelines, are all cargoes which are provided with wheels on tracks, including those which are used for the stowage and transport of other cargoes, except trailers and roadtrains, but including buses, military vehicles with or without tracks, tractors, earth-moving equipment, rolltrailers, etc.

**2      General Recommendations**

- 2.1 The cargo spaces in which wheel-based cargo is to be stowed should be dry, clean and free from grease and oil.
- 2.2 Wheel-based cargoes should be provided with adequate and clearly marked securing points or other equivalent means of sufficient strength to which lashings may be applied.
- 2.3 Wheel-based cargoes which are not provided with securing points should have those places where lashings may be applied, clearly marked.
- 2.4 Wheel-based cargoes, which are not provided with rubber wheels or tracks with friction-increasing lower surfaces, should always be stowed on wooden dunnage or other friction-increasing material such as soft boards, rubber mats, etc.
- 2.5 When in stowage position, the brakes of a wheel-based unit, if so equipped, should be set.
- 2.6 Wheel-based cargoes should be secured to the ship by lashings made of material having strength and elongation characteristics at least equivalent to steel chain or wire.
- 2.7 Where possible, wheel-based cargoes, carried as part cargo, should be stowed close to the ship's side or in stowage positions which are provided with sufficient securing points of sufficient strength, or be block stowed from side to side of the cargo space.
- 2.8 To prevent any lateral shifting of wheel-based cargoes not provided with adequate securing points, such cargoes should, where practicable, be stowed close to the ship's side and close to each other, or be blocked off by other suitable cargo units such as loaded containers, etc.
- 2.9 To prevent the shifting of wheel-based cargoes, it is, where practicable, preferable to stow those cargoes in a fore-and-aft direction rather than athwart ships. If wheel-based cargoes are inevitably stowed athwart ships, additional securing of sufficient strength may be necessary.
- 2.10 The wheels of wheel-based cargoes should be blocked to prevent shifting.
- 2.11 Cargoes stowed on wheel-based units should be adequately secured to stowage platforms or, where provided with suitable means, to its sides. Any movable external components attached to a wheel-based unit, such as derricks, arms or turrets should be adequately locked or secured in position.

## **ANNEX 5      Safe stowage and securing of heavy cargo items such as locomotives, transformers, etc.**

### **1      Cargo Information**

The master should be provided with sufficient information on any heavy cargo offered for shipment so that he can properly plan its stowage and securing; the information should at least include the following:

- .1 gross mass;
- .2 principal dimensions with drawings or pictorial descriptions, if possible;
- .3 location of the centre of gravity;
- .4 bedding areas and particular bedding precautions if applicable;
- .5 lifting points or slinging positions; and
- .6 securing points, where provided, including details of their strength.

### **2      Location of Stowage**

- 2.1 When considering the location for stowing a heavy cargo item, the typical distribution of accelerations on the ship should be kept in mind:

- .1 lower accelerations occur in the midship sections and below the weather deck; and
- .2 higher accelerations occur in the end sections and above the weather deck.

- 2.2 When heavy items are to be stowed on deck, the expected “weather side” of the particular voyage should be taken into account if possible.

- 2.3 Heavy items should preferably be stowed in the fore-and-aft direction.

### **3      Distribution of Weight**

The weight of the item should be distributed in such a way as to avoid undue stress on the ship's structure. Particularly with the carriage of heavy items on decks or hatch covers, suitable beams of timber or steel of adequate strength should be used to transfer the weight of the item onto the ship's structure.

### **4      Cargo Stowed in Open Containers, on Platforms or Platform-based Containers**

- 4.1 While the stowage and securing of open containers, ISO platforms or platform-based containers (flatracks) on a containership or a ship fitted or adapted for the carriage of containers should follow the information for that system. The stowage and securing of the cargo in such containers should be carried out in accordance with the *IMO/ILO Guidelines for Packing Cargo in Freight Containers or Vehicles*.

- 4.2 When heavy cargo items are carried on ISO platforms or platform-based containers (flat racks) the provisions of this annex should be followed.

- .1 The ISO standard platform, etc., used should be of a suitable type with regards to strength and MSL of the securing points.
- .2 The weight of the heavy cargo item should be properly distributed.

- .3 Where deemed necessary, the heavy cargo item(s) carried on ISO standard platform(s) or platform-based containers, etc., should not only be secured to the platform(s) or platform-based containers, etc., but also to neighbouring platform(s), etc., or to securing points located at fixed structure of the ship. The elasticity of the last-mentioned lashing should be sufficient in line with the overall elasticity of the stowage block underneath the heavy cargo item(s) in order to avoid overloading those lashings.

## 5 Securing Against Sliding and Tipping

- 5.1 Whenever possible, timber should be used between the stowage surface and the bottom of the unit in order to increase friction. This does not apply to items on wooden cradles or on rubber tyres or with similar bottom material having a high coefficient of friction.
- 5.2 The securing devices should be arranged in a way to withstand transverse and longitudinal forces which may give rise to sliding or tipping.
- 5.3 The optimum lashing angle against sliding is about  $25^\circ$ , while the optimum lashing angle against tipping is generally found between  $45^\circ$  and  $60^\circ$  (figure 1).

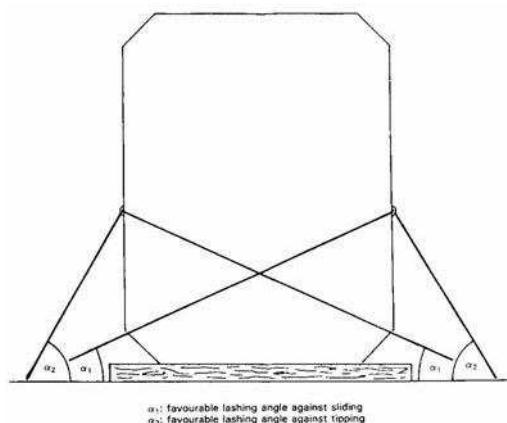


Figure 1 – Principles of securing heavy items against sliding and tipping

- 5.4 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.
- 5.5 If, owing to circumstances, lashings can be set at large angles only, sliding must be prevented by timber shoring, welded fittings or other appropriate means. Any welding should be carried out in accordance with accepted hot work procedures.

## 6 Securing Against Heavy Seas on Deck

Whilst it is recognised that securing cargo items against heavy seas on deck is difficult, all efforts should be made to secure such items and their supports to withstand such impact and special means of securing may have to be considered.

## 7 Heavy Cargo Items Projecting over the Ship's Side

Items projecting over the ship's side should be additionally secured by lashings acting in longitudinal and vertical directions.

## 8 Attachment of Lashings to Heavy Cargo Items

- 8.1 If lashings are to be attached to securing points on the item, these securing points should be of adequate strength and clearly marked. It should be borne in mind that securing points designed for road or rail transport may not be suitable for securing the items on board ship.
- 8.2 Lashings attached to items without securing points should pass around the item, or a rigid part thereof, and both ends of the lashing should be secured to the same side of the unit (figure 2).

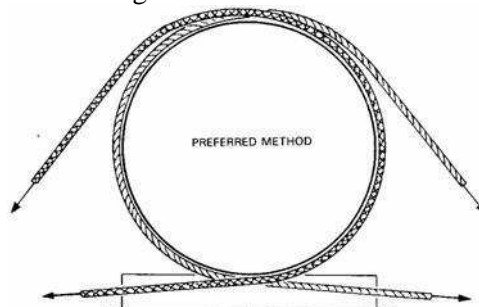


Figure 2 – Principle of securing heavy items having no suitable securing points

## 9. Composition and Application of Securing Devices

- 9.1 Securing devices should be assembled so that each component is of equal strength.
- 9.2 Connecting elements and tightening devices should be used in the correct way. Consideration should be given to any reduction of the strength of the lashings during the voyage through corrosion, fatigue or mechanical deterioration and should be compensated by using stronger securing material.
- 9.3 Particular attention should be paid to the correct use of wire, grips and clips. The saddle portion of the clip should be applied to the live load segment and the U-bolt to the dead or shortened end segment.
- 9.4 Securing devices should be arranged in such a way that each device takes its share of load according to its strength.
- 9.5 Mixed securing arrangements of devices with different strength and elongation characteristics should be avoided.

## 10 Maintenance of securing arrangements

- 10.1 The integrity of the securing arrangements should be maintained throughout the voyage.
- 10.2 Particular attention should be paid to the need for tight lashings, grips and clips and to prevent weakening through chafing. Timber cradles, beddings and shorings should be checked.
- 10.3 Greasing the tread of clips and turnbuckles increases their holding capacity and prevents corrosion.

## 11 Securing Calculation

- 11.1 Where necessary, the securing arrangements for heavy cargo items should be verified by an appropriate calculation in accordance with annex 13 to the Code.

## ANNEX 6 Safe stowage and securing of coiled sheet steel

### 1 General

1.1 This annex deals only with coiled sheet steel stowed on the round. Vertical stowage is not dealt with because this type of stowage does not create any special securing problems.

1.2 Normally, coils of sheet steel have a gross mass in excess of 10 tonnes each.

### 2 Coils

2.1 Coils should be given bottom stow and, whenever possible, be stowed in regular tiers from side to side of the ship.

2.2 Coils should be stowed on dunnage laid athwartships. Coils should be stowed with their axes in the fore – and – aft direction. Each coil should be stowed against its neighbour. Wedges should be used as stoppers when necessary during loading and discharging to prevent shifting (figures 1 and 2).

2.3 The final coil in each row should normally rest on the two adjacent coils. The mass of this coil will lock the other coils in the row.

2.4 If it is necessary to load a second tier over the first, then the coils should be stowed in between the coils of the first tier (figure 2).

2.5 Any void space between coils in the topmost tier should be adequately secured (figure 3).

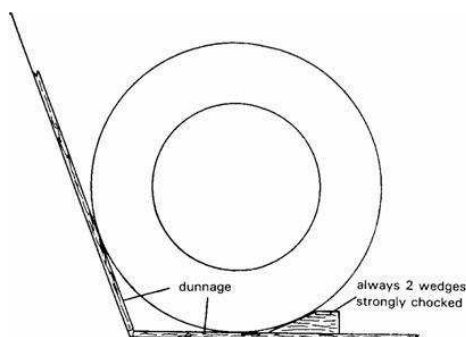


Figure 1 – Principle of dunnaging and wedging coils

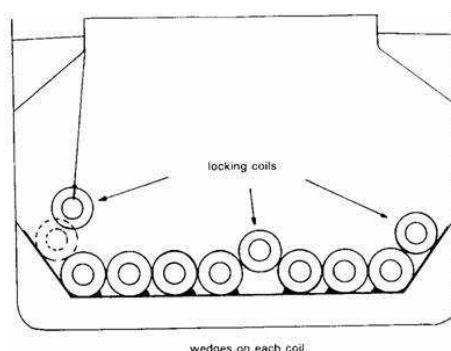


Figure 2 – Inserting of locking coils



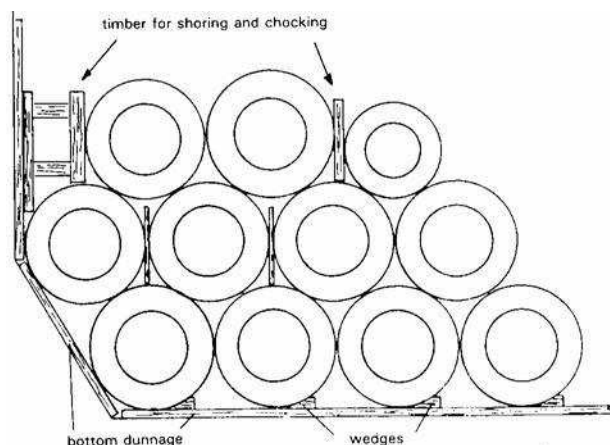


Figure 3 – Shoring and chocking in voids between coils

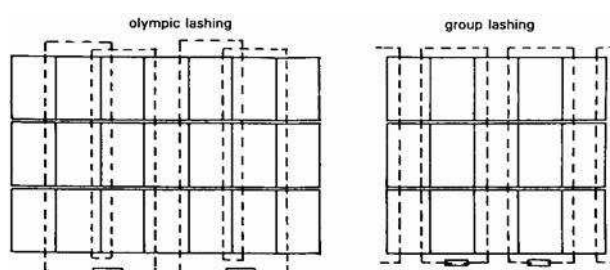


Figure 4 – Securing of top tier against fore-and-aft shifting (view from top)

### 3 Lashings

- 3.1 The objective is to form one large, immovable block of coils in the hold by lashing them together. In general, strip coils in three end rows in the top tier should be lashed. To prevent fore-and-aft shifting in the top tier of bare-wound coils group-lashing should not be applied due to their fragile nature; the end row of a top tier should be secured by dunnage and wires, which are to be tightened from side to side, and by additional wires to the bulkhead. When coils are fully loaded over the entire bottom space and are well shored, no lashings are required except for locking coils (figures 4, 5, and 6).

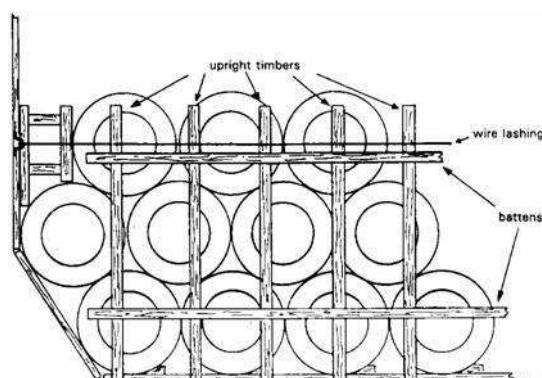


Figure 5 – Securing of end row in top tier against fore-and-aft shifting

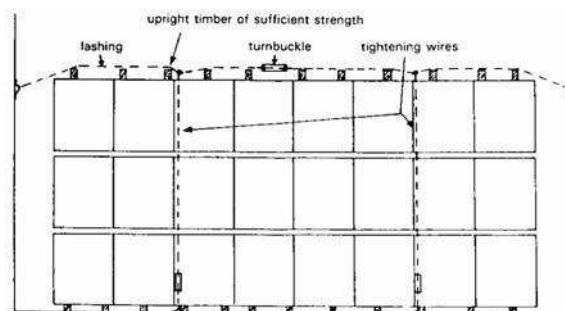


Figure 6 – Securing of end row in top tier against fore-and-aft shifting (view from top)

- 3.2 The lashings can be of a conventional type using wire steel band or any equivalent means.
- 3.3 Conventional lashings should consist of wires having sufficient tensile strength. The first tier should be chocked. It should be possible to re-tighten the lashings during the voyage (figures 5 and 6).
- 3.4 Wire lashings should be protected against damage from sharp edges.
- 3.5 If there are few coils, or a single coil only, they should be adequately secured to the ship, by placing them in cradles, by wedging, or by shoring and then lashing to prevent transverse and longitudinal movement.
- 3.6 Coils carried in containers, railway wagons and road vehicles should be stowed in cradles or specially made beds and should be prevented from moving by adequate securing.

## ANNEX 7 Safe stowage and securing of heavy metal products

### 1 General

- 1.1 Heavy metal products in the context of this Code include any heavy item made of metal, such as bars, pipes, rods, plates, wire coils, etc.
- 1.2 The transport of heavy metal products by sea exposes the ship to the following principal hazards:
  - .1 overstressing of the ship's structure if the permissible hull stress or permissible deck loading is exceeded;
  - .2 overstressing of the ship's structure as a result of a short roll period caused by excessive metacentric height; and
  - .3 cargo shifting because of inadequate securing resulting in a loss of stability or damage to the hull or both.

### 2 Recommendations

- 2.1 The cargo spaces in which heavy metal products are to be stowed should be clean, dry and free from grease and oil.
- 2.2 The cargo should be so distributed as to avoid undue hull stress.
- 2.3 The permissible deck and tank top loading should not be exceeded.

- 2.4 The following measures should be taken when stowing and securing heavy metal products:
- .1 cargo items should be stowed compactly from one side of the ship to the other leaving no voids between them and using timber blocks between items if necessary;
  - .2 cargo should be stowed level whenever possible and practicable;
  - .3 the surface of the cargo should be secured; and
  - .4 the shoring should be made of strong, non-splintering wood and adequately sized to withstand the acceleration forces. One shoring should be applied to every frame of the ship but at intervals of not less than 1 m.
- 2.5 In the case of thin plates and small parcels, alternate fore-and-aft and athwart ships stowage has proved satisfactory. The friction should be increased by using sufficient dry dunnage or other material between the different layers.
- 2.6 Pipes, rails, rolled sections, billets, etc., should be stowed in the fore and-aft direction to avoid damage to the sides of the ship if the cargo shifts.
- 2.7 The cargo, and especially the topmost layer, can be secured by:
- .1 having other cargo stowed on top of it; or
  - .2 lashing by wire, chocking off or similar means.
- 2.8 Whenever heavy metal products are not stowed from side to side of the ship, special care should be taken to secure such stowage's adequately.
- 2.9 Whenever the surface of the cargo is to be secured, the lashings should be independent of each other, exert vertical pressure on the surface of the cargo, and be so positioned that no part of the cargo is unsecured.
- 3 Wire Coils
- 3.1 Wire coils should be stowed flat so that each coil rests against an adjacent coil. The coils in successive tiers should be stowed so that each coil overlaps the coils below.
- 3.2 Wire coils should be tightly stowed together and substantial securing arrangements should be used. Where voids between coils are unavoidable or where there are voids at the sides or ends of the cargo space, the stow should be adequately secured.
- 3.3 When securing wire coils stowed on their sides in several layers like barrels, it is essential to remember that, unless the top layer is secured, the coils lying in the stow can be forced out of the stow by the coils below on account of the ship's motions.

## **ANNEX 8 Safe stowage and securing of anchor chains**

- 1 General
- 1.1 Anchor chains for ships and offshore structures are usually carried in bundles or in continuous lengths.
- 1.2 Provided certain safety measures are followed prior to, during and after stowage, anchor chains may be lowered directly onto the place of stowage in bundles without further handling, or stowed longitudinally either along the ship's entire cargo space or part thereof.

- 1.3 If the cargo plans given in the ship's documentation contain no specific requirements, the cargo should be distributed over the lower hold and 'tween-decks in such a way that stability values thus obtained will guarantee adequate stability.
- 2 Recommendations
  - 2.1 Cargo spaces in which chains are stowed should be clean and free from oil and grease.
  - 2.2 Chains should only be stowed on surfaces which are permanently covered either by wooden ceiling or by sufficient layers of dunnage or other suitable friction-increasing materials. Chains should never be stowed directly on metal surfaces.
- 3 Stowage And Securing Of Chains In Bundles
  - 3.1 Chains in bundles, which are lifted directly onto their place of stowage without further handling, should be left with their lifting wires attached and should preferably be provided with additional wires around the bundles for lashing purposes.
  - 3.2 It is not necessary to separate layers of chain with friction-increasing material such as dunnage because chain bundles will grip each other. The top layer of chain bundles should be secured to both sides of the ship by suitable lashings. Bundles may be lashed independently or in a group, using the lifting wires.
- 4 Stowage and Securing of Chains which are Stowed Longitudinally
  - 4.1 Stowage of each layer of chain should, whenever possible and practicable, commence and terminate close to the ship's side. Care should be taken to achieve a tight stow.
  - 4.2 It is not necessary to separate layers of chain with friction-increasing material such as dunnage because chain layers will grip each other.
  - 4.3 Bearing in mind the expected weather and sea conditions, the length and nature of the voyage and the nature of the cargo to be stowed on top of the chain, the top layer of each stow should be secured by lashings of adequate strength crossing the stow at suitable intervals and thus holding down the entire stow.

## **ANNEX 9 Safe stowage and securing of metal scrap in bulk**

- 1 Introduction
  - 1.1 This annex deals with the stowage of metal scrap which is difficult to stow compactly because of its size, shape and mass, but does not apply to metal scrap such as metal borings, shavings or turnings, the carriage of which is addressed by the Code of Safe Practice for Solid Bulk Cargoes.
  - 1.2 The hazards involved in transporting metal scrap include:
    - .1 shifting of the stow which in turn can cause a list;
    - .2 shifting of individual heavy pieces which can rupture the side plating below the waterline and give rise to serious flooding;
    - .3 excessive loading on tank tops or 'tween-decks; and
    - .4 violent rolling caused by excessive metacentric height.

## 2 Recommendations

- 2.1 Before loading, the lower battens of the spar ceiling should be protected by substantial dunnage to reduce damage and to prevent heavy and sharp pieces of scrap coming in contact with the ship's side plating. Air and sounding pipes, and bilge and ballast lines protected only by wooden boards, should be similarly protected.
- 2.2 When loading, care should be taken to ensure that the first loads are not dropped from a height which could damage the tank tops.
- 2.3 If light and heavy scrap is to be stowed in the same cargo space, the heavy scrap should be loaded first. Scrap should never be stowed on top of metal turnings, or similar forms of waste metal.
- 2.4 Scrap should be compactly and evenly stowed with no voids or unsupported faces of loosely held scrap.
- 2.5 Heavy pieces of scrap, which could cause damage to the side plating or end bulkheads if they were to move, should be overstowed or secured by suitable lashings. The use of shoring is unlikely to be effective because of the nature of the scrap.
- 2.6 Care should be taken to avoid excessive loading on tank tops and decks,

## **ANNEX 10 Safe stowage and securing of flexible intermediate bulk containers**

### 1 Introduction

- 1.1 A flexible intermediate bulk container (FIBC), in the context of these guidelines, means a flexible portable packaging to be used for the transport of solids with a capacity of not more than 3 m<sup>3</sup> (3,000 l) designed for mechanical handling and tested for its satisfactory resistance to transport and transport stresses in a one-way type or multi-purpose design.

### 2 Cargo Information

The master should at least be provided with the following information:

- .1 the total number of FIBCs and the commodity to be loaded;
- .2 the dimensions of the FIBCs;
- .3 the total gross mass of the FIBCs;
- .4 oneway type or multipurpose design; and
- .5 the kind of hoisting (one hook or more hooks to be used).

### 3 Recommendations

- 3.1 The ideal ship for the carriage of FIBCs is one with wide hatches so that the FIBCs can be landed directly in the stowage positions without the need for shifting.
- 3.2 The cargo spaces should, where practicable, be rectangular in shape and free of obstructions.
- 3.3 The stowage space should be clean, dry and free from oil and nails.

- 3.4 When FIBCs have to be stowed in deep hatch wings, easy access and sufficient manoeuvring space for suitably adapted forklift trucks should be available.
- 3.5 When FIBCs are stowed in the hatchway only, the space in the wings and the forward and aft end of the cargo space should be loaded with other suitable cargo or blocked off in such a way that the FIBCs are adequately supported.
- 4 Stowage
  - 4.1 The typical distribution of the accelerations of the ship should be kept in mind when FIBCs are loaded.
  - 4.2 The width of the ship divided by the width of the FIBC will give the number of FIBCs which can be stowed athwart ships and the void space left. If there will be a void space, the stowage of the FIBCs should start from both sides to the centre, so that any void space will be in the centre of the hatchway.
  - 4.3 FIBCs should be stowed as close as possible against each other and any void space should be chocked off.
  - 4.4 The next layers should be stowed in a similar way so that the FIBCs fully cover the FIBCs underneath. If in this layer a void space is left, it should also be chocked off in the centre of the hatchway.
  - 4.5 When there is sufficient room in the hatchway on top of the layers underneath to stow another layer, it should be established whether the coamings can be used as bulkheads. If not, measures should be taken to prevent the FIBCs shifting to the open space in the wings. Otherwise, the FIBCs should be stowed from one coaming to another. In both cases any void space should be in the centre and should be chocked off.
  - 4.6 Chocking off is necessary in all cases to prevent shifting of the FIBCs to either side and to prevent a list of the ship developing in rough weather (figure 1).
- 5 Securing
  - 5.1 In cases where only a part of a tweendeck or lower hold is used for the stowage of FIBCs, measures should be taken to prevent the FIBCs from shifting. These measures should include sufficient gratings or plywood sheets placed against the FIBCs and the use of wire lashings from side to side to secure the FIBC cargo.
  - 5.2 The wire lashings and plywood sheets used for securing should be regularly checked, in particular before and after rough weather, and re-tightened if necessary.

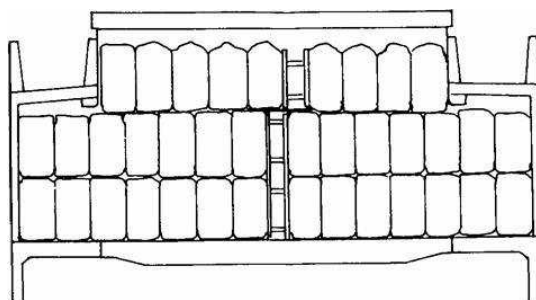


Figure 1 – Stowage of FIBCs with chocked void spaces in the centre of the stowage area

## ANNEX 11      General guidelines for the under-deck stowage of logs

### 1      Introduction

The purpose of this annex is to recommend safe practices for the under-deck stowage of logs and other operational safety measures designed to ensure the safe transport of such cargoes.

### 2      Prior to loading:

- .1 each cargo space configuration (length, breadth and depth), the cubic bale capacity of the respective cargo spaces, the various lengths of logs to be loaded, the cubic volume (log average), and the capacity of the gear to be used to load the logs should be determined;
- .2 using the above information, a pre-stow plan should be developed to allow the maximum utilisation of the available space; the better the under-deck stowage, the more cargo can safely be carried on deck;
- .3 the cargo spaces and related equipment should be examined to determine whether the condition of structural members, framework and equipment could affect the safe carriage of the log cargo. Any damage discovered during such an examination should be repaired in an appropriate manner;
- .4 the bilge suction screens should be examined to ensure they are clean, effective and properly maintained to prevent the admission of debris into the bilge piping system;
- .5 the bilge wells should be free of extraneous material such as wood bark and wood splinters;
- .6 the capacity of the bilge pumping system should be ascertained. A properly maintained and operating system is crucial for the safety of the ship. A portable dewatering pump of sufficient capacity and lift will provide additional insurance against a clogged bilge line;
- .7 side sparring, pipe guards, etc., designed to protect internal hull members should be in place; and
- .8 the master should ensure that the opening and closing of any high ballast dump valves are properly recorded in the ship's log. Given that such high ballast tanks are necessary to facilitate loading and bearing in mind regulation 22(1) of the International Convention on Load Lines, 1966, which requires a screw-down valve fitted in gravity overboard drain lines, the master should ensure that the dump valves are properly monitored to preclude the accidental readmission of water into these tanks. Leaving these tanks open to the sea could lead to an apparent inexplicable list, a shift of deck cargo and potential capsizing.

### 3      During loading operations:

- .1 each lift of logs should be hoisted aboard the ship in close proximity to the ship to minimise any potential swinging of the lift;
- .2 the possibility of damage to the ship and the safety of those who work in the cargo spaces should be considered. The logs should not be swinging when lowered into the space. The hatch coaming should be used, as necessary, to eliminate any swinging of the logs by gently resting the load against the inside of the coaming, or on it, prior to lowering;
- .3 the logs should be stowed compactly, thereby eliminating as many voids as is practicable. The amount and the vertical centre of gravity of the logs stowed under deck will govern the amount of cargo that can be safely stowed on deck. In considering this principle, the heaviest logs should be loaded first into the cargo spaces;
- .4 logs should generally be stowed compactly in a fore-and-aft direction, with the longer lengths towards the forward and aft areas of the space. If there is a void in the space between the fore and aft lengths it should be filled with logs stowed athwartships so as to fill in the void across the breadth of the spaces as completely as the length of the logs permits;



- .5 where the logs in the spaces can only be stowed fore-and-aft in one length, any remaining void forward or aft should be filled with logs stowed athwartships so as to fill in the void across the breadth of the space as completely as the length of the logs permits;
  - .6 athwartship voids should be filled tier by tier as loading progresses;
  - .7 butt ends of the logs should be alternately reversed to achieve a more level stowage, except where excess sheer on the inner bottom is encountered;
  - .8 extreme pyramiding of logs should be avoided to the greatest extent possible. If the breadth of the space is greater than the breadth of the hatch opening, pyramiding may be avoided by sliding fore-and-aft loaded logs into the ends of the port and starboard sides of the space. This sliding of logs into the ends of the port and starboard sides of the space should commence early in the loading process (after reaching a height of approximately 2 m above the inner bottom) and should continue throughout the loading process;
  - .9 it may be necessary to use loose tackle to manoeuvre heavy logs into the under-deck areas clear of the hatchways. Blocks, purchases and other loose tackle should be attached to suitably reinforced fixtures such as eyebolts or padeyes provided for this purpose. However, if this procedure is followed, care should be taken to avoid overloading the gear;
  - .10 a careful watch by ship's personnel should be maintained throughout the loading to ensure no structural damage occurs. Any damage which affects the seaworthiness of the ship should be repaired;
  - .11 when the logs are stowed to a height of about 1 m below the forward or aft athwartship hatch coaming, the size of the lift of logs should be reduced to facilitate stowing of the remaining area; and
  - .12 logs in the hatch coaming area should be stowed as compactly as possible to maximum capacity.
- 4 After loading, the ship should be thoroughly examined to ascertain its structural condition, bilges should be sounded to verify the ship's watertight integrity
- 5 During the voyage:
- .1 the ship's heeling angle and rolling period should be checked, in a seaway, on a regular basis;
  - .2 wedges, wastes, hammers and portable pump, if provided should be stored in an easily accessible place; and
  - .3 the master or a responsible officer should ensure that it is safe to enter an enclosed cargo space by:
    - .3.1 ensuring that the space has been thoroughly ventilated by natural or mechanical means;
    - .3.2 testing the atmosphere of the space at different levels for oxygen deficiency and harmful vapour where suitable instruments are available; and
    - .3.3 requiring self-contained breathing apparatus to be worn by all persons entering the space where there is any doubt as to the adequacy of ventilation or testing before entry.



## ANNEX 12 Safe stowing and securing of unit loads

### 1 Introduction

*Unit load* for the purposes of this annex means that a number of packages are either:

- .1 placed or stacked, and secured by strapping, shrink-wrapping or other suitable means, on a load board such as a pallet; or
- .2 placed in a protective outer packaging such as a pallet box; or
- .3 permanently secured together in a sling.

Note: A single large package such as a portable tank or receptacle, intermediate bulk container or freight container is excluded from the recommendations of this annex

### 2 Cargo Information

The master should be provided with at least the following information:

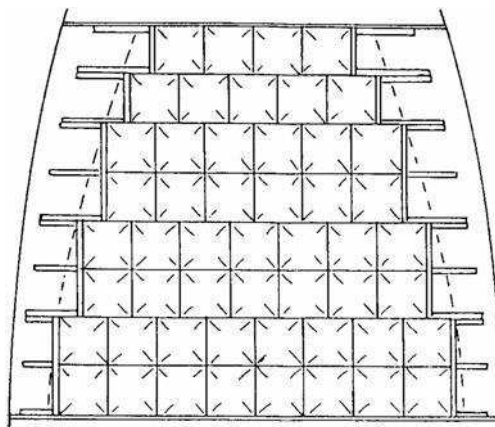
- .1 the total number of unit loads and commodity to be loaded;
- .2 the type of strapping or wrapping used;
- .3 the dimensions of a unit load in metres;
- .4 the gross mass of a unit load in kilogrammes; and
- .5 relevant examination certificates for pre-slung slings around cargo units. The slings should be identified by specific means, e.g., colour coding, batch number or otherwise.

### 3 Recommendations

- 3.1 The cargo spaces of the ship in which unit loads will be stowed should be clean, dry and free from oil and grease.
- 3.2 The decks, including the tank top, should be flush all over.
- 3.3 The cargo spaces should preferably be of a rectangular shape, horizontally and vertically. Cargo spaces of another shape in forward holds or in 'tweendecks should be transformed into a rectangular shape both athwartships and longitudinally by the use of suitable timber (figure 1).

### 4 Stowage

- 4.1 The unit loads should be stowed in such a way that securing, if needed, can be performed on all sides of the stow.



*Figure 1 – Stowage and chocking of unit loads in a tapered stowage area (view from top)*

- 4.2 The unit loads should be stowed without any void space between the loads and the ship's sides to prevent the unit loads from racking.
- 4.3 When unit loads have to be stowed on top of each other, attention should be paid to the strength of pallets and the shape and the condition of the unit loads.
- 4.4 Precautions should be taken when unit loads are mechanically handled to avoid damaging the unit loads.
- 5 Securing
  - 5.1 Block stowage should be ensured and no void space be left between the unit loads.
- 6 Securing when stowed athwart ships
  - 6.1 When unit loads are stowed in a lower hold or in a 'tween-deck against a bulkhead from side to side, gratings or plywood sheets should be positioned vertically against the stack of the unit loads. Wire lashings should be fitted from side to side keeping the gratings or plywood sheets tight against the stow.
  - 6.2 Additionally, lashing wires can be fitted at different spacing from the bulkhead over the stow to the horizontally placed wire lashings in order to further tighten the stow.
- 7 Stowage in a Wing of a Cargo Space and Free at Two Sides
  - 7.1 When unit loads are stowed in the forward or after end of a cargo space and the possibility of shifting in two directions exists, gratings or plywood sheets should be positioned vertically to the stack faces of the unit loads of the non-secured sides of the stow. Wire lashings should be taken around the stow from the wings to the bulkhead. Where the wires can damage the unit loads (particularly on the corners of the stow), gratings or plywood sheets should be positioned in such a way that no damage can occur on corners.
- 8 Stowage Free at Three Sides
  - 8.1 When unit loads are stowed against the ship's sides in such a way that shifting is possible from three sides, gratings or plywood sheets should be positioned vertically against the stack faces of the unit loads. Special attention should be paid to the corners of the stow to prevent damage to the unit loads by the wire lashings. Wire lashing at different heights should tighten the stow together with the gratings or plywood sheets at the sides (figure 2).

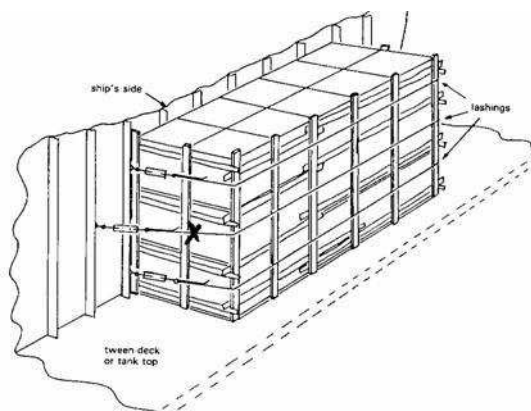


Figure 2 – Securing of units stowed at the ship's side

Note: Lashings must not place a sideways load on the frame/stiffener

## 9 General

- 9.1 Instead of gratings or plywood sheets, other possibilities are the use of aluminium stanchions or battens of sufficient strength.
- 9.2 During the voyage the wire lashings should be regularly inspected and slack wires should be re-tightened if necessary. In particular, after rough weather, wire lashings should be checked and re-tightened if necessary.



**Appendix VI – LASHCON™ IMO USER GUIDE**



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# LASHCON™ IMO

## USER GUIDE

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BY

DET NORSKE VERITAS

Version:  
Date:

## **1 General**

### **1.1 Introduction**

LASHCON™ is a MS EXCEL based calculation tool for evaluation of semi- and non-standardised securing arrangements.

The program calculates accelerations and balance of forces in semi- and non-standardised lashing arrangements in accordance with annex 13 to the Code of Safe Practice for Cargo Stowage and Securing (the CSS code) from IMO.

### **1.2 System requirements**

LASHCON™ requires Microsoft Windows version 3.1 or later, with Microsoft Excel 5.0 installed. Resources needed to run Microsoft Excel 5.0 are described in “Microsoft Excel User’s Guide”.

### **1.3 User requirements**


The user should be familiar with Microsoft products such as Excel and Word. This includes the use of mouse pointer.

NOTE: The decimal separator may differ from the examples given in this booklet.  
Normally either “.” or “,” is used.

## 2. User guide

### 2.1 Input sequence

- Once LASHCON™ has been started, the following screen picture will appear:

		Code of Safe Practice for Cargo Stowage and Securing 2003 Edition, Annex 13		<b>LASHCON IMO</b> Version 9.0 December 2003		Sign: <input type="text"/> Time: 16:48 Date: 04.02.19
<p><b>About LASHCON™:</b> LASHCON is a MS EXCEL based calculation tool for control of lashing-arrangements for semi- and non-standardised cargo. The program is developed by Det Norske Veritas, and is based on the calculation procedures outlined in Annex 13 to the Code of Safe Practice for Cargo Stowage and Securing, 2003 Edition.</p> <p><b>Program assumptions:</b> Reference is made to the User Manual.</p>						
<b>Input of main vessel data:</b>						Next page>>
Vessel Name:	Ship Id:	Lpp [m]:	B [m]:	V [kn]:	GM [m]:	
M/S Test Vessel	123456	73,5	14,0	10,0	1,8	Print
<p><b>NOTES:</b></p>						
<p>This version of Lashcon IMO contains the procedures for calculation of accelerations and lashing arrangement as given in the Code of Safe Practice for Cargo Stowage and Securing, 2003 Edition, Annex 13.</p> <p>Following enhancements have been incorporated:</p> <ol style="list-style-type: none"> <li>1. The range of validity for ship length has been extended down to L=30 m.</li> <li>2. The B/GM range has been extended down to B/GM = 4 by power series extrapolation.</li> </ol>						

- Input cells are marked white in LASHCON™. Not all input cells are necessary for successful computation. Ship name and identification is solely for user reference. Vessel main particulars are used for acceleration computation and must be filled in before proceeding. See 2.2 Input Data for details.

3. After successful completion of the input data, click on the button “*Next Page >>*” proceed to the “*Cargo and lashing data sheet*”. The following picture will then appear:

NAUTICUS hull		Code of Safe Practice for Cargo Stowage and Securing 2003 Edition, Annex 13		LASHCON IMO Version 9.0 December 2003		Sign: _____ Time: 16:48 Date: 04.02.19							
<b>Input of cargo unit data</b>				<b>Give cargo unit stowage position</b>									
Cargo unit specification: Mass of cargo unit: m _____ ton Coefficient of friction: $\mu$ _____ (-) ? Wind exposed area: $A_w$ _____ m <sup>2</sup> ? Sea exposed area: $A_s$ _____ m <sup>2</sup> ? Lever arm of tipping: a _____ m ? Lever arm of stability: b _____ m ?				Vertical: Deck, high ? Longitudinal: AP Calculation method: <input checked="" type="radio"/> Alternative calculation ? <b>Recommended.</b> <input type="radio"/> Advanced calculation ?									
<b>Input of lashing data</b>													
Max securing load [kN]: MSL				1	2	3	4	5	6	7	8	9	10
Transverse lashing direction				▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Longitudinal lashing direction				▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Vertical securing angle [degr]: $\alpha$													
Vertical securing angle [degr]: $\beta$													
Horizontal securing point distance: d [m]													
<b>RESULTS:</b>													
<b>Actual forces</b>				<b>Securing capacity [kN / kNm]</b>				<b>Accelerations</b>				<b>Show Graph &gt;&gt;</b>	
Transverse sliding force [kN]: 0,0				Transv. capacity: PS [kN] 0 OK SB [kN] 0 OK				Transverse: $a_t = 10,71$ m/s <sup>2</sup>					
Longitudinal sliding force [kN]: 0,0				Long. capacity: Fwd [kN] 0 OK Aft [kN] 0 OK				Vertical: $a_v = 9,28$ m/s <sup>2</sup>					
Cargo tipping moment [kNm]: 0,0				Tipping capacity: PS [kN] 0 OK SB [kN] 0 OK				Longitudinal: $a_l = 3,83$ m/s <sup>2</sup>					
<<< Main Data				Print				Save to stack				Clear last	
								Clear stack				Show stack >>	
<b>Main Vessel Data:</b>													
Vessel Name:		Ship Id:		Lpp [m]:		B [m]:		V [kn]:		GM [m]:			
M/S Test Vessel		123456		73,50		14,00		10,00		1,80			

For help on input data, press the “?” button to the right of the respective input. The input parameters are the same as explained in “Code of Safe Practice for Cargo Stowage and Securing Annex 13.

4. Fill in the in the “*Input of cargo unit data*” field.
5. Select the “*Cargo unit stowage position*” (vertical and longitudinal) by using the drop-down selection boxes in the upper right corner of the screen.
6. Select the desired method of calculation.
  - Advanced calculation, see 2.3 Calculation Methods
  - Alternative calculation, see 2.3 Calculation Methods
7. Give the applicable lashing particulars
  - MSL of lashing. [kN]
  - Lashing direction for drop down boxes.
  - Vertical securing angle [deg]
  - Horizontal securing angle [deg] (Alternative method only.)



- Horizontal securing point distance [m]
- 8. Calculation results are shown in the yellow area. “**Actual forces**” is the forces acting on the cargo unit due to the “**Accelerations**” at the given lashing position. “**Securing capacity**” is the accumulated lashing forces from applied lashings. If sufficient number of lashings is applied, compliance will be shown by “**OK**” in red fonts to the right of each capacity.
- 9. Acceleration data for the whole ship can be extracted from the “**Tables and graphs**” sheet. This can be accessed by either pressing the “**Show graph >>**” button or by pressing the “**Tables and graphs**” tab.

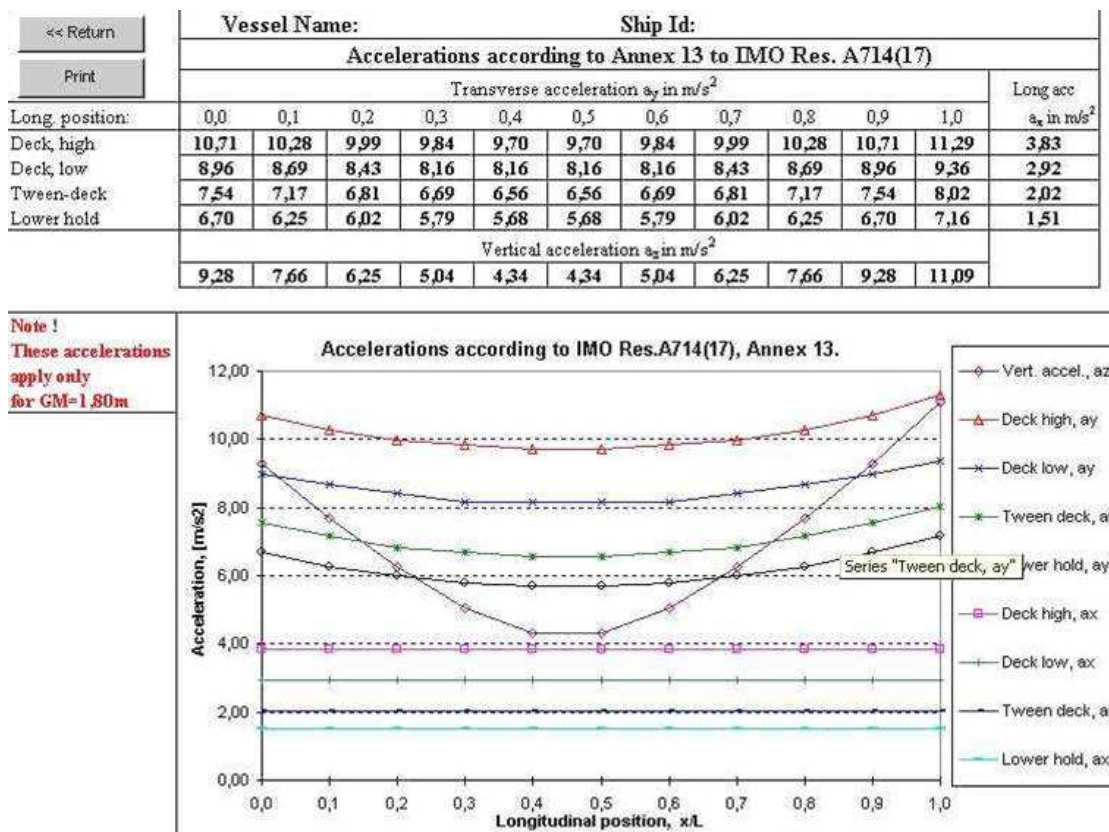


Chart and table showing the accelerations along the ship length, based on the annex 13 to the IMO CSS code.

## 2.2 Input data

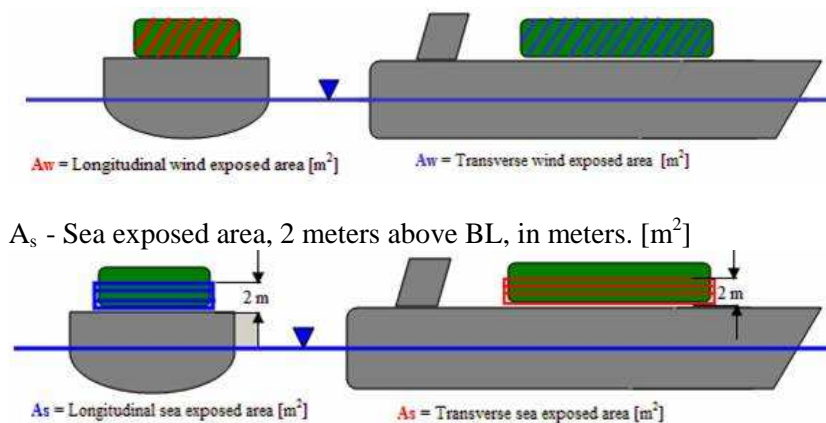
### Main ship data:

- Lpp - Length between perpendiculars in meters [m]
- B - Ship breadth in meters [m]
- V - Ship speed in knots [knots]
- GM - Ship GM value in meters [m]

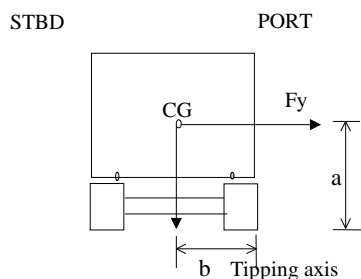
### Main cargo data:

- m - Mass of cargo unit in tonnes [ton]
- $\mu$  - Coefficient of friction [ - ]
- $A_w$  - Wind exposed area in square meters. [m<sup>2</sup>]



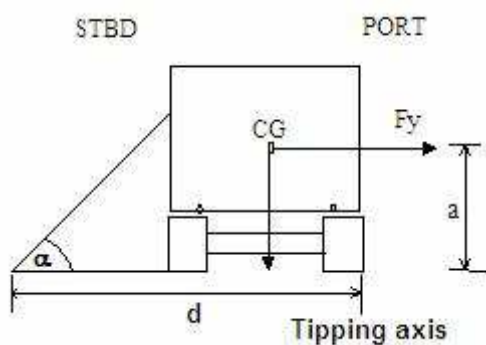


- a - Lever arm of tipping, i.e. height of cargo unit CG above deck, in meters. [m]
- b - Lever arm of stability in meters. [m]



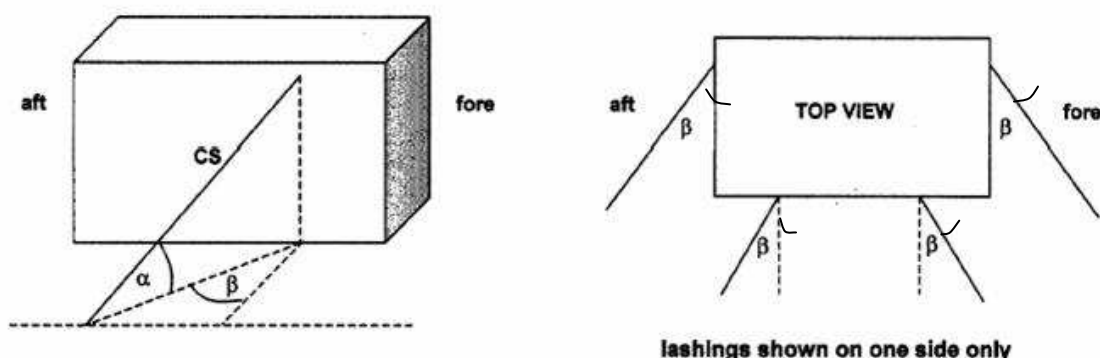
#### Advanced calculation, lashing parameters:

- MSL - Max securing load [kN]
- $\alpha$  - Vertical securing angle [degrees]
- d - Lever arm of securing force [m]



#### Alternative calculation, lashing parameters:

- MSL - Max securing load [kN]
- $\alpha$  - Vertical securing angle [degrees]
- $\beta$  - Horizontal securing angle [degrees]
- d - Lever arm of securing force [m] (See Advanced Calculation, lashing parameters)



## 2.3 Calculation methods

### Advanced calculation method

The advanced method is based on force equilibrium of internal inertia forces and external lashing forces. Additionally, the risk of tipping is evaluated on basis of moment equilibrium. Forces due to wind, sea and friction are accounted for. Elastic characteristics of lashings are not included.

In advanced calculations only the vertical angle of lashings,  $\alpha$ , is included. Calculated strength of lashing,  $CS$ , is  $MSL / 1.5$ .

For detailed theory outline, please refer to CSS, Annex 13.

### Alternative calculation method

The alternative calculation method is based on force equilibrium of internal inertia forces and external lashing forces. Additionally, the risk of tipping is evaluated on basis of moment equilibrium. Forces due to wind, sea and friction are accounted for. Elastic characteristics of lashings are not included.

The alternative method accounts for both the vertical of lashings,  $\alpha$ , and horizontal angle of lashing  $\beta$ . The alternative method approach is regarded as more accurate than the advanced method. Hence the utilization of lashing strength is higher. Calculated strength of lashing,  $CS$ , is  $MSL / 1.35$ .

### Which calculation method to choose?

The alternative calculation method is the most sophisticated with respect to force equilibrium. Hence, the allowable usage of the MSL is slightly higher. This method is therefore recommended. It should be noted that none of the calculation methods includes the elastic properties of the lashings. It is therefore important that the cargo unit is lashed with lashings of same type, with approximate equal elasticity. Lashing ropes and chains should not be combined. It is recommended to keep the lashings of approximately same lengths.

## 2.4 Special features of Lashcon IMO

### Stack function:

LASHCON<sup>TM</sup> offers the possibility of saving your results in a stack. Lashing results, together with basic input is saved in a compact form in a table. In this way, the effect of different lashing arrangements or stowing positions can be compared in an easy manner.

Stack buttons:

“Save to stack”: Current lashing data and results are saved to the stack.

“Clear last”: Removes the last entry in the stack.

“Clear stack”: Removes the contents of the entire stack.

“Show stack”: Shows the stack.

## 2.5 Program assumptions

The calculation of accelerations and evaluation of lashing arrangements is based on the method described in annex 13 to the CSS code. For details on theory for evaluation of forces, please refer to CSS Annex 13. The following assumptions are directly quoted from the code:

*A vertical securing angle  $\alpha$  greater than  $60^\circ$  will reduce the effectiveness of this particular securing device in respect of sliding of the unit. Disregarding of such devices from the balance of forces should be considered, unless the necessary load is gained by the imminent tendency to tipping or by a reliable pre-tensioning of the securing device and maintaining the pre-tension throughout the voyage.*

*Any horizontal securing angle, i.e. deviation from the transverse direction should not exceed  $30^\circ$ , otherwise an exclusion of this securing device from the transverse sliding balance should be considered.*

LASHCON<sup>TM</sup> applies to lashing arrangements with vertical securing angles in the range according to table 5 in annex 13, i.e.  $-30^\circ \leq \alpha \leq 90^\circ$ . Lashing angles outside this range may give corrupt results. In case such angle is given the program will give the following warning:

$\alpha < -30^\circ$  or  $\alpha > 90^\circ$  : **Warning! Securing angle outside range stated in annex 13.**

The acceleration figures shown in table 3 in annex 13 are basis for the calculation of accelerations in LASHCON<sup>TM</sup>, and apply in principle to ships with  $50 \text{ m} \leq L \leq 200 \text{ m}$ ,  $9 \text{ kn} \leq V \leq 24 \text{ kn}$  and  $B/GM \geq 7$ .

In LASHCON<sup>TM</sup>, however, the accelerations have been extrapolated by means of power series to apply for ships with  $L > 30 \text{ m}$ , and speed up to 25 knots. The B/GM has been extrapolated to apply down to  $B/GM = 4$ . LASHCON<sup>TM</sup> does not calculate transverse accelerations if  $B/GM < 4$ . If input parameters are outside the applicable range, the following warnings will appear:

$L > 200 \text{ m}$  : **Warning!  $L > 200$ .**  
**Accelerations are extrapolated outside the range given in annex 13!**

$B/GM < 7$  : **Warning!  $B/GM < 7$ .**  
**Accelerations are extrapolated outside the range given in annex 13!**

$B/GM < 4$  : **Warning!  $B/GM < 4$ .**  
**Transverse accelerations are not calculated!**

$V > 25 \text{ kn}$ : **Warning!  $V > 25 \text{ kn}$ .**  
**Accelerations are not calculated!**

Explanation of variables is given in the Help-function in LASHCON<sup>TM</sup>. A complete explanation of variables involved and a full set of assumptions may be found in annex 13.