



# Raise the Curtain for Correct Load Securing

Easily and Quickly Secure Freight and Transport it Reliably

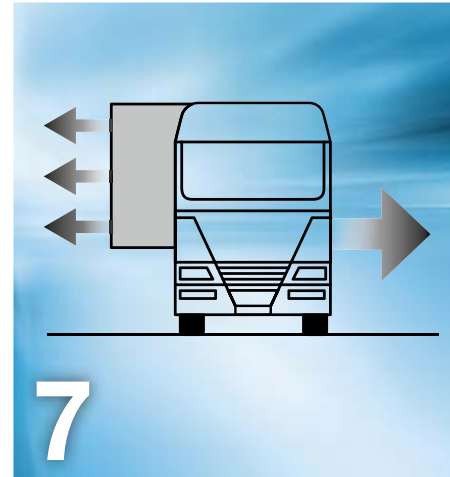
## Contents

- 4 Securing Loads Must Be Easy
- 5 The Legal Framework on the Topic of Securing Loads
- 7 Physical Forces – More Powerful Than You Think
- 8 These Forces Work for You
- 9 Acceleration and Friction in Figures
- 10 Frictional Coefficient – The Practical Values
- 11 The Technical Regulations as Firm Establishment of the Laws
- 12 The Statements of the Technical Regulations
- 13 VDI 2700: General Cargo
- 14 VDI 2700: Beverage Transport
- 15 VDI 2700: Paper and Steel Transport
- 16 Lashing Equipment and Eyes – the Right Equipment for Every Purpose
- 17 Identifying the Correct Equipment
- 18 Handling the Lashing Equipment
- 19 Forced Locking – Lashing Down at the Correct Angle
- 20 Positive Locking – Movement of the Load Prevented by the Body
- 23 Combined Security – Forced and Positive Locking
- 24 Securing Loads of Non-Stable Goods
- 25 Load Distribution

### Practical Examples

- 26 Heavy Point Loading, Paper Transport
- 28 High Point Loads When Transporting Coils
- 30 Automotive Pallet Cages
- 31 Tyre Transport
- 32 Beverage Transport
- 34 Piece Goods
- 36 Chemical Industry

- 38 Index
- 39 Contact



7

### Physical Forces

More Powerful Than You Think



10

### Coefficients of Friction

Practical Values



16

### Lashing Equipment

Types and Properties



19

### Positive Locking

Preventing Movement

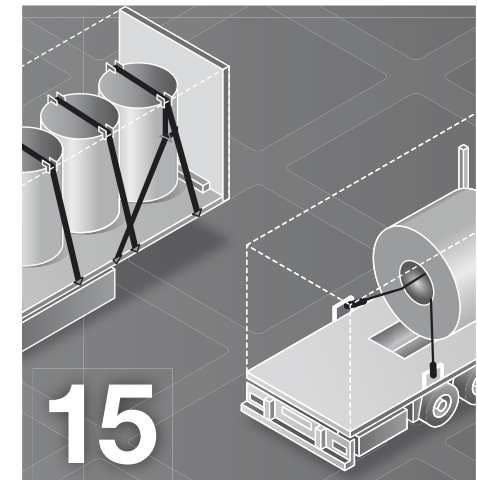
sidewall	0,4 P	10.800 daN
rearwall	0,3 P	8.100 daN
P = 27.000 Kg		
in compliance with		<b>EN 12642-XL</b> <b>certificate</b>
		

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**11**  
 Technical Regulations  
 Detailed Specifications



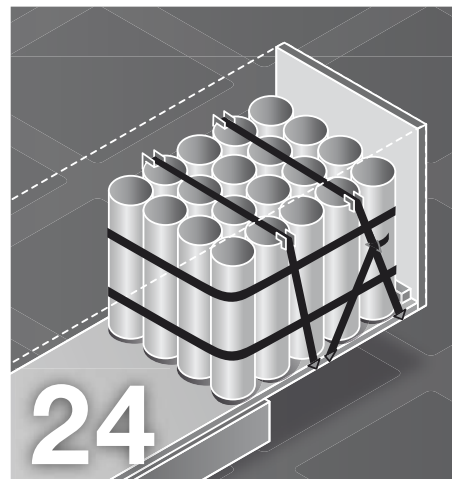
**14**  
 Beverage Transport  
 Securing Beverages



**15**  
 Paper and Steel  
 When Things Get Really Heavy



**20**  
 Forced Locking  
 Increasing Contact Pressure



**24**  
 High Centre of Gravity  
 Key Challenges



**26**  
 Practical Examples  
 Solutions from Various Industries

# Impossible Without You

## Securing Loads Must Be Easy

According to the German Federal Motor Transport Authority, in 2016 German trucks delivered a total of almost 3 billion tonnes of goods. Drivers had to pay attention to load security on around a quarter of billion journeys.

Schmitz Cargobull is part of the “freight traffic on the road” system, just like all the drivers out there. We all make a major contribution to ensure that this system functions.

With this brochure, we would like to remind you of things which may be otherwise forgotten during your stressful work day, namely the awareness that, in the event of an emergency, securing your semi-trailer’s load not only protects it, but also protects human life – above all your own, but also all other road users.



Load securing protects your life and the lives of all other road users.



The personal legal consequences due to inadequate load securing can be serious.



## Use and Uphold the Law

### The Legal Framework on the Topic of Securing Loads

Load securing is a freight hauling issue, for which the legislative authority and professional associations define regulations from their respective perspectives, so as to ensure that freight transport will neither damage the load, the vehicle or the traffic involved, nor injure the driver. Even though compliance with them creates work, the laws and directives are intended to protect you, from the vehicle, the load and other road traffic.

The reverse side of the coin is that those who violate the statutory regulations must not only compensate damage caused, but also face penalties. In accordance with the Road Traffic Act or road registration regulations (StVO/ StVZO), this can range from a fine, a driving ban and points in the central traffic register up to dangerous behaviour in road traffic (§ 315 b German Penal Code/StGB), or even manslaughter (§ 222 German Penal Code). In any case, non-adherence to the laws costs energy, time and money. All of this could be more sensibly invested elsewhere.

### Occupational Safety and Health Act (ArbSchG)

Securing loads is also significant under the aspect of occupational health and safety. **The vehicle is work equipment and, therefore, subject to occupational safety.** In detailed questions, the Occupational Safety and Health Act is based on the Accident Prevention Regulations (UwV) of the professional associations.

### Legal Consequences of Inadequate Load Securing\*

	Legal Consequences of Inadequate Load Securing*			
	Civil law		Public law	Penal law
	Contractual	Non-contractual claims and acting unlawfully		
Standard	Section 425 HGB Liability for damage to goods and default	Section 7 Para. 1 StVG Liability of the registered keeper of the vehicle	Section 49 Para. 1 No. 21 StVO Infringement i.a.w. section 22 StVO Loading	Section 222 StGB Manslaughter
	Art. 17 Para. 4 c CMR Liability of the carrier	Section 823 BGB Liability for damages due to unlawful acts	Section 49 Para. 1 No. 22 StVO Infringement i.a.w. section 23 StVO Other obligations of the driver	Section 229 StGB Negligent bodily injury
	Section 412 HGB Diligence of the carrier		Section 69 a Para. 5 No. 3 StVZO Infringement i.a.w. section 31 Para. 2 StVZO Responsibility for operation of the vehicles	Section 315 b StGB Dangerous behaviour in road traffic
Possible legal consequences	Compensation for damages	Compensation for damages, compensation for immaterial damage	Fine, driving ban, entry in the central traffic register	Fine, imprisonment, driving ban, divestment of the driving licence

\* Listed without warranty or claim of comprehensiveness.

# Obligation of Responsibility

## The Statutory Framework: Road Traffic Act, German Commercial Code and German Accident Avoidance Regulation

The German Road Traffic Act (StVO), the Commercial Code (HGB), the Occupational Safety and Health Act (ArbSchG), and Accident Prevention Regulations (UVV) of the professional associations all assign a particular responsibility to you as the driver / driver of the trailer / carrier for the correct securing of loads for transportation on the semi-trailer. Why you? You drive the load to its destination and are in close contact with the load during transportation and, therefore, have the best – direct – overview of the security measures required. Furthermore, you are the most familiar with your trailer. In addition, you are assumed to have a large vested interest in good load securing, because your welfare

### Commercial Code (Section 412 HGB)

Paragraph 1: Unless otherwise stated from the circumstances or common usage, the dispatcher must load, stow and secure (loading), and unload the goods for safe carriage. The carrier must ensure safe loading.

depends on whether you have taken all safety measures. Needless to say, your trailer must be also safely constructed and equipped (sections 22 Para. 1 and 37 Para. 4 of the UVV), so that you can correctly secure the load. This is why sections 30 and 31 of the German Road Traffic Regulations also mention the vehicle owner's obligations and why section 22 refers to the loading process.

### Accident Prevention Regulations (Section 22 UVV)

Paragraph 1: Vehicle bodies must be designed so that they secure the load (...) against sliding, rolling, falling down (...) during the intended use (...). If security of a load is not ensured solely by the vehicle body, auxiliary equipment must be available to secure the load (...).

### (Section 37 UVV)

Paragraph 4: The load must be stowed and secured, as required, so that under normal traffic conditions there is no risk to persons.



It is simply safer to comply with the laws.

### Road Traffic Act (Section 22 StVO)

Paragraph 1: The load, including devices for securing the load (...), must be stored and secured so that they cannot slip, fall down or generate unavoidable noise during full braking or sudden evasion movements (...). Thereby, all acknowledged codes of practice must be observed.

### Road Traffic Act (Section 23 StVO)

Paragraph 1: The driver is responsible for making sure that his vision and hearing is not impaired (...) by the load (...). The driver must also make sure that (...) the loads (...) are loaded as specified and that the road safety of the vehicle is not impaired by the load (...).

# The Physical Forces

## More Powerful Than You Think

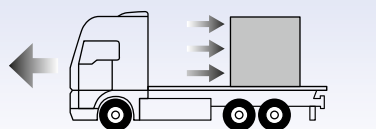
Physical forces are constant and determine our everyday life, consciously or unconsciously. Whether by gravitational force, centrifugal force or friction force – the natural laws make no exception for the load on your trailer. There are repeatedly situations in traffic in which you and your load feel the effects of these physical forces.

Our experience with physical forces is mainly based on human standards. However, we deal with significantly greater forces when securing loads.



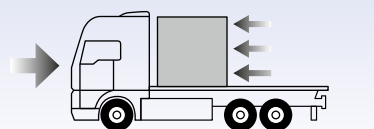
### Acceleration – Moving Off

Acceleration is the increase of speed within a specified time. It has the effect that the load wants to slide rearwards.



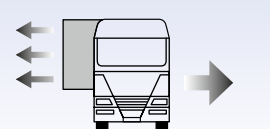
### Braking – the Opposite to Acceleration

Slowing down – braking – is also a change in speed. It has the effect that the load wants to move towards the driver's cab.



### Cornering – Sideward Acceleration

A change of direction is also evident when cornering at exactly the same speed: the centrifugal acceleration. It has the effect of moving the load towards the sidewall.



## The Other Side

### These Forces Work for You

During travelling, weight, inertia and friction cause the load to remain where it was placed, if it were not for the acceleration of the trailer during moving off, during the journey, when braking or changing direction, such as cornering. They move the load from its original position. Therefore, a counteracting force is required that – at the same magnitude – secures the load.

The relationship between the normal force (weight or pressure) and the friction, known as the friction combination, is defined by the sliding friction coefficient ( $\mu$ ) (pronounced 'mu').



The primary objective of load securing is that the load remains in its position in every situation.

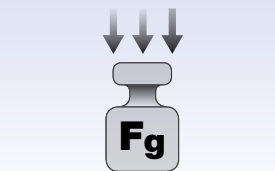
### Friction – Deceleration

Each surface – even if it appears smooth – has irregularities, small 'mountains' and 'valleys'. When two surfaces are pressed onto each other, they catch and make relative movement difficult. This resistance is expressed as a friction coefficient in  $\mu$ . The smaller the value, the lower the resistance. When stationary, the resistance is greater than when the objective is already moving.

When securing loads, this dynamic friction coefficient is taken as a basis because, due to vibration during travelling, it cannot be presumed that the load is stationary.

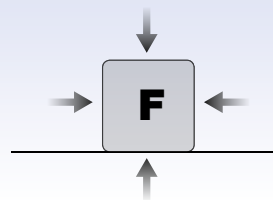
### The Weight

Vertically presses the load onto the loading surface.



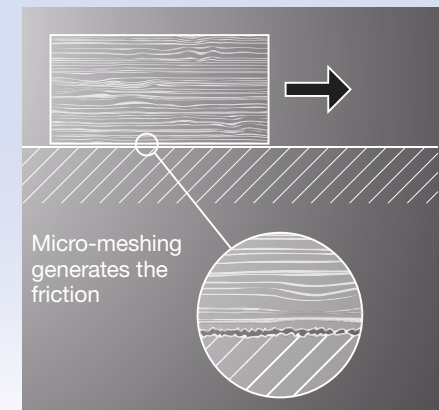
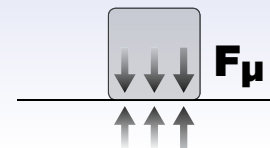
### The Inertia

Wants to retain the load in its present position/movement and acts against the acceleration, braking and changes in direction of the vehicle.

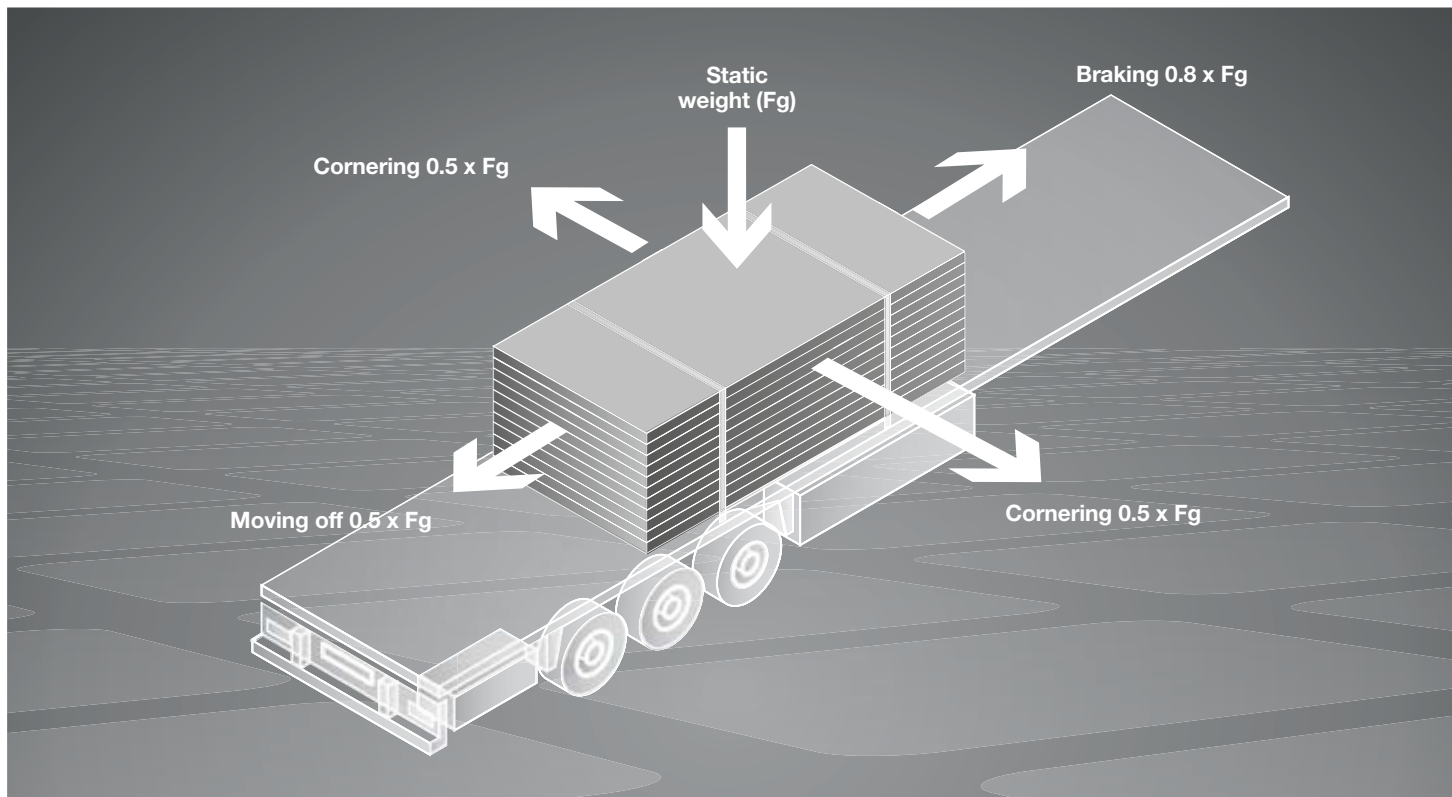


### The Friction Force

Prevents or reduces displacement of the load. Its effect is influenced by the surfaces of the load and loading surface.







## Correctly Estimating Forces

### Acceleration and Friction in Figures

Ideally, you have the opportunity to carefully prepare the load securing, taking into account all of the weights and dimensions. However, an assessment must frequently be made quickly on site in order to decide on suitable measures. What forces must I anticipate? The illustration on the right shows the size of the forces that normally occur during transportation. Multiply the weight ( $F_g$ )\* of the load with the relevant acceleration factor to calculate the force that attempts to move the load away from the trailer.

\* The weight is measured in deca-Newtons (daN). When rounded up, 1 daN corresponds to a weight of 1 Kg.

#### The formula for estimates:

Use this formula for the calculation so that the load remains in its position:

Weight x Acceleration factor  
= Force acting on the load.

This means:

The minimum counteracting force attained must be the same.

#### Example when braking:

The acceleration of the load when braking is 0.8 (see illustration)

Load 1000 daN x 0.8 = **800 daN**

This means:

With 800 daN (which corresponds to approx. 800 kg), the load is pushed forwards towards the driver's cab during braking.

#### What is the counteracting force?

With a frictional coefficient  $\mu = 0.3$ , the following counteracting force is anticipated:

Load 1000 kg daN 0.3 = **300 daN**

This means:

300 daN (which corresponds to approx. 300 kg) work as a counter-acting force, preventing the load from moving.

#### Summary:

800 daN acceleration minus 300 daN equals: 500 daN

This means:

load securing is required which can withstand at least 500 daN (which corresponds to approx. 500 kg) either by increasing the friction (lashing down) or by blocking (supporting against the body).

## Correctly Estimating Forces

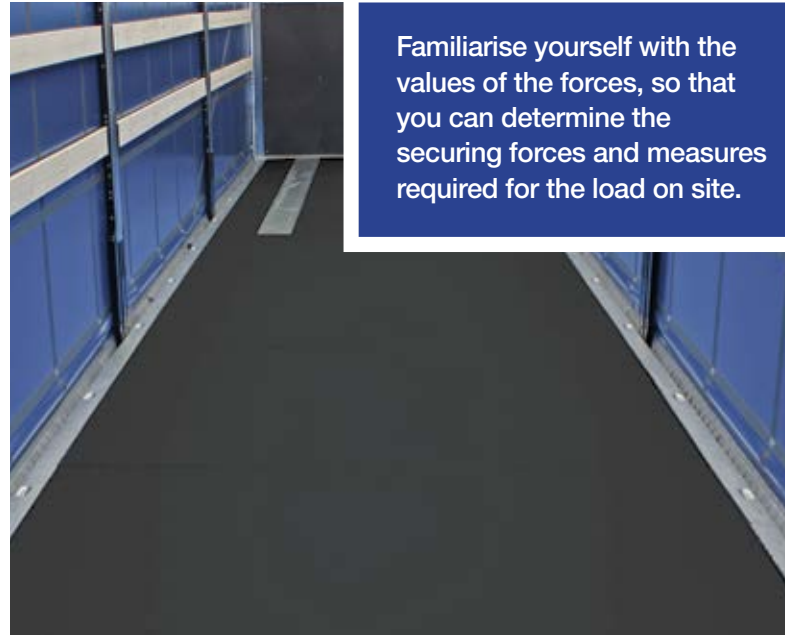
### Practical Values

The coefficients of friction for the most common combination of materials indicate large differences, therefore it is important to have an idea of the reference values. If in doubt, take the lower value. This is also applicable when estimating the location of friction joints, namely the connecting points between materials.

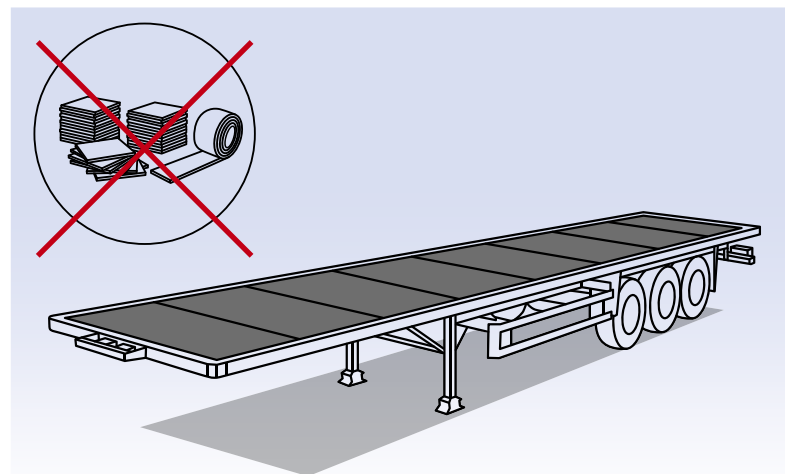
Example: A pallet is on the bed of the trailer, movement between bed and pallet can occur, but also between the pallet and goods and between the individual parts of the load. The respective weakest point is taken for the evaluation.

The table opposite shows the dynamic friction coefficients. It is also assumed that the load always moves a little during the journey, as a result of vibration, so that the initial adhesion is irrelevant.

If in doubt, take the smallest coefficient of friction, e.g.  $\mu = 0.2$  for a loading surface with no grouting.



A coated anti-slip floor with a sliding friction coefficient of  $\mu = 0.6$  makes load securing even easier and means that you don't need anti-slip mats.



Dynamic Friction Coefficients in $\mu$ for Different Pairs of Material*	
<b>Sawn timber</b>	
Sawn timber – laminated wood/plywood	0.45
Sawn timber – corrugated aluminium	0.40
Sawn timber – steel sheet	0.30
Sawn timber – shrink film	0.30
<b>Planed wood</b>	
Planed wood – laminated wood/plywood	0.30
Planed wood – corrugated aluminium	0.25
Planed wood – steel sheet	0.20
<b>Synthetic material pallet</b>	
Synthetic material pallet – laminated wood/plywood	0.20
Synthetic material pallet – corrugated aluminium	0.15
Synthetic material pallet – steel sheet	0.15
<b>Steel and metal</b>	
Steel box – laminated wood/plywood	0.45
Steel box – corrugated aluminium	0.30
Steel box – steel sheet	0.20
<b>Concrete</b>	
Set concrete – sawn timber slats	0.70
Smooth concrete – sawn timber slats	0.55
<b>Paper rolls</b>	
Laminated wood/plywood	0.25 – 0.4
<b>Beverages</b>	
Stainless steel kegs – Euro pallets	0.40 – 0.50
PU-coated kegs – Euro pallets	0.50 – 0.70
Kegs, lying down – Keg pallets	0.70 – 0.80
Multi-use plastic beverage cases – Euro pallets	0.20 – 0.35
Film wrapped single-use containers – Euro pallets	0.20 – 0.50
Cardboard packaging	0.25 – 0.50
<b>Anti-slip mat</b>	
Rubber	0.60

Source: DIN EN 12195-1, beverages: VLB logistics work group 2005

\* Surface dry or wet and clean, free of oil, ice, lubricating grease

\*\*If special materials are required for increased friction, such as anti-slipmats, certification of the coefficient of friction  $\mu$  is required.

The acknowledged codes of practice can also be relied upon from a legal point of view.



## The Recognised Codes of Practice

### The Technical Regulations as Firm Establishment of the Laws

In addition to the statutory civil and road traffic conditions for correct securing of loads, there are other ascertainties of goods – e.g. through DIN EN 12642 Code XL, as well as from VDI, the Daimler AG or trade associations – who set out detailed specifications for transportation of the respective goods. The Road Traffic Act states that the recognised codes of practice must be observed when securing loads, as well as the sources named.

Geprüfte Aufbaufestigkeit / Confirmed bodystrength		
Vorderwand / Frontwall	0,5 P	13.500 daN
Seitenwand / Sidewall	0,4 P	10.800 daN
Rückwand / Rearwall	0,3 P	8.100 daN
P = 27.000 Kg		
Fahrzeug entspricht Vehicle body in compliance with		<b>EN 12642-XL certificate</b>



Stickers on the trailer refer to the body's ability to absorb forces.

Left: Sticker to verify certified structural rigidity according to DIN EN 12642 Code XL.

Middle: Load securing equipment is tested by TÜV Nord and meets the requirements of EN 12642.

Right: Schmitz Cargobull Safety Roof increases structural rigidity.

# The Regulations Are Pertinent

## The Statements of the Technical Regulations

The more pertinent the "acknowledged codes of practice" in section 22 of the German Road Traffic Act are, the clearer it is that the specifications of the various organisations for securing loads partially overlap. Therefore, it is possible to receive semi-trailers that simultaneously conform to the regulations of the VDI Directive 2700, the Daimler Directive 9.5 and DIN EN 12642 Code XL.

### VDI 2700

The Verein Deutscher Ingenieure (Association of German Engineers) has published numerous topics about securing loads in its VDI 2700 series of directives for recognised codes of practice. These directives are each issued as one sheet. VDI 2700 includes sheets on lashing forces (2), load distribution plan (4), bulk goods (6), combined load transport (7), paper rolls (9), concrete steel (11), beverage (12), coils (19) and other issues. The publication series is being continuously expanded.



Obtain training in order to correctly apply the recognised codes of practice during daily work.

### DIN EN 12642

The European standard DIN EN 12642 is applicable in all member states of the EU, as well as Norway and Switzerland, and specifies the minimum requirements for the body of commercial vehicles of more than 3.5 tonnes. It includes a fixed front wall (0.5 x payload), rear wall (0.3 x payload) and sidewalls (0.4 x payload), that – due to particularly sharp cornering for example – must not bulge by more than 30 cm before they return to their original condition, resting on the frame of the vehicle. End-to-end lashing rings in the external frame and reinforced versions for tarpaulins and stanchions, as well as a minimum of 2 rows of support laths made from wood or aluminium are also part of the equipment.

The Code XL marking designates the high stability of the trailer body in contrast to the designation Code L, the superstructure indicated with less strength.

Code XL with the addition "suitable for beverage transport" designates a trailer body that is suitable for the special demands on the transportation of well pallets and barrels. The trailer body is distinguished by reinforced side tarpaulins with 24 closely arranged buckles, as well as a roof tarpaulin with side rail reinforcement. In addition, there are reinforced beverage stanchions and 4 rows of aluminium support laths for the beverage equipment.

### Daimler 9.5

The idea of the Daimler Directive 9.5 is the trouble-free transportation from and to the Daimler AG plants and it contains mandatory methods for securing loads. The directive is based on the statutory regulations for securing loads (Road Traffic Act and German Commercial Code). The equipment of a vehicle for correct securing of loads includes a front wall, tested with 0.5 x payload, a rear door, tested with 0.3 x payload, and 2 pairs of espagnolettes, as well as a reinforced roof and side tarpaulins with 24 Tyride buckles, a minimum of 3 pairs of reinforced stanchions, 4 rows of support laths made from wood or aluminium, and a pallet stop. The Daimler Directive 9.5 is increasingly used for all transportation in the automotive sector.

## VDI 2700 Sheet 6

### General Cargo

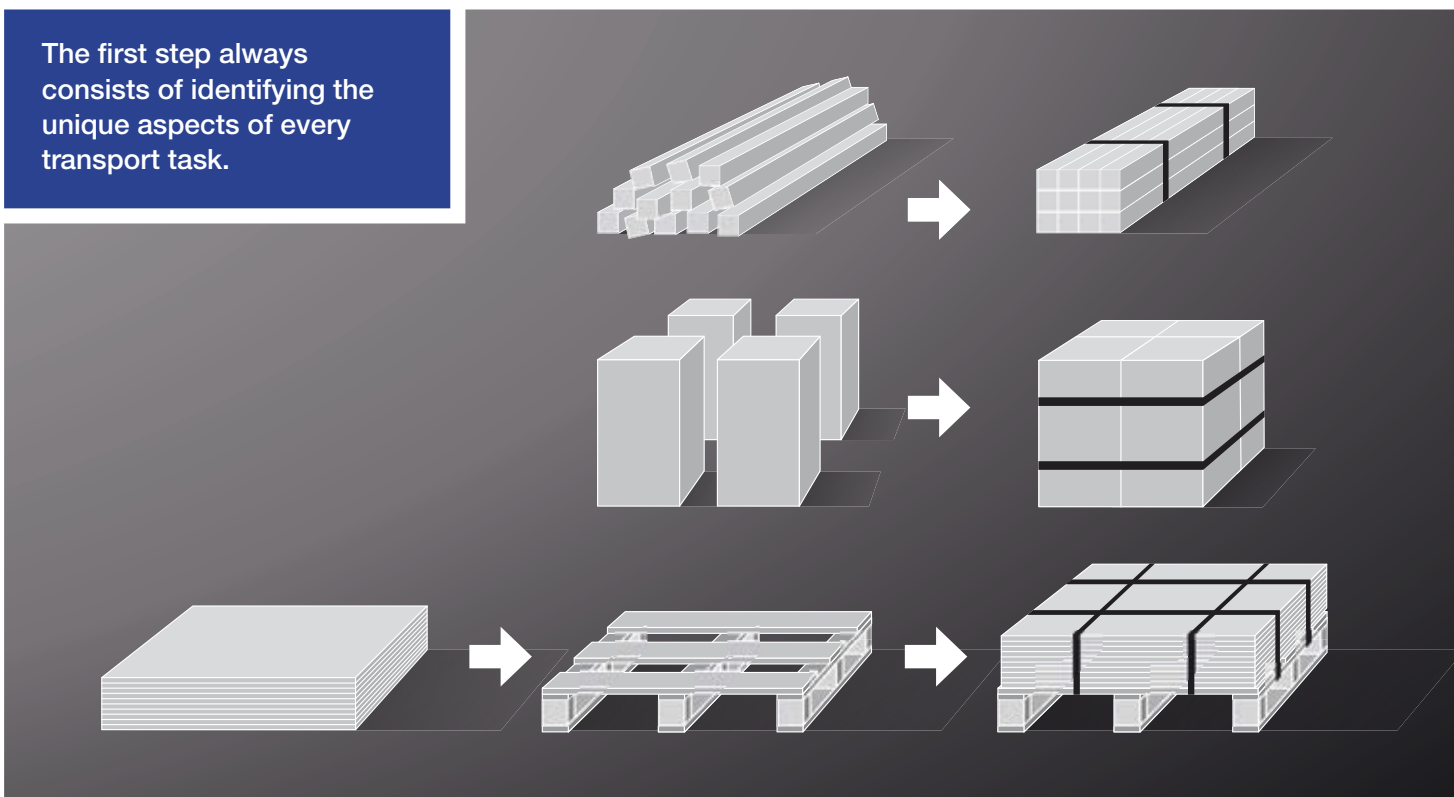
#### Sheet 6

#### Loading packaged goods

In addition to the load securing methods, the directive also describes the characteristics of the vehicle bodies and the equipment for transporting packaged goods. One unique aspect of packaged goods is that the cargo was often not uniform, especially when transporting combined loads. That is why combining the packages into larger loading units is highly important. This means that the individual parts are bound together and, ideally, transported with a load carrier such as a pallet or a container.

The amount of pressure the individual layers can withstand must be taken into consideration when vertically stacking loading units. The overall, orderly load distribution of the corresponding vehicle must also be complied with. Furthermore, the vehicle body and the transport equipment must comply with these DIN EN 12642 Code XL and EN 283 for swap container standards.

The first step always consists of identifying the unique aspects of every transport task.



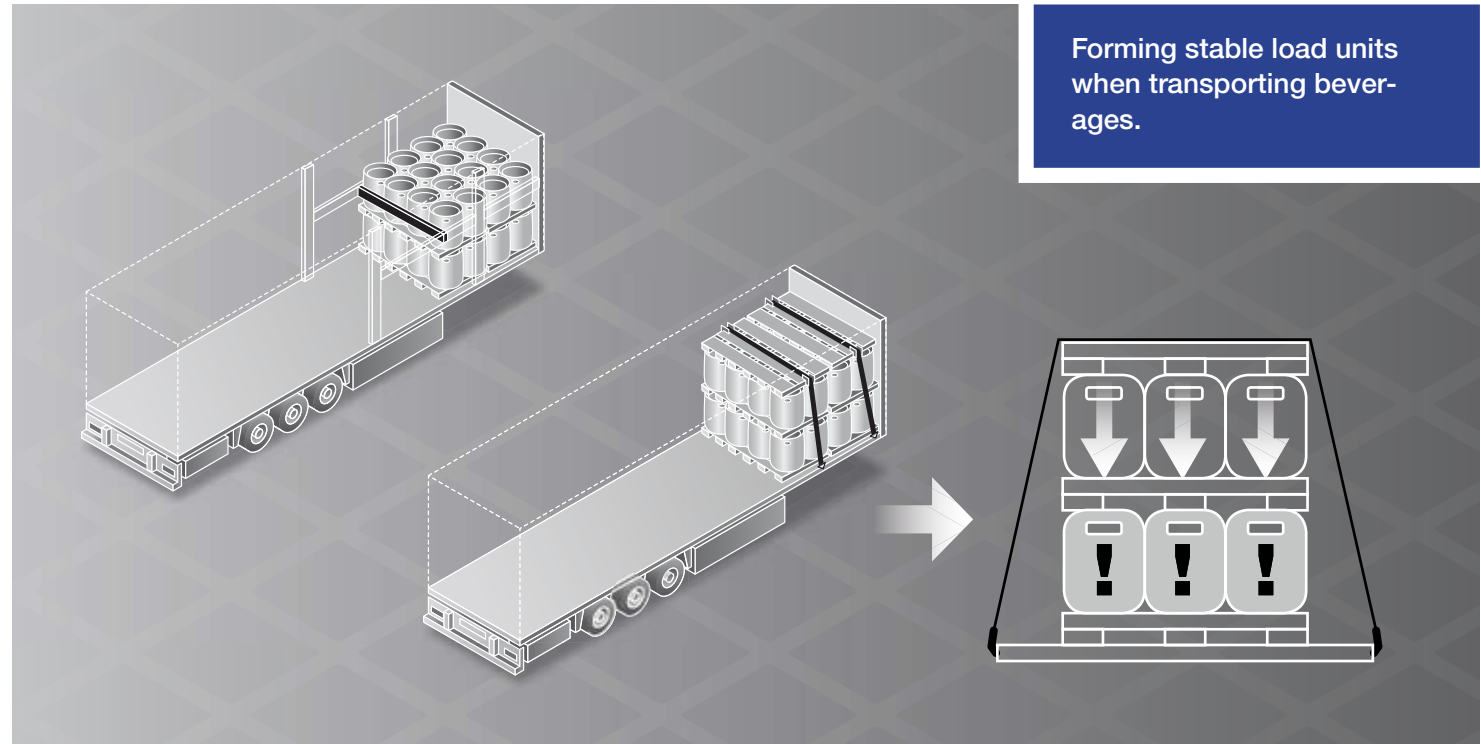
## VDI 2700 Sheet 12

### Beverage Transport

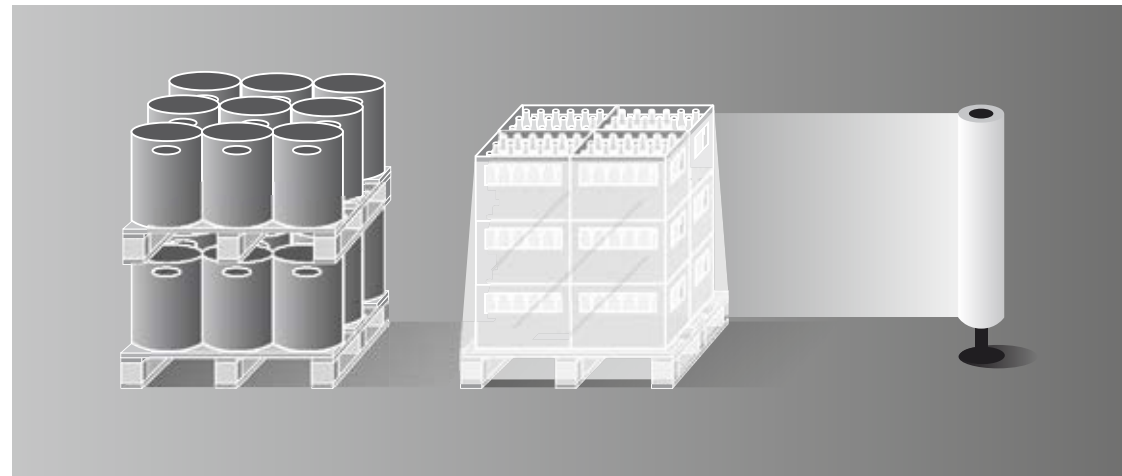
#### Sheet 12

#### Load securing for beverage products

Sheet 12 of the directive addresses the load securing for beverage products and accessories (e.g. cooling units, tap systems) on trailers with standard bodies and bodies with especially high structural strength as per DIN EN 12642 Code XL. Additional load securing measures can be omitted for the latter when transporting an interlocking complete load. In this case, the body is capable of absorbing all of the forces.



Positive locked loads of strapped kegs.



Top illustration:  
Securing partial loads with cross beams or locking rods to the rear or by lashing down. When lashing down, the load-bearing capacity of the lower loading units must be observed.

Bottom diagram:  
Two layers of kegs are separated from one another by pallets. Ideally, cases or other containers are bound with film to form compact loading units.

## VDI 2700 Sheet 9+19

### Paper and Steel Transport

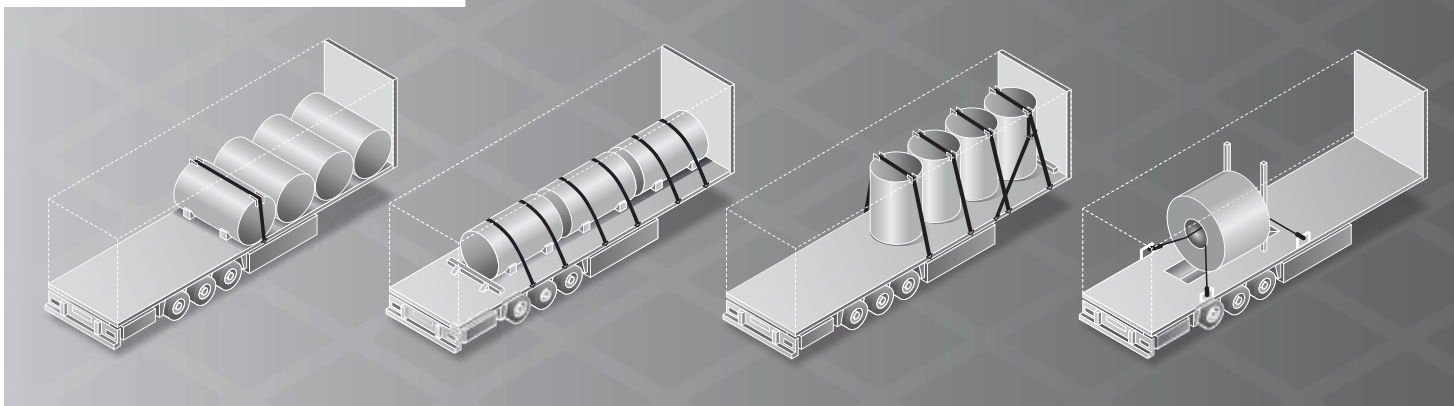
#### Sheet 19

#### Load securing for wound coils made of steel, sheet metal panels and shaped steel

This directive examines the issue of load distribution and load securing in great detail due to the very high weights which steel cargo exerts on the trailer chassis. Schematic illustrations, tables and calculation formula for the position and stability of the load, along with a glossary defining the terms for sheet metal panels and shaped steel, with the different-commercial signs in packaging, illustrate the complexity of this field. It is always important to consider that point loads or linear forces affecting the trailer must be avoided. The load may need to be distributed with the help of wooden beams.

Stanchions and heavy-duty lashing points with lashing chains are the most important load securing equipment.

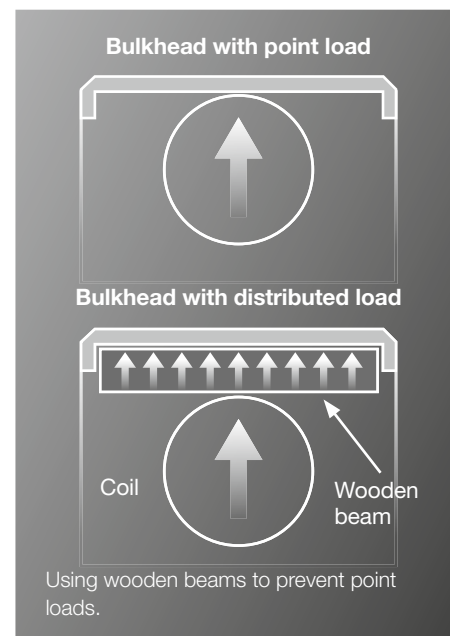
Even small details can have major effects when transporting heavy weights.



#### Sheet 9 Load securing of hard paper rolls

Sheet 9 of the directive only addresses transporting paper rolls on road vehicles and excludes intermodal transport, namely loading the trailer onto a railway wagon or ship. Separate regulations apply in these cases, e.g. from Deutsche Bahn. This directive also only applies to hard paper rolls and does not cover palletised paper formats or soft rolls such as toilet paper.

Depending on the material combination, the sliding friction coefficients for paper rolls are between  $\mu = 0.25$  and  $0.4$ . As a result, additional load securing is required despite the high weight and at the very least anti-slip materials are necessary. Only anti-slip material approved for transporting paper rolls may be used. This directive also provides a very detailed description of the conditions for transporting different arrangements of rolls: arranged as individual upright rolls, in a straight group, alternating and horizontal. In the case of horizontal rolls, both slipping and rolling must be taken into consideration.

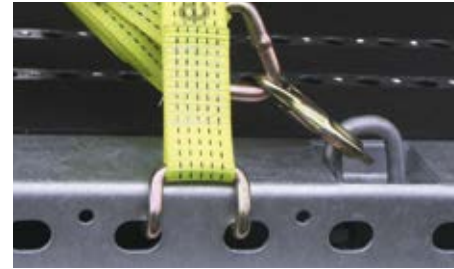


# Lashing Equipment and Eyes

The Right Equipment for Every Purpose



The belts can be equipped with a variety of different end fittings. The hook shown here can be attached to a recessed lashing ring on the outer frame.



The hooks and lashing eyes and rings must have compatible designs.



Tension ratchets rapidly and reliably generate the lashing forces. Depending on the design of the ratchet the force is generated by pulling or pressing the lever.



Always observe the trailer manufacturer's specifications regarding the load capacity of the lashing points.



Lashing chains for larger loads come with suitable lashing eyes, in this case a 5 t eye.



Built-in winch with lashing belt underneath the exterior frame.



The Sliding Lashing System mounted between the roof bars enables customised load securing. Movable retainers are used to fit the load securing straps. These can be pushed to any desired position inside the cargo area.



When not used or during loading, the load securing straps can simply be moved or pulled up to the roof using the retainers, keeping the cargo area free.

Lashing equipment	Tensioning equipment	Tensioning element	Connection element
Lashing strap	Webbed belt	Ratchet Winch Clamping lock	Lashing hook Last link Master link
Lashing chain	Round steel chain	Spindle tensioner Turnbuckle Chain hoist	Hook Shackles Last link Claw hook
Lashing cable	Wire cable	Winch Chain hoist	Hook Shackles Last link Combination link

Overview of approved lashing equipment according to DIN EN 12195



## The Lashing Strap

### Identifying the Correct Equipment

The labelling on the lashing equipment is standardised. The straps have a label which specifies their characteristics. Load capacity is specified in daN (deca-Newtons) which is the same as kg for the purpose of simplicity (it equals the weight that acts on a mass of 1 kg).

- **Normal manual force (SHF)**

This force must be applied to a clamping device (wretched) to achieve the normal pre-tension force.

- **Normal pre-tension force (STF)**

The clamping device applies this force to the strap when used by hand only – without tools to extend the lever. The force applied to the load when lashing down depends on the angle at which the strap is lashed (see page 19).

- **Maximum absorbable force (LC)**

This is the maximum force which may be applied directly to the strap, e.g. for direct lashing. This value doubles if the strap is used as a loop.

The lashing strap label provides information about the maximum tensile loading and material used.



#### Estimating the required number of straps:

For lashing down, the overall STF values of all straps should correspond to at least the weight of the load, in kg. At low sliding friction coefficients the pre-tension force may be multiple times the load weight.

#### Only use permissible lashing material

All of the straps must bear a label specifying the low-bearing capacity and must comply with the standard DIN EN 12 195, Part 2, 'Lashing straps made of chemical fibres'. In addition, an identification code, the manufacturing date, the length of the strap and the

maximum stretch are specified. The colour of the label (not the tensioning belts) indicates the type of material:

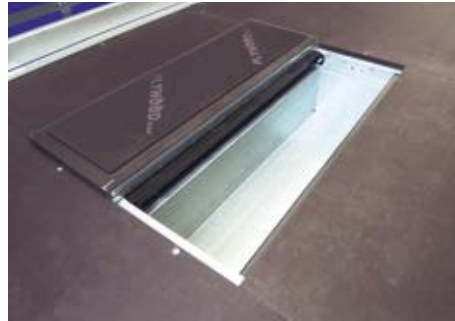
- Blue = Polyester (PES)
- Brown = Polypropylene (PP)
- Green = Polyamide (PA)
- White = Other materials



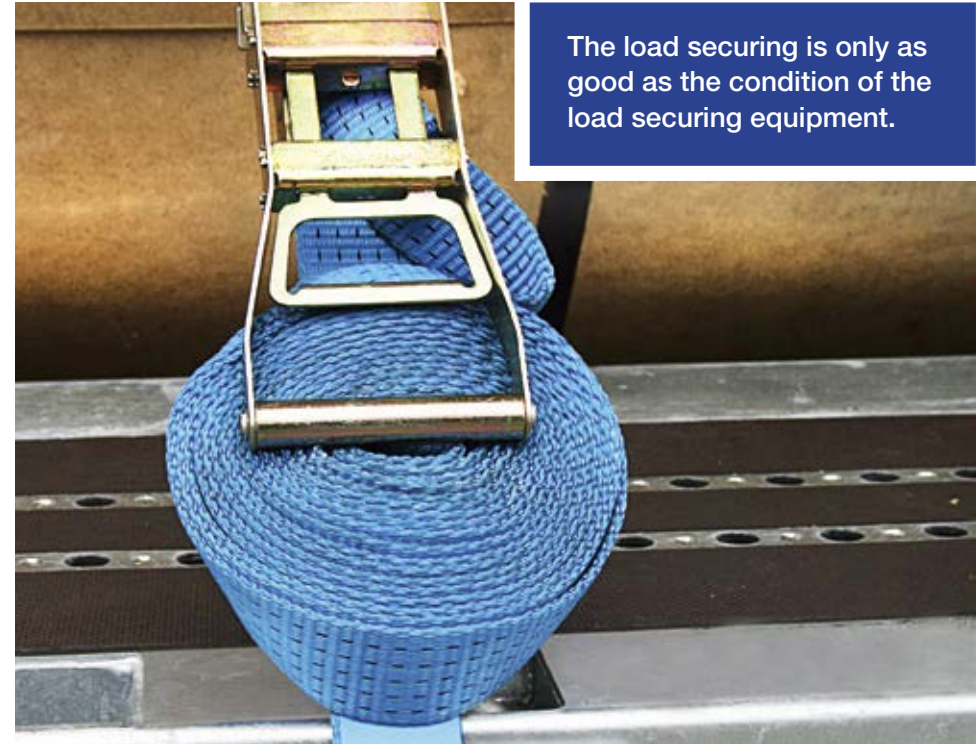
## Available Any Time

### Handling the Lashing Equipment

Securing the load should be a quick process. That is why the necessary equipment needs to be readily available and in perfect condition. A permanent, dedicated storage location is the best option for storing all of the lashing equipment. This allows the equipment to be checked at any time in order to remove any worn or damaged equipment.



Store the load securing equipment and a storage box in the floor of the loading surface.



The load securing is only as good as the condition of the load securing equipment.



Underneath the trailer in a large storage box ...

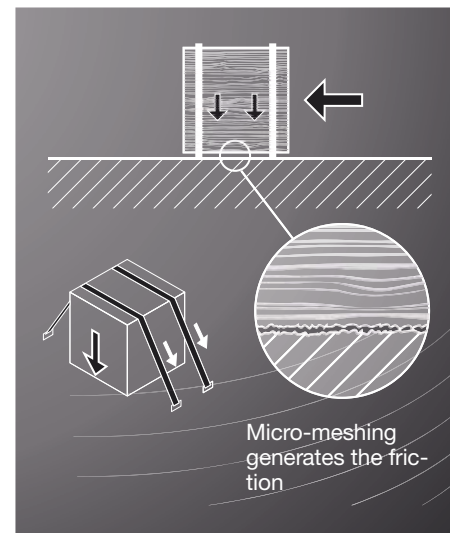


... or in the bulkhead.

### Practical Tips:

- Check the surface of the loading bed. Contamination by sand could result in a reduction of the friction resistance. If in doubt: sweep!
- Use a slip-resistant material, such as anti-slip mats.
- When lashing down, make sure not to damage the load. If the load yields (carton or similar), the pre-tension force is also lost.
- Uniformly distribute the lashing equipment over the load to secure.
- Do not use lashing straps over the tensile force.
- Do not twist or put knots in the lashing straps.
- Never tension lashing straps over sharp edges. Always use edge protection.
- After driving for a while, re-tension the straps.
- Avoid lashing angles of less than 30°.
- Observe the prohibition of unauthorised extension of the ratchet lever.
- Before using each time, check the lashing equipment for signs of wear or damage. Lashing straps without a test plate should not be used.

Pressure increases the friction resistance.



## Securing Using Forced Locking

Lashing down at the Correct Angle

### Forced locking or positive locking

Fundamentally, for securing loads we differentiate between two principles – securing by positive locking and securing by forced locking.

Forced locking for securing loads is based on intensifying the friction forces between the load and the loading surface. The pressure on the load is increased with the aid of lashing equipment, thus the load is more strongly pressed onto the loading surface, thereby retaining its position.

Securing loads using positive locking is based on limiting the loading area. This means each item of freight rests on another or on the limit of the loading area, on the front, rear or side-walls with no gap.

### When is it beneficial to secure the load by lashing down?

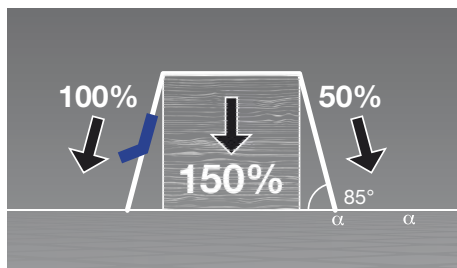
There is good reason why lashing down is the most frequently used form of securing loads – provided that the pre-tensioning forces can be attained. However, it must not be underestimated that this form of securing loads only functions for low weights.

### Lashing down – the pre-tension force

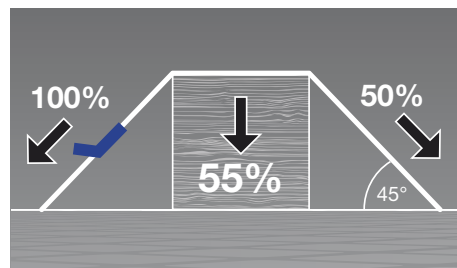
When lashing down a load, the lashing equipment does not directly secure a load, but instead increases the contact pressure. Thus, the load is exclusively secured against slipping by the friction force. Thereby, two lashing straps are placed over the item of freight. The straps are hooked onto lashing points on the loading surface and pretensioned using a tensioning element like a ratchet.

### Increased friction – increased security

If forced locking securing of loads is to be attained, the minimum friction forces must have the magnitude of the driving dynamic forces when cornering, accelerating or braking.



On the opposite side, the tensioning force generated on the ratchet is only half as effective due to the friction on the belt's contact points. The resulting contact pressure is therefore equivalent to 1.5 times the tensioning force, even though the angle of the belt is almost 90°.



The smaller the lashing angle, the lower the resulting contact pressure. In this example, the tensioning force would have to be greatly increased to balance out any losses.

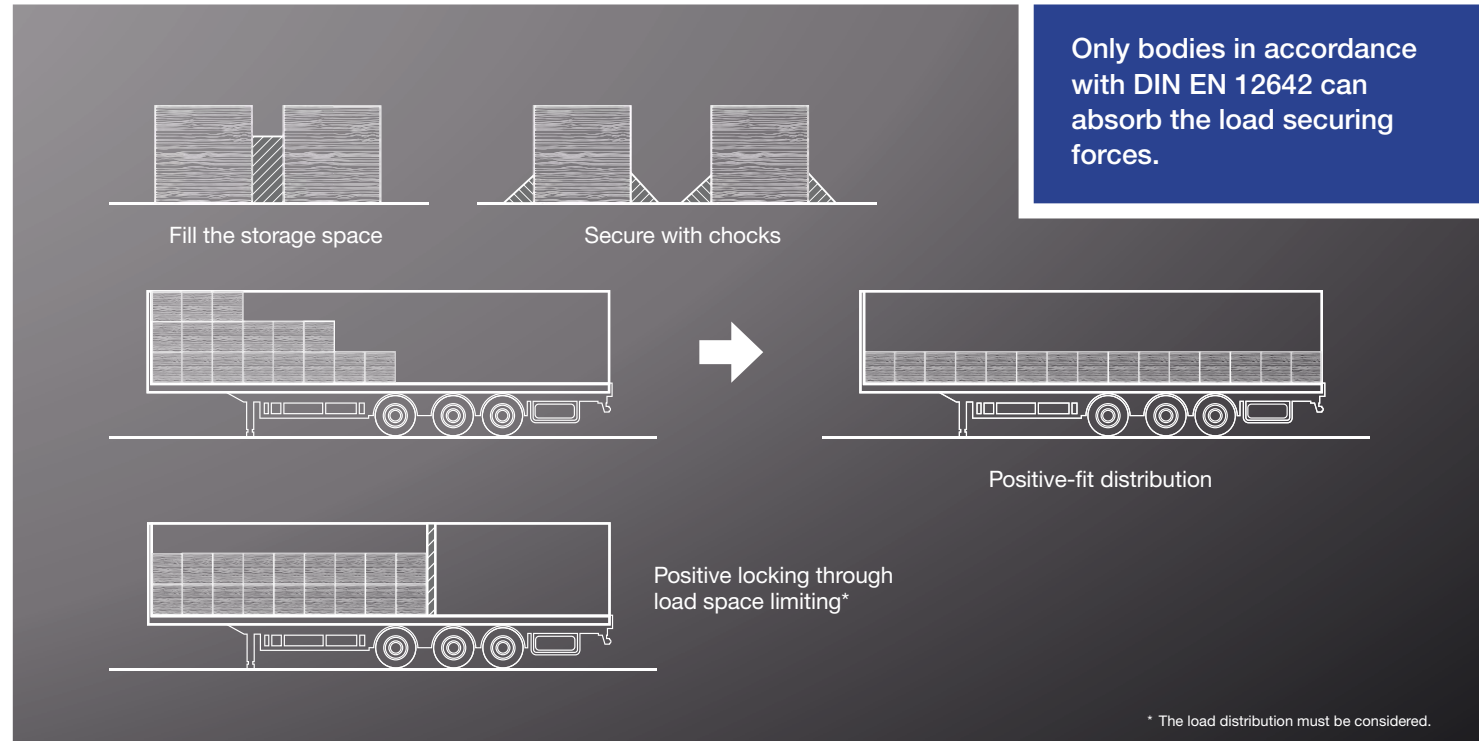
## Securing Using Positive Locking

### Movement of the Load Prevented by the Body

An optimum method to secure a load is to position the load sections tightly against the bulkhead, rear wall or sidewalls (impact edge of pallet) during loading, with no gaps between the individual parts. This requires the walls to be of a sufficiently stable construction. The individual parts of the load must be inherently stable, otherwise they cannot withstand the forces exerted – acceleration, braking, cornering. There must also be sufficient friction between the loading bed and loading surface.

#### Gaps in the load

Gaps between the individual parts cannot be completely prevented, however they must not be more than a few centimetres, otherwise they do not form positive locking. The gaps must then be accordingly filled, or the load must be secured using forced locking measures – lashing down.



A stable structure is the prerequisite for securing loads using positive locking.



The features of a certified body are visible on corresponding labels.

## Aids for Positive Locking

### The Right Equipment for Every Purpose

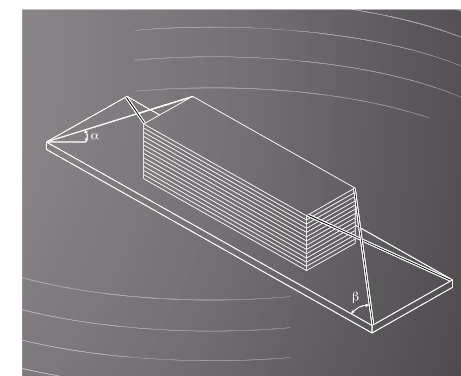
Each trailer provides different prerequisites to attain positive locking, even if the type of load does not normally permit this, such as pallets with sacks or that the packaging is too weak. This auxiliary equipment includes, for example, perforated rails in the trailer floor, guide rails for pallet rollers recessed into the floor (e.g. Joloda), insertable stanchions or transverse beams. Reinforced tarpaulins stabilise the load against forces from the side, for example, the Schmitz Cargobull SPEED CURTAIN – a tarpaulin with integrated stanchions – or the Schmitz Cargobull POWER CURTAIN – a tarpaulin reinforced with aramid belts and steel wires. Of course, another option is to block the load using the special structure of the trailer, or using straps.

diagonally tensioned from the corners of the load (not at a right angle) to the loading surface. The four corners of the load are secured.

A combination of these two direct forms of lashing is particularly suitable for securing heavier loads. The head loops secure the load at the front. Therefore, the side and rear inertial forces are counteracted using further head slings or by lashing down.

#### Direct lashing – inclined, diagonal, with loops.

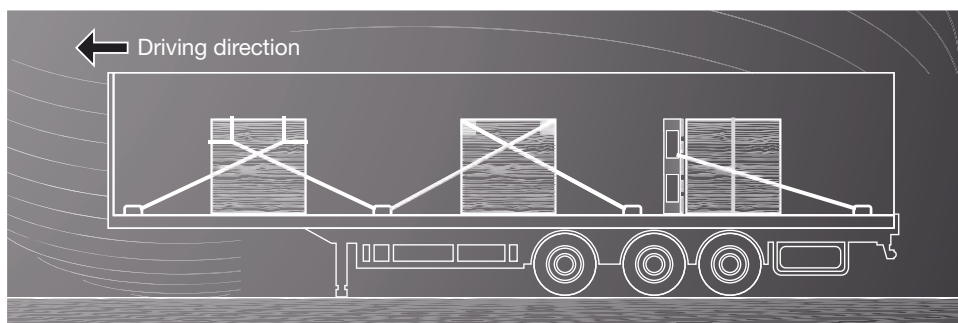
With direct lashing, in contrast to lashing down, the load is directly retained in position by the lashing equipment. It is a form of positive load securing that is similar in its function to limiting the loading area. For inclined lashing, a minimum of eight means of lashing, two each at each corner of the load, are directly tensioned to the loading surface at an angle of  $90^\circ$ . For diagonal lashing, a minimum of four means of lashing are required,



In diagonal lashing, the straps absorb the forces in all directions.



In order to absorb the forces of the positive locking of the load, an additional partitioning wall in the centre of the loading area should be braced towards the chassis.



Straps must be routed so that they cannot slide down. This can be achieved by using a head sling, anchoring points on the load or by positioning pallets.

## Aids for Positive Locking

### The Right Equipment for Every Purpose

#### When is it beneficial to secure the load using positive locking?

Fundamentally, it is recommended – wherever possible – to position the load directly on one of the four walls of the trailer. Here, the stable trailer body secures the load, providing that gaps in the load can be prevented.



#### When is it beneficial to secure the load by direct lashing?

If lashing points are available on the load, it is beneficial to secure the load using inclined or diagonal lashing. Side slings, or the combination of side and head slings, is an excellent method to secure the load against sliding.

### Practical Tips

Hazards arise when opening the rear door. If an additional transverse beam is not placed between the door and load, the load can move towards you.

Tensioned partitioning walls, or pallets placed against the direction of the force, also secure using positive locking.

Observe the certificate that indicates the structural rigidity of the trailer for the various levels – Code L, Code XL, beverage transport.

Check to make sure that the structure of the trailer can accept the percentage ratio of the max. payload as force: Front wall 50%, each sidewall 40%, rear wall 30%.

For diagonal lashing, pay attention to the suitable anchoring points for the load.



Stanchions inserted into the bed (top picture), or transverse beams anchored in the support laths (left picture), enable loading with positive locking despite gaps in the loading arrangement, e.g. partial unloading.



For particularly heavy loads, such as steel coils, stanchions and struts can be used to guarantee positive locking.

The correct measures for a combination of securing the loads is not only a technical requirement, but also a financial one.



Chocks lock rolls of paper, while lashing belts increase the contact pressure.



A supporting pallet held in place by belts is a simple solution for securing loads with positive locking.



Positive locking on the side and at the front, with the load lashed down.

## Combined Load Securing

### Forced and Positive Locking

#### The easy way

Normally, the combination of positive and forced locking for securing loads is the easiest and most advantageous form, because the elements of both methods are complemented. The decisive factor is that the time required and work intensity is low, yet the method still ensures optimum security.

This is also particularly applicable for high cargo. In this case, the combination of positive locking and lashing down is the best method to counter the risk of tipping.

The ideal combination for practical and clever securing of loads includes the common application of chocks and lashing straps, of head slings with lashing down, or head slings in conjunction with empty pallets.

#### When is it beneficial to use combined load securing?

For the transportation of paper rolls, heavy concrete sections, large containers, special construction sections, high goods and similar loads.

## If the Centre of Gravity Moves Upwards

### Securing Loads of Non-Stable Goods

#### Stability

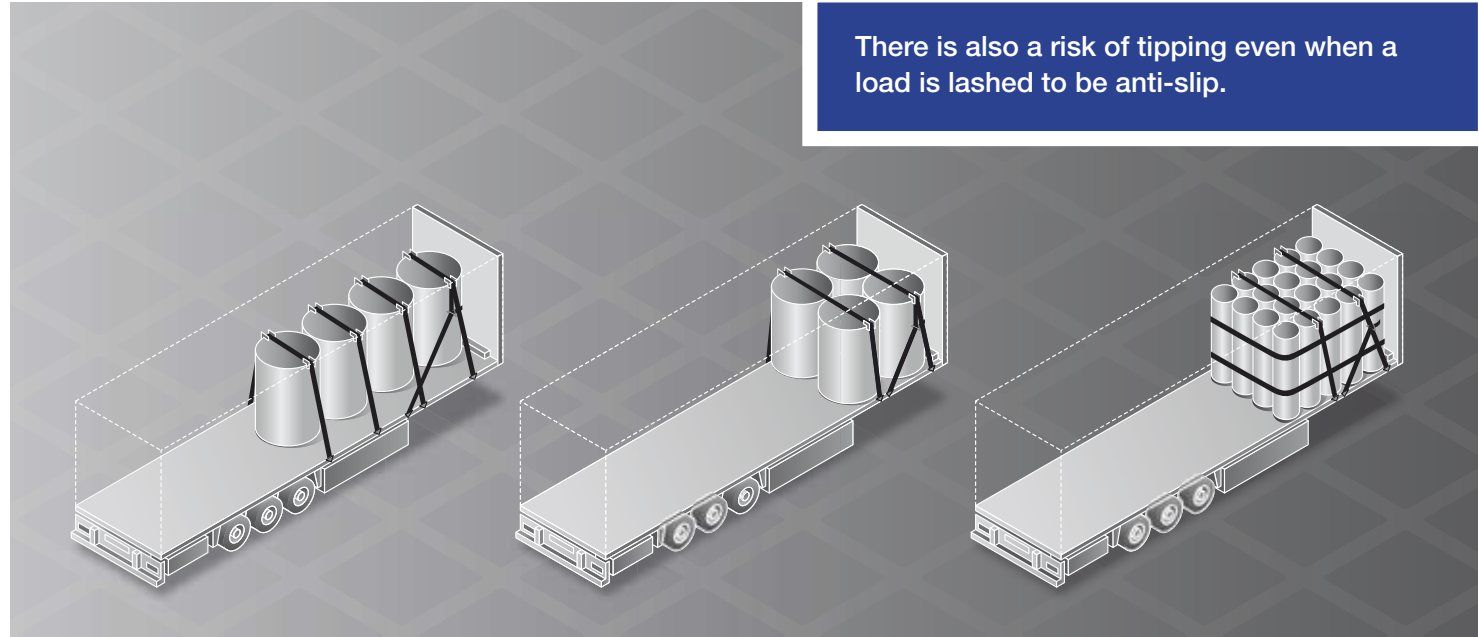
If the height of the load is significantly larger than its sides or diameter, its stability cannot be guaranteed or at the very least will be impaired. In this case there is a possibility that the load can tip, therefore additional securing is required.

#### Securing against tipping

After implementation of securing against sliding using forced or positive locking, the second stage is to secure against tipping. The lashing equipment used for this secures the load against tipping by using the tensile force and not the pre-tension force. If forced locking lashing down is used to secure against sliding, this lashing equipment can also be used simultaneously to secure against sliding and tipping.

#### Bundling

Non-stable loads of the same format can be encompassed into a unit using a lashing strap. Thereby, the relationship height to base area is positively changed. This unit must now only be secured by the conventional means, see the sketch top right.



#### Special trailers

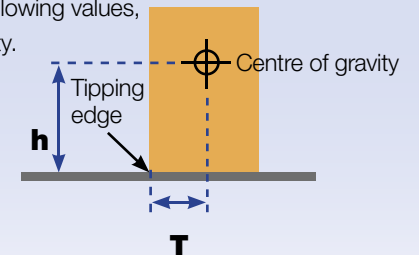
For the transportation of non-stable freight, e.g. stacked crates of drink or barrels, trailers specially designed for the freight are used. The reinforced body and equipment provide positive locking and ensure security against tipping. This then makes the application of tensioning straps dispensable. When transporting beverage crates on well pallets the sides are interlocked using the swivelling support laths.

#### Practical Tips

This simple calculation is an option for estimating the stability:

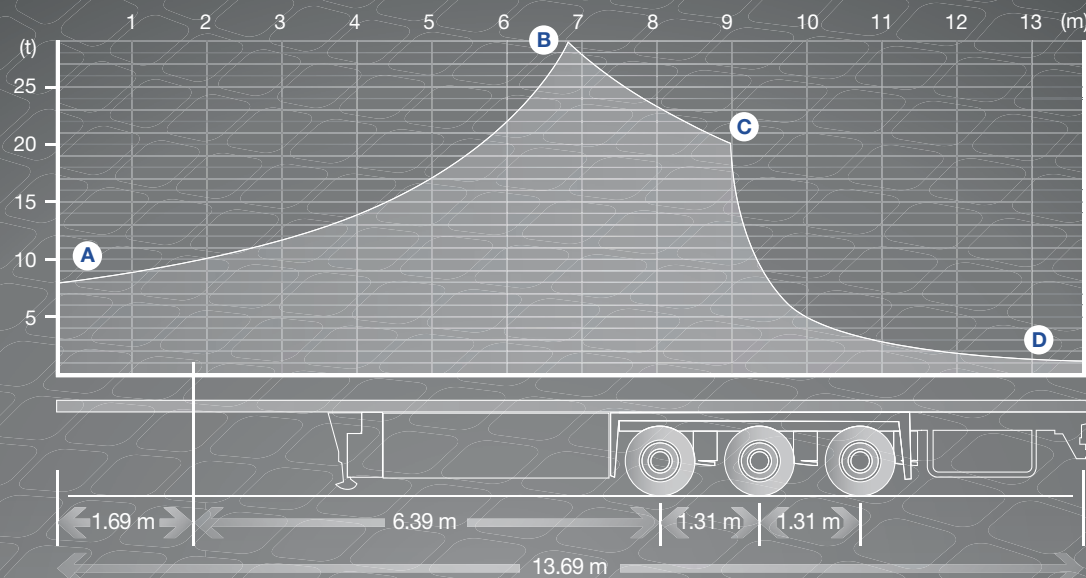
The distance  $D$  (tipping edge to the centre of gravity) is divided by the height of the centre of gravity  $h$ . If the result is less than the following values, effective action should be taken to ensure stability.

- minimum 0.8 (forwards)**
- minimum 0.7 (sideways)**
- minimum 0.5 (rearwards)**





Transportation can only be secure when the load conforms to the load distribution plan.



#### Taken from the operating instructions for tarpaulin trailers:

Commercial vehicles can only be loaded to their maximum payload when the complete centre of gravity of the load is in a specified area. However, loads less than the maximum payload can also only be positioned in specified areas of the loading surface. Otherwise, there is the possibility that the load on the axle will be exceeded or insufficient. Adherence to the axle loads is ensured if the complete centre of gravity of the load is within this area, the so-called load distribution curve. From the load distribution plan (LVP) and with the aid of the load distribution curve, you can see the distance from the front wall of the semi-trailer at which particular loads can be loaded.

#### The hazards of incorrect load distribution.

If the load is placed too far to the rear on the trailer, the result can be insufficient semi-trailer pressure on the tractor unit. That is important for the driving safety of the traction machine because, if there is insufficient pressure on the drive axle, the tyres have less grip. If the load is placed too far forward, overloading of the drive axle can occur, even if the overall weight is not exceeded. Good awareness of the load distribution plan makes it easier to adhere to the statutory and technical specifications for the axle load.

#### Special loads.

For special loads, for example high point loading, such as steel coil, there are specifically defined loading positions with the corresponding recesses and supports.

## Loading Correctly

### Load Distribution

All measures to secure the load are determined by the different types of load. This includes observing the Road Traffic Act (StVO). It requires a load distribution that impairs neither the safety of the traffic nor operation.

#### Practical Tips

- For a fully loaded trailer, uniform load distribution is attained when a Euro pallet does not weigh more than 750 kg.
- If a heavy load cannot be positioned against the front wall due to the load distribution, use the available inserts or perforated rails for positive locking.
- Special securing equipment, such as head slings, can also secure a load to the front wall that cannot be locked positively.
- Equally beneficial are a securing block or an additional partition that forms a positive lock to the front.

## Practical Examples:

### High Point Loads during Paper Transports

The measures previously mentioned are an indication of the most important aspects of securing loads. Of course, in practice each case must be individually considered. Meanwhile, there are many special forms of transport for which specific standards have been developed. Some of these solutions are indicated here.



Upright paper rolls, secured through direct lashing with the head strap and lashing down.



Horizontal paper rolls positioned perpendicular to the driving direction. Lashed down with two straps and secured at the front with securing chocks.



The Joloda rails with perforation grids and sturdy aluminium corner stanchions are easy to clean and simplify both handling and securing the load.



Transportation of paper rolls using positive and forced locking. The head strap of the standing rolls also secures against tipping.



Positive locking blockade of the roll using special chocks, in combination with anti-slip mats.



The securing chocks can be inserted into the perforated rails in four directions and exactly positioned.

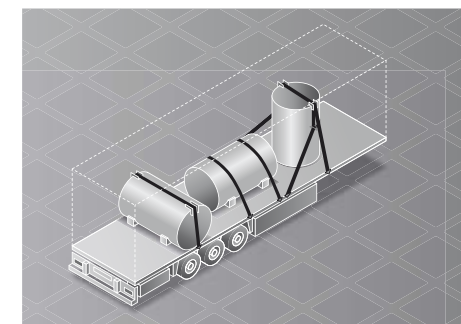


Storage cases – built into the bulkhead in this case – make sure that the necessary parts are available at any time.

## Practical Examples:

### Transporting Hard Paper Rolls

Chocks are important equipment for securing horizontal paper rolls and prevent them from rolling away. All of the surfaces must be fitted with anti-slip mats specifically designed for paper transport. Directly lashing paper rolls with a head strap can prevent them from tipping over.



The weight optimised metal chocks secure the horizontal rolls at an angle of 90°, longitudinally or laterally to the driving direction. Upright rolls are lashed down.

## Practical Examples:

### High Point Loads during Coil Transports

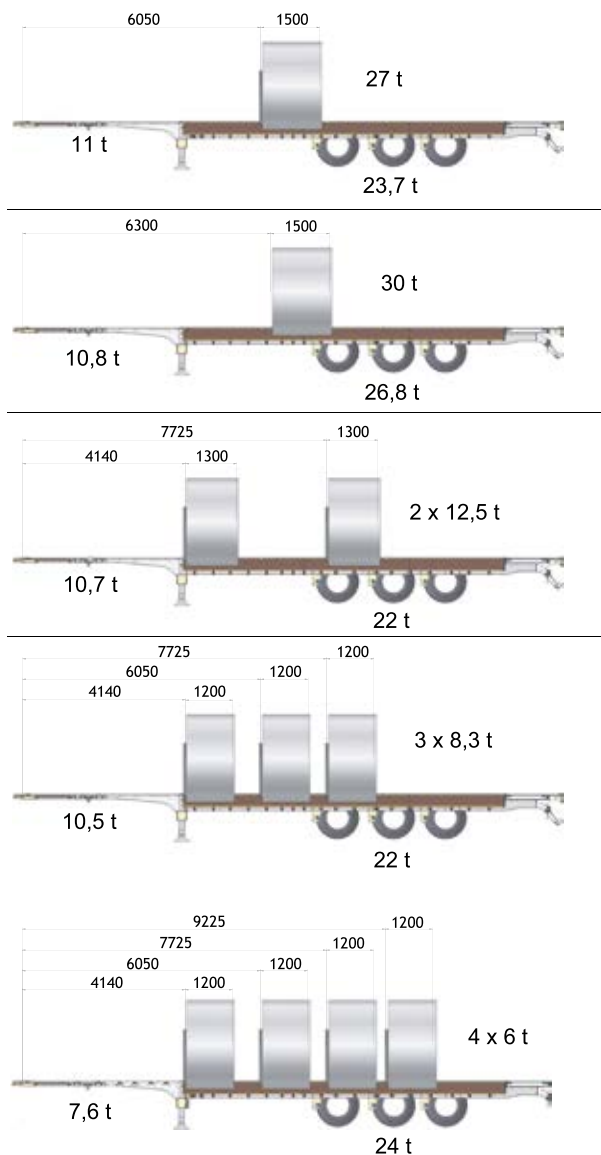
Heavy steel coils cannot be transported without installing special equipment in the trailer. It is paramount that the chassis is designed for high point loading. A recessed well automatically defines the correct position during loading. At first glance, all other measures are dimensioned on a larger scale than the standard equipment for securing loads: stanchions to insert in the recess, tensioning chains and heavy-duty lashing eyes.



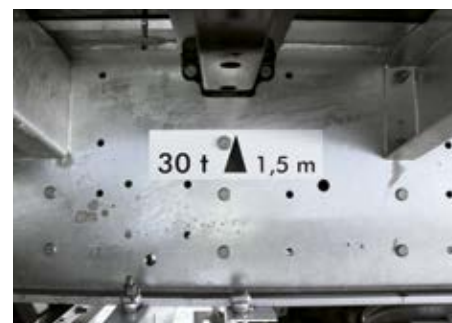
The coil well defines the ideal loading position.



Positive locking of a steel coil using special recess, inserted stanchions and chains anchored in heavy-duty lashing eyes.



Chassis with integrated coil well.



The load's centre of gravity is marked on the I-beam.



For transporting profiles and bar materials additional stanchions and steel support slats with horizontal beams are included.

## Practical Examples:

### Steel and Coil Transport

The necessary design details for coil transport cannot always be retrofitted. These are specially designed trailers which are configured correspondingly during production. It is important to ensure that the geometry of the coil well is compatible with the dimensions of the load.

Shaped steels, such as panels and profiles, can also be secured using standard general cargo load securing equipment, provided that units packaged with steel strapping – ideally on pallets – are loaded.

Finding the right position for the coil in the trailer is crucial for transport safety. The manufacturer's specifications must be taken into account.

## Practical Examples

### Automotive Pallet Cages

Pallet cages allow different goods to be secured quickly, because the uniform dimensions enable perfect positive locking loads. However, this advantage is only applicable when the trailer features specific conditions.

In addition to structural stability, these benefits include pallet stops for side fixing, transverse beams and telescopic bars to secure the gaps in the load and, despite the height of 3 meter, an elevating roof to enable quick loading of 3 boxes placed on top of one another.



Vertical supports which are anchored in the floor and roof in order to secure pallet cages with positive locking.



The narrow grid in the perforated rails allows for maximum flexibility when positioning the supports.



Lashing rings along the outer frame and the bolted on pallet stop rails simplify the lashing down of the freight at virtually every point, meaning the load can also be secured against moving sideways.



If the raised elevating roof is lowered for loading, the pallet cages are exactly enclosed on all sides by the body.



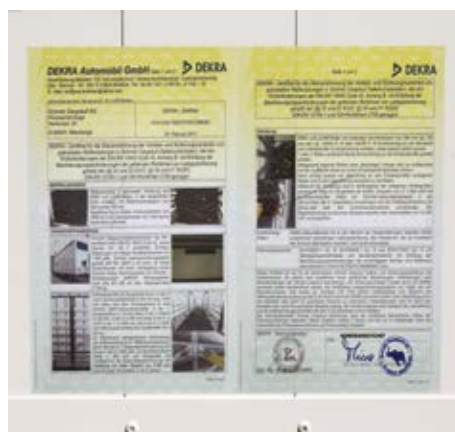
Tarpaulin with diagonal reinforcing straps and load securing beams for partial loads.



The necessary diagonal restraints are anchored in the side steel slats using perforated grids and the lashing points in the trailer frame.



Loose tyres in a laced arrangement tend to settle during transport and exert strong sideways pressure. The structural stability of the sides must be ensured.



Ideally, documentation covering the key points for transporting tyres should be attached inside the trailer doors.

## Practical Examples:

### Tyre Transport

For certified tyre transport, the equipment must be complemented by 6 rows of support laths and 2 rows of steel slats on each side, in accordance with the certificate Code XL. This provides strong side support. A crossed set of tension belts for each set of stanchions ensures stability. Additional retention is provided by side, steel laths with a narrow perforated grid. Here, engaged transverse beams establish a positive locking for a partial load. Quick, effective and easy.

## Practical Examples:

### Beverage Transport

The requirements for the transportation of beverages are demanding. There are various size containers for bottles and barrels. Free space to the limits of the loading area must be avoided. If flexible loading of these versions is required, the corresponding equipment must be available. If in doubt, the positive locking must be supplemented by positioning pallets and lashing down.



Barrels, with and without strapping, can be safely transported without lashing down when using the appropriate equipment.





Transverse beams at the front and rear of the freight secure partial loads against sliding longitudinally.



Spacing slats are folded so that they interlock along the sides for the transportation of well pallets.



Beverage cases with positive locking can be safely transported without lashing down when using the appropriate equipment.

## Practical Examples:

### Beverage Transport

Trailers with the body certified to Code XL are capable of absorbing all of the forces via the body. This requires the pallets to be loaded without gaps. Spacer slats are utilised to compensate for any gaps, as are securing systems anchored between the roof and the floor.

## Practical Examples:

### Piece Goods

Suitable equipment must be used to achieve form fitting loading when transporting packaged goods where the cargo is often different sizes. Creating loading units with standardised dimensions on pallets is one of the most important measures in this regard. Stanchions, vertical supports and locking bars which can be freely distributed throughout the loading area are a perfect option.



A system of supports and locking bars for free positioning.



Here is an example of an easily secured loading unit.



Horizontally used support slats provide the side interlocks for palletised octabins. Clamping beams secure the load longitudinally.

## Practical Examples:

### Piece Goods

Double-decker loading is an elegant means of perfectly securing packaged goods while still enabling rapid, partial unloading. This decouples the cargo while the individual units can be loaded in a form-fitting fashion or securely lashed down on the second level.



Variable loading space usage combined with uncomplicated load securing.



The I-beams and the telescoping cross beams are simply attached at the right height.



Lashing straps can be firmly secured to the I-beams on the second level.



Cross beams can be mounted on the stanchions and in the double-decker side support beams for positive locking of partial loads.

## Practical Examples:

### Chemical Industry

The chemicals industry has very high standards and is subject to additional safety regulations. In addition to ADR equipment for transporting hazardous goods, equipment for securing loads must always be up-to-date and, above all, flexible. Non-slip floors and a system of cross beams are a must if you wish to transport various types of cargo safely.



The non-slip floor means you don't have to deal with non-slip mats, making it the first choice for amorphous loads like big bags.



Steel laths with a tight grid for attaching cross beams and belts allow the trailer to be arranged any way you like while aluminium laths can be used to create a stable gate at the side.

## Practical Examples: Chemical Industry

Some loads are not suited for being lashed down as the packaging would not withstand the pressure. In this case, positive locking has to be ensured on all sides.



Gaps to the side of the load can be filled quickly and safely using folding laths.



Ideally, octabins on pallets are secured using positive locking and cross beams.



Positive locking for pliable big bags: Our aluminium and tarpaulin side laths with lashing belts.



Using suitable adapters, belts can be hooked into the side grid in the steel laths.

# Index.

- A** Acceleration 7, 9  
 Accident prevention regulations 6  
 Anti-slip floor 10  
 Anti-slip material 15  
 Assessment 9  
 Automotive 30
- B** Beverage transport 14, 32  
 Brakes 8  
 Bundling 24
- C** Cargo floor 18  
 Chocks 27  
 Code XL 11, 14, 31, 33  
 Coil 15, 29  
 Coil well 28  
 Combined load securing 23  
 Commercial Code 6  
 Complete centre of gravity 25  
 Cornering 7
- D** Daimler 9.5 11, 12  
 Diagonal lashing 22  
 DIN EN 12642 12  
 Direct lashing 21, 22  
 Double-decker system 35  
 Dynamic friction coefficients 10
- E** End fittings 16  
 Eyes 16
- F** Forced locking 19  
 Friction 8, 9  
 Friction coefficient 8, 10
- G** Gaps in the load 20, 33  
 General cargo 13  
 German Penal Code 5
- H** Head sling 21, 23  
 Heavy-duty lashing eyes 28  
 Hook 16
- I** Inertia 8
- L** Lashing angle 18, 19  
 Lashing down 18, 19  
 Lashing equipment 16  
 Lashing material 17  
 Lashing rings 16, 30  
 Lashing strap 16, 17  
 Lashing strap label 17  
 Legal consequences 5  
 Limiting the loading area 19  
 Load centre 29  
 Load distribution plan 25  
 Loading units 14, 29, 34
- M** Manual force 17  
 Material code (straps) 17  
 Material combinations 10
- O** Occupational Safety and Health Act 5  
 Octabins 34
- P** Packaged goods 34  
 Pallet 10, 14  
 Pallet cages 30  
 Panels 15, 29  
 Paper rolls (hard) 15, 26  
 Partial unloading (gaps) 20  
 Partition wall 21  
 Perforated rails 21, 27  
 Physical forces 7  
 Point loads 25, 26, 28  
 Positive locking 20, 21  
 Pre-tension force 17  
 Professional association 5
- R** Road Traffic Act 5, 6
- S** Shaped steel 15, 29  
 Stability 24  
 Stacking (cargo) 13  
 Stanchions 22, 28  
 Steel transport 15  
 Storage box 18  
 Strapping 29  
 Straps, number 17
- T** Technical regulations 11  
 Tension ratchets 16  
 Tip securing 24  
 Transverse beams 31, 33, 34  
 Tyre transport 31
- V** VDI Directive 2700 12, 13
- W** Weight 8  
 Wire ropes 16

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