

Packaging guidelines



3rd revised edition 2014

**German Federal Association for
 Wooden packaging ·
 Pallets ·
 Export packaging (HPE) e.V.**

**Bundesverband
 Holzpackmittel ·
 Paletten ·
 Exportverpackung (HPE) e.V.**

Packaging guidelines

Edited by



Bundesverband Holzpackmittel · Paletten · Exportverpackung (HPE) e.V.

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Packaging guidelines

Issued by
HPE, the German Federal Association for
wooden packaging, pallets and export packaging

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A. GENERAL REMARKS

1. INTRODUCTION

Trade in goods requires adequate protection of these goods against the many threats present during their handling in the logistical transport chain. Thanks to the HPE packaging guidelines, minimum standards are available for packaging to meet these loads and stresses. They aim to ensure that the goods arrive without damage at their point of destination and use. The condition of the packaging itself is of no concern once it has fulfilled this purpose.

The following guidelines refer to export packaging of technical goods. All indicated values and load assumptions are of an indicative nature only and do not claim to be universally valid. They are based on normal load assumptions during the transport chain, i.e. stresses due to transport by sea, overland or air and experienced handling, storage and safe stowage procedures. They do not cover stresses due to accidents or other hazards. Even fit-for-use quality packaging cannot free all participants in the logistical chain from their obligation to apply due care when handling goods.

Each packaging order is executed on the basis of the individual requirements of the goods, the chosen transport routes and means plus any other specific needs. This may also include the consideration to reduce packaging, for example when transporting in containers.

The following information must be given by the customer to the packer:

- Protection requirements of the goods to be packaged
The customer is responsible for the safety of the goods during transport and/or transshipment and interim storage between their point of origin and the packaging company's premises or place of packaging.
- the goods' hygroscopic properties
- means of transport to be used
- type of transport, conventional or container FCL / LCL
- transport route and duration, storage/ stop-over points and transshipment
- agreement on anti-corrosion measures
- centre of gravity and weight issues

The packaging firm is responsible for choosing the most suitable type of packaging for each particular item. The customer and packaging company must exchange all necessary information required to carry out the correct packaging job. The customer or manufacturer on behalf of the customer agrees to pass all relevant technical information to the packaging company to ensure a professional choice of packaging.

Construction characteristics and designs included in these guidelines are only given by way of examples. Other solutions than these may well correspond to the latest technical development and be a better suited option in a particular case. All materials used should be reusable or recyclable.

These guidelines form part of the quality management system developed by HPE.

The general commercial conditions of each packaging company form the basis of all orders accepted.

2. DEFINITIONS (CORE DEFINITIONS)

<i>Add-on packaging</i>	Add-on packaging is designed in such a way that it remains “added on” to the packaged goods during handling. The lifting tackle is applied directly to the goods.
<i>Air cargo packaging</i>	Generic term for fit-for-use packaging in air cargo transport
<i>Container packaging</i>	is a generic term and covers packaging of goods in such a way that they can be stowed inside a container.
<i>Export packaging</i>	See fit-for-use packaging
<i>Fit-for-use packaging</i>	Fit-for-use packaging is designed to counter normal stresses envisaged for a particular transport route, duration, means of transport, country and place of destination and usual handling and transshipment, storage before, after and during transit. It guarantees undamaged arrival of the packaging goods on the basis of transport, handling and storage stresses to be expected.
<i>Goods to be packed/ Packaging good</i>	Goods that are made fit for transport, handling and storage by their packaging
<i>Hazardous goods packaging</i>	Packaging of dangerous/hazardous goods according to relevant regulations. Design and construction types for dangerous goods are not within the scope of these Guidelines.

<i>Heavy/oversize goods</i>	Goods requiring special packaging due to their mass and/or design.
<i>Load-bearing packaging</i>	This type of packaging is designed in such a way that it carries the load of the packaged goods during handling. The lifting tackle is applied directly to the packaging unit. (External fastening)
<i>Load / stress</i>	general name for mechanical, atmospheric and biotic loads and stresses that affect the packaging and/or goods from the outside.
<i>Multi-trip packaging</i>	Packaging meant to be used repeatedly. It may be collapsible or can be disassembled and be returned for repeat use.
<i>One-way packaging</i>	Packaging meant to be used for a single transport movement.
<i>Packaging</i>	Generic term for all packaging means and aids, DIN 55 405 T5.
<i>Packaging material</i>	Material used to produce packaging means and aids, see DIN 55 405 T2.
<i>Packaging means</i>	Product made from packaging material to enclose or contain the packaging goods to make them fit for transport and storage according to DIN 55 405 T3.
<i>Packaging unit</i>	Single packaging or collection of single units to a transport unit.
<i>Packed goods</i>	Packaging unit/packed goods fit for transport.
<i>Period of preservation</i>	Period of time for which customer and packer have agreed to provide preservation measures.
<i>Preservation</i>	Anti-corrosion measures to protect against rain or sea water, high air humidity, temperature fluctuations. Also included are anti-corrosion measures for packaged goods inside an external packaging to protect them against external chemical and physical agents.
<i>Sea-worthy packaging</i>	See fit-for-use packaging
<i>Stress</i>	The result of the effect of loads on packaging and/or goods
<i>Transport duration</i>	Period of time from the delivery of the package to the haulier until its arrival at the place of destination.
<i>Transport route</i>	The route that is covered by a packaged good between consignment and arrival.

This list of core definitions cannot be exhaustive, nor is it meant to be. It is based on packaging definitions in DIN 55 405 (Verpackungswesen, Begriffe).

Further specialist terms such as case or crate are defined in subsequent special chapters.

Physical terms of reference

<i>Mass m</i>	The kilogram is the basic unit of mass [kg]. Mass is not the same as weight. An object's mass does not change on the moon, whilst its weight is only 1/6th of its value on earth. The reason for this lies in the different gravitational force of the moon.
<i>Acceleration g</i>	The basis for this is the earth's acceleration [g]. This is a constant value of $g = 9,81 \text{ [m/s}^2\text{]}$. Accelerations during logistical processes are indicated in multiples of g .
<i>Force F</i>	This is the product of mass times acceleration $= m * g \text{ [kgm/s}^2 = \text{N]}$ and expressed in Newton.
<i>Friction coefficient μ</i>	always inferior to 1 and indicates the friction resistance between to friction surfaces.
<i>Friction F_R</i>	Friction is a loss of mechanical energy during relative movements between two surfaces in contact. Friction is the product of mass force times friction coefficient $= FG \times \mu \text{ [N]}$.

3. STANDARDS, REGULATIONS AND GUIDELINES CITED

<i>DIN EN 300</i>	Oriented Strand Boards (OSB) – Definitions, classification and specifications
<i>DIN EN 312</i>	T5 particle boards, specifications – requirements for load-bearing boards for use in humid conditions
<i>DIN 436</i>	Square washers for use in timber constructions
<i>DIN 440</i>	Washers for use in timber constructions
<i>DIN 603</i>	Mushroom head with square neck bolts
<i>DIN 571</i>	Hexagonal screws
<i>DIN EN 622</i>	T2 fibreboards, specifications - specifications for Hardboards
<i>DIN EN 636</i>	plywood specifications
<i>ISO 668</i>	containers, external dimensions
<i>DIN EN ISO 780</i>	Packaging – Pictorial marking for handling of goods
<i>DIN 1052</i>	design, calculation and dimensioning of wooden constructions, General rules for dimensions and dimensioning in civil engineering
<i>DIN 4070-1</i>	Coniferous timber, statistical values for sawn wood
<i>DIN 4070-2</i>	B 1 dimensions of cross-sections and static values; standard square timber and roof battens B 2 dimensions of cross-sections and static values; Special and commercial merchandise
<i>DIN 1313-1</i>	Part 1, unplanned boards and planks made of coniferous timber; dimensions
<i>DIN ISO 1496-1</i>	Containers, internal measurements
<i>DIN 4073-1</i>	Part 1, planed boards and planks made of coniferous timber; dimensions
<i>DIN 4074-1</i>	Part 1, strength grading of coniferous wood; conif. sawn timber
<i>DIN EN 10230-1</i>	steel wire nails – part 1: bulk supplies for general use
<i>DIN EN 12246</i>	Quality classification of timber used in pallets and packaging
<i>DIN EN 12248</i>	cut timber in wooden packaging, admissible tolerances and preferential dimensions
<i>DIN EN 12249</i>	Sawn timber for pallets; permitted deviations; guidelines for dimensions

<i>EN ISO 4016</i>	Hexagon head bolts; product grade C
<i>DIN 50010-1</i>	Climate zones and their technical implications; definitions Part 1, general definitions
<i>DIN 50010-2</i>	Part 2, physical definitions
<i>DIN IEC 60721-2-1</i>	Classification of ambient conditions; natural influences, temperature and air humidity
<i>DIN 55402-2</i>	Part 1, shipping marks for packages; pictorial marking for handling of goods Part 2, marking for shipping of packages; directive for export packaging
<i>DIN 55405</i> <i>Parts 1-7</i>	Packaging terminology; Part 1, systematic concepts, alphabetical catalogue and definitions; part 3, packaging means; part 5, packaging, packaging goods, package and packaging unit Part 3, terminology; packages Part 5, terminology; packaging, content, package and packet
<i>DIN 55473</i>	Packaging; bagged desiccants; delivery conditions
<i>DIN 55474</i>	Packaging aids; bagged desiccants and their use calculation of the required number of desiccant units
<i>DIN 55499-1</i>	Packaging means, wooden cases types, dimensions, quality classes
<i>DIN 55530</i>	Plastic packaging films barrier materials made of low density polyethylene
<i>DIN 55531</i>	Packaging films; laminated aluminium foils and sandwiches
<i>DIN 68705-3</i>	Plywood; veneered boards for construction uses
<i>TL 8135-0003</i>	Packaging material, aluminium sandwich films
<i>TL 8135-0019</i>	Packaging material, Packaging films; low density polyethylene films PE-LD
<i>VDI guideline 2700 ff.</i>	Securing loads in road transport RGV/BFSV technical sheets for overseas shipments
<i>Technical sheet 3100</i>	Packaging and containers in overseas shipment
<i>CTU packaging guidelines</i>	Guidelines for the packaging of goods with the exception of loose goods in or on transport means of all types on water and land
<i>ISPM 15</i>	International Standard for Phytosanitary Measures, plant health standard
<i>GDV</i>	German load securing manual <i>the latest editions always apply</i>

DIN German Industrial Standards can be obtained exclusively from:

Beuth Verlag GmbH	Tel.: 030 / 26 01-22 60
Burggrafenstraße 6	Fax: 030 / 26 01-12 60
	E-Mail: postmaster@beuth.de
D-10787 Berlin	www.beuth.de

The technical terms of delivery (TL) of the German armed forces are obtainable from:

Bundesamt für Wehrtechnik und Beschaffung -T 2.6	Tel.: 0261 / 400-0
Postfach 30 01 65	Fax: 0261 / 400-76 30
D-56057 Koblenz	E-Mail: bwb@bwb.org
	www.bwb.org

The CTU guidelines are obtainable from:

Verkehrsblatt-Verlag	Tel.: 0180 / 534 01 40
Hohe Straße 39	Fax: 0180 / 534 01 20
	E-Mail: info@verkehrsblatt.de
D-44139 Dortmund	www.verkehrsblatt.de

The phytosanitary guidelines ISPM 15 are obtainable from:

Julius Kühn-Institut	Tel.: 0531 / 2995
Bundesforschungsinstitut für Kulturpflanzen (JKI)	Fax: 0531 / 299 3000
Messeweg 11/12	E-Mail: pressestelle@jki.bund.de
D-38104 Braunschweig	www.jki.bund.de

The GDV load securing manual is obtainable from:

Gesamtverband der Deutschen Versicherungswirtschaft e.V.	Tel.: 030 / 20 20 5363
Friedrichstraße 191	Fax: 030 / 20 20 6612
D-10117 Berlin	www.gdv.de

RGV-BFSV technical leaflets are obtainable from:

RG Verpackung im RKW	Tel.: 06196 / 495-1
Postfach 58 67	Fax: 06196 / 495 303
D-65733 Eschborn	www.rkw.de

4. SYSTEM OF ABBREVIATIONS

The following categories and their abbreviations can be used to indicate the extent of external packaging and anti-corrosion measures provided by the packing company.

4.1 EXTERNAL PACKAGING

4.1.1 Cases (K_v) and crates (V) made of solid timber, plywood (K_s) and OSB (K_o):

Table 1:
Description of
case construction

Net weight		Types
up to 500 kg	K _v V	K _v -A3/18, K _v -A4/18, K _v -A5/24, K _v -A6/24 V-A3/18, V-A4/18, V-A5/24, V-A6/24
500 – 3.000 kg	K _v V	K _v -B1/24 V-B1/24
more than 3.000 kg	K _v V	K _v -B2/24, K _v -B3/24 V-B2/24, V-B3/24

Net weight		Types
up to 500 kg	K _s	K _s -A3/9, K _s -A4/9, K _s -A5/12, K _s -A6/12
500 – 3.000 kg	K _s	K _s -B3/12
more than 3.000 kg	K _s	K _s -B3/12

Net weight		Types
up to 500 kg	K _o	K _o -A3/10, K _o -A4/10, K _o -A5/12, K _o -A6/12
500 – 3.000 kg	K _o	K _o -B3/12
more than 3.000 kg	K _o	K _o -B3/12

Note:

- Description of case construction types, see chapter F. 3.1
Description of crate construction types, see chapter F 3.3
- The case or crate symbol is followed by the thickness in mm of the planking wood used.
Tolerance: +/- 2 mm
- The cladding thickness of plywood should be half that of the thickness of planks used for a solid timber case.
Tolerance: +/- 1 mm

4.1.2 Partial packaging (T)

(valid for all net mass categories):

- claddings T V
- bundles T Bd
- sledge Skid
- square batten constructions Kako

See chapter F.3.4 for remarks on the manufacture of partial packaging.

4.2 PRESERVATION AND ANTI-CORROSION PROTECTION

Table 2:
*Duration of protection
through preservation and
anti-corrosion measures*

anti-corrosion methods	duration of protection in months				
	none	6	12	18	24
polyethylene films + desiccant	P0	P6	P12	-	-
alu sandwich film + desiccant	-	Alu 6	Alu 12	Alu 18*	Alu 24*
VCI	VCI				
protective coating	-	Ss 6	Ss 12	Ss 18	Ss 24

* Must include regular checks of anti-corrosion effectiveness and written test documentation.

Remarks on the application of preservation methods can be found in Chapter E.

4.3 EXAMPLE FOR USING THE ABBREVIATION SYSTEM

4.3.1 Schematic overview for sequence of abbreviations

- a) type of packaging (case, crate, partial packaging)
- b) construction type of external packaging (see chapter F.3)
- c) timber thickness in mm intended for claddings
- d) preservation and anti-corrosion measures (see chapter E)

4.3.2 Marking examples

- a) Lightweight, robust goods, net weight 400 kg and short transport duration, covered in polyethylene and packed inside a crate would be marked: V A3/18 - P 0
- b) Sensitive goods, net weight 1,500 kg, preservation period 12 months, in a case on skids, 12 mm plywood plus addition of desiccant and protective coating, marking: Ks B3/12 - Alu 12 - Ss 12
- c) Tubes, net weight 2,500 kg, partial packaging in bundles and protected for 12 months by a coating, marking: T Bd - Ss 12

B. LOAD ASSUMPTIONS

1. LOAD ASSUMPTIONS

The following load assumptions are based on normal transport stresses. Extreme and/or excessive stresses cannot be the basis for designing standard packaging units.

Table 3:
 Load assumptions according to the CTU directive for combined transport

means of transport	forwards acceleration	backwards acceleration	lateral acceleration
road transport	1,0 g	0,5 g	0,5 g
railway transport			
shunting traffic	4,0 g	4,0 g	0,5 g (a)
combined traffic*	1,0 g	1,0 g	0,5 g (a)
maritime transport			
Baltic Sea	0,3 g (b)	0,3 g (b)	0,5 g
North Sea	0,3 g (c)	0,3 g (c)	0,7 g
Ocean going traffic	0,4 g (d)	0,4 g (d)	0,8 g
air traffic	1,5 g	1,5 g	Vertical $\pm 3,0$ g

The above values shall be combined with vertical gravitational forces of 1 g and dynamic fluctuations, also vertical:

(a) = $\pm 0,3$ g (b) = $\pm 0,5$ g (c) = $\pm 0,7$ g (d) = $\pm 0,8$ g

*railway wagons with containers, swaps, trucks, lorries and complete trains type UIC and RIV.

Acceleration forces can be calculated by the multiplication of mass (the packaged goods or unit) times acceleration:

$$F = m * g$$

Other types of acceleration forces may occur.

ill. left:

Example: acceleration forces are often underestimated. In this case an insufficient secured cylinder perforates the end wall of a case.



ill. right:

Example: acceleration forces on high seas due to rolling and stamping of the ship. Rolling angles of up to 30° can occur.



2. LOADS DUE TO CRUSHING IN STACKS

When storing cases on level and horizontal surfaces and given an even distribution of weights on the case lid, the value for static, vertical loads in stacks is calculated as follows:

$$P = 10 \text{ kN/m}^2 (1 \text{ t/m}^2)$$

Static stacking loads are overridden by dynamic forces during the movement of transport vehicles, they may be de- or increased according to vertical acceleration forces, see table 3.

Note: Where there is a risk of punctual or linear loads occurring during transport, those responsible for the goods must take the necessary measures to spread the load more evenly.

Horizontal stresses on the case lid due to a ship's movement, especially when rolling, depend on the stacking weights involved and the lateral impact of horizontal loads.

Once the packaging company has been informed of larger than usual stacking loads P , the relevant values can be calculated as follows:

$$P = \sigma (h_{st} - h)$$

h = height of the packaged goods in m

h_{st} = stacking height in m

σ = specific mass of goods stacked on top according to the customer's indications (t/m^3)

Example:

Stacking of packaged goods in a cargo ship. High crushing loads can be caused by excessive stacking.



3. HORIZONTAL LOADS

Horizontal acceleration forces mainly occur when transport vehicles accelerate quickly or brake. This often happens when shock-like forces occur during shunting of freight trains. This inflicts major stresses on packaging units and their goods. Shunting peaks of 4 g during $t = 0,05$ sec. must be used as a statistical average load in calculations:

a) for the case assembly

$$H_1 = g_h * G_T$$

G_T = tare weight in kN

g_h = horizontal acceleration

b) for the lashing securing the packaged goods
(stresses on fasteners)

$$H_2 = (g_h * G_N) - (G_N * g * \mu)$$

G_N = net weight in kN

g = earth acceleration forces

μ = friction value

c) Horizontal acceleration forces attack the centre of gravity of the packaged goods or units.

Table 4:
Friction values for
different material
combinations

material combinations	dry	wet
timber/timber	0,2 – 0,5	0,2 – 0,25
metal/timber	0,2 – 0,5	0,2 – 0,25
metal/metal	0,1 – 0,25	0,1 – 0,2

The importance of the shunting impact can be greater or smaller in countries where other rail transport standards apply.

It is assumed that acceleration or deceleration of 1 g in the driving direction and 0,5 g laterally and towards the rear will not be exceeded when using road vehicles (see VDI directive 2700).

VERTICAL LOADS / STRESSES THROUGH FALLING AND VIBRATIONS / TRANSVERSE FORCES DURING CRANE HANDLING

4. VERTICAL LOADS

Vertical loads on the packaged goods result from crushing loads in stacks due to the weight of the goods above but also due to the mass of the packaged good itself. There are in both cases static loads during storage and static/dynamic loads during transport and handling.

5. STRESSES THROUGH FALLING AND VIBRATIONS

Vibration stresses occur with each transport movement, depending on the type of transport chosen. The customer must inform the packaging firm regarding the load assumptions for any sensitive goods. In certain cases the use of shock indicators or gauges should be considered.

6. TRANSVERSE FORCES DURING CRANE HANDLING

These forces occur on the lid during loading with lifting tackle. When assuming a cable spreading angle of 60° during the lifting manoeuvre in ill.1, we can calculate the loads on the lid as follows:

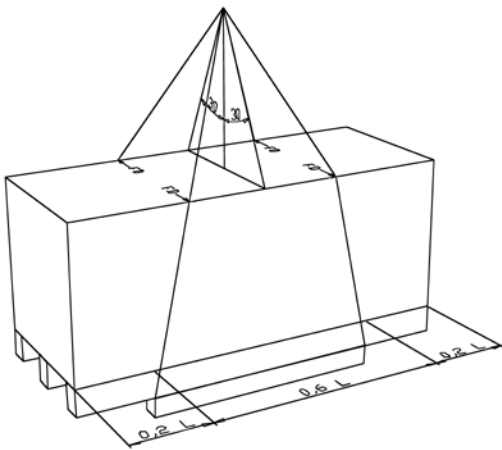
$$F_D = 0,145 \times F_g$$

In this case F_g is the load of the force expressed in N equals mass of the packaging good in kg multiplied by earth gravitation forces g .

$$g \sim 10 \text{ m/s}^2$$

In this calculation rope/cable friction was ignored, case height and width are of no concern. In order to avoid damage through these greatly differing spreading angles, we recommend using values of $F_D = 0,2 \text{ to } 0,3 \times F_g$.

ill.1: Traction stresses during lifting



Example:

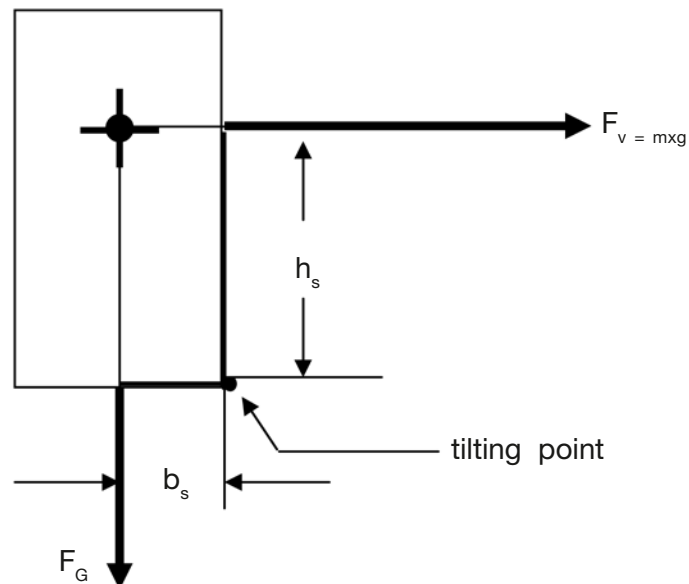
stowage of packaged goods in a cargo ship by crane. The packaging must be designed to withstand stresses due to rope/cable forces.



7. TILTING STRESSES

A case or a packaging unit is threatened by tilting when the centre of gravity lies above the point where lateral diagonals cross and/or is found to the side and outside of the middle section.

ill. 2:
Tilting of packaged goods



a) A case/packaged goods can tilt in the direction of acceleration:
when $b_s \leq g * h_s$

g = horizontal acceleration see table 3

b) The use of tilting gauges should be investigated

8. CENTRE OF GRAVITY INDICATIONS

Where goods are packaged individually and the marking of the centre of gravity is necessary, it is the duty of the customer/manufacturer to establish its position and indicate this to the packer. The centre of gravity must be marked according to DIN 55 402, DIN EN ISO 780 or according to the regulations of the country of destination.

C. ATMOSPHERIC LOADS

Goods can only be protected by suitable packaging against atmospheric influences if all expected atmospheric conditions during storage, interim storage, handling and transport have been known and carefully assessed when designing the packaging. This includes knowledge of temperatures, air humidity levels, precipitation etc.

This implies the prior agreement between the customer and the packaging company in charge on all the sites, regions and time zones to be encountered during handling, storage and transport (see chapter C.6).

1. TEMPERATURE

Normally to be measured and indicated in degree Celsius (°C).

2. AIR HUMIDITY

Air always contains water in the form of water vapour. Water vapour always flows from areas of higher concentration to areas of lower concentration to reach a situation of equilibrium. Materials forming a vapour barrier obstruct the transport of water vapour for example from the exterior into the interior of the packaging.

Air cannot absorb unlimited amounts of water vapour. As temperatures increase, the vapour saturation level increases. For example, at 10 °C the saturation level for water vapour is 9,4 g/m³; at 40 °C this amount increases to 51,5 g/m³. When the saturated air is cooled down, the excess water vapour will precipitate as mist or condensation.

In extreme situations air is not always saturated with water vapour. The water vapour level (g/m³) present in an unsaturated area is known as absolute air humidity (fa).

Atmospheric maps and climate charts according to DIN 50 010 show air humidity levels as relative air humidity (fr). The relation between water vapour levels present in the air (fa) and saturation levels (fs) at a given temperature results in the relative air humidity value (fr). The value is expressed in percentage points

$$f_r = \frac{f_a}{f_s} * 100 \text{ in } \%$$

3. PRECIPITATION

Precipitation can take the form of rain, snow, hail and fog. The unit of measurement is mm. 1 mm of precipitation corresponds to 1 l of water/m². According to DIN 50 010 a distinction must be made between the following:

- precipitation in mm/year
- frequency of precipitation in days/years

So-called rain charts give information on precipitation levels. They are published in the form of a manual by the German Weather Information Service, "Berichte des Deutschen Wetterdienstes Nr. 139" and include monthly precipitation charts for the whole world. They can be ordered from the Deutsche Wetterdienst, Zentrale, Frankfurter Straße 135, 63067 Offenbach, Tel.: 069/80 62-0, Fax: 069/80 62-4484, email address: info@dwd.de

4. OTHER ATMOSPHERIC FACTORS

- a) Air pressure: mean value at sea level is 760 mm Hg
(= 1013,3 hPa)

Extremes of air pressure during transport can cause important stresses for example on film wrappings. Examples: stowage areas in aeroplane holds without constant pressure levels, or regions above 4000 m above sea level, where air pressure values are only 60 % approx. of those at sea level.

- b) Heat reflection through sun and heating
c) Air and UV radiation
d) Sea and salt-laden air
e) Biological influences such as moulds and other fungi encouraged by damp climates with relative air humidity levels of 80 % and above, or stagnant air.

According to DIN 50 019 the above atmospheric factors from a) to e) need only be taken into consideration when they deviate quite clearly from the averages for the temperate regions such as central and northern Europe, Western Russia, the USA north of the 40th parallel.

5. OTHER EXPOSURE FACTORS

Other exposure factors cover the physical and chemical properties of the atmospheric conditions outside or inside, which the packaging has to withstand. The following distinctions can be made:

- Atmospheric conditions outside, where all usual climatic influences directly affect the packaging.
- Atmospheric conditions in storage and stowage areas including containers, sheds and wagons. These can be compared to those described under "atmospheric conditions on premises" in DIN EC 50 010 T1 and T2

a) External climate or techno climate

DIN IEC 60721-2-1 gives indications on external atmospheric conditions applying during transport and storage outside.

Depending on the sensitivity of the packaged goods, additional information can be obtained from the following institutions:

Informations on climatic zones in the Internet:
www.m-forkel.de/klima/klimazonen.html

Deutscher Wetterdienst, Zentralamt, Frankfurter Straße 135,
63067 Offenbach, Tel.: 0 69 / 80 62-0, Fax: 0 69 / 80 62-25 30,
E-Mail: info@dwd.de, www.dwd.de

Deutscher Wetterdienst, Wallneyer Straße 10, 45133 Essen,
Tel.: 02 01/71 02 10, Fax: 02 01/71 02 1-25 od. 71 02 1-26,
E-Mail: klima@dwd.de

Deutscher Wetterdienst,
Bernhard-Nocht-Str. 76, 20359 Hamburg,
Tel.: 0 40/66 90-0, Fax: 0 40/66 90 17 35,
E-Mail: seegutachten@dwd.de

Deutscher Wetterdienst,
Abteilung Seeschifffahrt,
Tel.: 0 40/66 90 18 35, Fax: 0 40/66 90 19 41,
E-Mail: seeschifffahrt@dwd.de

BFSV German Association for the advice, research, design of systems, packaging development and testing or (in German) Beratung-Forschung-Systemplanung-Verpackungsentwicklung und -prüfung e.V.,
Lohbrügger Kirchstraße 65,
21033 Hamburg,
Tel.: 0 40/4 28 91-27 56, Fax: 0 40/7 21 63 78,
E-Mail: institut@bfsv.de

b) Atmospheric conditions in stowage areas

Atmospheric stresses on packaged goods in these areas must not be underrated. Normally, the walls of closed and unaired stowage areas let through temperature but not water vapour present in the stowage area. This water vapour can be present in the stowage area itself or produced by hygroscopic loads like damp timber. Once the temperature drops through cooling of the surrounding air or sea water, excessive water vapour levels will be exuded by the air as condensation or so-called "sweat". It will collect on cooler wall areas. The chosen packaging materials and design must be able to withstand such extra stresses. The same applies to unaired containers.

c) Examples of atmospheric conditions in on-board stowage areas as noted by BFSV during 12 circum-navigation research voyages: Usually, mean stowage area temperatures lies in the summer between 21 and 28 °C and in the winter between 14 und 21 °C. The mean relative air humidity varies between 66 % for dry goods and 84 % during unfavourable damp weather.

The following maximum values can be expected under extreme conditions:

Table 5:
Atmospheric loads in cargo vessels

stowage area on board	maximum mean values for temperature in °C rel. humidity in (%)	
on deck, outside air	31 ± 3	100
main deck	67 ± 6	100
upper enclosed deck (air above stowed goods)	43 ± 3	100
hull stowage	32 ± 4	100

d) Example of atmospheric conditions inside containers Noted by BFSV during research voyages

Table 6:
Atmospheric stresses in containers

point of measurement	temperature in ° C max. mean		relative air humidity in % max. mean	
on deck	52	43	99	96
below deck	34	31	90	83

6. PRECAUTIONARY MEASURES

- a) Customer and packer must establish the following:
 - transport routes and storage/transshipment areas
 - duration of individual transport and storage phases
 - protection requirements of the packaged goods
 - hygroscopic properties of the packaged goods or to what extent they absorb or encourage air humidity
- b) Assessment of atmospheric conditions during the envisaged transport movement, gathering of information
- c) Checking of standards and specialist literature such as
 - DIN 50 019 T 1
definition and overview of charts, climatic conditions to be expected.
 - DIN 50 010
Atmospheric conditions and their technical implication, definition of terms.
 - RGV/BFSV technical leaflet 3100:
Packaging and containers during ocean-going transport
 - Rain charts, (to order see chapter C3)
- d) If required, provide proof of precautionary measures taken in form of a check list for example.

D. PREPERATION OF GOODS TO BE PACKED

Some form of preparation of the goods prior to packing may well be necessary to counteract potential stresses during transport.

Such pre-treatment can consist of the following:

1. PARTIAL DISASSEMBLY OF PACKAGING GOODS

Disassembly of the goods may be necessary in order to

- enable handling of the packaged goods,
- reduce the volume to be packaged,
- protect protruding or fragile construction components,
- avoid damage to the packaging by the goods themselves.

Goods may only be disassembled by the manufacturer after prior agreement with the customer.

2. PADDING OF FRAGILE PARTS

Often, goods are transported which are particularly sensitive to mechanical stresses during transport. They must therefore be protected against damage through knocks, jolts or vibrations by the use of suitable padding. Examples are electronic products, switching modules and micro mechanical products.

Padding can also be used to guard protective films against perforation and friction damage caused by sharp corners of the packaged goods or other protruding elements.

3. ADDITIONAL SUPPORT FOR PACKAGED GOODS

Where there is a risk of parts of the packaged goods twisting, bending or breaking due to mechanical transport loads, the goods must be supported or braced to make them fit for transport or alternatively and in agreement with the customer, they must be disassembled by the manufacturer.

4. SECURING MOVABLE PARTS

Movable parts must be secured by lashing down or the use of wedges and pads. These must be fixed to the goods by the manufacturer before packaging commences.

If disassembled parts are not packed separately, they must be padded and stored firmly against the packaging good or inside the internal packaging area as an add-on.

5. CLEANING

Packaging goods are assumed to be free of manufacturing aids, production residues, corrosion and other soiling agents like for example hand perspiration. Cooling aggregates and systems holding liquids must be purged by the manufacturer. Containers, voids and piping systems must be dried and hermetically closed. If this is impossible, the customer has to inform the packaging firm of the presence of such remaining liquids and their quantity.

If the manufacturer has provided anti-corrosion measures for the transport to the packaging firm, he must inform the packer accordingly and indicate the type and brand of the protection used. If an additional cleaning operation must be carried out by the packaging firm, this will be invoiced separately. No guarantee can be given for parts that have not been cleaned.

E. INTERNAL PACKAGING

1. ANTI-CORROSION MEASURES

During transport, handling and storage – especially during overseas shipping – more intensive stresses occur, which are often not sufficiently catered for by the manufacturer's anti-corrosion measures applied to the goods for the transfer to the packaging firm.

Such stresses can result from the influence of:

- rain
- sea water
- high air humidity
- high air salt content
- extremely high or low temperatures
- temperature fluctuations
- chemical agents
- biological agents

The type and intensity of these stresses depend on the transport route, transit duration, interim storage and the properties and sensitivities of the packaging good. Additional anti-corrosion measures are necessary if the packaging is to protect against all of these stresses. The customer must inform the packaging firm of the goods' vulnerability to corrosion and which type of measures are needed in view of the goods' properties. The packaging firm must also be advised if preliminary protection has already been applied and if so, whether this will have to be removed. Expressed differently, the customer must guarantee that the preliminary and subsequent protections measures do not clash and that no negative consequences will ensue for the goods to be packaged.

The choice of a preservation method must be made after consideration of the goods' properties. The manufacturer's instructions for use of a particular method must be closely followed.

Three methods are used for the preservation of packaging goods:

- the use of desiccants
- the use of protective films
- the VCI method

2. USE OF DESICCANTS

How to use them

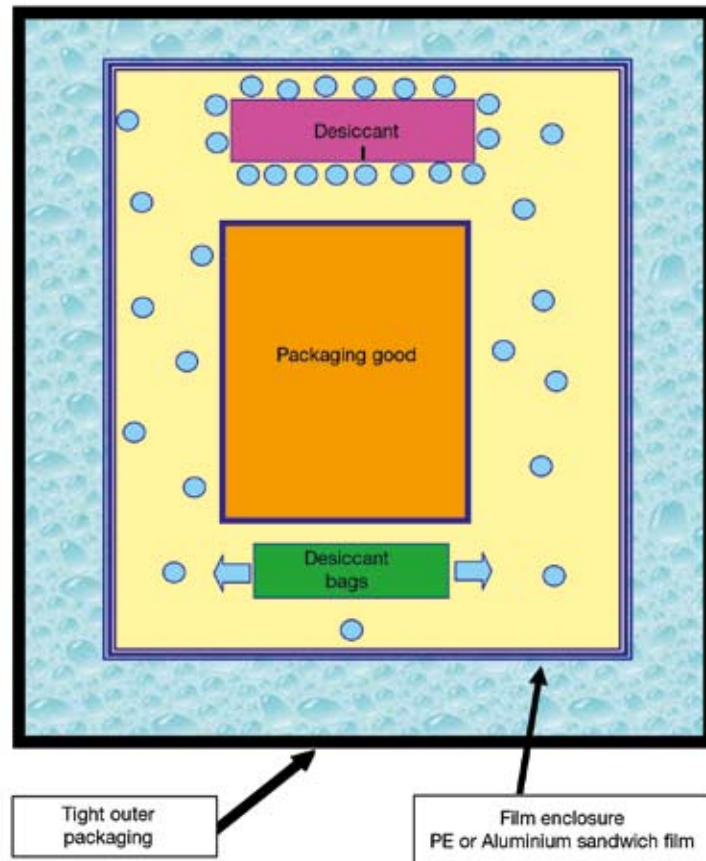
According to DIN 55473 2001-02 the use of desiccants aims to achieve the following: „Desiccants are used to protect the packaged goods against air humidity during transport and stowage in order to inhibit corrosion, attacks by moulds and similar.”

For this purpose the goods are inserted into a tight external packaging after having been enclosed in a sealed film in which the air is dehumidified to the extent that the remaining level of relative humidity (RH) cannot cause atmospheric corrosion during transport and storage. The drying of the remaining air in the protective film cladding is achieved by so-called desiccants or humidity adsorbers according to DIN 55473. Due to their high surface area, these can attract and bind air-borne water molecules on their surface structure and dehumidify the air. The dryness level must be kept at a constant level of $\leq 40\%$ RH. Below this threshold all corrosive processes based on water condensation effects will be inhibited, as the available amount of water needed for the corrosion process to function is not present anymore. The required desiccant quantities must be calculated according to DIN 55 474.

The sealed film enclosure is formed by vapor barrier material. Single sheets must be heat-sealed together for oversized goods. The following materials are suitable barrier films:

- Polyethylene film PE
LD polyethylene, 0.2mm strong to comply with DIN 55530
The use of PE films with thicknesses below 0.2mm for sealed enclosures can be accepted if the technical requirements in DIN 55530 for such exceptions are met.
- Aluminum multilayer films or sandwich films to comply with DIN 55531 / TL8135-0003

ill. 3:
 Correct use and layering
 of desiccants

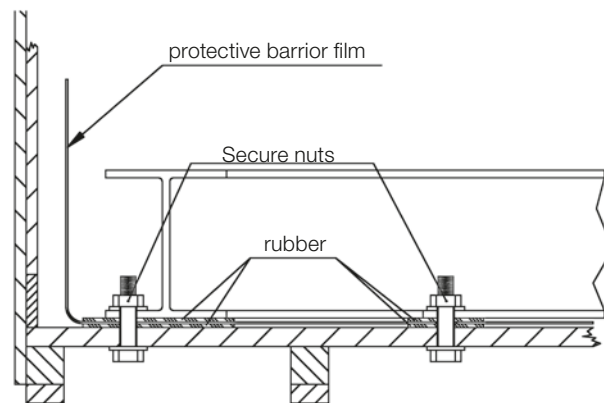


Important rules for the use of desiccants:

- Desiccants must be placed in the upper third of the barrier film enclosure.
- Stagnant water on the barrier film must be avoided by adequate design and skilled lid constructions.
- Professional execution of welded/sealed joints and seams
- No removal of existing protective layers or coats
- Max. 24 months protection, max. 12 months when using PE film
- Padding of sharp corners or edges of the packaging goods!
- Checking the air tightness of the film enclosure through air aspiration. Reintroduce air afterwards.
- Use hygroscopic bags inside the film enclosure, choose material with low humidity levels.
- No direct contact between desiccant bags and metal surfaces

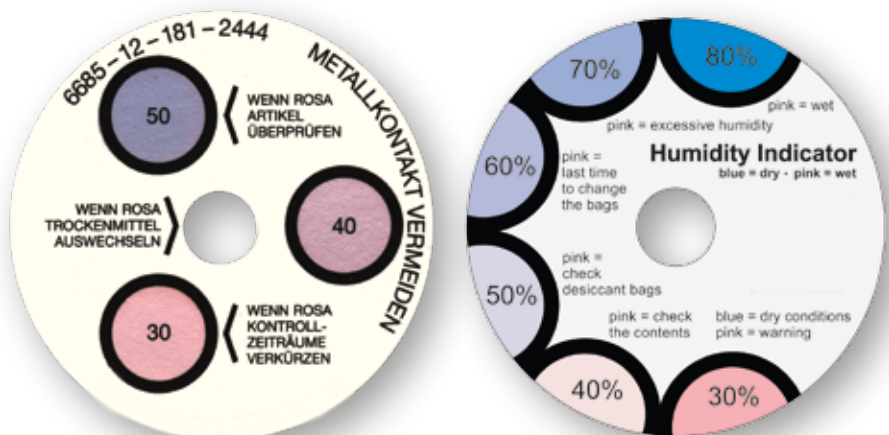
- Use only desiccants that were produced and comply with DIN 55473.
- Additional sealing of all perforations of the protective barrier film, e.g. bolts fastening the goods to the case bottom, see ill.4, or protruding nail shafts from battens.

ill. 4:
sealing required after
driving bolts through the
film cover



Additional monitoring of relative air humidity inside the barrier film cover can be achieved throughout the transport and storage period with the help of humidity indicators. (Example see ill.5)

ill. 5:
humidity indicators



- Do not place humidity indicators right next to desiccants.
- The reliability of humidity indicators is temperature dependent.
- Use correction tables if necessary.

3. PROTECTIVE COATINGS

This method implies the application of an even protective coat directly after cleaning and drying of the goods to be packaged. A suitable coating product is applied to the surface susceptible to corruptions.

These products were given their name because they form a coat on the surface. They must be diluted with a solvent, white spirit or similar, even water, in order to make them usable. The application is by immersion, brushing or spraying on. The solvent evaporates and leaves behind a more or less solid coat. This coat stops corrosive elements in the air, such as water and oxygen from reaching the metal surface. According to their specifications, these anti-corrosion coats can remain active during a few days (pre- or interim preservation) or a few years (final preservation). Normally, the removal of the protective coating from the packaged goods will be necessary at the end of the transport and storage period.

Important rules:

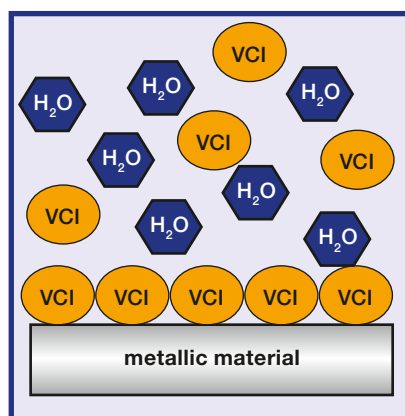
- Potentially used pre- and final preservation products must be compatible with each other.
- A sufficiently long period for evaporation of the cleaning solvents must be respected.
- When using products which include solvents, the necessary protection measures must be taken during their application.
- The manufacturer's instructions for use and protection periods must be respected!
- Protective coating must be removable from the treated goods with the recommended cleaning products without causing any damage.

4. VCI METHOD (VOLATILE CORROSION INHIBITOR)

The VCI method works via a vapour phase, i.e. the production of some type of protective atmosphere within the sealed protective enclosure. VCI molecules evaporate from the carrier material such as paper, films, foams or powders and saturate the surrounding air. They "cover" the surface of materials threatened by corrosion. The molecules form a protective film on the layer of oxides that is present on all metal surfaces and inhibit corrosive processes. There exists a whole range of different VCIs. They differ in their protective effect on iron and non-iron metals as well as their alloys. Each single active agent is generally suited for one metal or one alloy. Therefore they are often combined to offer a larger protection range. Prior checking with the VCI manufacturer is unavoidable as he knows his products best and their respective range of applications.

There is no final removal of VCI necessary with this method.

ill. 6:
 How do VCIs
 function



Important rules:

- Use VCI quantities according to the manufacturer's instructions.
- The time it takes for VCI materials to become effective must be respected (manufacturer's indications).
- Ensure compatibility of a given VCI with any earlier preservation method carried out.
- When applying anti-corrosives, different forms of application may be possible, e.g. VCI films or paper. Both types of product must use the same active VCI ingredient.
- As a rule of thumb a 30mm maximum distance is to be respected between the VCI and the material to be protected.

F. EXTERNAL PACKAGING

1. GENERAL REQUIREMENTS

Export packaging is generally made from wood and/or wood-based products. Other packaging material can be used after prior agreement with the customer. According to today's technical knowledge, solid timber or plywood are particularly suited to long transport and/or storage periods in the open.

1.1 PACKAGING MATERIALS

1.1.1 Solid timber

Boards, planks, squared battens or joists made from coniferous woods are used for packaging. Timber is a natural product and load-bearing properties can vary. Other criteria such as knots, cracks, fibrosity and infestation with insects may affect the load-bearing characteristics of sawn timber. Timber must therefore be graded. Grading of both soft and hard wood is dealt with in DIN 4074.

Table 7:
Quality grades of
packaging timber,
DIN 4074

	grading class	moisture content during transformation
boards	S 7 or MS 7	semi dry
boards used as battens planks squared battens joists/beams	S 10 or. MS 10	semi dry

Dimensions:

Boards and planks are normally not planed. The following rules apply to dimensions:

DIN 4071 T 1 boards and planks, admissible tolerance ± 2 mm (see A 4.1.1)

DIN 4070 T 2 squared timber

When using planed boards and planks, dimensions according to DIN 4073 T 1 apply.

In addition, sawn timber must comply with the relevant requirements in IPPC (International Plant Protection Convention) ISPM 15: the International Standard for Phytosanitary Measures in International Trade.

ISPM 15:

The ISPM 15 represents the International standard for Phytosanitary Measures for wooden packaging materials in international trade. The IPPC (International Plant Protection Convention), a daughter organisation of FAO (Food and Agricultural Organization of the UN) has agreed a common standard for wooden packaging in order to protect native forests from packaging-borne pests and to harmonize import regulations.

ISPM 15 enters into force via binding national implementations. In Germany this has been made law via the plant inspection regulation (Pflanzenbeschauverordnung).

The standard applies to solid timber (soft and hard woods) with thicknesses $\geq 6\text{mm}$ when used as packaging material or for bracing. It does not apply to timber-based manufactured materials.

ISPM 15 requires the following:

- standard treatments
- marking of the packaging as proof of treatment
- de-barking of packaging timber

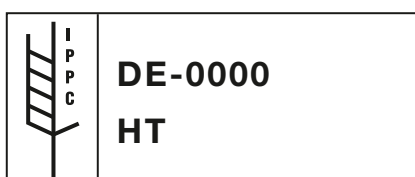
Bark residues of less than 3 cm width of any length, and greater width but less than 50 cm² (credit card size), are admissible. All measures are unlimited in time. No plant health certificate or so called non-timber declaration is required for timber-based packaging materials.

The following recognized treatment methods can be used:

- heat treatment HT. A core temperature of 56°C must be maintained during 30 minutes in the timber.
- Methyl bromide MB gas treatment. This is the only gas treatment allowed by ISPM 15. The use of MB is forbidden in Germany. The use of wooden packaging originating from third countries which have been treated with MB continues to be allowed.

ill. 7:

Example of an
ISPM 15 marking



The marking exists of the following (see illustration):

- The IPPC symbol
- Country code according to ISO 3166 for example DE for Germany
- 0000 = registration number of the treatment facility including regional code
- treatment method, either HT for heat treatment or MB for methyl bromide packaging

The marking must be:

- enclosed in a rectangle with a demarcation line between the IPPC logo on the left and the other indications
- easy to read, indelible and affixed visibly
- if possible, be affixed on two opposing sides of the packaging unit
- cannot be painted manually.

All plant protection authorities and services will be able to inform you in which countries the IPPC standard is accepted. Check out

www.hpe.de/Einfuhrvorschriften or

www.jki.bund.de/Pflanzengesundheit/Verpackungsholz)

1.1.2 Wood or timber-based products

All wood-based products used must comply with the relevant standards on dimensions and quality. Wood-based products can be used not only as planks but also as seamless surfaces, walls and lids. The choice of material depends on some of the following considerations:

- Loads and usage the packaging will have to cope with
- Properties of the packaging goods
- Requirements as to tare mass, properties and mass of the packaging goods
- Customer's specifications

One of the wood-based products is weather resistant plywood. Another option is OSB/3 or OSB/4 manufactured with liquid adhesives. OSB is not unconditionally suited to long term storage in the open, is today's technical verdict. Hard chipboard and fiber board (compressed flat boards) can be used for short distance transport.

When receiving these materials from outside the scope of these standards, material of similar glue specifications and grades must be used.

Table 8:
wood-based products

Wood-based products	Technical specifications	DIN grade
plywood (veneer boards)	Glue must be resistant to all climate and humidity influences (weather resistant)	BFU 100 DIN 68 705 T 3
OSB/3 OSB/4	Suited to load-bearing and resistant to high air humidity levels	DIN EN 300
hardboard (hard wood fibre board)	Resistant to high air humidity levels	HB.HLA1 DIN EN 622-2
Chip board (compressed flat board)	Glue resistant to high air humidity levels (limited weather resistance)	DIN EN 312-5

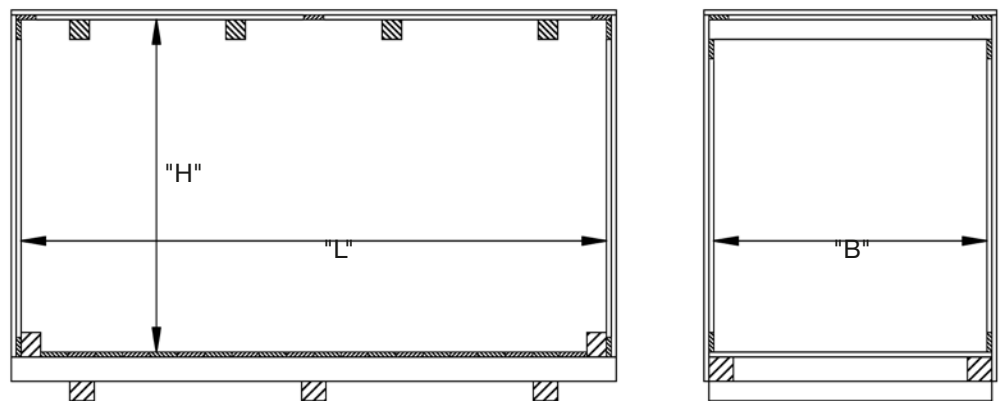
1.2 GUIDELINES FOR INDICATING DIMENSIONS

Indicated dimensions are internal measurements in cm and in the following order: Length (L) – Width (B) – Height (H)

When taking internal measurements of packaging, the following rules must be applied

- Internal measurements are taken between the structural elements facing each other, side to side, end to end, bottom to lid. Where internal battens are placed between other elements, the rules shown in ill.8 apply:

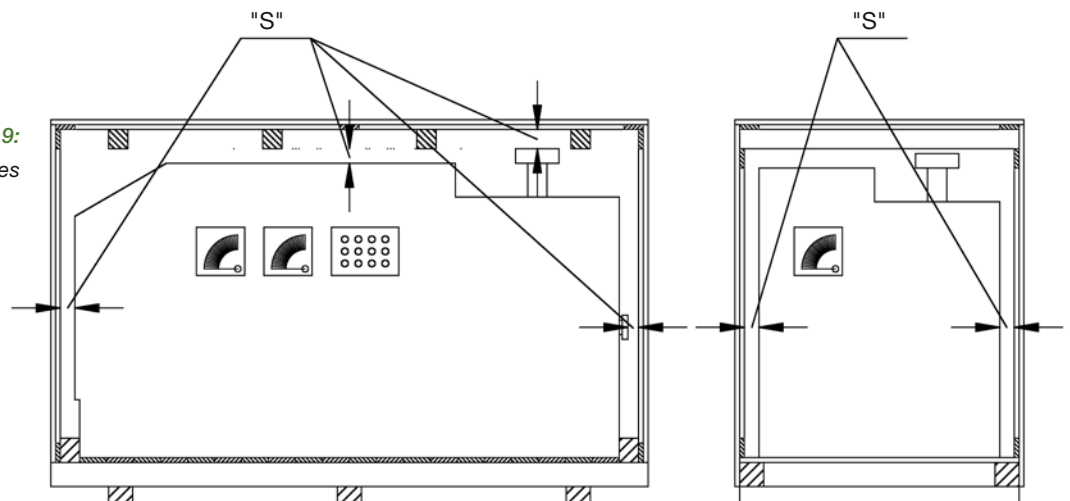
ill. 8:
 Internal measurements
 between battens



- The safety distance "S" between the packaged goods and the packaging itself must not fall below 3cm, with the exception of supports, struts, wedges and pressure compensating structures, (see ill. 9).

- A safe distance "S" of 5 cm should be kept at particularly sensitive points and where a thick vapour barrier has been used.

Abb. 9:
 Safety distances



2. TYPES OF PACKAGING

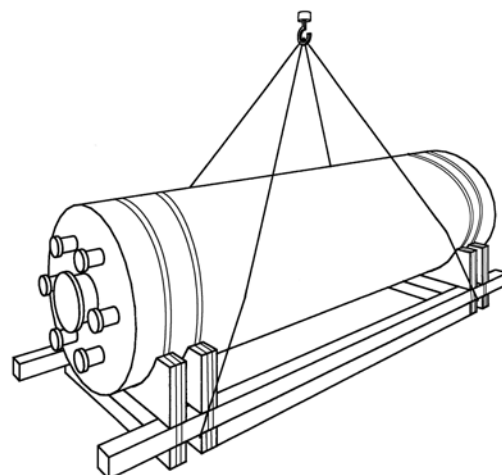
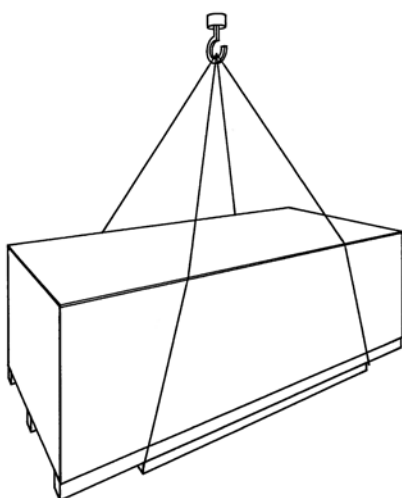
There are two different types of transport packaging to choose from:

Load-bearing packaging (external fastening)

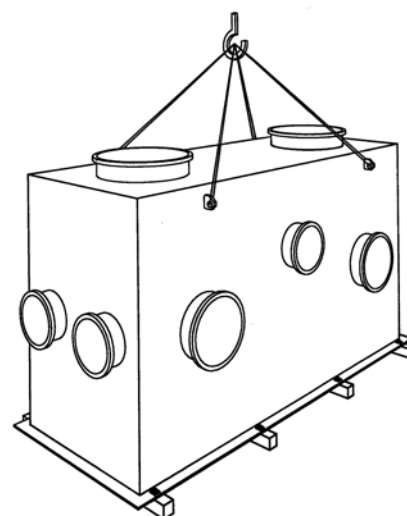
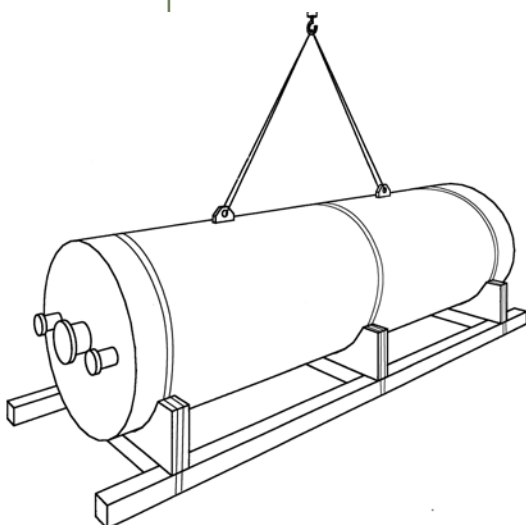
Add-on packaging (internal fastening)

(see definitions in A 2)

ill. 10:
 load-bearing packaging



ill. 11:
 Add-on packaging



Example:
 add-on packaging



Example:
 add-on packaging with
 OSB-cladding and marking to
 prohibit the use of forklift trucks
 as well as marking of the
 centre of gravity



Example:
 spreading of loads through
 additional extended floor
 construction



Load-bearing packaging has to resist different and higher stresses when lifted (bending forces on the bottom, transversal forces on the lid) compared to add-on packaging.

Other internal and external forces, such as horizontal, vertical and transverse acceleration, compression loads in stacks etc. are the same for all packaged units, provided they can be stacked.

Load-bearing packaging also fulfils the following tasks:

- to keep goods together which consist of individual units, to provide rigidity to unstable goods and enable stacking;
- to provide stability to the goods and protect them against tilting and falling over; this is particularly important with top heavy goods, goods with an eccentric centre of gravity and goods with a small standing surface;
- to ensure an even distribution of the load on the floor, if necessary by providing suitable support or enlarging the standing area and thus avoiding excessively high punctual or linear pressure - important for the load bearing properties of ships' decks, containers and aeroplanes;
- if necessary, prop single units against each other within the packaging;
- ensure that packaged goods can be handled by stacking equipment and lifting gear and cope with stacking conditions;
- ensure that there is no mechanical damage to the packaged goods.

The following packaging means can be distinguished by their **construction details** which in turn result from different demands due to the packaging goods themselves and their specific sensitive aspects:

- case
- crate
- partial packaging

Case

A case is a rigid hollow container which can be handled and loaded according to the load assumptions contained in these guidelines, see chapter B. It consists of six construction elements assembled at right angles to each other. The surfaces form a solid cladding.

It may be necessary to use angled lid surfaces when exceeding maximum loading dimensions. If such profiles are applied, we talk of a profiled case.

Crate

A crate in the definition of this guideline is a rigid wooden and hollow construction based on the case design but where the individual sides are not built in solid cladding without spaces, although it is not excluded that some of its parts are built in solid cladding without spaces.

The share of boards in the whole wall surface is normally around 40 – 60 % with a minimum board width of 10 cm.

Partial packaging

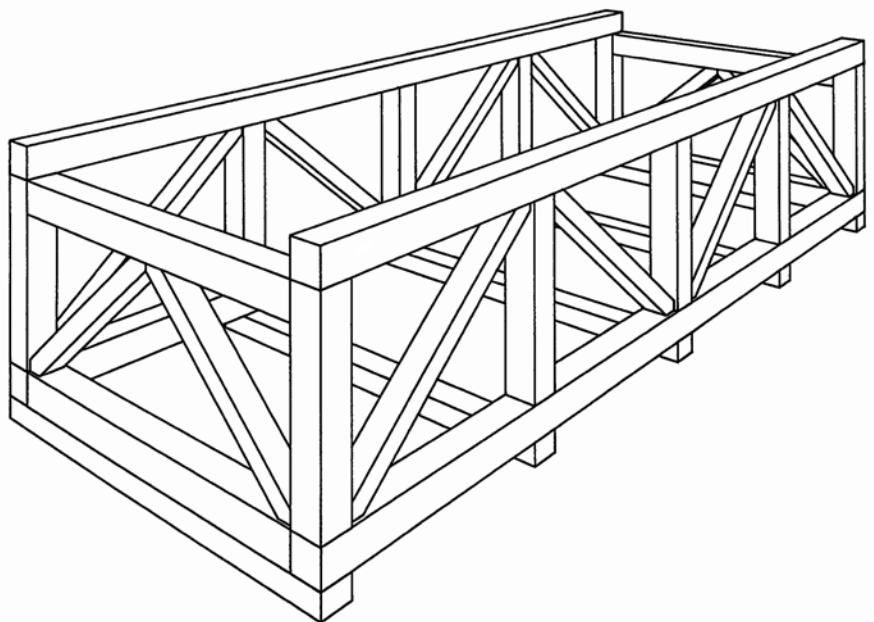
Partial packaging forms can be quite different.

Included in partial packaging types are

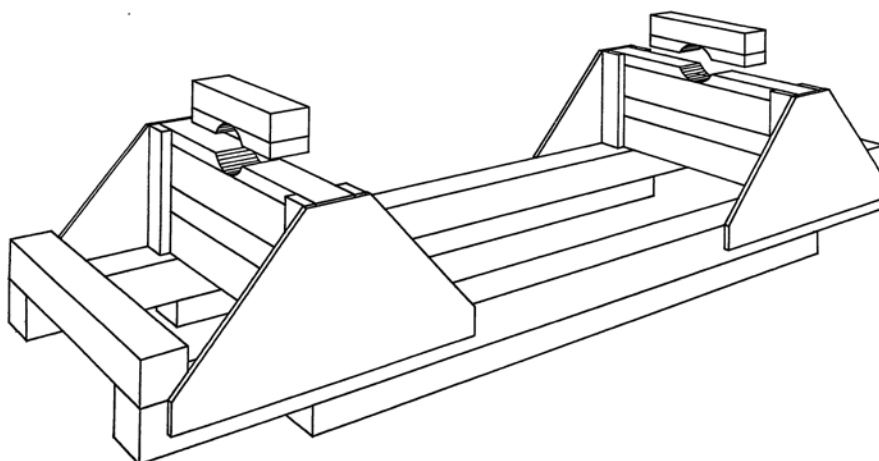
- square batten constructions
- sledges
- claddings
- bundles

Examples of partial packaging forms:

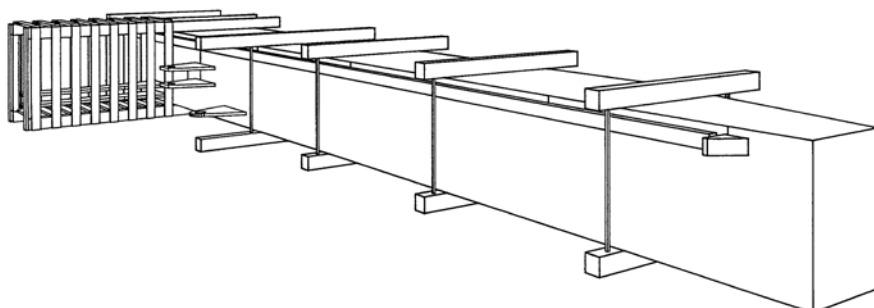
ill. 12:
 square timber construction



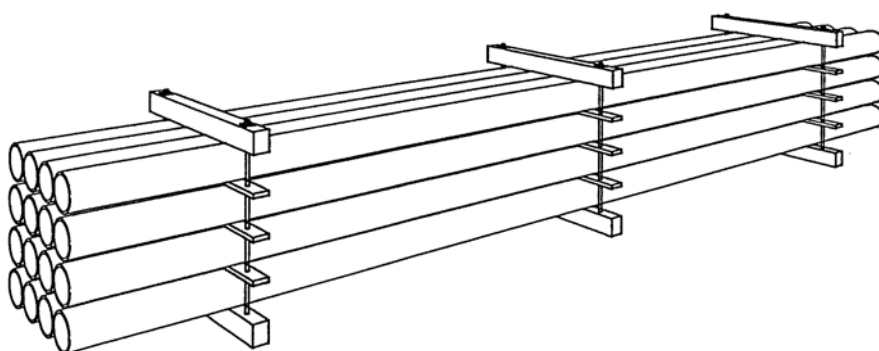
ill. 13:
 sledge or cradle



ill. 14:
 cladding



ill. 15:
 bundle



3. CONSTRUCTION FEATURES

Case/Crate

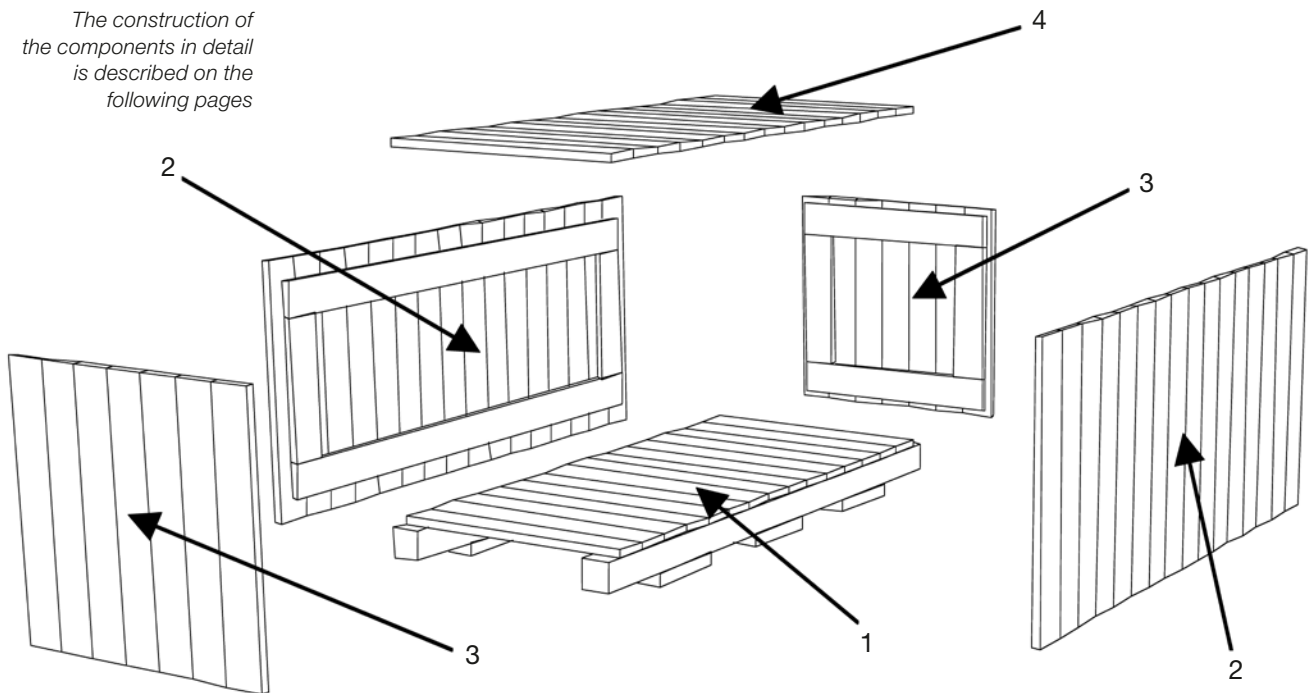
A load-bearing case or crate packaging is made of three construction components

- a) the bottom 1
- b) the side walls and end walls 2; 3
- c) the lid 4

ill. 16:

Case construction elements

The construction of the components in detail is described on the following pages



3.1 Load-bearing cases / construction types

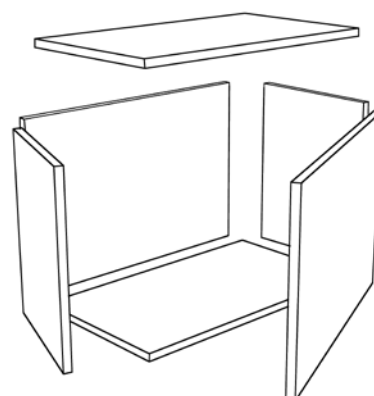
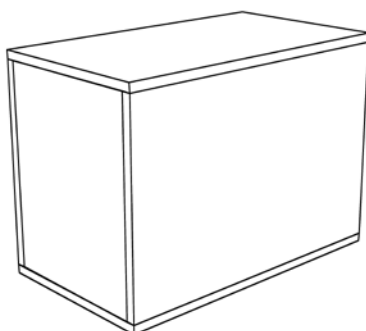
The construction type is determined by

- packaging good dimensions
- net weight
- load assumptions

3.1.1 Cases of construction type A1 – A6 according to DIN 55 499 T1 for masses up to 500 kg maximum

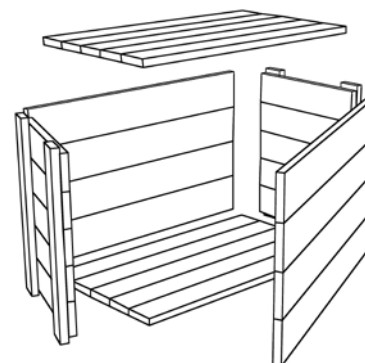
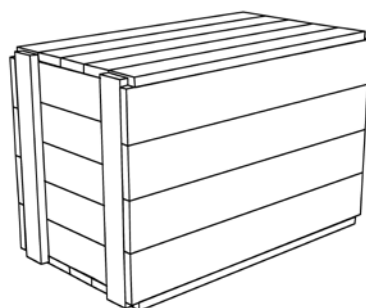
ill. 17:

construction type A1:
case without battens



ill. 18:

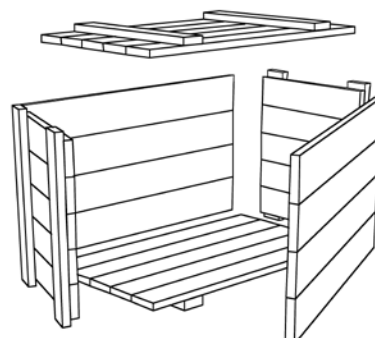
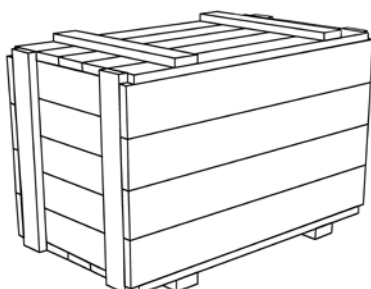
construction type A2:
case with end wall battens



Construction types A1 and A2 are not much used. They are difficult to handle as they have no runners and therefore cannot be used with forklift trucks or other automatic stacking vehicles. They are therefore of minor importance in these guidelines.

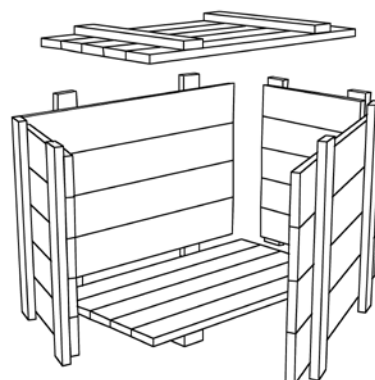
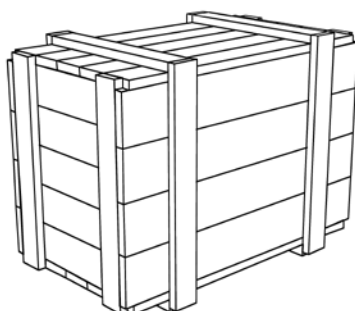
ill. 19:

construction type A3: case
with end wall, bottom and lid
battens/runners



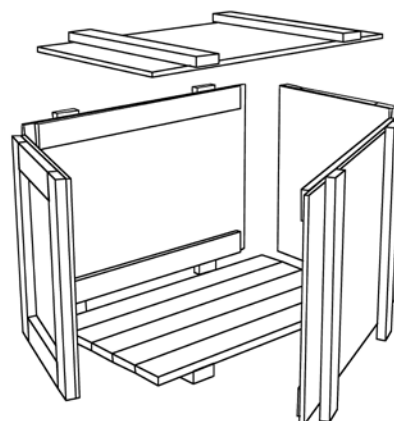
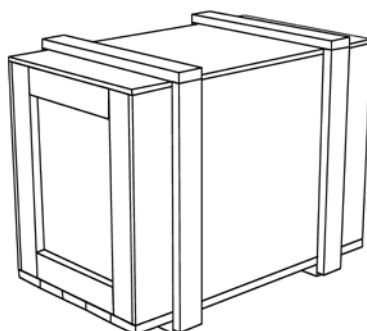
ill. 20:

*construction type A4:
case with end wall
and circumferential
battens*



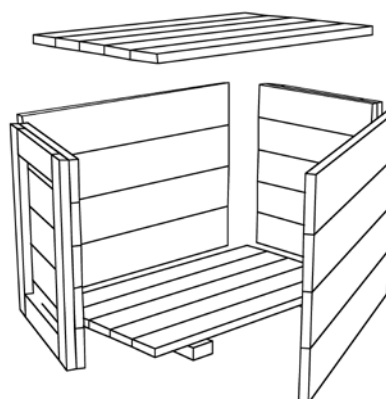
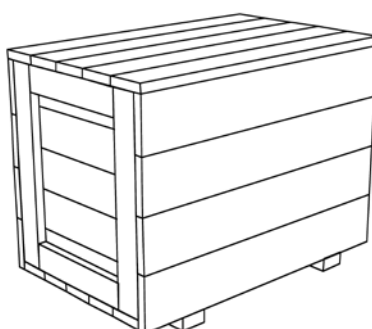
ill. 21:

*construction type A4:
case with batten frame
on end walls and circum-
ferential battens made
from OSB or plywood*



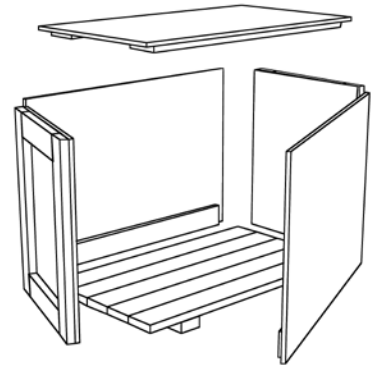
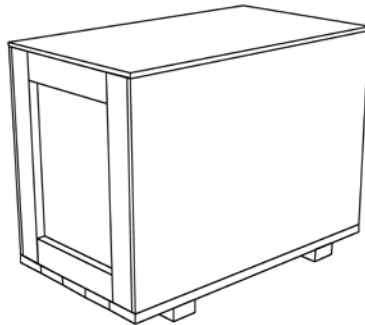
ill. 22:

*construction type A5:
case with batten frame
on end walls*



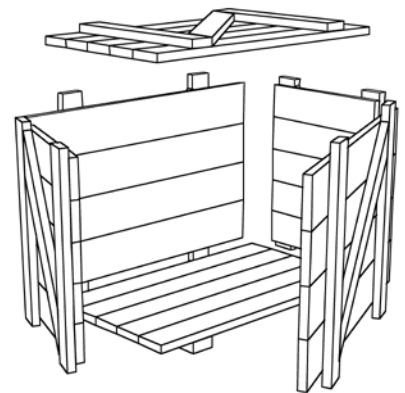
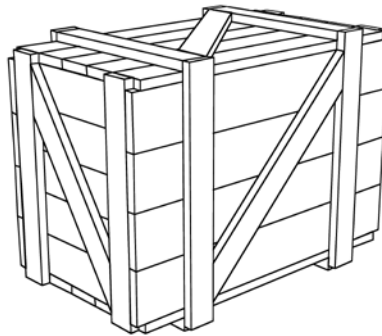
ill. 23:

construction type A5:
 case with batten
 frame on end walls
 made from OSB or
 plywood



ill. 24:

construction type A6:
 case with diagonal, end
 wall and circumferential
 battens



General notes on cases belonging to types A1 – A6

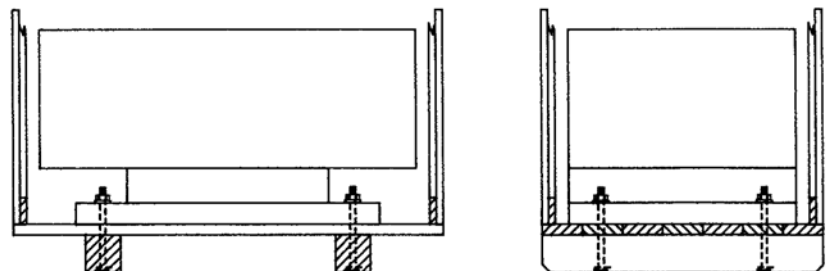
- The case bottom of all construction types must be dimensioned in such a way that occurring forces or load assumptions can be met.
- Case bottoms of types A3 – A6 must be constructed in such a way that there is no obstacle to fork entry for forklift trucks and other stacking vehicles.
- Edging boards in or on the wall surface must not be narrower than 8 cm.
- The thickness of battens for cases of types A3 – A6 must correspond to the thickness of boards used for the sides and end walls.
- The width of battens used with types A3 – A6 must not be below 8 cm.
- The distance between battens should be approx. 80 cm and must not exceed 100 cm.
- The required number of battens is relative to the length of the case.

Table 9:
 Number of battens
 for cases of types
 A3 – A6 max.
 height 150 cm

Kistenlänge [cm]	200	310	420	530	640	750	860	970	1080	1190
Anzahl der erforderlichen Leisten	2	3	4	5	6	7	8	9	10	11

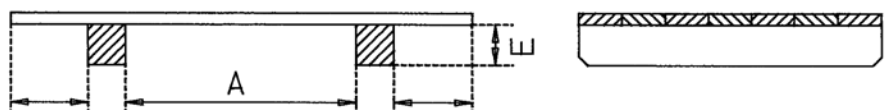
ill. 25:

Example: securing
 packaging goods to
 the bottom of types
 A3 – A6



ill. 26:

Bottom of runner cases
 types A3 – A6 including rope
 fastening provisions and entry
 opening for forklift trucks

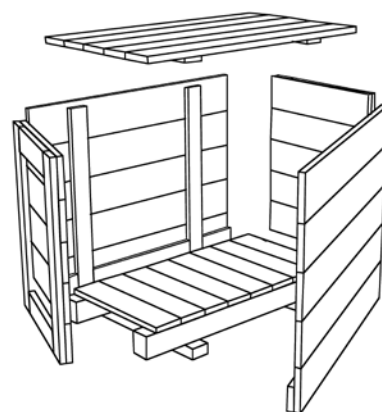
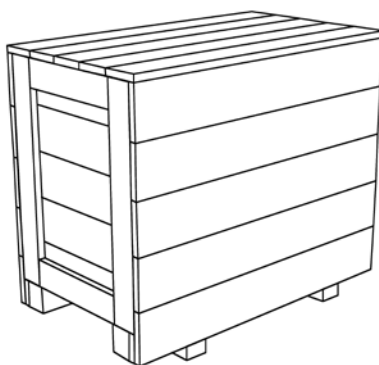


3.1.2 Cases of construction types B1 – B3 for masses above 500 kg

For cases used with gross masses exceeding 500 kg, 3 basic construction types can be distinguished, namely B1 – B3.

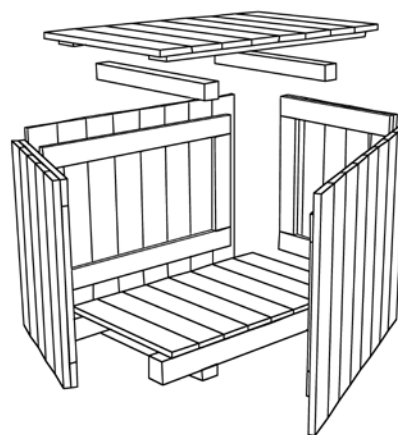
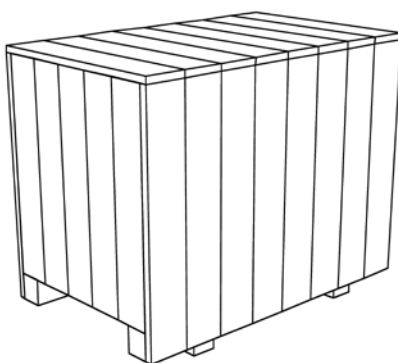
ill. 27:

construction type B1:
case on runners, horizontal
boarding, internal battens on
sides and lid, batten frame
externally on end walls



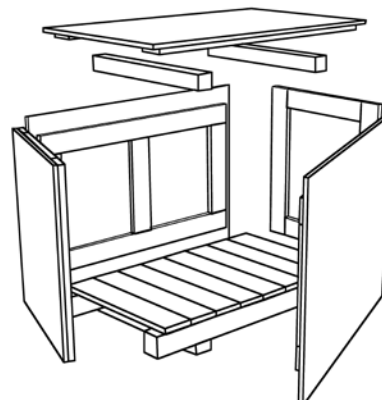
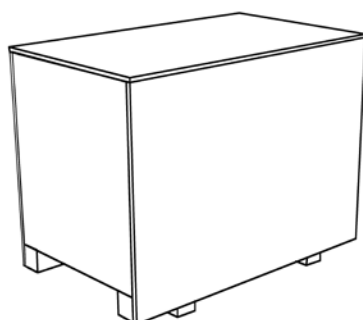
ill. 28:

construction type B2:
case on runners,
vertical boarding,
internal battens



ill. 29:

construction type B3:
case on runners with solid
plywood or OSB sides



Example:
 cases of construction type B2
 with vertical boarding
 and internal battens



Example:
 case of construction type B3
 with solid plywood surfaces
 and markings



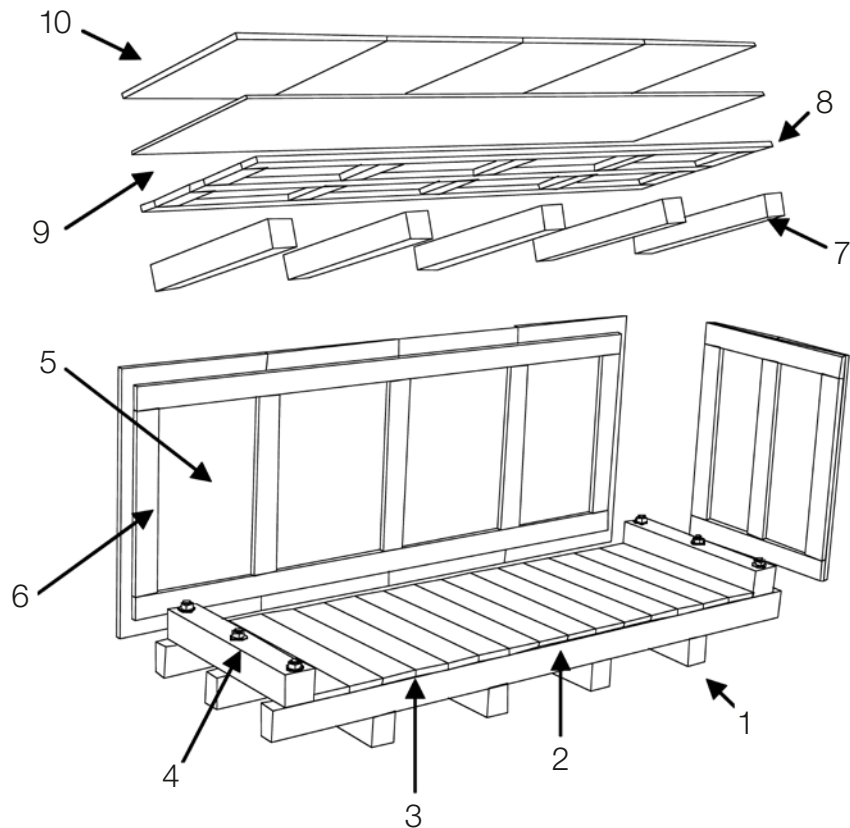
Table 10:
correlation between construction
types B1 – B3 and net masses of
packaging goods or static loads

net mass (static load)	construction types (B1 – B3)		
	sawn timber	OSB	plywood
0 – 3.000 kg	B1 – B2	B3	B3
from 3.000 kg	B1 – B2	B3	B3

Construction types B2 and B3 are most commonly used in practice. The following two illustrations show details of the assembly of construction types B2 and B3.

See below construction examples of bottom units designed for gross masses above 1.000 kg

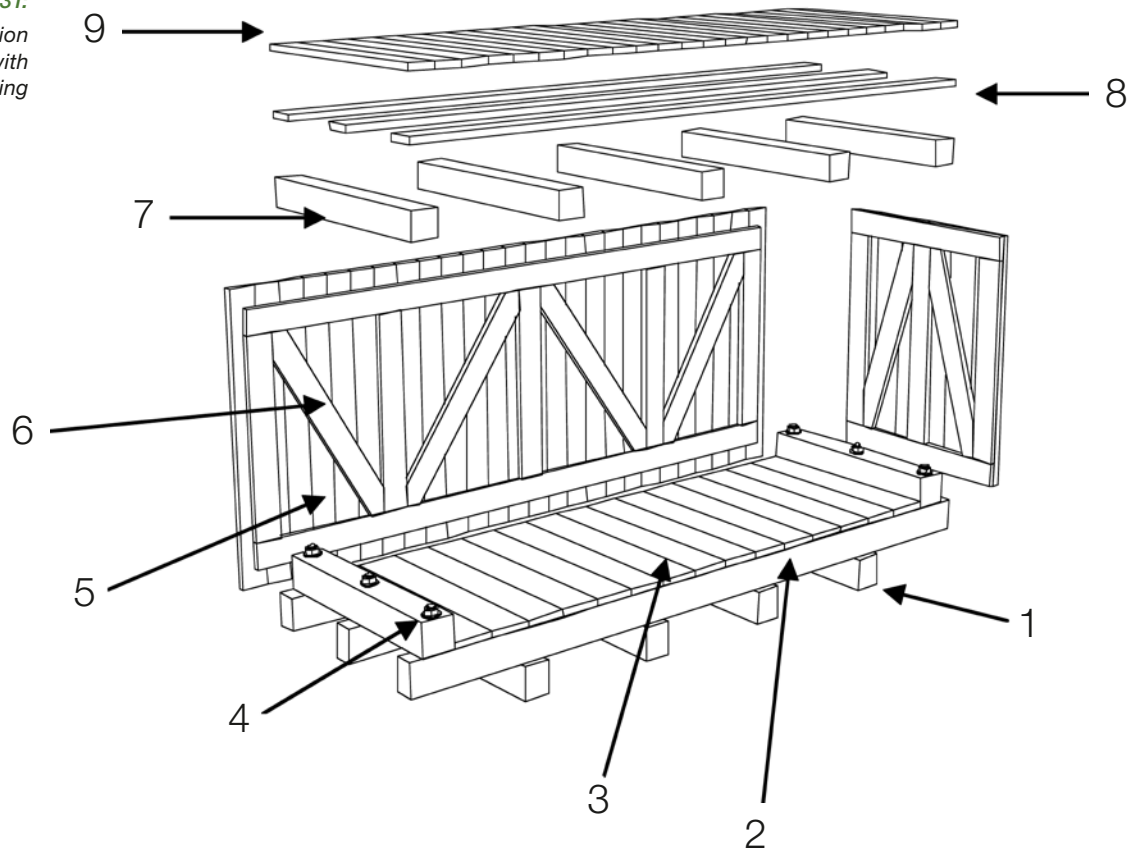
ill. 30:
Construction elements
for a case made from ply-
wood or OSB surfaces



key to numbers used:

- | | | | |
|---|----------------------|----|------------------|
| 1 | transversal runners | 6 | battens |
| 2 | longitudinal runners | 7 | top cross boards |
| 3 | bottom boards | 8 | battens |
| 4 | header joists | 9 | protective layer |
| 5 | plywood/OSB cladding | 10 | plywood/OSB |

ill. 31:
 example of construction
 elements for a case with
 wooden board cladding



key to numbers used in ill. 31

- 1 transversal runners
- 2 longitudinal runners
- 3 bottom boards
- 4 header joists
- 5 sawn timber cladding

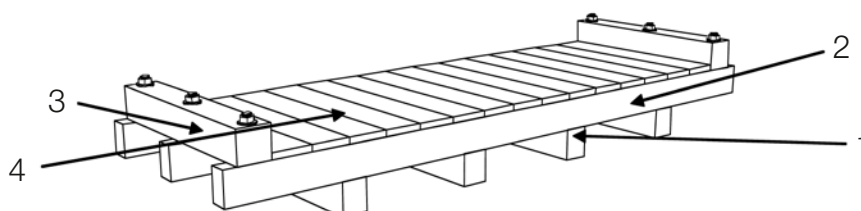
- 6 diagonals
- 7 top cross boards
- 8 battens
- 9 lid/ sawn timber

between battens and lid:
 additional protective layer made from
 double sided board or film plus hard
 fibre board

3.1.2.1 Indications on bottom constructions for construction types B1 – B3

The bottom of a case is its most important load bearing component, independent of the construction type. Battens, runners, load bearing bottom boards and/or cross boards must be dimensioned in such a way that all occurring loads (see chapter B, Load Assumptions) can be dealt with.

ill. 32:
 illustration of a bottom



key to the above illustration 32:

- | | |
|------------------------|-----------------|
| 1 transversal runners | 3 header joists |
| 2 longitudinal runners | 4 bottom boards |

The following principles must be respected:

- The bottom has to be provided with the necessary means for later lifting by crane or stackers, bearing in mind the subsequent centre of gravity of the packaged goods (Ill. 34 – Ill.36).
- Packaging goods must principally be firmly fastened to the bottom of the case. The goods must be fastened with bolts and screws all the way through the bottom. Where cases have runners, the bolts must be screwed through these (Ill.37 and Ill.38).
- If direct screwing or bolting onto the bottom is impossible, additional solidly screwed-on frames, cross or longitudinal bars, cleats or similar devices must be affixed to cope with horizontal loads (Ill.39).
- The mass of the packaging good or net mass must be distributed evenly over the surface of the bottom. If the standing or resting area of the packaging good is inferior to its maximum length and/or width dimensions, additional and suitable supports must be provided for with the construction (Ill.40). It must be ensured that all forces are transferred into the load points of attack (Ill.41).
- When packaging heavyweight loads, the bottom must be provided with additional square cross bars on the inside of the end wall panels. Their screws or bolts must be fully screwed through the longitudinal runners. (Recommendation for loads exceeding 10kN or 1000 kg gross mass) Ill.42.
- The bottoms of cases and crates of construction types B1 – B3 must be provided with at least two load-bearing longitudinal cross bars or runners.
- The distance between runners must not exceed 100 cm approx.
- Unless no specific rules for fastening the packaging goods to the runners must be met, the number of runners should be chosen according to the following table:

Table 11:
minimum number of
runners depending on
bottom width

minimum number of runners at bottom widths in cm of up to			
100	180	275	325
2	3	4	5

To enable lifting for stacking and crane handling purposes of cases and crates provided with runners of construction types B1 – B3, additional longitudinal runners (see ill.36) or cross bars (see ill. 26) should be provided as secondary runners or fastening points for ropes and cables.

Unless special transport conditions require tow ability of packaged goods (in which case runners must be chamfered), the choice of secondary runners should favour squared cross bars.

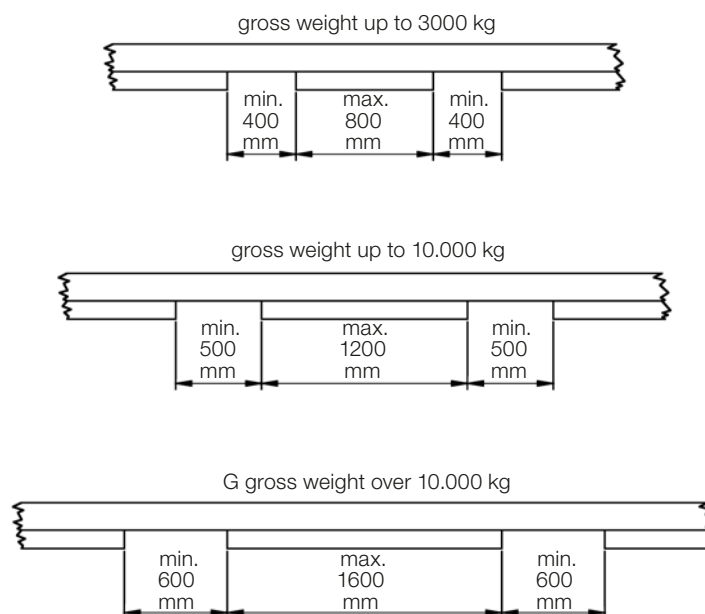
Rope and cable fastenings battens must be shortened in relation to the length of the runners and according to the centre of gravity and resting points of the packaged goods on the bottom. With a central point of gravity and even weight distribution on the bottom, the fastening points should be approx. 1/5th of the runner length away from the end walls.

The opening requirement for entry of stacking machines is independent of the weight and must always measure 10 cm.

The provision of rope/cable fastening battens must not hinder forklift entry and can correspond to the dimensions in the following illustration no. 33:

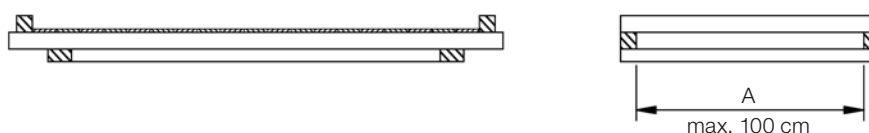
ill. 33:

distance between
battens E - height
of entry



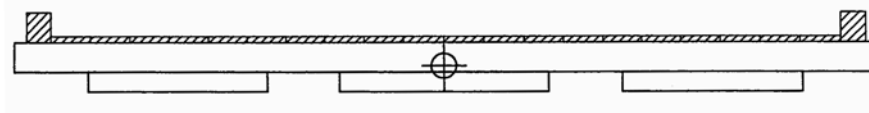
ill. 34:

bottom of a case on
runners, construction
types B1 – B3, with trans-
versal battens for rope/
cable fastening



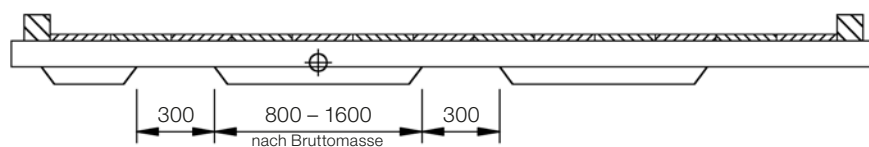
ill. 35:

bottom for cases with runners
construction types B1 – B3, with
longitudinal rope/cable fastening
battens and entry openings for
forklift trucks and given a central
point of gravity („CG“⊕)



ill. 36:

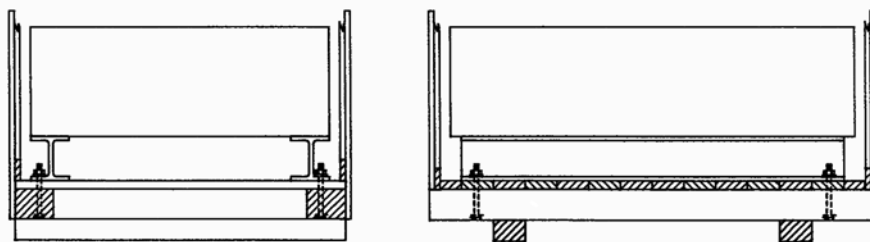
bottom for case with runners,
construction types B1 – B3,
length over 200 cm, eccentric
point of gravity („CG“⊕)



Examples for securing the packaging goods (Ill.37 and 38):

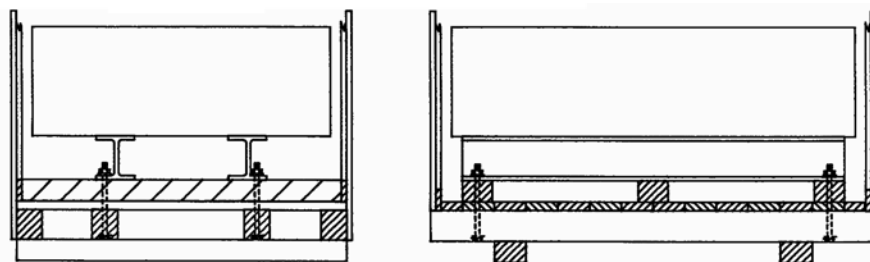
ill. 37:

Fastening of packaged goods to the bottom with construction types B1 – B3



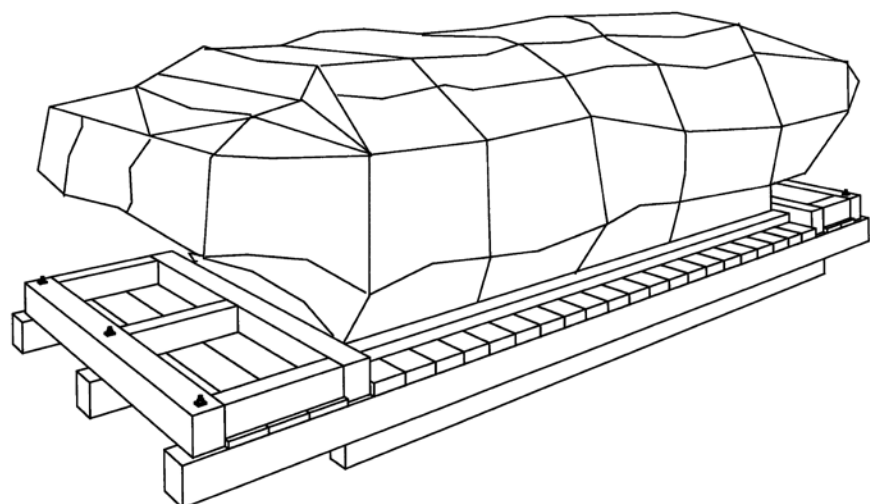
ill. 38:

Fastening of packaged goods to the bottom of construction types B2 and B3

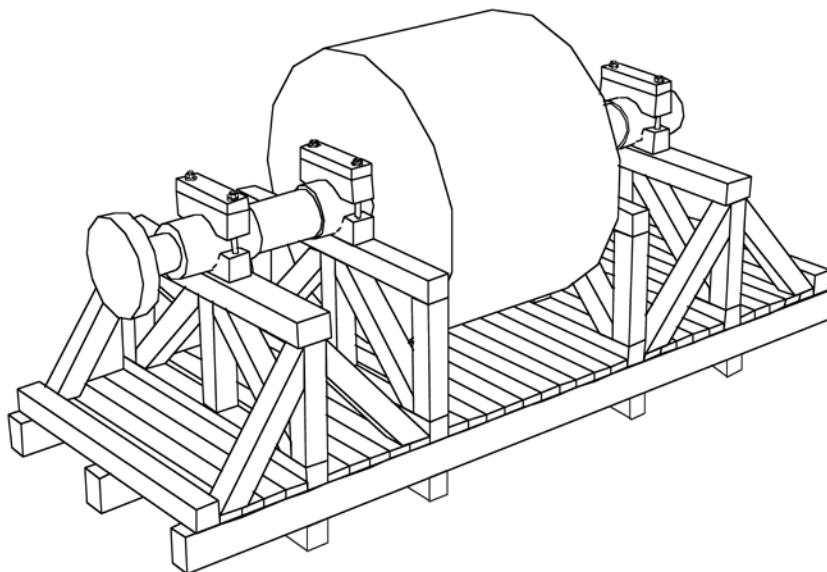


ill. 39:

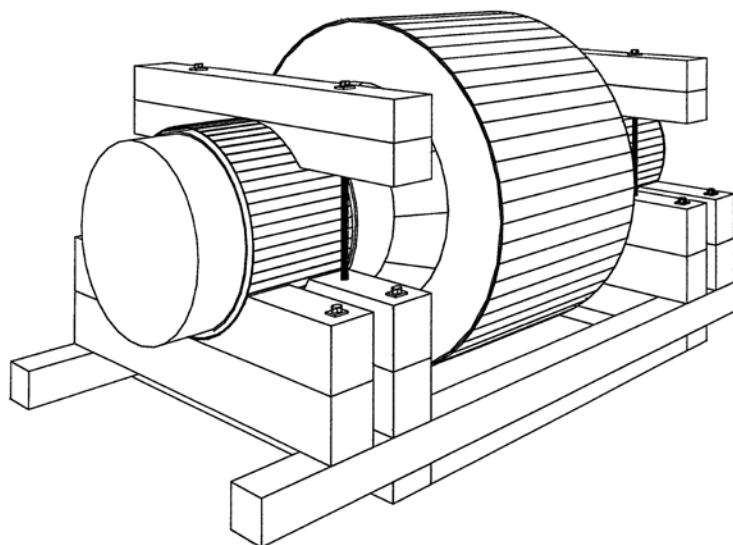
Fastening of packaged goods to the bottom without direct bolting



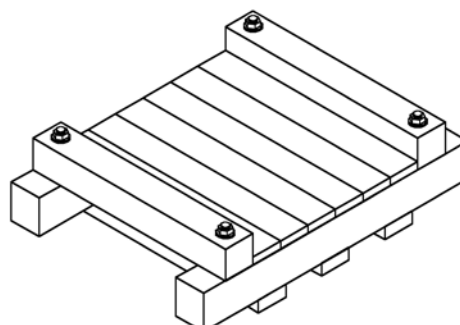
ill. 40:
 supporting the
 packaging goods to distri-
 bute loads evenly on the
 bottom



ill. 41:
 spreading of loads into
 the outer runners



ill. 42:
 cross bars fixed against
 the end walls of heavy
 loads cases and crates of
 construction types
 B 2 and B3

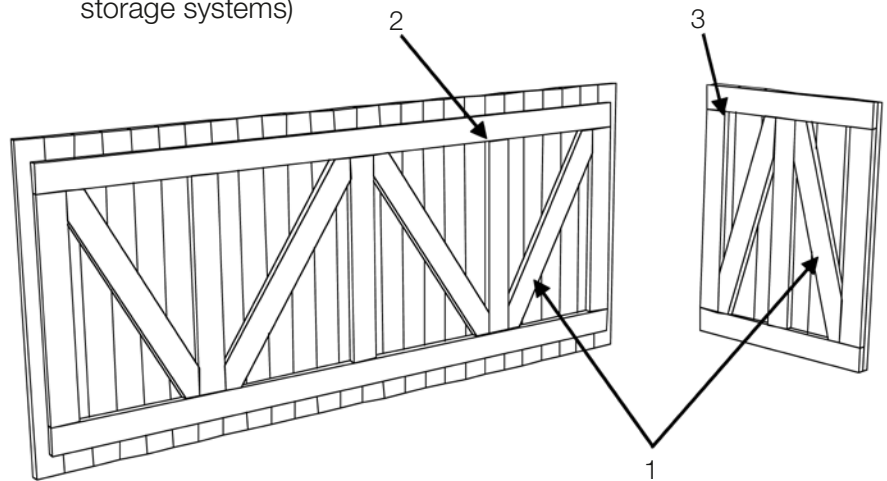


3.1.2.2 Lateral and end walls

Sides and end walls of cases with load bearing walls of all construction types are formed by load bearing components. When assembled, they form a static whole. They are mainly affected by:

- loads during transport,
- static forces during storage (compression forces in high storage systems)

ill. 43:
 side and end wall



key to the above illustration:

1 diagonals 2 lateral battens 3 header battens

A packaging good's overall stability is at risk when important construction components cannot meet the mathematical or actual load assumptions in this guideline. Battens and boards for bottom surfacing and corner assemblies must be chosen carefully according to the qualities they have to possess.

Edge boards must not be narrower than 10 cm. All other boards must measure at least 8 cm. The minimum width of battens for construction types B1 – B3 should be no less than 10 cm

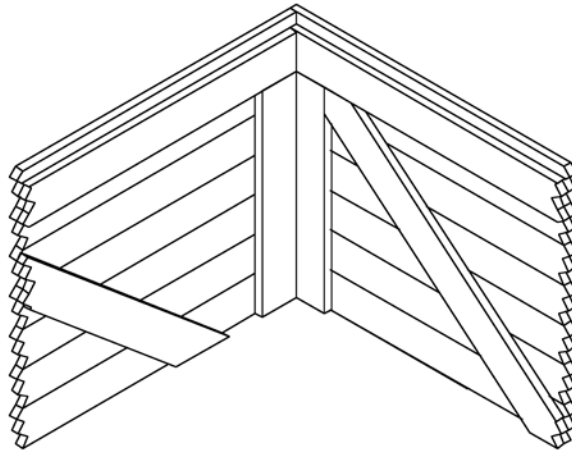
The number of battens per side is calculated according to the length of the case, see tables 9, 12 and 13.

The distance between battens should be approx. 80 cm and must not exceed 100 cm.

Cases higher than 150 cm externally need to be reinforced with diagonal battens on the side and end walls, with the exception of B3. To provide greater stability to the corner joint, the meeting point between sides and end walls must be reinforced with edge battens. Number of battens required see table 9. They must be in immediate contact with the end or head walls, see Ill. 44.

ill. 44:

Use of lateral/edge battens
in cases over 150 cm high



The number of battens of the end walls corresponds normally to the number of runners.

B1 only: If boards in the surface cladding are butt-joined because the available lengths are insufficient, the butt joint must be advanced by at least one batten's width and the joint must be reinforced with a backing batten.

Table 12:

Number of battens for cases of construction types B1 over 150 cm height and case lengths in cm of up to:

Case length	130	240	350	460	570	680	790	900	1010	1120
battens	2	3	4	5	6	7	8	9	10	11

The batten design for cases of construction types B2 and B3 is suitable for withstanding high crushing loads in stacks.

The distribution of battens with this construction type will be handled in sections according to the case length, width and height and according to table 13.

Table 13:

Minimum number of battens for construction types B2 and B3

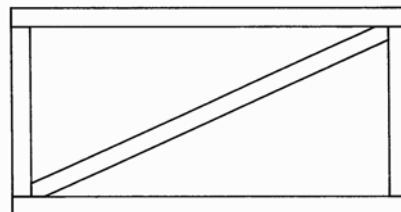
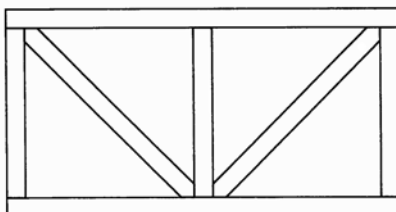
		number of sections per side/end wall				
number of s.	≥ 250 ≤ 350	a 3	b 6	c 9	D 12	e 15
	≥ 150 ≤ 250	a 2	b 4	c 6	D 8	e 10
	≤ 150	a 1	b 2	c 3	d 4	e 5
external dim. length in cm		≤ 300	≥ 300 ≤ 500	≥ 500 ≤ 700	≥ 700 ≤ 900	≥ 900 ≤ 1000

Plywood cases are provided with battens according to the board pattern. The general principle for the reinforcement of case walls with battens applies. Butt joints between panels must always be strengthened by backing battens. Diagonals are not required.

Examples for section distribution and use of diagonal battens see III 45 to 47 (end walls and sides)

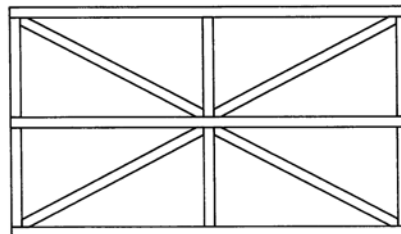
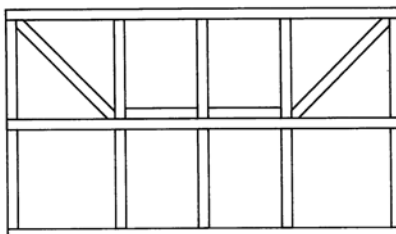
ill. 45:

1 section, a 1 maximum size
 300 cm long x 150 cm high



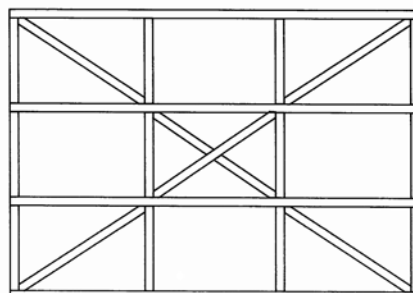
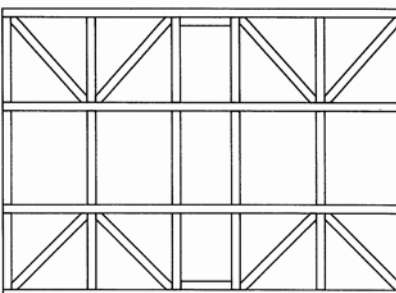
ill. 46:

2 sections long /
 2 sections high, b 4 max. size
 500 cm long x 250 cm high



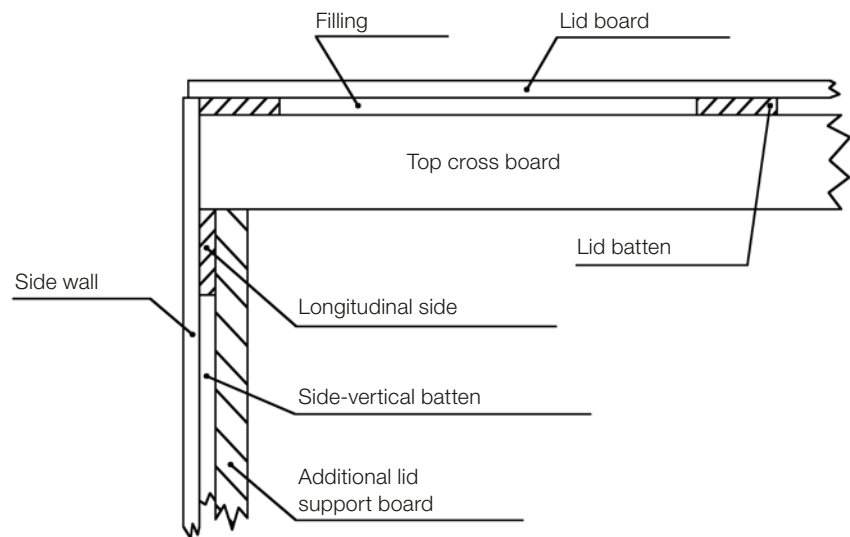
ill. 47:

3 sections long and 3 sections high, c 9 maximum size
 700 cm long x 350 cm high



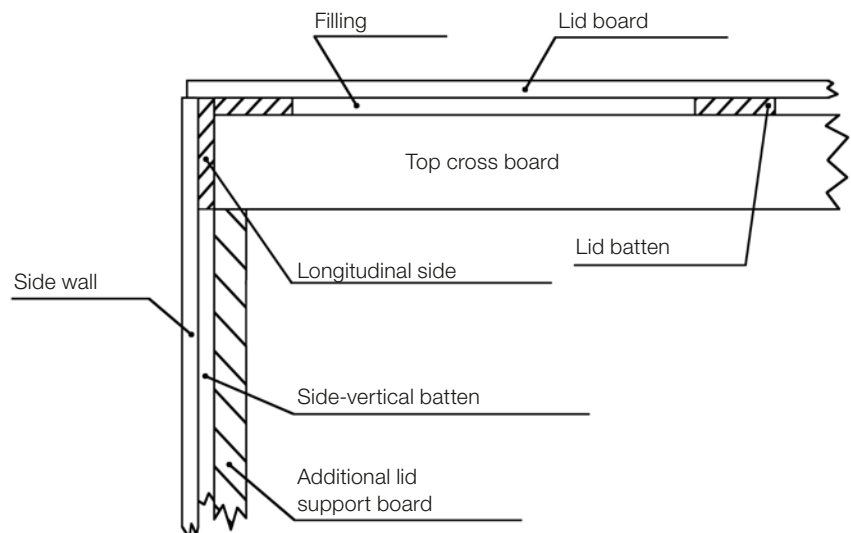
The upper longitudinal batten on the sidewalls of construction type B2 cases must be recessed sufficiently for the lid supports and top cross boards to rest on the longitudinal boards, see ill. 48.

ill. 48:
distribution of battens



Alternative distribution of battens of construction type B3, see (ill. 48a).

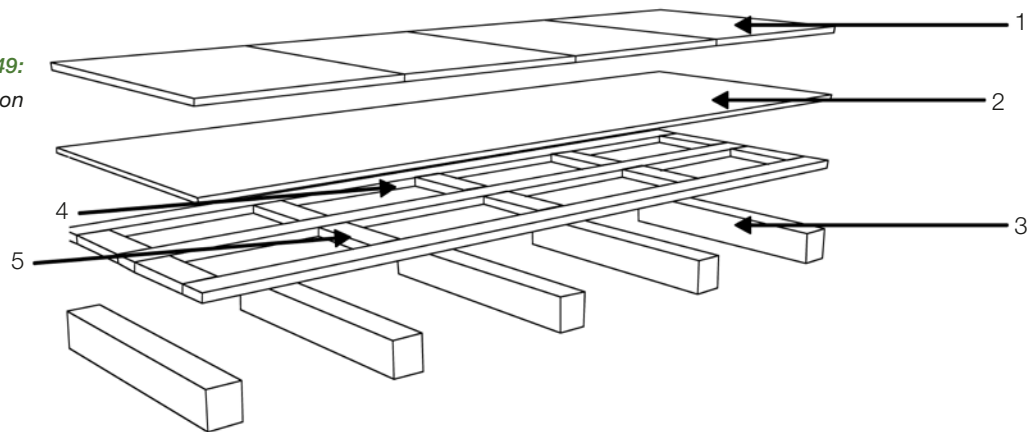
ill. 48a:
distribution of battens



3.1.2.3 The lid

The case lid closes the packaging unit at the top and forms a surface that is suitable for loads. The lid rests normally either directly on the end wall and side walls or on a suitable frame construction. It consists normally of a simple layer of boards and a batten frame.

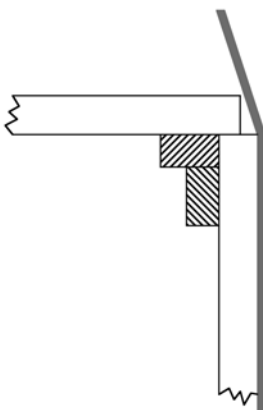
ill. 49:
 Lid construction



Key to the above illustration:

- 1 plywood or OSB, sometimes even solid wood
- 2 plastic cover or hardboards with film sandwich
- 3 top cross boards
- 4 battens
- 5 lining

ill. 50:
 Lid board,
 slightly set back



Apart from coping with crushing forces in stacks, caused by a number of cases on top of each other, the lid must also be designed to deal with transversal loads. These are produced during lifting when ropes, chains or cables are used. To avoid damage to the lid by such transversal forces, fastening points should be designed as indicated in ill. 50. The lid should be inferior by approx. 5mm on all sides to the external dimensions of the case (length and width) to avoid lifting off when using cranes.

Large and wide lids need added reinforcement to ensure resistance to stacking loads. Such reinforcements must be calculated by using load assumptions. Barrier materials can be provided by a PE film lining on the inside and by covering the whole surface. It must be protected against formation of water puddles or troughs by adding hardboard, veneered board or double sided polypropylene board. Profiled cases with angled lid surfaces need special provisions to support lids.

Top cross boards

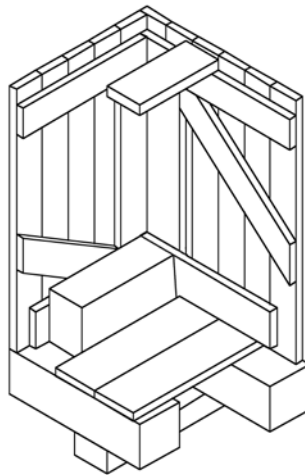
Top cross boards fulfil two basic tasks:

- they reinforce the lid and spread stacking stresses to the sides, end walls or bottom
- they provide support against transversal forces during crane handling when packaged goods come in load-bearing packaging with external fastenings

Cases with large lid surfaces must be provided with lid supports. If these rest directly on the upper longitudinal battens, loads can accumulate in such a way that battens may break under high stacking loads. To avoid such extreme loads on battens, vertical support struts can be affixed to the insides of cases to support the lid. This type of design is highly resistant although cases must be built bigger to provide for the extra space needed by these vertical supports.

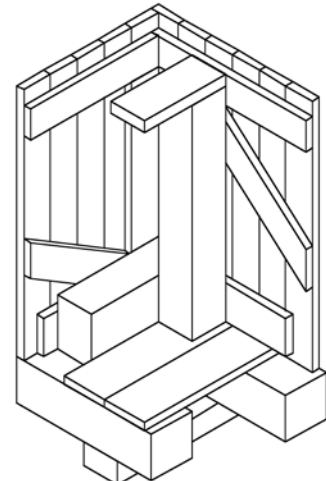
Illustrations 51 and 52 show different options for the fastening of lid supports.

ill. 51:
 example of a lid
 support resting on the
 longitudinal battens



The lid support rests directly on the longitudinal battens and causes punctual loads on the same.

ill. 52:
 example of a lid
 support resting
 on a vertical
 corner reinforce-
 ment



The lid support is affixed by means of a vertical support and finishes with the longitudinal batten so that loads are evenly spread. It is easy to see that the presence of the supports considerably reduces the space inside the case.

3.2 Internal structures

Internal structures are all those that give support, reinforce and lash goods down. They dampen jolts and vibrations that could affect the packaging goods. All elastic or sprung elements such as metal springs, air cushions, PU foam pads belong to the range of padding materials.

Internal structures in cases are normally made of timber. If very heavy loads occur, they are made of steel.

Structures on the bottom provide protection against horizontal and vertical loads during transport movements. The dimensions, number, position in the packaging and connection with the structural parts are tailor-made for the special needs of the goods.

(III. 25 and 26, p. 50 and III. 34 – III. 38, p. 57 et seq.)

Special attention must be given to internal structures within the hollow part of the packaging unit. Structures in this area can avoid tilting of the packaging goods. Cross and length supports in this area must be nailed or screwed into the sides or end walls. If nails can only be driven into the timber of the end walls one must remember that this is a very poor type of fastening.

Additional reinforcements of supports down into the runners or the battens must be favoured. The even spreading of large surface loads must be guaranteed.

The basis for such supports must be provided by diagonal reinforcements of the end walls and sides.

The necessary internal structures for the strengthening of lid surfaces fulfil two additional tasks:

- They support the lid and spread stacking loads to the sides, end walls or bottom
- They provide support against transversal loads during crane handling of packaging goods in load-bearing packaging (external fastening points)

The load spreading features of lid supports onto the sides must not be left to bear on nailed joints. Lid supports must rest either on the frame construction of the sides (construction types B2 and B3) or their loads must be spread into the bottom (construction types B1 and A3 – A6), if the packaging good itself must not accept the stacking loads.

Flattening of lid supports must not be done as this would weaken the timber cross section. If lid supports are exclusively used to cope with transversal loads, then one might envisage such a measure but as it is very time consuming to do, simpler constructions should be preferred.

Transversal loads produced by crane ropes or chains will normally be absorbed by the lid supports. The distance between lid supports should be shortened at the point of attack. If not, other measures must be taken to reinforce the corners such as affixing longitudinal battens, angle pieces etc.

The number of lid supports depends on the case design. Lids with a load-bearing batten frame (construction types B2 and B3) require fewer supports than cases with load-bearing walls (construction types A3 – A6 and B1).

Runners and angle irons

With masses exceeding 5.000 kg, angle irons should be fastened to the longitudinal runners and the upper part of the case.

*Example:
of protection through
angle irons*



3.3 Crates

This construction type is chosen depending on the following:

- dimensions of the packaging goods
- Net masses
- Load assumptions see Chapter B

*Example:
planed crate*



3.3.1 Normal crate

Construction type crates A3 – A6 see Ill. 53 to 56 correspond to the construction principles of cases, construction types A3 – A6 according to DIN 55 499, T 1 (for masses of max. 500 kg).

3.3.2 Crates on skids

Crates of construction types B1 and B 2 (see ill. 57 and 58) are designed as skid type crates to facilitate transport.

3.3.3 Components

For the components of crates the same principles apply as for cases (see 3.1.2 p. 53 seq.). Unlike cases, their wall surfaces are not closed but consist of open planks.

As a rule, the relation of planked to open areas is between 1 : 1 and 2 : 1. This means that the spacing between single boards should be about 1/2 to 1 board's width. The width of a plank should be no less than 10 cm.

The spacing on opposite components should be approximately equal, to allow the securing of internal fittings.

In addition, there must be sufficiently large areas for the application of markings. If necessary, some sections may need to be fully sheathed to allow for large markings. As an alternative, panels of weatherproof material can be attached.

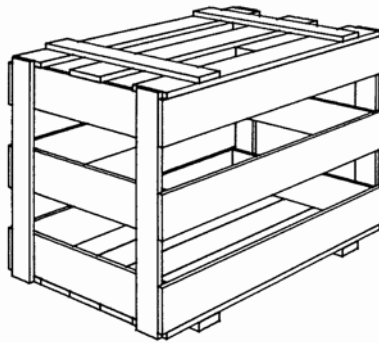
As a rule, the bottoms of crates are made from planks in the same way as the other components. In special cases full planking or covering of open bottom spaces with weatherproof plywood must be provided.

Side and end walls of all construction types must generally be braced with diagonal battens for crates according to the indication of height and width parameters for cases in order to meet the requirements in chapter B, Assumed Loads.

Internal fittings in crates must be designed in analogy with the explanations on internal fittings in cases. If crates are built from horizontal planks, particular attention must be paid to providing sufficient support for the lids to cope with stack compression loads.

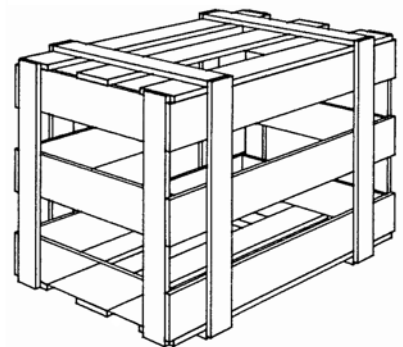
ill. 53:

Construction type A 3



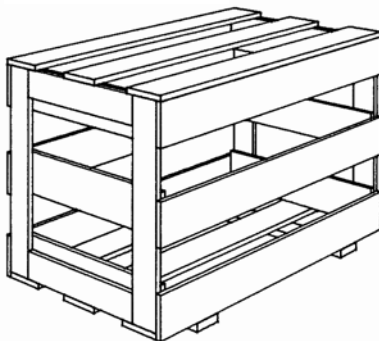
ill. 54:

Construction type A 4



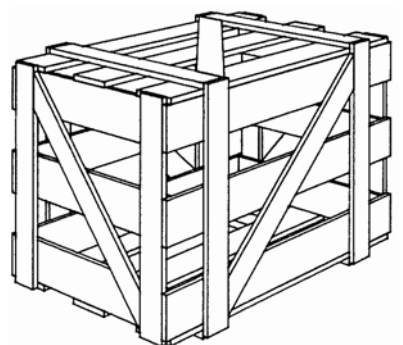
ill. 55:

Construction type A 5



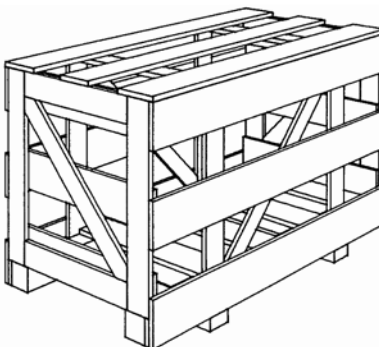
ill. 56:

Construction type A 6



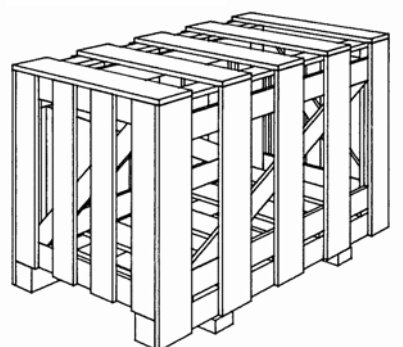
ill. 57:

Construction type B 1



ill. 58:

Construction type B 2



3.4 Partial packaging

The following different types exist:

- Cladding (3.4.1.)
- Bundles (3.4.2.)
- Sledges/cradles (3.4.3.)
- Squared batten constructions (3.4.4)

The type of partial packaging to be chosen depends on the following:

- Number of items in packaging unit (bundles)
- Dimensions of the goods to be packed
- Net mass
- Characteristics of the goods

3.4.1 Claddings

Cladding is a partial packaging for goods for which complete packaging into cases or crates is not necessary or useful, but which require partial protection. This has to be agreed with the customer.

This can be a functional, economical means of packaging for complete aggregate sets and sub-assemblies, as well as for vehicles and other over-sized consignments.

Planking is calculated and made like case walls and fitted to the object to be protected.

The fastening method depends on the features of the packaging goods. Existing bore holes or openings in the item itself are to be used to bolt on the cladding or the load-bearing substructure. If there are no fastening facilities on the goods to be packaged, auxiliary butt straps are welded to the article, if permissible.

Planking and cladding may be solid or open, like in crates.

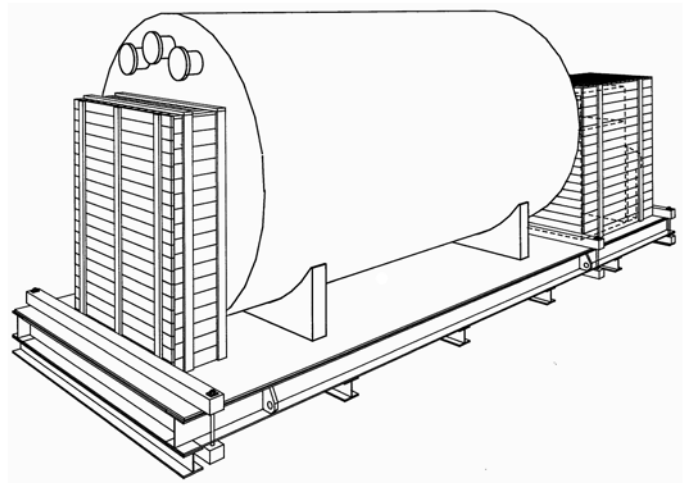
A cladding also includes the covering of large openings of receptacles and housings, as well as the direct jacketing of cylindrical apparatus.

Planking and cladding can be used in combination with sledges, see 3.4.3. or bundles 3.4.2., see Ill. 43 - 45).

Examples of planking and cladding

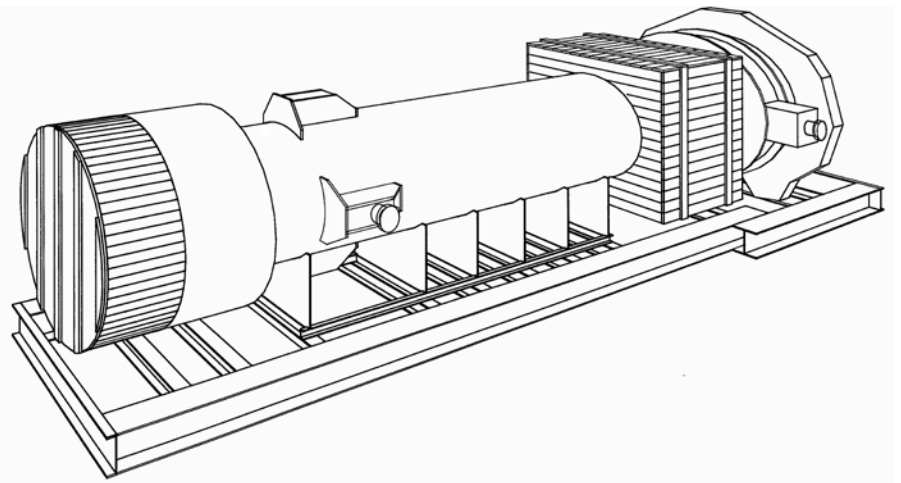
ill. 59:

Partial planking of a lubricating oil plant



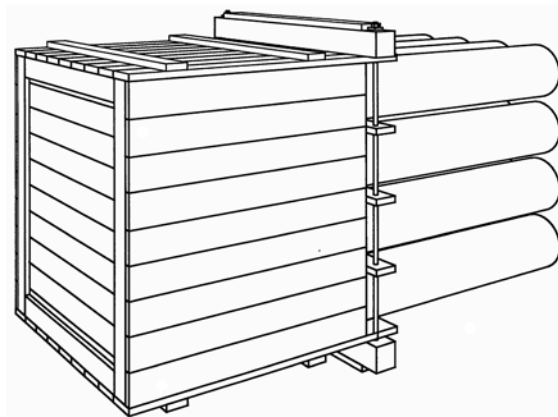
ill. 60:

Partial cladding of a reactor: planking of the cover and protective cladding for the compensator



ill. 61:

Partial packaging of a pipe bundle by planking one end wall; planking held in place by clamps



Example:
partial cladding



Example:
full cladding



3.4.2 Bundles

Bundles are transport or packaging units where the packaging effort is limited to joining a number of parts to make them transportable, secure, stackable and fit to be lifted by cranes and industrial trucks. Only goods may be bundled which can themselves bear the stack compression loads without additional support and do not bend or dent.

The usual closures are bolted timber clamps or, for higher net weights, clamps of sectional steel with timber inserts. Closures must be locked so firmly, that the goods cannot slide out of the bundle even if loaded slantwise. This must be guaranteed even after repeated transshipment and prolonged storage.

A bundle must be held together by at least three clamping devices. The squared timbers used must be able to withstand expected loads. The lateral projection of timber clamps to hold the lock bolt must be at least 10 cm long. The thickness of bolts must on no account be inferior to 12 mm in diameter. Filler battens must be nailed in place between opposite ends of screws and nuts of lock bolts so that they do not project see ill. 61.

Washers must be placed under the nuts and ends of the lock bolts in compliance with DIN 436 or DIN 440. Nuts are to be secured against loosening. Projecting bolts must be shortened to the required length after tightening.

Intermediate layers, if required, must be made of weatherproof plywood. Marking areas or end planking must also be retained by the clamps.

3.4.3 Sledges and cradles

A sledge or a cradle is an individual partial packaging solution with the features of the bottom part of skid-like cases or crates, but mostly without providing full cladding.

They consist of longitudinal skids and cross bracketing at right angles to the skids, bearing surfaces and saddles, all joined together in a suitable manner. For all wooden parts of a sledge or cradle which are subject to high bending and torsion stresses, mortise and ten on joints combined with tie rods are indispensable. As a rule, skids are made out of a single piece.

Sledges or cradles for heavy goods may also be strengthened with steel components, such as cross beams. They may be designed as a partial sledge or cradle if possible or necessary, depending on the means of transport.

A sledge or cradle must be as wide as the goods it carries (risk of tilting), if this leads to excessive widths which prevent the outer longitudinal skids from resting on the transport vehicle, the packaged unit must be secured by affixing a load-bearing sub-set of skids which fit the width of the vehicle and rest on its outer edges.

Generally the number of skids depends on the width of the packaged goods, on the bending stresses encountered and on the net weight.

To fasten the goods onto a sledge or cradle, their natural contact surfaces are used for bolting them down in the first place.

If that is not possible, straps of flat steel or synthetics with tensioning lock screws or steel wire riggings with turnbuckles must be wound round the packaging goods. The direct lashings must be homogeneously arranged and the lashing material must be protected against sharp-edged deflections. The safe tensile load of the turnbuckles must correspond to the tensile strength of the steel wire.

3.4.4 Squared timber structures

Squared timber structures are individual partial packaging structures made of squared timber and/or beams which fully or partly enclose the goods. As a rule they consist of tailor-made fittings, inserts, bracings and supports.

Square timber structures are used to pack heavy-weight goods which are insensitive to corrosion and mechanical damage or whenever a sledge does not offer sufficient protection and a case or crate would be too costly.

All wooden components of the structure are to be suitably joined. Appropriate joints and fastenings must be used for beams, vertical members, tie beams, braces and frames. Secondary components may also be secured by butt straps. Wood joints are to be carried out according to paragraph G.1 Guidance for the construction of the substructure is also given in paragraph 3.4.3, sledges and cradles.

Example:
Squared timber constructions as partial packaging solution



Example:
Squared timber construction: packaging a reversing reel (approx. 80.000 kg)



Example:
Squared timber construction: packaging a statue



G. PACKAGING AIDS

Packaging aids consist of the following:

- Types of jointing (1)
- Packaging films (2)
- Padding (3)
- Desiccants (4)
- Humidity, shock and tilt indicators (5)
- Banding strips (6)

1. TYPES OF JOINTS

1.1 Nails and their use

Nailed joints are made using round wire pins according to DIN EN 10230-I, bulk machined pins according to DIN 1143 T 1 or special nails according to DIN 1052.

Nail resistance values must be chosen according to DIN 1052, 12.2 and 12.5.2.

Nailing into cross-grained timber must not be considered to be statically load-bearing.

Nail thicknesses are calculated on the basis of the thinner of the wooden parts to be joined.

The length of nails passing through the whole joint must be chosen so that the tip can be hammered back by at least 5 mm. Nail tips must never protrude. Their heads must not be sunk by more than 2 mm.

The length of nails not passing through the whole joint must be chosen to comply with DIN 1052, 12.8.

Battens must be nailed in a staggered pattern to avoid splitting.

Nailing intervals are to comply with DIN 1052.

1.2 Staples and stapled joints

Stapled joints must follow rules set out in DIN 1052, 12.7, 12.8.3 and 12.9.

1.3 Screw nails

Screw nails are used with nailing machines. They are suited for joining sheet material like plywood or OSB. They can be unscrewed without difficulties if necessary, i.e. when opening lids during visual checks by custom authorities or the addition of desiccants if the validity period of anti-corrosion measures has been passed.

1.4 Bolted joints

DIN 603 1981-10 indicates the use of hexagon screws according to DIN EN ISO 4016, saucer head screws with square shoulder according to DIN 603 and threaded rods according to DIN 601.

Resistance values for these joints must be calculated according to DIN 1052.

The holes for the bolts must be machine-drilled and tight, with a max. tolerance of 1 mm.

Bolts must be min. 10 mm thick and 12 mm minimum with timber thicknesses above 8 cm.

Bolts should ideally be spaced at least 10 cm from each other and from the end of the piece of timber in the direction of the fibres.

Washers must be added on the head and nut side according to DIN 436 1990-05 or DIN 440 2001-03. The sizes of washers for load-bearing joints are set out in the following table:

Table 14:
Washer sizes
for load-bearing
bolted joints

Bolt diameter	M 12	M 16	M 20	M 22	M 24
Washer thickness	6	6	8	8	8
External Ø for round washers in mm	58	68	80	92	105
Lateral length for square washers in mm	50	60	70	80	95

2. PACKAGING FILMS

Included are only film products which are used in the packaging industry for the manufacture of film shrouds, see anti-corrosion protection with desiccants in Chapter E. This type of film material has to fulfil the highest quality specifications, unlike film material that is only used for covering purposes or to provide a hood when using the VCI method, see Chapter E.4, p. 38.

There are 2 types of foil material:

- Polyethylene foil (PE)
- Aluminium multilayer or sandwich films

2.1 Polyethylene foils (PE foils)

PE barrier films and their specifications are described in TL 8135-0019 and in DIN 55 530.

These foils normally consist of low density polyethylene (PE-LD).

Based on tests, their range of use according to DIN 55 530, and relevant water vapour permeability (WDD) should be limited to between + 40 °C approx. and –20 °C.

2.2 Aluminum multilayer or sandwich film

Aluminium multilayer products for the use as barrier material are dealt with in TL 8135-0003 and in DIN 55.531. They are described with their relative technical properties, e.g. water vapour permeability, resistance values and graded into different types according to the use of material to form the sandwich. The conformity of aluminium films with this standard is indicated by markings on the film itself. Instructions for the use of the film including sealing temperatures, times and pressure are equally marked on the film itself. Temperature ranges for the use of aluminium multilayer films can be deducted from the range of testing conditions in the standard and are assumed to cover -35 °C to +70 °C.

3. PADDING

Different types of padding materials can be used for the goods themselves or to pad corners, edges and protruding parts of the packaging goods:

- Air pads
- Bubble wrap
- Fibre pads
- foams

3.1 Air pads

Air pads are made from sealed units consisting of an elastic film suited to the particular use and filled with air. Only the static load of the packaging good's mass applies to the pad at rest. The pad compresses and works as a damper during additional dynamic loads.

The air quantity in the pad can be varied according to a specific good's properties and needs. Air pads are sold in different dimensions and designs. The range covers spheres, normal cushion types, corner and edge pads and tube shapes.

Advantages of air pads:

- Easy to handle
- Not hygroscopic
- Variable in their use
- Resistant to extremes of atmospheric conditions
- High recovery values and optimum buffering properties

Disadvantages of air pads:

- Susceptible to piercing by sharp objects, e.g. nails or similar
- Probable alteration of properties during air transport due to lower air pressures

3.2 Bubble wrap

The function of bubble wrap is basically the same as that of air pads. They consist of two plastic films sealed onto each other, where one is even and the other one provided with small round indents which trap the desired air once they are sealed together. Bubble wrap is mainly used inside the packaging unit. Advantages and disadvantages are the same as for air pads.

3.3 Fibre pads

Fibre pads are quality padding aids for highly sensitive goods. They are made from animal hair or coconut fibres. After cleaning and transformation, they are rubber coated and vulcanised to form a tight panel.

Fibre pads are relatively resistant to moisture and temperature influences. They have a high recovery coefficient, even after permanent loads.

3.4 Foams

Foam pads are mainly made from polystyrene (PS), polyurethane (PU) and polyethylene (PE). Foam material can be soft, semi-hard and hard. Not only their relative density but also their cell structure, open or closed, are important for their padding properties.

3.5 Vibration and shock absorbing elements

Such machine related elements are used for sensitive packaging goods in agreement with the customer.

4. DESICCANTS

Desiccants are supplied in bags with 1/6, 1/3, 1/2, 1, 2, 4, 8, 16 and 32 units. One unit of desiccant is standardized in DIN 55 473 and subject to permanent control. Make sure that the DIN reference and the certification symbol are printed on the bags before using them.

Example:
Vibration and shock
absorbing elements



5. TRANSPORT MONITORING SYSTEMS

5.1 Humidity indicators

Humidity indicators are mainly used for long term storage together with desiccants (see chapter E.2 p.34). They show if relative humidity values have passed a certain admissible threshold in a watertight and water vapour tight packaging. Humidity indicators are calibrated at a temperature of 20°C.

5.2 Shock indicators

Shock indicators exist for various levels of sensitivity. A shock exceeding the limit value is indicated by an irreversible discolouration of the indicator. These indicators are mainly used for smaller packages as they are more susceptible to suffer from shocks. In addition, a stick-on label can clearly warn of the presence of a shock indicator.

5.3 Tilt indicators

Tilt indicators are mainly used for packages that are smaller and/or at risk through tilting. An indicator is irreversibly discoloured when a tilting angle has been exceeded. In addition, a stick-on label can clearly warn of the presence of a tilt indicator on the packaging.

5.4 Devices to record shocks and vibration

After prior agreement with the customer such devices can be included with the packaging to monitor transport stresses.

6. BANDING STRIPS

Banding is useful for smaller type A3 – A6 cases as they run a higher risk of transport and transhipment stresses (falls). Banding provides additional stability. Banding can be used on larger type B1 to B3 cases and larger gross weights to give additional protection against unauthorized opening.

The choice and application of banding must be subject to DIN EN 13891 2003-09.

H. CONTAINER STOWAGE

1. GENERAL REMARKS

A major part of traded goods are transported in containers. The container is not packaging as such but only a means of transport. Some general rules for stowing of and in containers apply and will be described in this chapter.

The following recommendations assume normal stresses during traffic on land, water and by air and during handling, delivery before and after. They are to be used as examples only. Other models may be better suited. In addition, all other comments in the earlier chapters of the HPE packaging guidelines and the CTU packaging guidelines must be respected.

Further information can be found in the GDV container manual www.containerhandbuch.de.

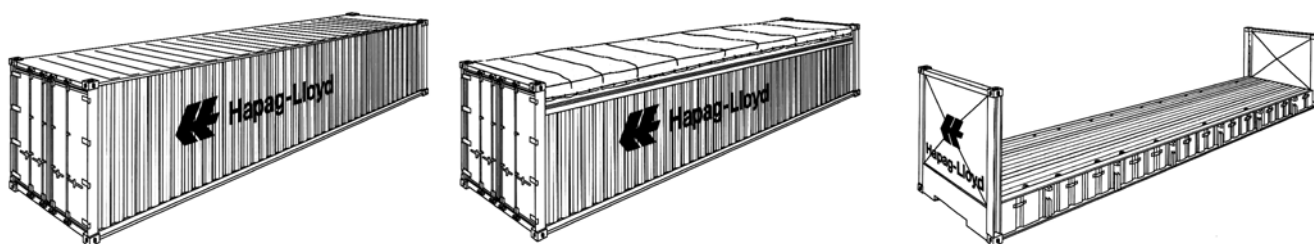
2. CONTAINER TYPES

Containers are used in 3 lengths, 20', 40' or 45'

The main types are the following:

ill. 62:

Container types



- a) General purpose container, suitable for all types of goods
ISO size type 22 / 42 G0
high cube container (as a but higher)
ISO size type 45 G0
- b) Open top container suitable for crane handling
ISO size type 22 / 42 U1
- c) Flats especially suited for heavy goods and extra wide goods
ISO size type 22 / 42 P1

3. TYPES OF CONTAINER TRAFFIC

There are two types of container traffic. They will determine storage and securing of packaging goods and their relevant handling/trans-shipment stresses.

- **Collective shipment (LCL container)**
Packaging goods are stowed together with other shipments in the container. This can take place on the haulier's premises or in the port. This type of transport is always subject to conventional delivery and retrieval of packaged goods and thus subject to higher handling stresses.
- **Door-to-door traffic (FCL container)**
In this case the packaged goods are stowed and secured in the container by the transport firm and only discharged at the destination. Transport stresses for individual packaging unit are greatly reduced.

4. TRANSPORT STRESSES IN CLOSED CONTAINERS

4.1 Mechanical loads see Chapter B

4.2 Atmospheric stresses

General purpose und high-cube containers are so-called closed systems. All moisture that is introduced with the packaging goods and during handling into the container remains inside throughout the whole transport and storage period. When transiting different climate zones and during temporary storage, condensation can occur, especially in conjunction with day/night temperature alterations. Of particular concern therefore is the moisture content of packaging material (timber), see table 7, page 39 and chapter C, page 29, "example: atmospheric conditions in containers".

5. CHECKS ON RECEPTION OF CONTAINERS

5.1 Checking container registration

The CSC safety approval label must be checked for validity of the registration, the validity date must not be exceeded. Alternatively the container must bear an ACEP label (Approved Continuous Examination Program), i.e. the container is subject to continual controls without indication of a specific control date.

5.2 Checking fitness for use

The following features must be checked on reception:

- Damage, e.g. state of the bottom, tightness of the roof etc.
- Functionalities, e.g. doors
- Cleanliness, dirt, smells
- Humidity
-

6. MINIMUM INTERNAL DIMENSIONS, DOOR SIZE

Minimum internal dimensions and door opening sizes of line 1 ISO containers according to DIN ISO 1496-1

Table 15:
container internal
dimensions

Container type	Min. internal dimensions [mm]			Min. Size of door openings [mm]	
	height	width	length	height	width
ISO 40'	2.350*	2.330	11.998	2.261*	2.286
ISO 40' High Cube	2.655**		11.998	2.566**	
ISO 20'	2.350*		5.867	2.261*	

* external container height 8' 6" ** external container height 9' 6" (ISO 668)

7. CONTAINER LOAD BEARING PROPERTIES

7.1 Container construction elements

- Side walls: max. pay load * 0,6
- End walls plus doors in the end walls: max. pay load * 0,4

Loads on side and end walls must be evenly distributed!

Loads on bottom: axle weights of up to 5.460 kg with fork lift trucks and tyre contact surface of min. 142 cm² per wheel.

Bottom: line load:

$$\text{line load}_{\text{acceptable}} = \frac{\text{container cargo}_{\text{acceptable}}}{\text{inside length of container}}$$

Actual line load of a single packaging item

$$\text{line load}_{\text{real}} = \frac{\text{mass of package}}{\text{length of seating in machine direction}}$$

Overloading the container bottom can be excluded if the following conditions are met:

$$\text{line load}_{\text{real}} = \text{line load}_{\text{acceptable}}$$

Container frame: struts can provide vertical and horizontal container sections with additional load bearing capacity.

7.2 Resistance of load securing devices in the container

Table 16:
resistance of load
securing devices
in the container

20' container	Lashing rings	1.000 daN
40' container		
20' open top		
40' open top		
20' flat		2.000 – 4.000 daN
40' flat		2.000 – 4.000 daN

8. PACKAGING AND STOWAGE ADVICE

8.1 Packaging advice

Different handling stresses apply to the two transport methods FCL and LCL. This can have an effect on the packaging chosen.

- **Collective shipment LCL:** atmospheric protection + rigid external packaging
- **Door-to-door container FCL:** atmospheric protection + rigid external packaging or atmospheric protection on sledge, cradle or some other bottom construction

8.2 Stowage advice

- Test stowage or establish stowage plan.
- The centre of gravity of a loaded container must be in the mid section of the container length.
- All empty spaces between the goods and container walls must be secured.
- Special securing provisions must ensure that the door is as free of loads as possible.
- Avoid the use of moist or wet timber as dunnage.
- Max. permitted line loads must not be exceeded, use load spreaders if necessary.
- Do not exceed the resistance values of lashing devices.
- Keep documentary evidence of stowage and load securing measures by taking photos

I. AIR FREIGHT PACKAGING

1. GENERAL REMARKS

Air freight has become ever more important during the last few years. This guideline makes a few suggestions on requirements for air freight packaging. The following recommendations are based on normal loads and stresses during air transport and delivery before and after. They are only meant as examples, other options may be better suited and different regulations may apply.

The regulations of IATA, the International Air Transport Association and of the German Luftfahrtbundesamt LBA (German equivalent authority) must be respected in all cases. Individual air hauliers often impose their own rules on delivery and packaging. The following remarks are therefore of an indicative nature only and details must be agreed with the air haulier beforehand.

Certain goods may not be transported by air freight or subject only to specific conditions. These are set out in the Technical Instructions of the International Civil Aviation Organisation (ICAO TI) and/or the IATA Dangerous Goods Regulations, IATA DGR.

2. PREPARATION AND PRECAUTIONARY MEASURES

Customer and packer must agree beforehand on the following aspects:

- Airline charged with the transport of the goods
- Type of aeroplane chosen for the transport
- Mass, dimensions and centre of gravity of the packaging good
- Route and sites chosen for storage and transshipment
- Sensitivity of the packaging goods
- Sensitivity of the goods against vibrations and temperature fluctuations
- Hygroscopic properties of the goods or to what extent they will effect the air humidity level inside the packaging

3. TRANSPORT STRESSES AND LOAD SECURING NEEDS

3.1 Transport stresses

Packaging must be designed to withstand vertical loads of 3 g and/or 1,5 g towards the front, rear and sides. This is the equivalent of 1.5 or 3 times the weight of the packaging goods.

ill. 63:
 acceleration forces
 during air transport



Mass per linear metre and maximum stowage heights must be taken into account when designing the packaging. It makes sense to optimize the external shape of the packaging in view of the stowage area and profile available.

Vibrations can reach values of between 5 – 500 Hz during air transport. The customer needs to inform the packer if special packaging is required to protect the goods against them.

3.2 Securing loads during air transport

Special air freight pallets are used for packaging goods. They are directly secured to the pallets with nets and/or lashing straps. The pallets are then loaded and secured with individual on-board transport and fastening systems.

If pallets exceed certain haulier or aeroplane specific weights and/or dimensions, they cannot be secured by on-board fastening systems. The goods must therefore be secured directly to the bottom of the hold itself and lashing straps are the only means used for that purpose. In this case a sufficient number of fastening devices, i.e. 1 per ton must be provided, including length wise. This number must be achieved even with open packaging and without damaging any anti-corrosion protection. Special straps are used to lash the goods down. They must be spaced at least every 0.50 m in a given direction.

4. ATMOSPHERIC INFLUENCES

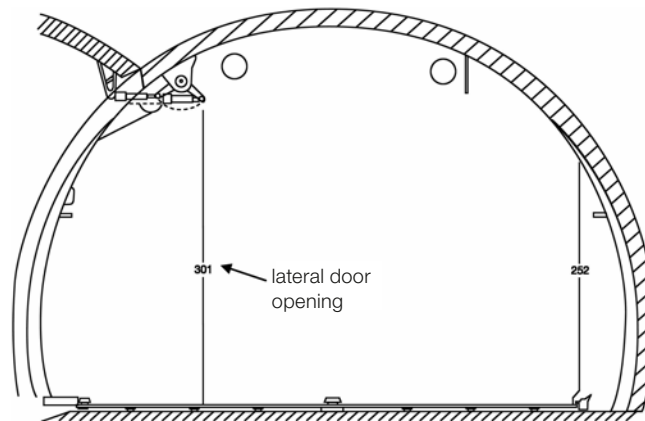
Many aeroplane types have temperature-controlled holds with pressure compensations. Nevertheless, temperature and pressure losses must be provided for. Opening the hold in the country of origin or during stopovers can also provoke sudden climate fluctuations. Precautionary measures to avoid corrosion must therefore be taken.

5. PACKAGING ADVICE

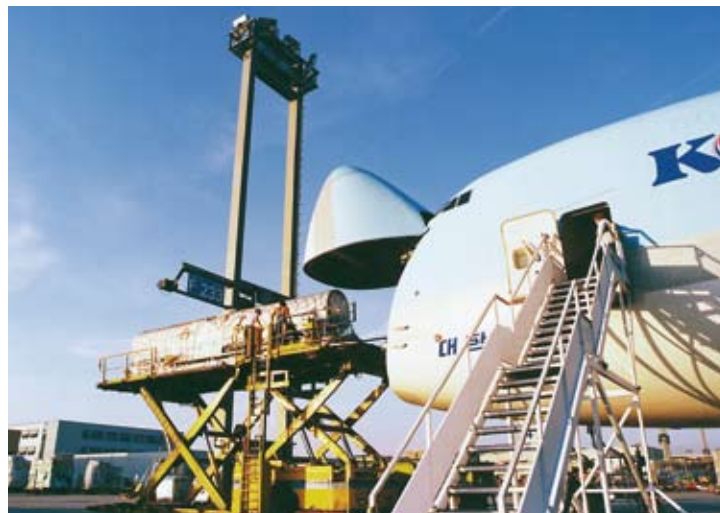
Individual authorizations by the air haulier may be needed for certain packaging goods or those above a given weight. Packaging goods above a certain mass may not be packed in closed packaging.

This HPE guideline applies generally to all aspects of the packaging itself.

ill. 64:
profile of the hold
of a Boeing 747-F



Example:
loading a
cargo plane



J. SECURING THE GOODS

1. GENERAL REMARKS

Correct stowage and securing of packaged goods is the pre-requisite for no-damage transport. If transport damages occur due to insufficient securing of the loads, collateral costs may follow which go way beyond the price of mere material damages. Just think of the undermining of the client/packer relationship, repair of goods or even financial sanctions for legal contraventions. The following lists a few general considerations.

2. RESPONSIBILITY AND LIABILITY

“Unless other conditions or transport practices demand a different approach, the sender must load, stow, secure and unload the goods in a way that is fit for the chosen transport. The haulier is responsible for safe operational loading“.

Fit for the chosen transport: The goods must be stowed and secured to the means of transport or stowage surface in such a way that they can safely endure normal transport according to the contract.

Safe operational loading: implies that the goods are loaded in such a way that they are sufficiently protected and they in turn cannot pose a risk or cause any damage.

Note:

This sharing of responsibilities is set out in § 412 HGB (German Commercial Law) but qualified by the words "Unless other conditions or transport practices demand a different approach."

Literature used:

Ladungssicherung, Der Leitfaden für die Praxis, Autor: Alfred Lampen, Verlag Günter Hendrich, ISBN 3-9807856-0-2

(Load securing, a Practical Manual by Alfred Lampen etc)

3. LOAD SECURING METHODS

Two different methods exist:

- Force related load securing by increasing friction
- Form related load securing by using surface contact, e.g. stowing against firm walls, filling of empty spaces or dunnage, use of lashes or straps

These methods can be used on any means of transport, they can be used alone or combined with each other. The relevant load securing values and means required must be calculated.

Literature on the use of these methods:

- GDV Load securing manual on www.tis-gdv.de
- BAM load securing manual on www.bam.de unter Service, Publikationen, Handbuch
- Practical manual „Laden und Sichern“ Sammelband, Bundesverband Güterverkehr, Logistik und Entsorgung (BGL) e.V.
- Berufsgenossenschaft für Fahrzeughaltungen, Max. Brauer Alle 44, 22765 Hamburg
- CTU-packaging guideline, document Nr. B 8087, Verkehrsblatt Verlag, Dortmund
- VDI Richtlinie 2700 ff, VDI, Postfach 10 11 39, 40002 Düsseldorf

Table 17:
use of load
securing devices

4. LOAD SECURING DEVICES AND THEIR USE

means	measures					
	Support, spreading of loads	Sectional securing of goods	Filling of open areas	Lashing down / Direct lashing	Increase friction	Separate packaged goods
Wooden boards, Squared timber, planks	X	X				X
Empty pallets, padding			X			X
Connectors for wood					X	
Lashing straps				X		
Rubber mats					X	

K. MARKINGS

1. GENERAL REMARKS

Marking is an essential feature of export packaging. It consists of:

- lettering
- symbols

If markings lack, are incomplete or illegible, the following can ensue:

- wrong routing
- wrong handling
- loss
- customs fines
- risk to life and limb of transport personnel

Markings must be indicated by the customer. They can be established according to DIN 55402 T2, if this is not the case. Marking symbols for packaged goods must comply with DIN EN ISO 780 in order to be generally understood.

According to DIN 55 402 T 2 the written indications consist of the following:

- control marking
- information marking

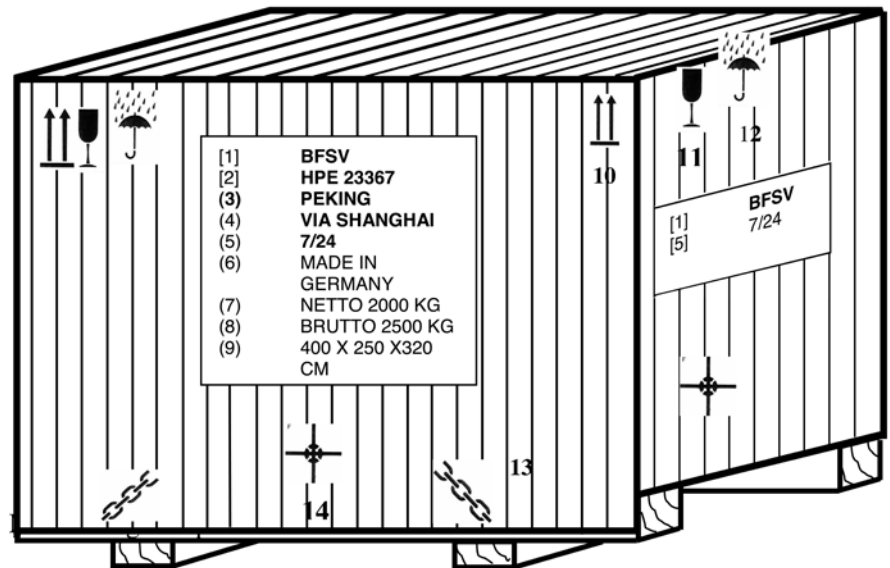
The control marking consists of the following:

- registration code or mark – receiver or sender
- identification mark – order number
- address – place and port of destination
- package nr. – if part of a grouped consignment

Information markings include:

- indication of origin
- weight – compulsory over 1.000 kg gross weight
- dimensions – L X W X H in cm

ill. 65:
Example of case marking



Key to ill. 65

Lettering		Marking symbols
(1) registration mark	(6) country of origin	(10) this side up
(2) identification number	(7) net weight	(11) fragile / sensitive
(3) place of destination	(8) gross weight	(12) protect from humidity
(4) port of destination	(9) dimensions	(13) apply lifting gear here
(5) package no. plus total no. of packages in consignment		(14) centre of gravity

Lettering must be parallel to the bottom of the packaged goods and legible during normal transport positions. All indications are to be written in Arabic numbers and capital letters of the Latin alphabet. The size of lettering depends on the available area. Preference is given to letters 12,5 mm, 25 mm, 45 mm, 70 or 100 mm high. Letters and numbers of the control marking should be larger than the others. All letters and numbers should be smaller than the symbols affixed to the packaged goods.

The marking should be made preferentially with black paint, type RAL 9005; it must be light fast and resist sea water. It must not become blurred. Special storage markings can be agreed between customer and packer, if required.

Markings for the transport of dangerous goods on sea-going vessels are prescribed in the IMDG -CODE, general introduction and can be ordered from K. Storck & Co., Verlag und Druckerei GmbH, Stahlwiete 7, 22761 Hamburg, Tel.: 040/85 32 920, Fax: 040/85 07 758).

Special conditions apply for rail, road and air cargo. They are set out relevant texts by GGVE (RID), GGVS (ADR) and IATA /ICAO.

Bei Packgütern, die unverpackt oder teilverpackt zum Versand kom-Goods which are shipped unpackaged or in partial packaging must be directly marked on their surface. The color of the marking must differ from that of the goods. Another option would be to firmly fix plywood, plastic or metal boards or labels to the goods.

Plywood must be weather resistant. The use of stencils for the markings is to be preferred

Other indications may be necessary on instruction by the sender or receiver, such as:

- handling instructions
- content indications
- colour markings for construction modules
- packing lists/documents in lead pockets
- quality marks
- manufacturers packaging instructions
- indication of desiccant use or VCI packaging
- notes on timber treatments
- marking to comply with ISPM 15

Such special markings should ideally not be applied to the side of the goods that bears the control marking.

The marking must applied to at least 2 sides of the packaging. The minimum length of letters on rough timber must be at least 20mm.

The marking must applied to at least 2 sides of the packaging. The minimum length of letters on rough timber must be at least 20mm.

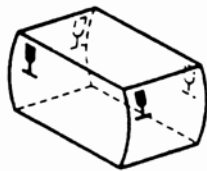
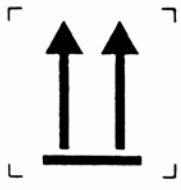
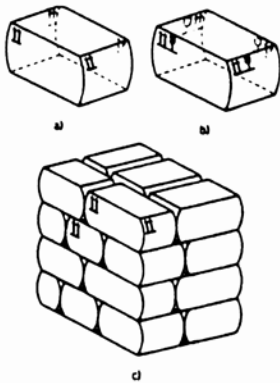
Affixing lettering and symbols

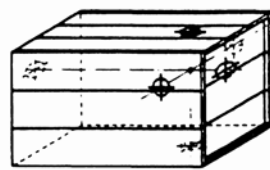
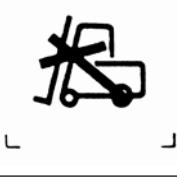
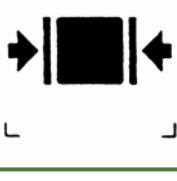
Symbols can be applied with stencils or stamps, printing stamps, burn marks, printed or adhesive labels, except symbols for lifting gear fasteners..

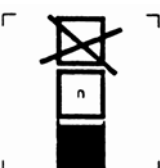
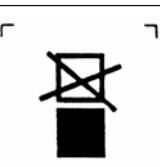
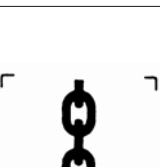
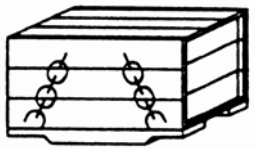
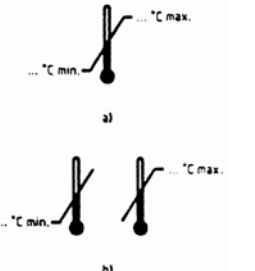
Letters should be applied with stencils, if possible. Ensure that the surface is not too rough for the marking to be easily legible

Old markings must be removed completely.

2. Standardized symbols

No.	Instruction / Information	Symbol	Meaning	Reference/Remarks
1	FRAGILE		Contents of the transport package are fragile therefore it shall be handled with care.	ISO 7000, No. 0 621 Example of application: 
2	USE NO HAND HOOKS		Hooks are prohibited for handling the transport package.	ISO 7000, Nr 0 222
3	THIS WAY UP		Indicates correct upright position of the transport package.	ISO 7000, No. 0 623 Example of application: 
4	KEEP AWAY FROM SUNLIGHT		Transport package shall not be exposed to sunlight.	ISO 7000, No. 0 624
5	PROTECT FROM RADIOACTIVE SOURCES		Contents of the package may deteriorate or may be rendered totally unusable by penetrating radiation.	ISO 7000, No. 2 401

No.	Instruction / Information	Symbol	Meaning	Reference/Remarks
6	KEEP AWAY FROM RAIN		Transport package shall be kept away from rain	ISO 7000, No. 0 626
7	CENTRE OF GRAVITY		Indicates the centre of gravity of the transport package which will be handled as a single unit.	See 2.4.1 and 2.4.3 ISO 7000, No. 0 627 Example of application: 
8	DO NOT ROLL		Transport package shall not be rolled.	ISO 7000, No. 2 405
9	DO NOT USE HAND TRUCK HERE		Hand trucks shall not be placed on this side when handling the transport package.	ISO 7000, No. 0 629
10	USE NO FORKS		Transport package should not be handled by forklift trucks.	ISO 7000, No. 2 406
11	CLAMP AS INDICATED		Clamps shall be placed on the sides indicated for handling the transport package.	See 2.4.1 ISO 7000, No. 0 631

Nr.	Instruction / Information	Symbol	Meaning	Reference/Remarks
12	DO NOT CLAMP AS INDICATED		Transport package should not be handled by the clamps on the sides indicated.	ISO 7000, No. 2 404
13	STACKING LIMIT BY MASS		Indicates the maximum stacking load permitted on the transport package.	ISO 7000, No. 0 630
14	STACKING LIMIT BY NUMBER		Maximum number of identical packages which may be stacked on one another, where "n" ist the limiting number	See 2.4.4 ISO 7000, No. 2 403
15	DO NOT STACK		Stacking of the transport package is not allowed and no load should be placed on the transport package.	ISO 7000, No. 2 402
16	SLING HERE		Slings shall be placed where indicated for lifting the transport package.	See 2.4.1 und 2.4.3 ISO 7000, No. 0 625 Example of application: 
17	TEMPERATURE LIMITS		Indicates temperature limits within which the transport package shall be stored and handled.	ISO 7000, No. 0 632 Example of application: 

*Example:
lettering and marking
according to stan-
dards laid down*



L. SHIPPING DOCUMENTS

1. GENERAL REMARKS

Different countries of destination demand different shipping documents. As the documentation of individual countries varies widely, it is not possible here to deal with every special regulation. Particulars can be found in the book "Konsulats- und Mustervorschriften" ("Consular and Model Regulations"), published by Carl H. Dieckmann, Fachverlag für Außenhandel, Große Burstah 34, D-20457 Hamburg, latest edition.

In general, the following documents are used:

2. DELIVERY NOTE, INVOICE, CERTIFICATE OF ORIGIN

They must be drawn up by the customer (exporter). Documents must be forwarded to their destination by the packer, if he is the sender.

3. PACKING AND ITEM LIST

The packing and item lists must be drawn up in agreement with the packer.

4. CONSIGNMENT NOTE, BILL OF LADING

For every transport a consignment note/bill of lading is necessary. Subject to the means of transport, different forms are required.

We distinguish between:

- Railway transport inside Germany
- Consignment note for wagon loads (DB-form) (DB = German Railways plc)
- Consignment note for piece goods (DB-form)
- Collective cargo consignment note (forwarder's secondary consignment note)
- Road transport inside Germany
- Consignment note for complete loads or piece goods by lorry (standard form)
- International rail transport
- Consignment note for wagon-loads (CIM-form)
- Consignment note for piece goods (CIM-form)

- International road transport
- Consignment note for road transport (CMR-form)
- International air transport
- Consignment note for air transport (AWB-form: Air Way Bill of Lading)
- International sea transport
- Bill of lading (BL-form: Ocean Bill of Lading)

AWB and BL-forms are issued only by forwarders.

5. EXPORT DECLARATION OR SIMILAR DOCUMENTS

As a rule, they are issued by the exporter. If the packer's firm is the sender, he arranges for the necessary completion and for customs clearance.

6. CERTIFICATES

In several countries there are import regulations for wooden packaging. An important development here is the global harmonization of import regulations as part of the IPPC standards (ISPM 15).

It is an advantage of ISPM 15 that no additional certificates will be required to prove suitability of the timber used. Only Australia and Indonesia are an exception to this rule as they demand an additional Packaging Declaration.