

**CONTAINER  
PACKING**

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## 1. Introduction

Transport plays a key role in our age of globalisation, and any company that sets out to develop new markets or establish production locations is dependent on reliable procurement and distribution channels. Hapag-Lloyd is present on all five continents. Our offices are linked by a globally standardised IT system that is the leader in the industry.

We have been a partner of the foreign trade and forwarding sector for 165 years. Today, we are among the leading carriers in container shipping. Our comprehensive network provides about 80 liner services calling at all major worldwide ports. Our fleet is constantly being adjusted to meet growing demand. It currently consists of more than 140 modern containerships plus a container stock running to over one million standard containers TEU. We are constantly expanding our containership and container fleet to be equipped for further growth and to make sufficient capacity available for our customers at all times.

Apart from standard containers, we offer a wide range of units, including refrigerated containers for temperature-sensitive goods, open-top or hard-top containers for cran-able cargo or items with excess height, and high cube boxes for light, bulky goods, as well as loading flatracks for cargo that, because of its dimensions or weight, does not fit into a closed container.

Hapag-Lloyd provides internal quality and environmental management, which is certified in accordance with ISO 9001 and 14001 and which also extends to the services of its subcontractors.

Hapag-Lloyd is keen to help ensure that customers' products arrive at their respective destinations quickly and, above all, reliably. Consignments are subjected to climatic influences and, in some cases, considerable mechanical stresses while being transported by road, rail or water all over the world.

This brochure has been produced to help you stow and secure your cargo adequately and thus avoid damage. It is based on the expertise of our loading specialists and ship crews, as well as analyses of cargo damage in the past.

Safely stowing cargo in containers involves expenditure, but the outlay is worthwhile, since if consignments are damaged costs are generally considerably higher.

This brochure cannot, of course, cover all aspects of securing cargo in containers. Our experts in our sales offices, one of which is very close to you, will gladly help you with further information. Please contact us. Addresses are given at: [www.hapag-lloyd.com](http://www.hapag-lloyd.com)



## 2. Stresses during transport

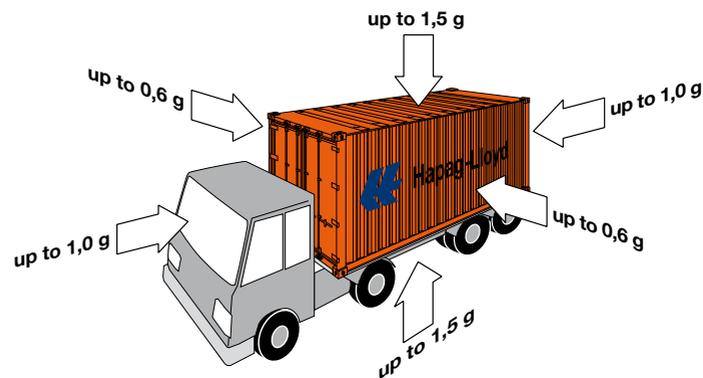
### 2.1. Mechanical stresses

Cargo securing must withstand all stresses resulting from sea and land transport, as well as container handling. Closed containers cannot be inspected during transport. Cargo securing cannot be improved or altered after the container has been closed. The packing company thus has to know what types of stress occur during transport. Basically, we differentiate between two types of mechanical stress.

**Static forces** are caused by stacking and standing cargo on the floor of the container. The main factor is stacking pressure, causing bending and buckling, particularly in the bottom layers. The stacking pressure depends on the dimensions, weight, shape and height of the cargo involved.

**Dynamic forces** occur during loading, land or sea transport and handling operations. There are differences between acceleration, impact and vibration forces. Acceleration and jolts occur during loading, braking, shunting, handling, lifting and setting down, and in curves. Even at sea, acceleration is caused by rolling, pitching and vertical movements. Vibrations are caused by, for instance, the ship's engine, gears and propeller, the truck suspension and road and rail surfaces in a wide range of frequencies and amplitudes.

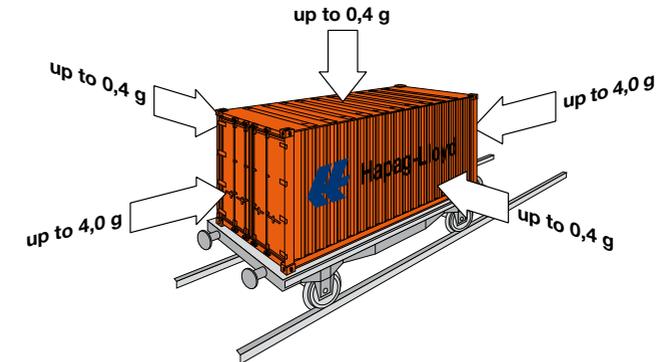
The acceleration forces to be expected for a consignment are not normally known in advance and can be estimated only on the basis of experience. These levels are given below. The letter "g" indicates gravitational acceleration ( $g=9.81 \text{ m/s}^2$ ). The acceleration may be higher than indicated during short impacts or vibrations.



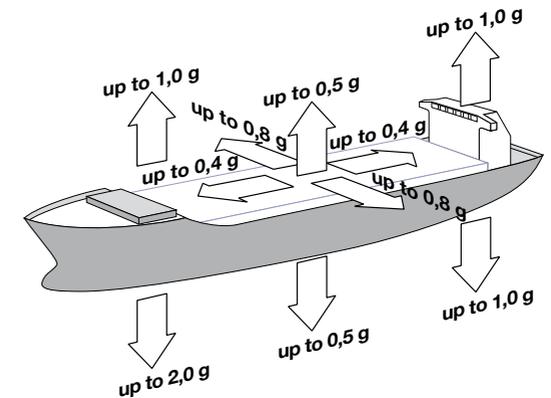
Potential acceleration during road transport

### 2.2. Climatic stresses

Goods are very frequently subject to climatic stresses while being transported. These occur even during storage, and while containers are being packed. Climatic stresses are caused by changing climatic conditions during transport by road, inland waterway vessel or rail, and particularly when cargo on board an ocean-going vessel passes



Potential acceleration during rail transport



Potential acceleration during sea transport

through various climatic zones. Extreme climatic stresses can occur in winter at temperatures below freezing point, when passing through tropical climatic zones or when moving from the tropics to temperate climatic zones.

All closed containers protect the cargo inside against external climatic influences, such as rain, snow, sea water, saltwater spray, fog and UV radiation. Even though the boxes

are protected against external influences, condensation may occur inside. The relative humidity in the container is influenced by the moisture that is brought into it on loading, and any subsequent change in temperature. Sources of moisture are the enclosed air in the container, the cargo itself, its packaging or the stowage material. Some cargoes emit a considerable amount of water over a longer period, while most packaging, stowage material and some cargoes absorb moisture. Moist air condenses if the ambient temperature falls below the dew point, the condensate forming first on the cargo packaging, container wall or roof. The condensate then drips from the roof on to the cargo, causing damage the cargo such as rust, marks, staining, mould, discolouration, sticking together of wet cartons, peeling off of labels or collapsing of stacks. The temperature inside a container depends on the outside temperature and the stowage position of the box on board the ship. The container can be warmed by direct solar radiation on deck or heated fuel tanks next to the hatch. The air temperature within the container below the roof can deviate from the ambient air by 20–30°C. Temperatures of up to 60°C are thus possible. The internal temperature can also increase as a result of the spontaneous heating of the cargo.



**Condensation water on roof, dry bag already completely soaked**

### **2.3. Biological stresses**

High temperatures, moisture or poor ventilation in the container can lead to cargo or packaging being attacked by insects, fungi, mould, bacteria or micro-organisms. Mostly, the cargo is biologically contaminated even before it is stowed in the container.

Insect infestation from outside in a closed container is almost impossible. The cargo should, therefore, be packed with the greatest possible care. Some countries regulate the fumigation of packaging and dunnage by law. The customer then requires a certificate confirming that the timber used is free of insects.

### **2.4. Chemical stresses**

Chemical stresses depend on the type of cargo, temperature, moisture and movement of the ship. Some chemical products tend to heat spontaneously. Hazardous goods must be transported in accordance with the hazardous goods regulations. One basis is the IMDG Code, published by the International Maritime Organisation. Hapag-Lloyd has its own dangerous goods department, which will gladly answer any queries.

### 3. Preparations for container transport

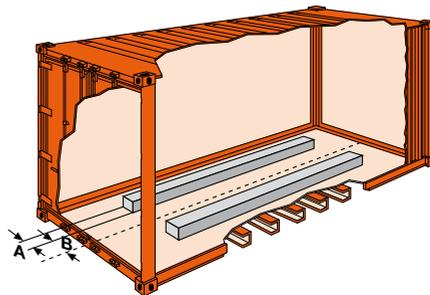
#### 3.1. Weight limits and weight distribution in standard containers

The weight limits of Hapag-Lloyd containers correspond to the international ISO standard 668.

The permissible gross weight of most 20' and 40' standard containers is 30,480kg. Some newer containers have higher gross weights. Depending on the design series, the maximum payload is derived from the gross weight minus empty weight, which varies. Exact details are given in the Hapag-Lloyd brochure "Container Specification" available on [www.hapag-lloyd.com](http://www.hapag-lloyd.com)

In addition to the maximum load limit of a container depending on the design, the weight limits for road and rail transport in the individual countries must be observed. Details on such restrictions are obtainable from every Hapag-Lloyd office.

The bottom crossbars of a container are the load support elements for taking the weight of the cargo. If the permitted load limit is fully reached, all bottom crossbars must be evenly loaded. The cargo weight must thus be distributed over the entire length of the container. The floor is not designed for heavy selective loads. If the cargo is short-er, or stands on a shorter length on the floor, the permitted load is lower. A maximum floor load is 4.5t per running metre for a 20' container and 3t per running metre for a 40' container. To check the floor load, the cargo length (m) is divided by the cargo weight (t). Example: cargo weight 10t, supporting length 4m, load per metre:  $10/4=2.5t/m$ . Wooden beams can be used lengthwise for distributing individual heavy weights. These must have specific minimum dimensions and a minimum distance from the centre of the container.

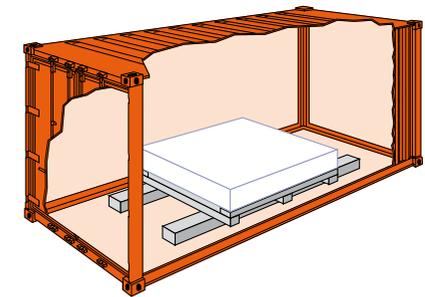


Design of a standard container floor and wooden beams required for bedding heavy cargo

Type of container		20'	40'
A	Min. width of wooden beam	10cm	15cm
B	Min. transverse distance container centre/wooden beam	40cm	40cm

A relatively heavy item of cargo or a consignment with small supporting points must be positioned on the container floor in such a way that the maximum floor load is not exceeded. The supporting length might have to be extended if necessary.

This is achieved by putting wooden beams (bedding) lengthwise on the floor and then placing the cargo on them or putting a further layer of wooden beams crosswise if required by the cargo. If the supporting length is extended, the free ends on each side, on which there is no cargo, must not exceed a maximum length of 1m.



#### Lengthened support for better weight distribution

If the cargo exceeds the weight limits, it must be loaded on flatracks, which are containers with a reinforced floor. Our specialists can give more precise details on the use of flatracks.

All Hapag-Lloyd containers comply with the ISO standard 1496/1, which includes regulations, for instance, on using a forklift on the container floor. A forklift can be used in the container if the following limits are not exceeded.

Item	Limit
Load front axis (forklift + cargo)	max. 5,460kg
Contact area per tyre	min. 142cm <sup>2</sup>
Width of tyre	min. 18cm
Wheel spacing (on one axis)	min. 76cm

The weight of the cargo should be evenly distributed in the container. The centre of gravity should be within the following limits:

Type of container	20'	40'
Lengthwise	max. 60cm from centre of container	max. 90 cm
Transverse direction	in centre of container	
Height	below or at half height of container	

All Hapag-Lloyd containers meet the following test requirements of ISO 1496/1 for load strength of side walls, end wall and roof:

Design element	Test weight
Side wall	0.6 times permitted loading
End wall and door	0.4 times permitted loading
Roof	300kg at surface of 60 x 30cm

### 3.2. Stowage planning

There are three main reasons why it is important to formulate a stowage plan before packing:

- To achieve optimal capacity utilisation of containers
- To simplify and speed up loading/unloading
- To calculate the necessary lashing materials promptly in advance

Precise details of the packaging, weights and dimensions of the cargo, as well as the container's internal dimensions and weight restrictions, are required before a stowage plan can be formulated.

Details of Hapag-Lloyd containers are given in the brochure "Container Specification" or at [www.hapag-loyd.com](http://www.hapag-loyd.com)

Before drawing up a stowage plan, a suitable container has to be selected, taking into consideration the following factors:

- Load limit and permitted weight distribution of container
- Weight restrictions for inland transport in country of sender and recipient
- Recipient's possibilities for unloading cargo from container

A stowage plan can be drawn up in various ways. Stowage software can be used for providing a scale drawing with various views or carrying out an actual pre-stowage on a free area with recorded container dimensions. It must be noted that the door and roof are generally smaller than the container's internal dimensions.

### 3.3. Function of packaging

Packaging has to:

- Protect cargo
- Enable cargo to be stacked
- Enable cargo to be lifted, moved and secured
- Possibly provide information on cargo characteristics and handling

The container itself is a means of transport. Cargo must, therefore, generally be packed for transport in containers. The type and quantity of packaging required depends on the type of transport and container used. If items of cargo of various sizes and weights are stowed together, more stable packaging is required.

If cartons or crates are stacked in several layers on top of one another, the lowest layer must be able to withstand the weight of the items stacked above.

The requisite stack strength depends on the packaging material, transport time and moisture conditions. Standard containers can be given linings for bulk freight cargo, rods for clothing or moisture-absorbing materials.

If the cargo is loaded in open containers or on flatracks, the packaging must withstand influences from the climate, weather and transshipment during the entire transport process.

### 3.4. General rules for packing a container

Cargo of the following types must not be packed together:

- Dusty goods with dust-sensitive cargo
- Odour-emitting with odour-sensitive cargo
- Moisture-emitting goods or packaging with moisture-sensitive cargo or packaging
- Items with protruding parts (e.g. sharp corners, edges) with goods in comparatively soft and sensitive packaging (e.g. sacks or bales)
- Moist goods with dry goods
- Heavy packages should not be stacked on top of light packages

If packing such goods together in a container cannot be avoided, the moist cargo should be stowed under the dry cargo and the two types of goods separated from one another with thin dunnage or packing material. Dunnage or sawdust must be placed under the moist cargo. For hazardous goods shipments, the relevant rules of the IMO (IMDG Code) and Hapag-Lloyd are to be followed.

Different types of packaging must be effectively separated from one another (e.g. cardboard cartons and wooden cases). Cargo with damaged packaging must not be transported unless the packaging is carefully repaired before loading. Packing paper or plastic sheeting must be used for lining containers carrying sensitive goods.

Containers used for transporting odour-sensitive goods must be free of smell; otherwise they must be cleaned before loading. Containers used for shipping odour-emitting goods, or cargo that could soil the containers in the event of leakage, must be lined with plastic sheets and absorbent material (e.g. peat moss, sawdust or silica gel) added in order to avoid unnecessary cleaning costs.

Hapag-Lloyd does not transport ore in containers.

### 3.5. Securing devices in containers

There are many ways of securing cargo in a standard container. Lashing devices are fixed along the longitudinal beams on the floor, on the roof and near the corner posts. Every lashing device has a safe working load of 1 t.

The corrugation in the side walls can be used for securing cargo lengthwise with transverse wooden beams.

It has to be noted that the container end and side walls can take only large surface loads and are not suitable for selective stresses.

The following table gives an overview of securing devices for containers and their use.

Design element	Cargo securing
Lashing eyes on corner posts, roof and floor longitudinal beams or rings in floor	For fastening ropes, plastic straps, metal brackets, quick-acting locks, etc. (for load restrictions, see "Container Specification").
Corrugation in side walls	For securing cargo lengthwise. Timber lying crosswise can be wedged in the corrugation.
Corner posts	Chocking heavy items of cargo to prevent horizontal slipping.



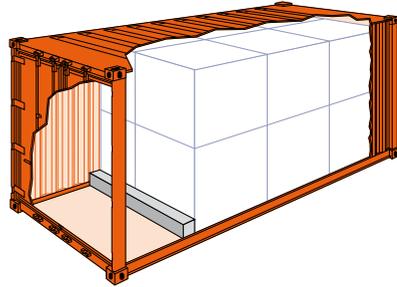
**Lashing points in a standard container on the roof edge, at the corner post and small vents for air-pressure equalisation**

### 3.6. General rules for securing cargo

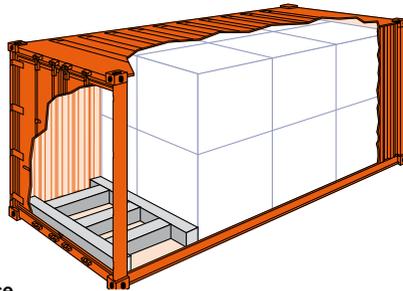
When packing a container or securing cargo, the Guidelines for Packing and Securing Cargoes in Containers for Transport by Land or by Sea (Container Packing Guidelines) issued by the International Maritime Organization (IMO) and International Labour Organization (ILO), must be observed.

Unlike cargo securing as is usual for land transport, cargo carried by sea must also be secured within a container against all ship movements, such as rolling, pitching and yawing. The best way of securing cargo is to distribute it without any gaps over the entire floor. If gaps cannot be avoided, the space between the packaging and container walls must be filled using air bags, dunnage or other stowage material.

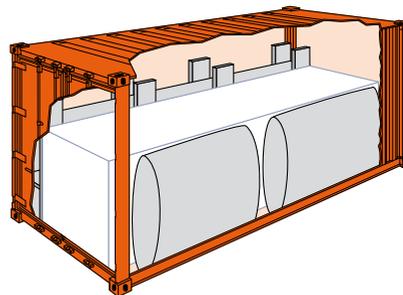
Individual cargo parts that do not fill up the floor must be secured by being chocked and lashed. Lashing eyes are provided on the longitudinal beams on the floor, roof and corner posts.



Cargo is secured against movement lengthwise with a wooden beam inserted in the corrugation of the side walls. The outer ends of the square timber must correspond to the shape of the side wall



The cargo is secured against movement lengthwise with a wooden beam, which is wedged in the groove on the corner post. The space up to the cargo is filled up with other wooden beams

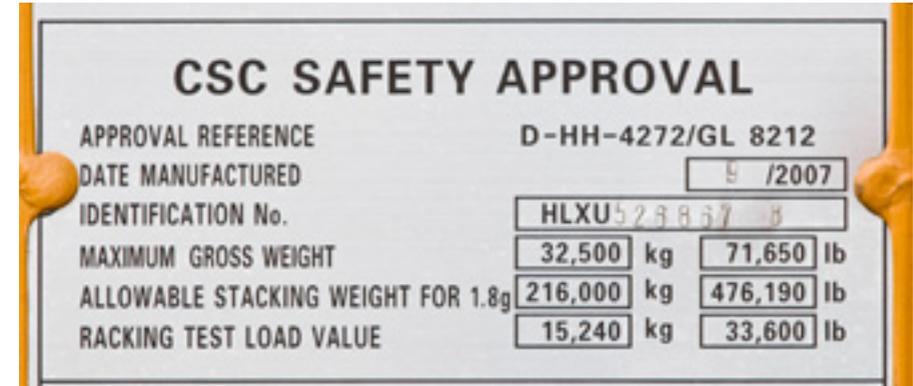


The crates are chocked against the side walls with large bearing areas, on the left with dunnage, on the right with air bags

### 3.7. Checking containers before loading

Every container shipped on international routes must have a valid CSC plate, as provided in accordance with the International Convention on Safe Containers, dated 02.12.1972.

All Hapag-Lloyd containers display this plate.



CSC plate of a 20' standard container

Containers are controlled at every interchange. In addition to these inspections, we recommend customers always carry out a careful check of the following items after receiving a container:

#### External checklist:

- There are no holes or cracks in walls, floor or roof.
- Doors are easy to operate.
- Locking devices and handles function properly.
- Customs seal device must be in orderly condition.
- No self-adhesive labels from previous cargo (e.g. IMDG placards); dangerous goods stickers are permitted only if there are dangerous goods in the container.

#### Additional points to note for special containers:

- Flatracks: End walls are folded up and firmly locked.
- Open-top containers: Upper door strap and roof bow must be completely and properly attached.
- Open-top containers: Roof cover is not damaged and is of the correct size, and its rope ends are not damaged.

- Hard-top containers: Roof is undamaged and roof fastening fits and functions correctly.
- On containers with electrical connections, the condition of the electrical equipment (e.g. cables and plugs) should be inspected before the unit is supplied with voltage.

**Check from inside:**

- Container is proof against condensation water. Possible test method: Enter the container, close both doors and check whether any light comes through cracks, holes or door seals.
- Container is completely dry inside. Any condensation or hoar frost must be removed in order to avoid corrosion and moisture damage to cargo.
- Container is free of dirt and cargo residue, clean and odourless.
- There are no nails or other protruding objects that could damage the cargo.
- If cargo is loaded in the customer's own container, it must be ensured that the CSC plate is valid. The rule at Hapag-Lloyd is that the inspection has been carried out within the past 18 months. Otherwise the container must be loaded conventionally.

If there are any irregularities, a Hapag-Lloyd office should be immediately informed so that an undamaged container can be provided.

**3.8. Checking containers after loading**

The following points must be checked after packing:

- The container is packed to meet the requirements of the cargo, to withstand the probable stress during transport and meet the requirements of the container itself. The weight of the cargo must not exceed the maximum load limit of the container.
- A copy of the packing list for customs inspections, etc. must be displayed at an easily visible place in the container.
- If timber is used as packaging material, it may, under some circumstances, be necessary to comply with the quarantine regulations of the country of destination. A fumigation certificate or certification that the wood has been treated may have to be displayed conspicuously on the container. The regulations and information are usually obtainable from the agricultural authority of the country concerned.
- Doors as well as detachable roofs of containers must be closed carefully.
- The seal number must be noted. Strong steel cable and container locks can protect the cargo from theft. Hapag-Lloyd prescribes high-security seals in accordance with ISO 17712.

- On open-top containers, the roof sheets must fit correctly and the ropes must be correctly inserted (customs seal).
- Covering sheets used to protect cargo in special containers must be securely fastened.
- Old self-adhesive labels must be removed.
- On refrigerated containers, the correct temperature and ventilation volume must be set, the temperature recorder (if provided) must be running and the temperature must be displayed.
- For hazardous goods shipments, the relevant packing and separating regulations must be complied with and the correct IMO placard must be attached outside on the container. The Hapag-Lloyd hazardous goods department will gladly provide the necessary support.
- The entire documentation must be punctually and properly completed.

If a container is overloaded or cargo incorrectly secured, the transport is interrupted and the insurance will not compensate for any possible damage.

**3.9. Returning containers**

After a shipment, the container is usually returned to the predetermined depot. The container must be:

- Clean and free of refuse (incl. remains of cargo and lashing material)
- Free of odours from other sources
- Free of nails or damage to floor
- Without damage to walls and doors
- Without cargo-relevant placards and lettering
- Without damage to sheets if open-top container
- Complete and incl. all accessories

## 4. Protection against climatic influences

### 4.1. Protection against moisture

Moisture is a main reason for cargo damage. Section 2.2. describes the climatic stresses cargo is subject to during transport. Tips on how cargo can be protected are given below.

Before the container is loaded, the type of protection required by the cargo must be determined. The general weather conditions of the climatic zones and the direction in which the zones are passed through should be considered. If the voyage is from a warmer to a colder zone, the risk of condensation is much higher than in the other direction.

Modern container ships have more slots for containers on deck than under deck.

The hatches can be ventilated with electric ventilators. The temperature and moisture under deck are thus similar to the conditions on deck.

Most standard containers have very small openings for pressure equalisation. These are not suitable for ventilation.

Hapag-Lloyd has a small number of 20' containers with ventilation slits along the roof and floor edge for passive air equalisation. However, if a specific volume of fresh air is necessary, a refrigerated container must be used. The relative humidity within a container depends on the moisture of the cargo, stowage material, air during loading and outside temperature during the voyage.

The following measures can be taken to protect cargo against damage from moisture:

- Moisture-sensitive cargo must not be packed together with moisture-emitting cargo. If this is unavoidable, the items of cargo must be well separated from one another and protected.
- Cargo and stowage material must be packed as dry as possible in the containers. Therefore, they have to be stored in dry rooms. Packaging and stowage material stored outside or in damp rooms absorb the dampness of their surroundings.
- Cargo must be secured only with material that cannot damage the cargo as a result of climatic influences; e.g. using stainless steel instead of normal steel prevents rust spots on the cargo.

When moisture-sensitive cargo is being transported, moisture-absorbing material (e.g. paper) must be placed on the cargo or under the container roof. Various products are

offered by a large number of suppliers (e.g. Cargo Dry system, Dew Catcher, Moisture Grip, Non-Sweat paper, Sweatking). Plastic sheets are not suitable for this.

Moisture-absorbing materials such as silica gel can prevent condensation. However, this is effective only if used in absolutely airtight spaces, for example, close to the cargo in cardboard cartons or within products that are wrapped in shrink foil. Approx. 500g of absorbing material is required for 1 m<sup>3</sup> of enclosed air. Silica gel bags are thus not suitable for use in the entire container.

Even if absorbing material is used, damage can result from condensation water. Under extreme conditions, these materials may sweat out the previously absorbed moisture.

### 4.2. Cargo carried in temperature-controlled containers

Hapag-Lloyd provides refrigerated containers for carrying cargo that has to be kept at a constant temperature and/or requires a specific fresh air supply. These boxes are equipped with an electrically operated plant, which cools, heats and generates a preset air exchange as required.

The requisite electricity is supplied by the ship or port terminal. During transport by road or rail, the necessary power is provided from the container wagon or a generator fixed on the container. All refrigerated containers are operated with environment-friendly refrigerants.



Hapag-Lloyd provides one of the world's largest reefer fleets

Chemicals, pharmaceuticals or hazardous goods are loaded in “non-food-grade refrigerated containers” to ensure no food is transported in a container previously used to carry chemicals.

Containers are available with the following functions/characteristics:

- Controlled air composition
  - CO<sub>2</sub>-controlled air exchange
  - Transfresh
- Control of humidity (dehumidification only)
- Cold treatment (USDA)
- Silicon-free cargo loading areas
- Refrigeration for temperatures to –35 °C

Integrated data storage devices record the temperature and other events hourly. The standard reefer container offers adjustable temperatures of between –35°C and +30°C.

Refrigerated containers are designed only to maintain the required temperature for a shipment. To maintain the quality of the merchandise, temperature-sensitive goods must have reached the transport temperature before loading.

Specific types of goods, such as fruit or vegetables, generate heat during transport, consuming oxygen and producing CO<sub>2</sub>. In such cases, the air in the container has to be exchanged. The air interchange can be set from 0 to a maximum of 250m<sup>3</sup> per hour. When booking refrigerated cargo, the exact setting temperature must always be given in degrees Celsius and the required air change in m<sup>3</sup> per hour.

In the profile sections of the floor, the cold air is blown under the cargo towards the door, and the heated air returned under the roof. The way goods are stowed and packed in a refrigerated container can thus have an influence on the air circulation. The following points must be observed when stowing to ensure optimal temperature distribution in the entire cargo:

- Chill Mode: Cargoes at and above freezing-point
  - Goods should be stowed loosely enough so that air can move above and between the packages. This is achieved with stowage material for separating or cartons with holes for ventilation. On the other hand, if stowage is too loose the air flow may not reach the merchandise on the door side adequately.
- Frozen Mode: Cargo below freezing-point
  - The entire floor must be evenly loaded (chock stowage). If this is not possible, cardboard or similar material must

be laid on the free areas to guarantee optimal air flow. This involves larger gaps that are created between the pallets or as a result of packages that have not been precisely stowed on one another.

In any case, at least 12 cm must be kept free between roof and cargo. Markings on the side walls indicate the maximum permissible height. Packing material must be sufficiently robust to carry the stack weight and protect the contents, and must be



**Max. cargo height is indicated by a red line**

suitable for the characteristics of the particular product; for example, cartons with vents should be used for goods that generate heat and/or need an air change. Cargo should be stowed in such a way that it can withstand all risks of sea and land transport. There are only lashing points in the floor, so cargo must also be secured by chocking or positive fit.

#### **4.3. Cargo under controlled atmosphere**

The composition of the ambient air can be changed to achieve a considerable slowing down of the ripening process during transport.

The following parameters can be regulated:

- Nitrogen
- Oxygen
- Carbon dioxide
- Humidity

The precise data depend on the relevant products. Relevant tables based on scientific findings have been published in, for instance, the "Guide to Food Transport – Controlled Atmosphere (Mercantila)".

The latest Hapag-Lloyd refrigerated containers offer the function of CO<sub>2</sub>-controlled air exchange (AFAM+ or E-Autofresh). In these containers, a specific carbon dioxide content (0.04% to 21%) is prescribed and thus the oxygen content of the air is automatically reduced. After the target level has been achieved by the natural ripening process, fresh air is introduced in a controlled manner.

With another method (e.g. Transfresh), the container is flooded with an atmosphere suitable for the product after loading. When the limit values for oxygen and carbon dioxide, set before the transport, have been reached, fresh air is introduced. Chemical absorption materials can also reduce the ethylene content.

## 5. Material for securing cargo

### 5.1. General comments

Various materials can be used to secure cargo. Each has advantages or disadvantages depending on how it is employed.

### 5.2. Material for laying under cargo (bedding)

Before cargo is stowed in a container, it must be decided whether or not it can be placed directly on the container floor.

The cargo can be loaded without special bedding if the cargo itself stands safely, the container floor is not damaged by the cargo and the weight restriction per running metre is not exceeded. Examples for cargo without bedding are cartons, light cases or pallets.

#### 5.2.1. Pallets

Pallets are normally used for faster loading/unloading of cartons and various small items. They can be secured with shrinking foil or straps tensioned over the pallets. In this case, the pallet is part of the cargo.

The disadvantage of EU pallets for road transport is that they cannot be stowed with a positive fit in a standard container. Gaps between packages must be filled with securing material or pallets.

The maximum permissible height of the container can frequently not be used if the pallets cannot be stacked or the height of the crates on the pallets does not correspond with the internal height of the container.

#### 5.2.2. Anti-slip material (rubber)

Sufficient anti-slip material is a main step for proper cargo securing. In general rubber is used as anti-slip material. It is available in a wide range from thin, simple rubber up to thick, high pressure rubber for heavy loads. Furthermore dunnage (thin timber) is commonly used as anti-slip material.

#### 5.2.3. Square timber and strong planks

A bedding of square timber or strong planks is needed for all consignments with small support areas and/or high weight, for distributing the weight on a greater support

length. The bedding used varies depending on the design, which differs for standard containers and flatracks. The substructure is positioned lengthwise in standard containers but crosswise on a flatrack.

Depending on the cargo, timber ranging from strong planks (approx. 5 cm thick) to square timber (20 x 20 cm) is used as substructure. It is sometimes necessary to increase the support length. However, there is no point in having free ends longer than 1 m, as the timber bends upwards at its ends, and thus does not transfer the weight to the outermost points.

#### **5.2.4. Steel girders**

Steel girders are normally used for heavy and massive cargo. Anti-slip materials must be used wherever steel rests on steel. This considerably increases the friction factor, which is very low for contact between steel items.

### **5.3. Lashing material**

Lashing materials are used to secure cargo. They prevent horizontal movements, cargo tipping and bouncing.

There are different terms and definitions for the strength of lashing material. The breaking load is the load lengthwise at which a rope tears. It is not permitted to load a securing element with this weight. A securing factor has thus been introduced. This securing factor depends on the type of lashing material and its use.

The breaking load divided by the securing factor yields the Maximum Securing Load (MSL). The MSL is normally given in the data specification or directly on the lashing material. In addition to the MSL, the load must be reduced if the lashing material is passed over sharp corners.

Different lashing materials have different elastic strength. Different types of lashing materials must thus not be used to secure the same item of cargo.

If various lashing materials are used, when there are movements, the cargo will be held first with the lashing material with the lowest elasticity. This lashing material will first break and the other lashings will then also no longer be able to take the entire load. Lashing materials can be mixed if the different materials are used in different lashing directions.

#### **5.3.1. Fibre ropes**

Fibre ropes are made from natural products such as hemp, manila or sisal, or from synthetic material. Depending on the material, they are able to withstand a very wide range of environmental influences.

Natural fibre ropes are sensitive to acids, alkaline solutions and solvents. They expand

when they absorb moisture and shrink when drying.

Synthetic fibres are more resistant to environmental influences but have a lower breaking load and are, therefore, used only to secure lighter cargo, such as tarpaulins, cars, drums or light cases.

One special type of fibre rope named "Hercules" has a thin steel wire as a core. It has the same breaking load as normal fibre ropes, but a lower elasticity. It is less flexible and stiffer if twisted.

#### **5.3.2. Nylon belts**

The most common lashing materials are nylon belts. They are available in a wide range of widths with different maximum stresses (MSL).

They are easy to use to prevent damage to cargo. Edge protection must be used on sharp corners.

It is absolutely prohibited to knot nylon belts, as they can take much lower loads at these points. The hooks on the belts must fit into the lashing eyes of the container and cargo.

#### **5.3.3. Steel strapping (Signode)**

A steel strap is a flat strap of steel. It has virtually no elastic stretch and thus cannot be used for soft items of cargo such as crates. If the wood gives somewhat, the steel strap immediately loses its fastening strength.

The same occurs when heavy cargo rests on weak wooden bedding. It is very important that cargo secured with steel straps does not lose volume during transport.

On the other hand, steel straps are very useful for fastening steel coils or bundling steel profiles. It is possible to achieve tight securing very quickly with steel straps.

However, this requires special tools. Signode must not be used on sharp or uneven corners.

#### **5.3.4. Steel wire, turnbuckles, shackles and wire clips**

Steel wires are very commonly used for lashing heavy unpacked cargo. Many different sizes and forms are available. Steel wires can take strong forces relative to their diameter and have low elasticity.

On the other hand, they lose much of their strength when passed over sharp corners or used in tight bends.

If steel wire is used for lashing, additional equipment is required. Shackles are used as a link between the tension screw, chain and lashing eyes.

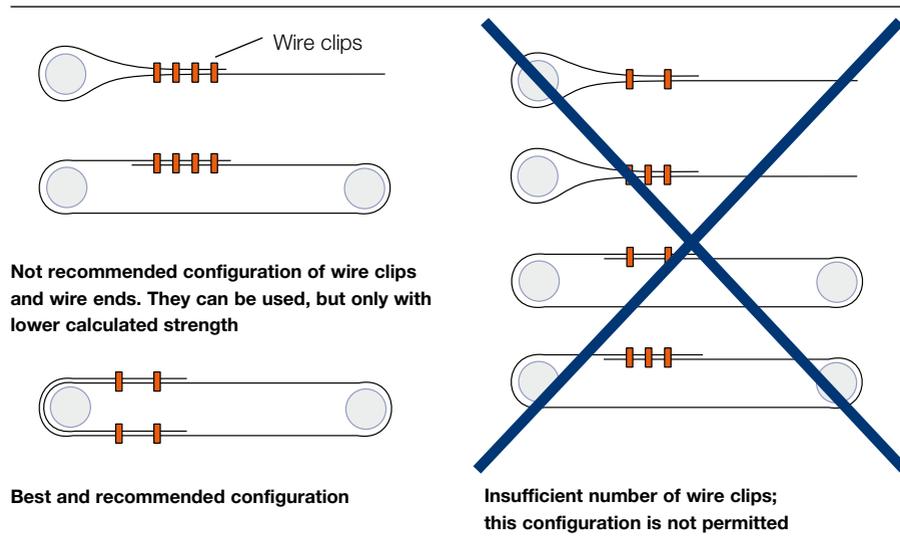
Often a hook with a short chain is used between the lashing eyes on the container and the tension screw on the lower part of the lashing.



**Correct lashing arrangement. The steel wire is twisted to increase the friction**

The chain links can be placed better around edges without losing strength. Wire clips are used to connect the ends of the steel wires, the entire lashing arrangement being tightened with a tension screw.

Wire clips are used to connect the loose wire ends. Only the correct size of wire clips and their torque must be used, otherwise the wire can slip through the wire clips. As the wire clips are usually the weakest part of a lashing arrangement, the way in which they are employed is very important. Recommended and not recommended arrangements are illustrated below. A minimum of four wire clips must be used.



### 5.3.5. Chains

Chains have a high breaking load. The lashing eyes on the cargo or on the container are usually weaker. Chains are generally used for securing heavy cargo. They do not lose any breaking strength on small edges as long as the individual chain links are not themselves bent on edges. Chains have virtually no elastic stretch. They are tightened with the aid of tension screws or tension levers with hooks. Chains can be adapted to the required length by using special grab hooks with securing levers.

### 5.4. Filling material

A very simple and useful method for securing cargo against sliding forwards or sideways is to fill the space in the container with stowage material. It is important that the container wall or the cargo opposite is strong enough to withstand the forces transferred.

#### 5.4.1. Airbags

When, for example, pallets are stowed in a standard container, gaps will remain. A wide range of airbags in various sizes and shapes are provided for this purpose. The airbags are placed empty in the gaps and then filled with compressed air so that all space is filled. Airbags are not designed to take forces from moving cargo and must not be placed over sharp edges.

#### 5.4.2. Timber

Timber can be used for securing generally heavy cargo against sliding. However, the walls of a standard container can absorb only low forces. If the cargo is chocked against the walls, a large contact surface must be provided. The best method is to jam the cargo against the corner posts of the container. A configuration with square timber must be designed so that it does not loosen during transport, or fall off due to vibration.

## 6. Stowing and securing various types of cargo

### 6.1. Cartons, crates and wooden cases

The following points must be observed when loading cartons in containers. If the cargo does not fill the entire volume of a container, the crates must be stowed at a similar height so that the entire floor of the container is covered and weight is evenly distributed. No gaps should be left.

If gaps are unavoidable, the cargo must be chocked row for row by filling the space with airbags, pallets or stowage material.

The height of a stack in a container depends on the stability of the cartons. A robust stowage can be achieved if the cartons are stacked interlocking like bricks. The pressure of the upper layer on the lower can be better distributed with intermediate layers of strong cardboard or dunnage.

Wet cartons are less stable. The comments in 2.2. "Climatic stresses" should thus also be observed.

Large and heavy items of cargo should be positioned in the centre of the container and chocked against the corner posts and roof or floor beams. If items are chocked against the side walls, the supporting surface must be as large as possible.

Stowage with positive fit means that there are no gaps between cargo and container, with no additional material for securing being needed.



Cartons stowed with positive fit



Sofas stowed with positive fit

Only door securing is recommended. This prevents cargo falling out when the container door is opened by the recipient.

### 6.2. Palletised cargo

The achievable capacity utilisation of a container depends on the dimensions of the pallets. The optimal pallet size depends on the internal dimensions of the container.

The packages stacked on the pallets must cover the entire pallet and be well secured, for example with straps or shrink foil.

When stowing the container, care should be taken to ensure that the centre of gravity is in the middle of the container, both lengthwise and across. The pallets must be adequately secured.



Stowage of non-standard pallets. Spaces are filled with airbags. The pallets in the second layer are each secured with three pieces of dunnage against slipping towards the door



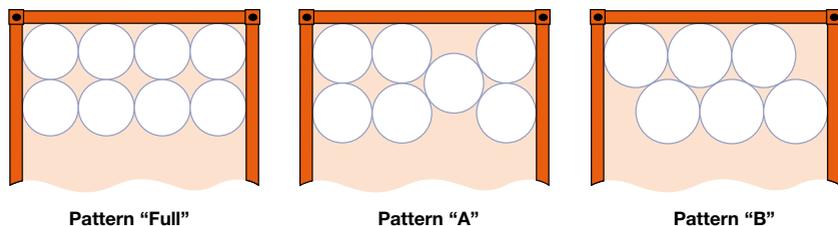
The size and structure of the packing for the motorcycles correspond with container dimensions

### 6.3. Drums and plastic cans

It is essential to ensure that no drums are leaking before loading. Drums leaking liquid must not be loaded. Basically, drums must be stowed with the opening upwards. They are best transported standing upright next to one another.

Plywood boards must be inserted between the individual layers to increase the stability of the drum stacks.

The optimal configuration of drums on the container floor can be determined from the relationship between the diameter of the drums and the inner dimensions of the container. Various packing patterns are possible.



The following formulae can be used for calculating the possible number of rows lengthwise:

$$\text{Pattern Full and A: } n = \frac{L}{D} \quad \text{Pattern B: } n = L + \frac{L - D}{0.866 \cdot D}$$

**n:** Number of rows **D:** Diameter of drums **L:** Inner length of container

All drums must be loaded fitting tightly in the container, without any gaps being left between the cargo and container. If gaps are unavoidable, these must be filled with dunnage, pallets or securing material.

The main securing work must be carried out in the door area. Usually a square timber is placed between the corner posts to prevent drums sliding against the door.

The drums can also be secured with steel straps in blocks superimposed over one another, with one drum being secured in a block of four drums and also connected with another unit of four drums.

Drums can be put at different heights for securing purposes. This is achieved with a mixed stowage, with drums of various heights, or by inserting pallets at different places.

Wooden barrels are not designed to withstand pressure around the centre. If wooden barrels are loaded horizontally, wooden strips for support must be laid under the ends so that the middle does not touch the container floor. Wedges can be used to prevent barrels rolling away.

Plastic cans must be checked for leakage and distortion before loading. A distorted can may endanger the stability of the entire stowage.

A dividing layer of strong stable plates or dunnage must be laid between every layer to ensure the stability of the stacks.

Jolts from below or vibrations could otherwise deform individual cans and then cause the stacks to collapse.

### 6.4. Sacks and bales

Incorrect handling and inadequate stowage of sacks may cause damage to packaging, cargo and the side walls of the container, and injure personnel opening the container doors.

Sacks must be stacked to prevent them sliding in bad weather at sea. They are stacked alternately in various directions and without gaps, so as to form a stable unit. This does not apply for plastic sacks because of the lower friction between plastic surfaces.

These are best secured by using shrinking foil around the entire stack on the pallet. It may be more cost-efficient to load a container with pallets rather than individual sacks, which are relatively time-consuming to load and unload.

Many of the goods packed in bales are comparatively insensitive to mechanical stresses, although the outer cover can be easily damaged on loading/unloading. To facilitate unloading with a forklift, wooden planks can be placed on the container floor and between every layer of bales. Chocking against the door posts is generally adequate to secure the door.



**Carpets protected by jute sacks on loading**

### **6.5. Rolls and coils**

If a standard container is used to carry rolls and coils, before loading, care must be taken to ensure that the maximum permitted weight per running metre is not exceeded. More details on this are given in 3.1. "Weight limits and weight distribution in standard containers". If the coils are too heavy, they must be loaded on flatracks. Rolls and coils can be positioned with eye to sky, or horizontally with axes lengthwise or crosswise.

### **6.5.1. Eye to sky**

Lighter rolls can be stowed like drums. They must be placed close to one another and the space in between must be filled. They must be secured with nets or planks at the door. Steel coils must also be stowed close to one another. They should be secured by being bound together with steel strapping or chocked with wood. Heavy steel coils shipped on loading frames or pallets should be securely fastened on their pallets and fastened with lashings.

### **6.5.2. Eye horizontal, axis lengthwise**

If several coils are loaded, these must be distributed over the entire floor. The centre of gravity must be both lengthwise and crosswise in the middle of the container. Pressure on the side walls should be avoided. Suitable bedding, lashing and chocking, sideways and in the direction of the door, are necessary.

### **6.5.3. Eye horizontal, axis across**

With this configuration, the floor is stressed to the full on account of the very short contact length. It is thus very important to place wooden beams or cradles as bedding lengthwise under every coil. Heavy steel coils must be placed on robust cradles made



**Steel coil loaded with axis across, chocked to the side and lengthwise and lashed with nylon belts**



**Steel coil secured on a Coil-Tainer cradle**

of wood or steel. Steel straps or wires should be used for securing the steel coils on the cradle or among one another.

For securing, the steel coils must be chocked on the side and lengthwise, and lashed through the eye.

Specialised companies such as Coil-Tainer offer reliable steel cradles for transporting steel coils in containers. These distribute the cargo weight over an adequate length and on the outer bearers of the container.

Lighter rolls of paper can be stowed on top of one another. The lower layers must be secured with wedges. Rubber mats must be inserted as anti-slip material between the individual layers. The gaps on the side walls must be filled up with stowage materials to prevent sliding. At the door, all layers must be chocked with a frame of wooden beams.

### 6.6. Steel plates

Steel plates, transported on a flatrack, are a very tricky type of cargo. They must be secured very carefully. Plates that loosen are extremely dangerous for other items of cargo, the ship and the crew. The following points must be observed when stowing steel plates:

- The container floor must not be loaded with excessive weight. Steel has a very high weight in relationship to its volume. Steel often looks lighter than it really is.

- Anti-slip materials such as rubber mats must be placed between the plates.
- Thin plates with a height of up to 15 mm and with identical width must be pre-bundled with steel straps so that they can be handled as one piece.
- If narrow plates lie on wider ones, the space on the sides must be filled up with timber to offset the differences. Alternatively, steel plates with different widths must be secured separately with loop lashing (see 7.2.2.).
- On the edges of steel plates, edge protection must be placed under the lashing material.
- Plates must be secured lengthwise by being chocked towards the end walls. Instead of chocking, diagonal lashing can also be used to prevent the steel plates sliding lengthwise. If the steel plates have various lengths, the differences must be filled with wood to produce a block with identical length.



**Minibus loaded in a standard container, not yet lashed**

### 6.7. Vehicles

Many types of vehicles, from cars to road-building machines, can be transported on containerships. Vehicles may be classified as hazardous goods in some countries, while other states have special transport regulations. The vehicles must comply with the local regulations of the country of destination.

It is recommended to disconnect the batteries when shipping older cars and drain the fuel to a minimum before loading a vehicle in a container.

Cars and delivery vans normally fit easily into a standard container. A small ramp is used for loading and enough space has to be left for the driver to get out of the vehicle. The vehicles must be loaded absolutely dry.

The windows must remain somewhat open to make air circulation possible. There are special tension belts for lashing the cars on the axes. Larger and heavier trucks must be loaded on flatracks. In this case, at least half the wheels must lay on the floor of the flatrack or a special wooden bedding under the chassis is necessary. Further details are given in 7.2. "Pre-lashed cargo".

### 6.8. Sheets of glass

Because of its dimensions and weight, glass is best loaded standing in a container. Hapag-Lloyd offers open-top containers with covering sheets, or hard-top containers with a removable roof.

Sheets of glass have to be carefully packed in cartons or wooden crates, or on A-frames. The sheets should be placed lengthwise in the container. If several A-frames are transported in one container, these must be kept apart with a buffer zone.

As glass is very sensitive to moisture, an additional covering is necessary.

### 6.9. Wet hides and skins

These items are also called "salted cowhide", "raw hides" or "salted skins". During transport, the skins give off brine, a very strong-smelling liquid. This permanently contaminates the container floor and also often runs out of the container and damages other containers and cargo, and the marine coating.

A damaged container floor must be completely replaced or the container has to be written off as a total loss. The transport of wrongly stowed, wet salted skins is thus a cause of constant annoyance because of the costs for cleaning and rectifying the damage.

Wet salted skins can be effectively transported only if the following precautions are taken:

- The container must be completely lined with a tube-like lining out of one piece. This lining must be of at least 8 mm thick polyethylene,

or a sheet with inserted threads that have a minimum diameter of 0.230 mm (9 mils). This lining must cover the entire floor and three-quarters of the side walls, and be secured on the lashing eyes on the roof brace.

- Cardboard or moisture-absorbing material should be placed on the floor in the lining before cargo is put on it.
- Plywood sheets should be used to protect the lining if cargo is loaded with a forklift.

### 6.10. Liquids

Liquids are usually transported in tank containers. These must be filled with at least 80% of the volume to avoid serious surge movements during transport. The maximum filling height is 95% of volume to allow liquids to expand with temperature variations. Special load limits, which are marked on various tank containers, must always be observed.

Apart from normal tank containers, special tank containers for temperature-controlled cargo with heating and refrigerating units are also available.

Liquids can be transported in normal standard containers in small, stable receptacles such as drums, cans or "intermediate bulk containers" (IBC).

Hapag-Lloyd does not recommend transporting liquids in flexi-bags. Under special circumstances, however, it ships food products such as wine and fruit juices in flexi-bags. In these cases, Hapag-Lloyd accepts only flexi-bags that meet its quality standards. Further information is obtainable from any Hapag-Lloyd office.

### 6.11. Bulk freight

Bulk freight can be transported with a lining in a 20' standard container or an open-top container. The lining protects the cargo against dirt and the smell of the container, and reduces the time required for cleaning the container after emptying.

Only products such as powder, granulate, maize or bulk freight without sharp edges can be transported with these lining bags. The bulk freight is usually loaded via a conveyor belt through the door, or through openings of a special roof.

The cargo must be secured with a bulkhead at the door to prevent any of it falling out when a door is opened. This is a strict and binding requirement in many countries. Most makers combine their lining directly with a door securing system. Other types of bulk cargo, such as scrap or stones, can be loaded only after inspection and approval by Hapag-Lloyd.

### 6.12. Long cargo

This section deals with long cargo that does not fit into a standard container. When shipping long cargo, please consult 7.2. "Pre-lashed cargo". Open-top, hard-top and flatrack containers are useful for carrying long cargo. Loading long items, such as pipes or logs, through the door can very easily damage the container floor, the corrugation of the side walls or the cargo. If several layers are stowed on top of one another, material must be laid between every layer to prevent slipping.

Long items have to be very carefully secured lengthwise by chocking or lashing on the front sides. Chocking is achieved with a vertical front wall of wood, which is chocked against the corner posts or held with lashing straps.

The cargo must be secured against sliding with loop lashing or chocking to the side walls.

### 6.13. Live animals

Hapag-Lloyd does not recommend transporting live animals on containerships. However, if the customer insists and it has been possible to clarify all relevant issues, livestock can be shipped.

The receptacles for the animals can be loaded on flatracks or in open-top containers on deck. Keepers must accompany the animals in transit.

Containers with feed can be stowed near the animals on deck. Shippers of live animals must familiarise themselves in advance with the quarantine regulations in the country of destination and the transit ports.

## 7. Oversized and heavy cargo

### 7.1. General comments

Cargo that has excess height, excess width and/or is heavy can be loaded pre-lashed on a flatrack or conventionally.

Pre-lashing means the cargo is loaded first in an open-top container or on a flatrack, and lashed there before both are lifted together on to the ship.

If the weight and/or cargo dimensions exceed the limits for a pre-lashed shipment, the cargo must be loaded conventionally, also referred to as break bulk.

This involves first putting flatracks as foundation in the ship. Wooden beams or steel girders are then laid-out for load distribution and the cargo loaded with the container crane or a floating crane on top, after which the cargo is secured.

### 7.2. Pre-lashed cargo

Hapag-Lloyd provides open-top containers (roof protected only with a tarpaulin), hard-top containers (roof made out of steel and detachable) and flatrack containers (reinforced floor, no side walls and no roof) in 20' and 40' lengths for transporting cargo with excess size.

It should be noted that the floor design of open-top and hard-top containers is the same as for standard containers. The load limits are thus the same as described in chapter 3.1.

Flatracks have two much stronger longitudinal beams outside as floor construction, which can carry much higher selective stresses.

If heavy cargo is being carried that is very narrow and rests not on the main girder but only in the middle on the weaker wooden floor, bedding must be laid athwart under the cargo so that the weight is transferred onto the main girder.

Flatracks can be loaded with the maximum payload only if the cargo stands over the full floor length on the flatrack. Less weight can thus be loaded for shorter consignments. The exact details are obtainable from our loading specialists.

The decision on whether or not an item of cargo has excess dimensions or what equipment is most suitable for transport depends on the dimensions such as length, width, height and weight.

The type, form and floor structure of the cargo also plays a role. If one limit value for standard containers is exceeded, special containers must be used.

Open-top containers are suitable for light, high cargo or for long consignments that cannot be lifted through the door. If the cargo is wider than the roof opening or heavier than the weight limits, flatracks must be used.

Cargo with excess length can be carried on platforms, which are flatracks with collapsible end walls. The following points must be observed when loading platforms:

- Corner castings must be kept free for lifting.
- It is not permitted to raise a platform with one end wall up and the other down. Both end walls must always be either up or down.
- Special care must be taken to secure the cargo against movement lengthwise.
- Platforms can be loaded only on deck.

### 7.2.1. Securing cargo in open-top containers

Securing cargo in these containers always involves a mixture of lashing and chocking. Chocking protects the cargo against slipping.

To secure lengthwise, wooden beams are to be laid-out between cargo and corner posts of the container. Chocking crosswise should be done as far below as possible against the side walls. The forces must be distributed over an area as large as possible by horizontal timbers. Side and front walls are not designed for selective stresses.

Lashings prevent cargo tipping and increase the friction on the floor. All open-top containers have small lashing eyes on the corner posts, as well as on the floor and on the roof rails, each with a Maximum Securing Load (MSL) of 1-2 t.

### 7.2.2. Securing cargo on a flatrack container

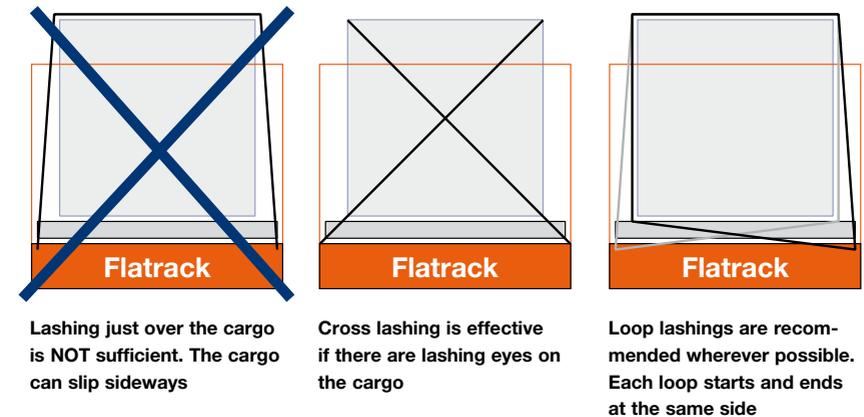
As for open-top containers, securing cargo on a flatrack must involve a combination of lashing and chocking. The cargo also has to be protected against environmental influences.

Hapag-Lloyd flatracks have lashing eyes on both sides and the front ends. All lashing points have a Maximum Securing Load (MSL) of 5t.

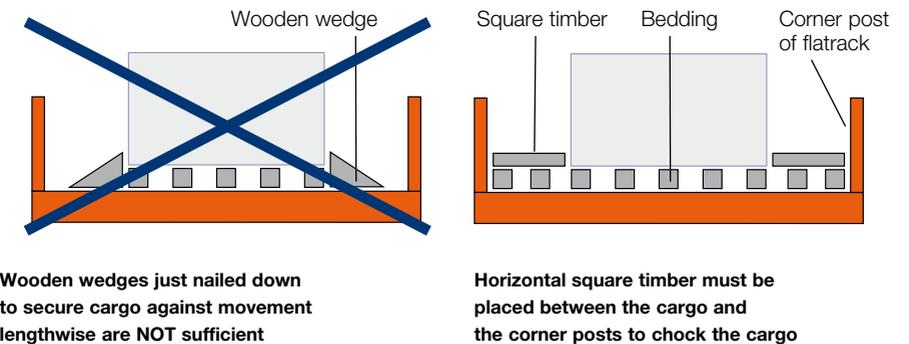
The lashing secures the cargo against tipping and holds it down to increase friction. It is not sufficient just to lash over the cargo. The preferred lashing method is cross lashing. However, lashing eyes on the cargo are required for this.

Otherwise, it is necessary to lash around the cargo, also referred to as loop lashing. The strap or wire is passed from one side over the cargo, and then under the cargo back to the starting point. The same procedure must always be repeated beginning on the other side. The various lashing methods are illustrated below.

It is possible to chock very effectively lengthwise against the corner posts. Wooden wedges, nailed on the wooden floor of the flat-racks, must not be used, as these are mostly not adequate and damage the floor.



Most flatracks have notches for stanchions along the side. Ordinary steel beams, inserted vertically into these holes, can be used as chocking against slipping sideways, for example, for lengthy items such as pipes.



When case will be stacked on top of each other and for increasing friction serrated steel plates can be applied.

These look like serrated washers and are placed between the crate and the wooden floor. They are fixed in position with nails or by the weight of the cargo. These serrated steel plates increase friction.

It is vital to display a marking on the crate to inform persons inspecting the cargo of the securing material used. In addition to being secured by serrated steel plates, the cargo must also, of course, be lashed.

It is vital to use edge protection to prevent straps chafing and tearing on sharp edges. This also protects soft wooden cases against being broken or cut into by the lashing materials, and prevents the resulting loosening of securing equipment. Cargo is normally loaded on flatracks below deck for protection against water. Containerships have guide rails in their holds to keep containers in position. These guide rails reduce the maximum loading length for shipments with excessive width (more than 244 cm) even if the cargo would fit on the flatrack. The maximum permitted length for cargo with excess width is 1160 cm on 40' flatracks and 550 cm on 20' flatracks. In other words, the cargo must be stowed at least 30 cm from the outer ends of the flatracks.

### 7.3. Conventional cargo

Cargo that exceeds the limits for pre-lashed consignments has to be loaded conventionally. These limits depend on a wide variety of factors and can be checked individually by Hapag-Lloyd.

Every conventional consignment requires special treatment, so a special procedure is used for every booking at Hapag-Lloyd.

Many people are involved in preparing and carrying out conventional shipments. Experts check whether or not the cargo can be loaded and if so how, formulating stowage proposals and lashing plans.

The Hapag-Lloyd agencies in the ports where cargo is loaded and unloaded calculate the probable costs and clarify all details of cargo handling with the local companies. Hapag-Lloyd can offer reliable transport for most large and heavy items of cargo.

Some examples of types of cargo carried by Hapag-Lloyd are given below.



**The press is placed on two flatracks. Sturdy square timbers are put under the press on the flatracks to distribute the weight and prevent damage to the cargo or to the flatrack. Nylon belts have been used for lashing**



**Loading a large ship propeller weighing 80t. The propeller has a very small contact area, so robust steel bedding is applied. Steel wires or nylon straps will be used for securing**



**This transformer, weighing approx. 160t, was placed on steel girders and lashed with chains**

## 8. Further information and contact addresses

Please visit our website: [www.hapag-lloyd.com](http://www.hapag-lloyd.com)

This is a very informative website providing addresses of sales offices, schedules and details of the ships and containers used by Hapag-Lloyd. Cargo can be booked online via our website.

Our brochure "Container Specification" describes all container types used by Hapag-Lloyd, giving exact dimensions and specifications.

Further information on stowing containers is given at [www.containerhandbuch.de](http://www.containerhandbuch.de).

This is a very detailed website of the Association of the German Insurance Industry, providing a great deal of information in both German and English on packing, lashing, stowing, products and legal regulations.

The International Maritime Organisation website [www.imo.org](http://www.imo.org) also offers a lot of information and details of many regulations. Many publications are obtainable via this website.

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