TRANSPORT QUALITY MANUAL

Requirements for handling and transportation of general cargo

Photo: Johann Ridder (http://www.tis-gdv.de)

This manual was developed in cooperation between Volvo Group and MariTerm AB, July 2014

Content

1. Introduction

These requirements are developed in cooperation between Volvo Group and MariTerm AB and are valid for loading and securing of Volvo cargo for transports by **road**, **rail** and at **sea** for all transporters, as well as subcontractors, involved in loading, unloading and transportation of Volvo products. The quality managers at the transport companies are responsible to make sure that all personnel involved have good knowledge regarding these requirements.

The purpose with these requirements is to achieve the following:

- Uniform systems for loading
- Uniform and secure systems for cargo securing
- Avoiding transport damages

Random inspections or planned audits will be made continuously within areas where loading/unloading takes place. This is regarding cargo securing in general but also securing of dangerous goods. The purpose is to make sure that all the transporters are following these requirements. Remarks will be reported to the actual transport company and to the purchaser of the transport.

These requirements are based on the international IMO/ILO/UN ECE CTU Code of Safe Practice for Packing Cargo Transport Units (CTU Code)[1] and are Volvo's minimum demands to be fulfilled by the personnel and transporters handling Volvo cargo.

Please note that these requirements do not in any way supersede regulations stipulated by various authorities. Where required by local legislation, national or regional regulations or standards shall also be complied with, in addition to these requirements. Some of the standards and regulations that may be applicable, as available on the date of publication of this document, are listed in Appendix 3 for information purposes.

In case of air transports, each air line operator has their own requirements, which must be complied with.

1.1 National and regional standards

Below national and regional standards are given for road, rail and sea transport respectively.

Road

Sweden
- TSVFS 1978:10, Föreskrifter om säkring av last på fordon under färd
- VVFS 1998:95, Föreskrifter om ändring i föreskrifterna (TSVFS 1978:10) (TFK 1998:2 Kap 5)

Finland
- Förordning om användning av fordon på väg, 1992-12-04

[1] IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code); final draft of Group of Experts, 2014-01-31

Norway - Bestemmelser om kjøretøj – Sikring av last, 1988-06-30

Great Britain - Code of Practice – Safety of Loads on Vehicles, May 2002

Germany - 22 StVO (Road Traffic Regulations)

Belgium - Federale Overheidsienst Mobilteit en Vervoer – cross-reference to EU Best Practice Guidelines

Luxemburg - Code de la Rutes, ver 6 maj 2010 – cross-reference EN 12195-1

Czech Republic - Cross-reference EN 12195-1

EU - EU Best Practice Guidelines on Cargo Securing for Road Transport, May 2006
(under revision 2014)
The EU Directive (2014/47/EU) about the technical roadside inspection of the roadworthiness of commercial vehicles came into force in May 2014. Member countries must implement it into their national legislation within 36 months. Until then, the EU Best Practice Guidelines may be used. In these guidelines there are cross-references both to the European standard EN 12195-1 and to the IMO Guidelines.

http://bookshop.europa.eu/is-bin/INTERSHOP.enfinity/WFS/EU-Bookshop-Site/en_GB/-/EUR/ViewPublication-Start?PublicationKey=KO7606419

North America - North American Cargo Securement Standard, September 2010

Australia - National Road Commission – Load restrain Guide, 2nd edition 2004

New Zeeland - Truck Loading Code, 2010

Railway

Europe - Based on cargo securing guidelines by the International Union of Railways (UIC).

North America - AAR Regulations

Australia - ARA Regulations

Sea

International – IMO

- IMO/ILO/UN ECE Guidelines for Packing of Cargo Transport Units (under revision 2014 to IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code))
- IMO Model course 3.18

Sweden - TSFS 2010:174, Transportstyrelsens föreskrifter och allmänna råd om transport av last
  - IMO/ILO/UN ECE Guidelines for Packing of Cargo Transport Units
  - IMO Quick Lashing Guides
  - TYA Quick lashing Guides, *www.tya.se*, *www.mariterm.se*

Booklet ***www.containerhandbuch.de***

Below a small compilation of the details regarding cargo securing of some of the regulations for road mentioned above is shown.

	Friction	Securing requirements	Acceleration factors for road transport (in parts of gravity acceleration 1g = 9.81 m/s^2)	Safety factor	Deviation from securing regulations/ recommendations allowed
International (revised IMO/ILO/ UNECE Guidelines – CTU Code)	0.3/0.2/0.1 or actual	General	Forward: 0.8 g Rearward: 0.5 g Sideways: 0.5 g Vertical: -	Specified for top-over lashing only	Arrangements to be individually designed; by detailed calculations or according to the Quick Lashing Guide
Europe	Actual may be used	General	Forward: 0.8 g Rearward: 0.5 g Sideways: 0.5 g Vertical: -	Specified in standard EN 12195-1:2010	Yes, the system should be designed according to basic parameters
Sweden	0.2 or actual	Detailed	Forward: 1.0 g Rearward: 0.5 g Sideways: 0.5 g Vertical: -	Not specified	Yes, if certificate available showing that basic parameters are fulfilled
Germany	Actual may be used	General	Forward: 0.8 g Rearward: 0.5 g Sideways: 0.5 g Vertical: -	Not specified in VDI 2700 part 2	Arrangements should be designed according to VDI 2700 part 2
United Kingdom	Not specified	Detailed	Forward: 1.0 g Rearward: 0.5 g Sideways: 0.5 g Vertical: -	Not specified	Yes, if following all basic principles
North America	No values are specified	Min four lashings required	Forward: 0.8 g Rearward: 0.5 g Sideways: 0.5 g Vertical: 0.2 g	Not specified	Yes, as no detailed regulations exist
Australia	Actual or a conservative value	Detailed	Forward: 0.8 g Rearward: 0.5 g Sideways: 0.5 g Vertical: 0.2 g	Not specified	Yes, if following the basic accelerations and meeting the performance standards
New Zealand	Actual may be used	Detailed	Forward: 1.0 g Rearward: 0.5 g Sideways: 0.5 g Vertical: 0.2 g	Not specified	Yes, if loaded on a special purpose vehicle

2. General requirements

The cargo should always be loaded in a way that makes the unloading easy. Cargo handling symbols shall always be taken into consideration at the loading. Pallets and boxes must be loaded with the right side up, as indicated for example by arrow symbols.

Volvo cargo shall always be secured in accordance with applicable regulations as well as these requirements. Note that the sum of void spaces in any horizontal direction shall not exceed 15 cm.

2.1 Weather protection

When loading cargo it is important to make sure that the cargo is weather protected. It is also important to notice that the cargo can be affected by local weather conditions with various temperature, precipitation and humidity of the air.

The Cargo Transport Unit (CTU) should be closed in such a way that water can't come through during the transport. When it is an open CTU the cargo should be covered with plastic wrapping or a tarpaulin. Covering with plastic wrapping or walking boards can eliminate leakage from below.

It is important that the cargo in closed CTUs is protected not only from exposure to water but also from condense that may occur during transports through different climatic regions. Condense may cause rust and mould damages, it may weaken cardboard boxes and can cause important signs to fall off. Damages by condense can be eliminated by good ventilation or by the use of moist absorbers.

2.2 Checking of transport documents

The transport company is responsible for checking that the transport documents (consignment note) are corresponding with the loaded cargo. Changes in the transport documents are never to be done by the transport company.

2.3 Inspection of damages and loading of damaged cargo

The transport company shall inspect the cargo for damages prior to loading. Attention should be drawn to external damages, deformations, moisture etc. If damaged cargo are to be loaded, the damage should be noted in the transport documents or in a special damage report, issued by the shipper. The transport company shall never load damaged cargo if the damage hasn't been documented.

2.4 Damaged wrapping

It is not allowed to use damaged wrapping. The wrapping shall be in good condition without damaged corners, cracks or holes. Damaged or worn out wrapping must be changed. (See “Emballagehandbok Kvalitet, Februari 1995”. Volvo Logistics AB Wrapping administration).

2.5 Damage routines

According to SOP.

2.6 Stacking

In general, heavy cargo should never be loaded on top of light cargo or cargo packaged in corrugated cardboard or plastic boxes. Heavy cargo and light cargo should be secured separately, not together.

2.7 Load distribution and verified weight

Cargo shall be loaded and transported in such a way that neither the cargo transport unit, the carrying vehicle nor the infrastructure is overloaded. Thus, the following limitations shall be observed:

- Concentrated load restriction on platform floor
- Axle loads
- Vehicle gross weight

In ISO containers, the eccentricity of the cargoes combined centre of gravity shall not exceed 5% of the containers length or width. As a rule of thumb, this may be achieved by not loading more than 60% of the cargo weight in one half and not less than 40% in the other.

Furthermore, transport operators may request a verified gross weight of containers. This may be provided either by weighing the container after loading or by summarizing the tare

weight of the container, the weight of all cargo items as well as any additional securing or packing material used.

2.8 Collective consignment

Other consignor that has collective consignment with Volvo shall also have its cargo secured according to valid regulations as well as the instructions found herein.

3. Basic principles for cargo securing

In order to prevent accidents, injuries, cargo damages and delays, all cargoes shall be secured during transport so that they are prevented from **sliding** and **tipping** in all directions. When dimensioning cargo securing arrangements so that these movements are prevented, the following aspects shall be given due consideration:

- The mode of transport and the expected accelerations throughout the journey
- The weight of the cargo
- The friction between the cargo and the platform as well as between layers
- The cargo's dimensions and centre of gravity
- The rigidity of the cargo and the integrity of the packing material
- The strength of the cargo securing equipment
- The strength of the walls of the cargo transport unit

3.1 Forces acting on the cargo during transport

During transportation, the cargo and the CTU are exposed to forces, which, depending on the transport, differ in magnitude in different directions. In case of a combined transport, the most critical combinations of horizontal and vertical acceleration in each direction for any leg of the journey must be observed.

Cargo securing arrangements shall be designed to at least withstand the accelerations given for different modes of transport in the table below[2]. The accelerations in the table are expressed in parts of g (gravity acceleration: 1 g = 9.81 m/s^2).

[2] IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code); final draft of Group of Experts; 2014-01-31, Chapter 5.5

Road transport				
Securing in	**Acceleration coefficients**			
	Longitudinally (c_x)		Transversely (c_y)	Minimum vertically down (c_z)
	forward	rearward		
Longitudinal direction	0.8	0.5	-	1.0
Transverse direction	-	-	0.5	1.0

Rail transport (combined transport)				
Securing in	**Acceleration coefficients**			
	Longitudinally (c_x)		Transversely (c_y)	Minimum vertically down (c_z)
	forward	rearward		
Longitudinal direction	0.5 (1.0)†	0.5 (1.0)†	-	1.0 (0.7)†
Transverse direction	-	-	0.5	1.0 (0.7)†
† **The values in brackets apply to shock loads only with short impacts of 150 milliseconds or shorter, and may be used, for example, for the design of packaging.**				

Sea transport					
Significant wave height in sea area		**Securing in**	**Acceleration coefficients**		
			Longitudinally (c_x)	Transversely (c_y)	Minimum vertically down (c_z)
A	$H_s \leq 8$ m	Longitudinal direction	0.3	-	0.5
		Transverse direction	-	0.5	1.0
B	8 m < $H_s \leq 12$ m	Longitudinal direction	0.3	-	0.3
		Transverse direction	-	0.7	1.0
C	$H_s > 12$ m	Longitudinal direction	0.4	-	0.2
		Transverse direction	-	0.8	1.0

The different sea areas are defined according to the table below:

A	B	C
$H_s \leq 8$ m	8 m < $H_s \leq 12$ m	$H_s > 12$ m
Baltic Sea (incl. Kattegat) Mediterranean Sea Black Sea Red Sea Persian Gulf Coastal or inter-island voyages in following areas: Central Atlantic Ocean (between 30°N and 35°S) Central Indian Ocean (down to 35°S) Central Pacific Ocean (between 30°N and 35°S)	North Sea Skagerak English Channel Sea of Japan Sea of Okhotsk Coastal or inter-island voyages in following areas: South-Central Atlantic Ocean (between 35°S and 40°S) South-Central Indian Ocean (between 35°S and 40°S) South-Central Pacific Ocean (between 35°S and 45°S)	unrestricted

3.2 Friction

Good friction helps preventing the cargo from sliding and reduces the demand for other cargo securing measures. Thus, in order to achieve as high friction factor as possible, the following measures should, when practicable, be taken:

- Keep the platform dry and clean
- Avoid snow and ice on platform and cargo
- Avoid steel to steel contact surfaces
- Use, where feasible, friction enhancing material such as friction boards or rubber mats

Friction factors for different material combinations may be taken from the table below[3].

Material combination in contact surface	Dry	Wet
SAWN TIMBER/WOODEN PALLET		
Sawn timber/wooden pallet against fabric base laminate/plywood	0.45	0.45
Sawn timber/wooden pallet against grooved aluminium	0.4	0.4
Sawn timber/wooden pallet against stainless steel sheet	0.3	0.3
Sawn timber/wooden pallet against shrink film	0.3	0.3
PLANED WOOD		
Planed wood against fabric base laminate/plywood	0.3	0.3
Planed wood against grooved aluminium	0.25	0.25
Planed wood against stainless steel sheet	0.2	0.2
PLASTIC PALLETS		
Plastic pallet against fabric base laminates/plywood	0.2	0.2
Plastic pallet against grooved aluminium	0.15	0.15
Plastic pallet against stainless steel sheet	0.15	0.15
CARDBOARD (UNTREATED)		
Cardboard against cardboard	0.5	-
Cardboard against wooden pallet	0.5	-

[3] IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code); final draft of Group of Experts, 2014-01-31, Annex 2 – Appendix 2

STEEL AND SHEET METAL		
Unpainted metal with rough surface against unpainted rough metal	0.4	-
Painted metal with rough surface against painted rough metal	0.3	-
Painted metal with smooth surface against painted smooth metal	0.2	-
Metal with smooth surface against metal with smooth surface	0.2	
STEEL CRATES		
Steel crate against fabric based laminate/plywood	0.45	0.45
Steel crate against grooved aluminium	0.3	0.3
Steel crate against stainless steel sheet	0.2	0.2
ANTI-SLIP MATERIAL		
Rubber against other materials when contact surfaces are clean	0.6	0.6
Materials other than rubber against other materials	as certified or tested according to appendix 3	

Friction factors (μ) should be applicable to the actual conditions of transport. When a combination of contact surfaces is missing in the table above or if its friction factor cannot be verified in another way, the maximum allowable friction factor of 0.3 should be used. If the surface contacts are not swept clean, the maximum allowable friction factor of 0.3 or, when lower, the value in the table should be used. If the surface contacts are not free from frost, ice and snow a static friction factor of 0.2 should be used, unless the table shows a lower value. For oily and greasy surfaces or when slip sheets have been used a friction factor of 0.1 applies.

3.3 Cargo dimensions and centre of gravity

In order to avoid tipping, the dimensions of the cargo as well as it's centre of gravity must be considered when deciding on the cargo securing method. High and narrow stows of cargo is more sensitive to tipping than low and wide ones.

Also, cargoes of irregular shape must be specially considered, since those may have a centre of gravity which is displaced towards the top or either side or a narrow base and therefore have an increased risk of tipping.

4. Cargo securing methods

Cargo is to be secured by blocking, lashing or mechanical locking or by a combination of these methods, in such a way that it is sufficiently prevented from sliding and tipping in all directions.

4.1 Blocking

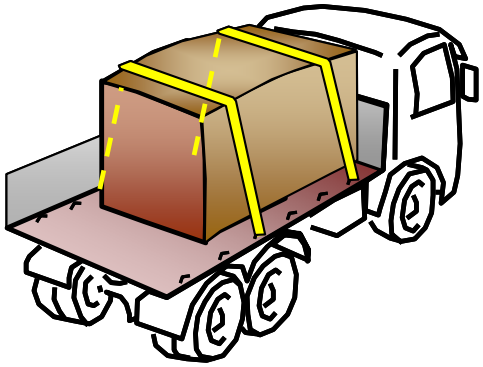
Blocking is the primary method for securing cargoes and it is achieved by placing cargo in tight stows between strong walls of the cargo transport unit, stanchions or other blocking devices. If the cargo is blocked at the bottom only, it is prevented from sliding but not tipping. As rules of thumb, bottom blocking devices should cover a height of at least 5 cm of the cargo. If the blocking device reaches up to the cargo's centre of gravity, the cargo is also secured against tipping.

In the case of form locking, void spaces should be filled and may be favourably stuffed by dunnage bags, empty pallets inserted vertically or battens as necessary. Small gaps between unit loads and similar cargo items, which cannot be avoided and which are necessary for the smooth loading and unloading of the goods, are acceptable and need not to be filled. **The sum of void spaces in any horizontal direction shall not exceed 15 cm**[4]. However, between fragile cargoes or dense and rigid cargo items, such as steel, concrete or stone, void spaces should be further minimized, as far as possible.

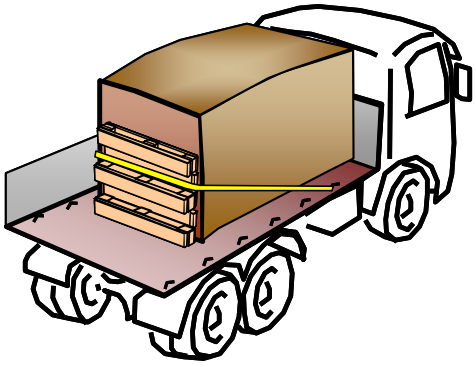
In case cargo is intended to be blocked against walls of road vehicles, these shall have a documented strength. This is extra important to observe for curtainsided vehicles.

4.2 Lashing

Cargo may be secured by several different lashing methods, as shown in the examples in the figures below.

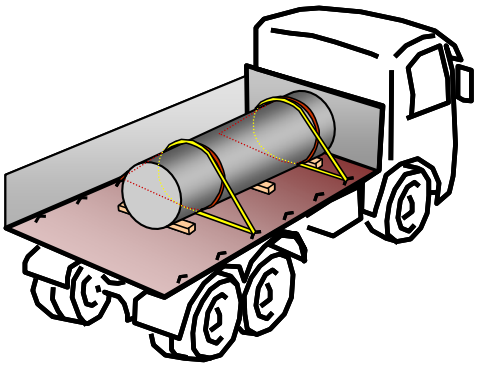


Top-over lashing

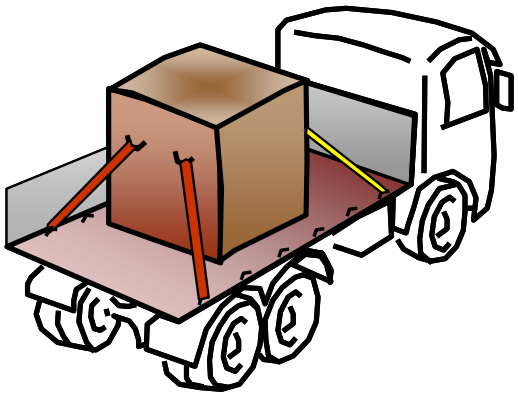


Spring lashing

[4] IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code); final draft of Group of Experts, 2014-01-31, Annex 7 Section 2.3.6



Loop lashing



Straight lashing

It must be noted that top-over lashing is a frictional lashing method which is designed to increase the pressure between the cargo and the platform, whereas the other methods are direct lashings. Top-over lashings utilize the pre-tension in the equipment achieved by the tensioning device. The other methods on the other hand, make full use of the safe working load in the lashings, since they are further tightened if the cargo begins to move.

4.3 Locking

Cargo securing by mechanical locking requires that both the cargo and the CTU have locking devices that are strong enough and suitable for each other. The locking devices must be able to withstand the forces on the cargo that results from the accelerations given in chapter 3.1. Consideration shall be given to the fact that due to the tolerances between the fittings and the locking device, not all devices are engaged simultaneously. For example, if four locking devices are used only two may be considered to take up any forces simultaneously in any direction.

5. Cargo securing equipment

When securing Volvo cargo, only cargo securing equipment of known strength and quality may be used. All equipment shall be in good, fully working condition and inspected prior to use.

Care shall be taken not to combine, in an inappropriate way, lashing equipment with different strength and elongation characteristics on the same cargo unit. Furthermore, the equipment may not be applied in such a way that it damages the cargo.

The strength of cargo securing equipment may be expressed in various ways, depending on the manufacturer and the country of origin, as shown in the table below.

Strength	Explanation	Common denominations
Breaking strength	The load at which new, unused equipment of that kind may break at testing	**BL** - Breaking Load **MBL** - Minimum Break Load **BS** - Breaking Strength
Safe working load	The load to which the equipment may safely be subjected when applied	**LC** - Lashing Capacity **MSL** - Minimum Securing Load **SWL** - Safe Working Load **WLL** –Working Load Limit
Pre-tension	The tension achieved in a lashing when applying normal hand force to the tensioning device or by applying a powered tensioning device according to suppliers instruction	**STF** - Standard Tension Force

When unknown, the MSL, i.e. the safe working load, may be determined from the equipment's breaking strength load according to the following table:[5]

Material	MSL
shackles, rings, deck eyes, turnbuckles of mild steel	50% of breaking strength
fibre ropes	33% of breaking strength
web lashings (single use)	75% of breaking strength[a]
web lashings (reusable)	50% of breaking strength
wire ropes (single use)	80% of breaking strength
wire ropes (reusable)	30% of breaking strength
steel band (single use)	70% of breaking strength[b]
chains	50% of breaking strength

[a] *Maximum allowed elongation 9% at MSL.*
[b] *It is recommended to use 50%.*

The transport company should provide all cargo securing equipment necessary, unless otherwise agreed.

5.1 Web lashings

Web lashings are produced in a great variety of material, dimensions and strengths. Both single use and re-usable equipment is available. Lashings intended for single use are delivered with a detachable tensioning device and loose hooks and locking devices. They are most commonly used in containers and on flat racks.

Lashings intended for re-use are delivered as a complete set and this equipment is the most common on trucks and trailers. When securing Volvo cargo with re-usable equipment, all lashings shall be in good condition and show limited wear only, without any significant tears,

[5] IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code); final draft of Group of Experts, 2014-01-31, Annex 7, section 2.4.2

clear cut marks or severe discoloration. Knots may not be used to fasten or repair re-usable lashings.

Lashing shall be applied and, where possible, checked during the voyage in such a way that it is ensured that they remain well tightened throughout the transport. Web lashings must be protected from sharp corners.

5.2 Chain lashings

Chain lashings are typically used for securing vehicles and heavy machinery. The lashing fittings to which the chain is fastened must have at least the same strength as the chain itself.

Just as web lashings, chain lashings come in a variety of dimensions and sizes. Their strength is decided by the link diameter and the steel grade. Chain lashings may be tightened either with a turn buckle or a lever arm.

Chain with lever arm tensioner

Chain with turn buckle

Short linked chains are heavier per meter but are useful if the lashing have to pass over a sharp corner since the short links bend less easily than those on a long linked chain.

Broken links due to bending over at sharp corners

Before use, chain lashings used to secure Volvo cargo shall be inspected for any visible damages that may weaken the lashing, such as bent links, deformed hooks or significant link wear. Any deficiencies found should result in the lashing being rejected.

Lashing shall be applied and, where possible, checked during the voyage in such a way that it is ensured that they remain well tightened throughout the transport. Where short and vertical chain lashings are used on machinery fitted with rubber tyres, shock absorbers may be used to reduce of the effect of sudden jerks and thereby limit the risk of the chains snapping off.

5.3 Corner protectors

Corner protections are typically made of rigid plastic, plastic-coated cardboard or light metal and they shall be used to perform any of the following functions:

- To protect the lashings from sharp corners
- To protect fragile cargo from being damaged by the lashings
- To spread out the effect of the lashings over several cargo sections

In case corner protectors are used to protect the cargo they should rest against a sufficiently large area on the cargo. The weaker the cargo, the bigger area is needed. An empty pallet turned upside down may be used to the same effect.

When corner protectors are used to spread the effect of the lashing over several cargoes, they must be made of strong plastic profiles or wooden boards (25x100 mm) nailed together.

5.4 Dunnage bags

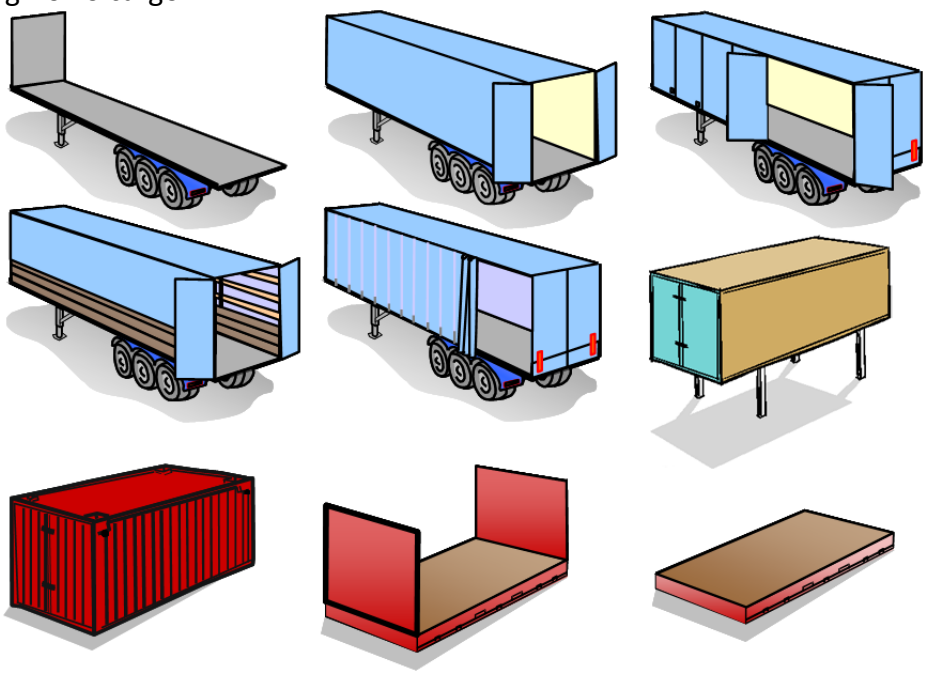
Dunnage bags may be used to fill out gaps between cargo units and ensure a tight stow to immobilize the cargo in cargo transport units with strong walls. The size and strength of the dunnage bag should be chosen in consultation with the supplier.

The supplier's instructions shall also be observed to ensure correct filling pressure. If the pressure is too low the bag might fall down and if it is too high the bag may burst or it may damage the cargo or cargo transport unit.

Dunnage bags are sensitive to sharp edges and must be protected from these by means of thick cardboard or wooden boards.

6. Cargo transport units

Below are shown some different types of vehicles and CTUs that could be used when transporting Volvo cargo.



Different types of vehicles and CTUs

The transport operator shall provide a CTU that:

- Is in good condition
- Is suitable for the intended voyage
- Is suitable for the cargo and weather proof when so required
- Provides suitable access to the cargo for loading and unloading
- Has a floor which is strong enough to support the cargo and any equipment needed to load or unload the cargo
- Provides suitable means of securing the cargo
- Have sufficiently strong walls with a documented strength if it is intended to use these to block the cargo any direction.

6.1 Inspection of CTUs

The CTU shall be checked before the loading of the goods is started. The check is performed according to the checklists in Appendix 2 and 3 and errors or deficiencies are noted. When anything is unclear the person responsible at the shipping department shall be consulted for decision on whether the CTU can be accepted, has to be rectified or refused. If the CTU is refused the transport company has to be informed accordingly.

In general, the CTU shall be in good condition and have functioning cargo securing gear. The cargo space shall be clean and free from fixed or loose protruding details that can damage the cargo.

Closed CTUs must be sufficiently weatherproof to minimize the risk of damaging the cargo.

6.2 Requirements on swap bodies, trailers and other vehicles

- The CTU shall have an undamaged platform, landing legs and headboard.
- The CTU shall be weatherproof and it shall be possible to close and seal it, which means that drop sides, tarpaulins, laths and tarpaulin sealings shall be undamaged.
- Any structure used for blocking of the cargo shall have sufficient strength[6].
- The cargo area including the platform shall be undamaged.
- The cargo area shall be clean, dry and free from odour.
- The load carrier shall be equipped with sufficient amount of cargo securing equipment.
- Securing points intended for internal securing of the goods shall be sufficiently strong for the intended lashing equipment.
- In case of sea transport, trailers shall be equipped with required amount of 12-tons external securing fittings for the securing of the unit in ferry traffic.

  Minimum amount of ferry eyes per trailer side:
  total weight up to 20 ton - 2 pcs
  total weight between 20 and 30 ton - 3 pcs
  total weight between 30 and 40 ton - 4 pcs

- Corner castings and other bottom fittings on swap bodies shall be undamaged.
- Invalid labels shall be removed or masked.
- CTU, which shall be transported by rail, shall be marked with the required code sign.
- CTU, which shall be transported by rail, shall fulfil the requirements from the rail administrations and/or rail operator regarding the strength of the stake body structure.

6.3 Requirements on containers

- The container shall be of type 1AA or 1CC and fulfil standard ISO 1496 for containers.
- The frame work of the container shall be undamaged.
- The container shall be weather tight and it shall be possible to seal it when closed. This means that walls, floor, roof, doors, door sealing as well as possible tarpaulin cover with sealing shall be undamaged.
- The cargo area including the floor shall be undamaged.
- The cargo area shall be clean, dry and free from odour.
- Ventilation openings shall be undamaged.
- Corner castings shall be undamaged.
- The container shall be marked with safety plate in accordance with the Container Safe Convention (CSC).
- Invalid labels shall be removed or masked.

[6] For European transport, the strength of headboard, drop sides and rear wall should fulfil the European standards CEN 283, CEN 12642 L or CEN 12642 XL. Curtainsiders shall be built and marked according to CEN 12642 XL.

7. Dangerous goods

Each mode of transport has its own regulation for transport of dangerous goods (DG). While some of the DG regulations are for a certain region, e.g. ADR for road transport in Europe, others are global like the IMDG Code for sea transport. The transport operator shall follow the DG regulations valid for the actual transport.

However, the basic requirements for cargo securing of dangerous goods are more or less the same in the different DG regulations, see example below from the IMDG Code[7]:

"Packages containing dangerous goods and unpackaged dangerous articles shall be secured by suitable means capable of restraining the goods (such as fastening straps, sliding slatboards, adjustable brackets) in the cargo transport unit in a manner that will prevent any movement during transport which would change the orientation of the packages or cause them to be damaged…"

In the different DG regulations there are references to different standards or guidelines to further explain *"Suitable means"* in the text above.

When dangerous goods are packed or loaded into any container or vehicle for a sea transport, those responsible for packing the container or vehicle shall provide a CPC (Container/Vehicle Packing Certificate) specifying the container/vehicle identification number(s) and certifying that the operation has been carried out in accordance with the conditions in section 5.4.2 in the IMDG Code. One of the points in section 5.4.2.1 is regarding cargo securing:

".4 Drums have been stowed in an upright position, unless otherwise authorized by the competent authority, and all goods have been properly loaded and, where necessary, adequately braced with securing material to suit the mode(s)† of transport for the intended journey.

† See IMO/ILO/UNECE Guidelines for packing of cargo transport units."

All personnel involved in handling or transporting dangerous goods shall have proper training according to applicable DG regulations.

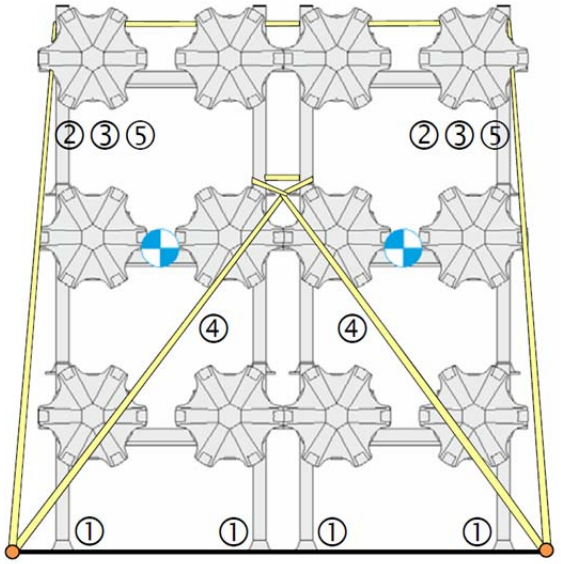
[7] IMDG Code Amdt 36-12; Section7.3.3.6

Appendix 1 – Instructions for cargo securing of Volvo cargo

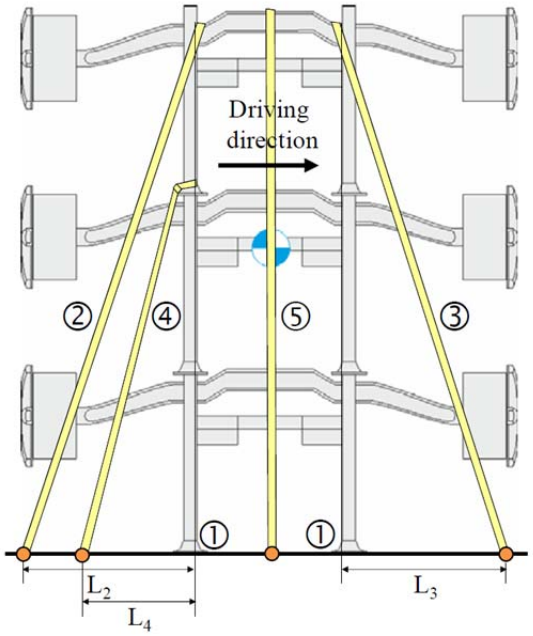
VOLVO MERITOR | Road / Sea area B | Date: 12.1.2012 | Page: 1 (2)

CARGO SECURING CERTIFICATE

Securing of front axle racks from Meritor HVS AB loaded on vehicles for road and North Sea (sea area B) transport.



Rear view of the section



Side view of the section

Each section of rear axle racks, stacked three high and with max weight 7.0 ton, is to be secured as follows:

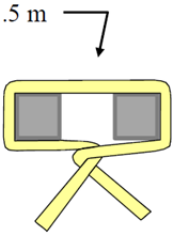
① Friction-enhancing material between the racks and the platform of type Lanocatch

② One spring lashing to prevent movements in forward direction, permissible interval L_2 = 1.0 – 2.0 m

③ One spring lashing to prevent movements in rearward direction, permissible interval L_3 = 1.0 – 2.0 m

④ One spring snare to prevent movements in forward direction, permissible interval L_4 = 0.5 – 1.5 m

⑤ One top-over lashing



L_2 – L_4 are the distances between the lashing point on the platform and the projected point, laterally at a right angle towards the edge of the platform from the lashing point on the racks.

Additional instructions are found on page 2.

The accuracy of the dimensioning data is hereby certified.

LINDESBERG, SWEDEN, 12.1.2012

Meritor HVS AB

Christer Edvardsson
P.O. Box 90, SE-711 22 Lindesberg
Phone: +46 581 84 355
E-mail: christer.edvardsson@meritor.com

This certifies that the securing methods in this certificate meet the Swedish Transport Agency's requirements for road TSVFS 1978:10 and for sea TSFS 2010:174, the principles in the IMO Model Course 3.18 and the standard EN 12195-1 (2010) for road transport.

HÖGANÄS, SWEDEN, 12.1.2012

MariTerm AB

Peter Andersson
P.O. Box 74, SE-263 21 Höganäs
Phone: +46 42 33 31 00
E-mail: peter.andersson@mariterm.se

This certificate for front axle racks is valid when the following conditions are met:

Design acceleration data

- Racks and axles are subjected to max accelerations of; 1.0 g forward, 0.7 g sideways and 0.5 g rearward.
- The above accelerations are acting individually and are combined with 1 g downward.

Front axle racks

- The axle racks from Meritor have the following dimensions: L × B × H = 900 × 1140 × 885 mm.
- Each rack is loaded with maximum two front axles.
- The total weight per section (two stacks with maximum three racks per stack) is maximum 7000 kg.
- The center of gravity for the stack is located maximum 1.425 meter above the platform and in the center of the stack sideways and in longitudinal direction.
- The axles are secured to the racks to withstand the above accelerations.

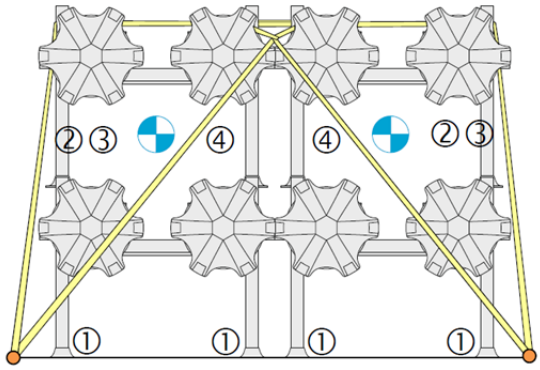
Vehicle and stowage

- The vehicle platform floor is made of wood or plyfa and is clean, dry and free from frost, ice and snow.
- Friction-enhancing material ① of type Lanocatch is placed between the rack and the platform.
- The static coefficient of friction between the rack and the friction-enhancing material is at least 0.59 in accordance with performed practical tests documented in the report "Documentation of practical tests with front and rear axles in racks from Meritor HVS AB, 13.12.2011". During these tests the lashing arrangement according to this certificate was also tested.

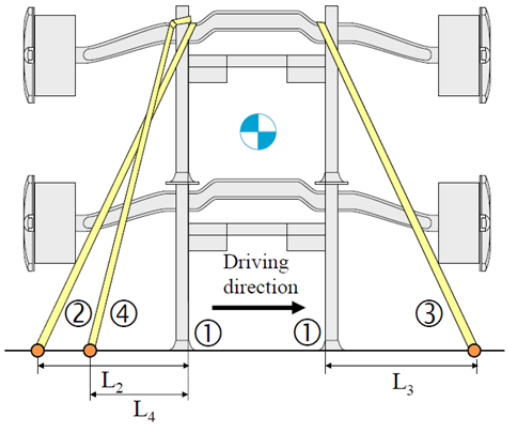
Lashing arrangement

- The lashings are pre-tensioned to at least 400 daN (400 kg) during the entire voyage.
- The lashings have a lashing capacity, LC, of at least 1600 daN (1.6 ton) and MSL is 50 % of the breaking strength, at least 2000 daN (2 ton).
- The lashing points on the vehicle have a lashing capacity of at least 2000 daN (2 ton).
- Lashings in the same direction are placed in different lashing points on the vehicle. Lashings drawn in opposite directions may be placed in the same lashing point on the vehicle.
- The lashings are protected from sharp edges and corners.

Front axle racks stacked two high only is secured in the same way as racks stacked three high:



Rear view of the section



Side view of the section

① Friction-enhancing material between the racks and the platform of type Lanocatch

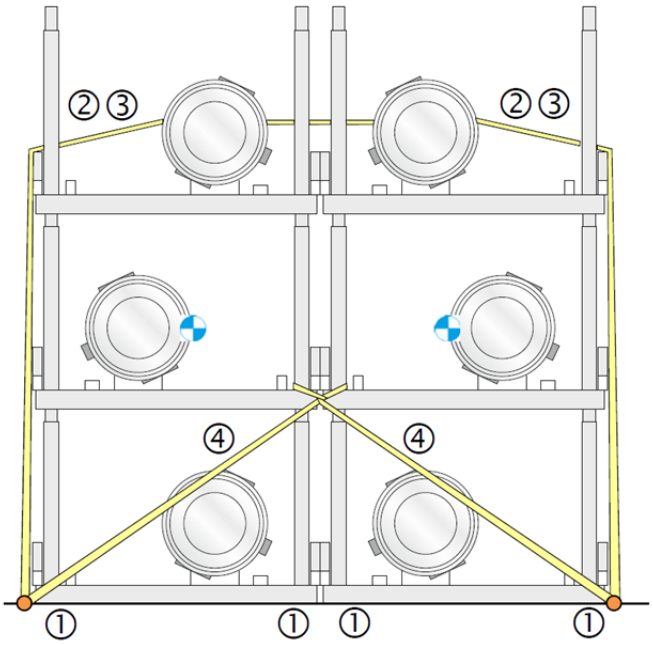
② One spring lashing to prevent movements in forward direction, permissible interval L_2 = 1.0 – 2.0 m

③ One spring lashing to prevent movements in rearward direction, permissible interval L_3 = 1.0 – 2.0 m

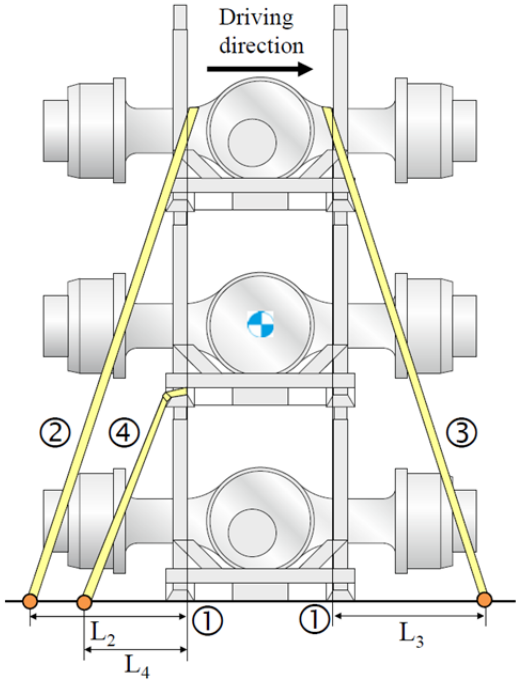
④ One spring snare to prevent movements in forward direction, permissible interval L_4 = 0.5 – 1.5 m

CARGO SECURING CERTIFICATE

Securing of rear axle racks from Meritor HVS AB loaded on vehicles for road and North Sea (sea area B) transport.



Rear view of the section



Side view of the section

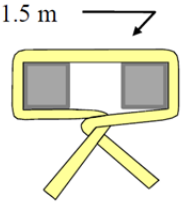
Each section of rear axle racks, stacked three high and with max weight 7.0 ton, is to be secured as follows:

① Friction-enhancing material between the racks and the platform of type Lanocatch

② One spring lashing to prevent movements in forward direction, permissible interval L_2 = 1.0 – 2.0 m

③ One spring lashing to prevent movements in rearward direction, permissible interval L_3 = 1.0 – 2.0 m

④ One spring snare to prevent movements in forward direction, permissible interval L_4 = 0.5 – 1.5 m



L_2 – L_4 are the distances between the lashing point on the platform and the projected point, laterally at a right angle towards the edge of the platform from the lashing point on the racks.

Additional instructions are found on page 2.

The accuracy of the dimensioning data is hereby certified.

LINDESBERG, SWEDEN, 12.1.2012

Meritor HVS AB

Christer Edvardsson
P.O. Box 90, SE-711 22 Lindesberg
Phone: +46 581 84 355
E-mail: christer.edvardsson@meritor.com

This certifies that the securing methods in this certificate meet the Swedish Transport Agency's requirements for road TSVFS 1978:10 and for sea TSFS 2010:174, the principles in the IMO Model Course 3.18 and the standard EN 12195-1 (2010) for road transport.

HÖGANÄS, SWEDEN, 12.1.2012

MariTerm AB

Peter Andersson
P.O. Box 74, SE-263 21 Höganäs
Phone: +46 42 33 31 00
E-mail: peter.andersson@mariterm.se

This certificate for rear axle racks is valid when the following conditions are met:

Design acceleration data

- Racks and axles are subjected to max accelerations of; 1.0 g forward, 0.7 g sideways and 0.5 g rearward.
- The above accelerations are acting individually and are combined with 1 g downward.

Rear axle racks

- The racks with axles from Meritor have the following dimensions: L × B × H = 800 × 1172 × 868 mm.
- Each rack is loaded with maximum one rear axle.
- The total weight per section (two stacks with maximum three racks per stack) is maximum 7000 kg.
- The center of gravity for the stack is located maximum 1.0 meter above the platform, on half of the length of the rack and not dislocated sideways more than 0.16 m from the center of the stack.
- The axles are secured to the racks to withstand the above accelerations.

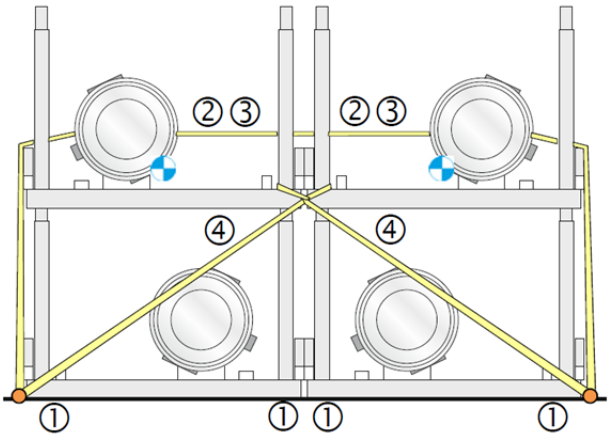
Vehicle and stowage

- The vehicle platform floor is made of wood or plyfa and is clean, dry and free from frost, ice and snow.
- Friction-enhancing material ① of type Lanocatch is placed between the rack and the platform.
- The static coefficient of friction between the rack and the friction-enhancing material is at least 0.59 in accordance with performed practical tests documented in the report "Documentation of practical tests with front and rear axles in racks from Meritor HVS AB, 13.12.2011". During these tests the lashing arrangement according to this certificate was also tested.

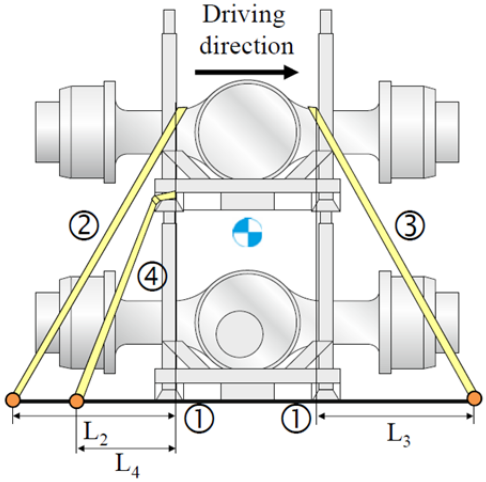
Lashing arrangement

- The lashings are pre-tensioned to at least 400 daN (400 kg) during the entire voyage.
- The lashings have a lashing capacity, LC, of at least 1600 daN (1.6 ton) and MSL is 50 % of the breaking strength, at least 2000 daN (2 ton).
- The lashing points on the vehicle have a lashing capacity of at least 2000 daN (2 ton).
- Lashings in the same direction are placed in different lashing points on the vehicle. Lashings drawn in opposite directions may be placed in the same lashing point on the vehicle.
- The lashings are protected from sharp edges and corners.

Rear axle racks stacked two high only is secured in the same way as racks stacked three high:



Rear view of the section



Side view of the section

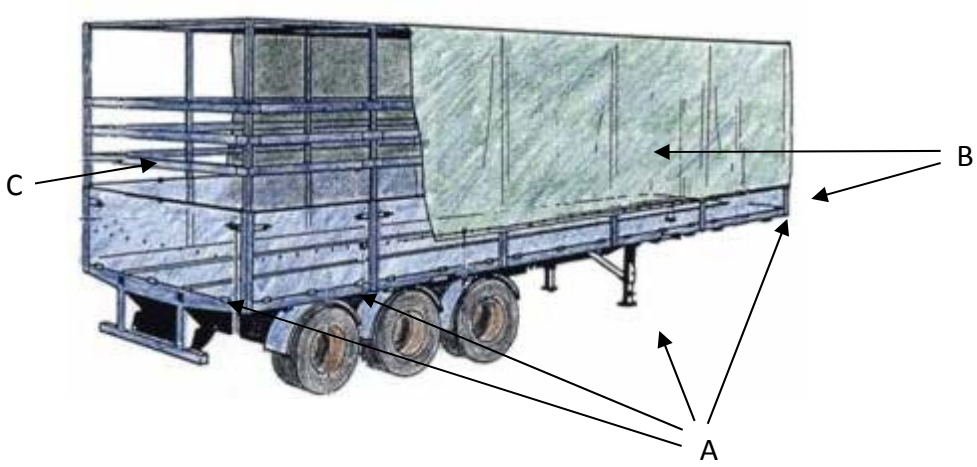
① Friction-enhancing material between the racks and the platform of type Lanocatch

② One spring lashing to prevent movements in forward direction, permissible interval L_2 = 1.0 – 2.0 m

③ One spring lashing to prevent movements in rearward direction, permissible interval L_3 = 1.0 – 2.0 m

④ One spring snare to prevent movements in forward direction, permissible interval L_4 = 0.5 – 1.5 m

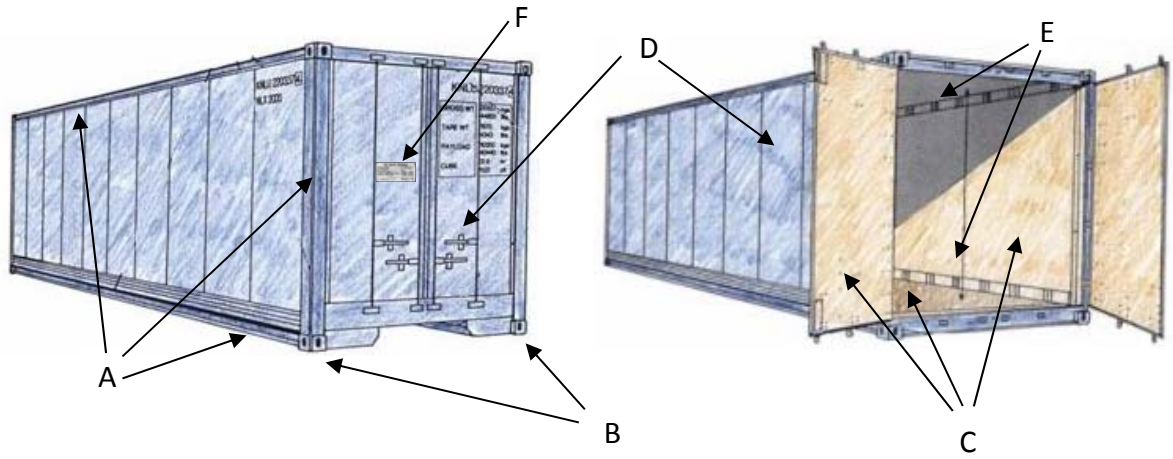
Appendix 2 – Checklist for inspection of trailers and swap bodies



CHECKLIST TRAILERS AND SWAP BODIES		YES	NO	COMMENTS
1	Are the platform, landing legs, the head board, alongside and crossways beams undamaged? (A)			
2	Are sideboards, cover laths, canopy, canopy seal and possible centre and side stanchions undamaged and complete? (B and C)			
3	Is the CTU weatherproof?			
4	Is the cargo area undamaged?			
5	Is the cargo area clean, dry and free from residue and odour?			
6	Does the CTU have functioning and undamaged cargo securing equipment?			
7	Is the CTU equipped with unbroken internal lashing points for securing of cargo?			
8	Does the CTU have enough numbers of unbroken external lashing points?			
9	Are the corner castings on the swap body undamaged?			
10	Are there pockets for dangerous goods labels? Are non-actual labels removed or masked?			
EXTRA CHECK POINTS FOR TRANSPORT BY RAILWAY				
11	Is there a UIC code number plate?			
12	Are the TIR-line and the sealing line correctly applied?			
13	Does the lock for the landing legs function and is the canopy unsplit?			

Date _____ **Number of CTU** _____ **Sign** _____

Appendix 3 – Checklist for inspection of containers



CHECKLIST CONTAINERS		YES	NO	COMMENTS
1	Is the framework undamaged? (A)			
2	Are the corner castings undamaged? (B)			
3	Are the walls, floor, roof, doors, door sealing's and possible canopy and canopy seal undamaged? (C)			
4	Is the CTU weatherproof?			
5	Are the doors possible to close and are the packing's unbroken and soft? (D)			
6	Is the cargo area undamaged?			
7	Is the cargo area clean, dry and free from residue and odour from previous cargoes?			
8	Are the ventilation devices open and undamaged?			
9	Is the CTU equipped with undamaged and functioning lashing points? (E)			
10	Is the container marked with a safety approved plate, CSC? (F)			
11	Are non-actual labels removed and marked?			

Date _____ Number of CTU _____ Sign _____

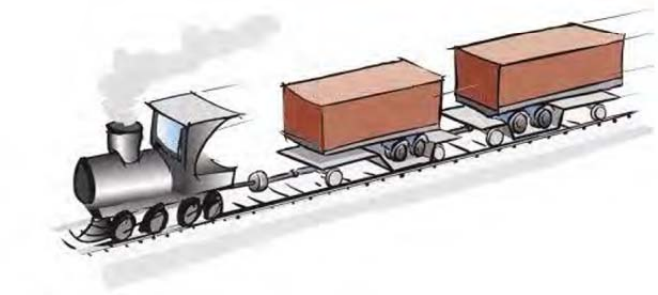
Appendix 4 – Quick Lashing Guide

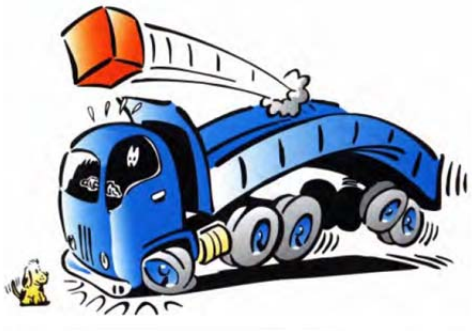
Quick Lashing Guide	Road, Combined Rail and Sea Area A, B & C

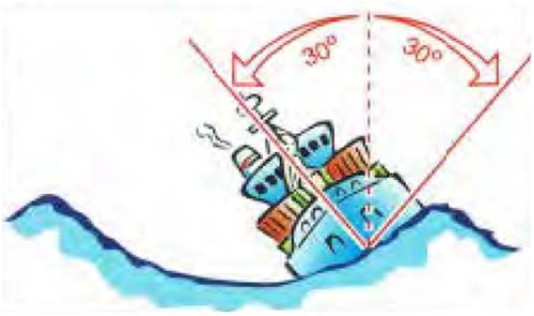
Informative material 5

QUICK LASHING GUIDE

Cargo securing on CTUs for transports on Road, Combined Rail and in Sea Area A, B & C







CONTENT

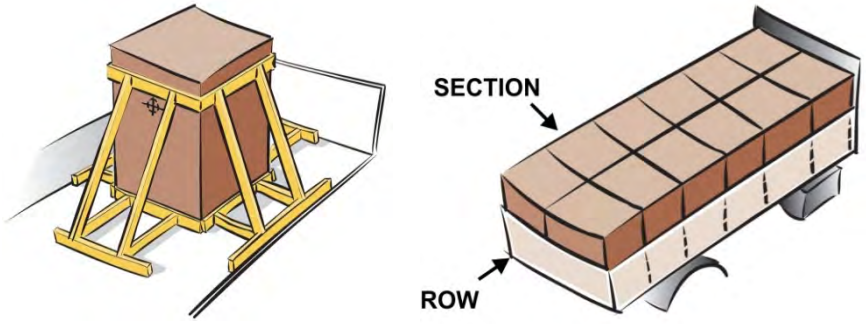
CARGO SECURING METHODS

Goods shall be prevented from sliding and tipping in forward, backward and sideways directions by locking, blocking, lashing or a combination of these methods.

Blocking and Bracing

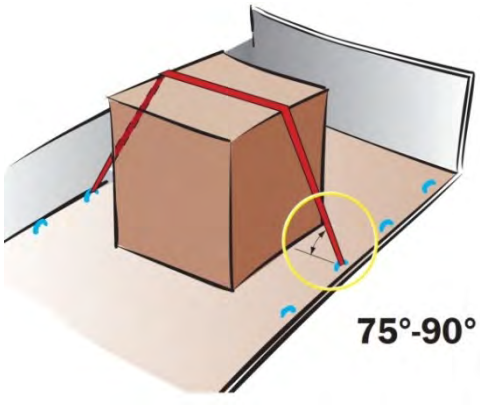
Blocking means that the cargo is stowed against fixed blocking structures and fixtures on the CTU. Clumps, wedges, dunnage, stanchions, inflatable dunnage bags and other devices which are supported directly or indirectly by fixed blocking structures are also considered as blocking.

Blocking is primarily a method to prevent the cargo from sliding, but if the blocking reaches high enough, it also prevents tipping. Blocking is the primary method for cargo securing and should be used as far as possible.



The sum of void spaces in any direction should not exceed 15 cm. However, between dense rigid cargo items, such as steel, concrete or stone, the void spaces should be further minimized, as far as possible.

Top-over lashing

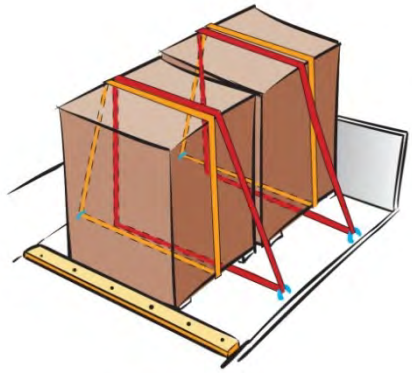


When using the tables for top-over lashing the angle between the lashing and the platform bed is of great importance. The tables are valid for an angle between 75° - 90°. If the angle is between 30° - 75° twice the number of lashings are needed (alternatively the table values are halved). If the angle is less than 30°, another cargo securing method should be used.

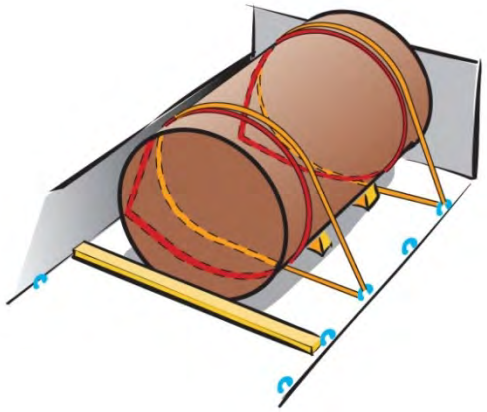
Top-over lashings preventing tipping forward **and** backward should be placed symmetrically on the cargo.

Half loop lashing

A pair of half loop lashings prevents cargo from sliding and tipping sideways. Minimum one pair of half loop lashings per section should be used.

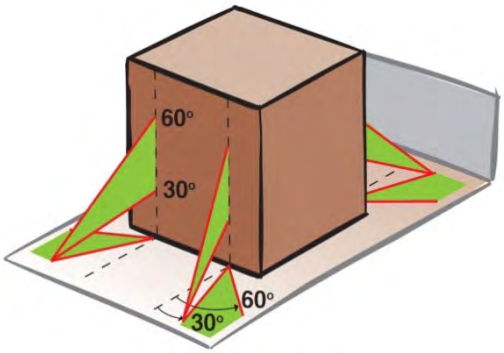


For tipping half the MSL value is to be used for design purposes.



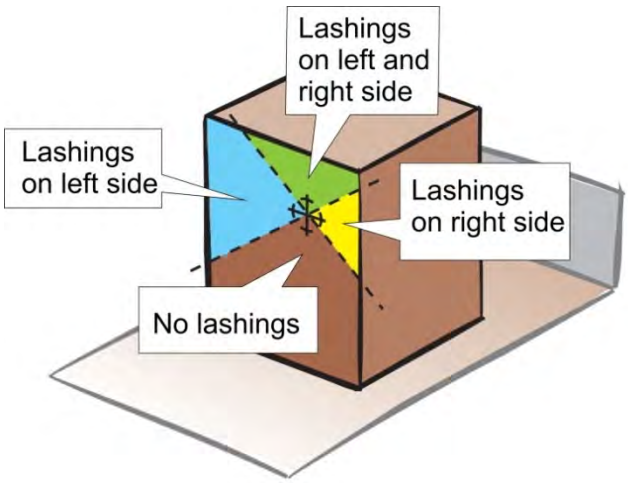
When long cargo units are secured with half loop lashings, at least two pairs should be used to prevent the cargo from twisting.

Straight lashing



The tables are valid for an angle of 30° - 60° between the lashing and the platform bed.

Sideways and lengthways the lashing angle should also lie between 30° - 60°.



The allowable areas for fixing the lashings on the cargo unit are bounded by straight lines (one for each side), drawn through the centre of gravity in an angle of 45°.

When the lashings are fixed above the centre of gravity, the unit may also have to be blocked in the bottom to prevent sliding.

Spring lashing

A spring lashing is used to prevent cargo from sliding and tipping forward or backward.

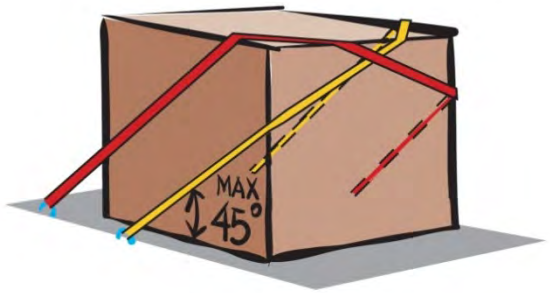
The values in the tables for spring lashings are valid when the diagonal parts of the lashing are close to parallel to the long sides of the CTU

The angle between the lashing and the platform bed should be maximum 45°.

There are a number of ways to apply spring lashings, as illustrated below.

A.

B.



C.

Observe:

- Alternative A is not fully effective for tipping avoidance.
- Alternative C has two parts per side and thus secures twice the cargo mass given in the lashing tables.

If the spring lashing doesn't act on the top of the cargo the mass prevented from tipping is decreased. E.g. if the spring lashing acts at half the cargo height, it secures half the cargo mass given in the tipping tables.

For cargo units with the centre of gravity above their half height, the table values for tipping should be halved.

To prevent tipping, the spring lashing needs to be dimensioned for the mass of the outer section only.

BASIC CARGO SECURING REQUIREMENTS

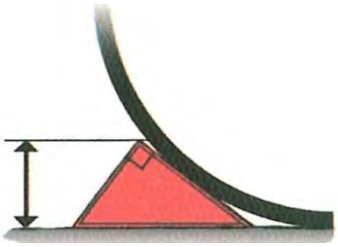
Non-rigid goods

If the goods are not rigid in form (bags, bales etc.) more lashings than prescribed in this quick lashing guide may be needed.

Rolling units

If rolling units aren't blocked, chocks with a height of at least 1/3 of the radius, shall be used.

If the unit is secured by lashings ensuring that the unit cannot roll over the chocks, the chock height need not to be greater than 20 cm.



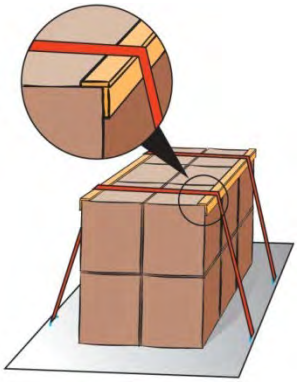
Bottom blocking

Bottom blocking preventing cargo from sliding must have a height of at least 5 cm, if the cargo isn't prevented from climbing over the blocking by suitable lashings.

Supporting edge beam

In some cases fewer lashings are needed than the number of sections that are to be secured. Since each unit has to be secured, the lashing effect may in these cases be spread out by supporting edge beams. For each end section one lashing shall be used as well as at least one lashing per every other section.

These edge beams can be manufactured profiles or deals (minimum 25x100 mm) nailed together.

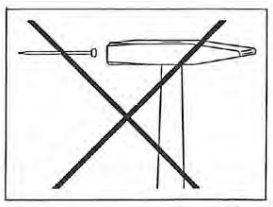


Blocking against the doors

When the door end of a CTU is designed to provide a defined wall resistance (e.g. the doors of a general cargo container) the doors may be considered as a strong cargo space boundary and used for cargo securing, provided the cargo is stowed to avoid impact loads to the door end and to prevent the cargo from falling out when the doors are opened.

Nailing

Nailing to the floor should not be done unless agreed with the CTU supplier.



SLIDING - FRICTION

Different material contacts have different friction factors (μ). The table below shows recommended values for the friction factor (92.5% of the static friction). The values are valid provided that both contact surfaces are "swept clean" and free from any impurities. In case of direct lashings, where the cargo may move a little before the elongation of the lashings provides the desired restraint force, the dynamic friction applies, which is to be taken as 75 % of the friction factor. This effect is included in the lashing tables.

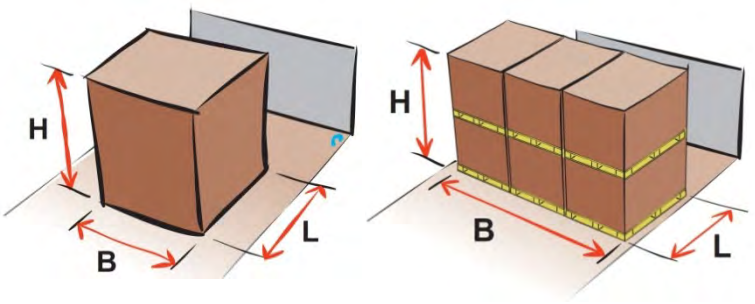
Material combination in contact surface	Friction factor μ	
	Dry	Wet
SAWN TIMBER/WOODEN PALLET		
Sawn timber/wooden pallet – fabric base laminate / plywood	0.45	0.45
Sawn timber/wooden pallet - grooved aluminium	0.4	0.4
Sawn timber/wooden pallet - stainless steel sheet	0.3	0.3
Sawn timber/wooden pallet - shrink film	0.3	0.3
PLANED WOOD		
Planed wood – fabric base laminate / plywood	0.3	0.3
Planed wood - grooved aluminium	0.25	0.25
Planed wood - stainless steel sheet	0.2	0.2
PLASTIC PALLETS		
Plastic pallet – fabric base laminate / plywood	0.2	0.2
Plastic pallet - grooved aluminium	0.15	0.15
Plastic pallet – stainless steel sheet	0.15	0.15
CARDBOARD (UNTREATED)		
Cardboard - cardboard	0.5	-
Cardboard - wooden pallet	0.5	-
BIG BAG		
Big bag - wooden pallet	0.4	-
STEEL AND SHEET METAL		
Unpainted metal with rough surface - unpainted rough metal	0.4	-
Painted metal with rough surface - painted rough metal	0.3	-
Unpainted metal with smooth surface - unpainted smooth metal	0.2	-
Painted metal with smooth surface - painted smooth metal	0.2	-
STEEL CRATES		
Steel crate – fabric base laminates / plywood	0.45	0.45
Steel crate - grooved aluminium	0.3	0.3
Steel crate – stainless steel	0.2	0.2

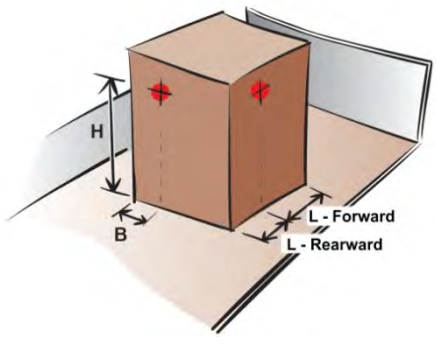
Material combination in contact surface	Friction factor μ	
	Dry	Wet
CONCRETE		
Concrete with rough surface - sawn timber	0.7	0.7
Concrete with smooth surface - sawn timber	0.55	0.55
ANTI-SLIP MATERIAL		
Rubber against other materials when contact surfaces are clean	0.6	0.6
Materials other than rubber against other materials	as certified	

Friction factors (μ) should be applicable to the actual conditions of transport. When a combination of contact surfaces is missing in the table above or if its friction factor cannot be verified in another way the maximum allowable friction factor of 0.3 should be used. If the surfaces are not swept clean, the maximum allowable friction factor of 0.3 or, when lower, the value in the tableshould be used. If the surface contacts are not free from frost, ice and snow a static friction factor of 0.2 should be used, unless the table shows a lower value. For oily and greasy surfaces or when slip sheets have been used a friction factor of 0.1 applies.[1]

TIPPING - DIMENSIONS

The definition of **H**, **B** and **L** as shown to the right are to be used in the tables for tipping for cargo units with the centre of gravity close to its geometrical centre.





The definition of **H**, **B** and **L** as shown to the left are to be used in the tables for tipping for cargo units with the centre of gravity away from its geometrical centre.

For defining required number of lashings to prevent tipping, H/B and H/L is calculated. The obtained values are to be rounded up to the nearest higher value shown in the tables.

[1] For sea transport please also see CSS Code Annex 13 sub-section 7.2 *Balance of forces and moments*.

CARGO SECURING EQUIPMENT

Labelling

Cargo securing equipment may be labelled with one or more of the following quantities:

- **MBL** = Minimum Break Load
- **MSL** = Maximum Securing Load
- **LC** = Lashing Capacity(generally used for road transport in Europe)
- **S_{TF}** = Standard Tension Force = Pre-tension
- **BS** = Breaking Strength

The unit **daN,** where *1 daN = 1 kg*, is sometimes used to indicate the LC and S_{TF} for cargo securing equipment. MBL and MSL are usually stated in **kN**, **kg** or **tons**.

Maximum Securing Load, MSL

- During sea transport the cargo securing arrangements are designed with respect to the **MSL** in the equipment.
- If labelling of MSL is missing MSL is primarily taken as LC when dimensioning according to the tables in this Quick Lashing Guide.
- Alternatively the MSL for different types of equipment is calculated from the **Breaking Strength (BS)**, according to the table below:

Equipment	MSL
Web lashing, reusable	50% of BS
Web lashing, single use	75 % *) of BS
Chain lashing (class 8), speed lash, turnbuckle	50% of BS
Wire, new	80% of BS
Wire, used	30% of BS
Steel strapping	70% of BS
Tag washer	50% of BS
Air bag, reusable	50% of BS
Airbag, single use	75% of BS

*) Maximum 9 % elongation at MSL

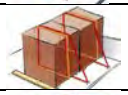
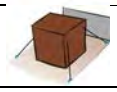
If labelling of the pre-tension force is missing **10% of Breaking Strength (BS)**, although not more than 1,000 kg, may be used as pre-tension when dimensioning according to the tables in this Quick Lashing Guide.

Lashing eyes

The lashing eyes should have at least the same strength in MSL as the lashings. For a half loop lashing the lashing eye should have at least the strength of 1.4 × MSL of the lashing if both ends of the lashing are fixed to the same eye.

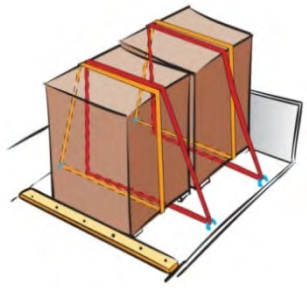
CONVERSION FACTORS FOR OTHER TYPES OF LASHING EQUIPMENT

For lashing equipment with MSL and pre-tension other than those shown in tables in this quick lashing guide, the table values should be multiplied by a conversion factor corresponding to the actual lashing method and type of equipment (see the table below). All values used should be taken in **daN**, where *1* ***daN*** *≈ 1* ***kg****.*

Lashing method		Webbing	Chain	Steel strapping	Wire
Top-over lashing		Pre-tension*/400	Pre-tension*/1,000	Pre-tension*/240	Pre-tension*/1,000
Half loop lashing		MSL*/2,000	MSL*/5,000	MSL*/1,700	MSL*/9,100
Spring lashing					
Straight lashing					

* Pre-tension and MSL are the values for the lashing equipment intended to be used

Example: A cargo unit is intended to be transported in Sea Area C. How many tons are prevented from sliding sideways by a pair of half loop web lashings with MSL 4 ton, if the friction factor is 0.3?



The quick lashing guide shows that a pair of half loop **web lashings** with MSL 2,000 daN prevents 4.3 ton of cargo from sliding sideways in Sea Area C, when the friction factor is 0.3.

MSL for the current web lashing is 4 ton ≈ 4,000 daN.

According to the table above, the conversion factor for half loop lashings is; MSL/2,000 = 4,000/2,000 = 2. The cargo mass prevented from sliding according to the lashing table shall be multiplied by the conversion factor and each pair of half loop web lashings thus prevents 2 × 4.3 = 8.6 ton of cargo from sliding sideways. This means that the cargo mass prevented from sliding by a pair of half loop lashings can be doubled when the MSL value for the lashing is doubled as long as the lashing eyes are strong enough.

REQUIRED NUMBER OF LASHINGS

The lashing tables in this quick lashing guide show the cargo mass in ton (1000 kg) prevented from sliding or tipping per lashing. The values in the tables are rounded to two significant figures.

The required number of lashings to prevent sliding and tipping is calculated by the help of the tables on the following pages according to the following procedure:

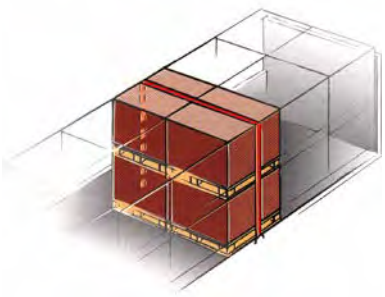
1. Calculate the required number of lashings to prevent sliding
2. Calculate the required number of lashings to prevent tipping
3. The largest number of the above is selected

Even if there is neither sliding nor tipping risk, it is recommended to always use at least one top-over lashing per every 4 ton of cargo or similar arrangement to avoid wandering for non-blocked cargo due to vibrations.

CARGO STOWED IN MORE THAN ONE LAYER

Method 1 (simple)

1. Determine the number of lashings to prevent sliding using the mass of the entire section and the lowest friction of any of the layers.
2. Determine the number of lashings to prevent tipping.
3. The largest number of lashings in step 1 and 2 is to be used.



Method 2 (advanced)

1. Determine the number of lashings to prevent sliding using the mass of the entire section and the friction for the bottom layer.
2. Determine the number of lashings to prevent sliding using the mass of the section’s upper layer and the friction between the layers.
3. Determine the number of lashings for the entire section which is required to prevent tipping.

The largest number of lashings in steps 1 to 3 should be used.

QUICK LASHING GUIDE A

Cargo securing on CTUs for transports on Road, Combined Rail and in Sea Area A

Accelerations to be expected expressed in parts of the gravity acceleration (1g = 9.81 m/s^2).

Transport mode/ Sea area	Sideways		Forward		Backward	
	S	V	F	V	B	V
Road	0.5	1.0	0.8	1.0	0.5	1.0
Combined Rail	0.5	1.0	0.5	1.0	0.5	1.0
Sea Area A	0.5	1.0	0.3	0.5	0.3	0.5

V = Vertical acceleration in combination with longitudinal or transverse acceleration

Goods; not rigid in form

If the goods aren't rigid in form, more lashings than stipulated in this quick lashing guide could be required.

- All dimensions referred to as ton are equal to metric ton of 1000 kg.
- Sideways, forward and backward refers to a fore-and-aft stowed CTU.

WEBBING

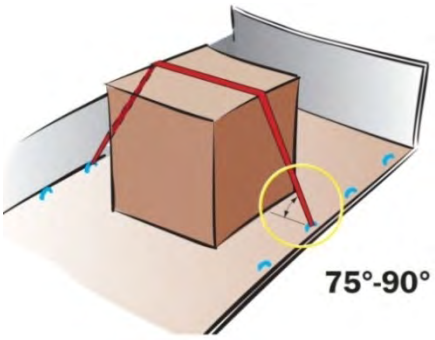
Top-over lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

The values in the tables are proportional to the pre-tension in the lashings.

The masses in the tables are valid for one top-over lashing.

TOP-OVER LASHING



Cargo mass in ton prevented from sliding *per top-over lashing*			
μ	SIDEWAYS	FORWARD	BACKWARD
0.00	0.00	0.00	0.00
0.05	0.08	0.05	0.08
0.10	0.18	0.10	0.18
0.15	0.30	0.16	0.30
0.20	0.47	0.24	0.47
0.25	0.71	0.32	0.71
0.30	1.1	0.43	1.1
0.35	1.7	0.55	1.7
0.40	2.8	0.71	2.8
0.45	6.4	0.91	4.3
0.50	no slide	1.2	7.1
0.55	no slide	1.6	16
0.60	no slide	2.1	no slide
0.65	no slide	3.1	no slide
0.70	no slide	5.0	no slide

Cargo mass in ton prevented from tipping per top-over lashing								
SIDEWAYS						FORWARD		BACKWARD
H/B	1 row	2 rows	3 rows	4 rows	5 rows	H/L	per section	per section
0.6	no tip	no tip	no tip	6.3	2.9	0.6	no tip	no tip
0.8	no tip	no tip	5.4	2.1	1.4	0.8	no tip	no tip
1.0	no tip	no tip	2.2	1.3	0.96	1.0	no tip	no tip
1.2	no tip	4.5	1.3	0.90	0.72	1.2	no tip	no tip
1.4	no tip	2.2	0.98	0.70	0.58	1.4	5.9	no tip
1.6	no tip	1.5	0.77	0.57	0.48	1.6	2.5	no tip
1.8	no tip	1.1	0.63	0.48	0.41	1.8	1.6	18
2.0	no tip	0.89	0.54	0.42	0.36	2.0	1.2	7.1
2.2	7.1	0.74	0.47	0.37	0.32	2.2	0.93	4.4
2.4	3.5	0.64	0.41	0.33	0.29	2.4	0.77	3.2
2.6	2.4	0.56	0.37	0.30	0.26	2.6	0.66	2.4
2.8	1.8	0.50	0.34	0.27	0.24	2.8	0.57	1.8
3.0	1.4	0.45	0.31	0.25	0.22	3.0	0.51	1.4

WEBBING

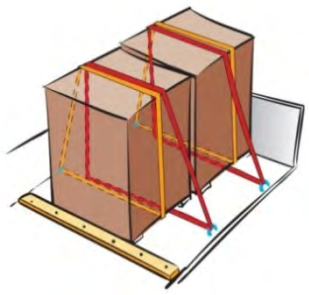
Half-loop lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

The masses in the tables below are valid for one pair of half loop lashings.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

HALF LOOP LASHING
SLIDING



Cargo mass in ton prevented from sliding *per pair of half loop lashing*	
μ	**SIDEWAYS**
0.00	4.1
0.05	4.6
0.10	5.2
0.15	5.9
0.20	6.7
0.25	7.7
0.30	9.1
0.35	11
0.40	13
0.45	17
0.50	no slide
0.55	no slide
0.60	no slide
0.65	no slide
0.70	no slide

Cargo mass in ton prevented from tipping *per pair of half loop lashing*					
SIDEWAYS					
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**
0.6	no tip	no tip	no tip	18	8.2
0.8	no tip	no tip	15	5.9	4.1
1.0	no tip	no tip	6.1	3.6	2.7
1.2	no tip	13	3.8	2.5	2.0
1.4	no tip	6.4	2.8	2.0	1.6
1.6	no tip	4.2	2.2	1.6	1.4
1.8	no tip	3.2	1.8	1.4	1.2
2.0	no tip	2.5	1.5	1.2	1.0
2.2	20	2.1	1.3	1.0	0.91
2.4	10	1.8	1.2	0.94	0.82
2.6	6.8	1.6	1.1	0.85	0.74
2.8	5.1	1.4	0.96	0.78	0.68
3.0	4.1	1.3	0.87	0.71	0.63

WEBBING

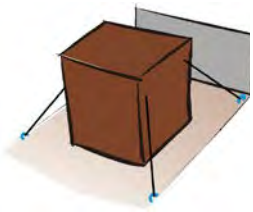
Straight lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

All masses are valid for one straight lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

STRAIGHT LASHING
SLIDING



Cargo mass in ton prevented from sliding *per straight lashing*			
μ	**SIDEWAYS per side**	**FORWARD**	**BACKWARD**
0.00	1.0	0.64	1.0
0.05	1.2	0.76	1.2
0.10	1.5	0.89	1.5
0.15	1.8	1.0	1.8
0.20	2.2	1.2	2.2
0.25	2.7	1.4	2.7
0.30	3.3	1.6	3.3
0.35	4.1	1.8	4.1
0.40	5.2	2.1	5.2
0.45	6.8	2.4	6.8
0.50	no slide	2.8	10
0.55	no slide	3.2	13
0.60	no slide	3.7	no slide
0.65	no slide	4.4	no slide
0.70	no slide	5.2	no slide

Cargo mass in ton prevented from tipping *per* straight lashing				
H/B	**SIDEWAYS per side**	**H/L**	**FORWARD**	**BACKWARD**
0.6	no tip	**0.6**	no tip	no tip
0.8	no tip	**0.8**	no tip	no tip
1.0	no tip	**1.0**	no tip	no tip
1.2	no tip	**1.2**	no tip	no tip
1.4	no tip	**1.4**	10	no tip
1.6	no tip	**1.6**	4.7	no tip
1.8	no tip	**1.8**	3.2	36
2.0	no tip	**2.0**	2.5	15
2.2	16	**2.2**	2.1	10
2.4	8.7	**2.4**	1.9	7.9
2.6	6.1	**2.6**	1.7	6.1
2.8	4.8	**2.8**	1.6	4.8
3.0	4.1	**3.0**	1.5	4.1

WEBBING

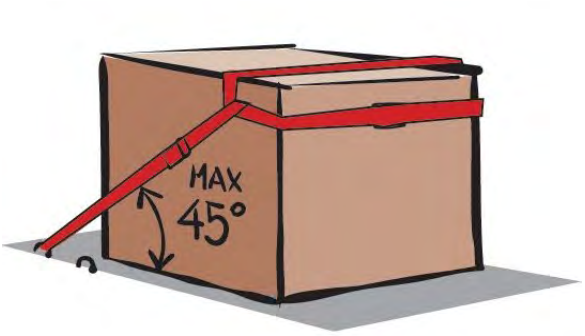
Spring lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

The masses in the tables are valid for one spring lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

SPRING LASHING



Cargo mass in ton prevented from sliding *per* spring lashing		
μ	**FORWARD**	**BACKWARD**
0.00	3.6	5.8
0.05	3.9	6.5
0.10	4.3	7.3
0.15	4.7	8.3
0.20	5.1	9.5
0.25	5.6	11
0.30	6.1	13
0.35	6.8	15
0.40	7.5	19
0.45	8.3	24
0.50	9.3	35
0.55	11	43
0.60	12	no slide
0.65	14	no slide
0.70	16	no slide

Cargo mass in ton prevented from tipping *per* spring lashing		
H/L	**FORWARD**	**REARWARD**
0.6	no tip	no tip
0.8	no tip	no tip
1.0	no tip	no tip
1.2	no tip	no tip
1.4	67	no tip
1.6	33	no tip
1.8	24	259
2.0	19	115
2.2	17	79
2.4	15	63
2.6	14	50
2.8	13	40
3.0	12	35

TAG WASHERS AND NAILS

TAG WASHER

Approximate cargo mass in ton prevented from sliding by one tag washer for wood on wood in combination with top-over lashing only

μ **	SIDEWAYS						
	∅ 48	∅ 62	∅ 75	∅ 95	30×57	48×65	130×130
MBL (ton)	0.5	0.7	0.9	1.2	0.5	0.7	1.5
0.10	0.31	0.44	0.56	0.75	0.31	0.44	0.94
0.20	0.42	0.58	0.75	1.00	0.42	0.58	1.3
0.30	0.63	0.88	1.1	1.5	0.63	0.88	1.9
	FORWARD						
0.10	0.18	0.25	0.32	0.43	0.18	0.25	0.54
0.20	0.21	0.29	0.38	0.50	0.21	0.29	0.63
0.30	0.25	0.35	0.45	0.60	0.25	0.35	0.75
	BACKWARD						
0.10	0.31	0.44	0.56	0.75	0.31	0.44	0.94
0.20	0.42	0.58	0.75	1.00	0.42	0.58	1.3
0.30	0.63	0.88	1.1	1.5	0.63	0.88	1.9

** Between tag washer and platform bed/cargo.

4" – NAIL

Approximate cargo mass in ton prevented from sliding by one nail

μ ***	SIDEWAYS per side		FORWARD		BACKWARD	
	blank	galvanised	blank	galvanised	blank	galvanised
MBL (ton)	0.22	0.32	0.22	0.32	0.22	0.32
0.00	0.22	0.32	0.14	0.20	0.22	0.32
0.05	0.24	0.36	0.15	0.21	0.24	0.36
0.10	0.28	0.40	0.16	0.23	0.28	0.40
0.15	0.31	0.46	0.17	0.25	0.31	0.46
0.20	0.37	0.53	0.18	0.27	0.37	0.53
0.25	0.44	0.64	0.20	0.29	0.44	0.64
0.30	0.55	0.80	0.22	0.32	0.55	0.80
0.35	0.73	1.1	0.24	0.36	0.73	1.1
0.40	1.1	1.6	0.28	0.40	1.1	1.6
0.45	2.2	3.2	0.31	0.46	1.5	2.1
0.50	no slide	no slide	0.37	0.53	2.2	3.2
0.55	no slide	no slide	0.44	0.64	4.4	6.4
0.60	no slide	no slide	0.55	0.80	no slide	no slide
0.65	no slide	no slide	0.73	1.1	no slide	no slide
0.70	no slide	no slide	1.1	1.6	no slide	no slide

*** *Between cargo and platform bed.*

QUICK LASHING GUIDE B

Cargo securing on CTUs for transports on Road, Combined Rail and in Sea Area B

Accelerations to be expected expressed in parts of the gravity acceleration (1g = 9.81 m/s2).

Transport mode/ Sea area	Sideways		Forward		Backward	
	S	V	F	V	B	V
Road	0.5	1.0	0.8	1.0	0.5	1.0
Combined Rail	0.5	1.0	0.5	1.0	0.5	1.0
Sea Area B	0.7	1.0	0.3	0.3	0.3	0.3

V = Vertical acceleration in combination with longitudinal or transverse acceleration

Goods; not rigid in form

If the goods aren't rigid in form, more lashings than stipulated in this quick lashing guide could be required.

- All dimensions referred to as ton are equal to metric tonne of 1000 kg.
- Sideways, forward and backward refers to a fore-and-aft stowed CTU.

WEBBING

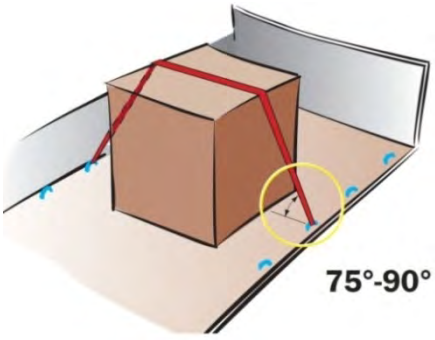
Top-over lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

The values in the tables are proportional to the pre-tension in the lashings.

The masses in the tables are valid for one top-over lashing.

TOP-OVER LASHING



Cargo mass in ton prevented from sliding *per* top-over lashing			
μ	**SIDEWAYS**	**FORWARD**	**BACKWARD**
0.00	0.00	0.00	0.00
0.05	0.05	0.05	0.08
0.10	0.12	0.10	0.18
0.15	0.19	0.16	0.30
0.20	0.28	0.24	0.47
0.25	0.39	0.32	0.71
0.30	0.53	0.43	1.0
0.35	0.71	0.55	1.3
0.40	0.95	0.71	1.6
0.45	1.3	0.91	1.9
0.50	1.8	1.2	2.4
0.55	2.6	1.6	2.9
0.60	4.3	2.1	3.5
0.65	9.2	3.1	4.4
0.70	no slide	5.0	5.5

Cargo mass in ton prevented from tipping *per* top-over lashing								
SIDEWAYS						**FORWARD**	**BACKWARD**	
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**	**H/L**	**per section**	**per section**
0.6	no tip	no tip	4.1	1.9	1.3	**0.6**	no tip	no tip
0.8	no tip	7.4	1.6	1.0	0.80	**0.8**	no tip	no tip
1.0	no tip	2.2	0.98	0.70	0.58	**1.0**	no tip	no tip
1.2	no tip	1.3	0.71	0.53	0.45	**1.2**	12	12
1.4	no tip	0.93	0.55	0.43	0.37	**1.4**	5.9	5.9
1.6	5.9	0.72	0.46	0.36	0.31	**1.6**	2.5	3.9
1.8	2.7	0.59	0.39	0.31	0.27	**1.8**	1.6	3.0
2.0	1.8	0.50	0.34	0.27	0.24	**2.0**	1.2	2.4
2.2	1.3	0.43	0.30	0.24	0.22	**2.2**	0.93	2.0
2.4	1.0	0.38	0.27	0.22	0.19	**2.4**	0.77	1.7
2.6	0.86	0.34	0.24	0.20	0.18	**2.6**	0.66	1.5
2.8	0.74	0.31	0.22	0.18	0.16	**2.8**	0.57	1.3
3.0	0.64	0.28	0.20	0.17	0.15	**3.0**	0.51	1.2

WEBBING

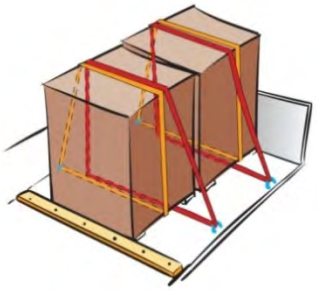
Half-loop lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

The masses in the tables below are valid for one pair of half loop lashings.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

HALF LOOP LASHING
SLIDING



Cargo mass in ton prevented from sliding *per* pair of half loop lashing	
μ	**SIDEWAYS**
0.00	2.9
0.05	3.2
0.10	3.5
0.15	3.9
0.20	4.3
0.25	4.7
0.30	5.3
0.35	5.9
0.40	6.6
0.45	7.5
0.50	8.6
0.55	10
0.60	12
0.65	14
0.70	no slide

Cargo mass in ton prevented from tipping *per* pair of half loop lashing					
SIDEWAYS					
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**
0.6	no tip	no tip	12	5.2	3.7
0.8	no tip	21	4.5	2.9	2.3
1.0	no tip	6.4	2.8	2.0	1.6
1.2	no tip	3.7	2.0	1.5	1.3
1.4	no tip	2.7	1.6	1.2	1.0
1.6	17	2.1	1.3	1.0	0.89
1.8	7.8	1.7	1.1	0.88	0.77
2.0	5.1	1.4	0.96	0.78	0.68
2.2	3.8	1.2	0.84	0.69	0.61
2.4	3.0	1.1	0.76	0.62	0.55
2.6	2.5	0.97	0.69	0.57	0.50
2.8	2.1	0.87	0.63	0.52	0.46
3.0	1.9	0.80	0.58	0.48	0.43

WEBBING

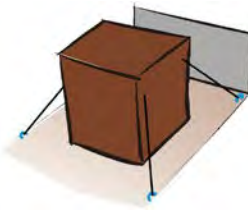
Straight lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

All masses are valid for one straight lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

STRAIGHT LASHING
SLIDING



Cargo mass in ton prevented from sliding *per* straight lashing			
μ	**SIDEWAYS per side**	**FORWARD**	**BACKWARD**
0.00	0.73	0.64	1.0
0.05	0.87	0.76	1.2
0.10	1.0	0.89	1.5
0.15	1.2	1.0	1.8
0.20	1.4	1.2	2.2
0.25	1.6	1.4	2.7
0.30	1.9	1.6	3.3
0.35	2.2	1.8	4.1
0.40	2.6	2.1	4.9
0.45	3.0	2.4	5.6
0.50	3.6	2.8	6.2
0.55	4.3	3.2	7.0
0.60	5.2	3.7	7.9
0.65	6.4	4.4	8.9
0.70	no slide	5.2	10.0

Cargo mass in ton prevented from tipping *per* straight lashing				
H/B	**SIDEWAYS per side**	**H/L**	**FORWARD**	**BACKWARD**
0.6	no tip	**0.6**	no tip	no tip
0.8	no tip	**0.8**	no tip	no tip
1.0	no tip	**1.0**	no tip	no tip
1.2	no tip	**1.2**	19	19
1.4	no tip	**1.4**	10	10
1.6	11	**1.6**	4.7	7.4
1.8	5.5	**1.8**	3.2	5.9
2.0	3.8	**2.0**	2.5	5.1
2.2	3.0	**2.2**	2.1	4.5
2.4	2.5	**2.4**	1.9	4.1
2.6	2.2	**2.6**	1.7	3.8
2.8	2.0	**2.8**	1.6	3.6
3.0	1.9	**3.0**	1.5	3.4

WEBBING

Spring lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

The masses in the tables are valid for one spring lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

SPRING LASHING

Cargo mass in ton prevented from sliding *per* spring lashing		
μ	**FORWARD**	**BACKWARD**
0.00	3.6	5.8
0.05	3.9	6.5
0.10	4.3	7.3
0.15	4.7	8.3
0.20	5.1	9.5
0.25	5.6	11
0.30	6.1	13
0.35	6.8	15
0.40	7.5	18
0.45	8.3	19
0.50	9.3	21
0.55	11	23
0.60	12	25
0.65	14	28
0.70	16	31

Cargo mass in ton prevented from tipping *per* spring lashing		
H/L	**FORWARD**	**REARWARD**
0.6	no tip	no tip
0.8	no tip	no tip
1.0	no tip	no tip
1.2	115	115
1.4	67	67
1.6	33	51
1.8	24	43
2.0	19	38
2.2	17	35
2.4	15	33
2.6	14	31
2.8	13	30
3.0	12	29

CHAIN

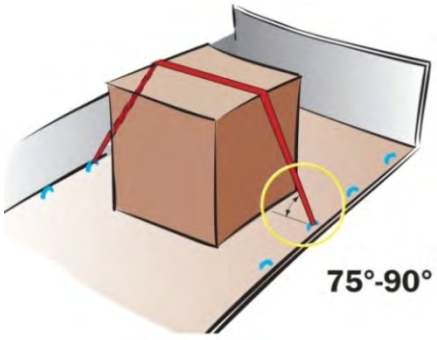
Top-over lashings

The tables are valid for **chain (∅ 9 mm, class 8)** with an MSL of 50 kN or 5,000 daN - (5,000 kg = 5 ton) and a pre-tension of minimum 10 kN or 1000 daN - (1000 kg = 1 ton).

The values in the tables are proportional to the pre-tension in the lashings.

The masses in the tables are valid for one top-over lashing.

TOP-OVER LASHING



Cargo mass in ton prevented from sliding *per* top-over lashing			
μ	**SIDEWAYS**	**FORWARD**	**BACKWARD**
0.00	0.00	0.00	0.00
0.05	0.14	0.12	0.20
0.10	0.30	0.25	0.44
0.15	0.48	0.41	0.76
0.20	0.71	0.59	1.2
0.25	0.98	0.81	1.8
0.30	1.3	1.1	2.5
0.35	1.8	1.4	3.2
0.40	2.4	1.8	3.9
0.45	3.2	2.3	4.8
0.50	4.4	3.0	5.9
0.55	6.5	3.9	7.2
0.60	11	5.3	8.9
0.65	23	7.7	11
0.70	no slide	12	14

Cargo mass in ton prevented from tipping *per* top-over lashing								
SIDEWAYS						FORWARD	BACKWARD	
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**	**H/L**	**per section**	**per section**
0.6	no tip	no tip	10	4.6	3.3	**0.6**	no tip	no tip
0.8	no tip	19	4.0	2.5	2.0	**0.8**	no tip	no tip
1.0	no tip	5.6	2.4	1.7	1.4	**1.0**	no tip	no tip
1.2	no tip	3.3	1.8	1.3	1.1	**1.2**	30	30
1.4	no tip	2.3	1.4	1.1	0.92	**1.4**	15	15
1.6	15	1.8	1.1	0.90	0.78	**1.6**	6.3	9.8
1.8	6.8	1.5	0.97	0.78	0.68	**1.8**	4.0	7.4
2.0	4.4	1.2	0.84	0.68	0.60	**2.0**	3.0	5.9
2.2	3.3	1.1	0.74	0.61	0.54	**2.2**	2.3	4.9
2.4	2.6	0.95	0.67	0.55	0.49	**2.4**	1.9	4.2
2.6	2.2	0.85	0.60	0.50	0.45	**2.6**	1.6	3.7
2.8	1.8	0.76	0.55	0.46	0.41	**2.8**	1.4	3.3
3.0	1.6	0.70	0.51	0.43	0.38	**3.0**	1.3	3.0

CHAIN

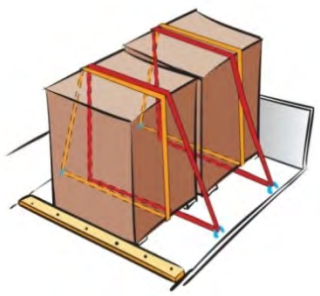
Half-loop lashings

The tables are valid for **chain (∅ 9 mm, class 8)** with an MSL of 50 kN or 5,000 daN - (5,000 kg = 5 ton) and a pre-tension of minimum 10 kn or 1,000 daN - (1,000 kg = 1 ton).

The masses in the tables below are valid for one pair of half loop lashings.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

HALF LOOP LASHING SLIDING



Cargo mass in ton prevented from sliding *per* pair of half loop lashing	
μ	**SIDEWAYS**
0.00	7.3
0.05	8.0
0.10	8.8
0.15	9.7
0.20	11
0.25	12
0.30	13
0.35	15
0.40	17
0.45	19
0.50	22
0.55	25
0.60	30
0.65	36
0.70	no slide

Cargo mass in ton prevented from tipping *per* pair of half loop lashing					
SIDEWAYS					
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**
0.6	no tip	no tip	29	13	9.3
0.8	no tip	53	11	7.2	5.7
1.0	no tip	16	7.0	5.0	4.1
1.2	no tip	9.4	5.0	3.8	3.2
1.4	no tip	6.6	3.9	3.1	2.6
1.6	42	5.1	3.2	2.6	2.2
1.8	20	4.2	2.8	2.2	1.9
2.0	13	3.5	2.4	1.9	1.7
2.2	9.4	3.1	2.1	1.7	1.5
2.4	7.5	2.7	1.9	1.6	1.4
2.6	6.2	2.4	1.7	1.4	1.3
2.8	5.3	2.2	1.6	1.3	1.2
3.0	4.6	2.0	1.4	1.2	1.1

CHAIN

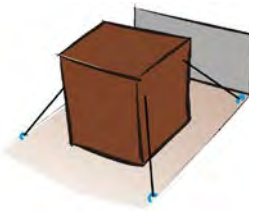
Straight lashings

The tables are valid for **chain (∅ 9 mm, class 8)** with an MSL of 50 kN or 5000 daN - (5000 kg = 5 ton) and a pre-tension of minimum 10 kN or 1000 daN - (1000 kg = 1 ton).

All masses are valid for one straight lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

STRAIGHT LASHING SLIDING



Cargo mass in ton prevented from sliding *per* straight lashing			
μ	**SIDEWAYS per side**	**FORWARD**	**BACKWARD**
0.00	1.8	1.6	2.5
0.05	2.2	1.9	3.1
0.10	2.6	2.2	3.8
0.15	3.0	2.6	4.6
0.20	3.5	3.0	5.5
0.25	4.1	3.4	6.7
0.30	4.8	3.9	8.2
0.35	5.6	4.5	10
0.40	6.5	5.2	12
0.45	7.6	6.0	14
0.50	9.0	6.9	16
0.55	11	8.0	18
0.60	13	9.3	20
0.65	16	11	22
0.70	no slide	13	25

Cargo mass in ton prevented from tipping *per* straight lashing				
H/B	**SIDEWAYS per side**	**H/L**	**FORWARD**	**BACKWARD**
0.6	no tip	**0.6**	no tip	no tip
0.8	no tip	**0.8**	no tip	no tip
1.0	no tip	**1.0**	no tip	no tip
1.2	no tip	**1.2**	47	47
1.4	no tip	**1.4**	25	25
1.6	28	**1.6**	12	18
1.8	14	**1.8**	8.1	15
2.0	9.6	**2.0**	6.4	13
2.2	7.6	**2.2**	5.4	11
2.4	6.4	**2.4**	4.7	10
2.6	5.6	**2.6**	4.2	9.6
2.8	5.0	**2.8**	3.9	9.0
3.0	4.6	**3.0**	3.6	8.5

CHAIN

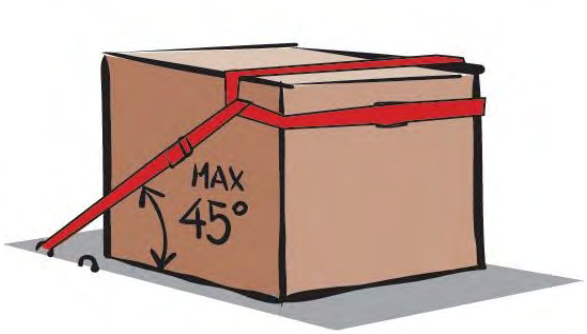
Spring lashings

The tables are valid for chain (∅ 9 mm, class 8) with an MSL of 50 kN or 5,000 daN - (5,000 kg = 5 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

The masses in the tables are valid for one spring lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

SPRING LASHING

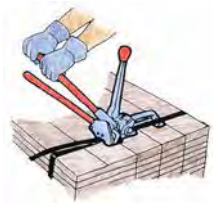


Cargo mass in ton prevented from sliding *per* spring lashing		
μ	**FORWARD**	**BACKWARD**
0.00	9.0	14
0.05	9.8	16
0.10	11	18
0.15	12	21
0.20	13	24
0.25	14	27
0.30	15	32
0.35	17	38
0.40	19	45
0.45	21	49
0.50	23	53
0.55	26	58
0.60	30	63
0.65	34	70
0.70	40	77

Cargo mass in ton prevented from tipping *per* spring lashing		
H/L	**FORWARD**	**REARWARD**
0.6	no tip	no tip
0.8	no tip	no tip
1.0	no tip	no tip
1.2	288	288
1.4	168	168
1.6	82	128
1.8	59	108
2.0	48	96
2.2	42	88
2.4	38	82
2.6	35	78
2.8	33	75
3.0	31	72

STEEL STRAPPING

Top-over lashings

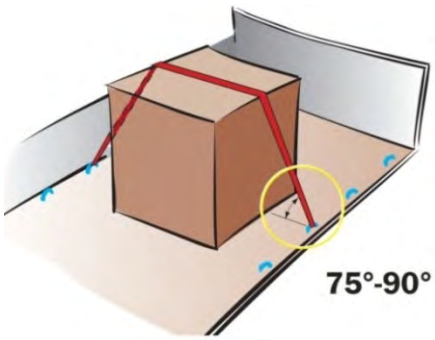


The tables are valid for **steel strapping** (**32 × 0.8 mm)** with an MSL of 17 kN or 1,700 daN - (1,700 kg = 1.7 ton) and a pre-tension of minimum 2.4 kN or 240 daN - (240 kg).

The values in the tables are proportional to the pre-tension in the lashings.

The masses in the tables are valid for one top-over lashing.

TOP-OVER LASHING

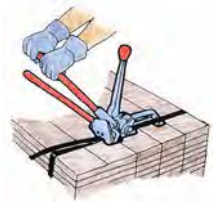


Cargo mass in ton prevented from sliding *per* top-over lashing			
μ	**SIDEWAYS**	**FORWARD**	**BACKWARD**
0.00	0.00	0.00	0.00
0.05	0.03	0.03	0.05
0.10	0.07	0.06	0.11
0.15	0.12	0.10	0.18
0.20	0.17	0.14	0.28
0.25	0.24	0.19	0.43
0.30	0.32	0.26	0.61
0.35	0.43	0.33	0.76
0.40	0.57	0.43	0.95
0.45	0.77	0.55	1.2
0.50	1.1	0.71	1.4
0.55	1.6	0.94	1.7
0.60	2.6	1.3	2.1
0.65	5.5	1.8	2.6
0.70	no slide	3.0	3.3

Cargo mass in ton prevented from tipping *per* top-over lashing								
SIDEWAYS							**FORWARD**	**BACKWARD**
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**	**H/L**	**per section**	**per section**
0.6	no tip	no tip	2.5	1.1	0.79	**0.6**	no tip	no tip
0.8	no tip	4.5	0.95	0.61	0.48	**0.8**	no tip	no tip
1.0	no tip	1.3	0.59	0.42	0.35	**1.0**	no tip	no tip
1.2	no tip	0.79	0.42	0.32	0.27	**1.2**	7.1	7.1
1.4	no tip	0.56	0.33	0.26	0.22	**1.4**	3.5	3.5
1.6	3.5	0.43	0.27	0.22	0.19	**1.6**	1.5	2.4
1.8	1.6	0.35	0.23	0.19	0.16	**1.8**	0.97	1.8
2.0	1.1	0.30	0.20	0.16	0.14	**2.0**	0.71	1.4
2.2	0.79	0.26	0.18	0.15	0.13	**2.2**	0.56	1.2
2.4	0.63	0.23	0.16	0.13	0.12	**2.4**	0.46	1.0
2.6	0.52	0.20	0.14	0.12	0.11	**2.6**	0.39	0.89
2.8	0.44	0.18	0.13	0.11	0.10	**2.8**	0.34	0.79
3.0	0.39	0.17	0.12	0.10	0.09	**3.0**	0.30	0.71

STEEL STRAPPING

Half-loop lashings

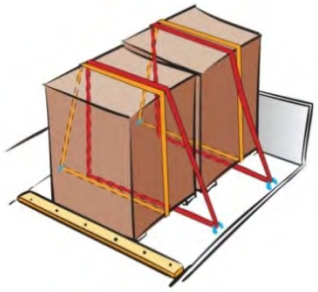


The tables are valid for **steel strapping** (**32 × 0.8 mm)** with an MSL of 17 kN or 1,700 daN - (1,700 kg = 1.7 ton) and a pre-tension of minimum 2.4 kN or 240 daN - (240 kg).

The masses in the tables below are valid for one pair of half loop lashings.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

HALF LOOP LASHING SLIDING

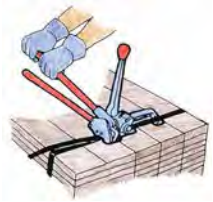


Cargo mass in ton prevented from sliding *per* pair of half loop lashing	
μ	**SIDEWAYS**
0.00	2.5
0.05	2.7
0.10	3.0
0.15	3.3
0.20	3.6
0.25	4.0
0.30	4.5
0.35	5.0
0.40	5.6
0.45	6.4
0.50	7.3
0.55	8.5
0.60	10
0.65	12
0.70	no slide

Cargo mass in ton prevented from tipping *per* pair of half loop lashing					
SIDEWAYS					
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**
0.6	no tip	no tip	10.0	4.5	3.2
0.8	no tip	18	3.8	2.4	1.9
1.0	no tip	5.4	2.4	1.7	1.4
1.2	no tip	3.2	1.7	1.3	1.1
1.4	no tip	2.3	1.3	1.0	0.89
1.6	14	1.7	1.1	0.87	0.75
1.8	6.7	1.4	0.94	0.75	0.65
2.0	4.3	1.2	0.81	0.66	0.58
2.2	3.2	1.0	0.72	0.59	0.52
2.4	2.5	0.92	0.64	0.53	0.47
2.6	2.1	0.82	0.58	0.48	0.43
2.8	1.8	0.74	0.53	0.44	0.39
3.0	1.6	0.68	0.49	0.41	0.36

STEEL STRAPPING

Straight lashings

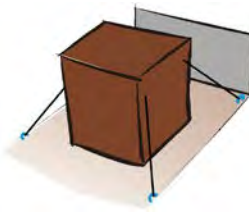


The tables are valid for **steel strapping** (**32 × 0.8 mm)** with an MSL of 17 kN or 1,700 daN - (1,700 kg = 1.7 ton) and a pre-tension of minimum 2.4 kN or 240 daN - (240 kg).

All masses are valid for one straight lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

STRAIGHT LASHING
SLIDING

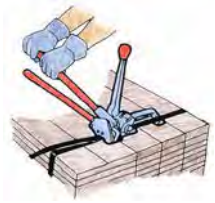


Cargo mass in ton prevented from sliding *per* straight lashing			
μ	**SIDEWAYS per side**	**FORWARD**	**BACKWARD**
0.00	0.62	0.54	0.87
0.05	0.74	0.64	1.1
0.10	0.87	0.75	1.3
0.15	1.0	0.88	1.6
0.20	1.2	1.0	1.9
0.25	1.4	1.2	2.3
0.30	1.6	1.3	2.8
0.35	1.9	1.5	3.5
0.40	2.2	1.8	4.2
0.45	2.6	2.0	4.7
0.50	3.1	2.3	5.3
0.55	3.7	2.7	6.0
0.60	4.4	3.2	6.7
0.65	5.5	3.7	7.6
0.70	no slide	4.4	8.5

Cargo mass in ton prevented from tipping *per* straight lashing				
H/B	**SIDEWAYS per side**	**H/L**	**FORWARD**	**BACKWARD**
0.6	no tip	**0.6**	no tip	no tip
0.8	no tip	**0.8**	no tip	no tip
1.0	no tip	**1.0**	no tip	no tip
1.2	no tip	**1.2**	16	16
1.4	no tip	**1.4**	8.7	8.7
1.6	9.4	**1.6**	4.0	6.3
1.8	4.7	**1.8**	2.8	5.1
2.0	3.2	**2.0**	2.2	4.3
2.2	2.6	**2.2**	1.8	3.9
2.4	2.2	**2.4**	1.6	3.5
2.6	1.9	**2.6**	1.4	3.2
2.8	1.7	**2.8**	1.3	3.0
3.0	1.6	**3.0**	1.2	2.9

STEEL STRAPPING

Spring lashings



The tables are valid for **steel strapping** (**32 × 0.8 mm)** with an MSL of 17 kN or 1,700 daN - (1,700 kg = 1.7 ton) and a pre-tension of minimum 2.4 kN or 240 daN - (240 kg).

The masses in the tables are valid for one spring lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

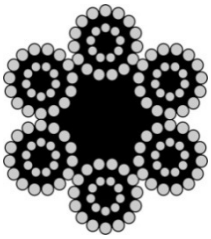
SPRING LASHING

Cargo mass in ton prevented from sliding *per* spring lashing		
μ	**FORWARD**	**BACKWARD**
0.00	3.1	4.9
0.05	3.3	5.5
0.10	3.6	6.2
0.15	4.0	7.0
0.20	4.3	8.1
0.25	4.8	9.3
0.30	5.2	11
0.35	5.8	13
0.40	6.4	15
0.45	7.1	16
0.50	7.9	18
0.55	8.9	20
0.60	10	22
0.65	12	24
0.70	14	26

Cargo mass in ton prevented from tipping *per* spring lashing		
H/L	**FORWARD**	**REARWARD**
0.6	no tip	no tip
0.8	no tip	no tip
1.0	no tip	no tip
1.2	98	98
1.4	57	57
1.6	28	44
1.8	20	37
2.0	16	33
2.2	14	30
2.4	13	28
2.6	12	27
2.8	11	25
3.0	11	25

WIRE

Top-over lashings

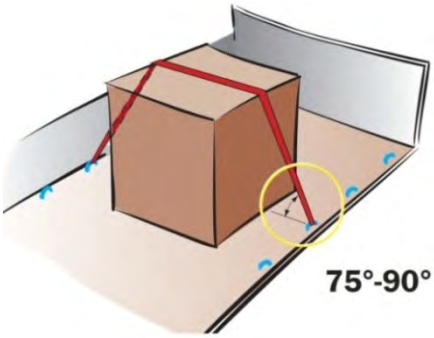


The tables are valid for **steel wire rope (∅ 16 mm/144 wires)** with an MSL of 91 kN or 9100 daN - (9,100 kg = 9.1 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1000 kg = 1 ton).

The values in the tables are proportional to the pre-tension in the lashings.

The masses in the tables are valid for one top-over lashing.

TOP-OVER LASHING



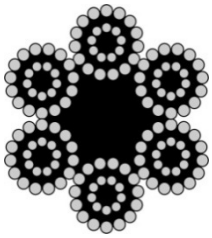
Cargo mass in ton prevented from sliding *per* top-over lashing			
μ	**SIDEWAYS**	**FORWARD**	**BACKWARD**
0.00	0.00	0.00	0.00
0.05	0.14	0.12	0.20
0.10	0.30	0.25	0.44
0.15	0.48	0.41	0.76
0.20	0.71	0.59	1.2
0.25	0.98	0.81	1.8
0.30	1.3	1.1	2.5
0.35	1.8	1.4	3.2
0.40	2.4	1.8	3.9
0.45	3.2	2.3	4.8
0.50	4.4	3.0	5.9
0.55	6.5	3.9	7.2
0.60	11	5.3	8.9
0.65	23	7.7	11
0.70	no slide	12	14

Cargo mass in ton prevented from tipping *per* top-over lashing								
SIDEWAYS						**FORWARD**	**BACKWARD**	
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**	**H/L**	**per section**	**per section**
0.6	no tip	no tip	10	4.6	3.3	**0.6**	no tip	no tip
0.8	no tip	19	4.0	2.5	2.0	**0.8**	no tip	no tip
1.0	no tip	5.6	2.4	1.7	1.4	**1.0**	no tip	no tip
1.2	no tip	3.3	1.8	1.3	1.1	**1.2**	30	30
1.4	no tip	2.3	1.4	1.1	0.92	**1.4**	15	15
1.6	15	1.8	1.1	0.90	0.78	**1.6**	6.3	9.8
1.8	6.8	1.5	0.97	0.78	0.68	**1.8**	4.0	7.4
2.0	4.4	1.2	0.84	0.68	0.60	**2.0**	3.0	5.9
2.2	3.3	1.1	0.74	0.61	0.54	**2.2**	2.3	4.9
2.4	2.6	0.95	0.67	0.55	0.49	**2.4**	1.9	4.2
2.6	2.2	0.85	0.60	0.50	0.45	**2.6**	1.6	3.7
2.8	1.8	0.76	0.55	0.46	0.41	**2.8**	1.4	3.3
3.0	1.6	0.70	0.51	0.43	0.38	**3.0**	1.3	3.0

NOTE: WIRES OF THIS SIZE ARE NOT SUITABLE FOR SECURING CARGO WITHIN CONTAINERS AS STRENGTH OF ANCHOR AND LASHING POINTS ARE LIKELY TO BE EXCEEDED.

WIRE

Half-loop lashings

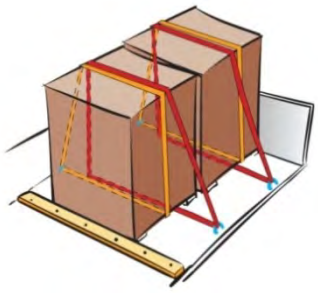


The tables are valid for **steel wire rope (∅ 16 mm/144 wires)** with an MSL of 91 kN or9,100 daN - (9,100 kg = 9.1 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

The masses in the tables below are valid for one pair of half loop lashings.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

HALF LOOP LASHING SLIDING

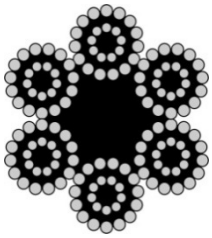


Cargo mass in ton prevented from sliding *per* pair of half loop lashing	
μ	**SIDEWAYS**
0.00	13
0.05	15
0.10	16
0.15	18
0.20	19
0.25	21
0.30	24
0.35	27
0.40	30
0.45	34
0.50	39
0.55	46
0.60	54
0.65	65
0.70	no slide

Cargo mass in ton prevented from tipping *per* pair of half loop lashing					
SIDEWAYS					
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**
0.6	no tip	no tip	54	24	17
0.8	no tip	97	20	13	10
1.0	no tip	29	13	9.0	7.4
1.2	no tip	17	9.2	6.9	5.8
1.4	no tip	12	7.2	5.6	4.8
1.6	77	9.4	5.9	4.7	4.0
1.8	36	7.6	5.0	4.0	3.5
2.0	23	6.4	4.3	3.5	3.1
2.2	17	5.6	3.8	3.1	2.8
2.4	14	4.9	3.4	2.8	2.5
2.6	11	4.4	3.1	2.6	2.3
2.8	9.7	4.0	2.9	2.4	2.1
3.0	8.4	3.6	2.6	2.2	2.0

WIRE

Straight lashings

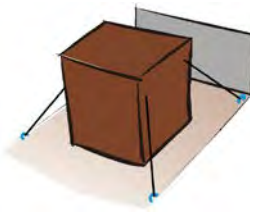


The tables are valid for **steel wire rope (∅ 16 mm/144 wires)** with an MSL of 91 kN or 9,100 daN - (9,100 kg = 9.1 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

All masses are valid for one straight lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

STRAIGHT LASHING SLIDING

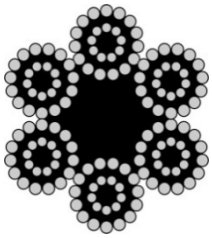


Cargo mass in ton prevented from sliding *per* straight lashing			
μ	**SIDEWAYS per side**	**FORWARD**	**BACKWARD**
0.00	3.3	2.9	4.6
0.05	4.0	3.4	5.7
0.10	4.7	4.0	6.9
0.15	5.5	4.7	8.3
0.20	6.4	5.4	10
0.25	7.5	6.2	12
0.30	8.7	7.2	15
0.35	10	8.2	19
0.40	12	9.5	23
0.45	14	11	25
0.50	16	13	28
0.55	20	15	32
0.60	24	17	36
0.65	29	20	41
0.70	no slide	23	45

Cargo mass in ton prevented from tipping *per* straight lashing				
H/B	**SIDEWAYS per side**	**H/L**	**FORWARD**	**BACKWARD**
0.6	no tip	**0.6**	no tip	no tip
0.8	no tip	**0.8**	no tip	no tip
1.0	no tip	**1.0**	no tip	no tip
1.2	no tip	**1.2**	85	85
1.4	no tip	**1.4**	46	46
1.6	50	**1.6**	22	33
1.8	25	**1.8**	15	27
2.0	17	**2.0**	12	23
2.2	14	**2.2**	9.8	21
2.4	12	**2.4**	8.6	19
2.6	10	**2.6**	7.7	17
2.8	9.2	**2.8**	7.1	16
3.0	8.4	**3.0**	6.6	15

WIRE

Spring lashings

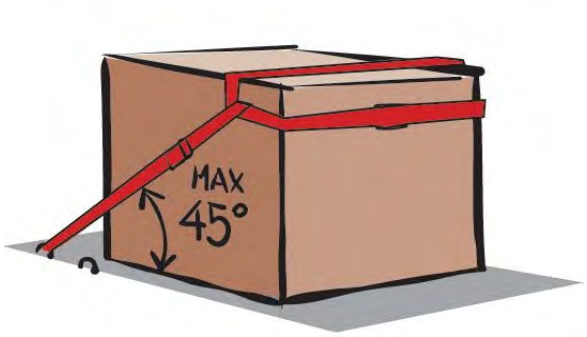


The tables are valid for **steel wire rope (∅ 16 mm/144 wires)** with an MSL of 91 kN or 9,100 daN - (9,100 kg = 9.1 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

The masses in the tables are valid for one spring lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

SPRING LASHING



Cargo mass in ton prevented from sliding *per* spring lashing		
μ	**FORWARD**	**BACKWARD**
0.00	16	26
0.05	18	29
0.10	19	33
0.15	21	38
0.20	23	43
0.25	25	50
0.30	28	58
0.35	31	70
0.40	34	81
0.45	38	88
0.50	42	96
0.55	48	105
0.60	54	115
0.65	62	127
0.70	73	140

Cargo mass in ton prevented from tipping *per* spring lashing		
H/L	**FORWARD**	**REARWARD**
0.6	no tip	no tip
0.8	no tip	no tip
1.0	no tip	no tip
1.2	525	525
1.4	306	306
1.6	150	233
1.8	107	197
2.0	87	175
2.2	76	160
2.4	68	150
2.6	63	142
2.8	59	136
3.0	56	131

TAG WASHERS AND NAILS

TAG WASHER

Approximate cargo mass in ton prevented from sliding by one tag washer for wood on wood in combination with top-over lashing only

μ **	SIDEWAYS						
	∅ 48	∅ 62	∅ 75	∅ 95	30×57	48×65	130×130
MBL (ton)	**0.5**	**0.7**	**0.9**	**1.2**	**0.5**	**0.7**	**1.5**
0.10	0.21	0.29	0.38	0.50	0.21	0.29	0.63
0.20	0.25	0.35	0.45	0.60	0.25	0.35	0.75
0.30	0.31	0.44	0.56	0.75	0.31	0.44	0.94
	FORWARD						
0.10	0.18	0.25	0.32	0.43	0.18	0.25	0.54
0.20	0.21	0.29	0.38	0.50	0.21	0.29	0.63
0.30	0.25	0.35	0.45	0.60	0.25	0.35	0.75
	BACKWARD						
0.10	0.31	0.44	0.56	0.75	0.31	0.44	0.94
0.20	0.42	0.58	0.75	1.00	0.42	0.58	1.3
0.30	0.60	0.83	1.1	1.4	0.60	0.83	1.8

** Between tag washer and platform bed/cargo.

4" – NAIL

Approximate cargo mass in ton prevented from sliding by one nail

μ ***	SIDEWAYS per side		FORWARD		BACKWARD	
	blank	galvanised	blank	galvanised	blank	galvanised
MBL (ton)	**0.22**	**0.32**	**0.22**	**0.32**	**0.22**	**0.32**
0.00	0.16	0.23	0.14	0.20	0.22	0.32
0.05	0.17	0.25	0.15	0.21	0.24	0.36
0.10	0.18	0.27	0.16	0.23	0.28	0.40
0.15	0.20	0.29	0.17	0.25	0.31	0.46
0.20	0.22	0.32	0.18	0.27	0.37	0.53
0.25	0.24	0.36	0.20	0.29	0.44	0.64
0.30	0.28	0.40	0.22	0.32	0.52	0.76
0.35	0.31	0.46	0.24	0.36	0.56	0.82
0.40	0.37	0.53	0.28	0.40	0.61	0.89
0.45	0.44	0.64	0.31	0.46	0.67	0.97
0.50	0.55	0.80	0.37	0.53	0.73	1.1
0.55	0.73	1.1	0.44	0.64	0.81	1.2
0.60	1.1	1.6	0.55	0.80	0.92	1.3
0.65	2.2	3.2	0.73	1.1	1.0	1.5
0.70	no slide	no slide	1.1	1.6	1.2	1.8

*** Between cargo and platform bed.

QUICK LASHING GUIDE C

Cargo securing on CTUs for transports on Road, Combined Rail and in Sea Area C

Accelerations to be expected expressed in parts of the gravity acceleration (1g = 9.81 m/s2).

Transport mode/ Sea area	Sideways		Forward		Backward	
	S	V	F	V	B	V
Road	0.5	1.0	0.8	1.0	0.5	1.0
Combined Rail	0.5	1.0	0.5	1.0	0.5	1.0
Sea Area C	0.8	1.0	0.4	0.2	0.4	0.2

V = Vertical acceleration in combination with longitudinal or transverse acceleration

Goods; not rigid in form

If the goods aren't rigid in form, more lashings than stipulated in this quick lashing guide could be required.

- All dimensions referred to as ton are equal to metric ton of 1000 kg.
- Sideways, forward and backward refers to a fore-and-aft stowed CTU.

WEBBING

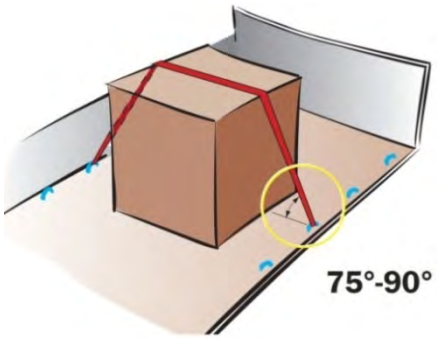
Top-over lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

The values in the tables are proportional to the lashings' pre-tension.

The masses in the tables are valid for one top-over lashing.

TOP-OVER LASHING



Cargo mass in ton prevented from sliding *per* top-over lashing			
μ	SIDEWAYS	FORWARD	BACKWARD
0.00	0.00	0.00	0.00
0.05	0.05	0.05	0.08
0.10	0.10	0.10	0.18
0.15	0.16	0.16	0.29
0.20	0.24	0.24	0.39
0.25	0.32	0.32	0.51
0.30	0.43	0.43	0.63
0.35	0.55	0.55	0.75
0.40	0.71	0.71	0.89
0.45	0.91	0.91	1.0
0.50	1.2	1.2	1.2
0.55	1.6	1.3	1.3
0.60	2.1	1.5	1.5
0.65	3.1	1.7	1.7
0.70	5.0	1.9	1.9

Cargo mass in ton prevented from tipping *per* top-over lashing								
SIDEWAYS						FORWARD		BACKWARD
H/B	1 row	2 rows	3 rows	4 rows	5 rows	H/L	per section	per section
0.6	no tip	no tip	2.4	1.4	1.0	0.6	18	18
0.8	no tip	3.2	1.2	0.81	0.66	0.8	5.9	5.9
1.0	no tip	1.5	0.77	0.57	0.48	1.0	3.5	3.5
1.2	no tip	0.97	0.57	0.44	0.38	1.2	2.5	2.5
1.4	5.9	0.72	0.46	0.36	0.31	1.4	2.0	2.0
1.6	2.5	0.57	0.38	0.31	0.27	1.6	1.6	1.6
1.8	1.6	0.47	0.32	0.26	0.23	1.8	1.4	1.4
2.0	1.2	0.41	0.28	0.23	0.21	2.0	1.2	1.2
2.2	0.93	0.35	0.25	0.21	0.18	2.2	0.93	1.0
2.4	0.77	0.31	0.23	0.19	0.17	2.4	0.77	0.93
2.6	0.66	0.28	0.21	0.17	0.15	2.6	0.66	0.84
2.8	0.57	0.26	0.19	0.16	0.14	2.8	0.57	0.77
3.0	0.51	0.23	0.17	0.15	0.13	3.0	0.51	0.71

WEBBING

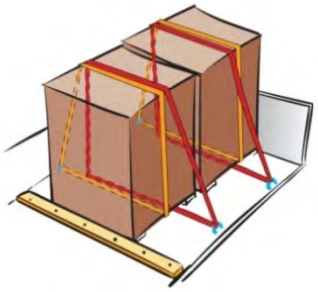
Half-loop lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

The masses in the tables below are valid for one pair of half loop lashings.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

HALF LOOP LASHING SLIDING



Cargo mass in ton prevented from sliding *per* pair of half loop lashing	
μ	**SIDEWAYS**
0.00	2.5
0.05	2.8
0.10	3.0
0.15	3.3
0.20	3.6
0.25	4.0
0.30	4.3
0.35	4.8
0.40	5.3
0.45	5.9
0.50	6.6
0.55	7.4
0.60	8.4
0.65	9.7
0.70	11

Cargo mass in ton prevented from tipping *per* pair of half loop lashing					
SIDEWAYS					
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**
0.6	no tip	no tip	7.0	3.9	2.9
0.8	no tip	9.1	3.3	2.3	1.9
1.0	no tip	4.2	2.2	1.6	1.4
1.2	no tip	2.8	1.6	1.3	1.1
1.4	17	2.1	1.3	1.0	0.89
1.6	7.3	1.6	1.1	0.87	0.76
1.8	4.6	1.4	0.92	0.75	0.66
2.0	3.4	1.2	0.80	0.66	0.58
2.2	2.7	1.0	0.71	0.59	0.52
2.4	2.2	0.90	0.64	0.53	0.47
2.6	1.9	0.81	0.58	0.49	0.43
2.8	1.6	0.73	0.53	0.45	0.40
3.0	1.5	0.67	0.49	0.41	0.37

WEBBING

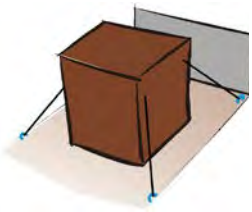
Straight lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

All masses are valid for one straight lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

STRAIGHT LASHING SLIDING



Cargo mass in ton prevented from sliding *per* straight lashing			
μ	**SIDEWAYS per side**	**FORWARD**	**BACKWARD**
0.00	0.64	0.64	1.0
0.05	0.76	0.76	1.2
0.10	0.89	0.89	1.5
0.15	1.0	1.0	1.8
0.20	1.2	1.2	2.1
0.25	1.4	1.4	2.3
0.30	1.6	1.6	2.6
0.35	1.8	1.8	2.8
0.40	2.1	2.1	3.1
0.45	2.4	2.4	3.3
0.50	2.8	2.8	3.6
0.55	3.2	3.2	3.9
0.60	3.7	3.7	4.2
0.65	4.4	4.4	4.5
0.70	5.2	4.8	4.8

Cargo mass in ton prevented from tipping *per* straight lashing				
H/B	**SIDEWAYS per side**	**H/L**	**FORWARD**	**BACKWARD**
0.6	no tip	**0.6**	20	20
0.8	no tip	**0.8**	7.6	7.6
1.0	no tip	**1.0**	5.1	5.1
1.2	no tip	**1.2**	4.0	4.0
1.4	10	**1.4**	3.4	3.4
1.6	4.7	**1.6**	3.0	3.0
1.8	3.2	**1.8**	2.7	2.7
2.0	2.5	**2.0**	2.5	2.5
2.2	2.1	**2.2**	2.1	2.4
2.4	1.9	**2.4**	1.9	2.3
2.6	1.7	**2.6**	1.7	2.2
2.8	1.6	**2.8**	1.6	2.1
3.0	1.5	**3.0**	1.5	2.0

WEBBING

Spring lashings

The tables are valid for **webbing** with an MSL of 20 kN or 2,000 daN - (2,000 kg = 2 ton) and a pre-tension of minimum 4 kN or 400 daN - (400 kg).

The masses in the tables are valid for one spring lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

SPRING LASHING

Cargo mass in ton prevented from sliding *per* spring lashing		
μ	**FORWARD**	**BACKWARD**
0.00	3.6	5.8
0.05	3.9	6.5
0.10	4.3	7.3
0.15	4.7	8.3
0.20	5.1	9.0
0.25	5.6	9.4
0.30	6.1	9.9
0.35	6.8	10
0.40	7.5	11
0.45	8.3	12
0.50	9.3	12
0.55	11	13
0.60	12	13
0.65	14	14
0.70	15	15

Cargo mass in ton prevented from tipping *per* spring lashing		
H/L	**FORWARD**	**REARWARD**
0.6	86	86
0.8	38	38
1.0	29	29
1.2	25	25
1.4	22	22
1.6	21	21
1.8	20	20
2.0	19	19
2.2	17	19
2.4	15	18
2.6	14	18
2.8	13	18
3.0	12	17

CHAIN

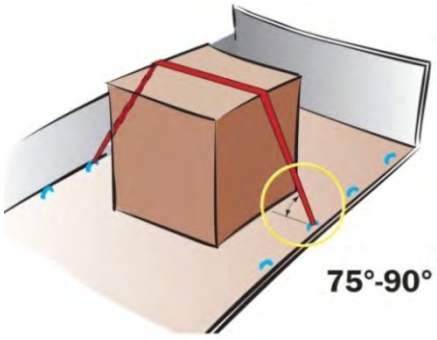
Top-over lashings

The tables are valid for **chain (∅ 9 mm, class 8)** with an MSL of 50 kN or 5,000 daN - (5,000 kg = 5 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

The values in the tables are proportional to the pre-tension in the lashings.

The masses in the tables are valid for one top-over lashing.

TOP-OVER LASHING



Cargo mass in ton prevented from sliding *per* top-over lashing			
μ	SIDEWAYS	FORWARD	BACKWARD
0.00	0.00	0.00	0.00
0.05	0.12	0.12	0.20
0.10	0.25	0.25	0.44
0.15	0.41	0.41	0.72
0.20	0.59	0.59	0.98
0.25	0.81	0.81	1.3
0.30	1.1	1.1	1.6
0.35	1.4	1.4	1.9
0.40	1.8	1.8	2.2
0.45	2.3	2.3	2.6
0.50	3.0	3.0	3.0
0.55	3.9	3.4	3.4
0.60	5.3	3.8	3.8
0.65	7.7	4.3	4.3
0.70	12	4.8	4.8

Cargo mass in ton prevented from tipping *per* top-over lashing								
SIDEWAYS						FORWARD		BACKWARD
H/B	1 row	2 rows	3 rows	4 rows	5 rows	H/L	per section	per section
0.6	no tip	no tip	6.1	3.4	2.6	**0.6**	44	44
0.8	no tip	8.0	2.9	2.0	1.6	**0.8**	15	15
1.0	no tip	3.7	1.9	1.4	1.2	**1.0**	8.9	8.9
1.2	no tip	2.4	1.4	1.1	0.95	**1.2**	6.3	6.3
1.4	15	1.8	1.1	0.90	0.78	**1.4**	4.9	4.9
1.6	6.3	1.4	0.95	0.76	0.67	**1.6**	4.0	4.0
1.8	4.0	1.2	0.81	0.66	0.58	**1.8**	3.4	3.4
2.0	3.0	1.0	0.71	0.58	0.52	**2.0**	3.0	3.0
2.2	2.3	0.89	0.63	0.52	0.46	**2.2**	2.3	2.6
2.4	1.9	0.79	0.57	0.47	0.42	**2.4**	1.9	2.3
2.6	1.6	0.71	0.51	0.43	0.38	**2.6**	1.6	2.1
2.8	1.4	0.64	0.47	0.40	0.35	**2.8**	1.4	1.9
3.0	1.3	0.59	0.43	0.37	0.33	**3.0**	1.3	1.8

CHAIN

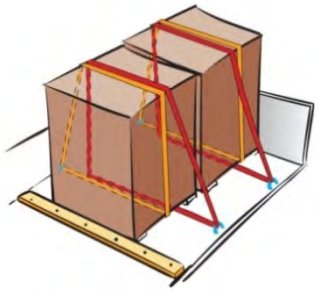
Half-loop lashings

The tables are valid for chain (∅ 9 mm, class 8) with an MSL of 50 kN or 5,000 daN - (5,000 kg = 5 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

The masses in the tables below are valid for one pair of half loop lashings.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

HALF LOOP LASHING
SLIDING



Cargo mass in ton prevented from sliding *per* pair of half loop lashing	
μ	**SIDEWAYS**
0.00	6.4
0.05	6.9
0.10	7.6
0.15	8.2
0.20	9.0
0.25	9.9
0.30	11
0.35	12
0.40	13
0.45	15
0.50	16
0.55	19
0.60	21
0.65	24
0.70	28

Cargo mass in ton prevented from tipping *per* pair of half loop lashing					
SIDEWAYS					
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**
0.6	no tip	no tip	17	9.7	7.3
0.8	no tip	23	8.3	5.7	4.6
1.0	no tip	11	5.5	4.1	3.4
1.2	no tip	6.9	4.1	3.1	2.7
1.4	42	5.1	3.2	2.6	2.2
1.6	18	4.1	2.7	2.2	1.9
1.8	12	3.4	2.3	1.9	1.6
2.0	8.5	2.9	2.0	1.7	1.5
2.2	6.7	2.5	1.8	1.5	1.3
2.4	5.5	2.2	1.6	1.3	1.2
2.6	4.7	2.0	1.5	1.2	1.1
2.8	4.1	1.8	1.3	1.1	1.00
3.0	3.6	1.7	1.2	1.0	0.93

CHAIN

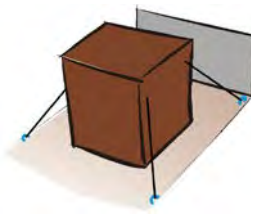
Straight lashings

The tables are valid for **chain (∅ 9 mm, class 8)** with an MSL of 50 kN or 5,000 daN - (5,000 kg = 5 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

All masses are valid for one straight lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

STRAIGHT LASHING SLIDING



Cargo mass in ton prevented from sliding *per* straight lashing			
μ	**SIDEWAYS per side**	**FORWARD**	**BACKWARD**
0.00	1.6	1.6	2.5
0.05	1.9	1.9	3.1
0.10	2.2	2.2	3.8
0.15	2.6	2.6	4.6
0.20	3.0	3.0	5.2
0.25	3.4	3.4	5.8
0.30	3.9	3.9	6.4
0.35	4.5	4.5	7.0
0.40	5.2	5.2	7.6
0.45	6.0	6.0	8.3
0.50	6.9	6.9	9.0
0.55	8.0	8.0	9.7
0.60	9.3	9.3	11
0.65	11	11	11
0.70	13	12	12

Cargo mass in ton prevented from tipping *per* straight lashing				
H/B	**SIDEWAYS per side**	**H/L**	**FORWARD**	**BACKWARD**
0.6	no tip	**0.6**	51	51
0.8	no tip	**0.8**	19	19
1.0	no tip	**1.0**	13	13
1.2	no tip	**1.2**	10	10
1.4	25	**1.4**	8.5	8.5
1.6	12	**1.6**	7.5	7.5
1.8	8.1	**1.8**	6.9	6.9
2.0	6.4	**2.0**	6.4	6.4
2.2	5.4	**2.2**	5.4	6.0
2.4	4.7	**2.4**	4.7	5.7
2.6	4.2	**2.6**	4.2	5.5
2.8	3.9	**2.8**	3.9	5.3
3.0	3.6	**3.0**	3.6	5.1

CHAIN

Spring lashings

The tables are valid for **chain (∅ 9 mm, class 8)** with an MSL of 50 kN or 5,000 daN - (5,000 kg = 5 ton) and a pre-tension of minimum 10 kN or 1000 daN - (1,000 kg = 1 ton).

The masses in the tables are valid for one spring lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

SPRING LASHING

Cargo mass in ton prevented from sliding *per* spring lashing		
μ	**FORWARD**	**BACKWARD**
0.00	9.0	14
0.05	9.8	16
0.10	11	18
0.15	12	21
0.20	13	22
0.25	14	24
0.30	15	25
0.35	17	26
0.40	19	28
0.45	21	29
0.50	23	30
0.55	26	32
0.60	30	34
0.65	34	35
0.70	37	37

Cargo mass in ton prevented from tipping *per* spring lashing		
H/L	**FORWARD**	**REARWARD**
0.6	216	216
0.8	96	96
1.0	72	72
1.2	62	62
1.4	56	56
1.6	52	52
1.8	50	50
2.0	48	48
2.2	42	47
2.4	38	46
2.6	35	45
2.8	33	44
3.0	31	43

STEEL STRAPPING

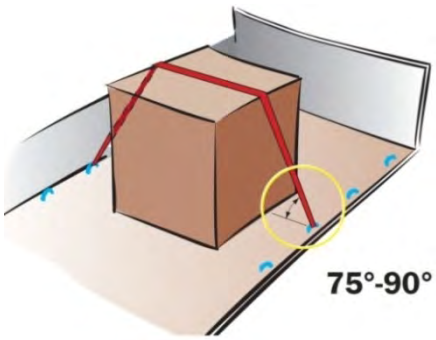
Top-over lashings

The tables are valid for **steel strapping** (**32 × 0.8 mm)** with an MSL of 17 kN or 1700 daN - (1,700 kg = 1.7 ton) and a pre-tension of minimum 2.4 kN or 240 daN - (240 kg).

The values in the tables are proportional to the pre-tension in the lashings.

The masses in the tables are valid for one top-over lashing.

TOP-OVER LASHING

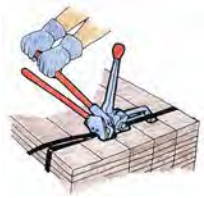


Cargo mass in ton prevented from sliding *per* top-over lashing			
μ	**SIDEWAYS**	**FORWARD**	**BACKWARD**
0.00	0.00	0.00	0.00
0.05	0.03	0.03	0.05
0.10	0.06	0.06	0.11
0.15	0.10	0.10	0.17
0.20	0.14	0.14	0.24
0.25	0.19	0.19	0.30
0.30	0.26	0.26	0.38
0.35	0.33	0.33	0.45
0.40	0.43	0.43	0.53
0.45	0.55	0.55	0.62
0.50	0.71	0.71	0.71
0.55	0.94	0.81	0.81
0.60	1.3	0.91	0.91
0.65	1.8	1.0	1.0
0.70	3.0	1.1	1.1

Cargo mass in ton prevented from tipping *per* top-over lashing								
SIDEWAYS							**FORWARD**	**BACKWARD**
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**	**H/L**	**per section**	**per section**
0.6	no tip	no tip	1.5	0.82	0.62	**0.6**	11	11
0.8	no tip	1.9	0.70	0.48	0.39	**0.8**	3.5	3.5
1.0	no tip	0.89	0.46	0.34	0.29	**1.0**	2.1	2.1
1.2	no tip	0.58	0.34	0.27	0.23	**1.2**	1.5	1.5
1.4	3.5	0.43	0.27	0.22	0.19	**1.4**	1.2	1.2
1.6	1.5	0.34	0.23	0.18	0.16	**1.6**	0.97	0.97
1.8	0.97	0.28	0.19	0.16	0.14	**1.8**	0.82	0.82
2.0	0.71	0.24	0.17	0.14	0.12	**2.0**	0.71	0.71
2.2	0.56	0.21	0.15	0.13	0.11	**2.2**	0.56	0.63
2.4	0.46	0.19	0.14	0.11	0.10	**2.4**	0.46	0.56
2.6	0.39	0.17	0.12	0.10	0.09	**2.6**	0.39	0.51
2.8	0.34	0.15	0.11	0.09	0.08	**2.8**	0.34	0.46
3.0	0.30	0.14	0.10	0.09	0.08	**3.0**	0.30	0.43

STEEL STRAPPING

Half-loop lashings

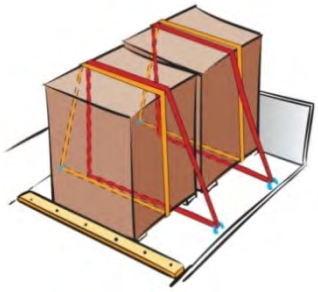


The tables are valid for steel strapping (32 × 0.8 mm) with an MSL of 17 kN or 1,700 daN - (1,700 kg = 1.7 ton) and a pre-tension of minimum 2.4 kN or 240 daN - (240 kg).

The masses in the tables below are valid for one pair of half loop lashings.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

HALF LOOP LASHING
SLIDING



Cargo mass in ton prevented from sliding *per* pair of half loop lashing	
μ	**SIDEWAYS**
0.00	2.2
0.05	2.4
0.10	2.6
0.15	2.8
0.20	3.1
0.25	3.4
0.30	3.7
0.35	4.1
0.40	4.5
0.45	5.0
0.50	5.6
0.55	6.3
0.60	7.2
0.65	8.2
0.70	9.6

Cargo mass in ton prevented from tipping *per* pair of half loop lashing					
SIDEWAYS					
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**
0.6	no tip	no tip	5.9	3.3	2.5
0.8	no tip	7.7	2.8	1.9	1.6
1.0	no tip	3.6	1.9	1.4	1.2
1.2	no tip	2.4	1.4	1.1	0.91
1.4	14	1.7	1.1	0.87	0.75
1.6	6.2	1.4	0.92	0.74	0.64
1.8	3.9	1.2	0.78	0.64	0.56
2.0	2.9	0.98	0.68	0.56	0.50
2.2	2.3	0.86	0.61	0.50	0.44
2.4	1.9	0.76	0.55	0.45	0.40
2.6	1.6	0.69	0.50	0.41	0.37
2.8	1.4	0.62	0.45	0.38	0.34
3.0	1.2	0.57	0.42	0.35	0.32

STEEL STRAPPING

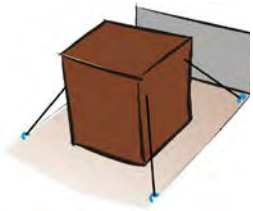
Straight lashings

The tables are valid for **steel strapping** (**32 × 0.8 mm)** with an MSL of 17 kN or 1,700 daN - (1,700 kg = 1.7 ton) and a pre-tension of minimum 2.4 kN or 240 daN - (240 kg).

All masses are valid for one straight lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

STRAIGHT LASHING
SLIDING



Cargo mass in ton prevented from sliding *per* straight lashing			
μ	**SIDEWAYS per side**	**FORWARD**	**BACKWARD**
0.00	0.54	0.54	0.87
0.05	0.64	0.64	1.1
0.10	0.75	0.75	1.3
0.15	0.88	0.88	1.6
0.20	1.0	1.0	1.8
0.25	1.2	1.2	2.0
0.30	1.3	1.3	2.2
0.35	1.5	1.5	2.4
0.40	1.8	1.8	2.6
0.45	2.0	2.0	2.8
0.50	2.3	2.3	3.1
0.55	2.7	2.7	3.3
0.60	3.2	3.2	3.6
0.65	3.7	3.7	3.9
0.70	4.4	4.1	4.1

Cargo mass in ton prevented from tipping *per* straight lashing				
H/B	**SIDEWAYS per side**	**H/L**	**FORWARD**	**BACKWARD**
0.6	no tip	**0.6**	17	17
0.8	no tip	**0.8**	6.5	6.5
1.0	no tip	**1.0**	4.3	4.3
1.2	no tip	**1.2**	3.4	3.4
1.4	8.7	**1.4**	2.9	2.9
1.6	4.0	**1.6**	2.6	2.6
1.8	2.8	**1.8**	2.3	2.3
2.0	2.2	**2.0**	2.2	2.2
2.2	1.8	**2.2**	1.8	2.0
2.4	1.6	**2.4**	1.6	1.9
2.6	1.4	**2.6**	1.4	1.9
2.8	1.3	**2.8**	1.3	1.8
3.0	1.2	**3.0**	1.2	1.7

STEEL STRAPPING

Spring lashings

The tables are valid for **steel strapping (32 × 0.8 mm)** with an MSL of 17 kN or 1,700 daN - (1,700 kg = 1.7 ton) and a pre-tension of minimum 2.4 kN or 240 daN - (240 kg).

The masses in the tables are valid for one spring lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

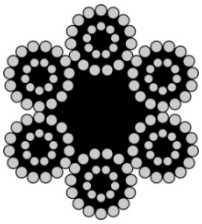
SPRING LASHING

Cargo mass in ton prevented from sliding *per* spring lashing		
μ	**FORWARD**	**BACKWARD**
0.00	3.1	4.9
0.05	3.3	5.5
0.10	3.6	6.2
0.15	4.0	7.0
0.20	4.3	7.6
0.25	4.8	8.0
0.30	5.2	8.5
0.35	5.8	8.9
0.40	6.4	9.4
0.45	7.1	9.9
0.50	7.9	10
0.55	8.9	11
0.60	10	11
0.65	12	12
0.70	13	13

Cargo mass in ton prevented from tipping *per* spring lashing		
H/L	**FORWARD**	**REARWARD**
0.6	74	74
0.8	33	33
1.0	25	25
1.2	21	21
1.4	19	19
1.6	18	18
1.8	17	17
2.0	16	16
2.2	14	16
2.4	13	15
2.6	12	15
2.8	11	15
3.0	11	15

WIRE

Top-over lashings

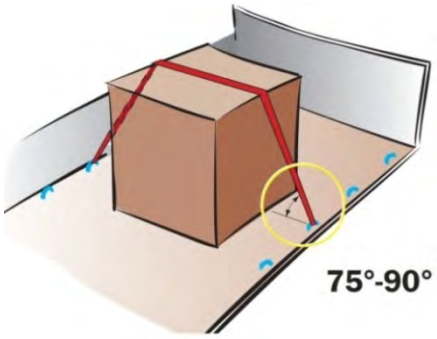


The tables are valid for **steel wire rope (∅ 16 mm/144 wires)** with an MSL of 91 kN or 9,100 daN - (9,100 kg = 9.1 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

The values in the tables are proportional to the pre-tension in the lashings.

The masses in the tables are valid for one top-over lashing.

TOP-OVER LASHING

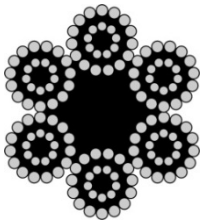


Cargo mass in ton prevented from sliding *per* top-over lashing			
μ	SIDEWAYS	FORWARD	BACKWARD
0.00	0.00	0.00	0.00
0.05	0.12	0.12	0.20
0.10	0.25	0.25	0.44
0.15	0.41	0.41	0.72
0.20	0.59	0.59	0.98
0.25	0.81	0.81	1.3
0.30	1.1	1.1	1.6
0.35	1.4	1.4	1.9
0.40	1.8	1.8	2.2
0.45	2.3	2.3	2.6
0.50	3.0	3.0	3.0
0.55	3.9	3.4	3.4
0.60	5.3	3.8	3.8
0.65	7.7	4.3	4.3
0.70	12	4.8	4.8

Cargo mass in ton prevented from tipping *per* top-over lashing								
SIDEWAYS						FORWARD	BACKWARD	
H/B	1 row	2 rows	3 rows	4 rows	5 rows	H/L	per section	per section
0.6	no tip	no tip	6.1	3.4	2.6	**0.6**	44	44
0.8	no tip	8.0	2.9	2.0	1.6	**0.8**	15	15
1.0	no tip	3.7	1.9	1.4	1.2	**1.0**	8.9	8.9
1.2	no tip	2.4	1.4	1.1	0.95	**1.2**	6.3	6.3
1.4	15	1.8	1.1	0.90	0.78	**1.4**	4.9	4.9
1.6	6.3	1.4	0.95	0.76	0.67	**1.6**	4.0	4.0
1.8	4.0	1.2	0.81	0.66	0.58	**1.8**	3.4	3.4
2.0	3.0	1.0	0.71	0.58	0.52	**2.0**	3.0	3.0
2.2	2.3	0.89	0.63	0.52	0.46	**2.2**	2.3	2.6
2.4	1.9	0.79	0.57	0.47	0.42	**2.4**	1.9	2.3
2.6	1.6	0.71	0.51	0.43	0.38	**2.6**	1.6	2.1
2.8	1.4	0.64	0.47	0.40	0.35	**2.8**	1.4	1.9
3.0	1.3	0.59	0.43	0.37	0.33	**3.0**	1.3	1.8

WIRE

Half-loop lashings

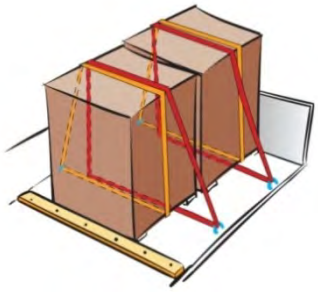


The tables are valid for **steel wire rope (∅ 16 mm/144 wires)** with an MSL of 91 kN or 9,100 daN - (9,100 kg = 9.1 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

The masses in the tables below are valid for one pair of half loop lashings.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

HALF LOOP LASHING SLIDING

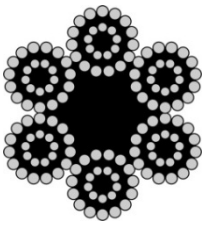


Cargo mass in ton prevented from sliding *per* pair of half loop lashing	
μ	**SIDEWAYS**
0.00	12
0.05	13
0.10	14
0.15	15
0.20	16
0.25	18
0.30	20
0.35	22
0.40	24
0.45	27
0.50	30
0.55	34
0.60	38
0.65	44
0.70	51

Cargo mass in ton prevented from tipping *per* pair of half loop lashing					
SIDEWAYS					
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**
0.6	no tip	no tip	32	18	13
0.8	no tip	41	15	10	8.4
1.0	no tip	19	9.9	7.4	6.2
1.2	no tip	13	7.4	5.7	4.9
1.4	77	9.4	5.9	4.7	4.0
1.6	33	7.4	4.9	3.9	3.4
1.8	21	6.2	4.2	3.4	3.0
2.0	15	5.3	3.7	3.0	2.7
2.2	12	4.6	3.3	2.7	2.4
2.4	10	4.1	2.9	2.4	2.2
2.6	8.6	3.7	2.7	2.2	2.0
2.8	7.5	3.3	2.4	2.0	1.8
3.0	6.6	3.1	2.2	1.9	1.7

WIRE

Straight lashings

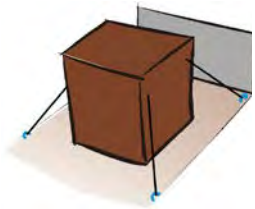


The tables are valid for **steel wire rope (∅ 16 mm/144 wires)** with an MSL of 91 kN or 9,100 daN - (9,100 kg = 9.1 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

All masses are valid for one straight lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

STRAIGHT LASHING SLIDING

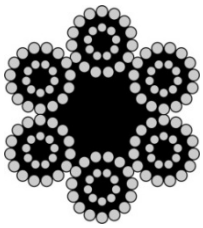


Cargo mass in ton prevented from sliding *per* straight lashing			
μ	**SIDEWAYS per side**	**FORWARD**	**BACKWARD**
0.00	2.9	2.9	4.6
0.05	3.4	3.4	5.7
0.10	4.0	4.0	6.9
0.15	4.7	4.7	8.3
0.20	5.4	5.4	9.5
0.25	6.2	6.2	11
0.30	7.2	7.2	12
0.35	8.2	8.2	13
0.40	9.5	9.5	14
0.45	11	11	15
0.50	13	13	16
0.55	15	15	18
0.60	17	17	19
0.65	20	20	21
0.70	23	22	22

Cargo mass in ton prevented from tipping *per* straight lashing				
H/B	**SIDEWAYS per side**	**H/L**	**FORWARD**	**BACKWARD**
0.6	no tip	**0.6**	93	93
0.8	no tip	**0.8**	35	35
1.0	no tip	**1.0**	23	23
1.2	no tip	**1.2**	18	18
1.4	46	**1.4**	15	15
1.6	22	**1.6**	14	14
1.8	15	**1.8**	12	12
2.0	12	**2.0**	12	12
2.2	9.8	**2.2**	9.8	11
2.4	8.6	**2.4**	8.6	10
2.6	7.7	**2.6**	7.7	9.9
2.8	7.1	**2.8**	7.1	9.6
3.0	6.6	**3.0**	6.6	9.3

WIRE

Spring lashings



The tables are valid for **steel wire rope (∅ 16 mm/144 wires)** with an MSL of 91 kN or 9,100 daN - (9,100 kg = 9.1 ton) and a pre-tension of minimum 10 kN or 1,000 daN - (1,000 kg = 1 ton).

The masses in the tables are valid for one spring lashing.

The values in the tables are proportional to the maximum securing load (MSL) in the lashings.

SPRING LASHING

Cargo mass in ton prevented from sliding *per* spring lashing		
μ	**FORWARD**	**BACKWARD**
0.00	16	26
0.05	18	29
0.10	19	33
0.15	21	38
0.20	23	41
0.25	25	43
0.30	28	45
0.35	31	48
0.40	34	50
0.45	38	53
0.50	42	56
0.55	48	58
0.60	54	61
0.65	62	65
0.70	68	68

Cargo mass in ton prevented from tipping *per* spring lashing		
H/L	**FORWARD**	**REARWARD**
0.6	394	394
0.8	175	175
1.0	131	131
1.2	112	112
1.4	102	102
1.6	95	95
1.8	91	91
2.0	87	87
2.2	76	85
2.4	68	83
2.6	63	81
2.8	59	80
3.0	56	79

TAG WASHERS AND NAILS

TAG WASHER

Approximate cargo mass in ton prevented from sliding by one tag washer for wood on wood in combination with top-over lashing only

μ **	SIDEWAYS						
	∅ 48	∅ 62	∅ 75	∅ 95	30×57	48×65	130×130
MBL (ton)	0.5	0.7	0.9	1.2	0.5	0.7	1.5
0.10	0.18	0.25	0.32	0.43	0.18	0.25	0.54
0.20	0.21	0.29	0.38	0.50	0.21	0.29	0.63
0.30	0.25	0.35	0.45	0.60	0.25	0.35	0.75
	FORWARD						
0.10	0.18	0.25	0.32	0.43	0.18	0.25	0.54
0.20	0.21	0.29	0.38	0.50	0.21	0.29	0.63
0.30	0.25	0.35	0.45	0.60	0.25	0.35	0.75
	BACKWARD						
0.10	0.31	0.44	0.56	0.75	0.31	0.44	0.94
0.20	0.35	0.49	0.63	0.83	0.35	0.49	1.0
0.30	0.37	0.51	0.66	0.88	0.37	0.51	1.1

** Between tag washer and platform bed/cargo.

4" – NAIL

Approximate cargo mass in ton prevented from sliding by one nail

μ ***	SIDEWAYS per side		FORWARD		BACKWARD	
	blank	galvanised	blank	galvanised	blank	galvanised
MBL (ton)	0.22	0.32	0.22	0.32	0.22	0.32
0.00	0.14	0.20	0.14	0.20	0.22	0.32
0.05	0.15	0.21	0.15	0.21	0.24	0.36
0.10	0.16	0.23	0.16	0.23	0.28	0.40
0.15	0.17	0.25	0.17	0.25	0.30	0.43
0.20	0.18	0.27	0.18	0.27	0.31	0.44
0.25	0.20	0.29	0.20	0.29	0.31	0.46
0.30	0.22	0.32	0.22	0.32	0.32	0.47
0.35	0.24	0.36	0.24	0.36	0.33	0.48
0.40	0.28	0.40	0.28	0.40	0.34	0.50
0.45	0.31	0.46	0.31	0.46	0.35	0.52
0.50	0.37	0.53	0.37	0.53	0.37	0.53
0.55	0.44	0.64	0.38	0.55	0.38	0.55
0.60	0.55	0.80	0.39	0.57	0.39	0.57
0.65	0.73	1.1	0.41	0.59	0.41	0.59
0.70	1.1	1.6	0.42	0.62	0.42	0.62

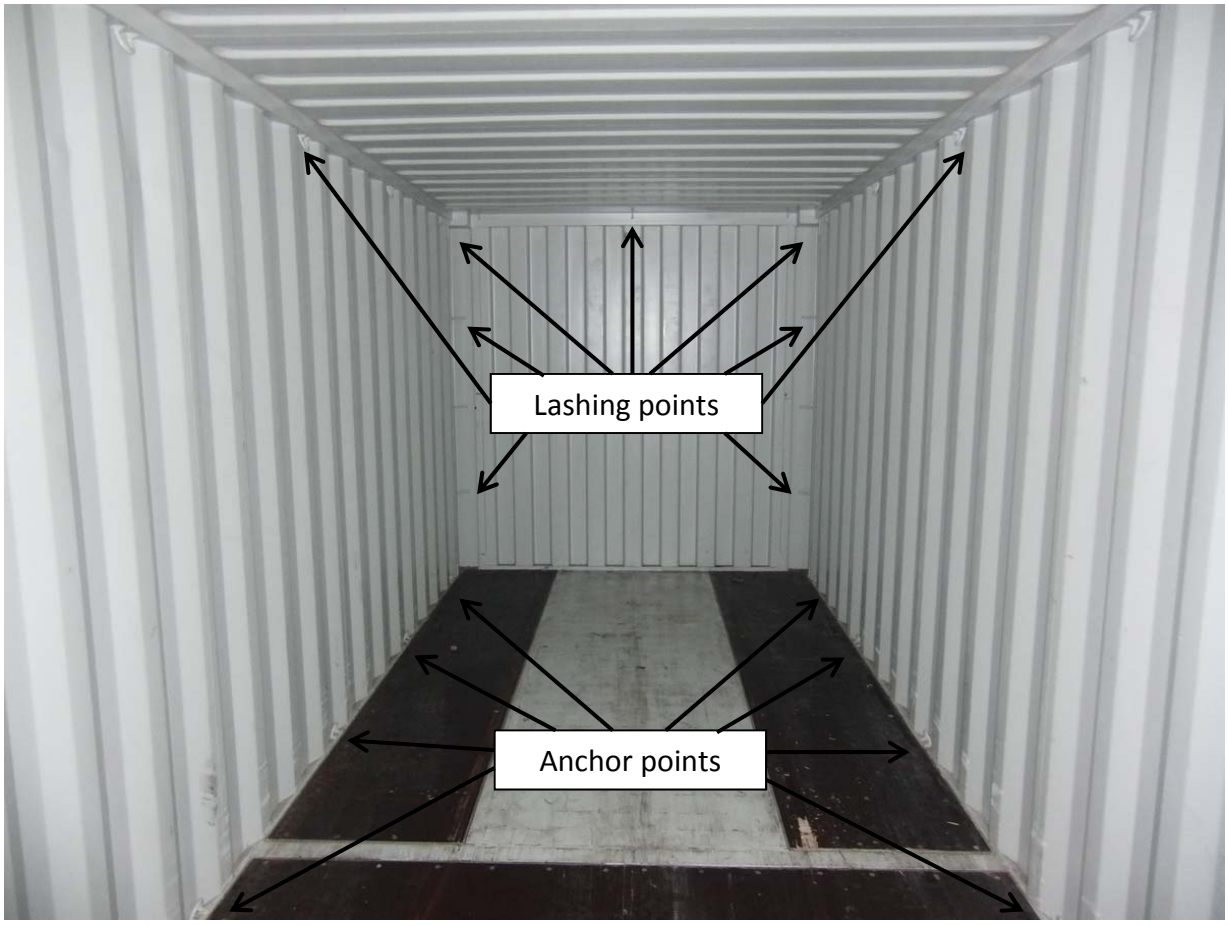
*** Between cargo and platform bed.

Appendix 5 – Strength in container lashing fittings

For general purpose containers, cargo securing fittings are optional. However, when fitted, they shall comply with the requirements of Annex F of the container standard ISO 1496-1. This standard makes a separation between two types of fittings:

- **Anchor points** – Securing devices located in the base structure
- **Lashing points** – Securing devices located in any other part of the container

Each anchor point shall provide a minimum rated load of 1 000 kg in any direction.
Each lashing point shall provide a minimum rated load of 500 kg in any direction



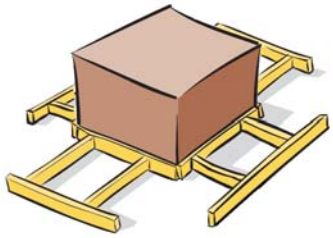
Appendix 6 – Blocking by timber

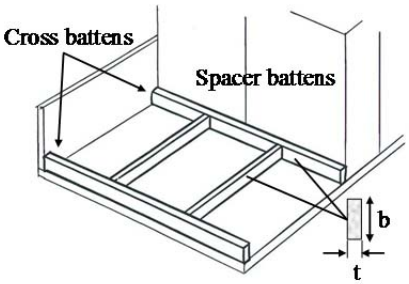
If there is a risk that the cargo will slide and/or tip, some type of cargo securing arrangement should be used to prevent the motion. Due to the limited strength in container lashing fittings, see Appendix 5, they cannot be used for securing of heavy cargo.

Thus, heavy cargo has to be blocked to the framework of the container. And, when it comes to heavy cargo any void space should be avoided.

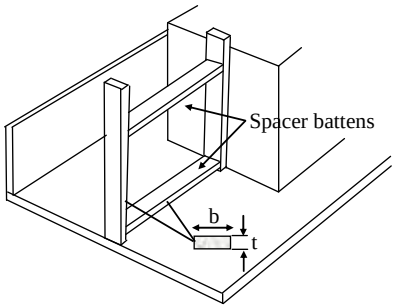
To prevent sliding the cargo may be bottom blocked by H-frames according to the principle in the figure to the left below.

The total compressive force, P, in ton of the blocking timber is derived from the following table. If the spacer battens are nailed to the platform and buckling is avoided, the blocking strength can be found in the column for L = 0.5.





Laying double H-frame



Standing double H-frame

Timber design	Compressive force **P** (ton) of blocking for 2 **spacer battens** with varying lengths L					
t × b mm	0.5 m	1.0 m	1.5 m	2.0 m	2.5 m	3.0 m
25 × 50	2.6					
25 × 75	4.0					
50 × 50	7.5	5.3	3.0	1.7		
50 × 75	11.3	7.9	4.6	2.6	1.7	
50 × 100	15.1	10.6	6.1	3.4	2.2	
50 × 150	22.6	15.9	9.1	5.1	3.3	2.3
75 × 75	18.6	15.3	11.9	8.5	5.6	3.9
75 × 100	24.8	20.3	15.9	11.4	7.4	5.1
75 × 150		30.5	23.8	17.1	11.1	7.7
75 × 200			31.7	22.7	14.8	10.3
100 × 100		30.1	25.6	21.2	16.7	12.2
125 × 125					33.4	27.4

The compressive force P in above table is valid for two spacer battens. If three spacer battens are used instead of two the compressive force will increase the compressive force with 40 %, i.e. the values in above table will increase with a factor 1.4.

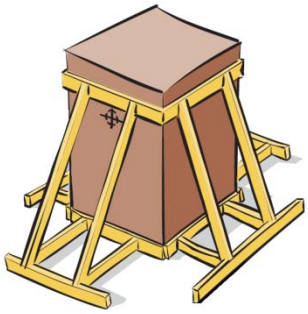
Required compressive force *P* is calculated according to the following formula:

$$P = m \cdot c_x \cdot g - m \cdot c_z \cdot g \cdot \mu$$

where *m* is the weight of the cargo, c_x the horizontal acceleration in longitudinal direction, *g* the gravity acceleration, c_z the vertical acceleration and μ the friction factor.

To prevent sliding the H-frames between the cargo and the container sides can be replaced by air bags or sound timber filling the entire space.

To prevent tipping in longitudinal and transverse direction, diagonal timber supports could be applied according to the principle in the figure below. To save space, these supports could alternatively be horizontal and be placed between cargo and the corner posts of the container.



As an alternative to diagonal timber supports to prevent tipping sideways the gap between the container sides and the cargo can be filled out. Note that vertical timbers must be placed from floor to roof against the container sides to avoid spot loads on the sides.

Accordingly, the best way of securing cargo in containers is to block it against the long sides and gables. Also the doors may be used for blocking but note that the cargo must be prevented from falling out when the doors are opened.