Nordic Road Association

Equipment for Efficient Cargo Securing and Ferry Fastening of Vehicles

Rapport nr. 4/2004
Utskott 54: Fordon

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NVF 54: Fordon

Equipment for Efficient Cargo Securing and Ferry Fastening of Vehicles

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FOREWORD

Technical Committee 54 Vehicles, in the Nordic Road Association, and the Swedish Association of Road Haulage Companies have taken part in producing this report. The report Equipment for Efficient Cargo Securing and Ferry Fastening of Vehicles is included in Technical Committee 54's area of work called Best Practice for the road transport of goods.

According to the EU's White Paper, the need for goods transport will increase substantially until 2010. The efficiency of all modes of transport must be improved to cope with this increased demand for goods transport. Increased use of module vehicles could boost the capacity for safe transport of goods on large parts of the European road network. Such vehicles are also suitable for use in multimodal traffic, on extra-urban roads, railways and in shipping.

Vehicles must be equipped with effective technical equipment for lashing and securing cargo to ensure safe road transport. In shipping, it must also always be possible to lash vehicles to the deck of the vessel to prevent them from overturning in rough weather.

The important sub-sections of load securing include:

- technical equipment on load carriers and vehicles for lashing and securing cargo
- regulations for lashing and securing cargo
- rules for liability and penalties for incorrect loading and/or securing of cargo

On behalf of Technical Committee 54 Vehicles and of the Swedish Association of Road Haulage Companies, MariTerm AB, Mr Peter Andersson, has worked out specifications of the cargo-securing equipment on the units in a module vehicle. The specifications are based on the result of a research and development project carried out in Sweden in 2001. The title of the project was "Outfitting for Rational Cargo Securing on Vehicles". A number of industries and transport-related companies as well as research organisations participated in the project. The chairman of the project was Mr Mårten Johansson of the Swedish Association of Road Haulage Companies.

Correct technical equipment in and on vehicles, combined with adherence to relevant regulations and rules on liability for securing cargo on vehicles, constitute a good basis for safe transport.

The working group for checking this report in Technical Committee 54 Vehicles consists of:
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Mads Oppegaard, Norwegian Public Roads Administration
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Stockholm, February 2004

Technical Committee 54 Vehicles
Swedish Association of Road Haulage Companies
Mårten Johansson

SUMMARY

To get efficient cargo securing equipment in a module vehicle, it is recommended to design according to below.

1. The vehicles sides should be of Box type (section 3.1) or Curtain sider with sideboards (section 3.4). The sides should fulfil the standards CEN 283 or CEN 12642.

2. The roof should be stiff by either a fixed material or by stiffeners that are built in as a framework (section 3.5).

3. Front end should fulfil the standards CEN 283 or CEN 12642 (section 3.6).

4. Rear end should consist of doors and fulfil the standards CEN 283 or CEN 12642 (section 3.7).

5. The floor should be made of wood (chapter 4).

6. Lashing points should be in a continuous securing bar in the platform side beam (section 5.2). Box type units are recommended to be equipped with lashing tracks on the side walls in addition to the securing bar (section 5.2). The platform should also be equipped with some fittings for heavy cargo (section 5.3).

7. The cargo unit should be equipped with support holes for stanchions (6.1) and a movable blocking wall (section 6.2).

8. The cargo unit should be equipped with outer lashing eyes for the fastening to ferries.

FÖRORD

NVF 54 Fordon i Nordiska Vägtekniska Förbundet och Sveriges Åkeriföretag har medverkat till att denna rapport har tagits fram. Rapporten Equipment for Efficient Cargo Securing and Ferry Fastening of Vehicles ingår i NVF 54:s arbetsområde “Best Practice” för godstransporter på väg.

Enligt EU:s White Paper kommer behovet av godstransporter att öka kraftigt till år 2010. Alla trafikslag behöver effektiviseras för att klara den ökade efterfrågan för godstransporter. Ökad användning av sk modulfordon skulle kunna öka kapaciteten för säkra godstransporter på en stor del av det europeiska vägnätet och är dessutom lämpligt för att användas i kombinerad trafik, landväg, järnväg och färja.

För säker godstrafik på väg behöver fordon vara utrustade med effektiv teknisk utrustning för surrning och förstängning av godset. Vid färjetransport behöver fordon också kunna surras fast till fartygsdäcket för att inte välta vid kraftig sjögång.

Några viktiga delområden inom lastsäkring är

- teknisk utrustning på lastbärare och fordon för surrning och förstängning av gods
- bestämmelser för surrning och förstängning av gods
- ansvarsregler och påföljder vid felaktig lastning och eller säkring av gods

På uppdrag av NVF 54 Fordon och Sveriges Åkeriföretag har MariTerm AB, Peter Andersson, tagit fram specifikationer av lastsäkringsutrustning på s.k. modulfordon. Beskrivningen baseras på resultat från ett svenskt projekt år 2001, Utrustning för Rationell Säkring av Last på Fordon, RASLA . I projektet medverkade flera industrier, transportföretag samt forskningsorgan. Ordförande i projektet var Mårten Johansson, Sveriges Åkeriföretag.

Rätt teknisk utrustning i och på fordonen kombinerat med god efterlevnad av relevanta bestämmelser och ansvarsregler för säkring av gods på fordon är en bra grund för en trafiksäker transport.

Arbetsgrupp för granskning av denna rapport i NVF 54 Fordon är:
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Stockholm i februari 2004

NVF 54 Fordon
Sveriges Åkeriföretag
Mårten Johansson

SAMMANFATTNING

För framtagning av effektiv utrustning för säkring av last på modulfordon så rekommenderas följande:

1 Fordonssidorna bör vara av typen skåp (3.1) eller lämmar med kapell (3.4). Sidorna bör dimensioneras enligt EN 283 eller EN 12642.

2 Taket bör vara styvt eller med styvt ramverk (3.5)

3 Framväggen bör dimensioneras enligt standard EN 283 eller EN 12642 (3.6)

4 Bakre vägg bör utgöras av dörrar som dimensioneras enligt EN 283 eller EN 12642 (3.7)

5 Golvet bör vara av trä (4)

6 Surrningsfästen bör integreras i flakkant med flera fästpunkter (5.2). Skåp bör dessutom ha fästskenor för surrningsutrustning i väggarna. Flaket bör vara utrustat med surrningsfästen för extra tungt gods (5.3)

7 Lastenhet bör vara utrustad med flera hål för stöttor (6.1) och flyttbara förstängningsanordningar (6.2)

8 Lastenhet bör vara utrustad med yttre surrningsfästen för surrning av enhet till fartygsdäck.

ESIPUHE

Pohjoismaisen Tieteknisen Liiton jaosto 54, Ajoneuvot, ja Ruotsin kuorma-autoliitto ovat yhdessä tehneet tämän raportin. "Tehokas kuormien varmistaminen ja ajoneuvojen kiinnittäminen aluksissa" on osa PTL 54: Best Practice toimintaa.

EU:n valkoisen kirjan mukaan tavarakuljetukset lisääntyvät voimakkaasti vuoteen 2010 mennessä. Tavaroiden kuljetuksia tulee tehostaa kasvavan kysynnän myötä. Ns. moduuliajoneuvojen lisääntyvä käyttö lisäisi turvallisten kuljetusten kapasiteettia suurimalla osalla Euroopan tieverkostoa ja toimisi myös yhdistetyissä kuljetuksissa maanteillä, rautateillä ja aluksilla.

Turvallisuuden takia ajoneuvoissa tulee olla tehokkaat tekniset varusteet lastien sitomiseen. Aluksilla ajoneuvot pitää voida sitoa ajokanteen, etteivät ne kaadu merenkäynnissä.

Lastien turvallisuuden kannalta tärkeitä ovat:

- tekniset laitteet ajoneuvossa ja perävaunussa lastien sitomiseksi ja lukitsemiseksi
- määräykset joiden mukaisesti sitominen ja lukitus tehdään
- vastuusäännöt ja seuraukset virheellisestä lastauksesta ja kuormien varmistamisesta.

PTL 54, Ajoneuvot, jaoston ja Ruotsin kuorma-autoliiton puolesta MariTerm Oy, Peter Andersson, on laatinut ohjeet lastien varmistamiseksi moduuliajoneuvoissa. Kuvaukset perustuvat ruotsalaisen v. 2001 valmistunen selvityksen, "Tehokkaassa lastien varmistamisessa tarvittavat laitteet" tuloksiin. Tähän selvitysprojektiin osallistui useita teollisuusyrityksiä, kuljetusliikkeitä sekä tutkimuslaitoksia. Projektin puheenjohtaja oli Mårten Johansson Ruotsin kuorma-autoliitosta.

Turvallisen tavarankuljetuksen perusteena on aina oikeat ajoneuvon ja lastin tarvitsemat laiteet sekä samanaikaiset ohjeet ja vastuiden määrittelyt lastien varmistamiseksi.

Tämän raportin on tarkistanut PTL 54:n työryhmä:
Mårten Johansson, Ruotsin kuorma-autoliitto
Anders Lundström, Scania
Hans Skat, Tanskan Liikenne ja Logistiikka
Mads Oppergaard, Norjan Tielaitos
Esko Kärki, Suomen Liikenne - ja viestintäministeriö
Peter Mose, Scania Tanska
Anders Lundqvist, Ruotsin tielaitos
Jukka Isotalo, Tiehallinto

PTL 54 Ajoneuvot
Ruotsin kuorma-autoliitto
Mårten Johansson

YHTEENVETO

Moduuliajoneuvojen kuormien varmistamiseksi annetaan seuraavat suositukset:

1. Ajoneuvon laitojen tulee olla mallia "kaappi" (3.1) tai siinä on sivulaidat ja suojapeite (3.4). Laidat on mitoitettava standardin EN 238 tai EN 12642 mukaisesti

2. Katon on oltava jäykkä tai sen on oltava jäykkä kehä (3.5)

3. Etuseinä on mitoitettava standardin EN 283 tai EN 12642 mukaisesti (3.6)

4. Takaseinän on oltava ovi joka mitoitetaan standardien EN 283 tai EN 12742 mukaisesti (3.7)

5. Lattian on oltava puuta (4)

6. Sidosten kiinnittimet on kiinnitettävä lavan reunoihin useilla kiinnityspisteillä (5.2). Kaapissa pitää lisäksi olla kiinnittimiä seinissä lastin sitomista varten. Lavassa pitää olla laitteet eritäin painavien lastien sitomiseen (5.3).

7. Lastitilassa tulee olla riittävästi reikiä tukipylväitä (6.1) ja siirrettäviä väliseinäkkeitä (6.2) varten.

8. Kuormayksikössä tulee olla ulkoisia siteiden kiinnikkeitä, jotta yksikkö voidaan kiinnittää aluksen kanteen.

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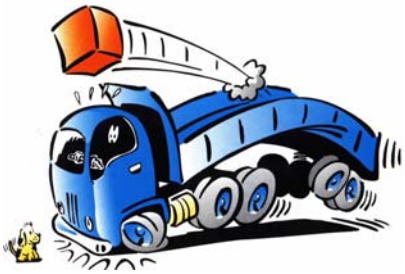
1 FORCES ACTING ON CARGO DURING TRANSPORT

The cargo is exposed to different kind of accelerations depending on mode of transport. In this section design accelerations for road, rail and sea transports according to rules and standards are presented.

Cargo securing outfitting should thus be designed according to these basic acceleration figures.

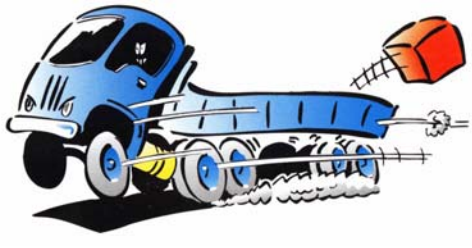
Road

In road transportation accelerations occur due to



heavy breaking…

driving in sharp curves…



and forward accelerations or immediately after heavy breaking.

The magnitude of the accelerations and forces in the above situations are according to most authority regulations the following:

Forward	Backwards	Sideways
0.8 g or 1.0 g	0.5 g	0.5 g

Railway

Accelerations on cargo transported by rail caused by alteration of speed show similar pattern as to when transported by road. However, accelerations caused by shunting of railcars can be very strong.

The following accelerations should be used for the design of cargo securing systems for rail transport according to UIC (International Union of railways):

Wagons not subject to hump and fly shunting in block trains AND wagons used in combined transport trains with containers, swap bodies, semi-trailers and lorries, where appropriate with trailers AND wagons fitted with long-stroke shock absorbers.

Lengthways in the wagon

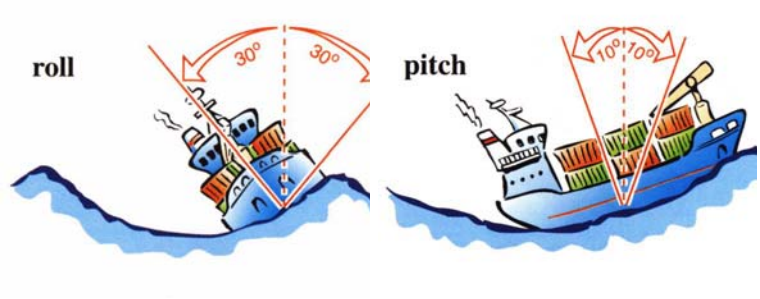
- up to once the weight of the load expressed in kg (1×g)

Sideways in the wagon

- up to 0.5 times the weight of the load expressed in kg (0.5×g)

Sea

A ship at sea has six modes of motion; roll and pitch are two of them. Accelerations caused by roll are the most trouble-some when it comes to the securing of cargo at sea.



The following accelerations should be used for the design of cargo securing systems for sea transport according to IMO (International Maritime Organisation):

Sea area	Sideways	Lengthways
Baltic Sea	0.5 × g	0.3 × g in combination with 1±0.5 × g vertically
North Sea	0.7 × g	0.3 × g in combination with 1±0.7 × g vertically
Unrestricted area	0.8 × g	0.4 × g in combination with 1±0.8 × g vertically

1.1 Consequences of badly secured cargo

Cargo not secured for the above accelerations is a large risk factor. Badly secured cargo may cause damages on the goods, the vehicle and not least persons working in the transportation chain.

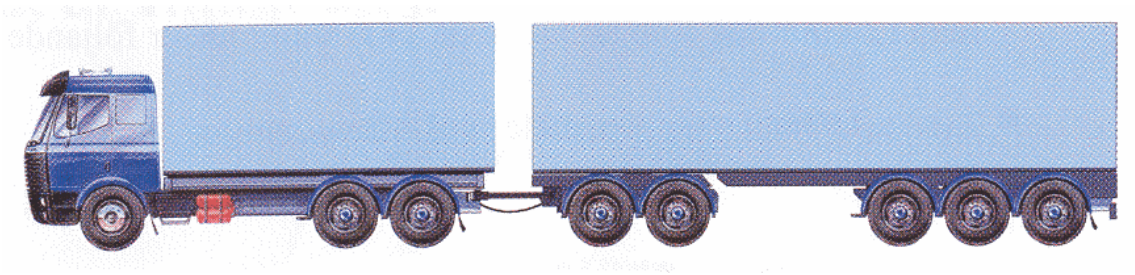
Badly secured cargo can be caused by inadequate knowledge by lorry drivers or packers. But very often also due to inadequately equipped vehicles and cargo transport units as well as due to inadequately maintained outfitting.

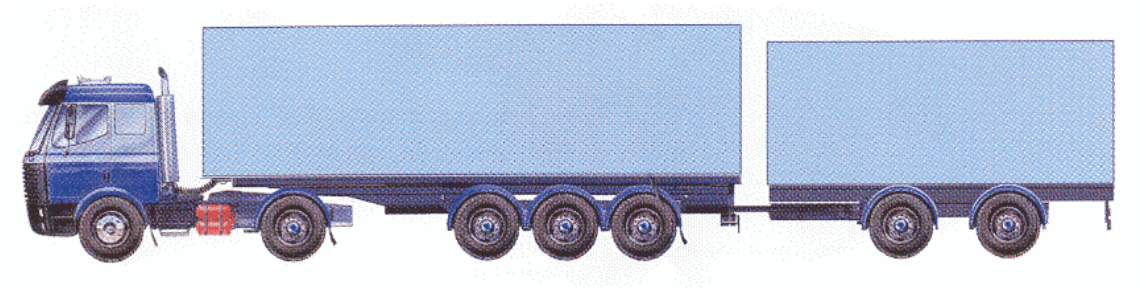
Below is an example of an accident caused by cargo coming out through the doors in the side of a box type trailer in a road bend. The out falling cargo hit a pick up vehicle coming in the opposite direction on the road. The driver of the pick up died immediately when he got one of the 600 kg pallets straight in his knee.

One of the reasons for the above accident was badly designed and maintained locking devices of the side doors of the trailer.

2 DESCRIPTION OF THE MODULE VEHICLE

A 25,25 m module vehicle consists of one 7,82 m unit (largest swap body according to the standard EN 284) and one 13,6 m trailer (the longest vehicle according to 96/53/EG), see figures below.





This module vehicle is a very efficient transportation tool as it can carry more cargo than ordinary vehicle combinations.

In order to also make loading, discharging and securing of the cargo efficient, it is important to design the following details of the units correctly:

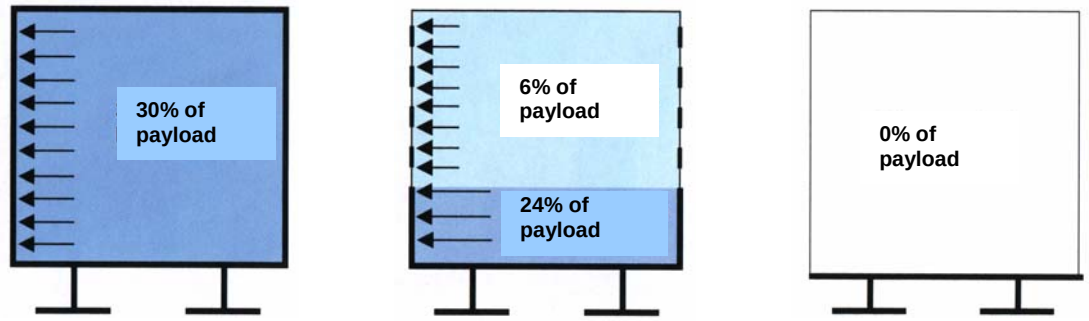
1. Vehicle sides
2. Roof
3. Front end
4. Rear end
5. Floor
6. Lashing points
7. Other cargo securing equipment
8. Lashing eyes for fastening to ferries

3 ROOFS, SIDES AND ENDS OF THE UNITS

Very important details when it comes to cargo securing are the sides and ends of the cargo transport units. Surroundings with adequate strength can take up the forces to which the cargo is exposed during transportation and can thus prevent the cargo from moving without additional lashing.

To be able to take up the forces from the cargo when exposed to accelerations during breaking, turning and speed increase, the sides and ends of the units should be designed according to the European standard EN 283 for swap bodies and EN 12642 for vehicles.

The design criteria for the sides according to the standards are illustrated in the figure below.



Box type | Cover/stake type | Curtain side type

3.1 Box type units

From the figure in the previous section it can be seen that the requirements on the sides of a box type unit is much larger than of a cover/stake body type.

A correctly designed box type unit is thus best when it comes to cargo securing, and the sides can be used to secure the cargo also when it is stowed in more than one layer.

The sides can take up the forces if the static friction between the cargo and the unit floor is 0,2 or larger and as long as the load from the cargo on the sides is spread out on a relatively large area. The sides are of course not design for spot loads.

General cargo and other types of volume cargo are secured in a box type vehicle by pure blocking. Lashing is normally only needed to prevent backwards movement of the cargo.

This way of stowing and securing cargo is the absolutely most efficient. For many types of cargo, side loading is required in addition to loading from the rear, and for this purpose one of the sides is often equipped with doors. If so, the doors should be designed according to the same requirements as fixed sides. Care should always be taken when cargo is secured against doors, as the cargo may fall out when the doors are opened.

3.2 Cover/stake body type units

According to the standards, the sides of cover/stake body types shall withstand the same loads as box type units. The largest part of the load (0,24 P) shall, however, be taken up by the lower rigid part of the sides, which is the sideboards. The remaining load (0,06 P) shall be taken up by the upper parts of the sides, which are the laths and the stakes.

A cover/stake body type unit designed according to the standards is thus strong enough to secure cargo in a first layer, but when it comes to cargo stowed in several layers and high cargo, additional lashing is often required. Light cargo only can be secured against the upper parts of cover/stake body type units.

Unfortunately also the upper parts of cover/stake body types are used for securing of heavy cargoes, which may lead to cargo shifting as shown in the figure below.

3.3 Curtain sided units

A curtain sided unit is very efficient when it come to cargo handling as the sides are easily opened from the ground level. Climbing around to take down laths etc is not required.

The sides are also light, which gives big payload for the unit.

When it comes to cargo securing the curtain sided units are, however, not efficient as the sides may not be used for cargo securing. This is clearly stated in the CEN-standard 283. In the CEN-standard 12642 no requirements at all are set up for curtain sided vehicles besides the mandatory lashing fittings for cargo securing according to the CEN-standard 12640.

Many road authorities in Europe have also clearly stated that cargo securing against curtain sides is not allowed.

The reason for not allowing cargo securing against curtain sides is the flexibility of the sides. When the sides are exposed to the loads from the cargo, they are too flexible, which allows the cargo to move quite a bit. If such a motions occurs in a road bend or a turnabout, there is a large risk that the vehicle tips over.

3.4 Curtain sided units with sideboards

An efficient unit is obtained if the strength of the sideboards of a cover/stake body type is combined by the rational handling of a curtain sider. This can be achieved if a curtain sided unit is equipped with sideboards and with the curtain extended between the roof beam and the top of the sideboards only, see figure below.

Curtain sided vehicle with sideboards.

As the curtains are not going down to the platform it is easy to get access to lashing points and to tighten lashings on both sides of the unit, see photo above.

As the curtain on this type of vehicle shall take up a load of 0,06 P only, no laths are required, and still the deflection of the curtain can be limited. As no laths are required this type of unit is almost as flexible when it comes to cargo handling as the pure curtain sided unit. The sides can be handled from the ground, and no climbing is required to open or close the sides.

The photos below show the reinforced curtain and the efficient tool for fastening of the curtain to the sideboard.

Reinforced curtain

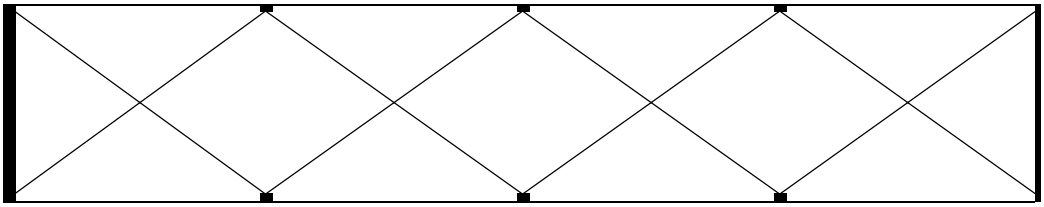
Efficient fastening of curtain to sideboard

3.5 Roof

The roof in a cover/stake body type and a curtain sided unit with sideboards is an essential part of the strength. To limit the deflection of the sides and to be able to keep down the number of stakes, the roof should be designed as stiff as possible. By a stiff roof the strength from the front and rear ends of the units can be used also to limit the deflection of the sides when these are exposed to side forces from the cargo.

One way of getting a stiff roof is to make it of a fixed plate or other types of a fixed material. If so is done, the roof will not be possible to open and top loading of the unit will be impossible.

Another way of getting the stiffness of the roof but still getting the roof possible to open is to build in stiffeners as in a framework. Wires or other flexible lashing material is applied in cross between the top of the stakes and the stiff front and rear ends of the unit, see figure below.



Arrangement for stiffing up the roof avoiding deflection when the sides are exposed to loads from the cargo.

3.6 Front end wall

If the front end walls of the units are designed according to the requirements in the CEN-standard 283 and the CEN-standard 12642, they should be strong enough to take up loads from the cargo in breaking situations.

When testing the front end wall it shall be subjected to an internal load of 0.4*Payload. However, the max test load according to EN 12642 shall be 50 kN (5 ton). The load shall be uniformly distributed over the entire end wall during the test.

3.7 Rear end wall

To make the units as efficient as possible when it comes to cargo handling, the rear end should be made of two stiff doors as on a container. The strength of the doors should be according to the CEN-standards 283 and 12642.

When testing the rear end wall it shall be subjected to an internal load of 0.4*Payload (EN 283) or 0.25*Payload (EN 12642). However, the max test load according to EN 12642 shall be 31 kN (3.1 ton). The load shall be uniformly distributed over the entire end wall during the test.

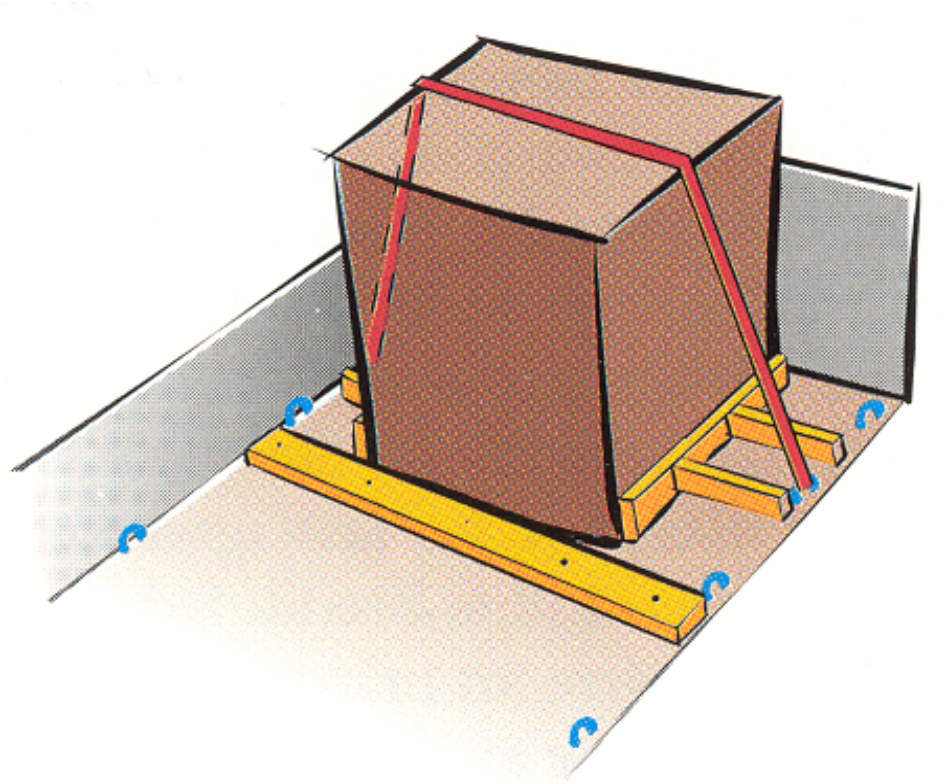
Note. If the trailer unit is equipped also for combined transport on rail, special consideration should be taken to the design of the rear end wall. Alternatively the unit should be equipped with special blocking/lashing devices in rear direction.

4 FLOOR

The design of the floor is important when it comes to efficient cargo securing. The floor shall as far as practical possible prevent the cargo form sliding.

Avoiding sliding can be done either by a high coefficient of friction between the floor and the cargo, by blocking or a combination of these methods. Floors of ribbed aluminium or wood often give good coefficients of friction. A rubber surface on the floor will increase the coefficient of friction for most types of cargo.

With a floor of wood it is possible to nail timbers and scotches to the floor. It makes the blocking of any type of cargo simple and efficient.



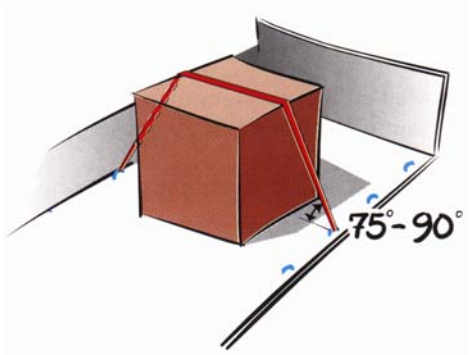
To meet the above cargo securing requirements, the floor should thus preferable be made of wood.

5 LASHING POINTS

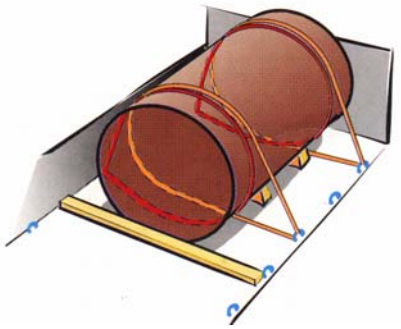
The units should be equipped with lashing points enabling application of all types of lashings in a flexible way.

5.1 Different types of lashing arrangements

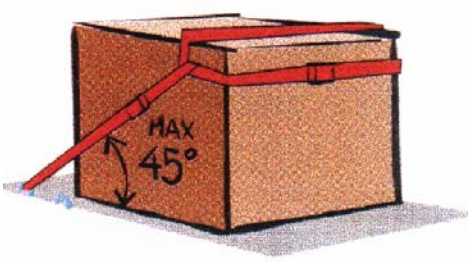
The figure below shows the following types of lashing arrangements; (over top-, loop-, spring- and straight lashing).



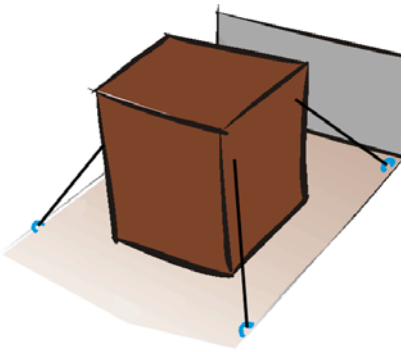
Over top lashing



Loop lashing

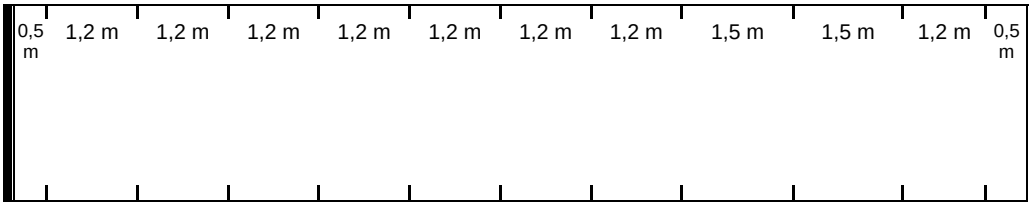


Spring lashing



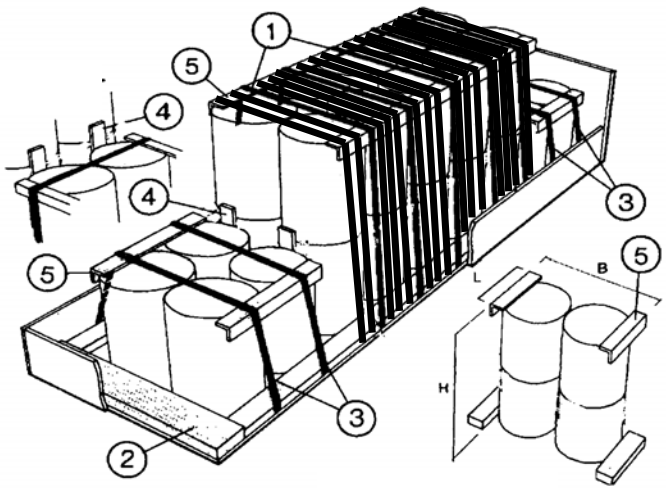
Straight lashing

All these types of lashings can theoretically be applied on a platform equipped with ordinary lashing fittings according to the minimum demands in the CEN-standard 12640, as shown in figure below. Maximum allowed distances are noted.



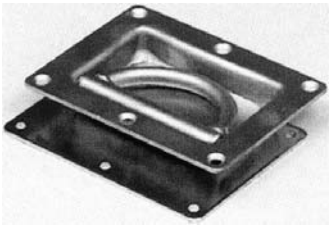
Minimum demand on positions for lashing points according to EN 12640

However, if several lashings have to be applied to a limited length of the platform as below, this is not possible with such a minimum arrangement.

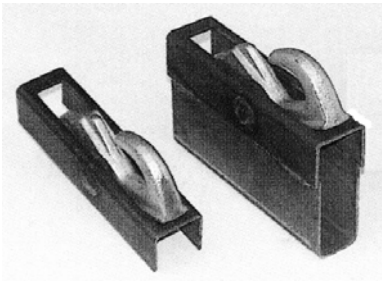


A much more flexible unit is obtained if a continuous securing bar is applied.

The strength of the lashing points in many trailers of today is 20 kN (2 ton). This is often too little and it is recommended that the minimum break load is 40 kN (4 ton). The figures below show fittings with a breaking strength of 20 kN, 40 kN and 60 kN.



Breaking strength 20 kN



Breaking strength 40 kN

Breaking strength 60 kN

5.2 Continuous lashing bar in the platform side beam

A continuous securing bar in the platform side beam makes it possible to fasten lashings anywhere along the platform.

Several such bars are available on the market. Many of these does, however, not allow securing applied as spring- or straight lashings. Some other criteria that should be considered when choosing lashing bar design are as follow:

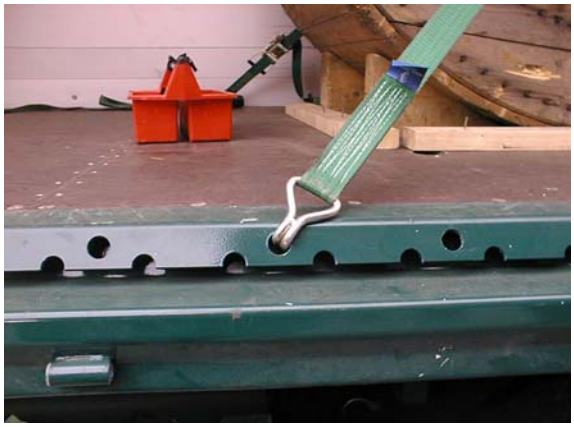
- From a users point of view it is often best if an ordinary lashing hook could be used direct in the lashing bar. An adapter between lashing/hook and the lashing bar is not preferably.

- It is essential to have in mind that dirt and scrap should be easy to remove from eventual tracks and holes.

- The lashings should be possible to fasten inside as well as outside the sideboards.

- A strong construction of the lower part of the platform side beam has two advantages: It can be used for the fastening of lashings and it can endure lashings to be drawn from the vehicle's framing to the cargo on the platform. If the lower part of the lashing bar is made of thin metal sheet this part of the lashing bar cannot be used for fastening lashings. Such a lashing bar will bend when the lashings are tensioned. The lashings will then be less tight and may loos their grip. Another problem occurs when strong lashings are fastened in the vehicle's framing and are passing the platform side beam to the cargo on the platform, as a thin lashing bar could be compressed which can lead to less tension in the lashings.

The lashing bar shown below is suited for common lashing hooks. The flange (including the half holes) is suitable for over top lashings and the holes are for loop-spring- and straight lashings. The holes on the under side of the bar are suitable for lashings that are drawn outside the sideboards. No breaking occurred when the lashing bar was tested with a tensile force of 50 kN (5 ton).



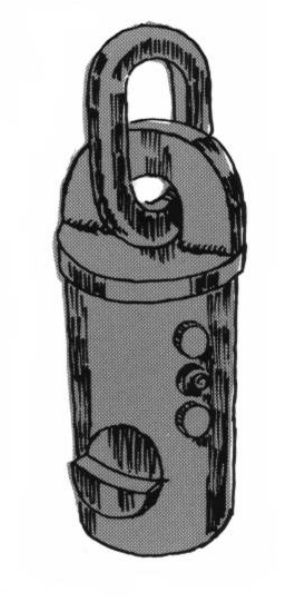
Lashing bar seen from below.

This lashing bar fulfil the criteria mentioned above and gives thus a flexible fastening of top over-, loop-, spring- and straight lashings inside as well as outside the sideboards and is simple to clean and do not collect dirt.

For efficient securing in rear direction, box type units are recommended to have lashing tracks on the side walls in addition to the lashing points on the floor, see figure below.

5.3 Fittings for heavy cargo

The cargo transport unit is recommended to be equipped with some strong fittings for securing of heavy cargo. The fittings should have a minimum break load of 100 kN. A flexible solution is to have movable fittings that could be placed in support holes for stanchions. There are different types on the marked. The one shown below have a break load of 130 kN (13 ton) but are available up to 320 kN (32 ton).



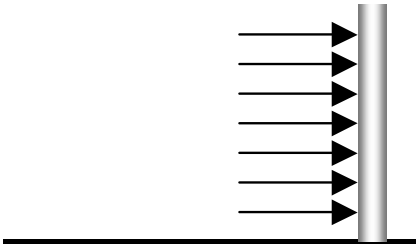
Fitting for heavy cargo to be placed in support holes for stanchions.

6 OTHER CARGO SECURING EQUIPMENT

6.1 Support holes for stanchions

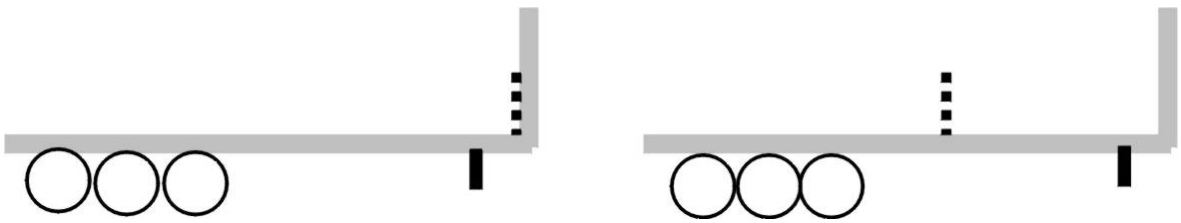
When transporting cargo that has a tendency to tip it is useful to have stanchions. For most flexibility there should be support holes for the stanchions at the sides as well as in the middle of the platform. The support holes are useful also for other securing equipment as shown in section 5.3 and 6.2.

The stanchions at one side should, all together, be dimensioned for a force of 0,3*Pay load. The force should be uniformly distributed over the stanchion, see figure below.



6.2 Movable blocking wall

With a movable blocking wall that can be placed in any position up to three meter behind the headboard there will be a possibility to block heavy cargo that cannot be placed direct against the headboard due to problems with the axle load. The wall should be slideable or easy to lift in place.

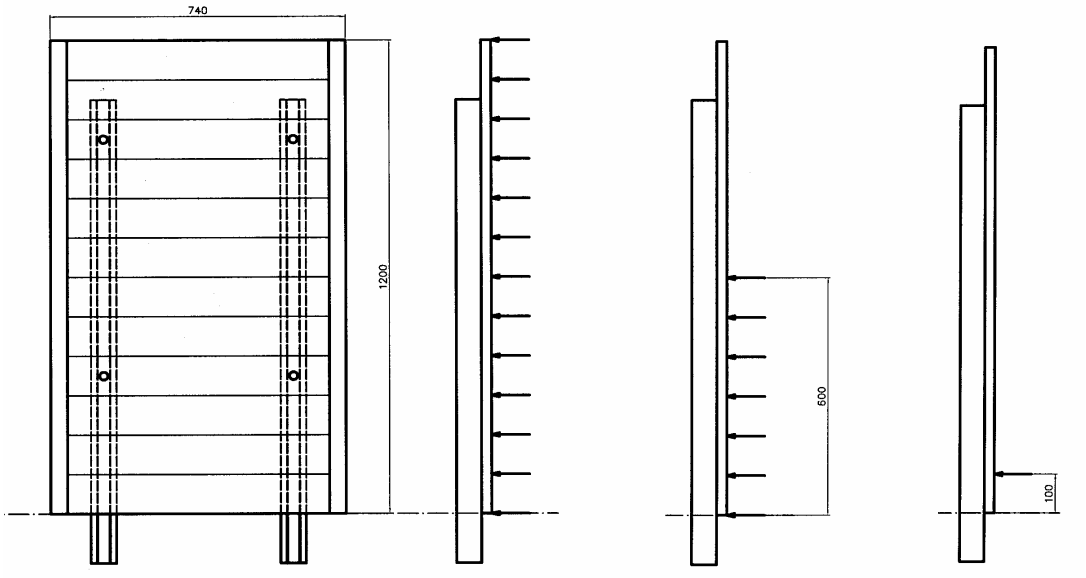


The movable blocking wall shown below consists of a total number of six stanchions with aluminium sheet metal as blocking wall. The stanchions are placed in holes, which the platform has to be equipped with. Several rows with holes give a larger flexibility to place the wall. The construction is divided into three parts so it can be easy to handle.

Section of blocking wall moved from its storage place.

As a side effect a different number of parts can be used at different occasions. The weight per part is about 20 kg. When the equipment is not in use it is stored in the headboard and consequently it do not take any volume from the cargo space.

Maximum allowed load against a wall section as shown above is according to the figure below.

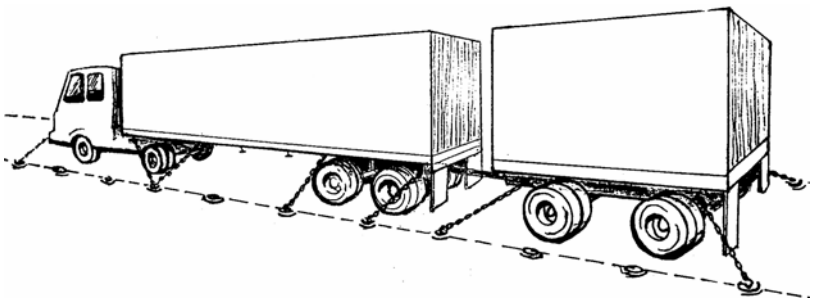


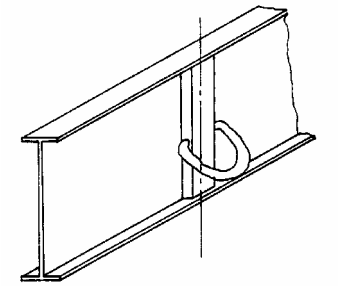
Maximum load: 23 kN (2,3 ton) 46 kN (4,6 ton) 140 kN (14 ton)

Seen from behind *Seen from the side*

7 LASHING EYES FOR FASTENING TO FERRIES

For unimpeded transport on ferries the vehicles should be equipped with outer lashing eyes for the fastening to the ships' deck. The number of lashing points, their strength and positions should be according to standard ISO 9367-1 (vehicles and combinations of vehicles) and ISO 9367-2 (semi-trailers).





8 LIST OF STANDARDS

The following standards are referred to in the document:

EN 283 Swap bodies – Testing.
EN 284 Swap bodies of class C – Dimensions and general requirements.
EN 12640 Securing of cargo on road vehicles – Lashing points on commercial vehicles for goods transportation – Minimum requirements and testing.
EN 12642 Securing of cargo on road vehicles – Body structure of commercial vehicles – Minimum requirements.

European standards are available from national standards bodies who are responsible for selling European Standards. Their web sites can be found at www.cenorm.be/catweb/.

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