GUIDELINES

FOR THE PREPARATION OF

THE CARGO SECURING MANUAL

NI 429 DNC R01 E
April 2004

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17 bis place des Reflets - La Défense 2 - 92400 Courbevoie
Tel. 33 (1) 42 91 52 91 - Telex 615676 F BVDNC - Fax 33 (1) 42 91 52 98
Postal Address 92077 Paris la Défense Cedex

MARINE DIVISION
GENERAL CONDITIONS

ARTICLE 1

1.1. - BUREAU VERITAS is a Society the purpose of whose Marine Division (the "Society") is the classification ("Classification") of any ship or vessel or structure of any type or part of it or system therein collectively hereinafter referred to as a "Unit" whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.
The Society:

- prepares and publishes Rules for classification, Guidance Notes and other documents ("Rules");
- issues Certificates, Attestations and Reports following its interventions ("Certificates");
- publishes Registers.

1.2. - The Society also participates in the application of National and International Regulations or Standards, in particular by delegation from different Governments. Those activities are hereafter collectively referred to as "Certification".

1.3. - The Society can also provide services related to Classification and Certification such as ship and company safety management certification; ship and port security certification, training activities; all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board.

1.4. - The interventions mentioned in 1.1., 1.2. and 1.3. are referred to as "Services". The party and/or its representative requesting the services is hereinafter referred to as the "Client". **The Services are prepared and carried out on the assumption that the Clients are aware of the International Maritime and/or Offshore Industry (the "Industry") practices.**

1.5. - The Society is neither and may not be considered as an Underwriter, Broker in ship's sale or chartering, Expert in Unit's valuation, Consulting Engineer, Controller, Naval Architect, Manufacturer, Shipbuilder, Repair yard, Charterer or Shipowner who are not relieved of any of their expressed or implied obligations by the interventions of the Society.

ARTICLE 2

2.1. - Classification is the appraisement given by the Society for its Client, at a certain date, following surveys by its Surveyors along the lines specified in Articles 3 and 4 hereafter on the level of compliance of a Unit to its Rules or part of them. This appraisement is represented by a class entered on the Certificates and periodically transcribed in the Society's Register.

2.2. - Certification is carried out by the Society along the same lines as set out in Articles 3 and 4 hereafter and with reference to the applicable National and International Regulations or Standards.

2.3. - **It is incumbent upon the Client to maintain the condition of the Unit after surveys, to present the Unit for surveys and to inform the Society without delay of circumstances which may affect the given appraisement or cause to modify its scope.**

2.4. - The Client is to give to the Society all access and information necessary for the performance of the requested Services.

ARTICLE 3

3.1. - The Rules, procedures and instructions of the Society take into account at the date of their preparation the state of currently available and proven technical knowledge of the Industry. They are not a code of construction neither a guide for maintenance or a safety handbook.

Committees consisting of personalities from the Industry contribute to the development of those documents.

3.2. - The Society only is qualified to apply its Rules and to interpret them. Any reference to them has no effect unless it involves the Society's intervention.

3.3. - The Services of the Society are carried out by professional Surveyors according to the Code of Ethics of the Members of the International Association of Classification Societies (IACS).

3.4. - The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not in any circumstances involve monitoring or exhaustive verification.

ARTICLE 4

4.1. - The Society, acting by reference to its Rules:

- reviews the construction arrangements of the Units as shown on the documents presented by the Client;
- conducts surveys at the place of their construction;
- classes Units and enters their class in its Register;
- surveys periodically the Units in service to note that the requirements for the maintenance of class are met.

The Client is to inform the Society without delay of circumstances which may cause the date or the extent of the surveys to be changed.

ARTICLE 5

5.1. - The Society acts as a provider of services. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty.

5.2. - The certificates issued by the Society pursuant to 5.1. here above are a statement on the level of compliance of the Unit to its Rules or to the documents of reference for the Services provided for.

In particular, the Society does not engage in any work relating to the design, building, production or repair checks, neither in the operation of the Units or in their trade, neither in any advisory services, and cannot be held liable on those accounts. Its certificates cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.

5.3. - The Society does not declare the acceptance or commissioning of a Unit, nor of its construction in conformity with its design, that being the exclusive responsibility of its owner or builder, respectively.

5.4. - The Services of the Society cannot create any obligation bearing on the Society or constitute any warranty of proper operation, beyond any representation set forth in the Rules, of any Unit, equipment or machinery, computer software of any sort or other comparable concepts that has been subject to any survey by the Society.

ARTICLE 6

6.1. - The Society accepts no responsibility for the use of information related to its Services which was not provided for the purpose by the Society or with its assistance.

6.2. - If the Services of the Society cause to the Client a damage which is proved to be the direct and reasonably foreseeable consequence of an error or omission of the Society, its liability towards the Client is limited to ten times the amount of fee paid for the Service having caused the damage, provided however that this limit shall be subject to a minimum of eight thousand (8,000) Euro, and to a maximum which is the greater of eight hundred thousand (800,000) Euro and one and a half times the above mentioned fee.

The Society bears no liability for indirect or consequential loss such as e.g. loss of revenue, loss of profit, loss of production, loss relative to other contracts and indemnities for termination of other agreements.

6.3. - All claims are to be presented to the Society in writing within three months of the date when the Services were supplied or (if later) the date when the events which are relied on of were first known to the Client, and any claim which is not so presented shall be deemed waived and absolutely barred.

ARTICLE 7

7.1. - Requests for Services are to be in writing.

7.2. - Either the Client or the Society can terminate as of right the requested Services after giving the other party thirty days' written notice, for convenience, and without prejudice to the provisions in Article 8 hereunder.

7.3. - The class granted to the concerned Units and the previously issued certificates remain valid until the date of effect of the notice issued according to 7.2. hereabove subject to compliance with 2.3. hereabove and Article 8 hereunder.

ARTICLE 8

8.1. - The Services of the Society, whether completed or not, involve the payment of fee upon receipt of the invoice and the reimbursement of the expenses incurred.

8.2. - Overdue amounts are increased as of right by interest in accordance with the applicable legislation.

8.3. - The class of a Unit may be suspended in the event of non-payment of fee after a first unfruitful notification to pay.

ARTICLE 9

9.1. - The documents and data provided to or prepared by the Society for its Services, and the information available to the Society, are treated as confidential. However:

- Clients have access to the data they have provided to the Society and, during the period of classification of the Unit for them, to the **classification file** consisting of survey reports and certificates which have been prepared at any time by the Society for the classification of the Unit ;
- copy of the documents made available for the classification of the Unit and of available survey reports can be handed over to another Classification Society Member of the International Association of Classification Societies (IACS) in case of the Unit's transfer of class;
- the data relative to the evolution of the Register, to the class suspension and to the survey status of the Units are passed on to IACS according to the association working rules;
- the certificates, documents and information relative to the Units classed with the Society may be reviewed during IACS audits and are disclosed upon order of the concerned governmental or inter-governmental authorities or of a Court having jurisdiction.

The documents and data are subject to a file management plan.

ARTICLE 10

10.1. - Any delay or shortcoming in the performance of its Services by the Society arising from an event not reasonably foreseeable by or beyond the control of the Society shall be deemed not to be a breach of contract.

ARTICLE 11

11.1. - In case of diverging opinions during surveys between the Client and the Society's surveyor, the Society may designate another of its surveyors at the request of the Client.

11.2. - Disagreements of a technical nature between the Client and the Society can be submitted by the Society to the advice of its Marine Advisory Committee.

ARTICLE 12

12.1. - Disputes over the Services carried out by delegation of Governments are assessed within the framework of the applicable agreements with the States, international Conventions and national rules.

12.2. - Disputes arising out of the payment of the Society's invoices by the Client are submitted to the Court of Nanterre, France.

12.3. - Other disputes over the present General Conditions or over the Services of the Society are exclusively submitted to arbitration, by three arbitrators, in London according to the Arbitration Act 1996 or any statutory modification or re-enactment thereof. The contract between the Society and the Client shall be governed by English law.

ARTICLE 13

13.1. - These General Conditions constitute the sole contractual obligations binding together the Society and the Client, to the exclusion of all other representation, statements, terms, conditions whether express or implied. They may be varied in writing by mutual agreement.

13.2. - The invalidity of one or more stipulations of the present General Conditions does not affect the validity of the remaining provisions.

13.3. - The definitions herein take precedence over any definitions serving the same purpose which may appear in other documents issued by the Society.

INTRODUCTION

1. APPLICATION

In accordance with Regulations VI/5 and VII/6 of SOLAS 1974, as amended, cargo units and cargo transport units are to be loaded, stowed and secured throughout the voyage in accordance with the Cargo Securing Manual approved by the Administration, which is to be drawn up to a standard at least equivalent to the Guidelines developed by IMO.

The Guidelines developed by IMO were adopted on 13 June 1996 under the reference MSC/Circ.745 « Guidelines for the preparation of the Cargo Securing Manual ».

As indicated in the preamble of these Guidelines, the Cargo Securing Manual is required on all types of ships covered by the SOLAS Convention and engaged in the carriage of all cargoes other than solid and liquid bulk cargoes. In particular, it means that a Cargo Securing Manual is also required for those ships equipped or adapted for the carriage of freight containers

The Cargo Securing Manual is required to be on board ship,

2. MODEL OF CARGO SECURING MANUAL

The « Model of Cargo Securing Manual », attached to the present Guidelines is established by BUREAU VERITAS, taking into account the following IMO documents :

- Guidelines for the preparation of the Cargo Securing Manual (MSC/Circ.745),
- Code of Safe Practice for Cargo Stowage and Securing (Resolution A.714(17)), called CSS Code,
- 1994 Amendments to the Code of Safe Practice for Cargo Stowage and Securing (MSC/Circ.664),
- 1995 Amendments to the Code of Safe Practice for Cargo Stowage and Securing (MSC/Circ.691),
- 1997 Amendments to the Code of Safe Practice for Cargo Stowage and Securing (MSC/Circ 812),
- 2002 Amendments to the Code of Safe Practice for Cargo Stowage and Securing (MSC/Circ1026),
- Elements to be taken into account when considering the safe stowage and securing of cargo units and vehicles in ships (Resolution A.533(13))
- Guidelines for Securing Arrangements for the Transport of Road Vehicles on Ro-Ro Ships (Resolution A.581(14)),
- 1997 Amendments to the Guidelines for Securing Arrangements for the Transport of Road Vehicles on Ro-Ro Ships (MSC/Circ 812).

In order to facilitate the reading of the« Model of Cargo Securing Manual », the requirements coming from CSS Code as amended, and from Resolutions A.533 and A.581 are identified by *italic characters*.

3. HOW TO USE THIS MODEL OF CARGO SECURING MANUAL

The « Model of Cargo Securing Manual » is established to give the Owners a basic Cargo Securing Manual, prepared in accordance with the IMO Guidelines (MSC/Circ.745).

This Model gives a large information on what to be included in the Cargo Securing Manual. Consequently, for the preparation of a Cargo Securing Manual for a particular ship, starting from this Model, some items are to be specified or added, and some other ones, not applicable to the ship considered, are to be deleted.

In order to obtain easily the Cargo Securing Manual for a particular ship from the Model, the complete text of the Model is available upon request. The Head Office of the Society or a local office should be contacted in order to have information on how to obtain this text.

To facilitate the use of the« Model of Cargo Securing Manual », the requirements coming from CSS Code as amended, and from Resolutions A.533 and A.581 are identified by *italic characters*.

4. BVLASH PROGRAM

The BVLASH program, as referred to in 3.2.3, which is developed for carrying out the calculation of lashing in accordance with annex 13 of CSS Code, as amended, is available to the clients of the Society. It runs on personal computers under Windows operating systems. It may be downloaded from the web site: http//www.veristar.com

MODEL of CARGO SECURING MANUAL

CARGO SECURING MANUAL
CONTENTS

SHIP IDENTIFICATION

1. Ship data

Name	
BUREAU VERITAS section number	
Class notation	
Flag	
IMO Number	

2. Ship dimensions

Length L (m)	
Breadth B (m)	
Depth D (m)	
Draft T (m)	
Speed V (knots)	
GM max. (m) GM min. (m)	

3. Reference documents

	Reference of drawing	Date of review
Loading Manual		
Trim & stability booklet		
Local permissible uniform and/or concentrated loads per deck (wheel load axles,..) : Deck 1 : Deck 2 : Deck 3 : Deck 4 : Deck 5 :		

PREAMBLE

In accordance with the International Convention for the Safety of Life at Sea, 1974 (SOLAS) chapters VI, VII and the Code of Safe Practice for Cargo Stowage and Securing (IMO Resolution A714(17), adopted 6 November 1991, called « CSS Code »), cargo units, including containers are to be stowed and secured throughout the voyage in accordance with this Cargo Securing Manual.

This Cargo Securing Manual has been established, for the ship identified above, in accordance with the IMO/MSC/Circ. 745 « Guidelines for the preparation of the Cargo Securing Manual »(adopted 13 June 96), with the CSS Code, as amended, with IMO Resolutions A.533(13) and A.581(14) and with the applicable requirements of BUREAU VERITAS Rules and Regulations for the Classification of Ships.

It is important that securing devices meet acceptable functional and strength criteria applicable to the ship and its cargo. It is also important that the officers on board are aware of the magnitude and direction of the forces involved and the correct application and limitations of the cargo securing devices. The crew and other persons employed for the securing of cargoes are to be instructed in the correct application and use of the cargo securing devices on board the ship.

This Cargo Securing Manual is to be kept on board this ship and shall be available for inspections by Authorities concerned by it and by Classification Society, if any..

This Cargo Securing Manual is to be re-examined by BUREAU VERITAS, in case of any modification of the cargo securing arrangement described in it.

It is recommended that the CSS Code, as amended, and the IMO/MSC/Circ. 745 be available on board.

1. GENERAL

1.1 Definitions

1.1.1 *Administration means the Government of the State whose flag the ship is entitled to fly.*

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

1.1.3 *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.*

1.1.4 *Standardized Cargo means cargo for which the ship is provided with an approval securing system based upon cargo units of specific types*

1.1.5 *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..*

1.1.6 *Non-standardized Cargo means cargo which requires individual stowage and securing arrangements.*

1.1.7 *Cargo unit means a vehicle, container, flat, pallet, portable tank, packaged unit, or any other entity, etc., and loading equipment, or any part thereof, which belongs to the ship but is not fixed to the ship as defined in IMO Resolution A.489(XII) (adopted 19 November 1981).*

1.1.8 *Intermediate bulk container (IBC) means a rigid, semi-rigid or flexible portable bulk container packaging of a capacity of not more than 3 m^3 (3000 litres), designed for mechanical handling and tested for its satisfactory resistance to handling and transport stresses.*

1.1.9 *Portable tank means a tank which is not permanently secured on board the ship, and has a capacity of more than 450 litres and a shell fitted with external stabilizing members and items of service equipment and structural equipment necessary for the transport of gases, liquids or solids.*

1.1.10 *Road tank-vehicle means a vehicle with wheels and fitted with a tank or tanks intended for the transport of gases, liquids or solids by both road and sea modes of transport, the tank or tanks of which are rigidly and permanently attached to the vehicle during all normal operations of loading, transport and discharge and are neither filled nor emptied on board.*

1.1.11 *Road vehicle means a commercial vehicle, semi-trailer, road train, articulated road train or a combination of vehicles, as defined hereafter.*

1.1.12 *Commercial vehicle means a motor vehicle which, on account of its design and appointments, is used mainly for conveying goods. It may be towing a trailer.*

1.1.13 *Semi-trailer means a trailer which is designed to be coupled to a semi-trailer towing vehicle and to impose a substantial part of its total mass on the towing vehicle.*

1.1.14 *Road train means the combination of a motor vehicle with one or more independent trailers connected by draw-bar. (For the purpose of article 3.4.2.4, each element of a road train is considered a separate vehicle.)*

1.1.15 *Articulated road train means the combination of a semi-trailer towing vehicle with a semi-trailer.*

1.1.16 *Combination of vehicles means a motor vehicle coupled with one or more towed vehicles. (For the purpose of article 3.4.2.4, each element of a combination of vehicles is considered a separate vehicle.)*

1.1.17 *Roll-trailer means a low vehicle for the carriage of cargo with one or more wheel axles on the rear and a support on the front end, which is towed or pushed in the port to and from its stowage on board the ship by a special tow-vehicle.*

1.1.18 *Ro-ro ship means a ship which has one or more decks either closed or open, not normally subdivided in any way and generally running the entire length of the ship, in which goods (packaged or in bulk, in or on road vehicles (including road tank-vehicles), trailers, containers, pallets, demountable tanks or in or on similar cargo transport units or other receptacles) can be loaded or unloaded normally in horizontal direction.*

1.1.19 *Unit load means that a number of packages are either:*

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

1.2 General information

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

1.2.2 The information and requirements set forth in this Manual are consistent with the requirements of the ship'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).

1.2.3 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.

1.2.4 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.

1.2.5 The cargo securing devices mentioned in this Manual are to 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 is to be revised accordingly. The strength of alternative cargo securing devices introduced is to be not less than the strength of the devices they replace.

1.2.6 A sufficient quantity of reserve cargo securing devices is to be on board the ship.

1.2.7 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 are to be maintained in a satisfactory condition. Items worn or damaged to such an extent that their quality is impaired are to be replaced.

2. SECURING DEVICES AND ARRANGEMENTS

2.1 Fixed cargo securing devices

2.1.1 The types and MSL values of the fixed securing devices are given in Table I.

2.1.2 The drawings of the arrangement of the fixed securing devices on board this ship are attached to this chapter (drawings references....).

2.1.3 The maximum securing load imposed by any connection to the ship's structure is not to be greater than :

- ..... tonnes, for attachment to 'tween deck frames,
- ..... tonnes, for attachment to lower hold frames,
- ..... tonnes, for attachment to transverse bulkhead stiffeners,
- ..... tonnes, for attachment to decks and tank tops.

Lashing arrangements such that applied loads exceeds the above given maximum values, may imply some damage to the ship's structure, and have to be avoided.

2.1.4 It is recommended to :

- avoid out of plane loading on stiffening members.
- align welded attachments to decks and bulkheads with stiffeners by using a weld area suitable for the load considered.
- design new eyeplates, lugs, etc. in accordance with recognized national or international standards suitable for the considered maximum securing load.

All these structural arrangement are to be submitted to the Classification Society.

Table I - Fixed securing devices

Manufacturer	Type designation	Sketch	Quantity	Material	Identification marking	Breaking load	MSL
	elephant foot						
	pad-eye						
	eyebolt						
	etc...						

2.2 Portable cargo securing devices

2.2.1 The types and MSL values of the portable securing devices are given in Table II.

2.2.2 Individual drawings and relevant certificates of the portable securing devices, if any, are attached to this chapter.

2.3 Inspection and maintenance schemes

2.3.1 Regular inspections and maintenance

Regular inspection and maintenance are to be carried out under the responsibility of the Master. Cargo securing devices inspections as a minimum are to include :

1 - routine visual examinations of components being utilised :
All cargo securing devices, both fixed and portable, including pad-eyes, eyebolts, container fittings, wire ropes, container stacking fittings, deck securing fittings, interlock fittings, rods, turnbuckles, tensioners, etc., including spares, are to be subjected to routine visual examinations every time they are used, but at least once every three months.

2 - periodic examinations / re-testing as required by the Administration:
When required, the cargo securing devices concerned are to be subjected to inspections by the Administration.

Table II - Portable securing devices

Manufacturer	Type designation	Sketch	Quantity	Material	Identification marking	Strength test	MSL
	stacking cone						
	twistlock						
	locking pin						
	hook						
	lashing wire						
	chain						
	rod						
	tensioner						
	twin-buckle						
	etc.						

2.3.2 Procedures and records

- Accepting procedure :

Cargo securing devices, as referenced in Tables I and II, are accepted on board this ship, subjected they are type approved by a Classification Society. The values of the maximum securing load (MSL) and/or the safe working load (SWL) and/or the breaking load of the securing device are to be indicated on the type approval certificate.

- Maintaining procedure :

The Master is responsible for the maintenance of all cargo securing devices. Corrosion is to be kept as low as possible by ensuring that coatings or grease layers provide a good protection. Manufacturer's instructions, if any, are also to be considered.

- Repairing procedure :

Generally, repairs are only acceptable for mild-steel fittings welded to the ship's structure. In such a case, re-welding is to be carried out carefully. Manufacturer's instructions, if any, are also to be considered.

- Rejecting procedure :

Any cargo securing device which has been cracked, bent, chipped or damaged and which cannot be repaired must be removed from service.
Any cargo securing device which presents some visible signs of overloading must be removed from service.
The rejected devices which are kept on board are to be clearly identified, and are to be stored in a separate space.

- Record of inspections :

Inspections, repairs and rejection are to be entered in a « record book of inspection ». These records are to be kept on board and attached to this Cargo Securing Manual. This « Record Book » can be presented in a computerised way.

2.3.3 Inspections and adjustment during voyage

During the voyage, all cargo securing devices, and in particular turnbuckles and chain tensioners, are to be regularly inspected, as far as practicable. In particular, these inspections are to be carried out during and after heavy weather voyages.

It is recommended to check that pre-tensioning are never too tight. In such a case, they stretch the wire rope or the tension bar, so that the Safe Working Load of the lashing decreases.

2.3.4 Computerised maintenance procedure

Computerised maintenance procedure may be referred to in this sub-chapter

3. STOWAGE AND SECURING OF NON-STANDARDIZED AND SEMI-STANDARDIZED CARGO

3.1 Handling and safety instructions

3.1.1 General principles of cargo securing

All cargoes are to be stowed and secured in such a way that the ship and persons on board are not put at risk.

The safe stowage and securing of cargoes depend on proper planning, execution and supervision.

Personnel commissioned to tasks of cargo stowage and securing is to be properly qualified and experienced.

Personnel planning and supervising the stowage and securing of cargo is to have a sound practical knowledge of the application and content of the Cargo Securing Manual, if provided.

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

Instructions of manufacturers of cargo securing devices, if any, are also to be considered. In such a case, they are to be attached to this Cargo Securing Manual.

All the cargo securing operations are to be fulfilled before the ship leaves the quay or its safe anchorage.

No cargo unsecuring operations are to be carried out before the ship is safely moored at quay or its safe anchorage.

Decisions taken for measures of stowage and securing cargo are to be based on the most severe weather conditions which may be expected by experience for the intended voyage.

Ship-handling decisions taken by the master, especially in bad weather conditions, are to take into account the type and stowage position of the cargo and the securing arrangements.

3.1.2 Suitability of cargo for transport

Cargo carried in containers, road vehicles, shipborne barges, railway wagons and other cargo transport units are to be packed and secured within these units so as to prevent, throughout the voyage, damage or hazard to the ship, to the persons on board and to the marine environment.

3.1.3 Cargo distribution

It is of the utmost importance that the master takes great care in planning and supervising the stowage and securing of cargoes in order to prevent cargo sliding, tipping, racking, collapsing, etc.

The cargo is to be distributed so as to ensure that the stability of the ship throughout the entire voyage remains within acceptable limits so that the hazards of excessive accelerations are reduced as far as practicable.

Cargo distribution is to be such that the structural strength of the ship is not adversely affected.

3.1.4 Cargo securing arrangements

Particular care is to be taken to distribute forces as evenly as practicable between the cargo securing devices. If this is not feasible, the arrangements are to be upgraded accordingly.

If, due to the complex structure of a securing arrangement or other circumstances, the person in charge is unable to assess the suitability of the arrangement from experience and knowledge of good seamanship, the arrangement is to be verified by using an acceptable calculation method.

3.1.5 Residual strength after wear and tear

Cargo securing arrangements and equipment are to have sufficient residual strength to allow for normal wear and tear during their lifetime.

3.1.6 Friction forces

Where friction between the cargo and the ship's deck or structure or between cargo transport units is insufficient to avoid the risk of sliding, suitable material such as soft boards or dunnage are to be used to increase friction.

3.1.7 Shipboard supervision

The principal means of preventing the improper stowage and securing of cargoes is through proper supervision of the loading operation and inspections of the stow.

As far as practicable, cargo spaces are to be regularly inspected throughout the voyage to ensure that the cargo, vehicles and cargo transport units remain safely secured.

3.1.8 Entering enclosed spaces

The atmosphere in any enclosed space may be incapable of supporting human life through lack of oxygen or it may contain flammable or toxic gases. The master is to ensure that it is safe to enter any enclosed space.

3.1.9 General elements to be considered by the master

Having evaluated the risk of cargo-shifting, taking into account the criteria set out in 3.1.5, the master is to ensure, prior to loading of any cargo, cargo transport unit or vehicle that:

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

3.1.10 Cargo stowage and securing declaration

Where there is reason to suspect that a container or vehicle into which dangerous goods have been packed or loaded is not in compliance with the provisions of regulation VII / 5.2 or 5.3 of SOLAS 1974, as amended, or with the provisions of section 12 or 17, as appropriate, of the General Introduction to the IMDG Code, or where a container packing certificate/vehicle packing declaration is not available, the unit is to be not accepted for shipment.

Where practicable and feasible, road vehicles are to be provided with a cargo stowage and securing declaration, stating that the cargo on the road vehicle has been properly stowed and secured for the intended sea voyage, taking into account the IMO/ILO guidelines for packing cargo in freight containers or vehicles. The vehicle packing declaration, recommended by the IMDG Code (see paragraph above), may be acceptable for this purpose.

3.2 Evaluation of forces acting on cargo units

3.2.1 Accelerations

Tables or 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 are to be included in this Cargo Securing Manual.

These accelerations may be obtained from Annex 13 to the CSS Code (MSC/Circ.664 -1994), as given in paragraph 3.2.4, or by the application of BUREAU VERITAS Rules for the Classification of Steel Ships in force (Pt B, Ch 5, Sec 3).

3.2.2 Forces

The following information are to be included in this Cargo Securing Manual :

- examples of forces acting on typical cargo units when subjected to the accelerations referred to in paragraph 3.2.1,

- 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.

Forces, which have to be absorbed by suitable arrangements for stowage and securing to prevent cargo shifting, are generally composed of components acting relative to the axes of the ship:

- longitudinal;
- transversal; and
- vertical.

Remark: For the purpose of stowage and securing cargo, longitudinal and transverse forces are considered predominant.

Transverse forces alone, or the resultant of transverse, longitudinal and vertical forces, normally increase with the height of the stow and the longitudinal distance of the stow from the ship's centre of motion in a seaway. The most severe forces can be expected in the furthest forward, the furthest aft and the highest stowage position on each side of the ship.

The transverse forces exerted increase directly with the metacentric height of the ship. An undue metacentric height may be caused by:

- improper design of the ship;
- unsuitable cargo distribution; and
- unsuitable bunker and ballast distribution.

Cargo is to be so distributed that the ship has a metacentric height in excess of the required minimum and, whenever practicable, within an acceptable upper limit to minimize the forces acting on the cargo.

In addition to the forces referred to above, cargo carried on deck may be subjected to forces arising from the effects of wind and green seas.

Improper shiphandling (course or speed) may create adverse forces acting on the ship and the cargo.

The magnitude of the forces may be estimated by using the appropriate calculation methods as contained in this Cargo Securing Manual, if provided.

Although the operation of anti-roll devices may improve the behaviour of the ship in a seaway, the effect of such devices are not to be taken into account when planning the stowage and securing of cargoes.

3.2.3 Calculation method

The following data are to be included in this Cargo Securing Manual :

- examples of how to calculate number and strength of portable securing devices required to counteract the forces referred to in paragraph 3.2.2,
- safety factors to be used for the different types of portable cargo securing devices.

Calculations may be carried out according to Annex 13 to the CSS Code, as amended and as explained in paragraph 3.2.4, or by any other agreed method.

The BVLASH program has been developed by BUREAU VERITAS for carrying out the calculation in accordance to Annex 13 to the CSS Code, as amended.

3.2.4 Methods to assess the efficiency of securing arrangements of non-standardized cargo

3.2.4.1 Scope of application

This method is to be applied to non-standardized cargoes, but is not applicable to containers on containerships.

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

All lashing assemblies used in the application of the methods described in 3.2.4 must be attached to fixed securing points or strong supporting structures marked on the cargo unit or advised as being suitable,or taken as a loop around the unit with both ends secured to the same side as shown in 3.3.6, Figure 15. Lashings going over the top of the cargo unit,which have no defined securing direction but only act to increase friction by their pre-tension, cannot be credited in the evaluation of securing arrangements under 3.2.4 .

Nothing in this article 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 article.

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

3.2.4.2 Presentation of the methods

The methods are presented in a universally applicable and flexible way. It is recommended that designers of Cargo Securing Manuals convert this presentation into a form suiting the particular ship, its securing equipment and the cargo carried. This form may consist of applicable diagrams, tables or calculated examples.

3.2.4.3 Strength of securing equipment

Manufacturers of securing equipment are, at least, to supply information on the nominal breaking strength of the equipment in kilo-Newton (kN).

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

The MSL for different securing devices are given in Table III if not given under following paragraph.

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

Table III - Determination of MSL from breaking strength

Material	*MSL*
shackles, rings, deckeyes, turnbuckles of mild steel	*50 % of breaking strength*
fibre rope	*33 % of breaking strength*
Web lashing	*50 % of breaking strength*
wire rope (single use)	*80 % of breaking strength*
wire rope (re-usable)	*30 % of breaking strength*
steel band (single use)	*70 % of breaking strength*
chains	*50 % of 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 is to 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 deck eye, the minimum MSL in the series apply to that device.

3.2.4.4 Rule of thumb method

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

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

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

3.2.4.5 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 is to be taken to use securing elements of similar material and length in order to provide a uniform elastic behaviour within the arrangement .

3.2.4.6 Advanced calculation method

a) Assumption of external forces

External forces to a cargo unit in longitudinal, transverse and vertical direction are to be obtained using the formula:

$$F(x,y,z) = m\, a(x,y,z) + Fw(x,y) + Fs(x,y)$$

F(x,y,z) = longitudinal, transverse and vertical forces

m = mass of the unit

a(x,y,z) = longitudinal, transverse and vertical acceleration (see Table IV)

Fw(x,y) = longitudinal and transverse force by wind pressure

Fs(x,y) = longitudinal and transverse force by sea sloshing

The basic acceleration data are presented in Table IV.

Table IV - Basic acceleration data

Transverse acceleration a_y in m/sec^2										Longitudinal acceleration a_x in m/sec2
on deck high	7.1	6.9	6.8	6.7	6.7	6.8	6.9	7.1	7.4	3.8
on deck low	6.5	6.3	6.1	6.1	6.1	6.1	6.3	6.5	6.7	2.9
tween deck	5.9	5.6	5.5	5.4	5.4	5.5	5.6	5.9	6.2	2.0
lower hold	5.5	5.3	5.1	5.0	5.0	5.1	5.3	5.5	5.9	1.5
0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	L
Vertical acceleration a_z in m/sec^2										
	7.6	6.2	5.0	4.3	4.3	5.0	6.2	7.6	9.2	

Remarks:

The given transverse acceleration figures include components of gravity, pitch and heave parallel to the deck. The given vertical acceleration figures do not include the static weight component.

The basic acceleration data are to be considered as valid under the following operational conditions:

***1.** Operation in unrestricted area.*

***2.** Operation during the whole year.*

***3.** Duration of the voyage is 25 days.*

***4.** Length of the ship is 100 m.*

***5.** Service speed is 15 knots.*

***6** B/GM greater or equal to 13. (B: breadth of ship, GM: metacentric height)*

For operation in a restricted area reduction of these figures may be considered taking also into account the season of the year and the duration of the voyage.

For ships of a length other than 100 m and a service speed other than 15 knots, the acceleration figures are to be corrected by a factor given in Table V.

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 :

Correction factor = (0.345 v / $\sqrt{L}$) + (58.62 L – 1034.5) / L^2

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

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

Table V - Correction factors for length and speed

Length (m) / **Speed (kn)**	**50**	**60**	**70**	**80**	**90**	**100**	**120**	**140**	**160**	**180**	**200**
9	1.20	1.09	1.00	0.92	0.85	0.79	0.70	0.63	0.57	0.53	0.49
12	1.34	1.22	1.12	1.03	0.96	0.90	0.79	0.72	0.65	0.60	0.56
15	1.49	1.36	1.24	1.15	1.07	1.00	0.89	0.80	0.73	0.68	0.63
18	1.64	1.49	1.37	1.27	1.18	1.10	0.98	0.89	0.82	0.76	0.71
21	1.78	1.62	1.49	1.38	1.29	1.21	1.08	0.98	0.90	0.83	0.78
24	1.93	1.76	1.62	1.50	1.40	1.31	1.17	1.07	0.98	0.91	0.85

Table VI - Correction factors for B/GM < 13

B/GM	**7**	**8**	**9**	**10**	**11**	**12**	**13 or above**
on deck high	1.56	1.40	1.27	1.19	1.11	1.05	1.00
on deck low	1.42	1.30	1.21	1.14	1.09	1.04	1.00
tween deck	1.26	1.19	1.14	1.09	1.06	1.03	1.00
lower hold	1.15	1.12	1.09	1.06	1.04	1.02	1.00

The following cautions are to be observed:

- *In the case of marked roll resonance with amplitudes above +/- 30 degrees, the given figures of transverse acceleration may be exceeded. Effective measures are to be taken to avoid this condition.*
- *In case of heading 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 is to be considered.*
- *In the case of running before large stern or aft 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 is to be considered.*

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

- *force by wind pressure = 1 kN / m^2*
- *force be sea sloshing = 1 kN / m^2*

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

Sea sloshing forces need only be applied to a height of deck cargo up to 2 metres above the weather deck or hatch top. For voyages in restricted area sea sloshing forces may be neglected.

b) Balance of forces and moments

The balance calculation is to preferably be carried out for

- *transverse sliding in port and starboard direction*
- *transverse tipping in port and starboard direction*
- *longitudinal sliding under conditions of reduced friction in forward and aft direction.*

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

Friction contributes towards prevention of sliding. The following friction coefficients (μ)given in Table VII are to be applied.

***i)** Transverse sliding*

The balance calculation is to meet the following condition (see Figure 1):

$$Fy \leq \mu\, m\, g + CS1\, f1 + CS2\, f2 + \ldots + CSn\, fn$$

where :

n is the number of lashings being calculated

Table VII – Friction coefficients

Materials in contact	*Friction coefficient, (μ)*
Timber-timber, wet or dry	*0.4*
Steel-timber or steel-rubber	*0.3*
Steel-steel, dry	*0.1*
Steel-steel, wet	*0.0*

Fy is transverse force from load assumption (kN)
m is mass of cargo unit (t)
g is gravity acceleration of earth = 9.81 m/s^2
μ is friction coefficient, given in Table VII
CS is calculated strength of transverse securing devices (kN)

$$CS = \frac{MSL}{1.5}$$

f is function of μ and vertical securing angle alpha α (see Table VIII)

Figure 1 - Balance of transverse forces

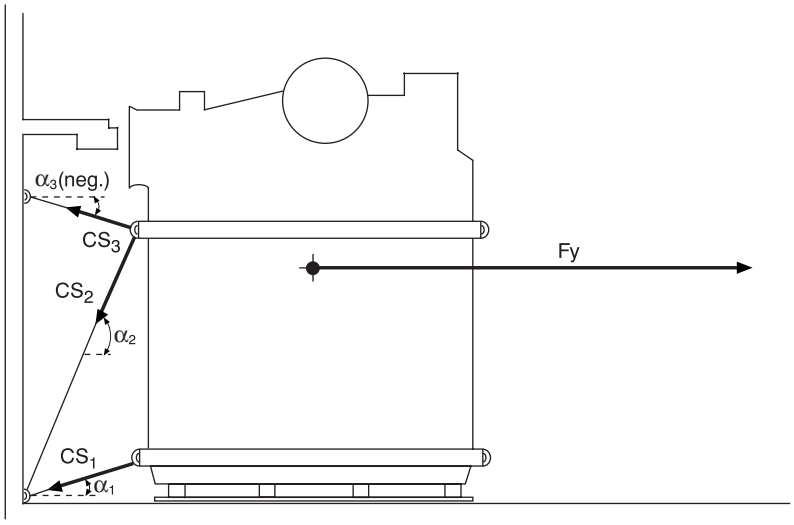


Table VIII - f-values as function of α and μ

α / μ	-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

Remark: f = μ sin α + cos α

A vertical securing angle alpha greater than 60 degrees 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 is to be considered, unless the necessary load is gained by the imminent tendency to tipping or by a reliable pretensioning of the securing device which includes maintaining the pretension throughout the voyage.

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

As an alternative to using Table VIII to determine the forces in a securing arrangement, the method outlined hereafter in paragraph Balance of forces - alternative method can be used to take account of transverse and longitudinal components of lashing forces.

***ii)** Transverse tipping*

This balance calculation is to meet the following condition (see also Figure 2);

$$Fy\ a \leq b\ m\ g + CS1\ c1 + CS2\ c2 + ...\ CSn\ cn$$

where:

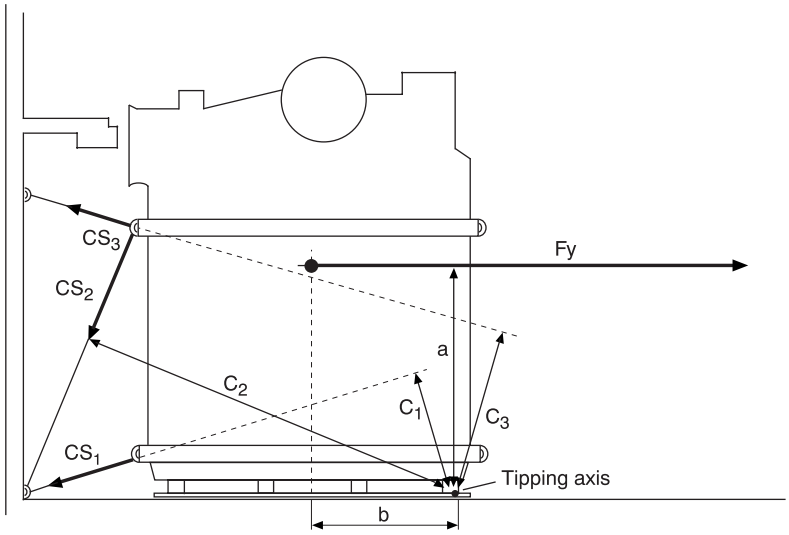
Fy, m, g, CS, n are explained under paragraph a)

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

b is lever-arm of stableness (m) (see Figure 2)

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

Figure 2 - Balance of transverse moments



iii) *Longitudinal sliding*

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

$$Fx \leq \mu (m\,g - Fz) + CS1\,fl + CS2\,f2 + ... + CSn\,fn$$

where :

Fx is longitudinal force from load assumption (kN)

n, μ; f; m, g are as explained under paragraph a)

Fz 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 are not to be assumed greater than 0.5 CS.

iv) *Calculated example*

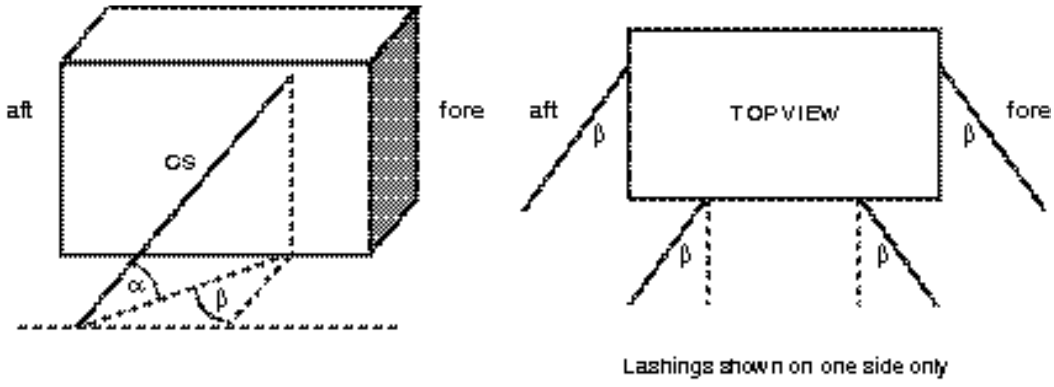
A calculated example for this method is shown in 3.2.4.7

c) Balance of forces – alternative method

The balance of forces described before under paragraph b)i) and paragraph b)iii) will normally furnish a sufficiently accurate determination of the adequacy of the securing arrangement. However, 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 β in the horizontal plane. This horizontal securing angle β is defined as the angle of deviation from the transverse direction. The angle β is to be scaled in the quadrantal mode, i.e. between 0 and 90°. (See Figure 3).

Figure 3 – Definition of the vertical and horizontal securing angles α and β



A securing device with an angle β develops securing effects both in longitudinal and transverse direction,which can be expressed by multiplying the calculated strength CS with the appropriate values of fx or fy. The values of fx and fy can be obtained from Table IX.

Table IX consists of five sets of figures, one each for the friction coefficients μ = 0.4, 0.3, 0.2, 0.1 and 0. Each set of figures is obtained by using the vertical angle α and horizontal angle β. The value of fx is obtained when entering the table with β from the right while fy is obtained when entering with β from the left, using the nearest tabular value for α and β. Interpolation is not required but may be used.

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

Transverse sliding : $\mathbf{Fy \leq \mu\, m\, g + fy_1\, CS_1 + \ldots + fy_n\, CS_n}$

Longitudinal sliding : $\mathbf{Fx \leq \mu\, (m\, g - Fz\,) + fx_1\, CS_1 + \ldots + fx_n\, CS_n}$

Transverse tipping : $\mathbf{Fy\, a \leq b\, m\, g + 0.9\, (CS_1\, c_1 + CS_2\, c_2 + \ldots + CS_n\, c_n\,)}$

Caution :

Securing devices, which have a vertical angle α of less than 45° in combination with horizontal angle β greater than 45°, 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 before except fy and fx, obtained from Table IX and CS is as follows :

$$CS = \frac{MSL}{1.35}$$

A calculated example for this method is shown in 3.2.4.7

Table IX – fx-values and fy-values as a function of α, β and μ

Table IX.1 for μ = 0.4

β for fy	α														β 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 IX.2 for μ = 0.3

β for fy	α														β 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 IX.3 for μ = 0.2

β for fy	α														β 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 IX.4 for μ = 0.1

β for fy	α														β for fx
	-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 IX.5 for μ = 0.0

β for fy	α														β for fx
	-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 : fx = $\cos\alpha \sin\beta + \mu \sin\alpha$ fy = $\cos\alpha \cos\beta + \mu \sin\alpha$

3.2.4.7 a) Calculated example 1 (See Figure 4)

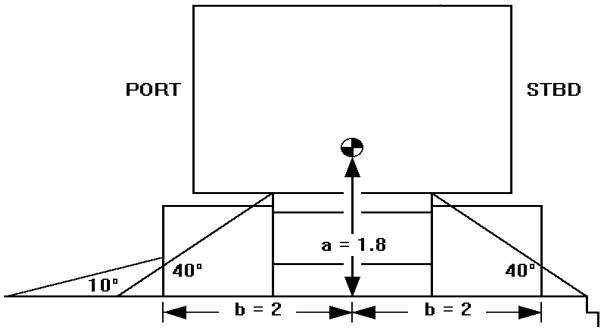
Refer to paragraph 3.2.4.6 b) Balance of forces and moments

Ship : L = 120 m; B = 20 m; GM = 1.4 m; speed = 15 knots

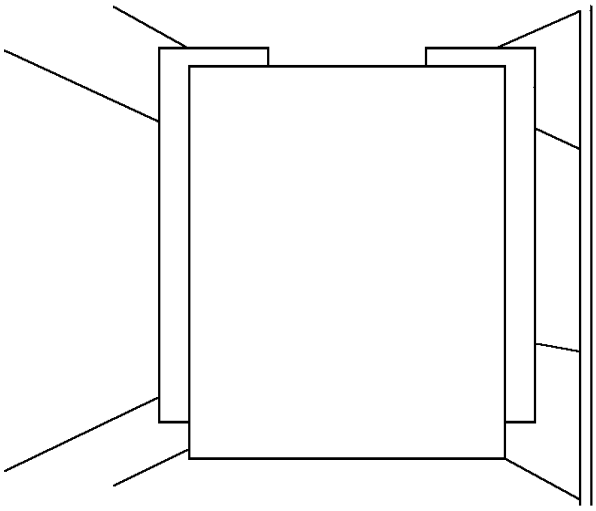
Cargo : m = 62 t; dimensions = 6 x 4 x 4 m; stowage at 0.7L on deck, low

Figure 4: Example 1

front view



top view



i) 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 : μ = 0.3; CS = 90/1.5 = 60 kN

ii) Securing arrangements

side	*n*	*CS*	*α*	*f*	*c*
STBD	*4*	*60 kN*	*40°*	*0.96*	*-*
PORT	*2*	*60 kN*	*40°*	*0.96*	*-*
PORT	*2*	*60 kN*	*10°*	*1.04*	*-*

Iii) External forces

Fx = 2.9 x 0.89 x 62 + 16 + 8 = 184 kN
Fy = 6.3 x 0.89 x 62 + 24 + 12 = 384 kN
Fz = 6.2 x 0.89 x 62 = 342 kN

iv) Balance of forces (STBD arrangement)

384 < 0.3 x 62 x 9.81 + 4 x 60 x 0.96
384 < 412 this is OK!

v) Balance of forces (PORT arrangement)

384 < 0.3 x 62 x 9.81 + 2 x 60 x 0.96 + 2 x 60 x 1.04
384 < 422 this is OK!

vi) Balance of moments

384 x 1.8 < 2 x 62 x 9.81
691 < 1216 no tipping, even without lashings!

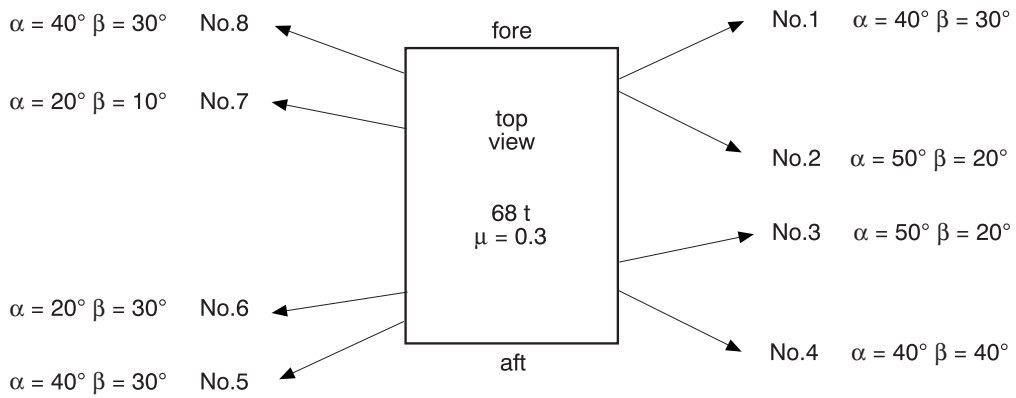
b) Calculated example 2 (See Figure 5)

Refer to paragraph 3.2.4.6 c) Balance of forces – alternative method

A cargo unit of 68 t mass is stowed on timber (μ = 0.3) in the 'tween deck at 0.7 L of a vessel. L = 160 m, B = 24 m, v = 18kn and GM = 1.5 m. Dimensions of the cargo unit are height = 2.4 m and width = 1.8 m. The external forces are : Fx = 112 kN, Fy = 312 kN, Fz = 346 kN

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

Figure 5: Example 2



i) Calculation of balance of forces

No	MSL (kN)	CS (kN)	α	β	fy	Cs.fy	fx	Cs.fx
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	0.99	66.3 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

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

312 < 0.3 x 68 x 9.81 + 68.8 + 55.6 + 55.6 + 62.4

312 < 443 this is OK

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

312 < 0.3 x 68 x 9.81 + 68.8 + 66.3 + 69.0 + 68.8

312 < 473 this is OK

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

112 < 0.3 (68 x 9.81 – 346) + 46.4 + 30.2 + 18.1 + 46.4

112 < 237 this is OK

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

112 < 0.3 (68 x 9.81 – 346) + 30.2 + 55.2 + 46.4 +38.2

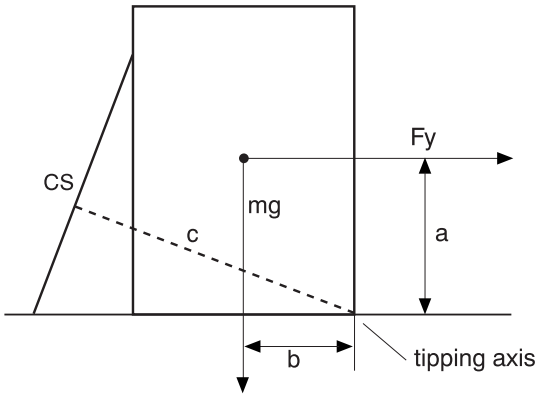
112 < 266 this is OK

vi) Transverse tipping

Unless specific information is provided, the vertical center of gravity of the cargo unit can be assumed to be at one half the height and the transverse center of gravity at one half the width.

Also, if the lashing is connected as shown in Figure 6, 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.

Figure 6: Lashing example



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

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

$374 < 600 + 476$

$374 < 1076$ *this is OK*

3.2.4.8 Explanations to the methods to assess the efficiency of securing arrangements for non-standardized cargo

a) *The exclusion from the scope of application of the methods of very heavy units as carried under the provisions of Chapter 1.8 of the Code of Safe Practice for Cargo Stowage and Securing is to be understood to accommodate the possibility of adapting the stowage and securing of such units to specifically determined weather- and sea-conditions during transport. The exclusion is not to be understood as restriction of the methods to units up to a certain mass or dimension.*

b) *The acceleration figures given in Table IV 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- direction 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 direction.*

Peak values in longitudinal and vertical direction may join more closely because they have the common source of pitching and heaving.

c) *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 transverse balance of forces and moments. These simultaneously acting vertical accelerations create an apparent increase of weight of the unit and thus improve the friction in the balance of forces respectively the moment of stableness in the balance of moments. For this reason there is no reduction of the normal force (m g) due to the present angle of heel.*

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

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

e) *The principal way of calculating forces within the securing elements of a complex securing arrangement necessarily includes the consideration of:*

- load-elongation behaviour (elasticity),

- geometrical arrangement (angles, length),

- pretension

of each individual securing element.

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

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

f) *When employing the advanced calculation method the way of collecting data is to 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 arrive at reasonable figures of the levers a, b and c for the balance of moments.*

It is to be born in mind that meeting or missing the balance calculation just by a tiny change of one or the other parameter indicates to be near the goal anyway. There is no clear-cut border line between safety and non-safety. If in doubt, the arrangements are to be improved.

3.3 Application of portable securing devices on various cargo units, vehicles and stowage blocks

3.3.1 General

For the correct application of portable securing devices, and in considering their number and strength, the Master shall take into account the following factors:

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

The application of portable securing devices as to number of lashings and allowable lashing angles is to be described in this Cargo Securing Manual.

Where necessary, suitable drawings or sketches to facilitate the correct understanding and proper application of the securing devices to various types of cargo and cargo units are to be supplemented.

For certain cargo units and other entities with low friction resistance, it is advisable to place soft boards or other anti-skid materials under the cargo to increase friction between the deck and the cargo.

The securing devices for non-standardized cargoes are to be so provided in order to withstand the transverse and longitudinal forces. In general, the lashing angles to be considered for non-standardized cargoes are not to be greater than 25 degrees against sliding and not less than 45 degrees to 60 degrees against tipping.

A guidance specifying recommended location and method of stowing and securing of containers, trailers and other cargo carrying vehicles, palletized cargoes, unit loads and single cargo items (e.g. woodpulp, paper rolls, etc.), heavy weight cargoes, cars and other vehicles is to be included in this Cargo Securing Manual. Information could helpfully be obtained in paragraphs 3.3.2 to 3.3.14 hereunder.

3.3.2 Safe stowage and securing of containers on deck of ships which are not specially designed and fitted for the purpose of carrying

3.3.2.1 Stowage

a) *Containers carried on deck or on hatches of such ships are preferably to be stowed in the fore-and-aft direction.*

b) *Containers are not to extend over the ship's sides. Adequate supports are to be provided when containers overhang hatches or deck structures.*

c) *Containers are to be stowed and secured so as to permit safe access for personnel in the necessary operation of the ship.*

d) *Containers are at no time to overstress the deck or hatches on which they are stowed.*

e) *Bottom-tier containers, when not resting on stacking devices, are to 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.*

f) *When stacking containers, use is to be made of locking devices, cones, or similar stacking aids, as appropriate, between them.*

g) *When stowing containers on deck or hatches, the position and strength of the securing points are to be taken into consideration.*

3.3.2.2 Securing

a) *All containers are to be effectively secured in such a way as to protect them from sliding and tipping. Hatchcovers carrying containers are to be adequately secured to the ship.*

b) *Containers are to be secured using one of the three methods recommended in Figures 7 to 9 or methods equivalent thereto.*

c) *Lashings are to preferably consist of wire ropes or chains or material with equivalent strength and elongation characteristics.*

d) *Timber shoring are not to exceed 2 m in length.*

e) *Wire clips are to be adequately greased, and tightened so that the dead end of the wire is visibly compressed (Figure 10).*

f) *Lashings are to be kept, when possible, under equal tension.*

Figure 7 - Recommended methods of non-standardized securing of containers

***Method A**: Medium weight containers: weight of top container not more than 70% of that of bottom container*

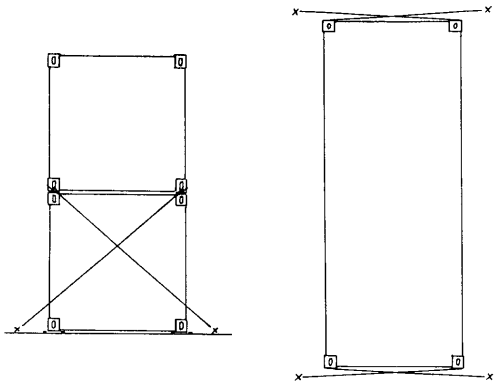


Figure 8 - Recommended methods of non-standardized securing of containers

***Method B**: Medium weight containers: weight of top container may be more than 70% of that of bottom container*

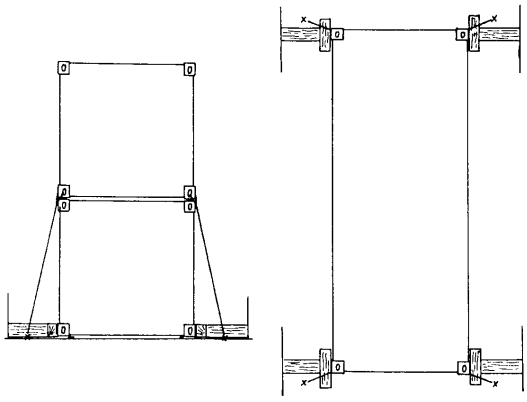


Figure 9 - Recommended methods of non-standardized securing of containers

***Method C**: Heavy weight containers: weight of top container may be more than 70% of that of bottom container*

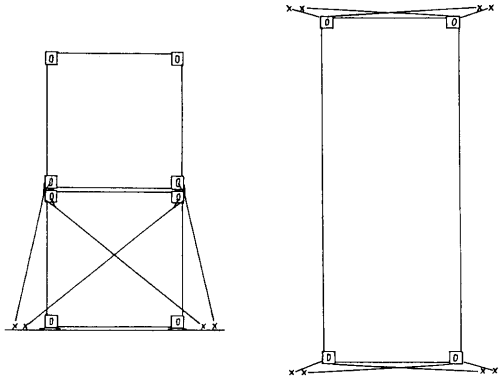
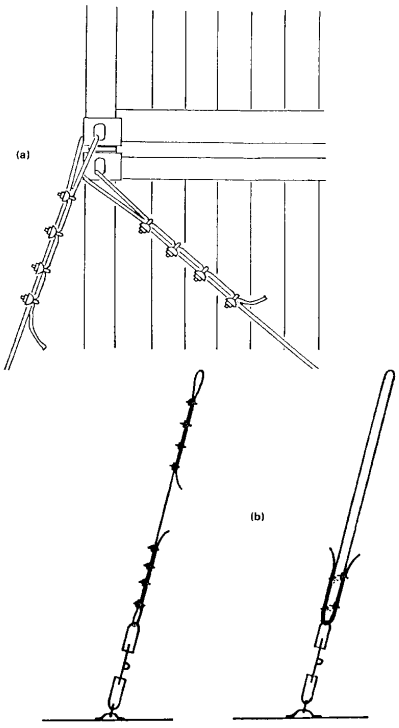


Figure 10 - (a) Fastening of wire lashings to corner fittings (b) Alternative constructions of wire lashings.



3.3.3 Safe stowage and securing of portable tanks

3.3.3.1 Introduction

a) *The provisions of this article apply to a portable tank, which in the context of this article, means a tank which is not permanently secured on board the vessel and has a capacity of more than 450 litres and a shell fitted with external stabilizing members and items of service equipment and structural equipment necessary for the transport of liquids, solids or gases.*

b) *These provisions do not apply to tanks intended for the transport of liquids, solids or gases having a capacity of 450 litres or less.*

Note: The capacity for portable tanks for gases is 1,000 litres or more.

3.3.3.2 General provisions for portable tanks

a) *Portable tanks are to be capable of being loaded and discharged without the need of removal of their structural equipment and be capable of being lifted on to and off the ship when loaded.*

b) *The applicable requirements of the International Convention for Safe Containers (CSC), 1972, as amended, are to be fulfilled by any tank-container 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 are to be met when the tank is used for the transport of dangerous goods.*

c) *Portable tanks are not to be offered for shipment in an ullage condition liable to produce an unacceptable hydraulic force due to surge within the tank.*

d) *Portable tanks for the transport of dangerous goods are to be certified in accordance with the provisions of the IMDG Code by the competent approval authority or a body authorized by that authority.*

3.3.3.3 Portable tank arrangements

a) *The external stabilizing 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.*

b) *Portable tank arrangements are to include fittings for lifting and securing on board.*

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

3.3.3.4 Cargo information

The master is to be provided with at least the following information:

- *dimensions of the portable tank and commodity if non-dangerous and, if dangerous, the information required in accordance with the IMDG Code;*
- *the gross mass of the portable tank; and*

- *whether the portable tank is permanently secured on to a platform-based container or in a frame and whether securing points are provided.*

3.3.3.5 Stowage

a) *The typical distribution of accelerations of the ship is to be borne in mind in deciding whether the portable tank will be stowed on or under deck.*

b) *Tanks are to be stowed in the fore-and-aft direction on or under deck.*

c) *Tanks are to be stowed so that they do not extend over the ship's side.*

d) *Tanks are to be stowed so as to permit safe access for personnel in the necessary operation of the ship.*

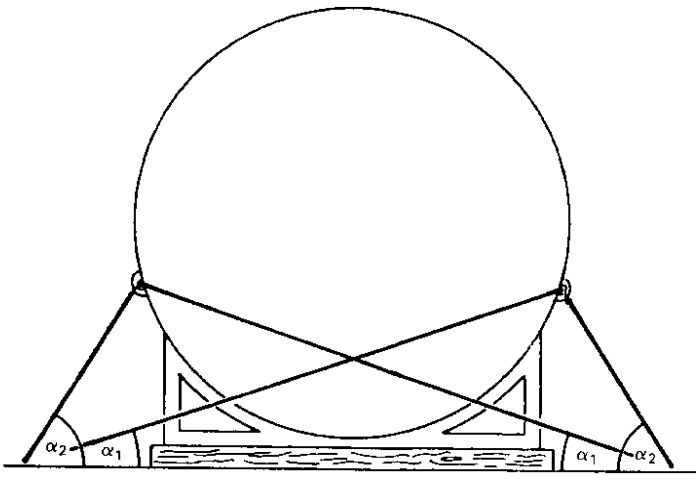
e) *At no time are the tanks to overstress the deck or hatches; the hatchcovers are to be so secured to the ship that tipping of the entire hatchcover is prevented.*

3.3.3.6 Securing against sliding and tipping

a) Non-standardized portable tanks

The securing devices on non-standardized portable tanks and on the ship are to 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 are not to be higher than 25 degrees and against tipping not lower than 45 degrees to 60 degrees (Figure 11).

Figure 11 - Securing of portable tanks with favourable lashing angles



α_1: favourable angle against sliding
α_2: favourable angle against tipping

Whenever necessary, timber is to 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.

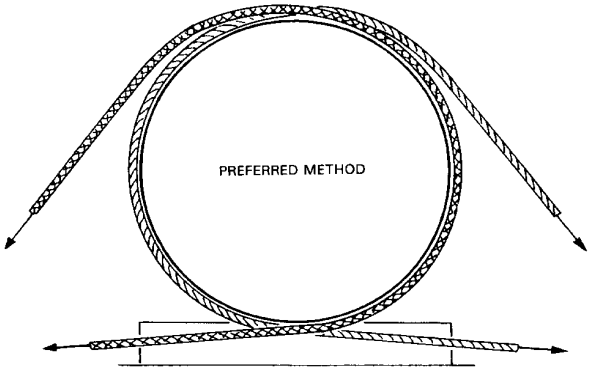
If stowage under deck is permitted, the stowage is to be such that the portable non-standardized tank can be landed directly on its place and bedding.

Securing points on the tank are to be of adequate strength and clearly marked.

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

Lashings attached to tanks without securing points are to pass around the tank and both ends of the lashing are to be secured to the same side of the tank (Figure 12).

Figure 12 - Securing of portable tanks having no securing points



Sufficient securing devices are to be arranged in such a way that each device takes its share of the load with an adequate factor of safety.

The structural strength of the deck or hatch components are to be taken into consideration when tanks are carried thereon and when locating and affixing the securing devices.

Portable tanks are to 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.

b) Standardized portable tanks (tank-containers)

Standardized portable tanks with ISO frame dimensions are to 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.

3.3.3.7 Maintenance of securing arrangements

a) *The integrity of the securing arrangements is to be maintained throughout the voyage.*

b) *Particular attention is to be paid to the need for tight lashings, grips and clips to prevent weakening through chafing.*

c) *Lashings are to be regularly checked and retightened.*

3.3.4 Safe stowage and securing of portable receptacles

3.3.4.1 Introduction

A portable receptacle, in the context of this article, means a receptacle not being a portable tank, which is not permanently secured on board the ship and has a capacity of 1,000 litres or less and has different dimensions in length, width, height and shape and which is used for the transport of gases or liquids.

3.3.4.2 Portable receptacles can be divided into:

a) *cylinders of different dimensions without securing points and having a capacity not exceeding 150 litres;*

b) *receptacles of different dimensions with the exception of cylinders in conformity with a) having a capacity of not less than 100 litres and not more than 1,000 litres and whether or not fitted with hoisting devices of sufficient strength; and*

c) *assemblies, known as "frames", of cylinders in conformity with a), 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).*

3.3.4.3 Cargo information

The master is to be provided with at least the following information:

- *dimensions of the receptacle and commodity if non-dangerous and, if dangerous, the information as required in accordance with the IMDG Code;*
- *gross mass of the receptacles; and*
- *whether or not the receptacles are equipped with hoisting devices of sufficient strength.*

3.3.4.4 Stowage

a) *The typical distribution of accelerations of the ship is to be borne in mind in deciding whether the receptacles should be stowed on or under deck.*

b) *The receptacles are preferably to be stowed in the fore-and-aft direction on or under deck.*

c) *Receptacles are to be dunnaged to prevent their resting directly on a steel deck. They are to be stowed and chocked as necessary to prevent movement unless mounted in a frame as a unit. Receptacles for liquefied gases are to be stowed in an upright position.*

d) *When the receptacles are stowed in an upright position, they are to be stowed in a block, cribbed or boxed in with suitable and sound timber. The box or crib are to be dunnaged underneath to provide clearance from a steel deck. The receptacles in a box or crib are to be braced to prevent movement. The box or crib are to be securely chocked and lashed to prevent movement in any direction.*

3.3.4.5 Securing against sliding and shifting

a) Cylinders

Cylinders are to be stowed fore-and-aft on athwartships dunnage. Where practicable, the stow is to be secured by using two or more wires, laid athwartships 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.

b) Cylinders in containers

Cylinders are, whenever practicable, to be stowed upright with their valves on top and with their protective caps firmly in place. Cylinders are to 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 are to be carried in an open top or a platform-based container.

c) Receptacles

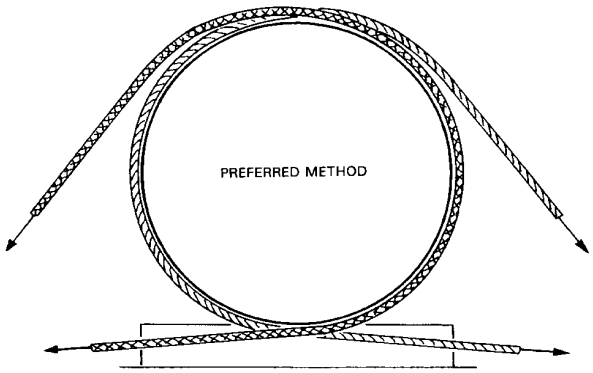
Securing of receptacles stowed on or under deck are to be as follows:

- lashings are to be positioned as shown in Figure 13;

- where possible, the hoisting devices on receptacles are to be used to lash them; and

- at regular times the lashings are to be checked and retightened.

Figure 13 - Securing of receptacles having no securing points



3.3.5 Safe stowage and securing of wheel-based (rolling) cargoes

3.3.5.1 Introduction

Wheel-based cargoes, in the context of this article, are all cargoes which are provided with wheels or tracks, including those which are used for the stowage and transport of other cargoes, except trailers and road-trains (covered by chapter 4 of the Code of Safe Practice for Cargo Stowage and Securing), but including buses, military vehicles with or without tracks, tractors, earth-moving equipment, roll-trailers, etc.

3.3.5.2 General recommendations

a) *The cargo spaces in which wheel-based cargo is to be stowed should be dry, clean and free from grease and oil.*

b) *Wheel-based cargoes are to be provided with adequate and clearly marked securing points or other equivalent means of sufficient strength to which lashings may be applied.*

c) *Wheel-based cargoes which are not provided with securing points are to have those places, where lashings may be applied, clearly marked.*

d) *Wheel-based cargoes, which are not provided with rubber wheels or tracks with friction-increasing lower surface, are always to be stowed on wooden dunnage or other friction-increasing material such as soft boards, rubber mats, etc.*

e) *When in stowage position, the brakes of a wheel-based unit, if so equipped, are to be set.*

f) *Wheel-based cargoes are to be secured to the ship by lashings made of material having strength and elongation characteristics at least equivalent to steel chain or wire.*

g) *Where possible, wheel-based cargoes, carried as part cargo, are to 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.*

h) *To prevent any lateral shifting of wheel-based cargoes not provided with adequate securing points, such cargoes are, where practicable, to 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.*

i) *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 athwartships. If wheel-based cargoes are inevitably stowed athwartships, additional securing of sufficient strength may be necessary.*

j) *The wheels of wheel-based cargoes are to be blocked to prevent shifting.*

k) *Cargoes stowed on wheel-based units are to 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 are to be adequately locked or secured in position.*

3.3.6 Safe stowage and securing of heavy cargo items such as locomotives, transformers, etc.

3.3.6.1 Cargo information

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

- gross mass;

- principal dimensions with drawings or pictorial descriptions, if possible;

- location of the centre of gravity;

- bedding areas and particular bedding precautions if applicable;

- lifting points or slinging positions; and

- securing points, where provided, including details of their strength.

3.3.6.2 Location of stowage

***a)** When considering the location for stowing a heavy cargo item, the typical distribution of accelerations on the ship is to be kept in mind:*

- lower accelerations occur in the midship sections and below the weather deck; and

- higher accelerations occur in the end sections and above the weather deck.

***b)** When heavy items are to be stowed on deck, the expected "weather side" of the particular voyage is to be taken into account if possible.*

***c)** Heavy items are to preferably be stowed in the fore-and-aft direction.*

3.3.6.3 Distribution of weight

The weight of the item is to 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 are to be used to transfer the weight of the item on to the ship's structure.

3.3.6.4 Cargo stowed in open containers, on platforms or platform-based containers

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

***b)** When heavy cargo items are carried on ISO platform or platform-based containers (flatracks) the provisions of this article are to be followed. Additionally, the following items are to be taken into account:*

- The ISO standard platform, etc., used is to be of a suitable type with regard to strength and MSL of the securing points.

- The weight of the heavy cargo item is to be properly distributed.

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

3.3.6.5 Securing against sliding and tipping

a) *Whenever possible, timber is to 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.*

b) *The securing devices are to be arranged in a way to withstand transverse and longitudinal forces which may give rise to sliding or tipping.*

c) *The optimum lashing angle against sliding is about 25 degrees, while the optimum lashing angle against tipping is generally found between 45 degrees and 60 degrees (Figure 14).*

d) *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.*

e) *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 is to be carried out in accordance with accepted hot work procedures.*

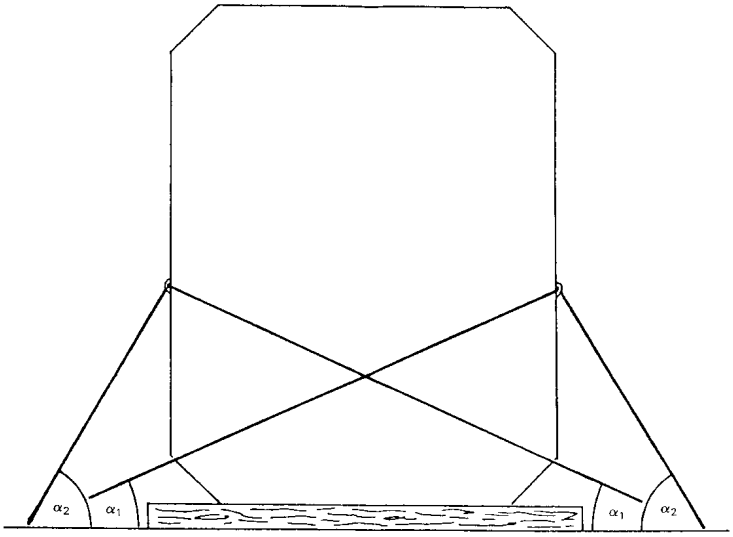
3.3.6.6 Securing against heavy seas on deck

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

3.3.6.7 Heavy cargo items projecting over the ship's side

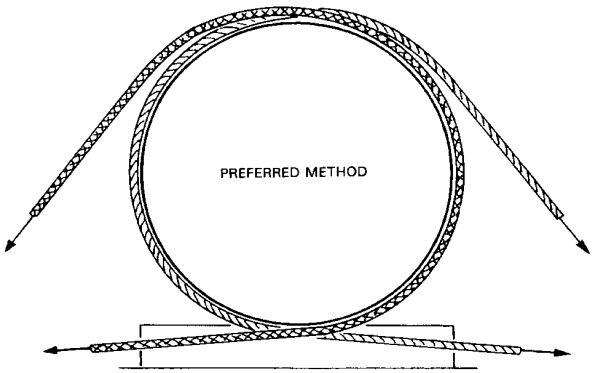
Items projecting over the ship's side are to be additionally secured by lashings acting in longitudinal and vertical directions.

Figure 14 - Principles of securing heavy items against sliding and tipping



α_1: favourable lashing angle against sliding
α_2: favourable lashing angle against tipping

Figure 15 - Principle of securing heavy items having no suitable securing points



3.3.6.8 Attachment of lashings to heavy cargo items

a) *If lashings are to be attached to securing points on the item, these securing points are to be of adequate strength and clearly marked. It is to be borne in mind that securing points designed for road or rail transport may not be suitable for securing the items on board ship.*

b) *Lashings attached to items without securing points are to pass around the item, or a rigid part thereof, and both ends of the lashing are to be secured to the same side of the unit (Figure 15).*

3.3.6.9 Composition and application of securing devices

a) *Securing devices are to be assembled so that each component is of equal strength.*

b) *Connecting elements and tightening devices are to be used in the correct way. Consideration is to 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.*

c) *Particular attention is to be paid to the correct use of wire, grips and clips. The saddle portion of the clip is to be applied to the live load segment and the U-bolt to the dead or shortened end segment.*

d) *Securing devices are to be arranged in such a way that each device takes its share of load according to its strength.*

e) *Mixed securing arrangements of devices with different strength and elongation characteristics are to be avoided.*

3.3.6.10 Maintenance of securing arrangements

a) *The integrity of the securing arrangements is to be maintained throughout the voyage*

b) *Particular attention is to be paid to the need for tight lashings, grips and clips and to prevent weakening through chafing. Timber cradles, beddings and shorings are to be checked.*

c) *Greasing the thread of clips and turnbuckles increase their holding capacity and prevent corrosion.*

3.3.6.11 Securing calculation

Where necessary, the securing arrangements for heavy cargo items are to be verified by an appropriate calculation in accordance with annex 13 to the Code of Safe Practice for Cargo Stowage and Securing.

3.3.7 Safe stowage and securing of coiled sheet steel

3.3.7.1 General

This article 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.

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

3.3.7.2 Coils

a) *Coils are to be given bottom stow and, whenever possible, be stowed in regular tiers from side to side of the ship.*

b) *Coils are to be stowed on dunnage laid athwartships. Coils are to be stowed with their axes in the fore-and-aft direction. Each coil is to be stowed against its neighbour. Wedges are to be used as stoppers when necessary during loading and discharging to prevent shifting (Figures 16 and 17).*

c) *The final coil in each row is normally to rest on the two adjacent coils. The mass of this coil will lock the other coils in the row.*

d) *If it is necessary to load a second tier over the first, then the coils are to be stowed in between the coils of the first tier (Figure 17).*

e) *Any void space between coils in the topmost tier are to be adequately secured (Figure 18).*

3.3.7.3 Lashings

a) *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 are to be lashed. To prevent fore-and-aft shifting in the top tier of bare-wound coils group-lashing is not to be applied due to their fragile nature, the end row of a top tier is to 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 19, 20, and 21).*

b) *The lashings can be of a conventional type using wire, steel band or any equivalent means.*

c) *Conventional lashings are to consist of wires having sufficient tensile strength. The first tier is to be chocked. It is to be possible to retighten the lashings during the voyage (Figures 20 and 21).*

d) *Wire lashings are to be protected against damage from sharp edges.*

e) *If there are few coils, or a single coil only, they are to 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.*

f) *Coils carried in containers, railway wagons and road vehicles are to be stowed in cradles or specially made beds and are to be prevented from moving by adequate securing.*

Figure 16 - Principle of dunnaging and wedging coils

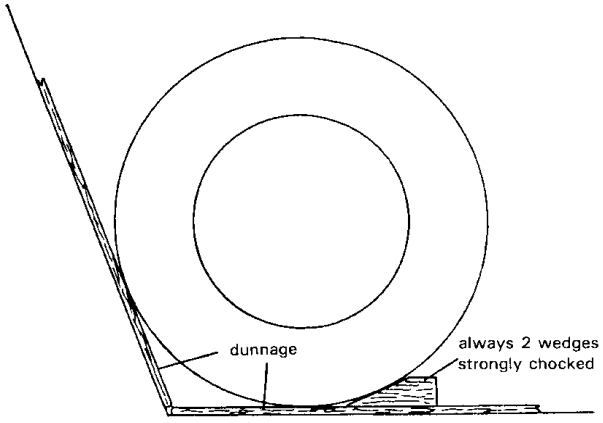


Figure 17 - Inserting of locking coils

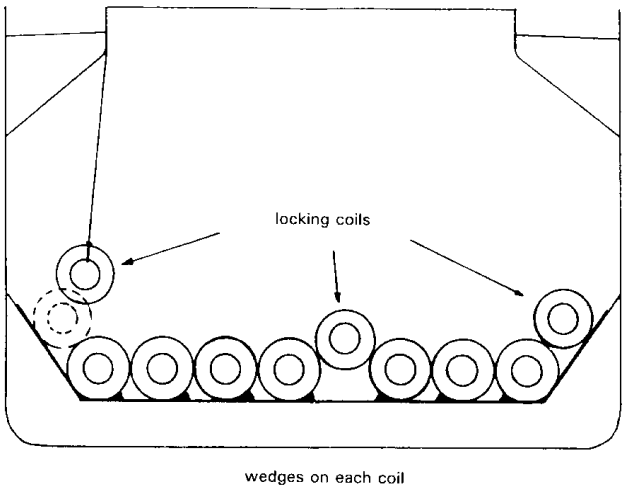


Figure 18 - Shoring and chocking in voids between coils

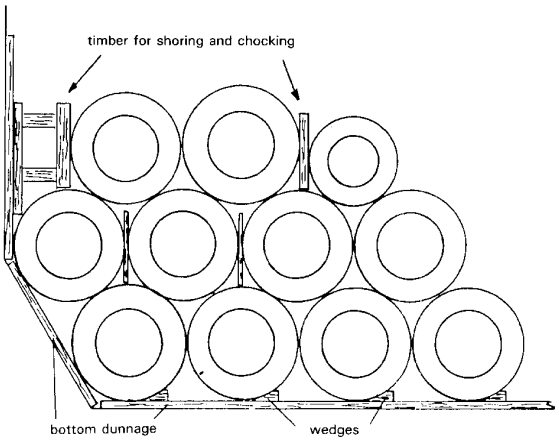


Figure 19- Securing of top tier against fore-and-aft shifting (top view)

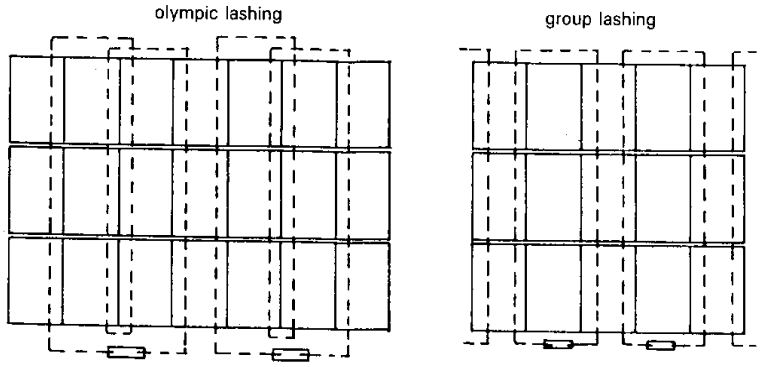


Figure 20 - Securing of end row in top tier against fore-and-aft shifting

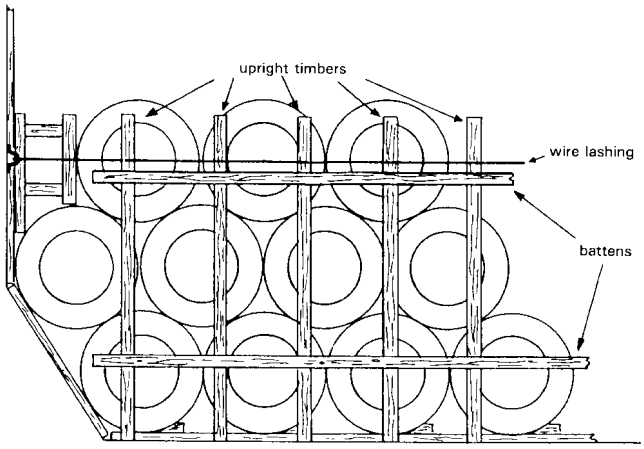
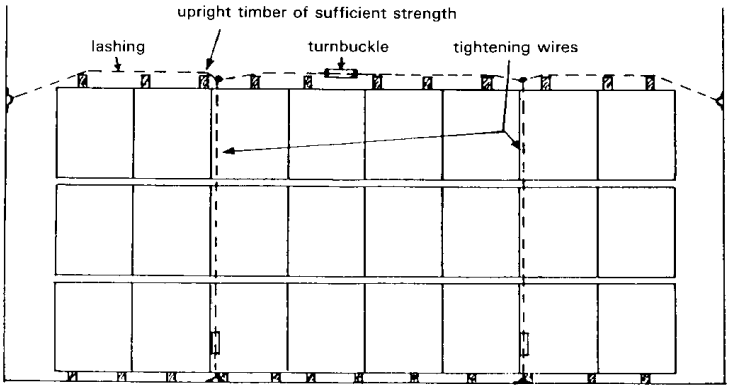


Figure 21 - Securing of end row in top tier against fore-and-aft shifting (top view)



3.3.8 Safe stowage and securing of heavy metal products

3.3.8.1 General

a) *Heavy metal products in the context of this Code of Safe Practice for Cargo Stowage and Securing include any heavy item made of metal, such as bars, pipes, rods, plates, wire coils, etc.*

b) *The transport of heavy metal products by sea exposes the ship to the following principal hazards:*

- overstressing of the ship's structure if the permissible hull stress or permissible deck loading is exceeded;

- overstressing of the ship's structure as a result of a short roll period caused by excessive metacentric height; and

- cargo shifting because of inadequate securing resulting in a loss of stability or damage to the hull, or both.

3.3.8.2 Recommendations

a) *The cargo spaces in which heavy metal products are to be stowed should be clean, dry and free from grease and oil.*

b) *The cargo are to be so distributed as to avoid undue hull stress.*

c) *The permissible deck and tank top loading are not to be exceeded.*

d) *The following measures are to be taken when stowing and securing heavy metal products:*

- cargo items are to 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;

- cargo is to be stowed level whenever possible and practicable;

- the surface of the cargo is to be secured; and

- the shoring is to be made of strong, non-splintering wood and adequately sized to withstand the acceleration forces. One shoring is to be applied to every frame of the ship but at intervals of not less than one metre.

e) *In the case of thin plates and small parcels, alternate fore-and-aft and athwartships stowage has proved satisfactory. The friction is to be increased by using sufficient dry dunnage or other material between the different layers.*

f) *Pipes, rails, rolled sections, billets, etc., are to be stowed in the fore-and-aft direction to avoid damage to the sides of the ship if the cargo shifts.*

g) *The cargo, and especially the topmost layer, can be secured by:*

- having other cargo stowed on top of it; or

- lashing by wire, chocking off or similar means.

h) *Whenever heavy metal products are not stowed from side to side of the ship, special care is to be taken to secure such stowages adequately.*

i) *Whenever the surface of the cargo is to be secured, the lashings are to 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.*

3.3.8.3 Wire coils

a) *Wire coils are to be stowed flat so that each coil rests against an adjacent coil. The coils in successive tiers are to be stowed so that each coil overlaps the coils below.*

b) *Wire coils are to be tightly stowed together and substantial securing arrangements are to 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.*

c) *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.*

3.3.9 Safe stowage and securing of anchor chains

3.3.9.1 General

a) *Anchor chains for ships and offshore structures are usually carried in bundles or in continuous lengths.*

b) *Provided certain safety measures are followed prior to, during, and after stowage, anchor chains may be lowered directly on to the place of stowage in bundles without further handling or stowed longitudinally either along the ship's entire cargo space or part thereof.*

c) *If the cargo plans given in the ship's documentation contain no specific requirements, the cargo is to be distributed over the lower hold and 'tween-decks in such a way that stability values thus obtained will guarantee adequate stability.*

3.3.9.2 Recommendations

a) *Cargo spaces in which chains are stowed are to be clean and free from oil and grease.*

b) *Chains are only to 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 are never to be stowed directly on metal surfaces.*

3.3.9.3 Stowage and securing of chains in bundles

a) *Chains in bundles, which are lifted directly on to their place of stowage without further handling, are to be left with their lifting wires attached and are preferably to be provided with additional wires around the bundles for lashing purposes.*

b) *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 is to be secured to both sides of the ship by suitable lashings. Bundles may be lashed independently or in a group, using the lifting wires.*

3.3.9.4 Stowage and securing of chains which are stowed longitudinally

a) *Stowage of each layer of chain is, whenever possible and practicable, to commence and terminate close to the ship's side. Care is to be taken to achieve a tight stow.*

b) *It is not necessary to separate layers of chain with friction-increasing material, such as dunnage because chain layers will grip each other.*

c) *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 is to be secured by lashings of adequate strength crossing the stow at suitable intervals and thus holding down the entire stow.*

3.3.10 Safe stowage and securing of metal scrap in bulk

3.3.10.1 Introduction

a) *This article 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.*

b) *The hazards involved in transporting metal scrap include:*

- *shifting of the stow which in turn can cause a list;*

- *shifting of individual heavy pieces which can rupture the side plating below the waterline and give rise to serious flooding;*

- *excessive loading on tank tops or 'tween-decks; and*

- *violent rolling caused by excessive metacentric height.*

3.3.10.2 Recommendations

a) *Before loading, the lower battens of the spar ceiling is to 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, are to be similarly protected.*

b) *When loading, care is to be taken to ensure that the first loads are not dropped from a height which could damage the tank tops.*

c) *If light and heavy scrap is to be stowed in the same cargo space, the heavy scrap is to be loaded first. Scrap is never to be stowed on top of metal turnings, or similar forms of waste metal.*

d) *Scrap is to be compactly and evenly stowed with no voids or unsupported faces of loosely held scrap.*

e) *Heavy pieces of scrap, which could cause damage to the side plating or end bulkheads if they were to move, are to be overstowed or secured by suitable lashings. The use of shoring is unlikely to be effective because of the nature of the scrap.*

f) *Care is to be taken to avoid excessive loading on tank tops and decks.*

3.3.11 Safe stowage and securing of flexible intermediate bulk containers

3.3.11.1 Introduction

A flexible intermediate bulk container (FIBC), in the context of this Cargo Securing Manual, means a flexible portable packaging to be used for the transport of solids with a capacity of not more than 3 m^3 (3,000 litres) designed for mechanical handling and tested for its satisfactory resistance to transport and transport stresses in a one-way type or multi-purpose design.

3.3.11.2 Cargo information

The master is at least to be provided with the following information:

- *the total number of FIBCs and the commodity to be loaded;*
- *the dimensions of the FIBCs;*
- *the total gross mass of the FIBCs;*
- *one-way type or multi-purpose design; and*
- *the kind of hoisting (one hook or more hooks to be used).*

3.3.11.3 Recommendations

a) *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.*

b) *The cargo spaces are, where practicable, to be rectangular in shape and free of obstructions.*

c) *The stowage space is to be clean, dry and free from oil and nails.*

d) *When FIBCs have to be stowed in deep hatch wings, easy access and sufficient manoeuvring space for suitably adapted fork-lift trucks are to be available.*

e) *When FIBCs are stowed in the hatchway only, the space in the wings and the forward and aft end of the cargo space is to be loaded with other suitable cargo or blocked off in such a way that the FIBCs are adequately supported.*

3.3.11.4 Stowage

a) *The typical distribution of the accelerations of the ship is to be kept in mind when FIBCs are loaded.*

b) *The width of the ship divided by the width of the FIBC will give the number of FIBCs which can be stowed athwartships and the void space left. If there will be a void space, the stowage of the FIBCs is to start from both sides to the centre, so that any void space will be in the centre of the hatchway.*

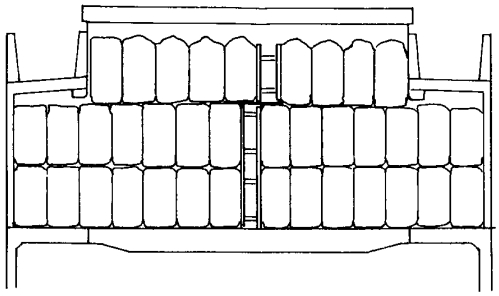
c) *FIBCs are to be stowed as close as possible against each other and any void space should be chocked off.*

d) *The next layers are to 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 is also to be chocked off in the centre of the hatchway.*

e) *When there is sufficient room in the hatchway on top of the layers underneath to stow another layer, it is to be established whether the coamings can be used as bulkheads. If not, measures are to be taken to prevent the FIBCs shifting to the open space in the wings. Otherwise, the FIBCs are to be stowed from one coaming to another. In both cases any void space is to be in the centre and is to be chocked off.*

f) *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 22).*

Figure 22 - Stowage of FIBCs with chocked void spaces in the centre of the stowage area



3.3.11.5 Securing

a) *In cases where only a part of a 'tween-deck or lower hold is used for the stowage of FIBCs, measures are to be taken to prevent the FIBCs from shifting. These measures are to 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.*

b) *The wire lashings and plywood sheets used for securing are to be regularly checked, in particular before and after rough weather, and retightened if necessary.*

3.3.12 General guidelines for the under-deck stowage of logs

3.3.12.1 Introduction

The purpose of this article 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.

3.3.12.2 Prior to loading

a) *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 are to be determined;*

b) *using the above information, a pre-stow plan is to be developed to allow the maximum utilization of the available space; the better the under-deck stowage, the more cargo can safely be carried on deck;*

c) *the cargo spaces and related equipment are to be examined to determine whether the condition of structural members, framework and equipment affect the safe carriage of the log cargo. Any damage discovered during such an examination is to be repaired in an appropriate manner;*

d) *the bilge suction screens are to be examined to ensure they are clean, effective and properly maintained to prevent the admission of debris into the bilge piping system;*

e) *the bilge wells are to be free of extraneous material such as wood bark and wood splinters;*

f) *the capacity of the bilge pumping system is to 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;*

g) *side sparring, pipe guards, etc., designed to protect internal hull members are to be in place; and*

h) *the master is to 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 is to 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 apparently inexplicable list, a shift of deck cargo, and potential capsize.*

3.3.12.3 During loading operations

a) *each lift of logs is to be hoisted aboard the ship in close proximity to the ship to minimize any potential swinging of the lift;*

b) *the possibility of damage to the ship and the safety of those who work in the cargo spaces is to be considered. The logs are not to be swinging when lowered into the space. The hatch coaming are to 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;*

c) *the logs are to 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 are to be loaded first into the cargo spaces;*

d) *logs are generally to 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 is to 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;*

e) *where the logs in the spaces can only be stowed fore and aft in one length, any remaining void forward or aft is to 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;*

f) *athwartship voids are to be filled tier by tier as loading progresses;*

g) *butt ends of the logs are to be alternately reversed to achieve a more level stowage, except where excess sheer on the inner bottom is encountered;*

h) *extreme pyramiding of logs is to 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 is to commence early in the loading process (after reaching a height of approximately 2 m above the inner bottom) and is to continue throughout the loading process;*

i) *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 are to be attached to suitably reinforced fixtures such as eyebolts or pad-eyes provided for this purpose. However, if this procedure is followed, care is to be taken to avoid overloading the gear;*

j) *a careful watch by ship's personnel is to be maintained throughout the loading to ensure no structural damage occurs. Any damage which affects the seaworthiness of the ship is to be repaired;*

k) *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 is to be reduced to facilitate stowing of the remaining area; and*

l) *logs in the hatch coaming area are to be stowed as compactly as possible to maximum capacity.*

3.3.12.4 After loading

the ship is to be thoroughly examined to ascertain its structural condition. Bilges are to be sounded to verify the ship's watertight integrity

3.3.12.5 During the voyage

a) *the ship's heeling angle and rolling period are to be checked, in a seaway, on a regular basis;*

b) *wedges, wastes, hammers and portable pump, if provided, are to be stored in an easily accessible place; and*

c) *the master or a responsible officer is to ensure that it is safe to enter an enclosed cargo space by:*

- *ensuring that the space has been thoroughly ventilated by natural or mechanical means;*

- *testing the atmosphere of the space at different levels for oxygen deficiency and harmful vapour where suitable instruments are available; and*

- *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.*

3.3.13 Safe stowage and securing of unit loads

3.3.13.1 Introduction

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

- *placed or stacked, and secured by strapping, shrink-wrapping or other suitable means, on a load board such as a pallet; or*

- *placed in a protective outer packaging such as a pallet box; or*

- *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.

3.3.13.2 Cargo information

The master is to be provided with at least the following information:

- *the total number of unit loads and commodity to be loaded;*

- *the type of strapping or wrapping used;*

- *the dimensions of a unit load in metres; and*

- *the gross mass of a unit load in kilograms.*

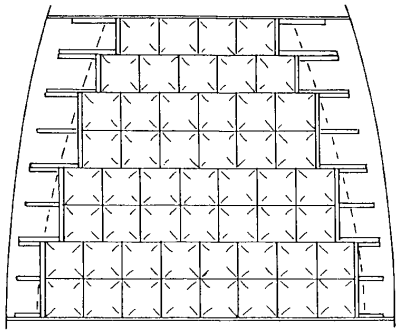
3.3.13.3 Recommendations

a) *The cargo spaces of the ship in which unit loads will be stowed are to be clean, dry and free from oil and grease.*

b) *The decks, including the tank top, are to be flush all over.*

c) *The cargo spaces are preferably to be of a rectangular shape, horizontally and vertically. Cargo spaces of another shape in forward holds or in 'tweendecks are to be transformed into a rectangular shape both athwartships and longitudinally by the use of suitable timber (Figure 23).*

Figure 23 - Stowage and chocking of unit loads in a tapered stowage area (top view)



3.3.13.4 Stowage

a) *The unit loads are to be stowed in such a way that securing, if needed, can be performed on all sides of the stow.*

b) *The unit loads are to be stowed without any void space between the loads and the ship's sides to prevent the unit loads from racking.*

c) *When unit loads have to be stowed on top of each other, attention is to be paid to the strength of pallets and the shape and the condition of the unit loads.*

d) *Precautions are to be taken when unit loads are mechanically handled to avoid damaging the unit loads.*

3.3.13.5 Securing

Block stowage is to be ensured and no void space be left between the unit loads.

3.3.13.6 Securing when stowed athwartships

a) *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 are to be positioned vertically against the stack of the unit loads. Wire lashings are to be fitted from side to side keeping the gratings or plywood sheets tight against the stow.*

b) *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.*

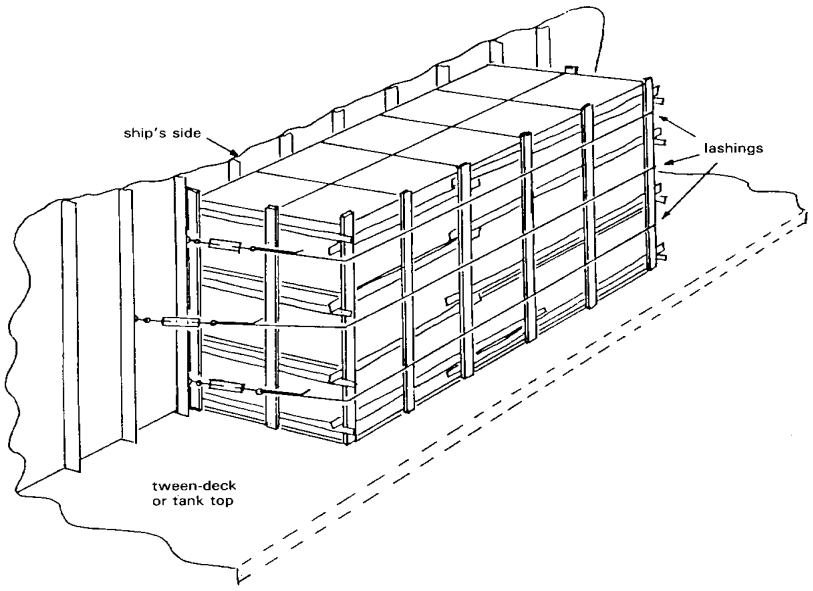
3.3.13.7 Stowage in a wing of a cargo space and free at two sides

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 are to be positioned vertically to the stack faces of the unit loads of the non-secured sides of the stow. Wire lashings are to 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 are to be positioned in such a way that no damage can occur on corners.

3.3.13.8 Stowage free at three sides

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 are to be positioned vertically against the stack faces of the unit loads. Special attention is to be paid to the corners of the stow to prevent damage to the unit loads by the wire lashings. Wire lashing at different heights is to tighten the stow together with the gratings or plywood sheets at the sides (Figure 24).

Figure 24 - Securing of units stowed at the ship's side



3.3.13.9 General

a) *Instead of gratings or plywood sheets, other possibilities are the use of aluminium stanchions or battens of sufficient strength.*

b) *During the voyage the wire lashings are to be regularly inspected and slack wires are to be retightened if necessary. In particular, after rough weather, wire lashings are to be checked and retightened if necessary.*

3.3.14 Elements to be taken into account when considering the safe stowage and securing of cargo unit and vehicles in ships

3.3.14.1 General

Cargo units in this article means wheeled or tracked cargo, containers, flats, portable tanks, vehicles and the ship's mobile cargo handling equipment not fixed to the ship.

The elements which are to be taken into account relate specifically to the safe shipment of cargo units, including vehicles. The aim is to indicate to the various parties involved the principal factors and features which need to be considered when designing and operating the ship or presenting the cargo unit, or vehicle, for such shipment. In addition, it is hoped that the elements will facilitate and promote better understanding of the problems and the needs of the masters of ships so engaged.

3.3.14.2 The parties involved

The elements are intended primarily for the information and guidance of the following parties which, it is considered, are in some way associated with either the design or the operation of the ship or, alternatively, with the design, presentation or loading of cargo units including vehicles. They are:

- shipbuilders;

- shipowners;

- shipmasters;

- port authorities;

- shippers;

- forwarding agents;

- road hauliers;

- stevedores;

- cargo unit and vehicle manufacturers;

- insurers;

- railway operators; and

- packers of containers at inland depots.

3.3.14.3 General elements

It is of the utmost importance to ensure that:

- 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

- cargo units and vehicles are provided with an adequate number of securing points to enable the cargo to be adequately secured to the cargo unit or vehicle so as to withstand the forces, in particular the transverse forces, which may arise during the sea transport.

3.3.14.4 Elements to be considered by the shipowner and shipbuilder

a) *The ship is to 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, items of cargo securing gear and the preparation of the Cargo Securing Manual, the following elements are to be taken into account:*

- duration of the voyage;

- geographical area of the voyage;

- sea conditions which may be expected;

- size, design and characteristics of the ship;

- dynamic forces under adverse weather conditions;

- types of cargo units and vehicles to be carried;

- intended stowage pattern of the cargo units and vehicles; and

- weight of cargo units and vehicles.

b) *The Cargo Securing Manual is to provide information on the characteristics of cargo securing items and their correct application.*

c) *Ship's mobile cargo handling equipment not fixed to the ship is to be provided with adequate securing points.*

3.3.14.5 Elements to be considered by the Master

a) *When accepting cargo units or vehicles for shipment and having taken into account the elements listed in paragraph 3.3.14.4.a) above, the master is to be satisfied that:*

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

- cargo units including vehicles are in an apparent good order and condition suitable for sea transport particularly with a view to their being secured;

- the ship has on board an adequate supply of cargo securing gear which is maintained in sound working condition;

- cargo units including vehicles are adequately stowed and secured to the ship; and

- where practicable, cargoes are adequately stowed on and secured to the cargo unit or vehicle.

b) *In addition, cargo spaces are to be regularly inspected to ensure that the cargo, cargo units and vehicles remain safely secured throughout the voyage.*

3.3.14.6 Elements to be considered by the shipper, forwarding agents, road hauliers and stevedores (and, when appropriate, by the port authorities)

Shippers or any other party involved with presenting cargo units including vehicles for shipment are to appreciate that such items can be subjected to forces of great magnitude, particularly in the transverse direction and especially in adverse weather conditions. Consequently, it is of importance that they are to be constantly aware of this fact and that they ensure that:

- cargo units including vehicles are suitable for the intended sea transport;

- cargo units including vehicles are provided with adequate securing points for the securing of the cargo unit or vehicle to the ship and the cargo to the cargo unit or vehicle;

- the cargo in the cargo unit or vehicle is adequately stowed and secured to withstand the forces which may arise during sea transport; and

- in general the cargo unit or vehicle is clearly marked and provided with documentation to indicate its gross weight and any precautions which may have to be observed during sea transport.

3.4 Supplementary requirements for ro-ro ships

3.4.1 General

The requirements of paragraph 3.3 above apply also to ro-ro ships. The following requirements are supplementary ones for ro-ro ships.

Sketches showing the layout of the fixed securing devices with identification of strength (MSL) as well as longitudinal and transverse distances between securing points are to be included in this Cargo Securing Manual.

For this purpose, further guidance may be helpfully utilized from IMO Resolutions A.533(13) and A.581(14) as appropriate (see paragraph 3.3.14 above and 3.4.2 hereafter).

In designing securing arrangements for cargo units, including vehicles and containers, on ro-ro passenger ships and specifying minimum strength requirements for securing devices used, forces due to the motion of the ship, angle of heel after damage or flooding and other considerations relevant to the effectiveness of the cargo securing arrangement are to be taken into account.

3.4.2 Guidelines for securing arrangements for the transport of road vehicles on ro-ro ships

3.4.2.1 Scope

This article for securing and lashing road vehicles on board ro-ro ships outline in particular the securing arrangements on the ship and on the vehicles, and the securing methods to be used.

3.4.2.2 Application

***a)** This article applies to ro-ro ships which regularly carry road vehicles on either long or short international voyages in unsheltered waters. They concern:*

- road vehicles as defined in 1.1 with an authorized maximum total mass of vehicles and cargo of between 3.5 and 40 tonnes; and

- articulated road trains as defined in 1.1 with a maximum total mass of not more than 45 tonnes, which can be carried on ro-ro ships.

***b)** This article does not apply to buses.*

c) *For road vehicles having characteristics outside the general parameters for road vehicles (particularly where the normal height of the centre of gravity is exceeded), the location and the number of securing points are to be specially considered.*

3.4.2.3 Securing points on ship's deck

a) *The ship is to carry a Cargo Securing Manual in accordance with resolution A.489(XII) containing the information listed and recommended in paragraph 10 of the Annex to that resolution.*

b) *The decks of a ship intended for road vehicles as defined in 1.1 are to be provided with securing points. The arrangement of securing points are to be left to the discretion of the shipowner provided that for each road vehicle or element of a combination of road vehicles, there is the following minimum arrangement of securing points:*

- *The distance between securing points in the longitudinal direction is in general not to exceed 2.5m. However, there may be a need for the securing points in the forward and after parts of the ship to be more closely spaced than they are amidships.*

- *The athwartships spacing of securing points are to be not less than 2.8m, not more than 3m. However, there may be a need for the securing points in the forward and after parts of the ship to be more closely spaced than they are amidships.*

- *The maximum securing load (MSL) of each securing point is to be not less than 100 kN. If the securing point is designed to accomodate more than one lashing (y lashings), the MSL is to be not less than 100 kN.*

c) *In ro-ro ships which only occasionally carry roads vehicles, the spacing and strength of securing points are to be such that the special considerations which may be necessary to stow and secure road vehicles safely are taken into account.*

3.4.2.4 Securing points on road vehicles

a) *Securing points on road vehicles are to be designed for securing the road vehicles to the ship and are to have an aperture capable of accepting only one lashing. The securing point and aperture are to permit varying directions of the lashing to the ship's deck.*

b) *The same number of not less than two or more than six securing points is to be provided on each side of the road vehicle in accordance with the provisions of c).*

c) *Subject to the provisions of notes 1, 2 and 3 hereunder, the minimum number and minimum strength of securing points are to be in accordance with Table X.*

d) *Each securing point on the vehicle is to be marked in a clearly visible colour.*

e) *Securing points on the vehicle are to be so located as to ensure effective restraint of the vehicle by the lashings.*

Table X - Securing points on road vehicles

Gross vehicle mass (GVM) (tonnes)	*Minimum number of securing points on each side of the road vehicle*	*Minimum strength without permanent deformation of each securing point as fitted (kN)*
3.5 t ≤ GVM ≤ 20 t	*2*	*(GVM x 10 x 1.2) / n*
20 t <GVM ≤ 30 t	*3*	
30 t < GVM ≤ 40 t	*4*	

Where n is the total number of securing points on each side of the road vehicle.

Note 1: For road trains, the table applies to each component, i.e. to the motor vehicle and each trailer, respectively.

Note 2: Semi-trailer towing vehicles are excluded from the table above. They are to be provided with two securing points at the front of the vehicle, strength of which should be sufficient to prevent lateral movement of the front of the vehicle. A towing coupling at the front may replace the two securing points.

Note 3: If the towing coupling is used for securing vehicles other than semi-trailer towing vehicles, this is not to replace or to be substituted for the above-mentioned minimum number and strength of securing points on each side of the vehicle.

f) *Securing points are to be capable of transferring the forces from the lashings to the chassis of the road vehicle and are never to be fitted to bumpers or axles unless these are specially constructed and the forces are transmitted directly to the chassis.*

g) *Securing points are to be so located that lashings can be readily and safely attached, particularly where side-guards are fitted to the vehicle.*

h) *The internal free passage of each securing point's aperture is to be not less than 80 mm but the aperture need not be circular in shape.*

i) *Equivalent or superior securing arrangements may be considered for vehicles for which the provisions of Table X are unsuitable.*

3.4.2.5 Lashings

a) *The maximum securing load (MSL) of lashings is to be not less than 100 kN, and they are to be made of material having suitable elongation characteristics.*

b) *Lashings are to 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 are to be examined during the voyage and tightened as necessary.*

c) *Lashings are to 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.*

d) *Only one lashing is to be attached to any one aperture of the securing point on the vehicle.*

e) *Lashings are only to be attached to the securing points provided for that purpose.*

f) *Lashings are to 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 degrees and 60 degrees.*

g) *Bearing in mind the characteristics of the ship and the weather conditions expected on the intended voyage, the master has to decide on the number of securing points and lashings to be used for each voyage.*

h) *Where there is doubt that a road vehicle complies with the provisions of Table VIII, the master may, at his discretion, load the vehicle on board, taking into account the apparent condition of the vehicle, the weather and sea conditions expected on the intended voyage and all other circumstances.*

3.4.2.6 Stowage

a) *Depending on the area of operation, the predominant weather conditions and the characteristics of the ship, road vehicles are to 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.*

b) *Taking into account the conditions referred to in a) and the fact that compressed air suspension systems may loose air, the air pressure should be released on every vehicle fitted with such a system if the voyage is of more than 24-hour duration. If practicable, the air pressure is to be released also on voyages of a shorter duration. If the air pressure is not released, the vehicle is to be jacked up to prevent any slackening of the lashings resulting from any air leakage from the system during the voyage.*

c) *Where jacks are used on a vehicle, the chassis is to be strengthened in way of the jacking-up points and the position of the jacking-up points should be clearly marked.*

d) *Special consideration is to 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 is to be given to the forces which may arise from such stowage.*

e) *Wheels are to be chocked to provide additional security in adverse conditions.*

f) *Vehicles with diesel engines are not to be left in gear during the voyage.*

g) *Vehicles designed to transport loads likely to have an adverse effect on their stability, such as hanging meat, are to have integrated in their design a means of neutralizing the suspension system.*

h) *Stowage is to be arranged in accordance with the following:*

- The parking brakes of each vehicle or of each element of a combination of vehicles are to be applied and locked.

- Semi-trailers, by the nature of their design, are not to 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 is to 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-trailer designers are to consider space and the reinforcements required and the selected areas are to be clearly marked.

3.5 Bulk carriers

The requirements of paragraph 3.3 above apply also to bulk carriers. The following requirements are supplementary ones for bulk carriers.

If bulk carriers carry cargo units falling within the scope of chapter VI/5 or chapter VII/5 of SOLAS Convention, this cargo shall be stowed and secured in accordance with this Cargo Securing Manual.

4. STOWAGE AND SECURING OF CONTAINERS AND OTHER-STANDARDIZED CARGO

4.1 Handling and safety instructions

4.1.1 Instructions on the proper handling of the securing devices

4.1.1.1 Lashings

The tasks are to raise and insert lash end fittings into corner castings, attach lash and tensioner and to tighten tensioner

When turnbuckles are tightened, the lash is also liable to twist. It is necessary for one man to hold the tensioner to the lash while the other men tensions the turnbuckle. Otherwise the lashings may actually twist off their end fittings.

4.1.1.2 Lowering of stacking gear

Twistlocks are not to be thrown down to the hatch cover, deck or another container roof. This may damage the twistlock, present a hazard to personnel or damage the container roof.

A bucket or other suitable means of lowering or lifting must always be used.

4.1.1.3 Insertion of twistlocks

Twitlocks must always be inserted the correct way round, and not upside down. This could lead to stacking or discharge problems and dangers

4.1.2 Safety instructions related to handling of securing devices and to securing and unsecuring of containers or other standardized cargo by ship or shore personnel

4.1.2.1 General

The following safety instructions apply to securing operations and securing devices for containers and other standardized cargo by ship or shore personnel.

4.1.2.2 Personal Safety

Proper safety gear consisting of safety helmets, safety boots, protective gloves, rain gear and protective clothing must be worn.

Only persons medically fit and adequately trained are allowed to perform operations.

4.1.2.3 Lashing Restriction

No person must stand under a container in case of falling objects. Hence no lashing is allowed under moving containers.

No person is allowed to work below an area where work is going on above

No work must be done if the lighting at night is not sufficient.

4.1.2.4 Lashing Practice

Men in charge of lashing must work from outboard to centre when discharging and from centre to outboard when loading.

All gear must be put into bins when nit in use.

All gear must be removed from hatch covers or container roofs before they are lifted and moved.

No throwing or dropping of any gear is allowed.

Defective gear must not be used, and reported to the Master.

Special care must be taken when working on roofs.

4.1.2.5 Environment

Working on deck in ice, snow strong wind or rain must be controlled to prevent slips and falls from heights.

Generally, if the wind is too strong for cranes to work, then personnel is to work with great caution, or seek shelter.

Personnel must never climb onto containers if wind, rain or snow create a hazard.

4.1.2.6 Ladders

Ladders are not to be used unless « non slip » fittings are attached to the bottoms.

The lower end is always to be attended to by another person, who can hand up the gear.

4.1.2.7 Personnel Cage Spreader

The personnel cage spreader must be used when working on top of three tiers of containers or more, an in inclement weather.

When men are working in a crib, foreman stevedore must be in attendance, with a portable radio.

Lashing equipment in a cage must be arranged in a tidy manner.

Inertia belts are required when men leave a cage at a height.

No person is allowed to ride a spreader when a box is attached.

Gear is not to be left on the spreader while it is carrying containers.

4.1.2.8 Crane Practice

The crane driver when discharging containers secured with locks must initially lift slowly to establish that the twistlock has been released correctly.

There must be no trailing rods or wires on containers when moving by crane.

Quay crane drivers must not land containers on deck stow when unsighted without first confirming area is clear.

Crane driver must always be in contact with men on the spreader or cage.

4.2 Stowage and securing instructions

4.2.1 General

This sub-chapter is applicable to any stowage and securing system (e.g. stowage within or without cellguides) for containers and other standardized cargo. On existing ships the relevant documents regarding safe stowage and securing may be attached to this Cargo Securing Manual.

4.2.2 Stowage and securing plan

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

1 - longitudinal and athwartship views of under deck and on deck stowage locations of containers as appropriate;

2 - alternative stowage patterns for containers of different dimensions;

3 - maximum stack masses;

4 - permissible vertical sequences of masses in stack;

5 - maximum stack heights with respected to sight lines; and

6 - application of securing devices using suitable symbols with due regard to stowage position, stack mass, sequence of masses in stack and stack height. The symbols used are to be consistent throughout the Cargo Securing Manual.

The plans and drawings giving these information are to be attached to this chapter.

Containers are to be loaded, carried, stowed and lashed in accordance with these plans and drawings

4.2.3 Stowage and securing principle on deck and under deck

This sub-chapter supports the interpretation of the stowage and securing plan with regard to container stowage, highlighting the use of specified devices and any guiding of limiting parameters such as :

- Dimensions : 20’ and 40’ standard ISO reefer and dry containers are carried on board this ship

- Locations : containers are carried on deck and in hold on board this ship

- Maximum stack masses : 20’ containers masses are limited to ..... tons on double-bottom and. tons on main deck and hatch covers. 40’ containers masses are limited to ..... tons on double-bottom, ... tons on hatch covers and ..... tons on main deck.

- Sequences of masses in stacks : containers are to be loaded in accordance with the limits given by the trim and stability booklet and considering the allowable maximum stack masses.

- Stack affected by the wind :the outboard stacks are affected by the wind, and their lashings are to be done accordingly.

- Heights of stacks : stacks height is limited to ..... tiers in hold and .... tiers on deck.

Lashing is to be carried out in accordance with these principles.

The lashing of the outboard stack of containers is to be carefully carried out in order to prevent excessive loading and racking due to accelerations, sea and wind loads.

The lashing wire are to be sufficiently tight, but not in excess which can reduce the safe working load.

4.3 Other allowable stowage patterns

This sub-chapter provides the necessary information for the Master to deal with cargo stowage situations deviating from the general instructions addressed to under 4.2 above, including appropriate warnings of possible consequences from misuse of securing devices or misinterpretation of instructions given.

Information are to be provided with regard to :

- alternative vertical sequences of masses in stacks;

- stacks affected by wind load in the absence of outer stacks;

- alternative stowage of containers with various dimensions; and

- permissible reduction of securing effort with regard to lower stacks masses, lesser stack heights or other reasons.

4.4 Forces acting on cargo units

4.4.1 General

This sub-chapter presents the reference of accelerations and forces on which the stowage and securing system is based.

Recommendations are to be given for reducing the risk of cargo loss from deck stowage by restrictions to stack masses or stack heights.

4.4.2 Ship motions and accelerations

4.4.2.1 General

Refer to the Rules for the Classification of Steel Ships in force-Pt B, Ch 5, Sec3

4.4.3 Forces applied to containers

The forces applied to containers are given in the Rules for the Classification of Steel Ships in force- Pt F,Ch 9, Sec 5, [4].