Appendix 2. Quick Lashing Guide

The quick lashing guide offers practical, simplified instructions for securing cargo in accordance with the formulas in the European standard EN 12195-1:2010 as well as the principles set out in these guidelines.

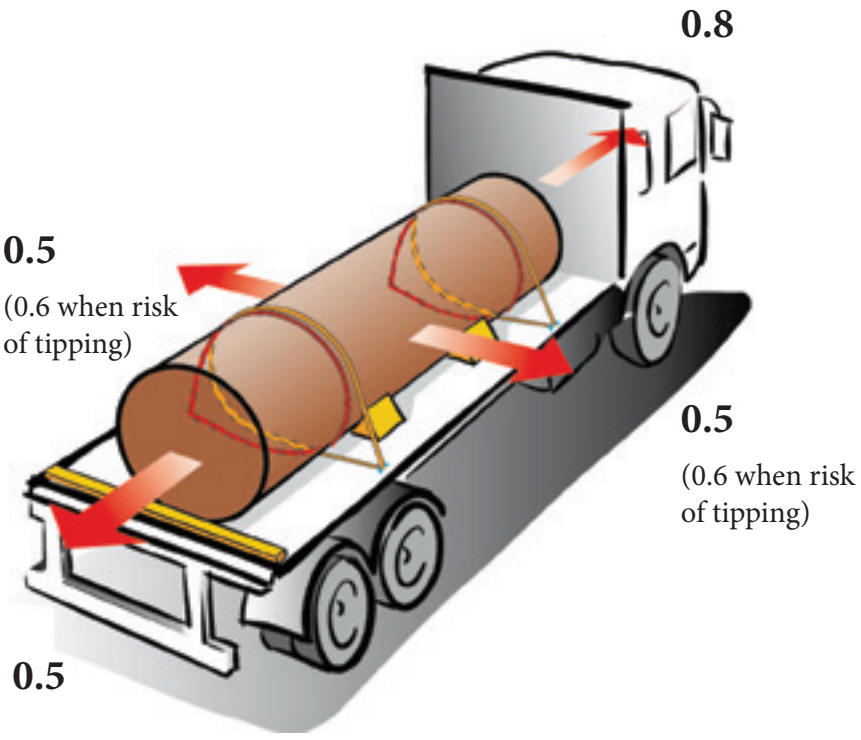
A.2.1. Procedure and limitations

The lashing tables in this Quick Lashing Guide show the cargo weight in ton (1000 kg) prevented from sliding or tipping per lashing. The values in the tables are rounded to two significant figures.

"no risk" indicated in the tables means that there is no risk of the cargo sliding or tipping. Even if there is neither sliding nor tipping risk, it is recommended to 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.

A.2.2. The cargo securing arrangement must carry...

... 0.8 of the cargo weight forwards
... 0.5 of the cargo weight sideways and towards the rear
... 0.6 of the cargo weight sideways if there is risk of the cargo tipping



A.2.3. Conditions for securing with this Quick Lashing Guide

The cargo must be prevented from sliding and tipping in all directions when exposed to forces occurring during transport.

The securing of cargo must be done using locking, blocking, lashing or a combination of these techniques.

Lashing equipment

The values in the tables in this Quick Lashing Guide have been calculated on the assumption that the;

... *lashing points* resist 2000 daN (2 tons under stress)

... *lashings* have a Lashing Capacity (LC) of 1600 daN (1.6 tons under stress)

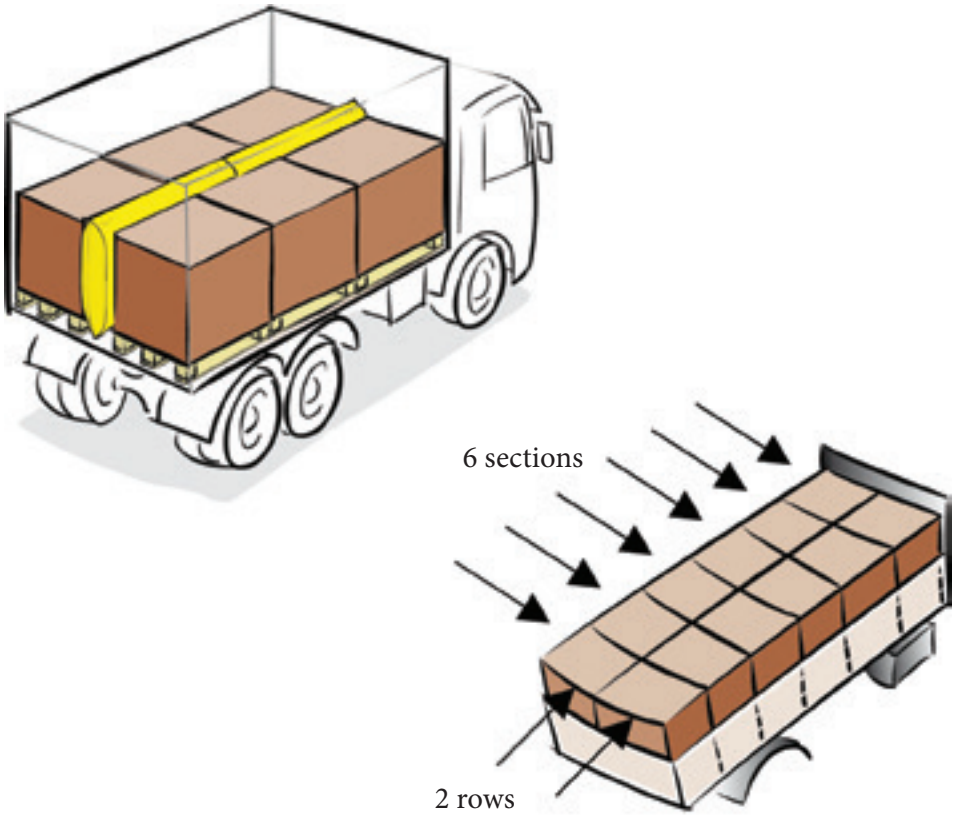
... *lashings* with S_{TF} = 400 daN (tightened to 400 kg).

The lashings must be tightened to a minimum of 400 daN (400 kg) throughout the transport.

A.2.4. Blocking

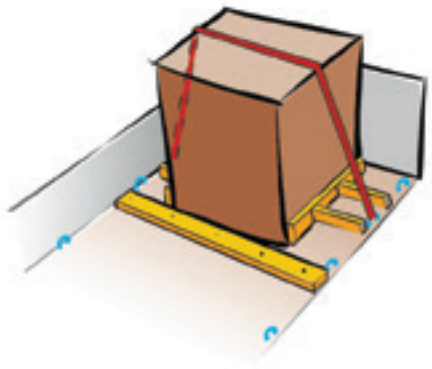
Where possible blocking should be used as method to secure the cargo

Blocking involves positioning the cargo, or parts of the cargo directly to the headboard, sideboards, stanchions, supports, walls or parts of the cargo to stop it from moving. In case of global blocking, the sum of void spaces in any horizontal direction should not exceed 15 cm. However, between dense and rigid cargo items, such as steel, concrete or stone, void spaces should be further minimized, as far as possible.



If the cargo is blocked to a sufficient height, this will effectively stop it from sliding and tipping.

If the cargo is only bottom blocked, lashing may be needed to prevent tipping, see the tipping tables in this Quick Lashing Guide.



Headboard and rear wall

Headboards and rear walls on vehicles with a payload over 12.5 tons built in accordance with EN 12642 L.

Headboard - EN 12642 L

Friction factor, μ	Cargo weight in ton possible to block against the headboard in forward direction
0.15	7.8
0.20	8.4
0.25	9.2
0.30	10.1
0.35	11.3
0.40	12.7
0.45	14.5
0.50	16.9
0.55	20.3
0.60	25.4

Rear wall - EN 12642 L

Friction factor, μ	Cargo weight in ton possible to block against the rear wall towards the rear
0.15	9.0
0.20	10.5
0.25	12.6
0.30	15.8
0.35	21.0
0.40	31.6

If the weight of the cargo is greater than that shown in the tables, then in addition to blocking, lashing will be required.

100mm (4") nail

100mm (4") – NAIL Cargo weight in ton prevented from sliding per nail						
μ	Sideways		Forwards		Towards the rear	
	Each side – 100 mm (4")- nail		100mm (4") - nail		100mm (4") - nail	
	Plain	Galvanized	Plain	Galvanized	Plain	Galvanized
0.2	0.36	0.53	0.18	0.26	0.36	0.53
0.3	0.55	0.80	0.22	0.32	0.55	0.80
0.4	1.1	1.6	0.27	0.40	1.1	1.6
0.5	no risk	no risk	0.36	0.53	no risk	no risk
0.6	no risk	no risk	0.55	0.80	no risk	no risk
0.7	no risk	no risk	1.1	1.6	no risk	no risk

These values are taken from the IMO Model Course 3.18 and recalculated in accordance with EN 12195-1: 2010.

Unlashed cargo and the risk of movement

If there is no risk of a cargo sliding or tipping (as shown in the tables of this guide) the cargo can be transported without the use of lashing straps.

Even if there is neither sliding nor tipping risk, *as a rule of thumb*, it is recommended to 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.

A.2.5. Other ways to secure cargo

Cargo can also be secured by using friction or lashing methods.

Calculation for lashing requirements

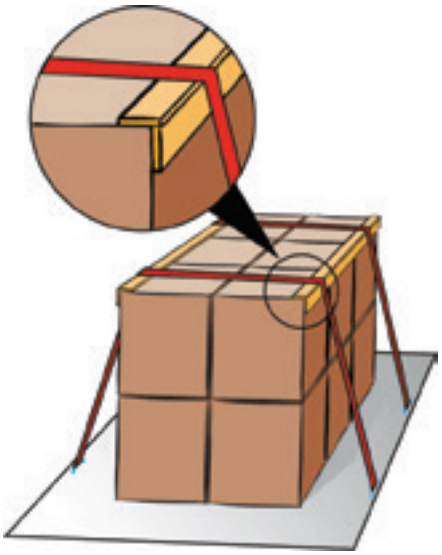
If lashing are used to stop the cargo from moving, then;

1. Calculate the number of lashing straps needed to prevent a sliding movement.
2. Calculate the number of lashing straps needed to prevent the cargo from tipping.
3. The highest number of these two values shows the minimum number of lashing straps needed.

Supporting edge profile

In some cases, less lashing straps than the number of sections of the cargo can be used. Each section of the cargo must be secured.

A 'supporting edge profile' may be used to spread the effects of each lashing. These profiles may be constructed of wooden planks (at least 25mm x 100mm). Other material with the same strength values can also be used, such as aluminium or similar material. At least one lashing strap should be used, for every 2nd section of the cargo, with one at each end.



A.2.6. Sliding

The friction between the cargo and the loading platform (or cargo beneath it) has a huge influence on how much one lashing can prevent from sliding.

The table in Appendix 4 gives the typical friction factors for common combinations of materials contacting each other or the vehicle load platform.

The values in the table are valid for dry and wet surfaces when the contact surfaces are clean, undamaged and without frost, ice or snow. If this is not the case, then a friction factor (μ) = 0.2 should be used. Special precautions shall be taken if the surfaces are oiled or greasy.

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 tables in the Quick Lashing Guide.

A.2.7. Tipping

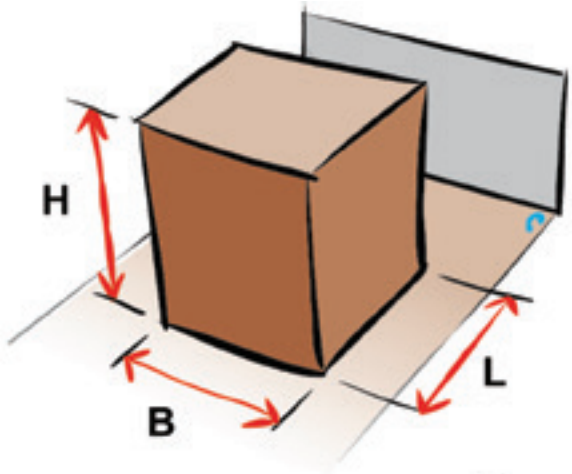
To find out the maximum cargo weight prevented from tipping, refer to the tables in this Quick Lashing Guide.

The H/B (height divided by the breadth) or H/L (height divided by the length) of cargo to be secured must be calculated.

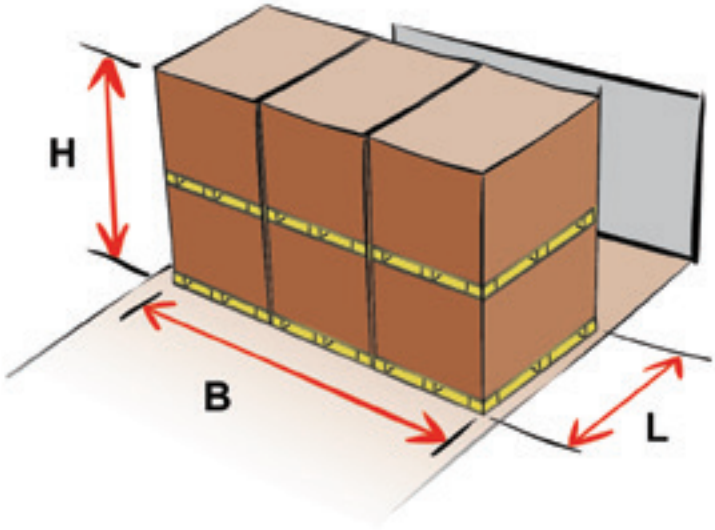
The calculations must be rounded up to the nearest higher value shown in the tables.

Cargo items with the centre of gravity close to their centre

The following sketches explain how to measure the H (height), L (length) and B (breadth) of the cargo.



Single cargo item

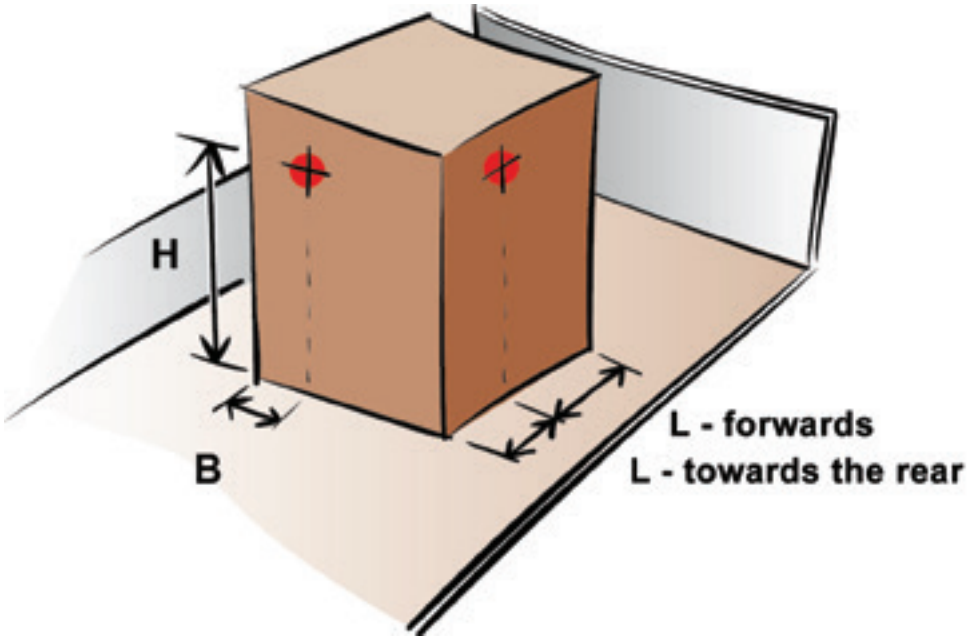


A section of the cargo (showing three rows and two layers)

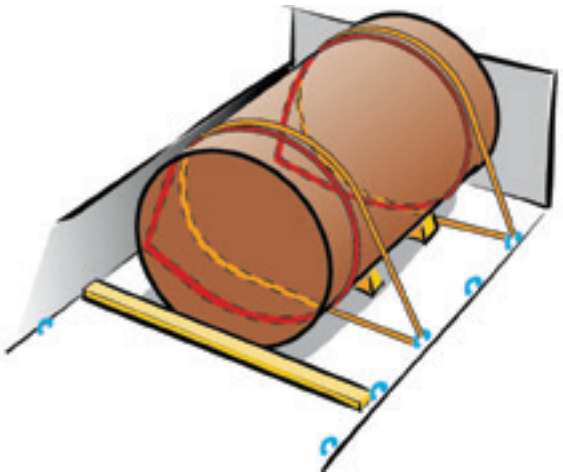
Cargo items with displaced centre of gravity

If the cargo item to be secured has a centre of gravity above its centre or out to the side, then the H, B and L measurements should be done as shown in the diagram below.

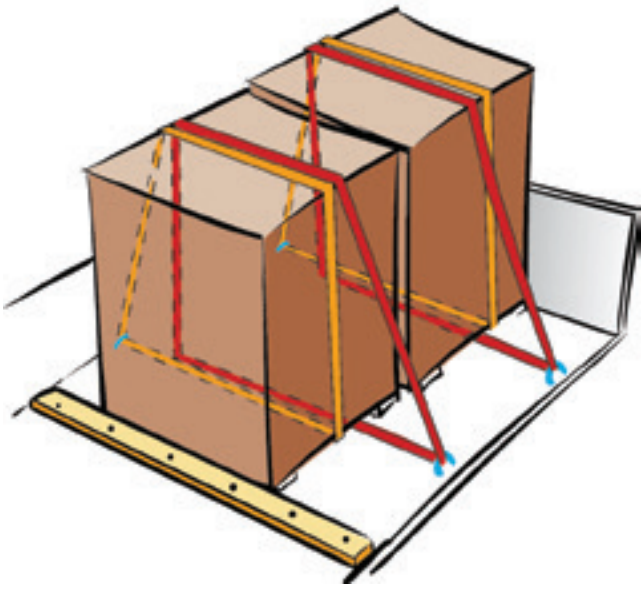
H = *Distance up to the centre of gravity*
B = *Shortest distance between the centre of gravity and the sideways tipping point*
L = *Distance according to the diagram*



A.2.8. Loop lashing



A loop lashing will secure a cargo item on each side with a pair of webbings. At the same time the cargo will be prevented from tipping. At least two loop lashings per long cargo item should be used.



If the cargo item contains more than one section and the sections support each other and stop any twisting from occurring, then only one loop lashing per section of the cargo, may be needed.

Cargo weight in ton prevented from sliding *per* pair of loop lashing			
μ*	Sideways	μ*	Sideways
0.15	4.7	**0.45**	13
0.20	5.4	**0.50**	no risk
0.25	6.2	**0.55**	no risk
0.30	7.3	**0.60**	no risk
0.35	8.7	**0.65**	no risk
0.40	11	**0.70**	no risk

** Friction factor according to Appendix 4*

Cargo weight in ton prevented from tipping *per* pair of loop lashing					
Sideways					
H/B	1 row	2 rows	3 rows	4 rows	5 rows
0.6	no risk	no risk	no risk	6.5	4.1
0.8	no risk	no risk	5.6	3.1	2.3
1.0	no risk	no risk	3.1	2.0	1.6
1.2	no risk	4.6	2.1	1.5	1.3
1.4	no risk	3.0	1.6	1.2	1.0
1.6	no risk	2.2	1.3	1.0	0.86

Cargo weight in ton prevented from tipping *per* pair of loop lashing					
Sideways					
H/B	1 row	2 rows	3 rows	4 rows	5 rows
1.8	no risk	1.8	1.1	0.86	0.74
2.0	no risk	1.5	0.94	0.75	0.65
2.2	5.1	1.2	0.83	0.67	0.58
2.4	3.7	1.1	0.74	0.60	0.53
2.6	2.9	0.96	0.66	0.54	0.48
2.8	2.4	0.86	0.61	0.50	0.44
3.0	2.0	0.78	0.56	0.46	0.41
3.2	1.8	0.72	0.51	0.43	0.38

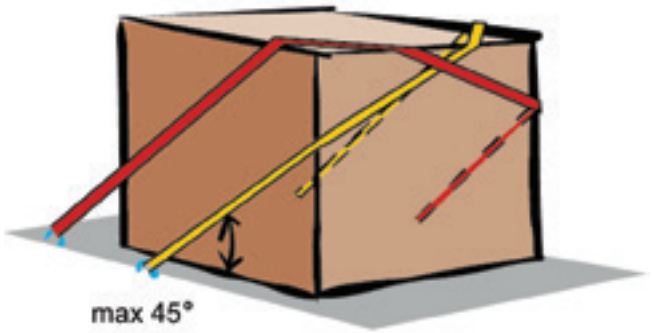
The values in these tables will apply only when each end of the loop lashing is fastened at different lashing points. If both ends of a loop lashing are fastened to the same lashing point, then this point must hold 1.4 × lashing LC.

A.2.9. Spring lashing

A spring lashing is used to stop movement of a cargo item forwards and/or towards the rear. It is important that the angle between the loading platform and the lashing strap does not exceed 45°.

The spring lashing can be done in many ways. However, if the lashing is not applied to the upper edge of the cargo item, the tipping limits of the cargo weight is reduced.

For example, if the spring lashing is placed half way up the cargo item, then it will only secure half the cargo weight indicated in the table.

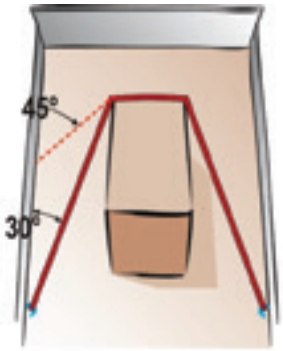


This spring lashing set-up has two legs on each side, which secures twice the weight that is indicated in the table.

Cargo weight in ton prevented from sliding *per* spring lashing					
μ*	Forwards	Towards the rear	μ*	Forwards	Towards the rear
0.15	3.7	6.6	**0.45**	6.7	19
0.20	4.1	7.6	**0.50**	7.5	no risk
0.25	4.5	8.8	**0.55**	8.4	no risk
0.30	4.9	10	**0.60**	9.6	no risk
0.35	5.4	12	**0.65**	11	no risk
0.40	6.0	15	**0.70**	13	no risk

** Friction factor according to Appendix 4*

Cargo weight in ton prevented from tipping *per* spring lashing		
H/L	**Forwards**	**Towards the rear**
1.2	no risk	no risk
1.4	54	no risk
1.6	26	no risk
1.8	19	no risk
2.0	15	no risk
2.2	13	101
2.4	12	55
2.6	11	40
2.8	10	32
3.0	9.9	28
3.2	9.5	25



If the angle sideways exceeds 5° the table values must be reduced with:

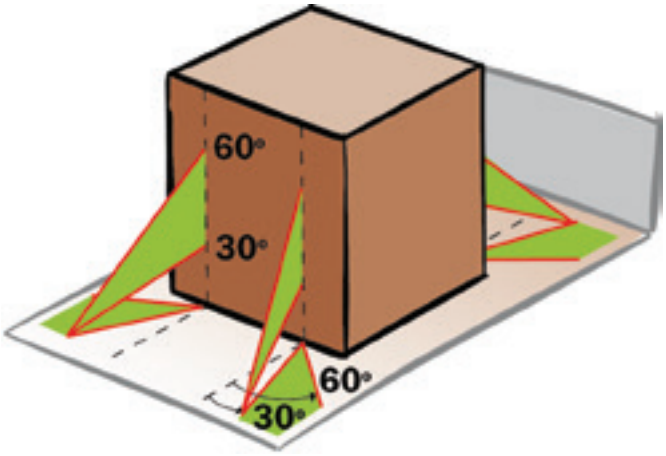
Angle 5°- 30° ⇒ 15%

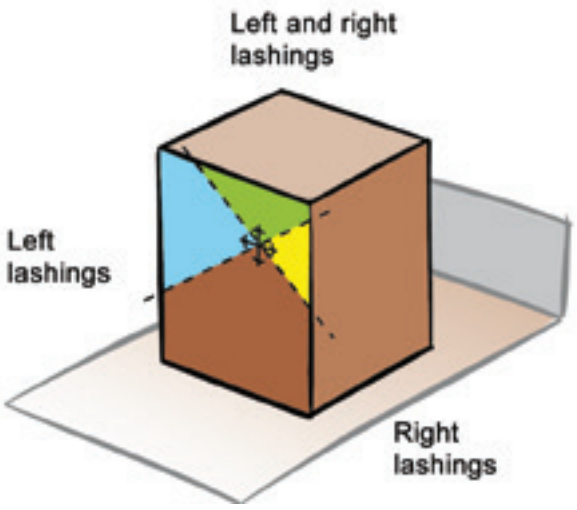
Angle 30°- 45° ⇒ 30%

A.2.10. Direct lashing

Lashings must be fixed within the green angles, as shown in the diagram.

This will ensure that they secure the individual cargo item in accordance with the table values.





The areas where you can attach lashing straps are limited by two straight lines running diagonally through the centre of gravity at an angle of 45°.

Cargo weight in ton prevented from sliding *per* straight lashing							
μ*	Sideways	Forwards	Towards the rear	μ*	Sideways	Forwards	Towards the rear
0.15	1.5	0.82	1.5	**0.45**	5.4	1.9	5.4
0.20	1.8	0.95	1.8	**0.50**	no risk	2.2	no risk
0.25	2.2	1.1	2.2	**0.55**	no risk	2.6	no risk
0.30	2.6	1.3	2.6	**0.60**	no risk	3.0	no risk
0.35	3.3	1.4	3.3	**0.65**	no risk	3.5	no risk
0.40	4.2	1.7	4.2	**0.70**	no risk	4.2	no risk

* *Friction factor according to Appendix 4*

Cargo weight in ton prevented from tipping *per* straight lashing				
H/B	Sideways	H/L	Forwards	Towards the rear
1.2	no risk	**1.2**	no risk	no risk
1.4	no risk	**1.4**	8.2	no risk
1.6	no risk	**1.6**	3.8	no risk
1.8	no risk	**1.8**	2.6	no risk
2.0	no risk	**2.0**	2.0	no risk
2.2	4.1	**2.2**	1.7	13.0
2.4	3.2	**2.4**	1.5	6.9
2.6	2.6	**2.6**	1.4	4.9
2.8	2.3	**2.8**	1.2	3.9

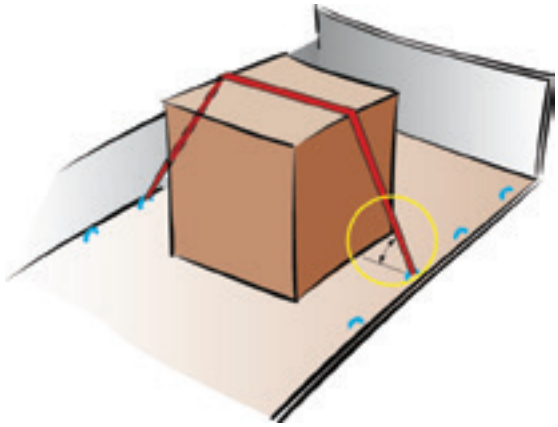
3.0	2.0
3.2	1.9

3.0	1.2	3.3
3.2	1.1	2.9

A.2.11. Top-over lashing

Using the table below, you must note that the angle between the lashing and the loading platform is of great importance. The tables should be used for angles between 75° and 90°. If the angle is between 30° and 75° double amount of lashing straps are needed, or you halve the table values.

If the angle is less than 30°, then another method of securing the cargo should be used.



Cargo weight in ton prevented from sliding *per* top-over lashing			
μ*	**Sideways**	**Forwards**	**Towards the rear**
0.15	0.31	0.15	0.31
0.20	0.48	0.21	0.48
0.25	0.72	0.29	0.72
0.30	1.1	0.38	1.1
0.35	1.7	0.49	1.7
0.40	2.9	0.63	2.9
0.45	6.4	0.81	6.4
0.50	no risk	1.1	no risk
0.55	no risk	1.4	no risk
0.60	no risk	1.9	no risk
0.65	no risk	2.7	no risk
0.70	no risk	4.4	no risk

* *Friction factor according to Appendix 4*

Cargo weight in ton prevented from tipping *per* top-over lashing								
Sideways						**H/L**	**Forwards**	**Towards the rear**
H/B	**1 row**	**2 rows**	**3 rows**	**4 rows**	**5 rows**			

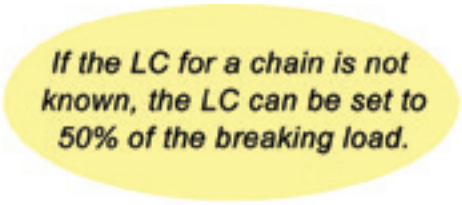
0.6	no risk	no risk	no risk	5.8	2.9	0.6	no risk	no risk
0.8	no risk	no risk	4.9	2.1	1.5	0.8	no risk	no risk
1.0	no risk	no risk	2.2	1.3	0.97	1.0	no risk	no risk
1.2	no risk	4.1	1.4	0.91	0.73	1.2	no risk	no risk
1.4	no risk	2.3	0.99	0.71	0.58	1.4	5.3	no risk
1.6	no risk	1.5	0.78	0.58	0.49	1.6	2.3	no risk
1.8	no risk	1.1	0.64	0.49	0.42	1.8	1.4	no risk
2.0	no risk	0.90	0.54	0.42	0.26	2.0	1.1	no risk
2.2	4.5	0.75	0.47	0.37	0.32	2.2	0.83	7.2
2.4	3.3	0.64	0.42	0.33	0.29	2.4	0.68	3.6
2.6	2.4	0.56	0.37	0.30	0.26	2.6	0.58	2.4
2.8	1.8	0.50	0.34	0.28	0.24	2.8	0.51	1.8
3.0	1.4	0.45	0.31	0.25	0.22	3.0	0.45	1.4
3.2	1.2	0.41	0.29	0.24	0.21	3.2	0.40	1.2

If more than one lashing is used for each section of the cargo, the tensioning devices should if possible be placed alternately on both sides.

The calculation values for movement forwards and towards the rear assume that lashing straps are spread equally on each section of the cargo.

A.2.12. Other lashing equipment

Values for LC and S_{TF} are marked on the lashing equipment.



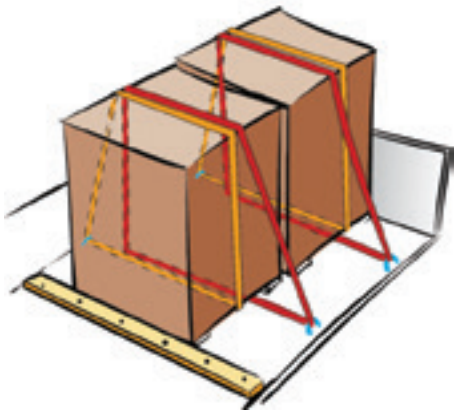
Recalculating

If equipment with a different capacity to LC 1600 or S_{TF} 400 is used, the figures in the sliding and tipping tables have to be multiplied with the following factors.

When recalculating, never use larger LC or S_{TF} than the lashing points can hold.

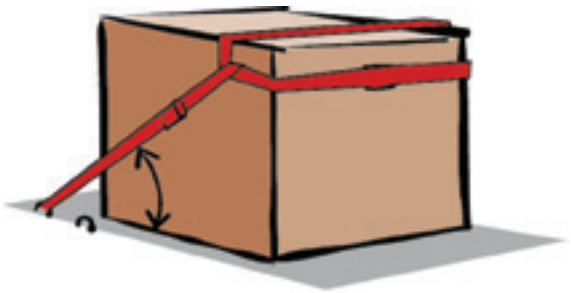
Methods

Loop lashing



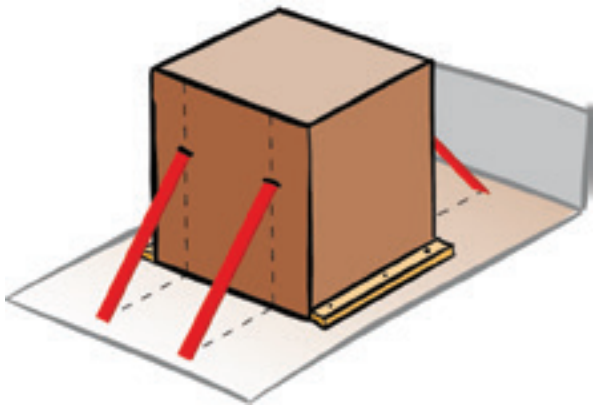
$$\frac{\text{Actual LC}}{1600} = \text{Multiplication factor}$$

Spring lashing



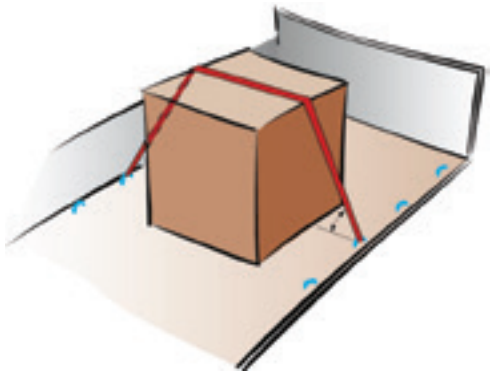
$$\frac{\text{Actual LC}}{1600} = \text{Multiplication factor}$$

Loop lashing



$$\frac{\text{Actual LC}}{1600} = \text{Multiplication factor}$$

Top-over lashing



For sliding:

$$\frac{\text{Actual } S_{TF}}{400} = \text{Multiplication factor}$$

For tipping the smallest of the following factors shall be used:

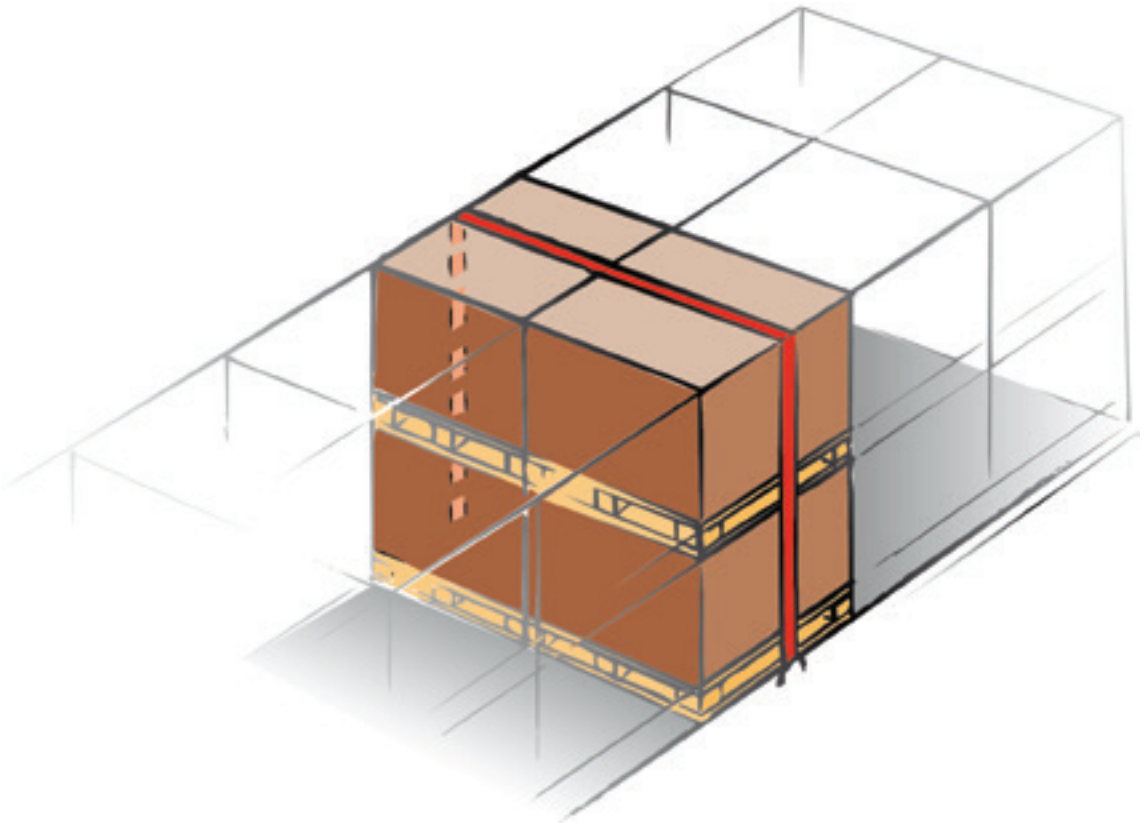
$$\frac{\text{Actual } S_{TF}}{400} \text{ or } \frac{\text{Actual LC}}{1600} = \text{Multiplication factor}$$

A.2.13. Cargo consisting of several layers

Determination of the number of top-over lashing straps needed to secure cargo items stowed in several layers when they are not blocked sideways.

Using the following four steps

1. Calculate the number of lashing straps needed to secure the weight of the whole section from sliding using friction in the bottom.
2. Calculate the number of lashing straps needed to secure the weight of the upper section from sliding, using friction between the upper and lower layer.
3. Calculate the number of lashing straps needed to stop tipping of the whole section.
4. The highest number of lashings from the three calculations should be used.



A.2.14. Other types of cargo

Rolling goods

You must prevent rolling goods from moving by using wedges or similar restraints.

Non-rigid goods

If the goods are not rigid, then more cargo restraints will need to be used than is shown in this guide.