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Fachgruppe Ladungssicherung  
(specialist group: load securing)  
Am TÜV 1  
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**Loading instructions for securing the load  
when transporting bags on pallets and big bags on  
pallets**

**LS 0210817V1A2**

**Client:**

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## 1 Fundamentals

The legal requirements for load securing are contained in the regulations of the StVO and StVZO. The technical rule for execution and calculation is VDI Guideline 2700 "Load securing on road vehicles" in particular; VDI 2700 No. 3.5, November 2004.

The necessary load securing forces are specified in VDI 2700 section 1.3.2.1:

- 0.8 x G in the direction of travel
- 0.5 x G against the direction of travel
- 0.5 x G transverse to the direction of travel or
- 0.7 x G transverse to the direction of travel for non-steady goods

Where G is the gravitational force of the respective load to be secured.

In the following, all information on paragraphs is based on VDI 2700.

## 2 Transport goods and load securing methods

The following list contains all examined transport goods with their main characteristics.

The load consists of big bags on pallets and bagged goods on pallets.

The contents of the bagged goods and big bags consist of mineral raw materials (e.g. sand and gravel in the grain size range 0 - 32 mm and dry mortar/concrete e.g. V1/50, V1/10, MH 20 etc.)

The dimensions of the Euro pallets (L x W x H) are 1,200 mm x 800 mm x 150 mm; weight about 20 kg. The wooden pallets are used new and used. The loaded pallets have an overhang of up to 100 mm on 2 sides of the pallets. The shortfall on the returnable pallets can be up to 40 mm on 2 sides. The stacking of the bags on the pallets is carried out in a composite system. The load height on the pallet is up to 900 mm (without pallet). The overhang of the big bags on the pallets can be up to 115 mm on each side.

The load height on the pallet is up to 1,000 mm (without pallet). The loads are placed in one layer on the various transport vehicles.

**For the loading units:**

### **2.1 Big bags**

The pallets are made of wood with a coarse wood structure  
Big bags weight up to about 1,000 kg, height up to 1.0 m,  
width up to 0.95 m, length up to 1.27 m  
Stretch hood with a thickness of 150  $\mu$   
Contents of the big bag: Mineral casting



**Figure 1: Big bag on pallet**

## 2.2 Palletised bags

The pallets are made of wood with a coarse wood structure  
Bagged goods weight up to about 1,000 kg, height up to 0.60 m,  
width 0.8 m, length 1.20 m  
Stretch hood with a thickness of 150  $\mu$   
Content of the palletised bags: V2/80 Quick-setting grout  
Stacking in a composite system:  
40 bags, 25 kg per bag  
8 pcs. composite stacking, 5 rows on top of each other  
Pallet slightly over- and underpacked.  
Film between bagged goods and the Euro pallet  
Paper bags



**Figure 2: Bagged goods on pallet**

### 2.3 Big bags

The pallets are made of wood with a coarse wood structure  
Big bags weight up to about 1,000 kg, height up to 0.80 m,  
width up to 1.00 m, length up to 1.24 m  
Stretch hood with a thickness of 150  $\mu$   
Contents of the big bag: Dry mortar/concrete



Figure 3: Big bag on pallet

## 2.4 Palletised bagged goods

The pallets are made of wood with a coarse wood structure  
Bagged goods weight up to about 1,250 kg, height up to 0.60 m,  
width 0.8 m, length 1.20 m  
Stretch hood with a thickness of 150  $\mu$   
Contents of the palletised bags: e.g. MH 02  
Stacking in a composite system:  
40 bags, 25 kg per bag  
8 pcs. composite stacking, 5 rows on top of each other  
Pallet slightly over- and underpacked.  
Film between bagged goods and the Euro pallet  
Paper bags



**Figure 4: Palletised bagged goods**

## 2.5 Palletised bagged goods

The pallets are made of wood with a coarse wood structure  
Bagged goods weight up to about 1,250 kg, height up to 0.55 m,  
width 0.85 m, length 1.20 m  
Stretch hood with a thickness of 150  $\mu$   
Contents of the palletised bags: e.g. V1/10  
Stacking in a composite system:  
40 bags, 25 kg per bag  
8 pcs. composite stacking, 5 rows on top of each other  
Pallet slightly over- and underpacked.  
Foil between the bagged goods and the Euro pallet  
Paper bags with anti-slip effect



**Figure 5: Palletised bagged goods**

## 2.6 Palletised bagged goods

The pallets are made of wood with a coarse wood structure  
Bagged goods weight up to about 1,000 kg, height up to 0.95 m,  
width 0.80 m, length 1.00 m  
Wrapping foil with a thickness of 21  $\mu$   
Content of the palletised bags: Moist material e.g. quartz gravel 8 – 16  
Stacking in composite system:  
40 bags, 25 kg per bag  
5 pcs. composite stacking, 8 rows on top of each other  
Pallet slightly over- and underpacked.  
PE bags with nubs  
Wrapping: 6 + 6  
80% overlapping of the wrapping



**Figure 6: Palletised bagged goods**



## 2.7 Palletised bagged goods

The pallets are made of wood with a coarse wood structure  
Bagged goods weight up to about 1,000 kg, height up to 0.90 m,  
width 0.84 m, length 1.00 m  
Wrapping foil with a thickness of 21  $\mu$   
Contents of the palletised bags: e.g. quartz gravel 5 – 8  
Stacking in a composite system:  
40 bags, 25 kg per bag  
5 pcs. composite stacking, 8 rows on top of each other  
Pallet slightly over- and underpacked.  
PE bags with nubs  
Wrapping: 6 + 7  
80% overlapping of the wrapping



**Figure 7: Palletised bags**

## 2.8 Palletised bagged goods

The pallets are made of wood with a coarse wood structure  
Bagged goods weight up to about 1,000 kg, height up to 0.90 m,  
width 0.80 m, length 1.20 m  
Wrapping foil with a thickness of 21  $\mu$   
Contents of the palletised bags: e.g. quartz sand 0.7 - 1.2  
Stacking in a composite system:  
40 bags, 25 kg per bag  
5 pcs. composite stacking, 8 rows on top of each other  
Pallet slightly over- and underpacked.  
PE bags with nubs  
Wrapping: 8 + 8  
80% overlapping of the wrapping



**Figure 8: Palletised bags**

## 2.9 Big bags

The pallets are made of wood with a coarse wood structure  
Big bags weight up to about 1,250 kg, height up to 0.80 m,  
width up to 1.10 m, length up to 1.10 m  
Wrapping foil with a thickness of 21  $\mu$   
Contents of the palletised big bags: e.g. quartz gravel 2 – 3  
Wrapping: 6 + 6  
80% overlapping of the wrapping



**Figure 9: Big bag on pallet**

## 2.10 Palletised bagged goods

The pallets are made of wood with a coarse wood structure  
Bagged goods weight up to about 1,000 kg, height up to 0.90 m,  
width 0.85 m, length 1.14 m  
Wrapping foil with a thickness of 21  $\mu$   
Contents of the palletised bags: e.g. quartz sand 0.7 - 1.2  
Stacking in a composite system:  
40 bags, 25 kg per bag  
5 pcs. composite stacking, 8 rows on top of each other  
Pallet slightly over- and underpacked.  
PE bags with nubs  
Wrapping: 6 + 6  
80% overlapping of the wrapping



Figure 10: Palletised bags

### 2.11 Palletised bagged goods

The pallets are made of wood with a coarse wood structure  
Bagged goods weight up to about 1,000 kg, height up to 0.85 m,  
width 0.85 m, length 1.04 m  
Wrapping foil with a thickness of 21  $\mu$   
Contents of the palletised bags: e.g. quartz gravel 5 – 8  
Stacking in a composite system:  
40 bags, 25 kg per bag  
5 pcs. composite stacking, 8 rows on top of each other  
Pallet slightly over- and underpacked.  
PE bags with nubs  
Wrapping: 6 + 6  
80% overlapping of the wrapping



**Figure 11: Palletised bags**

## 2.12 Palletised bagged goods

The pallets are made of wood with a coarse wood structure  
Bagged goods weight up to about 1,000 kg, height up to 0.85 m,  
width 0.85 m, length 1.04 m  
Wrapping foil with a thickness of 21  $\mu$   
Contents of the palletised bags: e.g. quartz sand 1.4 - 2.2  
Stacking in a composite system:  
40 bags, 25 kg per bag  
5 pcs. composite stacking, 8 rows on top of each other  
Pallet slightly over- and underpacked.  
Paper bags  
Wrapping: 6 + 6  
80% overlapping of the wrapping



Figure 12: Palletised bags

### 3 Loading and load securing

The load is loaded in the middle of the loading area; normally the loading units are standing:

- in single rows, one behind the other, in the middle of the loading area
- in two rows next to each other, distributed over the width of the loading area

The transported goods are bagged goods on pallets and big bags on pallets.

#### 3.1 General requirements

Vehicle superstructures must not be damaged. No parts of the superstructure such as roof bow boards, roof reinforcements etc. may be missing.



**Figure 13: Superstructure undamaged**



**Figure 14: Intact front wall**

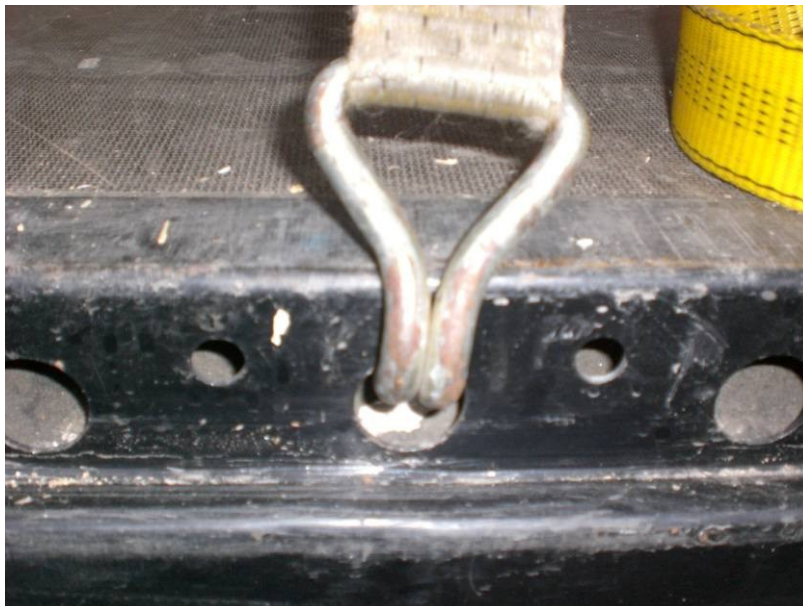


**Figure 15: No superstructure parts damaged**





**Figure 16: Broom-clean loading area**



**Figure 17: Lashing belt hooked into the outer frame with holes**



**Figure 18: Lashing belt hooked into the lashing point**

### **Lashing the load without lashing points:**



**Figure 19: Claw hooks**

Lashing points on the vehicle are a prerequisite for the safe lashing of loads. In exceptional cases, suitable connecting elements (e.g. claw hooks) can also be used to attach to the vehicle frame. A prerequisite is that the required securing forces can also be introduced here.

The load should not be lashed over the tail boards.

### **Do not use lashing belts any more in case of:**

- **Lateral cuts of more than 10%**
- **Damage to the main seam**
- **Absence of the label**
- **Deformation due to heat influence**
- **Damage caused by exposure to aggressive substances**



Lashing eyes: min. 2,000 daN lashing eye strength.

Broom-clean dry loading area (to be cleaned from ice and snow in any case).

**The load units are to be placed in and against the direction of travel as well as in themselves in a tight fitting manner**



**Figure 21: Loading units positioned with tight fit**

**Lashing belt and Euro pallets placed on top:**

Each loading row is lashed down with at least one lashing belt (LC = 2,500 daN, S<sub>TF</sub> 300 daN) with a normal ratchet and Euro pallets placed on top.



**Figure 22: Lashing belt applied to the Euro pallet  
(do not twist the lashing belt)**

**or**

**Lashing belt and interposed anti-slip (RH) mats between the vehicle floor and the pallet:**

Each row of loads is lashed down between the vehicle floor and the pallet with at least one lashing belt (LC = 2,500 daN, S<sub>TF</sub> 300 daN) with a normal ratchet and interposed anti-slip (RH) mats.



**Figure 23: Interposed anti-slip (RH) mats and lashing belt**

**Please note:** The Euro pallets must not have any contact to the vehicle floor.

**Please note:** In the case of open boxes (building material trucks) and trailers where the tail board height is less than 800 mm or which have no tail boards, Euro pallets are always required on the loaded goods.

## 4.2 Further measures

Non-certified superstructures do not provide sufficient front wall force. The additional front wall force to be applied is to be applied by **two** additional direct lashings for semi-trailers and **one** additional direct lashing each for motor vehicles/trailers (head lashing or support with Euro pallets and lashing belt on pallets).

When changing from single row one behind the other to double rows side by side, a direct lashing is required.

Direct lashing is also required if the loading units are not positioned tight fit in the direction of travel.



**Figure 24: Example head lashing**

Vertical angle  $\alpha$  between 20- 65 degrees; horizontal angle  $\beta$  between 6- 55 degrees

Explanation:

Vertical angle  $\alpha$  = Lashing belt run from bottom to top.



Horizontal angle  $\beta$  = Lashing belt run from the loading area to the load.

#### 4.3 Further possibilities of loading:

This applies to all loading units:

If the complete load is standing on anti-slip (RH) mats ( $\mu$  greater than 0.6), **no** direct lashing is required if the load is positioned tight fit in the direction of travel. The loading units must not have any contact to the vehicle floor.



**Figure 25: No pallet contact to the vehicle floor**

## **5 Loading on certified superstructures**

The requirements are specified in the certificate.

The following applies to all certificates:

**1 The load must stand in, against and transverse to the direction of travel, as well as in itself, in a tight fit.**

**2 Vehicle superstructures must not be damaged. No superstructure parts such as roof bow boards, roof reinforcements etc. may be missing.**

**3 Broom-clean dry loading area (to be cleaned from ice and snow in any case).**

**4 Minimum coefficients of sliding friction can be taken from the respective certificate.**

### **Minimum requirements for the certified superstructure:**

Front wall 0.5 x payload

Side wall 0.3 x payload or 0.4 x payload

Tailgate 0.3 x payload

These superstructure strengths are achieved, inter alia, by the superstructure of type:

- Superstructure strength Code XL
- Superstructure strength code L with strength specification of the side wall

**To be observed for each loading:**

If the load is not resting against the front wall, this force must be applied by additional direct lashing (head lashing or support with Euro pallets and lashing belt on pallets).

If the load does not rest on the tailgate (distance greater than 15 cm), this force must be applied to the load by additional direct lashing (head lashing or support with Euro pallets and lashing belt on pallets) or the storage space must be filled.

When changing from single row one behind the other to double rows side by side, a direct lashing is required.

If the requirements as stated in the certificate of the vehicle superstructures are not met or cannot be met, the load must be secured as for non-certified superstructures.

If the requirements as stated in the certificate of the vehicle superstructure are not met or cannot be met, the respective row of the load must be secured as for non-certified superstructures.

**6 Summary**

If the above conditions are met, load securing in accordance with VDI 2700 and following or DIN EN 12 195 -1 is fulfilled.

**7 Associated documents:**

Test Report No.: LS 0210817A2 TÜV NORD Mobilität, Fachgruppe Ladungssicherung  
(specialist group: load securing).

**TÜV NORD Mobilität GmbH & Co. KG**  
**Fachgruppe Ladungssicherung**  
**(specialist group: load securing)**

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