



Cargo securing to prevent cargo damages on road, sea, rail and air

Cargo Securing at Rail Transport

General

Transport system needs rail transport mode services in places where cargoes are transported long distances. Cargoes are typically moved from other modes into the rail transport mode. Then we are talking about combined transport, where loading and unloading are necessary operations.

The point of view of cargo securing in this section is combined transport. Railway company's conventional services are not considered.

Cargo Securing at Rail Transport

General

Two forms of combined transports:

- 1 In an intermodal transport the cargo is loaded into a cargo transport unit (CTU) used for the entire transportation.
- 2 In a multimodal transport several modes of transport are involved but the cargo is not moved in one and the same CTU for the entire transportation.

Railway company has also the role of conventional transport. In this situation wagons are loaded at the shipper and transported to the customer for unloading.



Photo: Kari Erho

Cargo Securing at Rail Transport

Typical factors for rail transport

Typical factors for rail transport are:

- Forward and backward forces can be large due to when wagons are shunted or during braking.
- Side forces can be also large due to oscillation (a kind of yaw).
- Long journey creates long lasting forces.
- A lot of heavy cargo is handled by rail transports.
- Road transport company has to take into account the rail transport requirements.
- Rail transport company's three service types: Conventional, intermodal and multimodal.



Photo: Kari Erho

Cargo Securing at Rail Transport

Consequences of Poor Cargo Securing

Insufficient cargo securing in one vehicle or swap body can start a “chain reaction” which ends up in direct consequences like

- Loss of cargo and CTUs
- Damages to the locomotive and wagons, rails and environment

and in worst case

- Loss of locomotive and wagons
- Loss of lives



Cargo Securing at Rail Transport

Typical Cargo Transport Units and Cargoes

Road-rail transport system's wagon can be loaded with

- Vehicles and trailers
 - General cargo
 - Pulp and paper
 - Steel products
- Swap bodies
 - General cargo
- Box containers (ISO)
 - General cargo
 - Pulp and paper
 - Steel products
 - Machinery
- Flat rack containers (ISO)
 - Machinery
 - Steel products



<http://www.kaupe.fi/vaihtokuormatilat.html>



http://www.vrtransport.fi/attachments/newfolder_5/65TKmT7Hf/Vaunu_kuvasto_Kotimaa.pdf

Cargo Securing at Rail Transport

Cargo Transport Units – Freight Container

Freight containers constructed according to ISO standard are:

- + Firm structure which can block cargo in all directions
- + Many containers can be piled
- + Built for transportation in unrestricted areas
- The securing points inside the container are a weak link
- Difficulties to load EUR-pallets

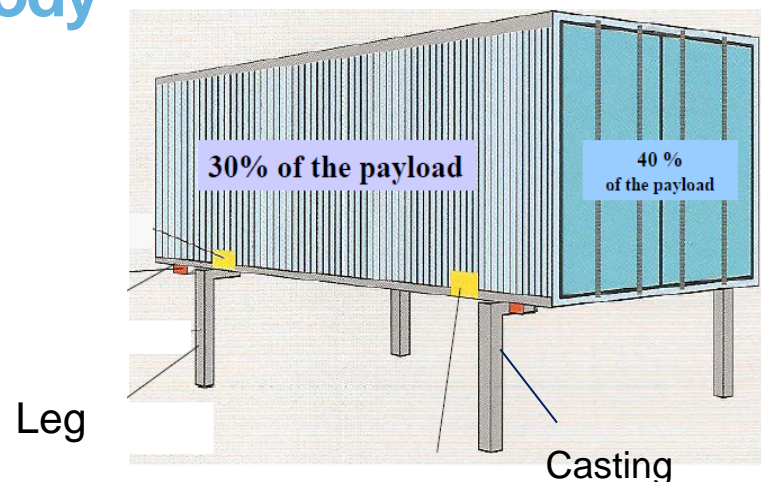


Cargo Securing at Rail Transport

Cargo Transport Units – Swap-body

Swap bodies are standardized loading units
(Standard EN 283)

- + equally suitable for carriage on road vehicles and railway wagons
- + simple in design and inexpensive
- + one of the most widely used vehicle in road and road-rail transport systems
- + EUR-pallets is well fitted into the swap-body
- The structure not so strong as container
- The swap-body is not accepted outside Europe



Grap handling groove

Source: Marc Wiltzius–Fastening expert www.arrimage-charges.com presentation in <http://www.uic.org/>



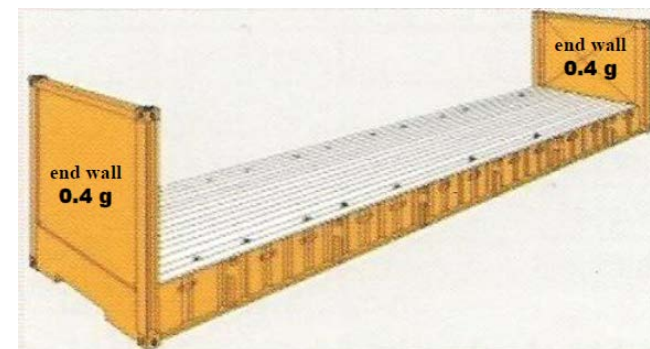
Source: <http://www.tes.bam.de/en/regelwerke/ladungssicherung/index.htm>

Cargo Securing at Rail Transport

Cargo Transport Units – Flat rack container

Flat rack containers are fabricated according to ISO standard.

- + suitable for heavy, over-height and/or over-width cargo.
- + simple in design
- + widely used vehicle in road, road-rail and road-sea transport systems
- + Cargo is rather easy to secure with all available securing methods



Source: Marc Wiltzius—Fastening expert www.arrimage-charges.com presentation in <http://www.uic.org/>



<http://www.matts-place.com/intermodal/part2/flatracks.htm>

Cargo Securing at Rail Transport Wagons

There are many kinds of wagons available for combined transport

- Most common are flat wagons, fitted with scotching systems for swap bodies and different containers
- Base plates for swap bodies
- Low floor wagons for vehicle combinations (truck and trailer)
- Pocket wagons for semi-trailers



Source: Juhani Lepikkö, VRTransport Ltd

Source: Marc Wiltzius—Fastening expert www.arrimage-charges.com presentation in <http://www.uic.org/>

Photos: VR-Transport Ltd, <http://www.vrtransport.fi/>

Cargo Securing at Rail Transport Liabilities

- The staff of railway members are charged of checking whether the consignments are suitable for transporting by rail
- Shipper is charged in loading the cargo into the cargo transport unit
 - Shipper is liable for all consequences of its improper cargo securing
 - Rail company has to prove that loading was made improperly
 - Note! Rail company is liable if it knows that cargoes are not properly secured, but let's the train go to a journey

Note!

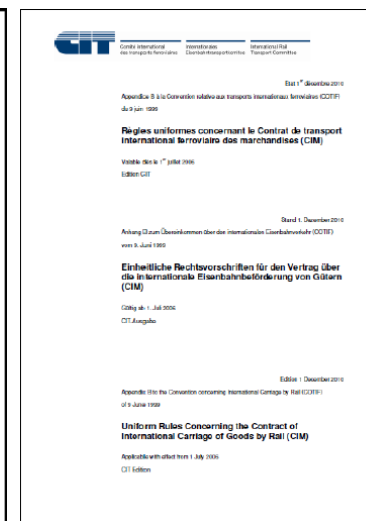
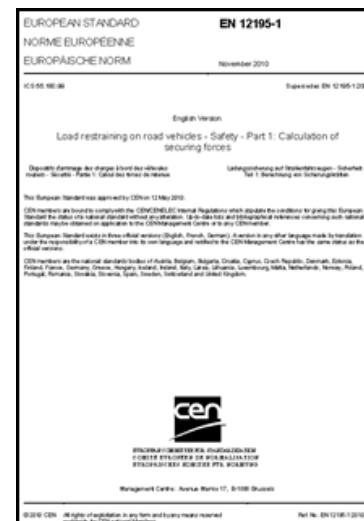
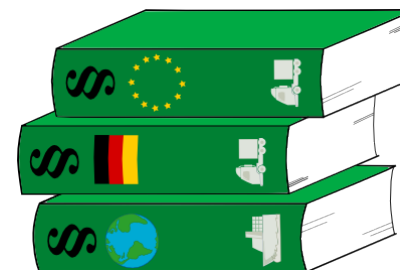
In terminal the staff member of railway company loads a CTU onto wagon by reach stacker and do not check the content of a CTU



Photo: Kari Erho

Cargo Securing at Rail Transport Regulations, Standards and Guidelines

- The directive 2004/49 is the framework for rail transport safety
- National regulations
- CIM
- Loading guidelines by UIC
- Guidelines of the combined transport operator
- RID
- ADR
- European Standard: EN-12195-1:2010



Sources: Marc Wiltzius—Fastening expert www.arrimage-charges.com presentation in <http://www.uic.org/>
Juhani Lepikkö, VRTranspoint Ltd

Cargo Securing at Rail Transport Handling at the Rail Depot

The cargo securing on a Cargo Transport Unit (CTU) in an intermodal transport chain is only inspected at the goods rail depot or transshipment station if bad cargo securing is suspected.

The cargo securing of the CTUs on the train is done by the crane operators, reach stacker or other personal at the rail depot.



Cargo Securing at Rail Transport

Acting Forces

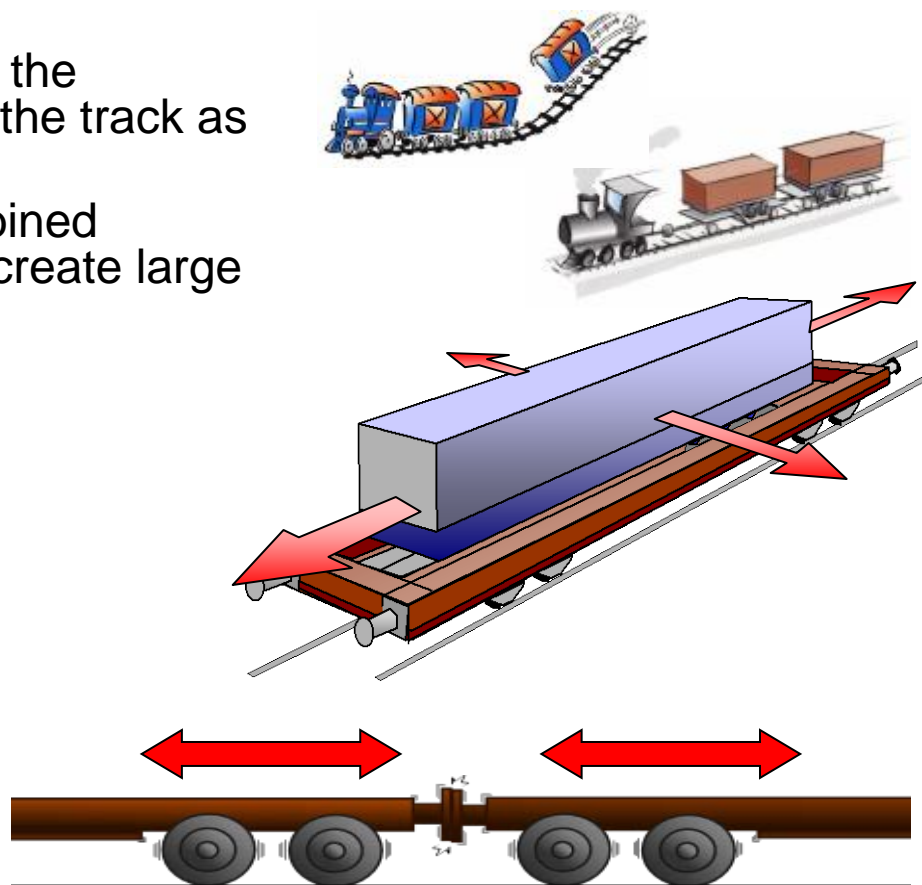
Acting forces on the cargo depend on the structure of a wagon, the condition of the track as well as how the cargo is transported

Normally shunting is avoided in combined transport because this operation can create large forces

The acting forces are:

- Longitudinal and horizontal forces
 - During braking
 - Acceleration
- Transverse horizontal forces
 - Wagon oscillation (yaw) during transport
- Centrifugal force
- Gravity
- Vibration

These forces may cause sliding, tipping and wandering for the cargo in CTU



Cargo Securing at Rail Transport

Acting Forces

The acceleration coefficients for load carriers during rail transport are as follows:

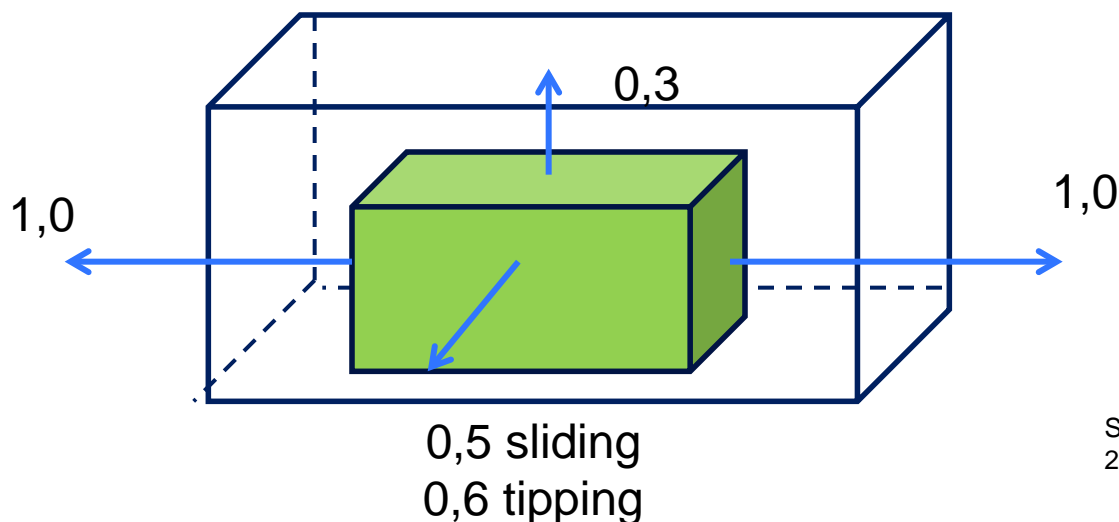
Securing in	Acceleration coefficients				
	Longitudinally		Trans-versely	Minimum vertically down	
	Sliding	Tilting		Sliding	Tilting
Longitudinal direction	1,0	0,6	-	1,0	1,0
Transvers direction			0,5	0,7	1,0

EN 12195-1:2010

Because the direction of the rail wagon can change in the main railway movement there is no difference in securing the load towards the front and towards the rear.

Cargo Securing at Rail Transport

Acceleration Coefficients during a Road/Rail Transport



Source: Onorato Zanini, presentation in UIC conference 2011, <http://www.uic.org/>

Cargo securing requirements:

- 100 % of the weight towards front and back
- 50 % (60 %) of the weight toward sides



<http://www.matts-place.com/>

Cargo Securing at Rail Transport

Load distribution in a Container

- In a container the distribution of cargo weight must be maximum 60 % in one half of the container and minimum 40 % in the second half
- Also the center of gravity should be located as low as possible
 - Light cargo on heavy cargo
 - Dry cargo on wet cargo

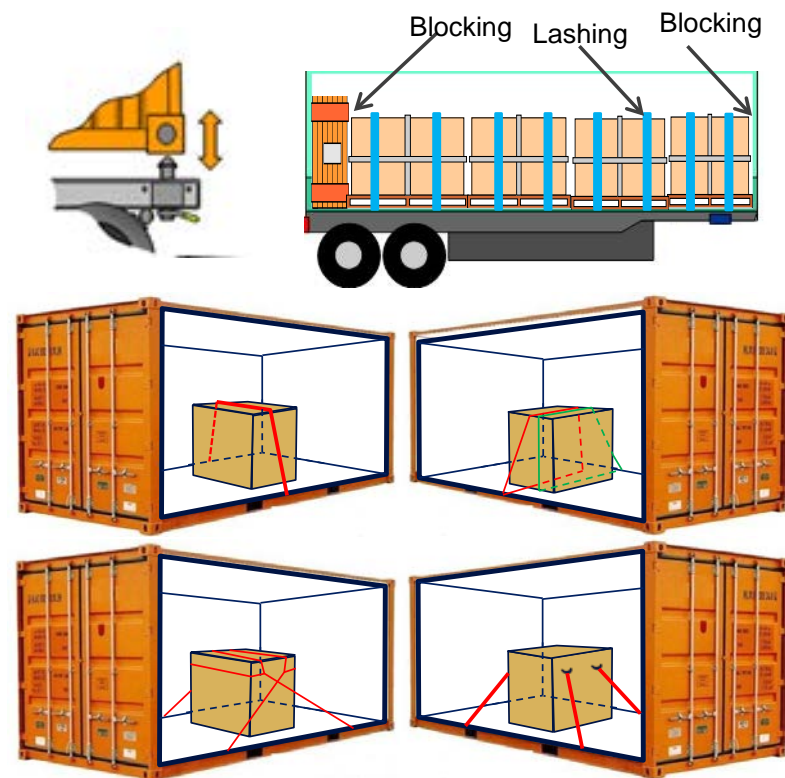


Cargo Securing at Rail Transport

Securing Methods

Different securing methods:

- Blocking
- Locking
- Lashing
 - Top-over lashing
 - Loop lashing
 - Spring lashing
 - Straight/Cross lashing



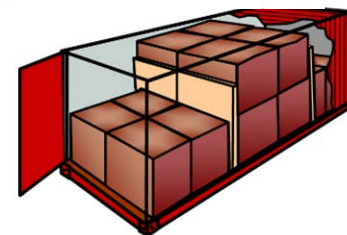
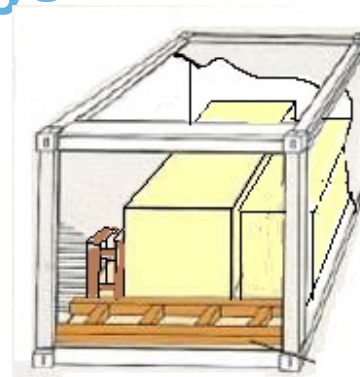
The securing methods must ensure that the load remains secured throughout all the stages of transport (road transit, transshipment, rail transit).

Cargo Securing at Rail Transport

Securing in Different Directions - Lengthways

If possible, block the cargo in lengthways directions against

- Firm structures of the CTU
- Boards
- Empty pallets
- Other cargo
- Threshold made of other packages
- H-bracing
- Wooden battens



Cargo Securing at Rail Transport

Securing in Different Directions - Lengthways

Examples of securing by blocking in lengthways direction



Source: www.upm.com/safety



Source: www.upm.com/safety



Source: www.gdv.de



Photo: Kari Erho



Photo: Kari Erho

Cargo Securing at Rail Transport

Securing in Different Directions - Lengthways

If necessary use lashings in combination with blocking

Lashing methods:

- Top over lashing
- Spring lashing
- Straight/cross lashing
- Round turn lashing

Note!

The securing points in a container are a weak link!

Note!

Trailer shall be EN 12642
XL type



Photo: Kari Erho



Photo: Kari Erho



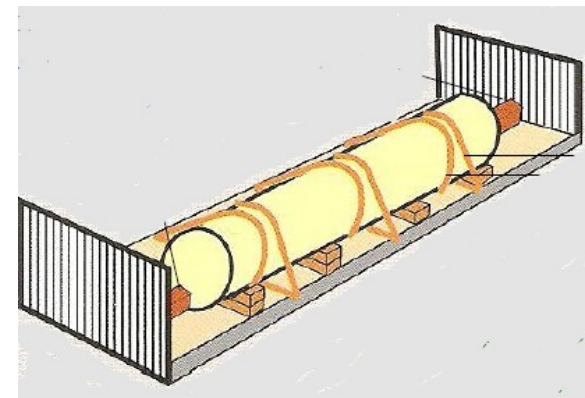
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Cargo Securing at Rail Transport

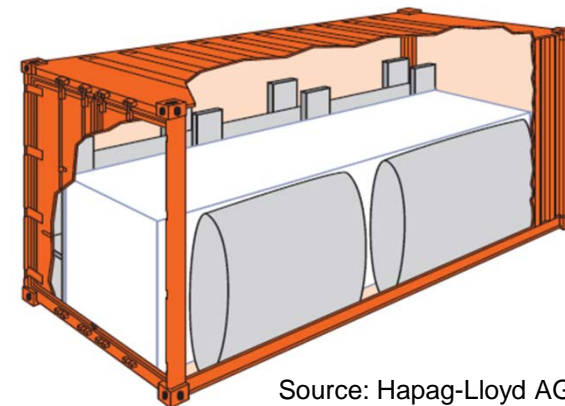
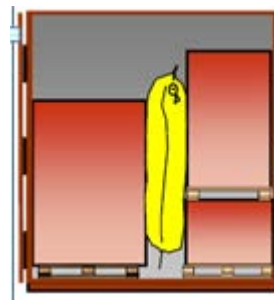
Securing in Different Directions - Sideways

If possible, block the cargo in sideway directions against

- Firm structures of the CTU
- Other cargo
- Empty pallets
- Dunnage bags
- Wooden battens
- Stanchions
- Wedges



Source: Marc Wiltzius—Fastening expert www.arrimage-charges.com presentation in <http://www.uic.org/>



Source: Hapag-Lloyd AG

Note!

The securing points in a container are a weak link!

Cargo Securing at Rail Transport

Securing in Different Directions - Sideways

Examples of securing by blocking in sideways direction



Source: www.upm.com/safety



Source:
<http://www.tes.bam.de/en/regelwerke/ladungssicherung/index.htm>



Cradle

Photo: Kari Erho

Cargo Securing at Rail Transport

Securing in Different Directions - Sideways

Use of dunnage bags in sideways direction

- Only in CTUs with firm side walls

Advantages:

- Follows the cargo well
- Form tight stowage

Note!

- Protect the bag from sharp edges



Source:

<http://www.tes.bam.de/en/regelwerke/adungssicherung/index.htm>

Cargo Securing at Rail Transport

Securing in Different Directions - Sideways

If necessary use lashings in combination with blocking

Lashing methods:

- Top over lashing
- Loop lashing
- Straight/cross lashing

Note!

Some authorities demand sideways blocking in addition to the top-over lashing

Note!

Protect web lashing from sharp edges by edge protectors



Photo: Kari Erho



Photo: Kari Erho



Cargo Securing at Rail Transport

Securing in Different Directions – End Section

The end section of the container has to be secured by:

- Wooden battens or
- Boards or
- Empty pallets or even
- Wooden battens and lashings



Source: www.gdv.de

Cargo Securing at Rail Transport

Securing in Different Directions – End Section

Note!

- the result of bad securing of the last section could be fatal!
- Don't use dunnage bags directly against the container doors!



Cargo Securing at Rail Transport

Securing Steel Products

Steel products are often heavy and secured by blocking, if necessary by lashing.

Note:

- Loop lashing is often more efficient than top-over lashing
- Steel coils shall be transported in firm cradles
- Protect web lashing from sharp edges by edge protectors
- Use friction sheet to increase the friction



Photos: Kari Erho

Cargo Securing at Rail Transport

Securing Sawn Timber and Round Timber

Sawn timber

- Sawn timber has to be blocked in all directions when loaded in a freight container
- Note! Same force affect both forward and backwards



Source: www.upm.com/safety

Round timber

- Not transported in CTUs
- Special regulation and instructions for the securing on wagons



Photo: Kari Erho

Cargo Securing at Rail Transport

Securing Pulp and Paper

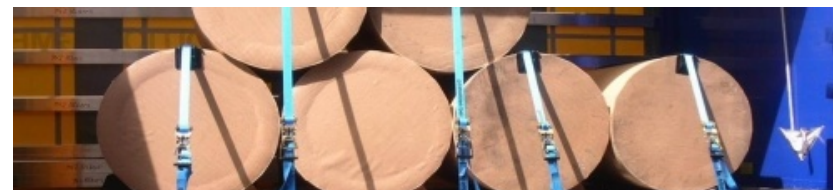
Pulp and paper secured by blocking and if necessary by lashing

Note:

- Supporting edge beams protect the paper and make the lashings more efficient
- Protect the paper from damages by use of edge protectors
- Low friction between wooden pallets and plastic film
- Pulp not rigid in form may require additional lashing
- Same force affect both forwards and backwards



Source: www.upm.com/safety



Source: www.upm.com/safety