Rules for Classification and Construction

Part 4 Special Equipment and System

RULES FOR STOWAGE AND LASHING OF CONTAINERS

Volume I

January 2025 Edition

Biro Klasifikasi Indonesia

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Rules for Classification and Construction

Part 4 Seagoing Ships

RULES FOR STOWAGE AND LASHING OF CONTAINERS

Volume I

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Jl. Yos Sudarso No. 38-40, Tanjung Priok
Jakarta 14320 - Indonesia
rules@bki.co.id
www.bki.co.id

Amendments to the preceding Edition are marked by red color and expanded text. However, if the changes involve the whole section or sub-section normally only the title will be in red colour.

Foreword

This Rules for Stowage and Lashing of Containers (Pt.4, Vol.I) January 2025 Edition replaces the Rules for Stowage and Lashing of Containers (Pt.4, Vol.I) 2012 Edition. In this edition, new amendments are introduced which are mainly derived from IACS publications, and inputs from BKI Branch Offices and Technical Division BKI Head Office.

The summary of the previous edition and amendments, including the implementation date, is indicated in the table below:

No.	Edition/ Rule Change Notice (RCN)	Effective Date	Link
1	Edition 2012	1th October 2012	🔗

A summary of amendments to the previous edition, including the implementation date for each section, is presented in **Table 1 - Amendments incorporated in This Notice**.

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Further queries or comments concerning this Rules are welcomed through communication to BKI Head Office.

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Rules Amendment Notice

Table 1 - Amendments incorporated in This Notice

These amendments will come into force on 1st January 2025, except stated otherwise as indicated in the Table

Paragraph	Title/Subject	Status/Remark
Section 1 - General Definitions		
A.	**Application**	Renumbered
1.1		Renumbered and added a new requirement about strength effect for stowage and lashing system wich are welded to the ship and accordance to Rules for Hull (Pt.1, Vol.II) and for dimensioned accordance to Section 3
1.2		Renumbered and added a new requirement about associated document and examined for apporval of the entire stowage dan lashing system in accordance to this Rules
1.3		Renumbered and added a new requirement about mandatory for ships assigned the class notations Container Ship or Equipped for Carriage of Containers (ECC)
1.1.4		Deleted the paragraph
1.1.5		Deleted the paragraph
1.4		Renumbered and added a new requirement about A container securing arrangement plan for unrestricted service approved by BKI is to be kepton board as part of the cargo securing manual
1.5		Renumbered and added a new requirement about if the container stowage and lashing equipment is to be modified or removed, BKI shall be informed accordingly
1.1.6		Deleted and paraphrased the paragraph

Paragraph	Title/Subject	Status/Remark
1.6		Renumbered and added a new requirement about loose and fixed stowage and lashing fiiting fabricated in series
1.7		Renumbered and added a new requirement about lashing computer on board with lashing software approved by BKI
1.4		Deleted the requirement
2.	**Stowage of containers**	Deleted the requirement
2.	**Ships classed with other Classification Societies**	To add new requirements about other class ship that can be certified by BKI
3.	**Cargo securing manual**	To add new requirements that cargo securing manual will be certified by BKI upon request and provided authorisation by the Flag Administration
Section 2 - Dimensioning of Container Securing Systems		
A.	**General**	Renumbered, added new requirements, and paraphrased the paragraph
B.	**On-Deck Stowage of Containers**	Renumbered, added new requirements, and paraphrased the paragraph
C.	**Below-Deck Stowage of Containers**	Renumbered, added new requirements, and paraphrased the paragraph
Section 3 - Dimensioning of Container Securing Systems		
A.	**Wind and Sea Induced Loads on Containers**	To add new requirement and paraphrase the paragraph
B.	**Container Stowage without Lateral Support**	To add new requirement and paraphrase the paragraph
C.	**Container Stowage with Lateral Support**	To add new requirement and paraphrase the paragraph
D.	**Permissible Loads**	To add new requirement and paraphrase the paragraph
Section 5	**Approval and Certification of Container Securing Systems**	To add new requirement base on IACS UR C7 *The amendments are effective from 1 July 2025*
Section 6	**Requirements for Lashing Software**	To add new requirement base on IACS UR C6 *The amendments are effective from 1 July 2025*

Paragraph	Title/Subject	Status/Remark
Annex A - Instruction for the Performance of Inspections of Container Lashing Elements		
A.	**Performance of Inspections**	
3.	**Load tests (type test)**	To add new requirement about safety factor ν_{Br} apply for container lashing element and rigid
Annex B	**Certificates of The Test and Examination of Container Stowage- and Lashing Parts**	To change te title
Annex C	**Welding Procedure Qualification Test Flash Butt Welding or Friction Welding of Container Lashing Elements**	To change the title
Annex D	**Container Lashing Fittings**	To change the title
Appendix E	**Survey of Container Stowage and Lashing Equipment**	To delete the requirement and add the requirement to the Rules for Classification and Surveys (Pt.1, Vol.I) base on the notations
Annex E	**Approvals of Computer Software for Determination of Forces in the Lashing System**	To change the title & renumbering
Annex F	**Weights, Measurements and Tolerances**	To change the title & renumbering and update about weight of container 20’
Annex G	**Container Dimensions**	To change the title & renumbering
Annex H	**Code of Container Position**	To change the title & renumbering
Annex I	**Height Tolerances of Container Foundations**	To change the title & renumbering
Annex J	**Maximum Allowable Forces on ISO Container**	To change the title & renumbering
Annex K	**Determination of the Existing Stack Weight for Mixed Stowage (20’ and 40’ Container) for the Individual Foundation Points**	To change the title & renumbering
Annex L	**Specification of Standard and Individual Routes for Route specific Container Stowage**	To add new requirement about Standard routes for Asia - Europe service, Pacific service, Pacific-Atlantic service, North Sea- Mediterranean Short Sea service, North Atlantic service, Intra-Asia service, North Sea - Baltic service, Europe - South America East Coast service, Europe - West Africa service and Asia - Europe service via Cape of Good Hope are defined for route specific container stowage

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Table of Contents

Section 1 General Definitions

A. Application

1. Ships classed with Biro Klasifikasi Indonesia

1.1 Parts of the container stowage and lashing system which are welded to the ship's hull and thereby may affect its strength, as well as connections of these parts to the hull and their substructures are subject to classification of the ship in accordance with Rules for Hull (Pt.1, Vol.II) and Rules for Container Ships (Pt.1, Vol.XVIII) (BKI). These systems shall be dimensioned according to the loads given in Section 3. Corresponding drawings indicating locations of connections and material properties are to be submitted for approval.

1.2 For other parts of stowage and lashing systems such as loose lashing elements and removable guide structures, associated documents (drawings, calculations reports, etc.) will be examined within the approval of the entire stowage and lashing system in accordance with this Rules . These other parts shall be fabricated in conformity with the provisions laid down in Section 4 and they shall be subjected to strength tests according to Annex C.

1.3 The exclusive use of onboard container stowage and lashing system approved and tested by BKI in accordance with Section 4 and Annex A of these Rules, as well as the BKI approved container securing arrangement plan are mandatory for ships assigned the class notations **Container Ship** or Equipped for Carriage of Containers (**ECC**) (see Guidance for Classification Notation (Pt.0, Vol.B)).

Certificates of the container stowage and lashing fittings used onboard the ship shall be kept on board. The Container securing arrangement plan has to contain a parts list with the following specification of the Container stowage and lashing equipment:

- Number of parts with position number
- Designation (type)
- Manufacturer and
- Breaking load and working load.

In the Class Certificate of the ship a Notation will be entered to this effect.

The manufacturer of the approved stowage and lashing system has to ensure, that clear instructions for the safe operation of all components of the system are available to the ship's crew.

Responsibility for compliance with these requirements rests with the owner of the ship.

BKI surveyors will examine the compliance with the conditions for granting the class notation during periodical class surveys.

1.4 A container securing arrangement plan for unrestricted service approved by BKI is to be kept on board as part of the cargo securing manual and is to be made available to the BKI Surveyor on request.

If route specific container stowage is planned, a BKI approved route specific container stowage manual is to be kept on board. The route specific container stowage manual shall include route specifications according to Annex L and excerpts of the route specific container securing arrangement plans for deck and hold stowage of 20ft and 40ft containers for three different longitudinal ship positions for each route.

1.5 If the container stowage and lashing equipment is to be modified or removed, BKI shall be informed accordingly.

The owners and/or the shipyard charged with the conversion have to submit relevant drawings to BKI for approval.

This refers also to modifications of the stowage arrangement caused by an increased number of container stowed on the weather deck and on hatch covers including, for instance, the arrangement of additional container layers, increased stack weights and modified container weights in individual container layers.

1.6 BKI grants type approval of loose and fixed stowage and lashing fittings fabricated in series. The approval procedure comprises examination of drawings as well as load tests and serves as a basis for individual approval in connection with the assignment of Class and also see Section 5.

Note:

Where container stowage and lashing elements are intended to be used as loose gear - e.g. lifting pots, lifting foundations on the hatch covers.– "Guidelines for loading Gear on Seagoing Ships and Offshore Installations (Pt.4, Vol.3), are to be applied.

1.7 Use of a lashing computer on board with lashing software approved by BKI as given in Section 6 and Annex E is mandatory.

2. Ships classed with other Classification Societies

For ships other than covered by 1.1, compliance with these Rules can be certified by BKI upon request for container stowage and lashing systems after the corresponding examination.

3. Cargo securing manual

According to IMO requirement, all ships subject to SOLAS have to be equipped with an approved cargo securing manual. Exempted are ships for liquid cargo and bulk cargo and fishing vessel and offshore units. The cargo securing manual will be certified by BKI upon request, provided authorisation by the Flag Administration has been obtained.

Section 2 Requirements on Container Securing Arrangement and Construction

A. General

1. Container stowage

These Rules apply to stowage of containers designed according to ISO Standard Series 1 ISO 1496-1. For weights, dimensions and tolerances of standard containers see Annex F.

Containers shall be stowed aboard the ship in the fore-to-aft direction.

Requirements according to Rules for Hull (Pt.1, Vol.II) Sec.21, H and Rules for Container Ships (Pt.1, Vol.XVIII) Sec.21, H are to be considered.

Requirements according to IMO CSS-Code Annex 14 are to be considered. Under specific conditions, operational walkways can be permitted below deck.

2. Container foundations

2.1 Transmission of forces on foundations

Sufficient size of transmission surface for vertical forces from the twistlock and/or from the stacking cone acting on the foundation shall be provided. Thus, if vertical loads exceeds 600 kN (700 kN max. pressure for a twistlock at the first tier top and higher), the minimum surface for direct pressure transmission of the twistlock (i.e., the web surface of a corner fitting covered by the twistlock foundation plate) is to be 25 cm².

Note:

At twistlock foundations with elongated ISO holes an even larger base is recommended to achieve a longer lifetime.

Load transition into the deck and into longitudinal coamings etc. shall be sufficiently smooth to avoid stress concentrations.

2.2 Foundation tolerances

2.2.1 Height tolerances

The following tolerances for the height of container resting levels are recommended by BKI (see Annex I).

Transversely:

One point is zero (reference point), the other ± 3 mm

Longitudinally:

One point is zero (reference point), the other ± 6 mm

2.2.2 Distance tolerances

The following tolerances for transverse and longitudinal distances of aperture centrelines of container foundations are recommended by BKI.

Transversely:

± 3 mm for 20ft and 40ft containers

Longitudinally:

± 3 mm for 20ft containers and

± 4 mm for 40ft containers

For other container sizes, accordingly (see also ISO 668).

B. On-Deck Stowage of Containers

1. Container seating

1.1 Seating conditions

A check shall be made whether hull deformations may cause relative shifting of seating points of a container or a container stack. This may be the case, for instance, aboard ships having large hatch openings, where a container rests partly on a hatch cover and partly on a container stanchion situated adjacent to the hatchway. Relative dislocations of container seating points shall also be taken into account when the container rests on two adjacent hatch covers.

Where necessary, the alignment steps (cones) at the container's seating points shall be used to prevent damage to the container itself or of fittings and foundations caused by forces induced by relative dislocations of the seating points. Sliding plates or foundations with elongated apertures may be provided, for instance. Except for the aperture length, the shape of elongated apertures shall be in compliance with Standard ISO 1161 apertures.

Where container stanchions situated adjacent to hatchways are relieved of transverse forces by the use of, e.g., sliding plates, suitable devices shall used to transmit the transverse forces into the hatch covers.

1.2 Linear seating of containers

1.2.1 If containers are stowed with linear seating in several layers, the total weight of the containers above the first layer shall not exceed the following values:

— 0,8 G for 40 ft containers and

— 1,0 G for 20 ft containers

where G is the container's maximum gross weight according to Annex F.

This kind of seating may be set up by arranging continuous steel or wooden dunnages below the longitudinal bottom rails of the containers or by directly seating these bottom rails on the hatch covers or the decks, with sunk-in pockets being arranged below the container corners.

The arrangement of short steel pads serving as dunnage placed on the girders of short hatch covers shall be avoided.

1.2.2 Equipment used to obtain a linear seating shall be configured to leave a sufficient clearance (about 5 mm) between corner fittings of the container and hatch covers or decks. For ISO standard containers, a protruding depth of their corner fittings of 4 to 17,5 mm from their bottom longitudinal rails and of 11 to 17,5 mm from the bottom transverse girders may be assumed. Special container types may require additional dunnage for their transportation.

Linearly seated containers shall be secured against shifting by locking devices arranged on the hatch covers and/or the deck.

2. On-deck stowage without lashing and lateral support

2.1 Containers in one layer

Containers carried in one layer shall be secured against tilting and shifting by locking devices arranged at their lower corner fittings.

Where containers are coupled to container blocks by dual cone adapters or equivalent devices and bridge fittings, it is sufficient to lock the two outer containers at least at three corner fittings.

2.2 Containers in several layers

2.2.1 If containers are stowed in several layers, locking devices shall be arranged between the container layers. Containers located in the lowermost layer shall be locked at their lower corner fittings.

2.2.2 If four or more container layers are arranged, bridge fitting should be provided athwartships on the uppermost layer if possible. Tension pressure bridge fittings should be used, which can be inserted into variable gaps between containers.

2.3 Dunnage

Placing containers on dunnage without lashing them is only permissible if effective securing devices can be arranged to prevent them from shifting and tilting (see 2.1), see also 1.2.

3. On-deck stowage with lashing (without lateral support)

3.1 Lashing of containers

3.1.1 If lashings of containers are used, pretension of lashings shall be kept as small as possible.

3.1.2 To improve the efficiency of lashings, lashing bridges can be arranged. In this case, corresponding drawings of lashing bridges and force diagrams of the abutment loads are to be submitted for examination.

3.1.3 All front-ends and all door-ends of containers shall be stowed in the same direction. If this requirement is not met, the stack in question shall be examined separately.

3.1.4 For single lashings lashing elements, such as lashing rods, are to be fitted to the containers' bottom corner castings.

3.1.5 For vertical lashings, lashing shall be "loose" to equalize the clearance in the twistlock. This equalization may also be achieved by spring elements.

3.1.6 Generally, internal lashings shall be used if containers are stowed with lashings. For individual cases, after consultation with BKI and appropriate verification, approval may be granted for external lashings (see Fig. 2.1).

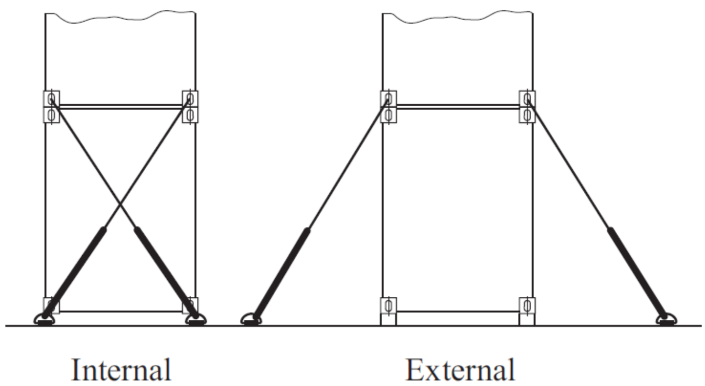

Figure 2.1 Internal and external lashings

3.2 Containers in one layer

Lashing is required only if locking devices are arranged at lower corner fittings of containers. Lashings shall be arranged vertically.

3.3 Containers in several layers

3.3.1 Container stacks of several layers may be lashed as shown in Fig. 2.2 or in a similar way.

3.3.2 Locking devices shall be arranged between container layers.

3.3.3 Container stacks shall be secured against horizontal displacements by cones, locking devices or alignment steps arranged on hatch covers and/or on deck.

3.3.4 If container stacks of four or more layers are lashed only at one end, e.g., if 20ft containers are stowed on 40ft stowing places with an inaccessible 20ft gap, the use of bridge fittings on the uppermost layer at the unlashed end is recommended, according to 2.2.2.

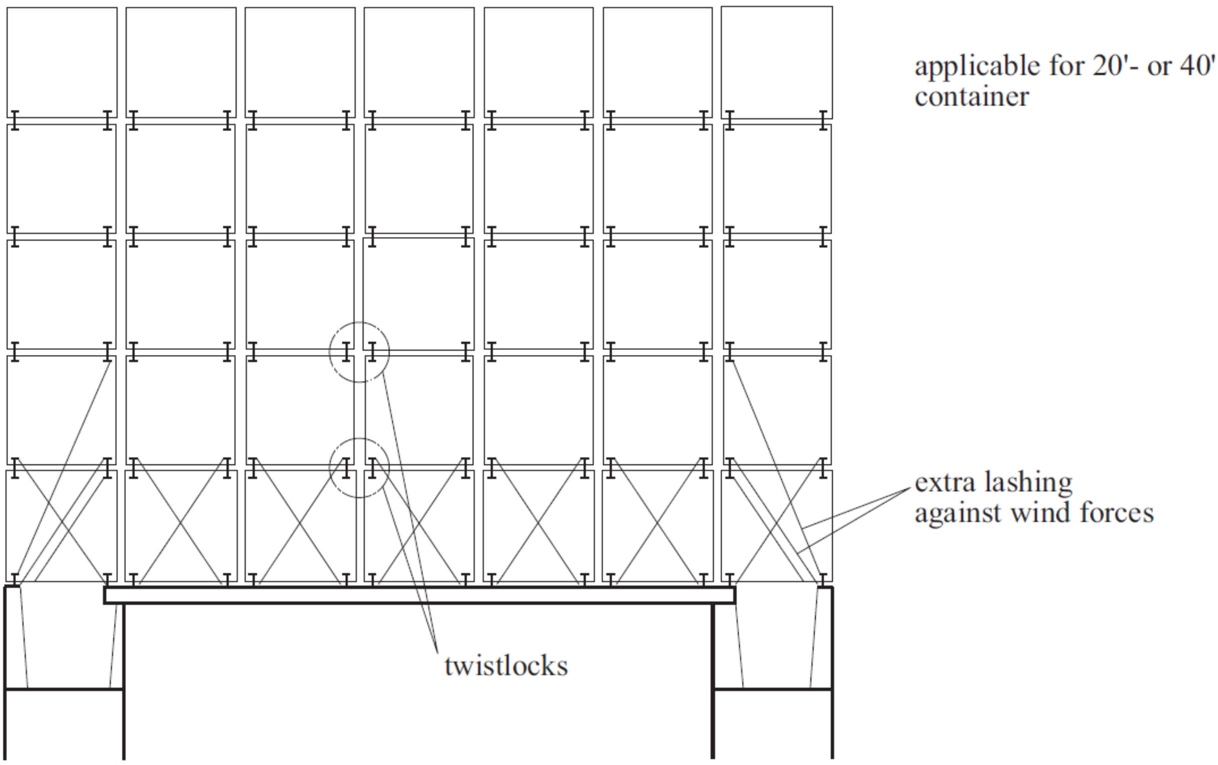

Figure 2.2 Basic arrangement of lashings

4. On-deck stowage with lateral support

4.1 Buttress system stowage

4.1.1 Instead of being lashed, containers may also be secured against sideward shifting and/or tilting by means of buttress structures placed on deck (if necessary, on hatchways) or by a system consisting of buttress structures and cone adapters.

4.1.2 Containers shall be shored by buttress structures in such a way that inadmissible deformations of the container framework are prevented and the permissible container racking loads are not exceeded.

4.2 Cell guides on deck

Containers stowed above the height of cell guides are to be sufficiently secured against racking and lifting forces. Vertical lashings are recommended. This also holds for containers whose upper part exceeds the height of cell guides.

The 20ft containers can be stowed in 40ft cell guides according to C.1.6. However, outer stacks shall be additionally secured against green water loads, including buoyancy and wind forces, by suitable devices.

5. Containers endangered by green water loads

Containers stowed in positions especially endangered by green water loads and by buoyancy forces of incoming water have to be additionally secured by locking devices, by container foundations of increased height and/or by reinforced lashings. For smaller ships, a buoyancy force, based on the entire volume of the container, shall be considered acting on the lowermost container.

C. Below-Deck Stowage of Containers

1. Stowage in cell guide structures

1.1 General requirements

1.1.1 Cell guide structures for containers may be welded to the ship's hull or be arranged in a detachable manner (screwed connections, suspended structures).

1.1.2 Doubling plates or, for ships fitted with an inner bottom ceiling, other suitable means shall be provided at lower ends of guide rails to reinforce the container supporting area, see Rules for Hull (Pt.1, Vol.II) Sec.21, H and Rules for Container Ships (Pt.1, Vol.XVIII) Sec.21, G.

1.2 Vertical guide rails

1.2.1 Vertical guide rails consist, in general, of equal-sided steel angles. On account of abrasion and local forces, e.g., due to jamming occurring when hoisting and lowering of containers, the flange thickness of steel angles should be at least 12 mm.

1.2.2 Horizontal forces from containers are transmitted as point loads through the container corners to the guide rails.

Where vertical guide rails consist of several steel angles, steel angles should be connected to each other by horizontal web plates arranged at least at the level of container corners and, additionally, halfway between them.

1.2.3 Guide heads

Top ends of guide rails shall be fitted with sufficiently strong guide heads, according to operating conditions. To minimise the impact on fatigue strength, it is recommended to support guide heads in way of hatch corners horizontally against transverse bulkhead only. A vertical support may be fitted to the longitudinal or transverse bulkhead.

It is recommended to provide a vertical connection to the transverse bulkhead in way of the guide heads, to transfer shear forces caused by loading and off-loading.

1.2.4 Self-supporting guide rails

Self-supporting guide rails in the cargo hold shall be sufficiently secured by, e.g., transverse ties. The ties shall be fitted, if possible, at the level of the container corners.

Guide rails may consist of main girders (e.g., I-beams) to which steel guide angles are attached.

1.2.5 Guide rails at bulkheads

Vertical guide rails at transverse or longitudinal bulkheads shall be connected to the bulkhead plating or to bulkhead stiffeners by horizontal web plates or other elements that resist shear and bending loads. A connection as free from notches as possible shall be aimed at, especially for tank bulkheads.

1.3 Cross ties

Depending on the construction of the cell guide system, cross ties support the guide rails athwartships by distributing local loads to all rails. If possible, they shall be arranged at the level of the container corner fittings to allow a direct absorption of horizontal forces. Sufficiently dimensioned cross ties may also absorb longitudinal forces.

1.4 Longitudinal ties

Where cross ties are not designed to absorb longitudinal forces, longitudinal ties shall be provided to support the vertical guide rails.

When steel wire pendants are used for longitudinal ties, they shall be provided with adjusting devices. Where bars are used, their end connections shall be constructed to exclude compressive stressing.

1.5 Clearances

1.5.1 Clearance of standard containers in guide rails shall not exceed 25 mm athwartships and 38 mm in the fore-to-aft direction. Maximum clearance in the fore-to-aft direction includes the deformation of the cell-guide system itself. Where containers are stowed in less than six layers, larger clearances can be permitted, provided container strength has been proven to be sufficient.

1.5.2 Transverse spacing of the cell guide system shall be sufficient to prevent damage to longitudinal supports of cell guide structures and to containers by loading and off-loading of containers with deformed side walls.

1.6 Stowage of 20ft containers in 40ft cell guides

1.6.1 Stowage with lateral support in 20ft gap

If 20ft containers are stowed in 40ft cell guides, in general, container ends in the 20ft gap shall be secured, analogous to 2.1, that is:

Containers placed side by side shall be coupled in the 20ft gap by dual cone adapters or equivalent devices. Containers in the lowermost layer shall be secured against shifting. Outer containers shall be laterally supported in the 20ft gap, according to 2.1.

1.6.2 Longitudinal stowage system

For a longitudinal stowage system, i.e., linkage of two 20ft containers by longitudinal tension/pressure adapter cones to a 40ft unit, lateral support of containers in the 20ft gap is not required. The maximum permissible stack weight is 120 t. The lowermost container shall have space for shifting.

1.6.3 Mixed stowage

The 20ft containers may be stowed in 40ft cell guides without lateral support, provided they are secured by single cones at least at both bottom corners in the 20ft gap of each container layer. The lowermost layer shall be secured against shifting in the 20ft gap. This is possible for up to 12 tiers. The maximum permissible stack weights, listed in Table 2.1, depend, first, on transverse container accelerations at their respective location and, second, on the number of tiers.

If a 20ft stack is topped by one or more 40ft containers (also linked by single cones), higher stack weights are permissible, as listed in Table 2.2 for different transverse container accelerations and different numbers of tiers.

Table 2.1 Depending on the containers' transverse acceleration, permissible total weight of 20ft containers stowed in 40ft cells not topped by 40ft containers, according to 1.6.3

$\overline{b_q}$ \ tiers	2	3	4	5	6	7	8	9	10	11	12
0,30	61,0	91,4	121,9	152,4	165,3	166,3	167,0	167,5	168,1	168,6	169,0
0,31	61,0	91,4	121,9	152,4	159,9	160,8	161,5	162,1	162,6	163,1	163,5
0,32	61,0	91,4	121,9	152,4	154,8	155,7	156,4	156,9	157,4	157,9	158,3
0,33	61,0	91,4	121,9	148,8	150,1	150,9	151,6	152,1	152,6	153,0	153,4
0,34	61,0	91,4	121,9	144,3	145,6	146,4	147,1	147,6	148,0	148,4	148,8
0,35	61,0	91,4	121,9	140,2	141,4	142,2	142,8	143,3	143,7	144,1	144,5
0,36	61,0	91,4	121,9	136,2	137,4	138,2	138,8	139,3	139,7	140,1	140,4
0,37	61,0	91,4	121,9	132,5	133,6	134,4	135,0	135,4	135,8	136,2	136,6
0,38	61,0	91,4	121,9	129,0	130,1	130,8	131,4	131,8	132,2	132,6	132,9
0,39	61,0	91,4	121,9	125,6	126,7	127,4	128,0	128,4	128,8	129,1	129,5
0,40	61,0	91,4	121,8	123,2	124,3	125,2	125,8	126,2	126,5	126,9	127,2
0,41	61,0	91,4	119,1	120,4	121,5	122,3	122,9	123,3	123,7	124,0	124,3
0,42	61,0	91,4	116,3	117,6	118,7	119,5	120,1	120,5	120,8	121,2	121,5
0,43	61,0	91,4	113,6	114,9	115,9	116,7	117,3	117,7	118,0	118,3	118,6
0,44	61,0	91,4	110,9	112,1	113,1	113,9	114,4	114,8	115,1	115,4	115,7
0,45	61,0	91,4	108,1	109,3	110,4	111,1	111,6	112,0	112,3	112,6	112,9
0,46	61,0	91,4	105,9	107,1	108,1	108,8	109,3	109,7	110,0	110,3	110,6
0,47	61,0	91,4	103,7	104,9	105,9	106,6	107,1	107,4	107,7	108,0	108,3
0,48	61,0	91,4	101,5	102,6	103,6	104,3	104,8	105,2	105,4	105,7	106,0
0,49	61,0	91,4	99,3	100,4	101,4	102,0	102,5	102,9	103,2	103,4	103,7
0,50	61,0	91,4	97,1	98,2	99,1	99,8	100,3	100,6	100,9	101,1	101,4
0,51	61,0	90,5	95,3	96,4	97,3	98,0	98,4	98,8	99,0	99,3	99,5
0,52	61,0	89,5	93,6	94,6	95,5	96,1	96,6	96,9	97,2	97,4	97,6
0,53	61,0	88,5	91,8	92,8	93,7	94,3	94,7	95,1	95,3	95,5	95,8
0,54	61,0	87,5	90,0	91,0	91,9	92,5	92,9	93,2	93,5	93,7	93,9
0,55	61,0	86,6	88,2	89,2	90,0	90,6	91,1	91,4	91,6	91,8	92,0
0,56	61,0	85,1	86,7	87,7	88,5	89,1	89,5	89,8	90,1	90,3	90,5
0,57	61,0	83,6	85,3	86,2	87,0	87,6	88,0	88,3	88,5	88,77	88,9
0,58	61,0	82,2	83,8	84,7	85,5	86,1	86,5	86,8	87,0	87,2	87,4
0,59	61,0	80,7	82,3	83,2	84,0	84,5	84,9	85,2	85,5	85,6	85,8
0,60	61,0	79,3	80,8	81,7	82,5	83,0	83,4	83,7	83,9	84,1	84,3
0,61	61,0	78,0	79,6	80,4	81,2	81,7	82,1	82,4	82,6	82,8	83,0

Table 2.1 Depending on the containers' transverse acceleration, permissible total weight of 20ft containers stowed in 40ft cells not topped by 40ft containers, according to 1.6.3 *(continued)*

$\overline{b_q}$ \ tiers	2	3	4	5	6	7	8	9	10	11	12
0,62	61,0	76,8	78,3	79,2	79,9	80,4	80,8	81,1	81,3	81,5	81,7
0,63	61,0	75,6	77,0	77,9	78,6	79,2	79,5	79,8	80,0	80,2	80,4
0,64	61,0	74,4	75,8	76,6	77,4	77,9	78,2	78,5	78,7	78,9	79,1
0,65	61,0	73,1	74,5	75,4	76,1	76,6	76,9	77,2	77,4	77,6	77,7
0,66	61,0	72,1	73,5	74,3	75,0	75,5	75,8	76,1	76,3	76,4	76,6
0,67	61,0	71,0	72,4	73,2	73,9	74,4	74,7	75,0	75,2	75,3	75,5
0,68	61,0	70,0	71,3	72,1	72,8	73,3	73,6	73,9	74,1	74,2	74,4
0,69	61,0	68,9	70,3	71,0	71,7	72,2	72,5	72,8	72,9	73,1	73,3
0,70	61,0	67,9	69,2	70,0	70,6	71,1	71,4	71,6	71,8	72,0	72,1
0,71	61,0	66,9	68,3	69,0	69,7	70,1	70,4	70,7	70,9	71,0	71,2
0,72	61,0	66,0	67,3	68,1	68,7	69,2	69,5	69,7	69,9	70,0	70,2
0,73	61,0	65,1	66,4	67,1	67,8	68,2	68,5	68,8	68,9	69,1	69,2
0,74	61,0	64,2	65,5	66,2	66,8	67,3	67,6	67,8	68,0	68,1	68,3
0,75	61,0	63,3	64,5	65,3	65,9	66,3	66,6	66,8	67,0	67,1	67,3
0,76	60,2	62,5	63,7	64,4	65,0	65,5	65,8	66,0	66,2	66,3	66,4
0,77	59,4	61,7	62,9	63,6	64,2	64,6	64,9	65,2	65,3	65,5	65,6
0,78	58,7	60,9	62,1	62,8	63,4	63,8	64,1	64,3	64,5	64,6	64,7
0,79	57,9	60,1	61,3	62,0	62,5	63,0	63,3	63,5	63,6	63,8	63,9
0,80	57,2	59,3	60,5	61,2	61,7	62,1	62,4	62,6	62,8	62,9	63,1
$\overline{b_q}$ = transverse acceleration factor calculated for the middle of stack height (see Section 3)											
Permissible 20ft container stackweights [t] for stowage in hold cell guides.											
Shown container stack weights are not to be exceeded. Inside the container stack the single container weights may differ from each other. Calculated acceleration factors are to be rounded up to two decimal places maximum.											

Table 2.2 Depending on the containers' transverse acceleration, permissible total weight of 20ft containers stowed in 40ft cell guides and topped by at least one 40ft container, according to 1.6.3

$\overline{b}_q$ \ tiers	2	3	4	5	6	7	8	9	10	11	12
0,30	61,0	91,4	121,9	152,4	182,9	213,4	243,8	238,4	227,3	218,3	210,7
0,31	61,0	91,4	121,9	152,4	182,9	213,4	240,7	237,8	226,6	217,5	209,9
0,32	61,0	91,4	121,9	152,4	182,9	213,4	233,2	237,1	225,9	216,7	209,1
0,33	61,0	91,4	121,9	152,4	182,9	213,4	226,2	232,0	225,2	216,0	208,3
0,34	61,0	91,4	121,9	152,4	182,9	213,0	219,6	225,2	224,6	215,2	207,5
0,35	61,0	91,4	121,9	152,4	182,9	206,9	213,3	218,8	223,5	214,5	206,7
0,36	61,0	91,4	121,9	152,4	182,9	201,2	207,4	212,7	217,4	213,8	205,9
0,37	61,0	91,4	121,9	152,4	182,9	195,8	201,8	207,0	211,5	213,0	205,2
0,38	61,0	91,4	121,9	152,4	182,9	190,6	196,5	201,6	206,0	209,8	204,4
0,39	61,0	91,4	121,9	152,4	179,4	185,8	191,5	196,4	200,7	204,5	203,6
0,40	61,0	91,4	121,9	152,4	176,3	182,6	188,3	193,2	197,5	200,3	203,5
0,41	61,0	91,4	121,9	151,9	172,4	178,6	184,2	188,9	193,0	196,1	199,2
0,42	61,0	91,4	121,9	151,5	168,5	174,5	180,0	184,5	188,5	191,8	194,9
0,43	61,0	91,4	121,9	151,0	164,6	170,5	175,8	180,1	184,0	187,5	190,6
0,44	61,0	91,4	121,9	150,6	160,7	166,5	171,6	175,7	179,5	183,2	186,3
0,45	61,0	91,4	121,9	150,1	156,8	162,4	167,5	171,3	174,9	179,0	182,0
0,46	61,0	91,4	121,9	147,1	153,7	159,2	164,1	167,9	171,4	175,2	178,1
0,47	61,0	91,4	121,9	144,2	150,6	155,9	160,8	164,5	168,0	171,5	174,3
0,48	61,0	91,4	121,9	141,2	147,5	152,7	157,4	161,1	164,5	167,8	170,5
0,49	61,0	91,4	121,9	138,2	144,3	149,5	154,1	157,7	161,0	164,1	166,7
0,50	61,0	91,4	121,9	135,2	141,2	146,2	150,7	154,3	157,5	160,3	162,9
0,51	61,0	91,4	120,8	132,8	138,7	143,6	148,0	151,5	154,6	157,4	159,9
0,52	61,0	91,4	119,7	130,4	136,1	140,9	145,3	148,7	151,8	154,5	156,9
0,53	61,0	91,4	118,6	127,9	133,6	138,3	142,5	145,9	148,9	151,6	154,0
0,54	61,0	91,4	117,5	125,5	131,0	135,7	139,8	143,1	146,0	148,7	151,0
0,55	61,0	91,4	116,4	123,1	128,5	133,0	137,1	140,3	143,2	145,8	148,1
0,56	61,0	91,4	114,5	121,0	126,4	130,8	134,8	137,9	140,8	143,3	145,6
0,57	61,0	91,4	112,6	119,0	124,2	128,6	132,5	135,6	138,4	140,9	143,1
0,58	61,0	91,4	110,6	116,9	122,1	126,4	130,2	133,3	136,0	138,5	140,6
0,59	61,0	91,4	108,7	114,9	120,0	124,2	127,9	130,9	133,6	136,0	138,2
0,60	61,0	91,4	106,8	112,9	117,9	122,0	125,6	128,6	131,3	133,6	135,7
0,61	61,0	91,4	105,2	111,2	116,0	120,1	123,7	126,6	129,2	131,6	133,6
0,62	61,0	91,4	103,5	109,4	114,2	118,3	121,8	124,6	127,2	129,5	131,5
0,63	61,0	91,4	101,9	107,7	112,4	116,4	119,9	122,7	125,2	127,4	129,4
0,64	61,0	91,4	100,3	106,0	110,6	114,5	117,9	120,7	123,2	125,4	127,3
0,65	61,0	91,4	98,7	104,3	108,8	112,7	116,0	118,7	121,2	123,3	125,2

Table 2.2 Depending on the containers' transverse acceleration, permissible total weight of 20ft containers stowed in 40ft cell guides and topped by at least one 40ft container, according to 1.6.3 *(continued)*

$\overline{b_q}$ \ tiers	2	3	4	5	6	7	8	9	10	11	12
0,66	61,0	90,2	97,3	102,8	107,3	111,1	114,3	117,0	119,4	121,6	123,4
0,67	61,0	88,9	95,9	101,3	105,8	109,5	112,7	115,3	117,7	119,8	121,7
0,68	61,0	87,6	94,5	99,8	104,2	107,9	111,0	113,6	116,0	118,0	119,9
0,69	61,0	86,4	93,1	98,4	102,7	106,3	109,4	111,9	114,3	116,3	118,1
0,70	61,0	85,1	91,7	96,9	101,1	104,7	107,7	110,3	112,5	114,5	116,3
0,71	61,0	84,0	90,5	95,6	99,8	103,3	106,3	108,8	111,0	113,0	114,7
0,72	61,0	82,9	89,3	94,3	98,4	101,9	104,8	107,3	109,5	111,5	113,2
0,73	61,0	81,7	88,0	93,0	97,1	100,5	103,4	105,8	108,0	109,9	111,6
0,74	61,0	80,6	86,8	91,7	95,8	99,1	102,0	104,4	106,5	108,4	110,1
0,75	61,0	79,5	85,6	90,5	94,4	97,7	100,5	102,9	105,0	106,9	108,5
0,76	61,0	78,5	84,5	89,3	93,2	96,5	99,3	101,6	103,7	105,5	107,2
0,77	61,0	77,5	83,5	88,2	92,1	95,3	98,0	100,3	102,4	104,2	105,8
0,78	61,0	76,5	82,4	87,1	90,9	94,1	96,8	99,1	101,1	102,9	104,4
0,79	61,0	75,5	81,4	86,0	89,7	92,8	95,5	97,8	99,8	101,5	103,1
0,80	61,0	74,6	80,3	84,9	88,6	91,6	94,3	96,5	98,5	100,2	101,7
$\overline{b_q}$ = transverse acceleration factor calculated for the middle of stack height (see Section 3)											
Permissible 20ft container stackweights [t] for stowage in hold cell guides.											
Shown container stack weights are not to be exceeded. Inside the container stack the single container weights may differ from each other. Calculated acceleration factors are to be rounded up to two decimal places maximum.											

2. Stowage without cell guide structures

2.1 Stowage without lashings

2.1.1 Container securing

Container stacks placed side by side are to be coupled by dual cone adapters or equivalent devices to form container blocks. For container blocks extending over the hold width, bridge fittings for compression shall be provided on the uppermost layer of containers if there is a lateral shoring point at this level. If containers are separated into two blocks, bridge fittings for tension and compression are to be arranged at the level of the shoring points.

In the lowest container layer each container shall be secured against shifting at all four corner castings.

Each container block shall be laterally supported at its container corner fittings. Support is to be provided by sufficiently strong structural elements of the ship, such as decks and web frames.

2.1.2 Shoring forces

The number of lateral shoring points shall be determined so that the corner fitting loads and container racking loads will not be exceeded (see Section 3).

Where necessary, the force at a shoring point can be distributed to the two adjacent corner fittings by a special design of the shoring element.

Shoring forces can also be reduced by dividing the containers to be shored into two separate container blocks (see C.2.1.1), thus splitting up the transverse container forces into compressive shoring forces on one side and tensile shoring forces on the other side of the hold.

2.1.3 Shoring element construction

Shoring elements shall be constructed to transmit compressive loads or, where necessary, compressive and tensile loads. Shoring elements can be of fixed or removable configuration. Both kinds shall ensure that the clearance between their contact faces and the container corner fittings is as small as possible.

Wedges shall be sufficiently secured against their inadvertent loosening (e.g., on account of vibrations).

Shoring elements shall be easily accessible. Their weight and the associated number of loose parts shall be restricted to a minimum.

2.2 Stowage with lashing in cargo hold

Instead of or in combination with shoring systems described in C.2.1, cargo hold containers can also be secured by lashings. If this is the case, provisions in B.3 apply analogously.

3. Hatchcoverless container ships

3.1 Longitudinal and transverse acceleration The accelerations are to be determined in general according to Section 3, A.

For a ship's length of 120 meters 4 (four) tiers, for a ship's length of 270 meters 9 (nine) tiers are to be considered as containers under deck. Lengths in between are to be interpolated linearly.

The transverse loads shall be increased by the values given in Section 3, A. for the 2nd tier and higher accordingly for containers which side walls are exposed to wind pressure.

3.2 Stackability

According to ISO 1496-1, the lowermost container in hold may be overstowed with 192.000 kg (vertical acceleration of 1,8 g included). This value can be converted in accordance with the vertical acceleration given in these Rules. However, a special safety factor of 1,2 shall persist. A maximum number of tiers is not given.

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Section 3 Dimensioning of Container Securing Systems

A. Wind and Sea Induced Loads on Containers

1. General

1.1 Transverse, longitudinal and vertical loads on containers given below are to be understood as forces aligned in the ship's coordinate axes. They include static gravity loads, dynamic loads caused by the ship's pitch, heave, yaw, sway and roll motions, as well as wind loads.

1.2 The following values for minimum and maximum gross weights of containers are to be assumed for subsequent calculations (see also Annex F):

20ft	minimum	2,5 tons
	maximum	30.5 tons
40ft	minimum	3.5 tons
	maximum	30.5 tons
45ft	minimum	4.5 tons
	maximum	32.5 tons

Other container sizes correspondingly

1.3 The height of the centre of gravity of the container and its cargo is assumed at 45 % of container height.

2. Transverse forces on containers

2.1 The transverse force, F_q, acting on a container parallel to the deck is to be calculated as follows:

$$F_q = G \cdot b_q \cdot 9,81 + F_W \quad [kN]$$

where,

G	=	container's gross weight [t]
b_q	=	transverse acceleration factor, see 2.2 and 2.3
F_W	=	lateral wind load on the container, see 2.4

Where containers or container stacks placed side by side are coupled to form container blocks, transverse loads acting on containers, such as wind loads on outer container stacks, shall be equally distributed over a maximum of three stacks.

2.2 Transverse acceleration factor for unrestricted service

2.2.1 The transverse acceleration factor, b_q, includes combined effects of the ship's pitch, heave, yaw, sway and roll motions:

$$b_q = (1 + b_v) \cdot \sin(\psi) + b_h \cdot \cos(\psi) + \frac{1}{9,81 \cdot \frac{m}{s^2}} \cdot \left(\frac{2 \cdot \varphi}{T_{Roll}}\right) \cdot \psi(z_{cont} - z_{Roll})$$

b_v	=	dimensionless acceleration in the global vertical direction due to pitch and heave
b_h	=	dimensionless acceleration in the global horizontal direction due to yaw and sway
φ	=	ship's roll angle
T_{Roll}	=	roll period [s]
z_{Roll}	=	height of roll axis above base [m]
z_{cont}	=	height of container's centre of gravity above base [m]

In the formula above, values of b_v, b_h and φ represent simultaneously acting accelerations and roll angle of the ship. They are to be determined from the respective design values $b_{v,D}$, $b_{h,D}$ and ψ_D, i.e., the extreme values occurring once in 20 years operation of the ship, such that bq attains its maximum value and

$$\left(\frac{b_v}{b_{v,D}}\right)^2 \cdot \left(\frac{b_h}{b_{h,D}}\right)^2 \cdot \left(\frac{\psi}{\psi_D}\right)^2 = 1$$

2.2.2 For ships with unusual form and design regarding, e.g., stern and bow shape, BKI may require determination of the transverse acceleration factors by an alternative calculation method.

2.2.3 The container securing arrangement plan submitted for approval shall be based on b_q values for unrestricted service and one initial metacentric height GM_0, which can be chosen freely within operational range but to be greater than or equal to the minimum G_M value of the approved stability booklet for the respective draught.

2.2.4 The dimensioning of cell guide structures shall be based on bq-values for unrestricted service and the initial metacentric height, $GM_{0,max}$, to be determined as follows:

B ≤ 32.2 m	$GM_{0.max} = 0.04 \cdot \frac{B^2}{Z}$
32.2 m < B ≤ 40 m	$GM_{0.max} = \frac{B - 25.96}{156} \cdot \frac{B^2}{Z}$
B > 40 m	$GM_{0.max} = 0.09 \cdot \frac{B^2}{Z}$

B = ship's moulded breadth [m]

$$Z = h_{cont} + H_{st} \quad [m]$$

$h_{cont.}$ = maximum number of container tiers (n_{tiers}) in the stack on the hatch covers or on the weather deck, as specified in the container securing arrangement plan, multiplied by 1,05

$$h_{cont.} = n_{tiers} \cdot 1,05 \quad [m]$$

H_{st} = vertical distance between designed waterline and lower edge of container stack considered.

In general, this is the maximum allowable initial metacentric height for container stowage systems approved according to these Rules. Other GM_{0max} values require special considerations.

2.3 Transverse acceleration factor for route specific container stowage

2.3.1 For route specific container stowage, loads on containers and container securing equipment shall be determined based on transverse acceleration factors b_q according to 2.2, reduced by route specific reduction factors f_{route}.

2.3.2 For standard routes according to Annex L, the reduction factors froute are given in Table 3.1.

2.3.3 For an individual route according to Annex L, BKI will determine a reduction factor, f_{route}, by statistical evaluation of ship motions, assuming the operation period on this route to be 20 years. For this purpose, an individual wave scatter diagram will be generated by BKI for each specified route, based on wave statistics of recognised weather bureaus.

Table 3.1

Standard route according to Annex L	Reduction factor f_{route}
Asia - Europe service	0,88
Pacific - Atlantic service	0,94
Pacific service	0.94
North Sea - Mediterranean Short Sea service	0,93
North Atlantic service	0,97
Intra-Asia service	0,86
North Sea - Baltic service	0,83
Europe - South America East Coast service	0,91
Europe - West Africa service	0.91
Asia - Europe service (via Cape of Good Hope)	0,90

2.4 Wind loads

In general, lateral wind loads, F_W, on exposed side walls of containers according to Table 3.2 shall be considered.

Wind loads are not to be considered for containers the side walls of which are exposed to wind over a height of less than 0,33 x 8' 6''.

If inside positioned stacks form a gap larger than 1/2B for B > 16 m or more than three rows wide for B ≤ 16 m , free standing stacks are to be imposed with wind loads according to Table 3.2 reduced by a factor of 0,33.

Table 3.2

Wind load Fw per container [kN]		
	Container type	
	20ft	40ft
1st tier [1)]	30	60
2nd tier and higher	15	30

[1] The load Fw for the first tier accounts additionally for green water loads on outer stacks. The green water loads do not need to be accounted for in case of open holds of hatchcoverless ships.

[2] The stated values are valid for 8' 6" high containers. For other container heights and lengths, the wind force has to be adjusted according their side wall area.

3. Longitudinal forces on containers

The longitudinal force, F_ℓ, acting on a container parallel to the deck is to be calculated as follows:

$$F_\ell = G \cdot b_\ell \cdot 9,81 \quad [kN]$$

b_ℓ = longitudinal acceleration factor, see Table 3.3

The b_ℓ values for containers located between the lowermost layer in the cargo hold and the lowermost layer on deck shall be determined by interpolation; for containers above the first layer on deck, by linear extrapolation.

Table 3.3 Longitudinal acceleration factor b_ℓ

for lowermost container in cargo hold	for lowermost container on deck
$b_\ell = \left(0,22 - \frac{L}{1710}\right)$ for $L \leq 120$ m b_ℓ = 0,15 for $L > 120$ m	For any length of the ship: $b_\ell = \left(0,35 - \frac{L}{1000}\right)$ min $b_\ell = 0,15$

4. Vertical forces on containers

The vertical force Fv acting downwards on a container or container stack is to be calculated as follows:

$$F_v = \sum_{i=1}^{n} G_i \cdot (1 + a_v) \cdot 9,81 \quad [kN]$$

n = number of tiers in container stack
a_v = acceleration factor according to Rules for Hull (Pt.1, Vol.II) Sec.4, C.1 .

B. Container Stowage without Lateral Support

1. Calculation of forces

1.1 Container stowage without lashings

1.1.1 The transverse racking force, RF_T, on each container end frame in the i^{th} tier is:

$$RF_{T,i} = RF_{T,i+1} + 0,275 \cdot F_{q,i+1} + 0,225 \cdot F_{q,i}$$

F_q = transverse container force according to A.2

1.1.2 The longitudinal racking force, RF_L, on each container side frame in the i^{th} tier is:

$$RF_{L,i} = RF_{L,i+1} + 0,275 \cdot F_{\ell,i+1} + 0,225 \cdot F_{\ell,i}$$

F_q = longitudinal container force according to A.3

1.1.3 The corner post force, CPL, on the upper corner casting of a container in the i^{th} tier is:

$$CPL_i = CPL_{i+1} + RF_{T,i+1} \cdot \frac{H_{c,i+1}}{B_c} + \frac{1}{4} \cdot G_{i+1} \cdot b_t \cdot 9,81 \cdot \cos\ 30^0$$

B_c = 2.260 m for ISO-containers (8' width)
H_c = container height [m]

The container position correction factor, b_t, shall be calculated as follows:

$$b_t = 1,15 + \frac{80,5 - 0,75 \cdot x - 105\frac{x}{L_{PP}}}{L_{PP} + 70} \qquad \text{for} \quad \text{AP to } 0,2L$$

$$b_t = 1 + \frac{70}{L_{PP} + 70} \qquad \text{for} \quad 0,2L \text{ to } 0,6L$$

$$b_t = 0,55 + \frac{38,5 + 0,75 \cdot x + 105\frac{x}{LPP}}{L_{PP} + 70} \qquad \text{for} \quad 0,6L \text{ to FP}$$

x = distance of the container's centre of gravity from A.P. [m]
L = ship's length [m]

1.1.4 The lifting force, LF, on the bottom corner casting of a container in the i^{th} tier is:

$$LF_i = LF_{i+1} \cdot RF_{T,i} \cdot \frac{H_{c,i}}{B_c} - \frac{1}{4} \cdot G_i \cdot b_t \cdot 9,81 \cdot \cos\ 30^0$$

1.1.5 The vertical forces on each foundation point of a container or container stack are:

$$CPL_{found} = CPL_1 + RF_{T,1} \cdot \frac{Hc,1}{B_c} + \frac{1}{4} \cdot G_1 \cdot b_t \cdot 9,81 \cdot \cos\ 30^0$$

$$LF_{found} = LF_1 \quad \text{at stack's tensioned side}$$

1.1.6 The transverse force on a foundation point is:

$$F_{T,found} = RF_{T,1} + 0,275 \cdot F_{q,1}$$

If this force is not intended to be determined separately, a maximum value of 210 kN is to be assumed.

For container stanchions provided with a sliding plate or an athwartships arranged "dove tail base", the transverse force, FT,found, on a foundation point is to be calculated as a friction force resulting form the vertical compressive force, CPL_{found}, acting on this foundation point:

$$F_{T,found} = \mu \cdot CPL_{found}$$

μ = 0,25 for cast steel combinations; 0,5 for steel for steel-steel combinations; other combinations upon agreement with BKI

The horizontal force need not be taken greater than the force causing the stanchion's transverse deflection which is equal to the transverse clearance of the bottom locking device (usually, abt. 10 mm). In case of major deformations of hatches e.g., with long hatches they are to be taken into account in connection with the container's horizontal shift.

1.1.7 The longitudinal force on container's foundation is:

$$F_{L,found} = \sum_{i=1}^{n} F_{\ell,i}$$

1.2 Container stowage with lashings

1.2.1 The transverse racking force, RF_T, on a container in the i^{th} tier is to be calculated according to 1.1.1, additionally taking into account transverse components of lashing forces, if any, on top of this container and on bottom of the container above as follows:

$$RF_{T,i} = RF_{T,i+1} + 0,275 \cdot F_{q,i+1} + 0,225 \cdot F_{q,i} - Z_{top,i} \cdot \sin\alpha_{top,i} - Z_{bottom,i+1} \cdot \sin\alpha_{bottom,i+1}$$

Z = total lashing force [kN]
α = lashing angle

The transverse racking forces acting on container end frames and the lashing forces on these frames are to be calculated by solving the system of linear equations based on compatibility of deflections of container corners and lashing elements at their corresponding positions.

Where the arrangement of container stacks is such that tilting may occur, forces induced in the lashing elements are to be specially considered.

In general, static forces caused by pretension of lashings are neglected. If these forces represent a significant portion of the total loads on containers and container securing equipment, special consideration is required.

A load increase on some lashing elements caused by horizontal shifting of containers owing to clearance at, e.g., cone adapters and lower shifting locks is, in general, to be taken into account as follows:

A transverse displacement of containers in the first and second layers of 4 mm each is to be considered for the stack's door end. For the front end, in general, a transverse displacement of containers shall not be considered. If more than three container stacks placed side by side are coupled by double cone adapters to a container block, it is assumed that containers will not shift horizontally.

Lashing forces are to be calculated by taking into account deformations of lashing bridges of 10 mm and 25 mm in the direction of the lashing force for one-tier and two-tier high bridges, respectively. For higher lashing bridges, the lashing bridge deformation is to be determined upon consultation with BKI

For calculation of the lashing forces according to 1.2, the following values of overall modulus of elasticity can be assumed for steel lashing rods (including tensioning device and eyes) depending on their design:

$$E_z = 1,4 \cdot 10^4 + 1,9 \cdot 10^4 \quad [\text{kN/cm}^2]$$

In general, lashing computations shall be based on standard values according to Table 3.4. In case of significant deviations from these standard values, actual values are to be submitted.

Table 3.4

Lashing to	**Length of lashing l** $[\text{cm}]^1$	**Angle of lashing** α^1	**E-module of lashing rode** $E_z[\text{kN/cm}^2]$
1^{st} tier top	354	43^0	$1,4 \cdot 10^4$
2^{nd} tier bottom	365	41^0	
2^{nd} tier top	560	24^0	$1,75 \cdot 10^4$
3^{rd} tier bottom	575	22^0	
3^{rd} tier top	710	19^0	$1,9 \cdot 10^4$
4^{th} tier bottom	725	18^0	

[1] The stated standard values for the length and the angle of lashing are valid for 8' 6" high containers. For other container heights, these values have to be adjusted accordingly.

For calculation of lashing forces, where the racking resilience values of the container end frames are unknown, the following mean values can be used for steel frame containers:

	Door frame	**Front wall frame**
Racking resilience c_C [cm/kN]	$2,7 \cdot 10^{-2}$	$0,60 \cdot 10^{-2}$

For aluminium containers values of cc are to be specially agreed.

Determination of transverse racking forces and lashing forces is demonstrated below by means of a simple example for a container stack consisting of two tiers lashed to the bottom of the second tier (see Fig.3.1).

Racking force on top of upper tier:

$$RF_{T,2} = 0,225 \cdot F_{q,2}$$

Racking force on top of lower tier:

$$RF_{T,1} = RF_{T,2} + 0,275 \cdot F_{q,2} + 0,225 \cdot F_{q,1} - Z \cdot \sin\alpha$$

Total lashing force:

$$Z = Z_0 + \Delta Z$$

$$\Delta Z = c_z \cdot \Delta\ell$$

$$c_z = \frac{E_z \cdot A}{\ell}$$

$$\Delta\ell = \delta \cdot \sin\alpha$$

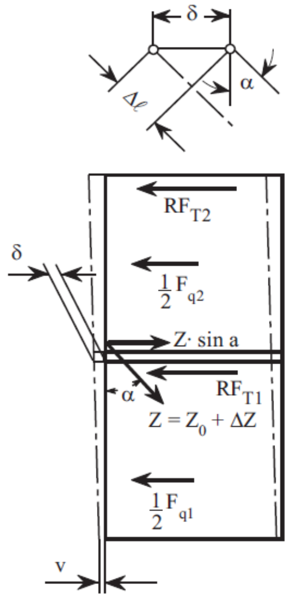

Figure 3.1

Z_0	=	pretension force [kN]
ΔZ	=	increase of lashing force [kN]
c_Z	=	tension stiffness of lashing element [kN/cm]
ℓ	=	length of lashing [cm]
$\Delta\ell$	=	elongation of lashing element [cm]
A	=	effective cross-section of lashing [cm²]
E_Z	=	overall modulus of elasticity of lashing [kN/cm²]

Transverse deflection of lashed container corner:

$$\delta = c_C \cdot RF_{T,1} + \upsilon$$

c_C	=	racking resilience of the container's transverse frame [cm/kN]
υ	=	transverse offset caused by shifting of bottom container [cm]

1.2.2 The longitudinal racking force, RF_L, on a container's side frames is to be calculated according to 1.1.2.

1.2.3 The corner post force, CPL, on the upper corner casting of a container in the i^{th} tier is to be calculated according to 1.1.3, additionally taking into account vertical components of lashing forces, if any, on top of this container and on bottom of the container located above as follows:

$$CPL_i = CPL_{i+1} + RF_{T,i+1} \cdot \frac{H_{c,i+1}}{B_c} + \frac{1}{4} \cdot G_{i+1} \cdot b_t \cdot 9,81 \cdot \cos 30^0 + Z_{top,i} \cdot \cos \alpha_{top,i} + Z_{bottom,i+1} \cdot \cos \alpha_{bottom,i+1}$$

1.2.4 The lifting force, LF, on the bottom corner casting of a container in the ith tier is to be calculated according to 1.1.4.

1.2.5 The vertical force on each foundation point of a container or container stack at the compressed side is to be calculated according to 1.1.5, additionally taking into account the vertical component of the lashing force, if any, acting on top of the lowermost container as follows:

$$CPL_{found} = CPL_1 + RF_{T,1} \cdot \frac{H_{c,1}}{B_c} + \frac{1}{4} \cdot G_1 \cdot b_t \cdot 9,81 \cdot \cos 30^0 + Z_{top,1} \cdot \cos \alpha_{top,1}$$

The vertical force on each foundation point of a container or container stack at the tensioned side is to be calculated according to 1.1.5.

1.2.6 The transverse force on a foundation point is to be calculated according to 1.1.6.

1.2.7 The longitudinal force on container's foundation is to be calculated according to 1.1.7.

2. Design loads

2.1 Design loads on container frameworks and corner castings

Design values for transverse and longitudinal container racking forces, corner post forces, lifting forces and, where applicable, lashing forces calculated according to 1. are to be used for dimensioning container securing systems without lateral supports.

2.2 Design loads on lashing gear

For container stowage with internal lashings, container lashings are to be dimensioned based on the lashing forces calculated according to 1.2, taking also into account the load assumptions given below.

Dimensioning of external lashings requires special consideration.

2.3 Design loads for lashing bridges

2.3.1 Dimensioning of the lashing bridge shall be based on the lashing case of the container securing arrangement plan which produces the highest lashing forces. Alternatively, a force of 230 kN per lashing acting in the lashing direction can be applied. The global system of the individual lashing bridge shall be loaded with 61 % of these forces only. The lashing forces have to be applied according to their x, y and z components.

2.3.2 The individual lashing plates and their substructures have to be dimensioned based on the lashings' maximum Safe Working Loads (SWL), see Annex D.

2.4 Design loads for container stanchions and substructures

2.4.1 In general, for container stowage without lateral support, container stanchions and substructures are to be dimensioned based on the most adverse simultaneously acting transverse forces, $F_{T,found}$, and vertical forces, CPL_{found} and LF_{found}, acting on foundation points calculated according to 1.

If the bending strength of container stanchions is smaller in the longitudinal than in the transverse direction, the vertical forces on the foundation points at the stanchion are to be considered as acting simultaneously with the longitudinal force, $F_{L,found}$, according to 1., instead of the transverse forces, $F_{T,found}$.

2.4.2 Where lashings are arranged at the stanchions, the stanchions are to be dimensioned also considering the most adverse vertical and horizontal loads resulting from lashing forces calculated according to 1.2.

2.4.3 To dimension container stanchions, the most unfavourable eccentricity of the vertical compressive forces, CPL_{found}, acting on foundation points is to be assumed.

2.4.4 Detached stanchions are to be designed to safely absorb shocks occurring during normal loading operations.

2.4.5 Under major hatch deformations, containers situated on stanchions and hatch covers shall not transmit shifting forces (see Section 2, B.1).

2.5 Design loads for container foundations

2.5.1 Container foundations welded on and/or welded into the ship structure have to be dimensioned taking into account simultaneously acting horizontal and vertical forces, according to 2.4.

2.5.2 To dimension foundations welded in to the ship's longitudinal main structures (strength deck, inner bottom, etc.), stresses resulting from the ship's global loads are also to be considered.

2.5.3 Substructures for container foundations are to be dimensioned according to BKI Rules for Hull (Pt.1, Vol.II) and Rules for Container Ships (Pt.1, Vol.XVIII).

C. Container Stowage with Lateral Support

1. Dimensioning of cell guide structures

1.1 General

1.1.1 Load assumptions

Cell guide structures are to be dimensioned for the maximum number of container layers and for the maximum permitted container gross weight in each layer. Combinations of different container heights in a stack, yielding the most adverse stresses in cell guide structures, are to be considered.

Calculations of resulting forces and stresses in structural members, such as ties and guide rails, may be carried out with suitable computer programs. In this case, the computer model, the boundary conditions and load cases are to be agreed upon with BKI. The calculation documents are to be submitted, including input and output documentation.

1.1.2 Transverse loads on cell guide structures

To dimension cell guide structures, the transverse load on each container is to be taken into account as follows:

$$F_q = G_{max} \cdot b_q \cdot 9,81 + F_W$$

where,

G_{max} = maximum permitted container gross weight [t]

F_W = wind load according to A.2.4

b_q = transverse acceleration factor for unrestricted service and for the metacentric height $GM_{0,max}$ according to A.2.2

Transverse loads on cell guides are to be considered for stowage of both 40ft containers and 20ft containers as follows:

For stowage of 40ft containers in cell guides, it is to be assumed that one-quarter of F_q is transmitted to the cell guide structure at each of the four corner fittings of one longitudinal side wall of the container.

For stowage of 20ft containers in 40ft cell guides, it is to be assumed that a share of 1/3 of F_q is transmitted to the cell guide structure at each of the two corner fittings of one longitudinal side wall at the container end placed in the cell guide.

1.1.3 Longitudinal loads on cell guide structures

The longitudinal load, F_ℓ, on each container is to be taken into account according to A.3, assuming the maximum permitted gross weight, G_{max}, of the container.

It may be assumed that a share of one-quarter of F_ℓ is transmitted to the cell guide structure at each of the four corner fittings of the container's front end or door end. A Force reduction in calculations due to friction between container layers is not permissible.

1.1.4 Vertical loads on cell guide structures

Vertical design loads on vertical guide rails supporting hatch covers, decks or similar parts loaded with containers shall be determined, including the vertical acceleration factor, a_v, according to BKI Rules for Hull (Pt.1, Vol.II) Sec. 4 and Rules for Container Ships (Pt.1, Vol.XVIII)Sec.4. The scantlings resulting for the corresponding structural members shall not be taken less than those obtained according to BKI Rules for Hull (Pt.1, Vol.II) Sec.10.C and Rules for Container Ships (Pt.1, Vol.XVIII) Sec.10.C.

1.1.5 Where parts of the cell guide structures are to be considered as components of the ship's hull, BKI Rules for Hull (Pt.1, Vol.II) and Rules for Container Ships (Pt.1, Vol.XVIII). shall be taken into consideration as well.

1.2 Dimensioning of cross ties

1.2.1 In general, forces acting on cross ties shall be calculated as indicated in 1.1.1, based on the transverse container loads according to 1.1.2. Where necessary, additional compressive or tensile loads on the cross ties caused by transverse deformations of the ship's hull shall be taken into account.

The resulting tensile and compressive stresses in cross ties shall not exceed permissible values given in D.

Where longitudinal ties are not arranged, also bending and shear stresses in cross ties induced by longitudinal container loads according to 1.1.3 shall not exceed permissible stresses given in D. The distribution of longitudinal loads on cross ties follows from the arrangement of vertical guide rails and may be determined as indicated in 1.1.1. Alternatively, a load distribution throughout the length of the cross tie may be assumed, as shown in Fig. 3.2.

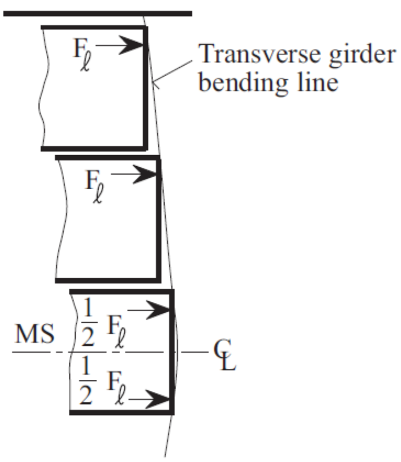

Figure 3.2 Load distribution throughout cross tie

1.2.2 For cross ties not directly connected to the hull, the minimum required sectional area, A_{sreq}, of the cross tie bar subject to the compressive load, P_s, is:

$$A_{sreq} = 10 \cdot \frac{P_s}{\sigma_P} \quad [\mathrm{cm}^2]$$

where,

σ_P = permissible compressive stress [N/mm2]

$\frac{\varkappa}{S} \cdot R_{eH}$

P_s = compressive tie bar load [kN]

$\varkappa$ = reduction factor

$\frac{1}{\psi + \sqrt{\psi^2 - \lambda_s^2}}$

ψ = $0,5[1 + n_p(\lambda_s - 0,2) + \lambda_s]$

0,34 for tubular and rectangular profiles

0,49 for open sections

λ_s = degree of slenderness of the tie bar

$\frac{\ell_s}{i_s \cdot \pi} \cdot \sqrt{\frac{R_{eH}}{E}} \geq 0,2$

ℓ_s = length of the tie bar [cm]

E = modulus of elasticity [N/mm^2]

i_s = radius of gyration of the tie bar

= $\sqrt{\frac{I_s}{A_s}}$ [cm]

I_s = smallest moment of inertia of tie bar cross section [cm^4]

S = safety factor

= 1,4 for $\lambda_s \leqslant 1$

= 1,65 for $\lambda_s > 1$

1.2.3 For cross ties rigidly connected to the hull, the slenderness ratio of tie bars is required to be $_s \leq 250$. The slenderness, $_s$, is to be calculated according to 1.2.2, where the effective (buckling) length, s_K, is used instead of the tie bar length, ℓ_s:

$s_\varkappa = 0,7 \cdot \ell_s$ for welded connections

$s_\varkappa = \ell_s$ for screw connections and suspended structures

1.3 Dimensioning of longitudinal ties

Compressive and tensile loads on longitudinal ties shall be calculated as indicated in 1.1.1, based on longitudinal container loads according to 1.1.3 and the number and arrangement of longitudinal ties. Resulting stresses shall not exceed the permissible values given in D.

For longitudinal ties subject to compressive forces, the slenderness ratio, λs, according to 1.2.1 shall not exceed 250.

Longitudinal ties shall be connected to the ship's hull in a manner to not absorb compressive and tensile stresses resulting from the ship's global deformations.

1.4 Dimensioning of vertical guide rails

1.4.1 To dimension non-displaceable end and intermediate shoring points (see Fig. 3.3), rails shall be considered as continuous girders simply supported at both ends. For a system shown in Fig. 3.3, the total transverse load acting at each cross tie level is distributed among the vertical guide rails according to their rigidity values

$$k_i = \frac{I_i}{\ell_i^3}$$

where,

I_i = moment of inertia of rail cross section [cm^4]
ℓ_i = length of the guide rail [cm] (In the example, Fig. 3.3, all the lengths ℓ_i would be the same.)

$$P_i = \sum P_q \cdot \frac{k_i}{\sum k} \qquad [kN]$$

where,

$\sum P_q$ = total transverse force at the cross tie level
$\sum k$ = sum of the rigidity values of all vertical guide rails

Resulting stresses shall not exceed the permissible values given in D.

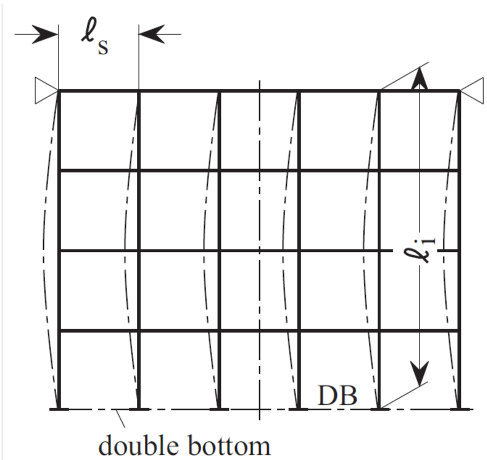

Figure 3.3 Deformation of vertical guide rails caused by transverse loads

1.4.2 Where vertical guide rails support hatch covers, decks or similar parts loaded with containers, vertical loads on these guide rails shall be based on vertical accelerations including factor, a_v, according to BKI Rules for Hull (Pt.1, Vol.II) Sec.4 and Rules for Container Ships (Pt.1, Vol.XVIII)Sec.4. Resulting stresses shall not exceed the permissible values given in D. The resulting scantlings for the corresponding structural members shall not be taken less than those obtained following BKI Rules for Hull (Pt.1, Vol.II) Sec.10.C and Rules for Container Ships (Pt.1, Vol.XVIII)Sec.10.C.

1.5 Dimensioning lateral supporting rails

The shoring forces according to 2. shall be used for dimensioning these rails. Resulting stresses shall not exceed the permissible values given in D.

2. Design loads for shoring of containers in cargo hold

2.1.1 Where a largely rigid shoring of a container block may be assumed on account of the ship's construction, the transverse shoring forces on lateral supports and corner castings at corresponding positions may be determined, with sufficient accuracy, as given below. Hull deformations, if significant, shall also be taken into account.

The total transverse load on container layers positioned between two support levels is to be assumed to be completely distributed between these supports. The total transverse load is to be assumed to be equally distributed in the longitudinal direction, i.e., between supports at the container ends. In the vertical direction, i.e., between both support levels, the total transverse load is to be assumed to be distributed according to the vertical distance of these supports from the centre of the total transverse load:

$$F_{shore,1} = \frac{1}{2} \cdot F_{q,total} \cdot \frac{d_2}{d_1 + d_2}$$

$$F_{shore,2} = \frac{1}{2} \cdot F_{q,total} \cdot \frac{d_1}{d_1 + d_2}$$

where,

$F_{shore,j}$	=	transverse shoring force on a support point at support level j
d_j	=	vertical distance of centre of the total transverse load from support level j
$F_{q,total}$	=	sum of transverse loads F_g according to A.2 on containers in layers between both support levels

In the following, the determination of shoring forces is demonstrated for a simple example, considering a container block with two supports consisting of five layers and n stacks as shown in Fig. 3.4. In this example, the same transverse load, F_g, (see A.2) is assumed for each container in the container block.

The load from the container layers is to be distributed ideally to the supports.

The total transverse load from the two uppermost container layers induces the following shoring force on each support point of the upper and the lower supports:

$$F_{shore,upper} = \frac{2 \cdot n}{4} \cdot F_q$$

The lower support is additionally loaded with the proportional share from the three lower container layers. Thus, each of the lower supports are loaded with

$$F_{shore,lower} = \frac{5 \cdot n}{4} \cdot F_q$$

The remaining share of the total transverse load is transmitted into the double bottom.

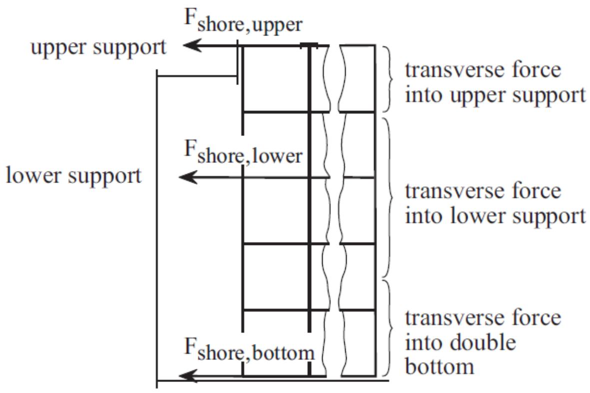

Figure 3.4

2.1.2 Where the number of stacks in the container block is greater than four, the transverse shoring forces calculated according to 2.1.1 may be reduced by the following factor f_r:

$$\text{If } (n - m) \leq 4, \text{ the factor } f_r = 1 - \frac{(n-4)^2}{2 \cdot n \cdot m}$$

$$(n - m) > 4, \text{ the factor } f_r = \frac{8 + m}{2 \cdot n}$$

where,

m = number of container layers
n = number of container stacks to be supported at the respective shoring point.

Where two opposite shoring points are designed to act simultaneously in tension and compression, n shall be taken as half the number of stacks.

If the container block is not complete, e.g., due to the container bench structures in holds, the number of container layers, m, and the number of container stacks, n, are to be determined as follows:

Number of layers m:

1) Maximum number of layers of the considered block / 3 = A (whole numbers, not rounded)
2) Original total number of layers to be reduced by A.

The layers having fewer rows than A are not considered.

This gives the corrected number of layers.

Number of stacks n:

1) Corrected number of layers (see above) / 2 = B (whole number, not rounded)
2) Stacks for which number of layers is smaller or equal to B are to be neglected.

Tank steps still existing are not considered.

The corrected number of layers and stacks is to be inserted into the formula for the reduction factor, f_r, as described above.

The reduction is admissible, provided the following requirement is met:

$$0,3 \cdot m \cdot G_{aver} \cdot 9,81 \cdot (1 - f_r) \leq 150 \text{ kN}$$

G_{aver} = average gross weight of containers to be supported by support point under consideration [t]

3. Stackability

According to ISO 1496-1, the lowermost container in the hold may be overstowed with 192000 kg, taking into account a vertical acceleration of 1,8 g. This can be converted to the maximum allowable stack mass stowed on top of the first layer in accordance with the vertical acceleration $(1 + a_v) \cdot g$, where a_v is obtained according to A.4, when considering a safety factor of 1,2. The number of tiers is not limited.

D. Permissible Loads

1. Permissible forces

1.1 Transverse racking force

The maximum permissible transverse racking force acting on the container's end frame is, in general, 150 kN.

For container stowage in cell guides with only one container end in the guide, the maximum permissible transverse racking force on the lowermost container is 185 kN and 170 kN for 30ft and 40ft containers, respectively.

1.2 Longitudinal racking force

The maximum permissible longitudinal racking force acting on the side wall frame of a container is 125 kN each.

1.3 Corner post force

The maximum permissible corner post force acting on the upper corner casting of the container is, in general, 848 KN.

If 45' containers are stowed on top of 40ft containers, the corner posts may be loaded with 270 kN maximum. This may be applied for 48ft, 49ft and 53ft long containers.

1.4 Lashing forces

For lashing angles between 40° and 45°, the maximum permissible lashing force is, in general, 230 kN.

For lashing angles between 20° and 25°, the maximum permissible lashing force is, in general, 270 kN for lashing to the lower corner casting and 175 kN for lashing to the upper corner casting.

For vertical lashing, the maximum permissible lashing force is, in general, 300 kN for lashing to the lower corner casting and 125 kN for lashing to the upper corner casting (see Annex L).

If suitable technical proof is given, a lashing force of up to 300 kN may be permitted for other lashing angles.

1.5 Shoring forces on corner fittings

The maximum permissible transverse shoring forces for tension and compression are, in general, 250 kN for upper corner fittings and 400 kN for lower corner fittings.

Where containers are stowed which may not withstand the loads mentioned above due to their type of construction, the maximum transverse shoring forces shall be adequately reduced (see also ISO 1496/I).

The maximum permissible longitudinal shoring forces for tension and compression on upper corner fittings are 125 kN for closed type containers, so-called box containers, and 75 kN for tank containers, open top containers, open-side containers and platform based containers. The maximum permissible longitudinal shoring forces on lower corner fittings equate to container weight.

1.6 Lifting forces

The lifting force acting on a twistlock may not exceed the twistlock's maximum SWL and the maximum permissible tensile force on a container corner casting (in general 250 kN).

For vertical lashings according to Section 2, which are not accounted for in the model to calculate container and lashing forces, a calculated lifting force of up to 375 kN is permissible, in general.

2. Permissible stresses

The maximum permissible stresses for container supports, foundations, lashing bridges, etc. are:

$$\sigma_N = \frac{R_{eH}}{1,25}$$

$$\tau = \frac{R_{eH}}{2,5}$$

$$\sigma_v = \sqrt{\sigma_N^2 + 3\tau^2} = \frac{R_{eH}}{1,13}$$

σ_N = perm. normal stress [N/mm^2] (tension, compression, bending)
τ = perm. shear stress [N/mm^2]
σ_v = perm. equivalent stress [N/mm^2]
R_{eH} = reference yield stress of the material used [N/mm^2]

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Section 4 Materials, Welding and Tests

A. Materials and Constructional Parts

1. Manufacture and testing

1.1 Works approval

Materials and constructional parts for cell guides and lashing elements may only be supplied by manufacturers approved by BKI in this respect. Approval shall be applied for in writing to BKI and will be granted, as a rule, on basis of an inspection of the works and approval tests of the products. The scope of testing will be laid down in this respect from case to case.

1.2 Requirements for the materials, quality evidence

All materials and constructional parts decisive for the strength of the buttress and cell guide structures as well as lashing elements shall satisfy, in respect of their quality characteristics, the Rules for Materials (Pt.1, Vol.V) Sec.1, H.1.2 and 3.1 respectively.

Where parts not welded to the ship's hull or not relevant for the ship's strength are concerned, testing by the manufacturer with a certificate according to Rules for Materials (Pt.1, Vol.V) Sec.1, H.1.2 and 3.1 e.g. an acceptance test certificate 3.1 as to EN 10204, may be consented[1)].

The material records shall contain specific details on the manufacturing procedure, composition, heat treatment mechanical properties and marking.

Relevant equivalent certificates can be recognized.

Inspection of constructional parts:

All parts shall be made available to the Surveyor for an inspection of their surface condition and a dimensional check. The dimensional checks and in case of piece numbers above 100 also the visual inspection will be carried out at random. On request of the Surveyor non-destructive tests are to be carried out, e.g. ultrasonic, x-ray or surface crack indication tests.

1.3 Retests

Where no or insufficient material records are furnished for the materials and/or individual parts or if the association with the test certificates is insufficient, BKI may call for retests to be carried out under their supervision. The kind and scope of the tests will be laid down from case to case in conformity with the Rules for Materials (Pt.1, Vol.V)

1.4 Selection and materials

The selection of materials shall be done taking all qualities into account, a confirmation of BKI is done normally by the drawings approval.

[1)] Lashing elements welded on hull are in general of minor importance to ship's strength and are normally sufficiently certified by a material certificate 3.1 according to EN 10204.

1.5 Marking

Materials and fittings shall be marked by the manufacturer in such a way that an unobjectionable identification can be done by the material certificates. Materials tested by BKI are stamped additionally according to the Rules for Materials (Pt.1, Vol.V) Sec.1, F.

Cast steel and forged pieces are to be marked with the manufacturer's identification, short identification of the kind of cast and a marking respect. identification number. for the charge (i.e. last 3 (three) numbers of the charge number). Additional markings can be agreed between manufacturer and customer.

2. Approved materials

2.1 Materials for cell guides, blind frames and similar structures

Plates, sections, bars and pipes for cell guides and blind frames, container stanchions and similar structures shall be in accordance with the Rules for Materials (Pt.1, Vol.V) Sec.4.

The materials shall fulfil the requirements of the minimum impact strength of the rules mentioned before.

Table 4.1 furnishes a summary of permissible BKI-shipbuilding steels and comparable steels acc. to EN 10025-2. Steels from other norms may be used if equivalent to those listed in the Table, if it can be proved that they are suitable for welding and if they meet the requirements of the Rules for Materials (Pt.1, Vol.V) Sec.4, C.2.3.

Table 4.1 Materials for cell guides, container stanchions and similar structures (excerpt of properties required)

Hull structural steels[1]			Comparable structural steels[2]			
Grade	Min yield point [N/mm²]	Tensile strength [N/mm²]	Steel quality acc. to EN 10025-2 and EN10025-3	Min. yield point R^3_{eH} [N/mm²]		Tensile[3] strength R_m [N/mm²]
				t ≤16 mm	16 < t ≤40 mm	
KI-A	235	400-520	S 235 JR S 275 JR	235 275	225 265	360 - 510 410 - 560
KI-B			S 235 J0 S 275 J0	235 275	225 265	360 - 510 410 - 560
KI-D			S 235 J2 S 275 J2	235 275	225 265	360 - 510 410 - 560
KI-E			275 NL	275	265	370 - 510
KI-A 36	355	490-630	355 J2	355	345	470 - 630
KI-D 36			S 235 K2 S 355 N			
KI-E 36			S 355 NL			

[1] For more requirements, see Rules for Materials (Pt.1, Vol.V)

[2] Extract from the standards EN 10025-2 and EN 10025-3 respectively.

[3] When dimensioning the components, possibly, the lower yield points or tensile strengths – depending on steel quality and/or thickness of products – have to be considered by increasing the cross sections accordingly.

2.2 Materials for stowage and lashing fittings above or below weather deck

The steels shall fulfil following requirements:

- The steels shall be killed and fine grain treated.

— All products shall be heat treated, that means normalised or quenched and tempered.

— The steels shall fulfil the requirements for impact strength mentioned in the Standards and approved specifications respectively, at least fulfil the requirements mentioned in Table 4.2.

— Unalloyed steels intended for welding shall not have a higher carbon content than 0.22% (ladle analysis)

— If the type of product requires it, additional non destructive test can be required.

Proof of impact energy is to be given for the temperatures at ISO-V specimen.

Table 4.3 gives an overview of the materials to be used for stowage and lashing fittings.

Use of the grades KI-A, KI-B and S235JR, S235J0, S275JR, S275J0, S355JR respectively and S355J0 (EN 10025-2) according to the Rules for Materials (Pt.1, Vol.V) Sec.4, B. and C. is not permitted.

If stowage and lashing fittings are fabricated from materials according to EN 10025-2 and EN 10025-3 by hot forming, the requirements as regards chemical composition of the Rules for Materials (Pt.1, Vol.V) Sec.4, C.2.3.1 are to be observed.

If an impact strength of 14 (11) Joule at –20 °C is proofed for nodular cast iron of grade EN-GJS-400-18-LT, it can be used for fittings for service above and below deck. Nodular cast iron shall not be used for dynamically high loaded fittings (bottom twistlocks, midlocks etc.).

The temperature at which the necessary impact strength values are proofed is to be chosen with –20 °C for above-deck and with 0 °C for below-deck service.

2.3 Materials for lashing chains

For manufacture of lashing chains preferably fully killed steels (e.g. 21 Mn 5, 27 Mn Si 5) according to DIN 17115 or equivalent steels shall be used. The grade RSt 35-2 may be used after special approval.

Where the material grade and the welding procedure so require, the chains are to be properly heat treated.

Table 4.2 Minimum values of impact energy for stowage and lashing fittings above and below the weather deck

Product from	Impact energy KV[1] [J] min		Test temperature for materials with usage above weather deck [^{0}C]	Test temperature materials with usage below weather deck [^{0}C]
	longitudinal	transverse		
Rolled products[2] $R_{emin} \geq 235$N/mm^2	27(19)	20 (14)	-20	$\pm$0
Rolled products[2] $R_{emin} \geq 355$N/mm^2	34(24)	24(17)		
Forged steels	27(19)			
Cast steels	27(19)			
Nodular cast iron	14(11)			

[1] Obtained from ISO-V-specimens as an average value from three tests. One of these values may occur as the lowest individual value; see data indicated in brackets.

[2] Plate, section, bar

Table 4.3 Materials for stowage and lashing fittings

Type of product standard	Steel or casting grade
Structural steels acc. to Rules for Materials (Pt.1, Vol.V)	KI-D, KI-D 32, KI-D 36, KI-E, KI-E 32, KI-E 36
General steels EN 10025-2	S 235 J2 +N , S 275 J2 +N, S 355 J2 +N
Fine grain steels suitable for welding acc. to EN 10025-3	basic qualities (N) tough at sub-zero temperatures (NL)
Cast steel DIN 1681, DIN 17182	GS–38, GS–45, GS–52, GS–16Mn5, GS–20Mn5
High temperature steel castings DIN 17245	GS–C 25
Low-temperature steel castings SEW 685	GS–21Mn5, GS–26CrMo4
Quenched temperature steel castings EN 10083	41Cr4, 42CrMo4
Nodular cast iron EN 1563	EN-GJS-400-18-LT

B. Welding

The following summarises the most important quality assurance measures to be observed and/or to be taken during welding. The scope of quality assurance measures is to be brought into conformity with the production. For any additional requirements having to be imposed the Rules for Welding (Pt.1, Vol.VI) and Rules for Hull (Pt.1, Vol.II) Sec.19 apply analogously.

1. Conditions in respect of workshops

1.1 Works' approval

Works and shops, subsidiaries and also sub-contractors intending to carry out welding work on container lashing elements shall be approved by BKI in this respect. The approval is to be applied for at BKI head office with the following statements and particulars:

— description of the workshop

— materials used

— welding procedure and consumables

— welding personnel

— test equipment as far as available

1.2 Facilities

The works and shops shall avail themselves of the necessary facilities permitting expert and perfect weldings. Such facilities are, inter alia, working places protected against atmospheric influences, machinery and equipment for an expert preparation of the welding joints, reliable welding machinery and equipment, stationary or portable drying spaces or cabinets for storing the welding filler metals and consumables.

1.3 Welding jigs

For assembly and welding, it is recommendable to use jigs in order to ensure correct dimensions of the structural parts. The jigs shall be of such a configuration that the weld seams are easily accessible and can be welded in the most favourable position possible (cf. i.a. also 5.1 and 6.5). Tack or temporary weldings shall be avoided wherever possible.

2. Welders, welding supervision

2.1 Welder's qualification test

All welding work on container lashing elements may only be carried out by BKI-recognized welders examined in connection with the welding process in question. For manual arc welding and semi-mechanized gas-shielded welding on stowage or lashing fittings as well as on the hull only welders are permitted, who have qualified according to EN 287 respect. ISO 9606 and, additionally, fulfil Rules for Welding (Pt.1, Vol.VI) Sec.3.

Welders to be employed for special grade structural steels shall have qualified by analogy with Rules for Welding (Pt.1, Vol.VI) Sec.3 or in a corresponding qualification group as to EN 287 and ISO 9606 respectively. Equivalent welder's qualification tests on the basis of other rules or standards may be recognized.

2.2 Welding supervisors

Each workshop carrying out welding work shall have in its employ a welding supervisor whose professional qualification shall be evidenced. Depending on the type and scope of the welding work to be carried out, welding supervision may be effected by, e.g., a welding specialist or a graduate welding engineer. Changes in respect of the welding supervisors shall be communicated to BKI without any prior request to do so. The welding supervisor(s) shall responsibly supervise the preparation for, and execution of, the welding work.

3. Welding processes, procedure tests

3.1 Evidence of suitability

Only welding processes shall be used the suitability of which has been proved in a procedure test.

As to welding procedure tests for the flash butt welding and friction welding see Annex C

3.2 Application, execution

The execution of a procedure test in order to extend the approval according to 1.1 is to be applied for at BKI head office with the following statements and particulars:

- description of the procedure and the equipment (if possible also pictures, leaflets or similar)
- particulars of the procedure (preparation of seams, welding data, etc.)
- materials to be welded and dimensions of the parts to be connected
- welding consumables to be used and auxiliaries
- subsequent works, if applicable
- subsequent heat treatment data, if applicable
- intended testing during manufacture
- place and time of procedure testing

Welding of samples and testing is to be done under supervision of BKI.

3.3 Scope of testing, requirements, welders

The scope of testing, test pieces and specimens, and requirements will be laid down, by analogy with the Rules for Welding (Pt.1, Vol.VI) Sec.12 from case to case in accordance with the application range applied for. Welders employed in procedure tests are considered qualified in the welding technique concerned and/or for the respective materials, provided that the procedure tests have been successfully completed. Where further welders or operator groups are to be employed with the procedure application range enlarged later on, the welders or operator groups shall be adequately trained and tested.

4. Welding filler metals and consumables

4.1 Approval and range of application

All welding filler metals and consumables (such as rod electrodes, shielded-gas welding wires etc.) shall have been approved by BKI in accordance with the Rules for Welding (Pt.1, Vol.VI) Sec.5. The required quality grade depends on the base materials to be welded.

5. Design of weld joints

5.1 General principles

The weld joints shall be designed from the beginning in such a way that they be easily accessible during manufacture and can be made in the most favourable welding sequence and welding position possible (cf. also 6.5), care being taken that only the least possible residual welding stresses and distortions will remain in the constructional components after manufacture. Small distances of the welded joints from one another and local accumulations of welds shall be avoided.

5.2 Weld shapes

Butt weld joints (such as I, V or X seams) and corner or cross joints (such as single-bevel butt joints) shall be designed in such a way that the full plate or shape cross section is fused. In order to achieve this, the constructional components shall be prepared with adequately chosen weld shapes as to the standards being given a sufficient angle between the planes of the fusion faces, a sufficient air gap, and the smallest possible depth of the root faces in accordance with the plate thickness. Special weld shapes require BKI approval; where necessary, the weld shapes are laid down in connection with a procedure test.

5.3 Fillet welds

Fillet welds shall, in zones of high local stress (i.e. load introductory zones), whenever possible, be so designed as to be continuous on both sides. Only fillets continuous on both sides or intermittent fillets shall be provided at especially corrosion endangered parts (i.e. exposed to sea water) where the fillets being led around the stiffener or scallop ends to seal them. The fillet throat depends on the stressing in each case, and proof calculations of its sufficiency shall be furnished in cases of doubt. The "a" dimension (throat thickness) shall not exceed 0,7 t (t = thickness of the thinner part) nor be less than 3,0 mm.

5.4 Overlapped welds

Overlapped weld joints (instead of butt-seam connections) shall only be used in connection with structural parts subject to small loads and only be arranged, wherever possible, in parallel to the direction of the main stress. The overlap width shall be at least 1,5 t + 15 mm, as t being the thickness of the thinner plate. The fillets shall be made in accordance with 5.3.

6. Manufacture and testing

6.1 Welding preparation

The constructional components shall be dry and clean in way of the weld. Any scale, rust, flame cutting slag, grease, paint (with the exception of permitted over-weldable production coatings), and dirt shall be thoroughly removed prior to welding.

Where plates, shapes or constructional components are provided with a corrosion-reducing production coating (shop-primer) prior to welding, this coating shall not affect the quality of the welded joints.

6.2 Assembly

When preparing and fitting together the constructional parts, care shall be taken to meet the specified weld shapes and gap widths (air gaps). Where the permissible gap width is slightly exceeded, the same may be reduced by deposit welding on the fusion faces of the joint. Filling pieces or wires shall not be welded in.

6.3 Alignment of constructional components

Plates and shapes shall be accurately aligned, in particular in structures interrupted by crossing members. A displacement of the edges relative to one another of more than 15% of the plate or shape thickness, but maximum 3 mm, the lesser figure being applicable, is not acceptable.

6.4 Protection against atmospheric influences

During welding operations, the area where work is carried out shall be protected against atmospheric influences. In cold air (below 0°C), suitable measures shall be taken (covering, heating the constructional components) to ensure satisfactory execution of the weld joints. Welding shall cease at temperatures below −10 °C. Any rapid cooling - in particular in the welding of thickwalled parts or steels susceptible to hardening shall be avoided.

6.5 Welding position and sequence

Welding work shall be carried out in the most favourable welding position possible. Welding in vertical downward position shall be avoided wherever possible and shall not be applied to connecting load bearing components, not even after a procedure test for vertical downward welding in general and irrespective of the approval of welding consumables. A suitable welding sequence shall be chosen to ensure the least possible restriction of the weld seam shrinkage.

6.6 Workmanship

In welding operations, care shall be taken to achieve uniform penetration, perfect fusion down to the root, and uniform, not excessively convex weld surfaces. In multi-pass welding, slag having originated from the preceding runs shall be thoroughly removed. Cracks (including broken tack welds), larger pores or slag inclusions etc. are not to be welded over but shall be gouged out.

6.7 Repair of defects

The repair of major workmanship defects may only be carried out after consent of BKI has been obtained.

6.8 In-shop control

Workmanlike, perfect and complete execution of the welding work shall be ensured by a close control by the works or shop concerned. BKI will check the welds at random during fabrication and, where necessary, during the final inspection after completion. BKI is entitled to reject insufficiently checked constructional components and require their being tendered a new for inspection after successful in-shop control and completion of any repairs necessary.

6.9 Weld seam testing

BKI is entitled to demand additional non-destructive tests to furnish evidence of a satisfactory weld quality, to be carried out on important structural parts. The type and scope of the tests will be laid down by BKI from case to case.

Section 5 Approval and Certification of Container Securing Systems

A. General

All seagoing dedicated container ships are to comply with these minimum requirements. For the approval and certification of container securing systems, refer to Annex A and Guidance for The Approval and Type Approval of Materials and Equipment for Marine Use (Pt.1, Vol.W) Sec.3

It is important for the safety of the ship and the protection of the cargo and personnel that the cargo is secured properly especially accounting for strength of the supporting structures and securing fittings. Hereto, a scope containing the following for approval and/or certification of container securing systems is defined:

- fixed and portable container securing fittings;
- arrangement plan of fixed container securing fittings;
- drawings of container supporting structures (container stanchions, hatch covers, lashing bridges, and cell guides, if any);
- cargo safe access plan;
- container stowage and securing plan;
- lashing software.

B. Fixed and Portable Container Securing Fittings

Fixed container securing fittings are used to secure and support containers and are permanently welded to the ship structure.

Portable[1)] container securing fittings are used to secure containers and are not categorised as fixed container securing fittings.

Minimum Breaking Load corresponds to the minimum load at which the first crack appears in the tested representative samples.

Minimum Proof Load corresponds to the test load specified by this Rules below which visible permanent deformation is not allowed.

[1)] "Portable" and "loose" container securing fittings are used interchangeably in different container securing contexts.

1. Drawings

Drawings of fixed and portable container securing fittings showing dimensions, materials, design loads, and manufacturer's markings are to be approved in accordance with this Rules.

2. Prototype Testing

Each fixed and portable container securing fitting type is subject to prototype testing to determine the minimum breaking loads.

The minimum breaking load obtained from prototype testing is to be equal to or exceed the design minimum breaking load.

3. Production Testing

Fixed and portable container securing fittings are subject to production testing prior to delivery or installation.

A number of samples from a batch of the container securing fittings is to be loaded to minimum proof load of the fittings, as per this Rules.

The production testing approval documents of delivered container securing fittings are to be kept on board and may be included in the approved Cargo Securing Manual.

4. Arrangement Plan of Fixed Container Securing Fittings

The plan detailing the arrangement of the fixed container securing fittings is to be approved. The arrangement plan is to include the following for all areas where the fittings are installed:

- The type of fixed container securing fittings such as container foundations[2)] and lashing eye plates
- Unambiguous location of installed fittings such as their location relative to clearly described locations of the ship structures.

C. Drawings of Container Supporting Structures

The drawings of the structures necessary for conducting container stowage and securing are subject to approval.

The drawings are to be detailed enough to allow their model generation for structural analyses.

A plan is to be provided showing all relevant design loads for structural assessment of the container supporting structures and their foundations.

Structures involved in container stowage and securing include:

- hatch covers;
- container stanchions[3)];
- lashing bridges;
- cell guides.

D. Cargo Safe Access Plan

The cargo safe access plan is to be examined for its compliance with the requirements prescribed in MSC.1/Circ.1353/Rev.2.

[2)] Container foundations are called twistlock foundations, or base foundations in different container securing contexts. Likewise, "foundation" and "socket" are used interchangeably.

[3)] Container stanchions are called container stools, or container pedestals in different container securing contexts.

E. Container Stowage and Securing Plan

If the stowage and securing plan, as referred to in MSC.1/Circ.1353/Rev.2 4.2.1 and 4.2.2, is required by the Administration, the plan is subject to approval in accordance with 1. and 2..

1. Container Stowage Plan

The container stowage plan is to include at least the following information for each container type the ship is designed for:

— longitudinal and athwartship views of under deck and on deck stowage locations of containers including reefers as appropriate;

— alternative stowage patterns for containers of different dimensions;

— maximum stack masses[4)];

— maximum stack heights with respect to approved sight lines; and

— maximum nominal container capacity.

2. Container Securing Arrangement Plan

The container securing arrangement plan is to contain all information necessary to prepare lashing calculations in accordance with this Rules. The container securing arrangement plan is to include at least the following information:

— summary of ship particulars such as IMO No., length and breadth;

— summary of loading conditions showing relevant input parameters such as draught and GM;

— longitudinal views of under deck and on deck stowage locations of containers as appropriate showing nominal capacity;

— maximum stack masses;

— relevant properties of securing fittings, including permissible loads;

— graphical presentation of container and lashing arrangements in each bay on deck and in holds for sample loading conditions in accordance with this Rules for each container type the ship is allowed to carry;

— stack total mass and the sequence of masses in a stack;

— minimum quantity of fittings required to secure containers for the presented sample loading conditions.

F. Lashing Software

If the ship is equipped with lashing software on board as per this Rules, the approval is to follow the requirements of Section 6.

[4)] “Mass” and “weight” are used interchangeably in different container securing contexts.

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Section 6 Requirements for Lashing Software

A. General

1. Application

All seagoing dedicated container ships are to comply with these minimum requirements and for ships equipped with lashing software, the class notation **SLC** may be assigned, see also Annex E.

2. Definition

Lashing software is an electronic data processing tool for onboard analysis of forces in container stacks and thereby reflects the parameters of the lashing system as described in the Cargo Securing Manual prepared in accordance with the Administration requirements.

An approved lashing software is not a substitute for the approved Cargo Securing Manual. It is considered as a supplement to the approved Cargo Securing Manual.

The lashing software is a ship specific tool, and the results of the calculations are only applicable to the ship for which it has been approved.

B. Operation Manual

An operation manual is to be provided for the lashing software and be kept on board.

The language of the operation manual is to be the same as the language of the approved Cargo Securing Manual. A translation into another language considered appropriate may be required.

The operation manual should contain descriptions and instructions, as appropriate, as per the following list:

— a general description of the lashing software;

— installation;

— function keys;

— menu displays;

— input and output data;

— required minimum hardware to operate the software;

— instruction on testing the lashing software with the test loading condition;

— a list of all terms, definitions, error messages and warnings likely to be encountered by the user; and

— in the case of error messages and warnings, there are to be unambiguous user instructions for subsequent action to be taken in each case.

C. Functional Requirements

The lashing software is to be capable of calculating forces on containers and container securing equipment for any loading conditions for each container stack.

It is also to be capable of indicating the respective permissible values in order to assist the master in his/her judgement on whether the ship is loaded within the approved limits. The following parameters are to be presented:

— summary of ship particulars such as IMO No., length, and breadth;

— summary of loading conditions showing relevant input parameters such as draught and GM;

— stack and container positions;

— actual stack weights verified against permissible stack weights;

— relevant properties of securing devices, including permissible loads;

— accelerations and other external forces such as wind containers are exposed to;

— listing of all calculated forces on containers and container securing equipment, and evaluation of compliance of the calculated forces with the corresponding allowable values.

The container and lashing arrangements in each bay on deck and in holds are to be shown graphically.

The data are to be presented on screen and in hard copy printout in a clear and unambiguous manner.

A clear warning is to be given on screen and in hard copy printout if any of the allowable forces are exceeded.

In addition to the printout content, each page of the printout is to contain ship's identification, lashing software name and version number, date and time of the printout, and the title of the loading condition. The printout is to be paginated sequentially, and the total number of printout pages are to be shown.

Units of measurement are to be clearly identified and used consistently.

Incorrect data input by the users, such as negative draught values, are to be prohibited. An error message is to be prompted on screen and in hard copy printout in a clear and unambiguous manner.

D. Test Loading Conditions

The lashing software is to be delivered with test loading conditions for selected stacks and bays covering applicable stowage patterns for containers of different dimensions contained in the Cargo Securing Manual, as per this Rules.

The test loading conditions and their results are to be permanently stored in the computer where the lashing software is installed and be protected against unintentional or unauthorized modifications and access.

E. Approval of Lashing Software

The lashing software is subject to approval by BKI and is to include:

- verification of type approval, if any;
- verification that the latest ship data has been used;
- verification and approval of the test loading conditions and their results;
- verification if requirements of C are satisfied;
- checking of proper installation, and verification of the instrument on board in accordance with the approved test loading conditions;
- checking the availability of the operation manual on board.

In case of modifications implying changes in the ship's design or container securing arrangement, the software is to be modified accordingly and re-approved by BKI.

Any changes in software version related to the container securing calculations are to be reported to and be approved by BKI.

Upon installation, the lashing software is to be verified with the approved test loading conditions in the presence of BKI surveyor. It is to be checked that the operation manual for the lashing software is available on board.

Verification by BKI does not absolve the shipowner of responsibility for ensuring that the information supplied into the lashing software is consistent with the current condition of the ship and approved Cargo Securing Manual.

F. Acceptable Tolerances

The accuracy of the computational results from the lashing software for the particular ship, on which the lashing software will be installed, is to be determined by using reference computation results deemed appropriate by BKI.

The tolerance of the accuracy of the results from the lashing software is to be below 1,0% of the allowable values. However, deviations may be accepted subject to review by BKI provided that there is a satisfactory explanation for the deviation and that there will be no adverse effects on the safety of the ship.

G. Annual and Renewal Survey

At each annual and renewal survey, it is to be checked that the operation manual is available on board.

The lashing software is to be checked for accuracy annually by the ship's Master by applying the test loading conditions. If BKI surveyor is not present for lashing software check, a copy of the test loading condition results obtained by this check is to be retained on board as documentation of satisfactory testing for the surveyor's verification at the next scheduled survey.

At each renewal survey this checking is to be done in the presence of surveyor.

H. Other Requirements

The lashing software and its data are to be protected against unintentional or unauthorized modifications and access.

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Annex A Instruction for the Performance of Inspections of Container Lashing Elements

A. Performance of Inspections

1. General

1.1 All components for container stowage and lashing elements are in principle subject to testings in accordance with the following requirements. The testings and inspections required are to be carried out at manufacturers', prior to delivery.

1.2 The scope and type of testings shall comply with the requirements of items 1., 2. and 3. below. Where deemed necessary, deviations therefrom may be admitted upon agreement with BKI.

1.3 In general, proofs of materials as defined in item 2 below are to be furnished for the components presented for testing. Where such proof cannot be presented, in agreement with Biro Klasifikasi Indonesia head office, a subsequent material test is to be carried out. To this effect, the relevant components are to be marked unmistakably.

1.4 Generally with the test the drawings approved by head office have to be presented to the surveyor.

1.5 All components exposed to tension/compression are to be subjected to load tests, see 3. For this purpose, at least 2% of the items delivered are to be selected and subjected to the test load prescribed to which the component shall be able to resist without cracks or permanent deformations occurring. If the test reveals any deficiencies, the Surveyor may extend the scope of testing at his own discretion. Any deficient parts are to be eliminated.

Where a series consists of less than 50 parts, at least 1 (one) of them is to be load tested. Where a manufacturer repeatedly produces minor series of equal parts at certain intervals, proof of quality is to be furnished by load testing of each individual series.

1.6 The parts to be subjected to the test load to be arranged on/clamped into the test bench in a manner corresponding to onboard conditions.

For fittings which have to be welded-in for the purpose of testing and which therefore cannot be used anymore after testing, the scope of testing may be reduced. For this an acceptance test is to be presented, not older than 12 month. Furthermore a type Certificate of BKI shall be presented for these fittings.

1.7 Where a lashing element is composed of several components (e.g. turnbuckles, twistlocks) supplied by different manufacturers, testing has to be carried out upon final assembly. For components not subject to load testing, only proofs of materials as defined in item 2. below are to be furnished by the subcontractors.

1.8 In case of doubt, the Surveyor is entitled to have testings carried out beyond the prescribed scope, e.g., additional materials tests.

1.9 Break-load-tests are carried out in conjunction with the type test (see 3.). Break-load-test are to be repeated depending on production numbers upon agreement with the surveyor, however, latest after 5 years.

1.10 Kinds of testings

1.10.1 Testing on a lot basis

In general, testing is carried out by lots, combining into one testing unit elements manufactured by the same process, from the same material and in the same form. The Surveyor will select not less than 2% of the parts of each lot and check these for their surface finish and accuracy to size and tolerances.

1.10.2 Testing on a piece basis

Where testing on a piece basis is required, e.g. on account of the kind of element, special agreements will have to be reached between manufacturers and BKI.

2. Special test

2.1 Cell guides are to be controlled for measurements after installation. A function test has to be done as a random check with containers or a corresponding pattern.

2.2 Generally a material-test certificate of a neutral institution of the maker has to be presented with the test. Welded-in lashing elements, that are welded into ship structures which are important for ships strength, require a BKI certificate. The welded-in plates shall reach at least the characteristic values of the plates where they are welded into. Exceptions have to be agreed upon with BKI Head Office.

2.3 Welded fittings have to be randomly checked for welding thicknesses aside of the normal welding seam examination (especially with container foundations).

2.4 Welding-in foundations (pots) All welding-in pots have to be checked for tightness (proof by makers certificate). BKI reserves the right to be present at this test. Exceptions shall be arranged with BKI head office.

3. Load tests (type test)

In general, following safety factors ν_{Br} apply for container lashing elements and rigid fittings:

safety factor in general = $\nu_{Br} = 2,0$

for lashing ropes applies factor = $\nu_{Br} = 2,25$

for lashing chains applies factor = $\nu_{Br} = 2,50$

$$\nu_{Br} = \frac{BL}{WL}$$

BL = minimum breaking load [kN]

WL = working load [kN]

The table in Annex C shows working load, test load and breaking load for the most frequent fittings, as well as the test arrangement for the load tests. The stated values are applicable in case the materials which are usual for the specific fitting are used. The test loads are calculated in accordance with the values of the table below and are to be transmitted correspondingly onto other fittings.

Container lashing fittings are also approved and tested for lower safe working loads as long as it fits into the system The number of necessary test- and breaking load tests for the type-test (-approval) will be stated for each fitting with the drawings approval by the BKI head office. For standard elements, however, at least 3 (three) pieces are to be tested with break load.

On completion of the load test, an operational test shall be carried out.

Under the test load no permanent deformations or incipient cracks may occur.

The successfully carried out type test will be certified with a type-certificate by BKI Head Office (sample see

A load test plus an operational test may be required for lashing appliances consisting of several individual parts the joint performance of which has not yet been proven.

For common designs of fully automatic locks, an operational test is required as described in Annex C. For novel concepts for fully automatic locks, details of the operational test will be individually laid down by BKI Head Office.

4. Marking of components

4.1 General

The marking of the fittings is to be done in such a way that an identification on account of the material certificates to be presented is possible. The stamping by the surveyor is done after examination of the material certificates, after visual inspection of the finished product and, if need be, the successful practical testing. In order to avoid damages to the component, the method of fixing the marking may have to be agreed upon with the Surveyor (see 4.3.5 below).

4.2 Marking by BKI stamp

4.2.1 Testing on a lot basis

Materials and components tested on a lot basis, which met the test conditions are provided with the BKI stamp

4.2.2 Testing on a piece basis

Materials and components tested or inspected individually in accordance with the Rules and meeting their requirements will be provided with the stamp

4.2.3 Extent of stamping

At random checks all examined fittings are stamped (2% of the delivery). With individual inspection all parts are stamped.

4.3 Examples for marking of individual parts

4.3.1 Castings are to be provided by manufacturers at least with their symbol and with a marking showing the charge or heat treatment batch. In addition, parts are to be marked as defined in 4.2.

4.3.2 Forgings are to be provided with the manufacturer's symbol and a marking showing the charge, production or heat treatment batch. In addition, parts are to be marked as defined in 4.2.

4.3.3 Parts made of rolled steels Stamping is to be done in accordance with 4.2.

4.3.4 Lashing bars

Following the tensile test according to 4.2 each testal lashing bar is to be stamped.

4.3.5 Lashing chains

Following the tensile test each chain is to be stamped at one end according to 4.2. In addition, following testing in accordance with the standards applicable to chains, each chain is to be stamped by manufacturers with their symbol (or identification character) as well as with the grade characteristic of the chain material employed (see DIN 685). In principle, stamping is to be effected on the unwelded side of the chain link and shall not create any deterioration of the link.

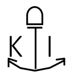
4.3.6 Lashing ropes

For marking the nominal strength of the wires, lashing ropes are to be provided with coloured spun in identification threads, as follows:

- nominal strength 1570 N/mm^2= red
- nominal strength 1770 N/mm^2= green

Ropes tested by approved manufacturers or dealers independently and supplied with BKI approved Works Test Certificates shall additionally be provided with a spun in identification thread carrying the manufacturer's symbol or the identification No. designated by BKI.

Ropes tested in the Surveyor's presence are marked by a lead seal carrying the stamp:



5. Survey of Container Stowage and Lashing Components

5.1 This survey is required only for ships with the notation "**Container Ship**" or "Equipped for Carriage of Containers (**ECC**)" appended to their Character of Class.

5.2 A random survey is to be carried out on the basis of the relevant BKI Certificates carried on board to verify that only such container stowage and lashing components are used as have been approved and, where applicable, tested by BKI. Defective parts are to be replaced or repaired, as necessary. Should the result of the survey be unsatisfactory, its scope is to be increased.

> ***Note:***
>
> *Loose container stowage and lashing components are generally inspected only in batches, i.e. about 2-5% of a consignment. This means that not every unit bears a stamp mark.*

5.3 Approved documents relating to the container equipment (container stowage and lashing plan with documentation of the various components) are to carried on board [1)] and are to be presented, on request, to the Surveyor.

1) Ships built before 1980 were not subject to any equipment Regulations involving the approval by BKI of individual components, so that exceptions may occur in the case of these ships. The procedure then followed shall be analogical to the aforementioned instruction. Where no approved stowage and lashing plans are available, it is recommended that these be prepared, approved by BKI and placed on board. When replacement part are procured, only such stowage and lashing components as have been approved and, where applicable tested by BKI may be placed on board together with the relevant Certificates

Annex B Certificates of The Test and Examination of Container Stowage- and Lashing Parts

BIRO KLASIFIKASI INDONESIA

Sertifikat Uji dan Pemeriksaan
Alat Pengikat dan Pengaman Peti Kemas
Certificate of Test and Examination of Container Stowage and Lashing Parts

Jumlah bagian-bagian yang dikirim *Number of Parts Delivered*	**Uraian/Jenis** *Designation of parts/type*	**Jumlah Bagian yang diuji** *Number of parts tested*	**Tanggal uji** *Date of Test*	**Beban uji yang digunakan***) *Test Load applied [kN]*	**Beban yang diijinkan** *Permitted Load [kN]*

Beban Putus / Breaking Load
Material ini telah diverifikasi sesuai dengan peraturan BKI.
Proof of materials has been tested according to BKI Rules.

Nama dan alamat pembuatan atau pemasok: __________
Name and address of manufacturer or suppliers.

Bagian-bagian ini ditujukan untuk: __________
The parts are intended for.

No. Surat: ________
Customer Order No.

No. Kontrak: ________
BKI Contract No.

Nama dan alamat Perusahaan atau Petugas yang melakukan pengujian: __________
Name and address of Surveyor, Firm, or Person having carried out the test and examination.

Dengan ini menyatakan bahwa, pada tanggal __________ bagian-bagian diatas telah diperiksa oleh Surveyor. Beban yang diijinkan seperti ditunjukkan pada kolom (6) dengan ini disetujui.
The parts listed above have been examined by Surveyor. The permitted load indicated in Column (6) is hereby approved.

Catatan: __________
Remarks:

BIRO KLASIFIKASI INDONESIA

No. Form: ________
Form No.

Annex C Welding Procedure Qualification Test Flash Butt Welding or Friction Welding of Container Lashing Elements

A. Procedure Qualification Flash Butt Welding

1. A.1 Scope and purpose

The present working sheet applies to welding procedure qualification tests for flash butt welding or friction welding of Container lashing elements. It supplements the Rules for Welding (Pt.1, Vol.VI) as well as the "Rules for Stowage and Lashing of Containers aboard Ships" and describes the special test pieces, test specimens and requirements for proof of unobjectionable workmanship and adequate mechanical properties of the welding joints.

2. Types of joints, materials, requirements

In accordance with the state of technology and application the above procedures are mainly employed for joining lashing bars, including their end fittings, such as hooks, eyes etc., made from quenched and tempered steels 41 Cr 4 (Mat.-No. 1.7035), 25 Cr Mo 4 (Mat.-No. 1.7218) and 42 Cr Mo 4 (Mat.-No. 1.7225). As a rule their diameters are approx. 25 mm.

In most cases these steels are used in quenched and tempered condition and owing to their chemical composition are relatively susceptible to hardening. Particularly in the case of flash butt welding embattlement of the weld area is to be reckoned with, which can only be compensated by subsequent systematical heat treatment. Therefore, apart from furnishing proof of strength, the main purpose of the procedure test is to furnish proof of adequate toughness (ductility). The welding and, where applicable, annealing data shall be capable of being reproduced.

3. Test pieces and specimens

The test pieces are to be welded from known steels, for which proofs are available. If different materials are employed, the different steels are to be welded to each other and/or welded to each other in the envisaged combination. All welding and annealing data, if any, including the pertinent machine adjustment characteristics, are to be recorded. The length of the test pieces is to be taken such as to enable them to be perfectly clamped, to exclude heat accumulation and to enable sampling as required. The minimum length of test specimens is 300 mm.

For each kind and/or combination of material(s) in the presence of a BKI representative at least six equal test pieces are to be welded, from which following a magnetic particle or dye penetration test for surfaces flaws the following specimens are to be taken:

- 1 round tensile test specimen according to DIN 50120 Part 2 (diameter of test specimen do = 20 mm)
- 3 transverse bending test specimens according to DIN 50121 Part 2 (cross-section of test specimen ≈ cross section of component)

- 1 notched transverse bending test specimen analogously to DIN 50121 Part 2 (cross-section of test specimen ≈ cross-section of component)
- 1 macro-etching (longitudinally) with hardness measurements (1 × at specimen centre, 1 × near surface of specimen)

In particular cases BKI may stipulate other supplementary examinations (e.g. ultrasonic test) or testings (e.g. of notch impact bending test specimens); in that case the number of test specimens will have to be increased accordingly.

4. Testing and requirements

Testing is to be effected in the presence of a BKI representative subject to the standards mentioned. The tensile strength is to be at least equal to the values fixed for the quenched and tempered condition in the materials' standards for the material concerned. In the transverse bending tests using a mandrel diameter of 4 × specimen thickness, a minimum bending angle of 60° shall be reached. The bending elongation (measuring length lo = 2 × specimen thickness) is to be reported.

The notched transverse bending test specimen shall not show any welding flaws, such as pores, inclusions, cracks and the like in the broken section. The same supplies to macro-etchings. The hardness survey shall be as even as possible and shall not show any pre-eminent hardness peaks. The requirements for possible additional testings will be fixed from case to case.

5. Recording of results

During the test weldings all parameters essential for the constancy and quality of the weld connections are to be recorded.

In the case of flash butt welding these include:

- Welding machine (kind, manufacturer, type, output, steering mechanism, control devices, etc.)
- Basic material (kind, shape and dimensions)
- Workpiece preparation (clamping and abutting surfaces)
- Length tolerance (overlength) and clamping length
- Clamping jaws (shape and material)
- Clamping force
- Upsetting force and upsetting pressure
- Welding current and platen speed
- Welding time
- Axial reduction of parts length
- Post-heating current and time
- Removal of welding burrs

It is advisable to this effect to equip the welding machine with a device for recording the time curve of current, distance and force.

In the case of friction welding these include:

- Welding machine (kind, manufacture, type, output, steering mechanism, control devices etc.)
- Basic material (kind, shape and dimensions)
- Workpiece preparation (clamping and abutting surfaces)
- Length tolerance (overlength) and clamping length
- Speed (number of revolutions)
- Contact pressure
- Welding time
- Axial reduction of parts length
- Removal of welding burrs

Here, too, it is advisable to record the time curve of relative speed and contact pressure and under all circumstances to equip the machine with relevant control devices.

During the tests the shapes of test specimens and their dimensions, mechanical properties achieved, findings of tests (flaws) are to be recorded and the hardness curves are to be represented graphically. The protocols are to be countersigned by the Surveyor.

6. Literature

The literature will refer to recognized welding standards

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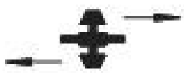
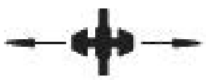
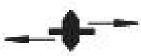
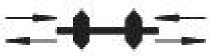
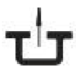
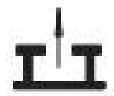
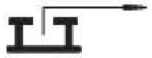
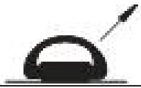
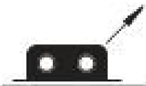
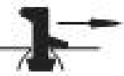
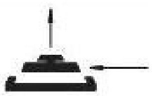
Annex D Container Lashing Fittings

A. Loads for Container Stowage- and Lashing Fittings

Type	Test Arrangement		WL Usual Working Load [kN]	TL Test Load [kN]	min BL Breaking Load [kN]
Lashing rod			230	288	460
Lashing Chain			80	100	200
Lashing Steel wire rope			200	250	450
Turnbuckle			230	288	460
Twistlock (single)/ Midlock[1]			210	263	420
Twistlock (single)/ Midlock[1]			250	313	500
Stacker			210	263	420
Doublestacker		Deck	200	250	400
		Hold	560	620	730
Flush socket			250	313	500
Pedestal socket			250	313	500

Type	Test Arrangement		WL Usual Working Load [kN]	TL Test Load [kN]	min BL Breaking Load [kN]
Pedestal socket			210	263	420
D-Ring			230	288	460
Lashing Plate			230	288	460
Penguin Book			230	288	460
TP Bridge fitting			210	263	420
Buttress		Between tiers	650	715	850
		Top tier	250	275	325
Dove Tail Twistlock		Zug	200	250	400
		Schub	210	263	420
Linkage Plate			150	188	300
General Note:	Deck		WL	1.25 WL	2.0 WL
	Hold		WL	1.1 WL	1.33 WL

The loads above are valid for Ro-Ro lashing elements also. Lashing belts are also tested with factor 2,0 BL/SWL.

1. Load requirement for fully automatic locks are the same as for twistlocks. Additionally required is testing in a test jig, where pressure, shear and lifting forces can be applied simultaneously.

2. Pedestal sockets shall be tested additionally for a SWL of 1000 kN pressure.

B. Type Certificate for Container Lashing Fittings

BIRO KLASIFIKASI INDONESIA

SERTIFIKAT JENIS
Type Certificate

No. Sertifikat: ________________
Certificate No.

Untuk:
For
Pabrik Pembuat Peralatan pengaman
The lashing fitting of the manufacturer

Telah diuji dengan dihadiri oleh Surveyor
Was type tested in presence of the undersigned Surveyor

Persetujuan gambar No: ___________ **Tanggal:** ________
Drawing approval under *Dated*

Beban kerja yang diizinkan: _______ KN
Allowable working load:
Elemen Utama peralatan dispesifikasikan sebagai berikut:

The main elements of the fitting are specified as follows:

Bagian *Part*	**No. Gambar** *Drawing No.*	**Bahan** *Material*	**Pabrik Pembuat** *Manufacturer*

Pengujian beban putus:
Breakload test - results

Pada......KN beban uji,tidak deformasi permanen dan tidak ada retak baru terdeteksi:
At..........KN test load no permanent deformation and no incipient cracks were detected

Masa berlaku Sertifikat sampai dengan :
The validity of this Certificate expires on

Tanggal dan tempat pengujian *Place and date of test*

(...)

No. Form: ________
Form No.

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Annex E Approvals of Computer Software for Determination of Forces in the Lashing System

A. Approval of Lashing Computers/Software

1. General remarks

A lashing calculation program is computer-based software for calculation and control of container securing arrangements in compliance with the applicable strength requirements. A BKI approved lashing calculation program is to be used onboard each ship carrying containers.

BKI examines and approves calculation programs on test condition basis. This examinations and the corresponding approval are done in relation to a specific ship.

BKI recommends using the lashing program on a BKI type approved hardware only. If it is not the case, the program shall be installed on two nominated computers.

2. General requirements

For each vessel the printouts of the test conditions, a copy of the program and a user's manual have to be sent to the BKI Head Office for examination. Test conditions of different bays shall include the following cases:

For each ship the printouts of the test conditions of different bays for unrestricted service (see Section 3, A.2), a copy of the program and a user's manual have to be submitted for examination. For ships intended to be assigned the notation **SLC** for route specific container stowage, additional printouts of test conditions of bays according to route specific container stowage manual (see Section 1, A.1.3) have to be submitted for examination. Test conditions shall include the following cases:

- twistlocks only
- complete lashing
- with exceeding of stack weight
- with exceeding of lashing load
- with exceeding of lifting force
- an example with outboard stacks missing
- one example, where 20' and 40' containers are arranged in mixed stowed
- typical stowage in hold

The software has to be user-friendly, with a graphic presentation of the container arrangement. It has to reject input errors from user. For example negative weight input, container positioned outside or lashings, which are not possible on board are not to be accepted. The software and the stored characteristic data are to be protected against any erroneous use.

For Class Notation **SLC**, an option shall be available in the software to choose between accelerations for unrestricted service and for specified routes. The chosen acceleration basis shall be visible on the screen as well as in printouts.

BKI has to be informed immediately about any modifications which may affect the approved lashing program installed on board of the ship. BKI will decide about a re-approval case by case. Failure to advice of any modifications will annul the issued certificate.

The following details have to be given for each container arrangement in addition to the GM Value of the ship:

- position of each stack
- container weight
- actual stack weights
- permissible stack weights
- lashing arrangement
- transverse acceleration of each stack
- racking forces
- lifting forces
- lashing forces
- corner post loads
- pressure loads at bottom
- percentage of exceeding
- a warning has to be given if any of the strength limit is exceed

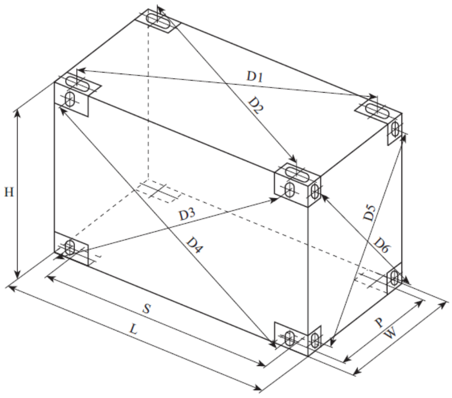
The lashing program certificate, the approved test conditions and the user's manual have to be kept on board.

Annex F Weights, Measurements and Tolerances

Table F.1 Weights, measurements and tolerances

ISO designation of container	**Max. permitted gross weight [kg]**	**External dimensions**			**Distance between centres of holes in corner fittings**			
		Length L [mm]	**Height H [mm]**	**Width W [mm]**	**Longitudinally S [mm]**	**Crosswise P [mm]**	**Permitted difference d^1 of diagonals [mm]**	**Permitted difference d^2 of diagonals [mm]**
1 AAA 1 AA 1 A 1 AX	30.480	12.192_{-10}^{0}	2.896_{-5}^{0} ** 2.591_{-5}^{0} 2.438_{-5}^{0} < 2.438	2.438_{-5}^{0}	11.990_{-10}^{0}	2.260_{-4}^{0}	19	10
1BBB 1BB 1B 1BX	25.400	9.125_{-10}^{0}	2.896_{-5}^{0} 2.591_{-5}^{0} 2.438_{-5}^{0} < 2.438	2.438_{-5}^{0}	8.923_{-10}^{0}	2.260_{-4}^{0}	16	10
1CC 1C 1CX	24.000 (30.48)[3]	6.058_{-6}^{0}	2.591_{-5}^{0} 2.438_{-5}^{0} < 2.438	2.438_{-5}^{0}	5.854_{-6}^{0}	2.260_{-4}^{0}	13	10
1DD 1D 1DX	20.160	2.991_{-5}^{0}	2.591_{-5}^{0} 2.438_{-5}^{0} < 2.438	2.438_{-5}^{0}	2.788_{-5}^{0}	2.260_{-4}^{0}	10	10

[1] Allowable difference of the diagonals of whole-center of the corner castings of bottom and roof areas and side walls.
[2] Allowable difference of the diagonals of hole center of the corner castings of front walls, see following sketch.
[3] This max. gross weight can be used in lashing calculations except for lineload stowage of containers see Section 2
** In certain countries there are legal limitations to the overall height of vehicle and load.



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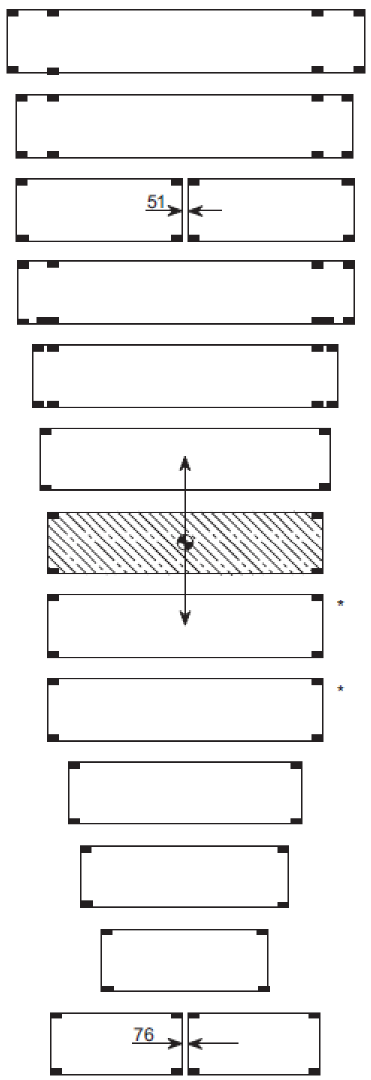
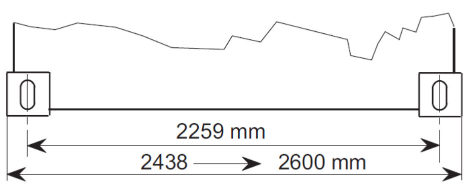
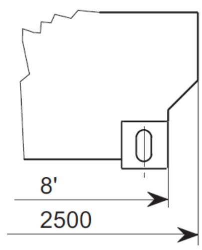
Annex G Container Dimensions

Size	Length (side view)	Width	Height
53’ (16150 mm)		8’6” (2591 mm)	9’6 1/2”
49’ (14935 mm)		2600 mm	9’6” 2896 mm
2x24 1/2’ (2x7442 mm)		2600 mm	9’6” 2896 mm
48’ (14630 mm)		8’6” (2591 mm)	9’6” 1/2”
45’ (13720 mm)		8’ (2438 mm)	9’6” 9’ 6 1/2”
43’ (13103 mm)		8’ (2438 mm)	
40’ ISO (12192 mm)		8’ (2438 mm)	8’ 9’ 8’6” 9’6”
40’ EURO (12192 mm)	*	2500 mm	8’6” 9’6”
40’ Bell Lines (12192 mm)	*	2500 mm	
35’ (10660 mm)		8’ (2438 mm)	8’6”
30’ (9125 mm)		8’ (2438 mm)	8’ 8’6”
24’ (Matson) (7430 mm)		8’ od. 8’6” (2438 mm or 2591 mm)	8’6” 9’6”
2x20’ (2x6058 mm)		8’ (2438 mm)	8’ 9’6” 8’6”



Common for all containers in the transverse measure from center to center point of the holes of corner castings = 2259 mm





* to EURO-/”Bell Lines” Container view on top

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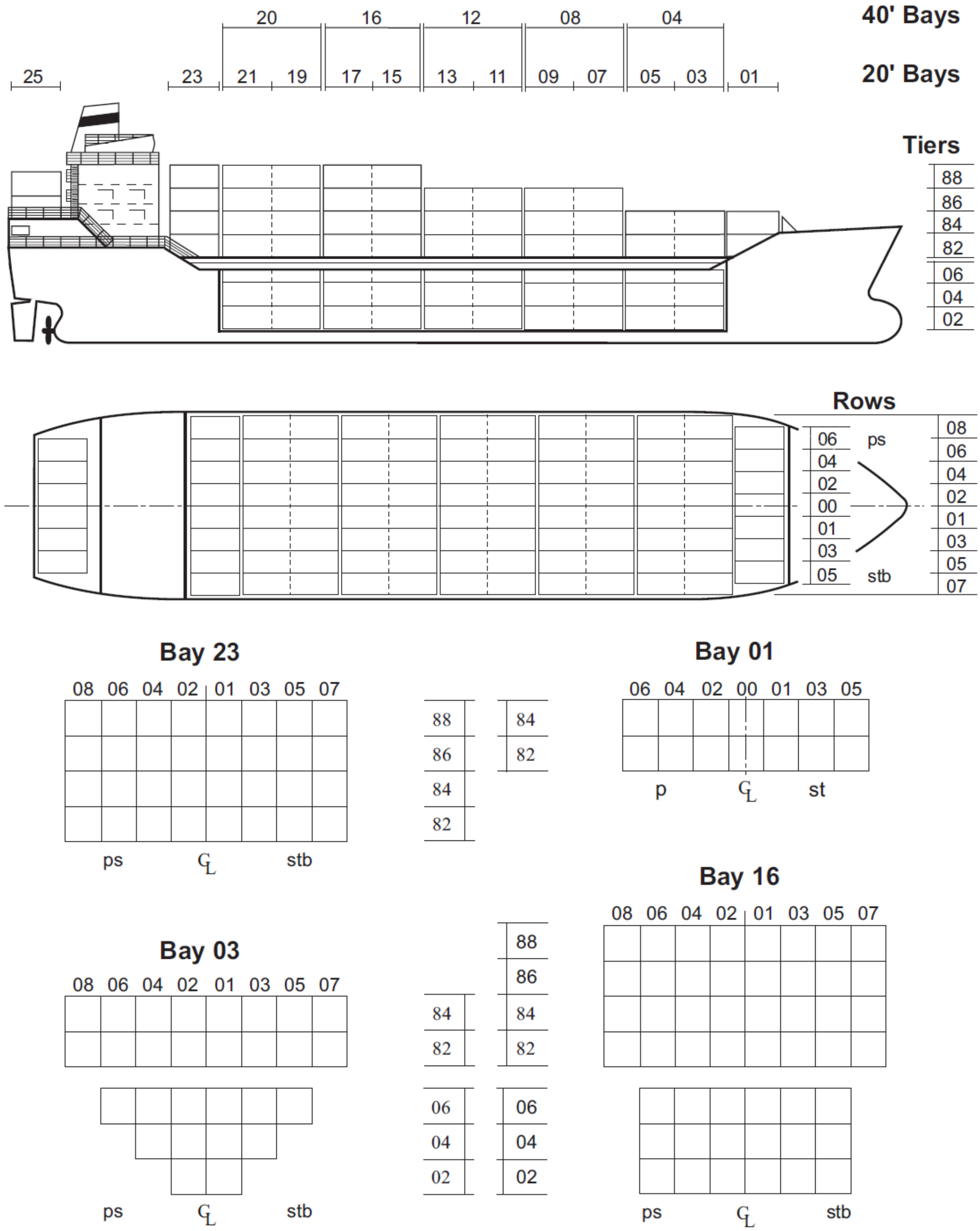
Annex H Code of Container Position



It shall be started with tier 82 at each different deck level (Forecastle/poopdeck).

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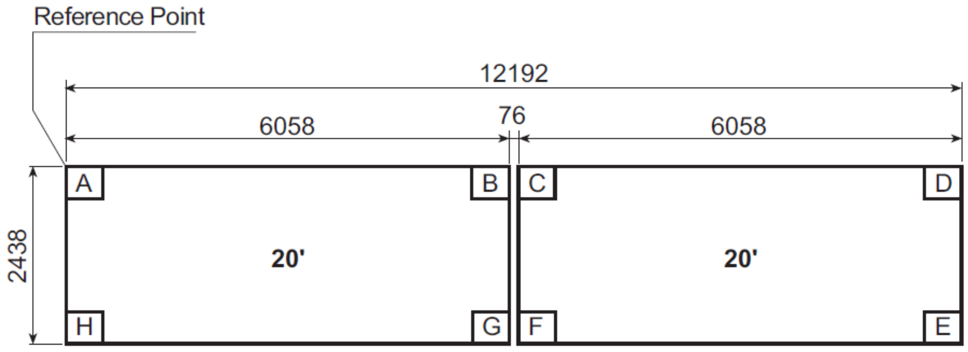
Annex I Height Tolerances of Container Foundations

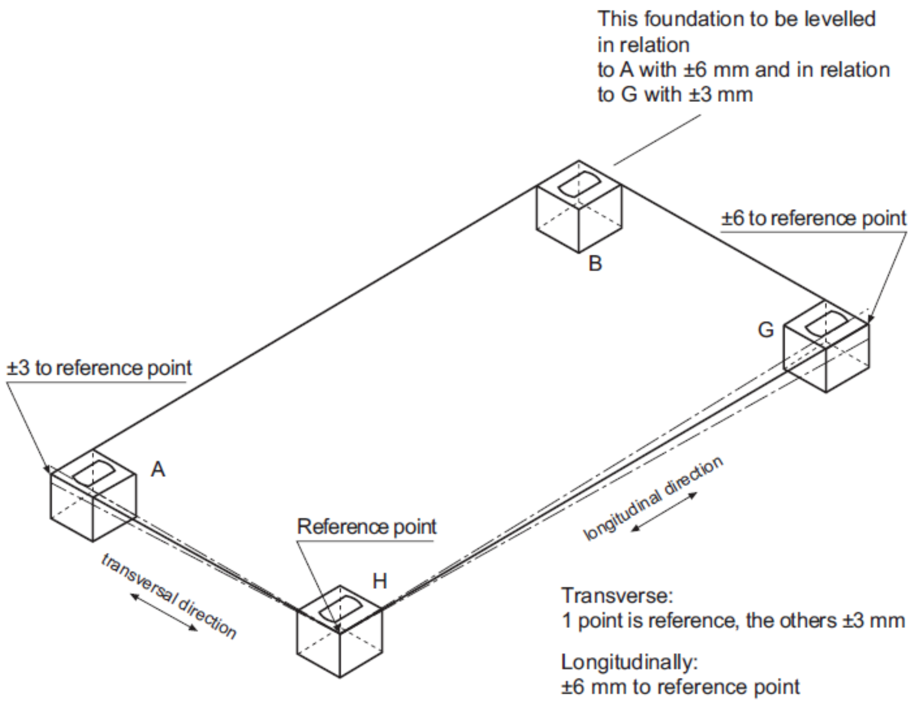


in general the following tolerances have to be kept

Example in mm

A	=	0
B + C	=	3
D	=	-6
E	=	-9
F + G	=	-6
H	=	-3

In longitudinal (not more than ±6)	**In transversal (not more than ±3)**
A to B	A to H
C to D	B to C
A to D	C to F
H to G	D to E
H to E	



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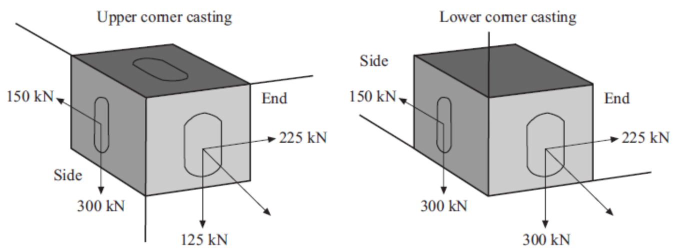
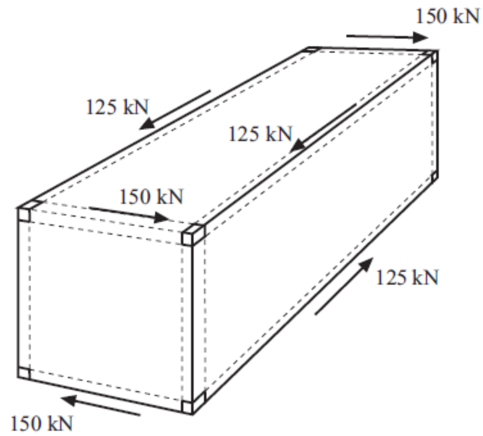
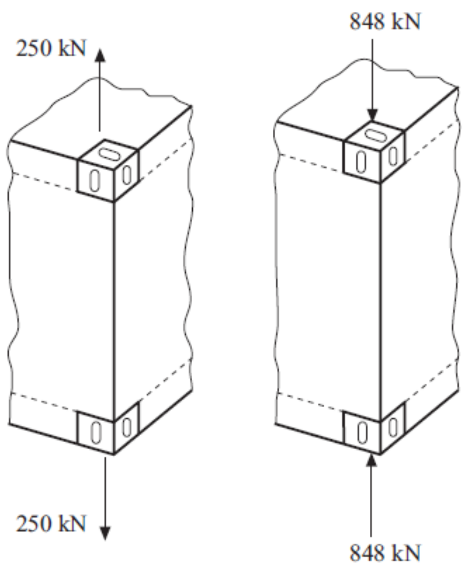
Annex J Maximum Allowable Forces on ISO Container



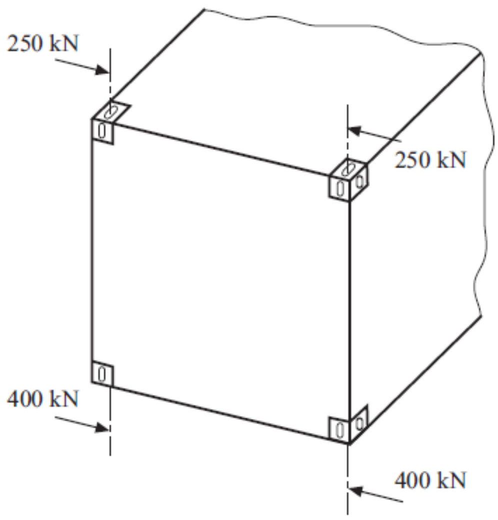
a) Corner casting lashing loads



b) Racking loads



c) Max. vertical corner lifting and compressive forces



d) Transverse compressive forces

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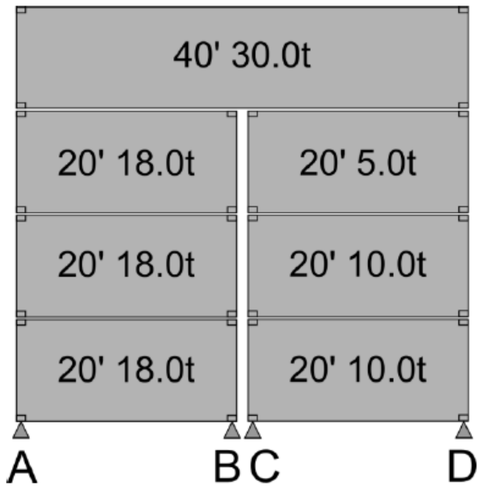
Annex K Determination of the Existing Stack Weight for Mixed Stowage (20’ and 40’ Container) for the Individual Foundation Points

Example:



Stackweight:

A = 14 · 3 + 30 = 72 t
B = 14 · 3 = 42 t
C = 2 · 10 + 14 = 34 t
D = 2 · 10 + 14 + 30 = 64 t

At foundation A and D we get the existing stackweight for 40’ Container, at foundation B and C the stackweight for 20’ Container.

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Annex L Specification of Standard and Individual Routes for Route specific Container Stowage

A. Specification of Routes

1. Standard routes

Standard routes for Asia - Europe service, Pacific service, Pacific-Atlantic service, North Sea- Mediterranean Short Sea service, North Atlantic service, Intra-Asia service, North Sea - Baltic service, Europe - South America East Coast service, Europe - West Africa service and Asia - Europe service via Cape of Good Hope are defined for route specific container stowage.

Route specification is based upon the sea areas defined in BMT's Global Wave Statistics (www.globalwavestatisticsonline.com). Standard routes are illustrated in Fig.L.1 to L.10, including a map of sea area subdivisions according to BMT. Standard routes are characterized by travelled sea areas and time portions of the voyage in these sea areas as listed in Table L.1 to L.10. Coordinates of area boundaries according to BMT are listed in Table L.11.

An actual route of a ship is considered equivalent to one standard route unless significant deviations from the voyage path and the voyage of this standard route occur.

Table L.1 Specification of the standard route for Asia - Europe service

Area No. acc. to BMT	Time Portion
11	6 %
16	3 %
17	3 %
25	3 %
26	9 %
27	10 %
37	11 %
38	1 %
39	5 %
40	12 %
41	3 %
50	11 %
60	4 %
61	11 %
62	8 %

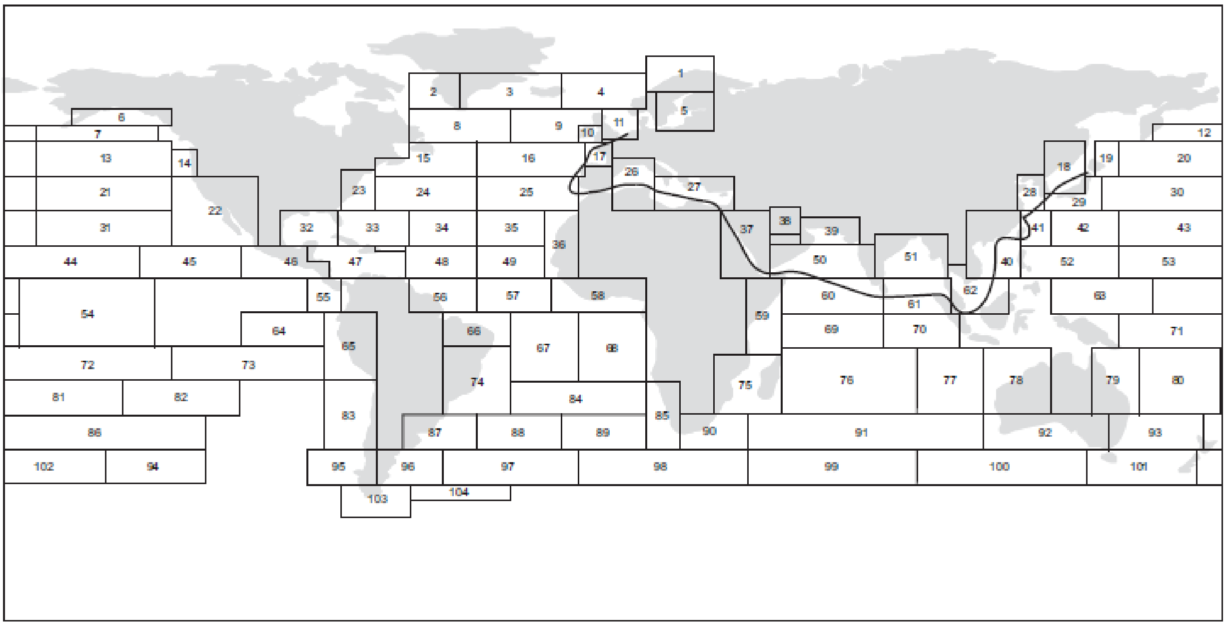

Figure L.1 Standard route for Asia - Europe service

Table L.2 Specification of the standard route for Pacific service

Area No. acc. to BMT	Time Portion
7	10%
12	9%
13	10%
14	7%
18	1%
19	2%
20	11%
21	3%
22	13%
29	13%
30	5%
40	7%
41	5%
42	1%
62	3%

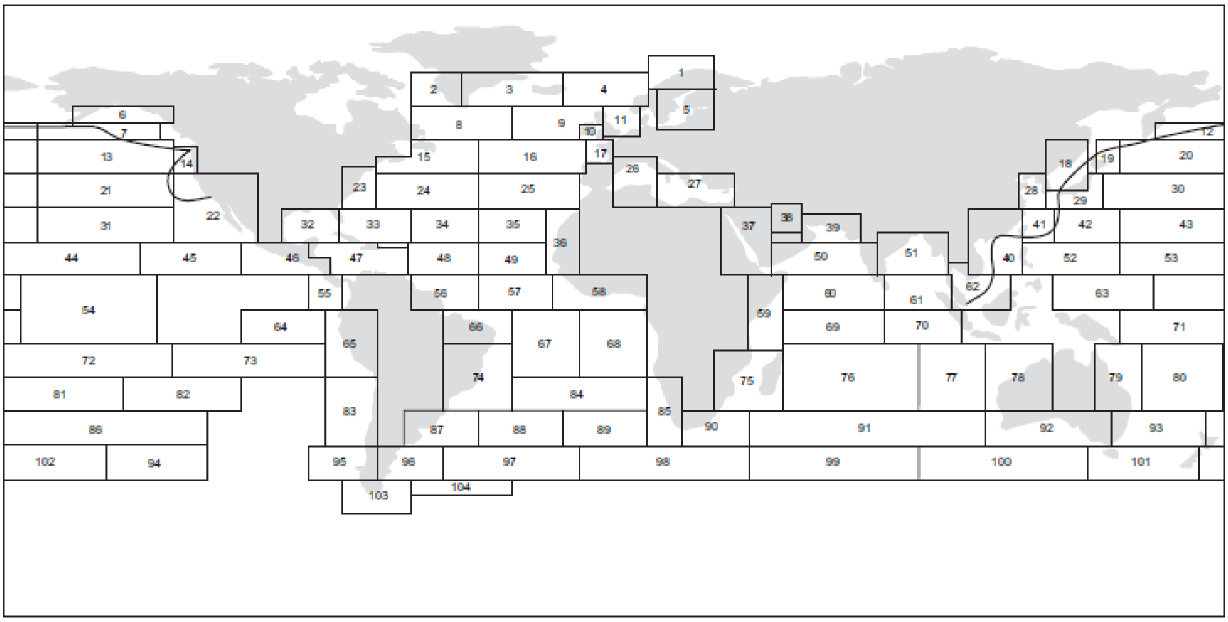

Figure L.2 Standard route for Pacific service

Table L.3 Specification of the standard route for Pacific - Atlantic service

Area No. acc. to BMT	Time Portion
7	4 %
8	1 %
9	3 %
11	6 %
12	3 %
13	4 %
14	2 %
15	10 %
16	6 %
17	2 %
19	1 %
20	4 %
21	1 %
22	9 %
23	12 %
29	4 %
30	2 %
32	1 %
33	4 %
40	2 %
41	2 %
46	7 %
47	5 %
55	5 %

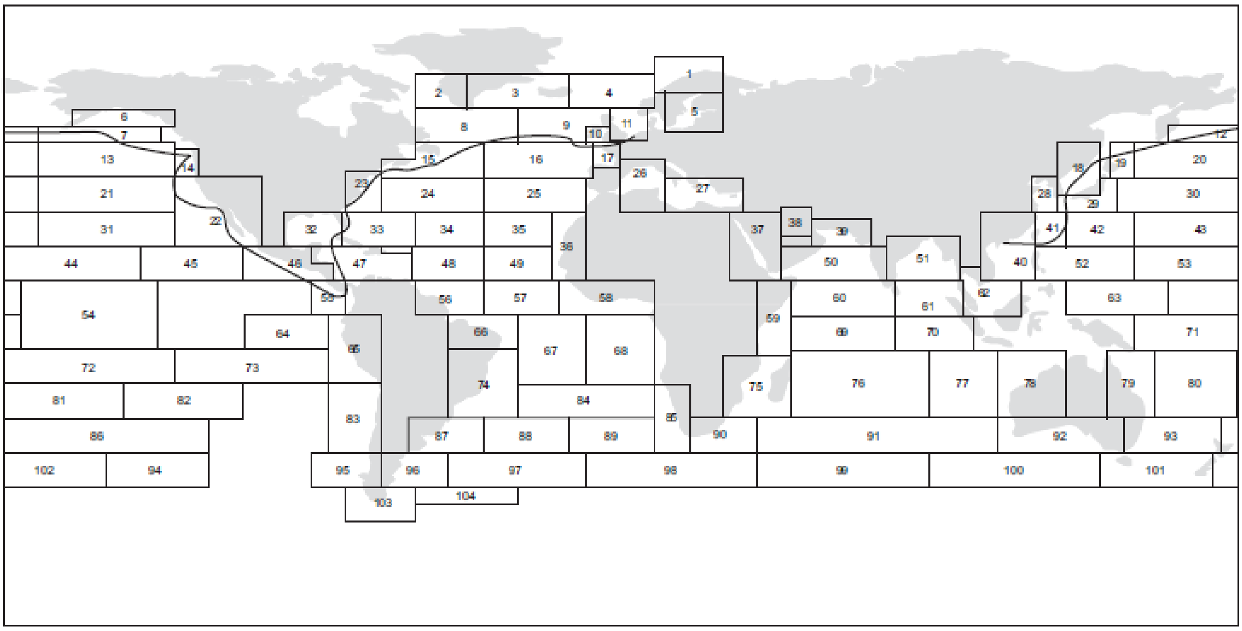

Figure L.3 Standard route for Pacific - Atlantic service

Table L.4 Specification of the standard route for North Sea - Mediterranean Short Sea service Area No. acc. to BMT Time Portion

Area No. acc. to BMT	Time Portion
11	17 %
16	9 %
17	9 %
25	10 %
26	26 %
27	29 %

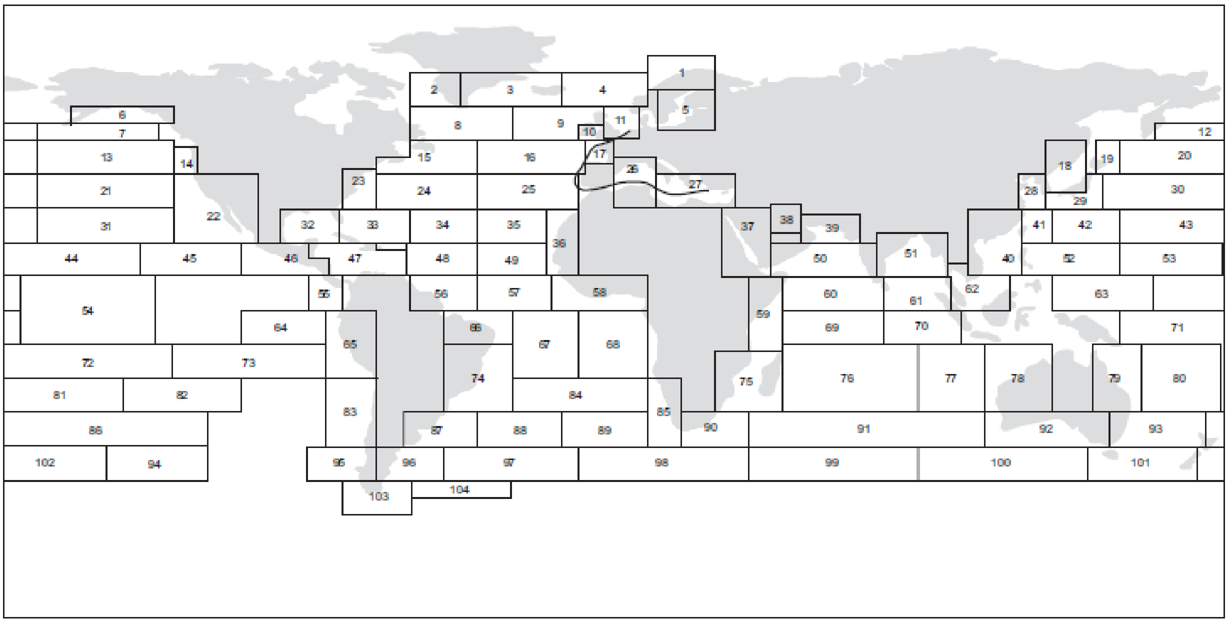

Figure L.4 Standard route for North Sea - Mediterranean Short Sea service

Table L.5 Specification of the standard route for North Atlantic service Area No. acc. to BMT Time Portion

Area No. acc. to BMT	Time Portion
8	3 %
9	8 %
10	1 %
11	14 %
15	24 %
16	15 %
17	4 %
23	27 %
33	4 %

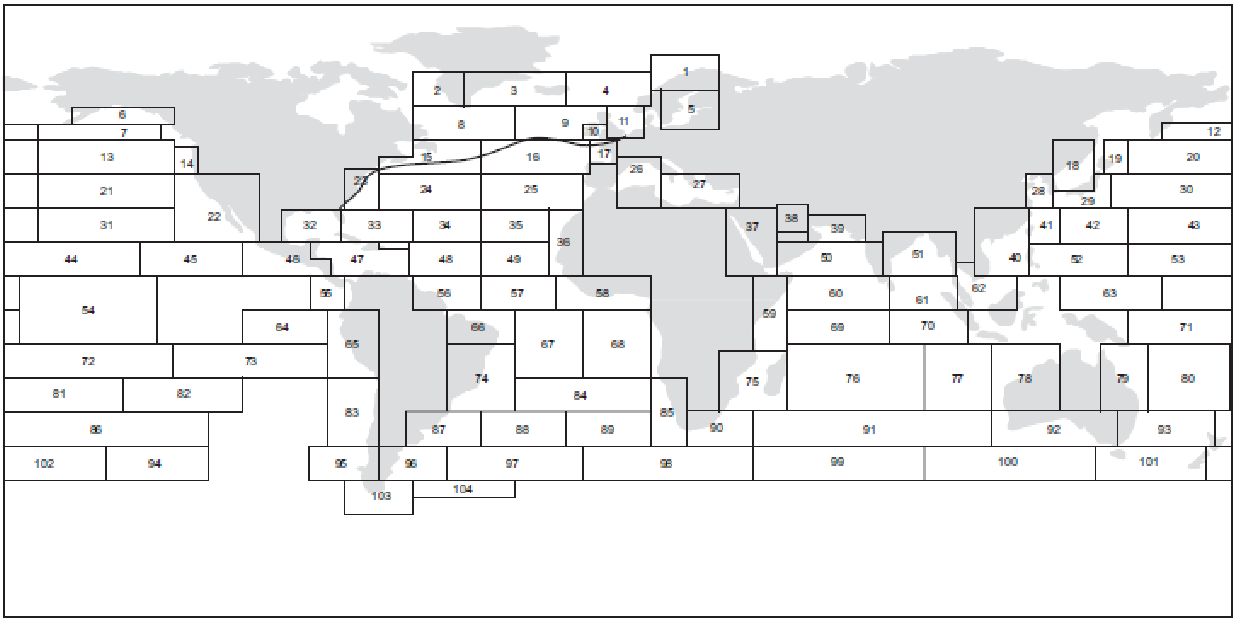

Figure L.5 Standard route for North Atlantic service

Table L.6 Specification of the standard route for Intra-Asia service

Area No. acc. to BMT	Time Portion
62	30 %
40	31 %
41	5 %
28	15 %
29	19 %

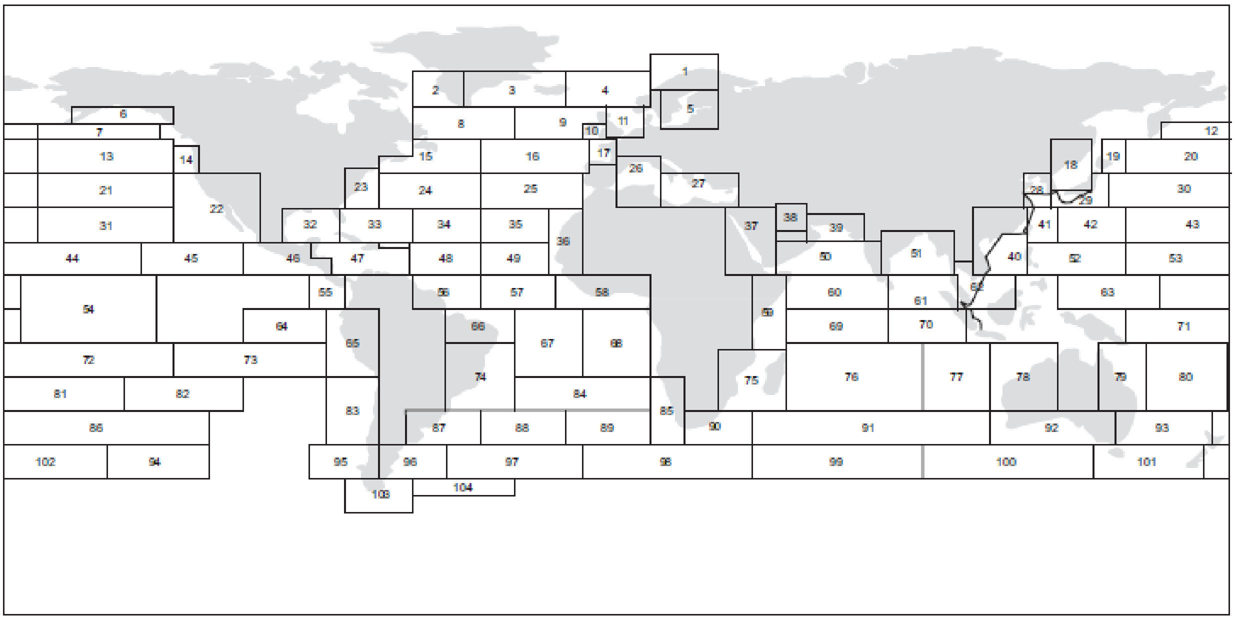

Figure L.6 Standard route for Intra-Asia service

Table L.7 Specification of the standard route for North Sea - Baltic service

Area No. acc. to BMT	Time Portion
5	54 %
11	46 %

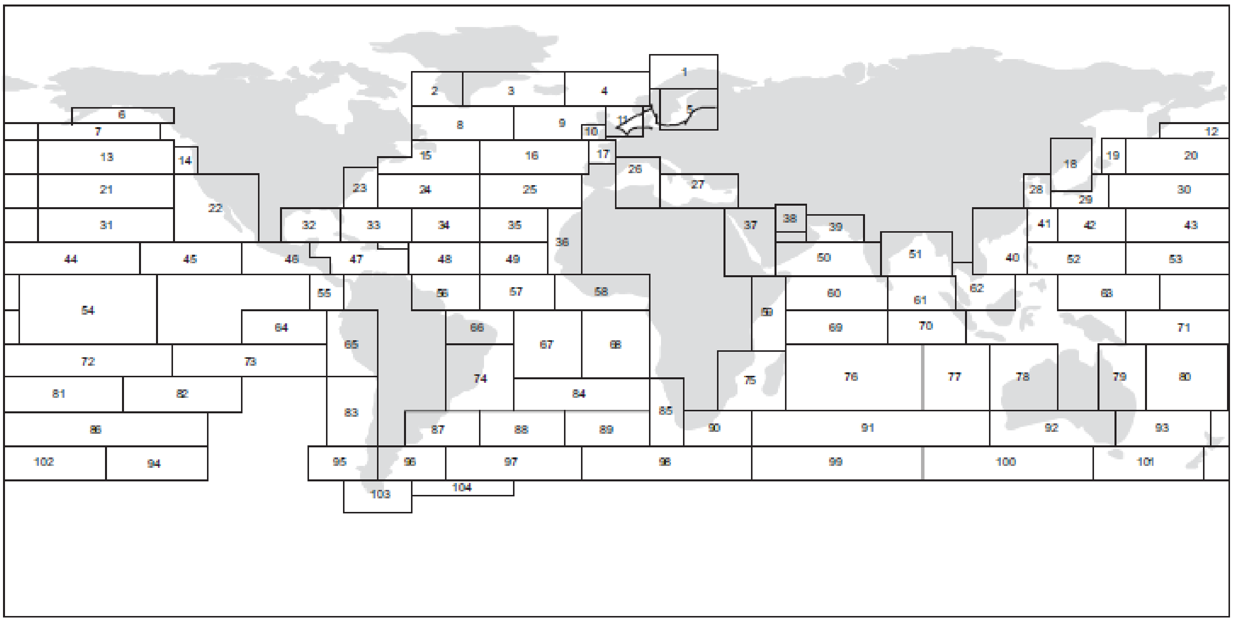

Figure L.7 Standard route for North Sea - Baltic service

Table L.8 Specification of the standard route for Europe – South America East Coast service

Area No. acc. to BMT	Time Portion
11	7 %
17	8 %
16	5 %
25	9 %
36	10 %
49	9 %
57	10 %
66	9 %
74	24 %
87	9 %

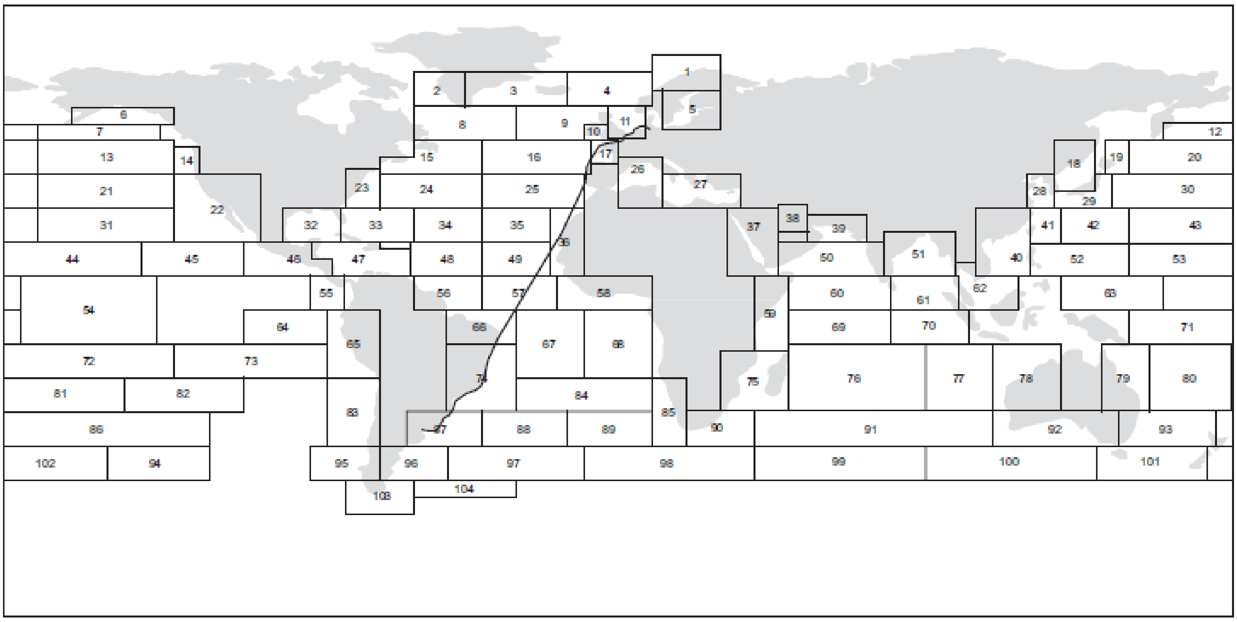

Figure L.8 Standard route for Europe – South America East Coast service

Table L.9 Specification of the standard route for Europe – West Africa service

Area No. acc. to BMT	Time Portion
11	6 %
17	6 %
16	4 %
25	11 %
36	17 %
58	20 %
68	15 %
85	13 %
90	8 %

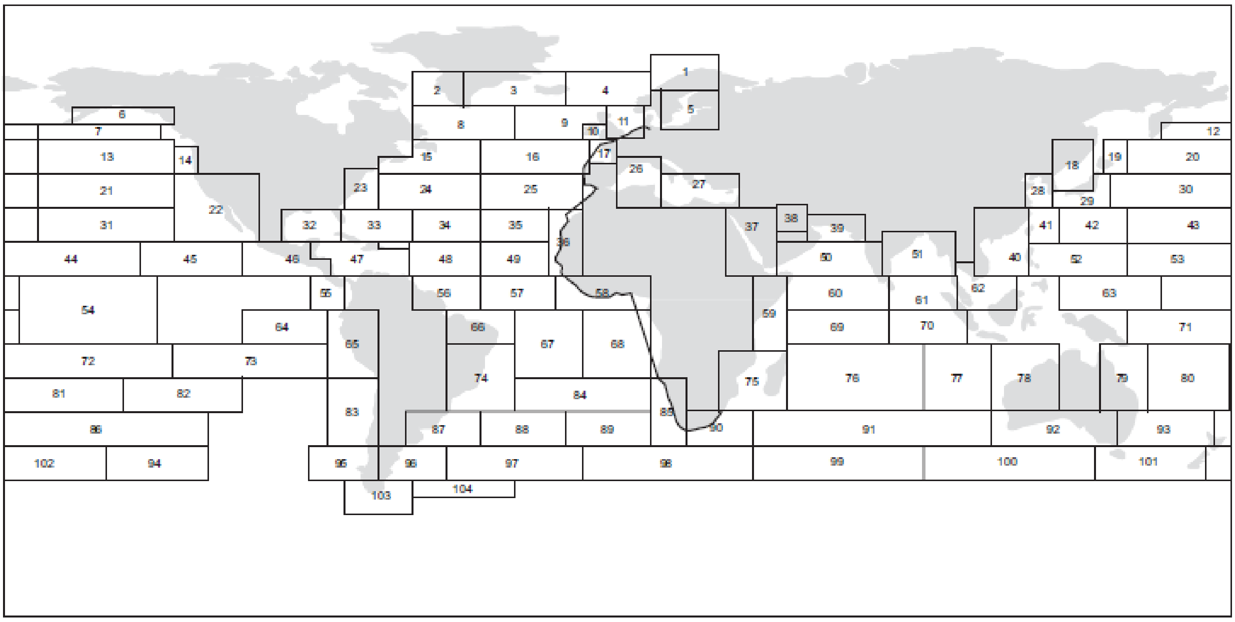

Figure L.9 Standard route for Europe – West Africa service

Table L.10 pecification of the standard route for Asia - Europe service via Cape of Good Hope

Area No. acc. to BMT	Time Portion
29	6 %
28	3 %
41	1 %
40	9 %
62	6 %
61	5 %
70	5 %
76	12 %
75	6 %
90	5 %
85	7 %
68	10 %
58	5 %
36	8 %
25	4 %
16	2 %
17	3 %
11	3 %

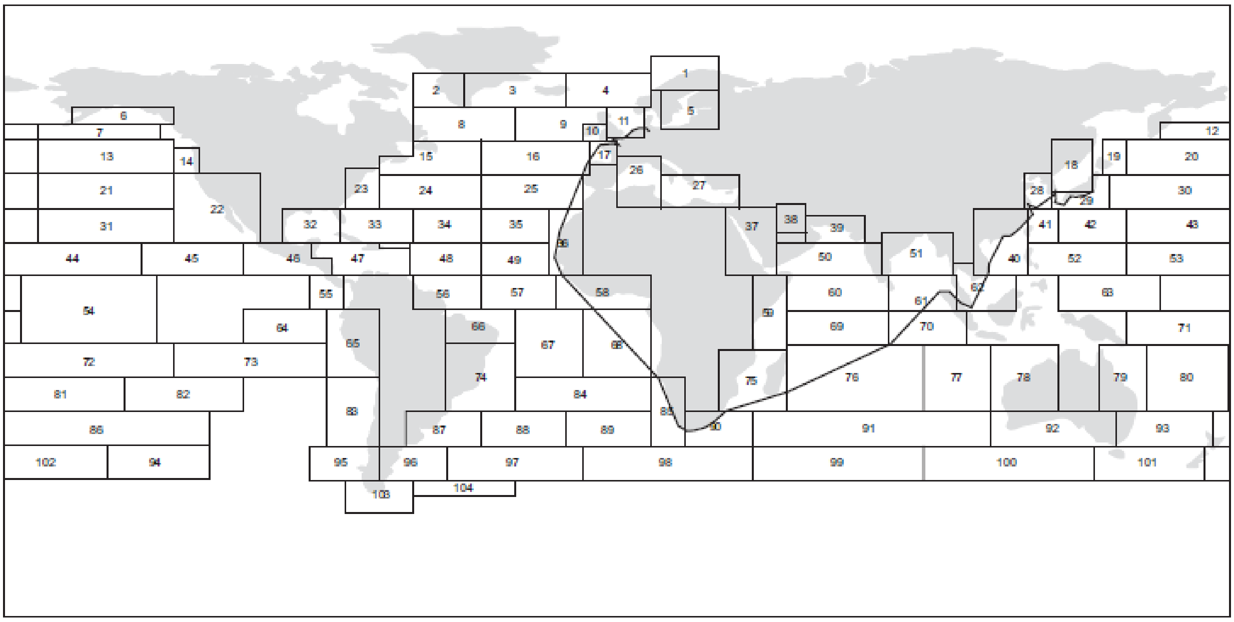

Figure L.10 Standard route for Asia - Europe service via Cape of Good Hope

Table L.11 Coordinates of area boundaries according to BMT

AREA NO.	LATITUDE RANGE	LONGITUDE RANGE	AREA NO.	LATITUDE RANGE	LONGITUDE RANGE
1	65°N-75°N	10°E-30°E	27	30°N-40°N	13°E-36°E
2	60°N-70°N	45°W-60°W	28	30°N-40°N	120°E-128°E
3	60°N-70°N	15°W-45°W	29	30°N-40°N	128°E-145°E
4	60°N-70°N	10°E-15°W		–35°N-40°N	128°E-140°E
5	53°N-65°N	13°E-30°E	30	30°N-40°N	145°E-170°W
6	55°N-60°N	130°W-160°W	31	20°N-30°N	130°W-170°W
7	50°N-55°N	134°W-170°W	32	20°N-30°N	81°W-98°W
8	50°N-60°N	30°W-60°W	33	20°N-30°N	60°W-81°W
9	50°N-60°N	3°W-30°W	34	20°N-30°N	40°W-60°W
	–50°N-55°N	3°W-10°W	35	20°N-30°N	20°W-40°W
10	50°N-55°N	3°W-10°W	36	10°N-30°N	10°W-20°W
11	51°N-60°N	3°W-8°W	37	10°N-30°N	32°E-47°E
12	50°N-55°N	160°E-170°W	38	23°N-31°N	47°E-56°E
13	40°N-50°N	130°W-170°W	39	20°N-28°N	56°E-73°E
14	40°N-48°N	123°W-130°W	40	10°N-30°N	105°E-121°E
15	40°N-50°N	40°W-70°W	41	20°N-30°N	121°E-130°E
	–45°N-50°N	60°W-70°W	42	20°N-30°N	130°E-150°E
16	40°N-50°N	8°W-40°W	43	20°N-30°N	150°E-170°W
17	43°N-50°N	0°-8°W	44	10°N-20°N	140°W-180°W
18	35°N-50°N	128°E-140°E	45	10°N-20°N	110°W-140°W
19	40°N-50°N	143°E-150°E	46	10°N-20°N	84°W-110°W
20	40°N-50°N	150°E-170°W		–15°N-20°N	84°W-90°W
21	30°N-40°N	130°W-170°W	47	10°N-20°N	61°W-90°W
22	20°N-40°N	105°W-130°W		–10°N-15°N	84°W-90°W
23	30°N-42°N	70°W-80°W		–18°N-20°N	61°W-70°W
24	30°N-40°N	40°W-70°W	48	10°N-20°N	40°W-61°W
25	30°N-40°N	10°W-40°W	49	10°N-20°N	20°W-40°W
26	30°N-45°N	0°-13°E	50	10°N-20°N	47°E-78°E

Table L.11 Coordinates of area boundaries according to BMT *(continued)*

AREA NO.	LATITUDE RANGE	LONGITUDE RANGE	AREA NO.	LATITUDE RANGE	LONGITUDE RANGE
51	10°N-23°N	78°E-99°E	77	10°S-30°S	90°E-110°E
52	10°N-20°N	121°E-150°E	78	10°S-30°S	110°E-130°E
53	10°N-20°N	150°E-180°E	79	10°S-30°S	142°E-156°E
54	10°S-20°N	135°W-175°W	80	10°S-30°S	156°E-180°E
55	0° -10°N	80°W-90°W	81	20°S-30°S	145°W-180°W
56	0° -10°N	40°W-60°W	82	20°S-30°S	110°W-145°W
57	0° -10°N	18°W-40°W	83	20°S-40°S	70°W-85°W
58	0° -10°N	10°E-18°W	84	20°S-30°S	10°E-30°W
59	12°S-10°N	40°E-50°E	85	20°S-40°S	10°E-20°E
60	0° -10°N	50°E-80°E	86	30°S-40°S	175°E-120°W
61	0° -10°N	80°E-100°E	87	30°S-40°S	40°W-62°W
62	0° -14°N	99°E-117°E	88	30°S-40°S	15°W-40°W
	–10°N-14°N	105°E-117°E	89	30°S-40°S	10°E-15°W
	–0° -10°N	99°E-100°E	90	30°S-40°S	20°E-40°E
63	0° -10°N	130°E-160°E	91	30°S-40°S	40°E-110°E
64	0° -10°S	85°W-110°W	92	30°S-40°S	110°E-147°E
65	0° -20°S	70°W-85°W	93	30°S-40°S	147°E-175°E
66	0° -10°S	30°W-50°W	94	40°S-50°S	120°W-150°W
67	0° -20°S	10°W-30°W	95	40°S-50°S	70°W-90°W
68	0° -20°S	10°E-10°W	96	40°S-50°S	50°W-70°W
69	0° -10°S	50°E-80°E	97	40°S-50°S	10°W-50°W
70	0° -10°S	80°E-103°E	98	40°S-50°S	40°E-10°W
71	0° -10°S	150°E-175°W	99	40°S-50°S	40°E-90°E
72	10°S-20°S	130°W-180°W	100	40°S-50°S	90°E-140°E
73	10°S-20°S	85°W-130°W	101	40°S-50°S	140°E-173°E
74	10°S-30°S	30°W-50°W	102	40°S-50°S	173°E-150°W
75	12°S-30°S	30°E-50°E	103	50°S-60°S	60°W-80°W
76	10°S-30°S	50°E-90°E	104	50°S-55°S	30°W-60°W

2. Individual routes

On request of the owner individual routes may be considered for route specific container stowage. An individual route is to be specified by the owner in terms of a series of latitude and longitude coordinates describing discrete route points for a voyage. For each involved sea area according to BMT (seeTable L.11), at least one point is to be specified. The route specified in this form is to be representative regarding possible scattering of the actual route. Alternatively, an individual route may be specified by the owner in terms of a sequence of port calls and, if applicable, canal passages.