VDA	Standardized expendable packaging for sea container applications	4525

This VDA Guide pursues the following objectives:

As an intermediate step on the way to achieving overarching global Container Management with e.g. “World-KLT” without movements of empties, it is necessary to standardize the design of expendable packaging used for intercontinental transportation.

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Project Group “Sea Container Applications”

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TABLE OF CONTENTS

1 Introduction

Each partner in the automotive supply chain depends on a functioning logistic process with a high level of availability to ensure and guarantee the supply chain.

Appropriate packaging, load containers and cargo carrying systems must be available for packing, transportation, quality assurance and storage of materials, parts and products. During the last few decades, automotive manufacturers, suppliers and logistic service providers have developed supply concepts that ensure virtually 100% supply of automotive production lines in inner-continental movement with goods using reusable packaging. These concepts are designed for regional transportation in order to achieve optimal usage rates and thus the lowest possible transportation costs.

Increased globalization is accompanied by the challenge of servicing the delivery networks evolving throughout the world with new or revised packing and packaging concepts. As international goods are transported primarily by sea, sea containers are becoming increasingly important in supplying automotive production. Packaging concepts must therefore be adapted to address these unique dimensions as well as new weather-related influences affecting transportation units.

Costs can be substantially reduced by implementing new concepts for the design of packs and packaging, standardization of types of packs, reducing the variety of packs and packaging, optimizing inner to outer volumes, reducing weight while at the same time improving features of use (e.g. stackability), etc. The role this plays in maintaining competitiveness should not be underestimated.

Standardized concepts also help to improve supply reliability, planning of processes, cost transparency and the quality of transportation while lowering damage rates in transportation and storage, stocks in store and environmental impacts.

2 Objective of the VDA Recommendation

The objective of this VDA Recommendation is to develop standard specifications for expendable packaging (dimensions, design, quality) related to sea container dimensions and their applications in the over-arching logistic process.

Key Actions comprise

1. Comparing, and where appropriate, standardizing and optimizing already existing packing solutions in the member companies, federations and associations, standards and recommendations
2. Defining standards related to sea container dimensions (development trend – Euro-Container)

3 Analysis of the current situation

Unsuitable loading units frequently used in intercontinental transportation are described below. Damage and extra costs can result from poor container usage rates, high cargo lashing inputs and, despite this, a high damage potential.

3.1 Container usage rates

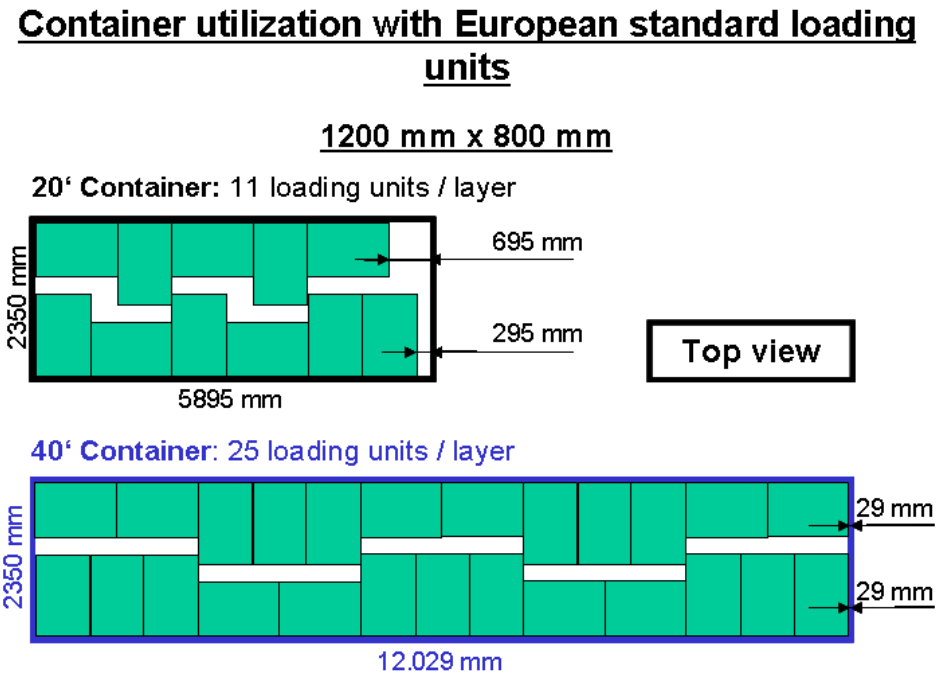
In intercontinental traffic, container dimensions are geared to the Anglo-American measuring system. Loading sea containers with Euro-pallet dimensions (1200 mm x 800 mm) as well as a wide variety of other packaging systems, fails to make optimal use of space available in the container.

Reasons for this include:

- Unsuitable dimensions of the loading units
- Unsuitable packing concepts
- Unsuitable quality of packaging materials

This becomes particularly clear when units from different sources are consolidated into one container.

Even when the containers are filled with segregated loading units that do not display dimensions adapted to the container (e.g. Euro-pallet dimensions), the area/volume of the containers is not used in full, as the illustration below shows.



3.2 Stackability

Currently, most loading units are not stackable in a sea container.

Reasons for this include:

- Insufficient quality of packing materials
- Use of inadequate packing concepts (e.g. see photo alongside)
- Lacking or unclear labels (printing on the packing).

Consequently, the volume (height) of the container is not optimized and additional transportation costs result.

3.3 Transportation damage

Incorrect packaging for intercontinental transportation and the resulting potential sources of error in filling containers represents the largest risks in container transportation.

Shipping these unsuitable loading units causes damage that could be avoided if proper packaging had been utilized.

Selecting unit load dimensions that do not fit those of the container leads to gaps inside the sea container that require extensive cargo securing measures. The gaps must be filled with stowage bags or wooden struts and units are lashed with belts in order to eliminate any movement and consequent damage. The time and materials required to stabilize the container create preventable, additional costs.

The most frequent causes of damage and low container usage rates include:

- Unsuitable dimensions of the loading units
- Non-stackable units
- Insufficient quality of the packing materials
- Pallets with point loads
- Deficient cargo securing measures
- Lacking or imprecise marking

Damage and low container usage rates result in the following costs:

- Higher transportation costs due to poor container usage rates
- Additional labor and materials needed to secure the cargo
- Replacement of damaged or non- available parts
- Labor required to process claims
- Labor and materials required to obtain replacements to avoid capacity bottlenecks

4 Mechanical and climatic stresses

4.1 External influences - sea freight

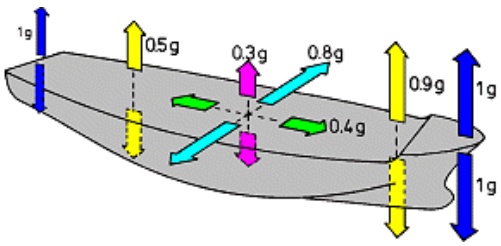
In intercontinental transportation, stresses such as mechanical and climate need to be addressed. Further information is available in the “Containerhandbuch der Deutschen Transportversicherer” (container manual of the German cargo insurers) and the CTU "Cargo Transport Unit" – packing guidelines: ***transportation-Informations-Service (TIS) des Gesamtverbandes der Deutschen Versicherungswirtschaft e.V. (GDV)***

http://www.tis-gdv.de

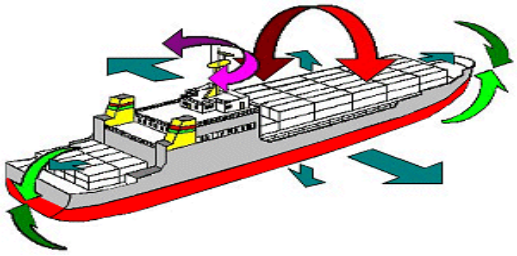
4.1.1 Mechanical stresses in intercontinental traffic

Transport operations are carried out under a great variety of weather conditions. Consequently, the vessel and its cargo are exposed to a multitude of forces acting in different directions and in varying intensity at the same time.

Acceleration forces expected in intercontinental traffic depend on the above-water and below-water design of the vessel, its width, the center of gravity and similar parameters that determine the behavior of the vessel at sea.



Overview of the accelerations on board of a vessel [Container manual]



Ships movements in seas can be reduced to straight and rolling motions [Container manual]

The conditions in the above photos are not unusual during stormy weather! [Container manual]

4.1.2 Climatic stresses in intercontinental traffic

In intercontinental transport, the prevailing climatic conditions (temperature, humidity, etc.) can fluctuate considerably. This can affect the interior conditions inside a container and thus act directly on the cargo (corrosion caused by condensation water). Additional measures, not part of the VDA Recommendation, are needed to provide any necessary **protection against corrosion**.

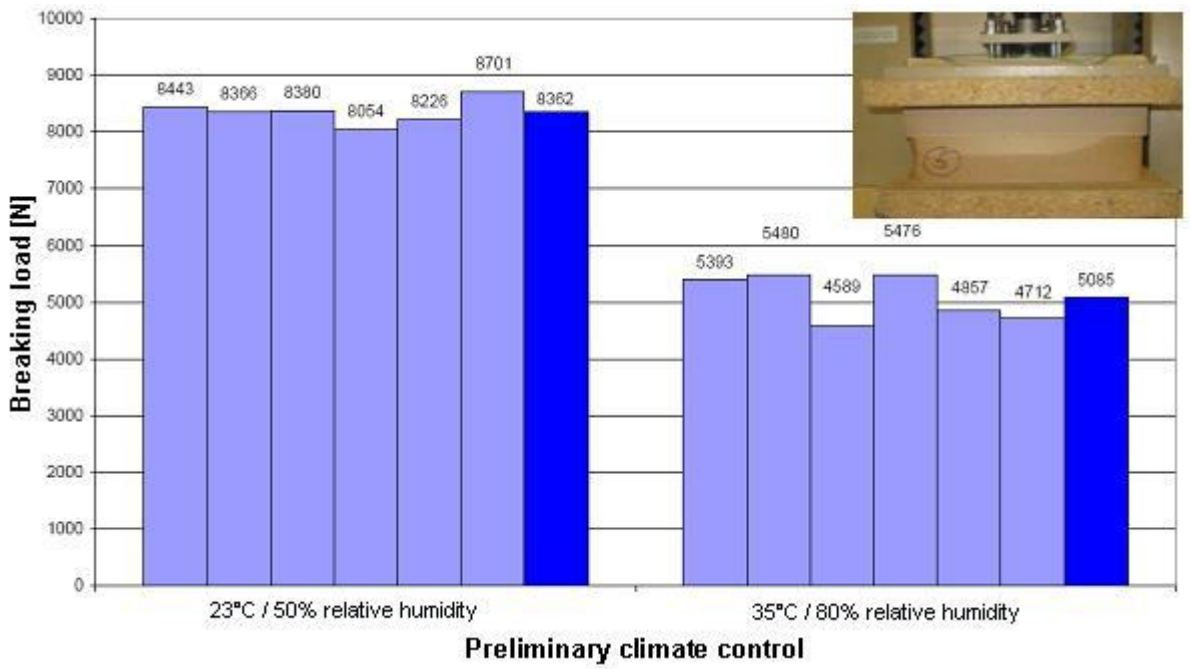
A few common methods include:

- VCI (Volatile Corrosion Inhibitor)
- Coating (film of oil or wax)
- Use of desiccant agents
- …

On the other hand, climatic conditions can also affect the stability of packaging. For example, materials of organic origin (corrugated, wood) with hygroscopic properties are largely used here. Yet with corrugated a **loss of stability due to moisture influence can reach >30%**. Crucial criteria for absorbing or giving-off water vapor are:

- the relative atmospheric humidity of the surrounding air
- the water content of the product/packing (moisture)
- the temperature
- the water absorption capacity of the corrugated (Kraftliner, Testliner, type of gluing, …)

The following example illustrates these influences. It shows the results of the **B**ox **C**ompression **T**est (BCT) on a folding corrugated box. This was tested at 23°C and 50% relative atmospheric humidity and at 35°C and 85% relative atmospheric humidity. In this case the stability loss was approx. 40%!



4.2 Requirements for unit loads

The stresses described result in the following requirements for loading units. In particular, when using expendable packaging made of **organic materials** (corrugated cardboard, wood or wood materials) the resistance capability is subject to the influences of many factors. The exact impact of these factors can be only roughly estimated. These influences include:

- Style of corrugated used (geometry, type/variety of corrugated cardboard used, quality) and wood/materials used
- Climatic stresses (atmospheric humidity, temperature)
- Mechanical stresses (static and dynamic)
- Duration of stress
- Fatigue of material
- Transport route, means of conveyance
- Load distribution
- Load content

In order to make a statement about the suitability and sufficient load capacity of a unit, a safety factor must be applied. There are influencing factors that have not been address in the experiment.

The safety factor describes the quotient of load capacity of the pack and its required stackable load.

$$\text{Safety factor} = \frac{\text{Load capacity (det. from breaking load in normal climate)}}{\text{Required, admissible, stackable load}}$$

Depending on the application, appropriate safety factors need to be applied in order to design a suitable pack/loading unit. It must be taken into account, for example, that the sensitivity to moisture of corrugated is certainly greater than that of wood materials.

In the following passages a safety factor (SF) of ≥ 3.5 is assumed. This is applied to the breaking load of the loading unit determined in normal climate.

The recommendations made here do not absolve users from the responsibility of evaluating from case to case whether the packaging is suitable for the specific application! In particular, attention is drawn to the fact that the complete unit load must be considered. For example, the introduction of force has a crucial influence. As shown below, the breaking load of the unit load was tested with a pallet on top as well.

Determining the breaking load of a corrugated GLT.

4.3 Securing unit loads

The following points must be considered when securing loading units, i.e. securing the goods on the pallet:

- Goods must be secured against movement of any kind on the pallet.
- Four straps are to be used, two lengthways and two crossways.
- Wide plastic straps made of PET or PP are to be used to secure goods on the pallet. See also VDI Guideline 3968 Sheet 3. Plastic straps with a rupture force of min. 4200N and an elongation on rupture of max. 12% have proved expedient. The highest possible working tension should be applied without cutting into the corrugated!
- In order to avoid the straps from cutting in and thus become loose, edge protectors should be used. Edge protectors can be eliminated if a plywood lid is used as a cover for the pallet.
- Loading flaps on the GLTs (large load carriers) are to be closed with min. 70 mm wide, filament-reinforced adhesive tape (filament tape applied crossways in order to prevent splitting parallel with the loading flap).
- Any stretch-wrapping of the unit load is to be discussed and agreed upon bilaterally between the shipper and the consignee.

5 Loading units and their system elements

5.1 Modularizing loading units

Container dimensions are to be within certain boundaries to assure proper transportation.

5.1.1 Modularizing storage space in sea containers

The inner dimensions of a sea container result in the following modularization requirements:

- Make full use of the space inside the sea container (ISO dimension)
- Designed for use in both 40’ and 20’ containers
- Use of slip lids (handling, place on the belt)
- Orientation to European standard dimensions (1200 mm x 800 mm and 1200 mm x 1000 mm) for use as alternative packaging.

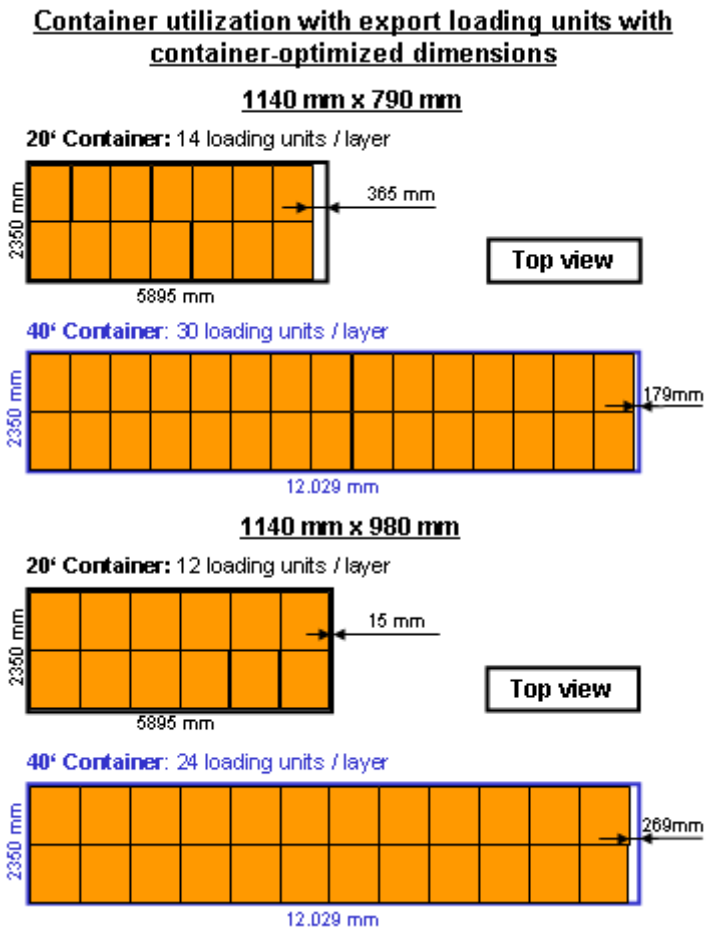
Preferred module

With the inside width of a sea container measuring 2350mm, the standard length of a loading unit must be reduced from 1200 mm to 1140 mm in order to place two units side by side in the container. This dimension has proved successful in the past and accounts for tolerances as well as the width of the container (bumps and dents) and of the corrugated (bulging). The above requirements result in width dimensions of 790 mm and 980 mm.

The dimensions of e.g. 1170 mm x 760 mm also satisfy the requirements. However, these loading units would be placed in rows of three next to each other in the container. Because they are difficult to distinguish optically from the loading units with dimensions 1140 mm x 790 mm, problems will occur during loading.

Thus the following dimensions are optimal footprints for a unit loading:

- 1140 mm x 790 mm
- 1140 mm x 980 mm



Loading units with dimensions larger than 1140 mm are specified by the CKD Department (no standard series supply).

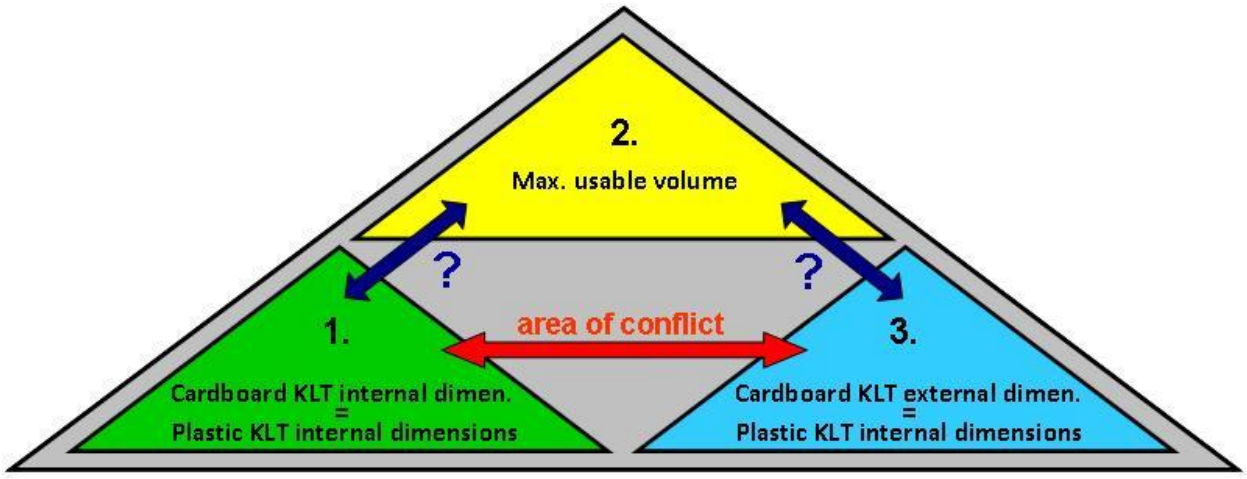
5.1.2 Modularizing storage space of the unit load

On the grounds of various restrictions (e.g. automation), production processes are generally supplied with parts in small packages. These are generally VDA-KLT (small load carriers) made of plastic. As a consequence, it is necessary to repack the parts transported in the container into corrugated packs.

Two main concepts are:

- The content of the corrugated KLT is transferred to a plastic KLT. Thus the same inner packing components can be used for both the corrugated and plastic KLTs.
- The filled corrugated KLT is placed in a plastic KLT.

This results in the following approaches for dimensional modularizing of container-optimized packs:



To what extent can these approaches be harmonized?

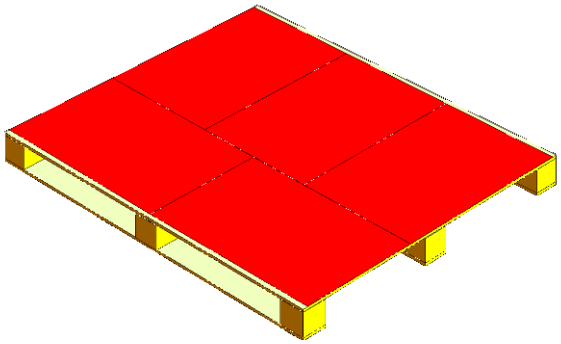
1. The inner dimensions of the container-optimized pack are the same as the inner dimensions of the plastic KLT, whereby the largest dimension in each direction (length, width, height) of the R-KLT or RL-KLT is to be used.
   Advantage: inner packing of multiple-use supplies can be taken over. Simple transfer into returnable KLT is possible.
   (Series B1)
2. Maximum useful volume in the use of an outer carton both on container-optimized pallets and in the container.
   (Series B2)
3. Outer dimensions of the container-optimized packaging are the same as the inner dimensions of the plastic KLT, whereby in each case the smallest dimension in each direction (length, width, height) of the R-KLT or the RL-KLT is to be used.
   Advantage: the carton can be placed directly in plastic KLTs to use automatic conveying systems (Series B3).

5.1.3 Result of modularizing storage space

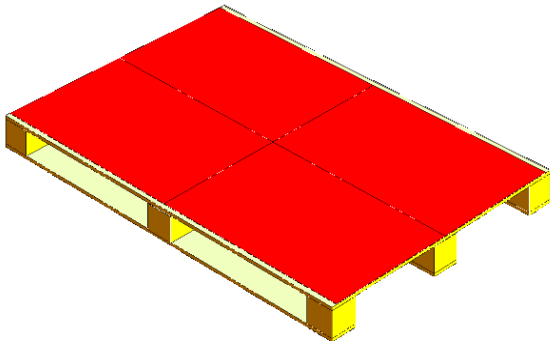
Preferred modules (modularizing from the outside to the inside and from the inside to the outside): Positioning scheme of the corrugated cardboard KLT depending on the series of selected pallets

Nominal dimensions module series B1: 570*380* *(max. outer dimension, max. useful volume, inner dimensions >= plastic KLT inner dimension, can only be used without outer ring/frame (GLT))

1140x980, 570x380, B1



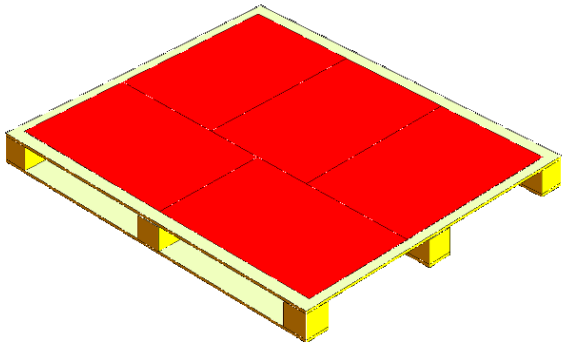
1140x790, 570x380, B1



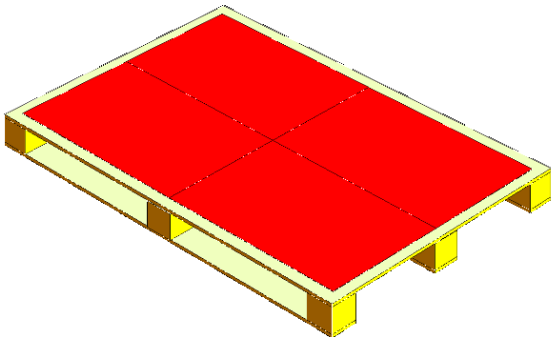
For series B1 no additional outer carton possible!

Nominal dimensions module series B2: 540*360* *(max. outer dimension, max. useful volume module with use of outer ring/frame(GLT))

1140x980, 540x360, B2



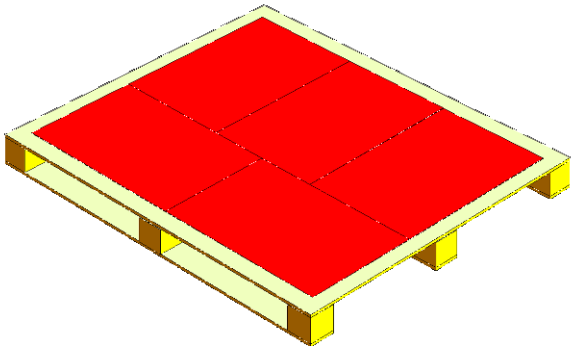
1140x790, 540x360, B2



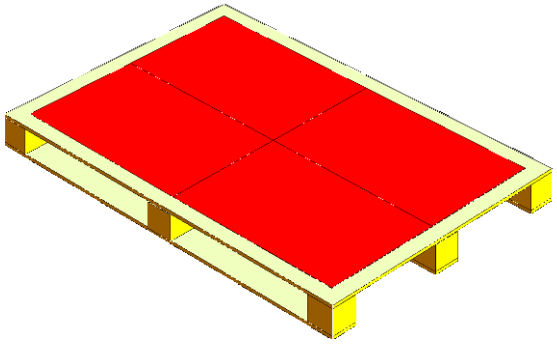
For series B2 simple 3-corrugation outer ring (GLT) is used.

Nominal dimensions module series B3: 530*350* *(outer dimension <= plastic KLT inner dimension, use of outer ring/frame (GLT))

1140x980, 530x350, B3



1140x790, 530x350, B3



For series B3 3-corrugation outer ring/frame (GLT)+3-corrugation inner ring can be used.

Overview: Number of corrugated KLTs per layer on the pallet.

Series	Pallet without GLT		Pallet with 3-corrugation GLT		Pallet with 3-corrugation GLT + 3-corrugation inner ring	
	1140x980mm	1140x790mm	1095x925mm	1095x735mm	1070x900mm	1070x710mm
KLT-B1-5730	5	4				
KLT-B1-5715	5	4				
KLT-B1-3830	10	8				
KLT-B1-3815	10	8				
KLT-B1-2815	20	16				
KLT-B2-5730			5	4		
KLT-B2-5715			5	4		
KLT-B2-3830			10	8		
KLT-B2-3815			10	8		
KLT-B2-2815			20	16		
KLT-B3-5730			5	4	5	4
KLT-B3-5715			5	4	5	4
KLT-B3-3830			10	8	10	8
KLT-B3-3815			10	8	10	8
KLT-B3-2815			23	23	19	17

An additional advantage of the container-optimized packs is that in many cases the load containers can also be used as alternative packs. It is often required that the alternative packs must contain the same number of parts as the series packs, a condition which is satisfied e.g. in the case of KLT deliveries by Series B1. In addition, the inner dimensions of the outer packs developed here are very similar to the multiple use loading units that are used in the series (1200 mm x 1000 mm and 1200 mm x 800 mm), so that these too are very suitable as alternative or substitute packs and thus do not present any hindrance in the given material flow.

5.2 Structure of load carriers (LT)

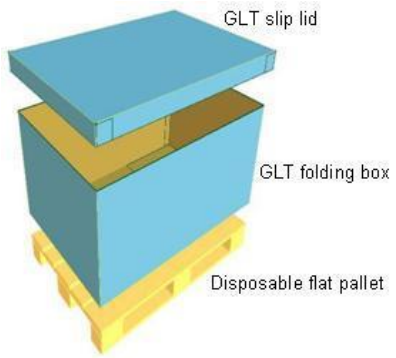
5.2.1 General

The variants of GLT and KLT units described in the following sections represent the most frequently used variations. The removable lids make it possible to simplify direct supply of material at the belt so that major repacking processes can be avoided and are only necessary for a very small spectrum of parts (e.g. body shop production). The recommended dimensions for these structural forms have been determined and confirmed by appropriate tests.

5.2.2 Corrugated large load carriers (corrugated GLT)

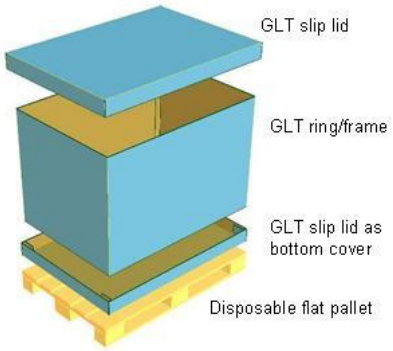
Structure of container optimized GLT

The three most frequently used variants of GLT load carriers are shown below. As already described, one important criterion of this recommendation is the use of slip lids.



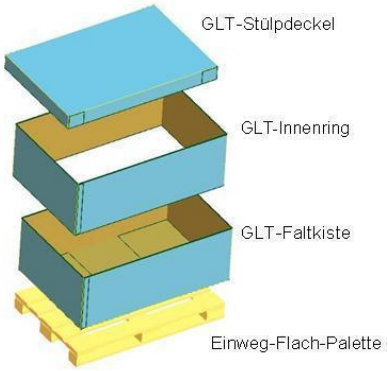
System: FEFCO 0312

- GLT slip lid
- GLT folding box
- Disposable flat pallet



System: FEFCO 0310/0314

- GLT slip lid
- GLT ring/frame
- GLT slip lid as bottom cover
- Disposable flat pallet



System: FEFCO 0312 + 0501

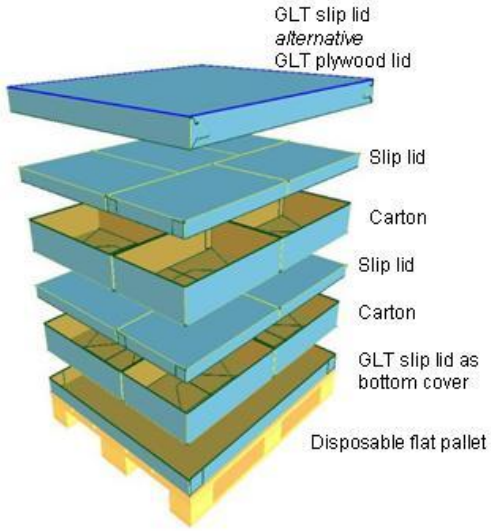
- GLT slip lid
- Inner ring/frame
- GLT folding box
- Disposable flat pallet

5.2.3 Corrugated small load carriers (corrugated KTL)

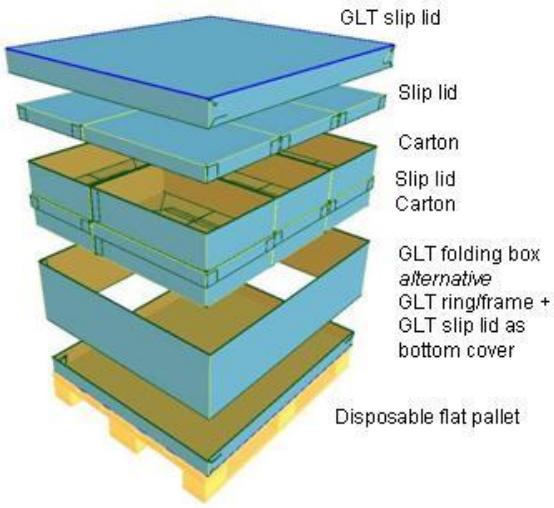
Based on the results of the load tests, column stacking is preferred to interlocking stacking.

Corrugated KLTs with individual slip lid

Series B1

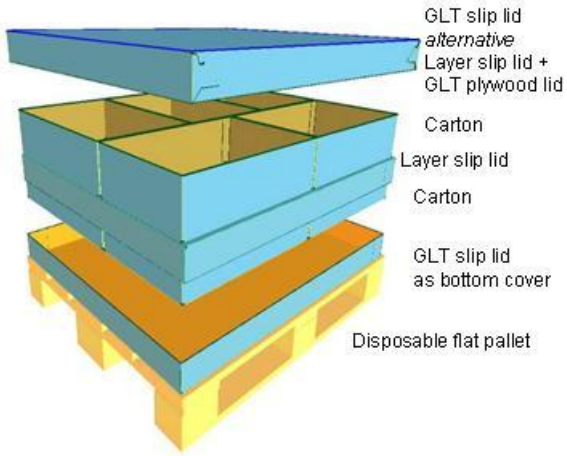


Series B2 and B3 without inner ring/frame

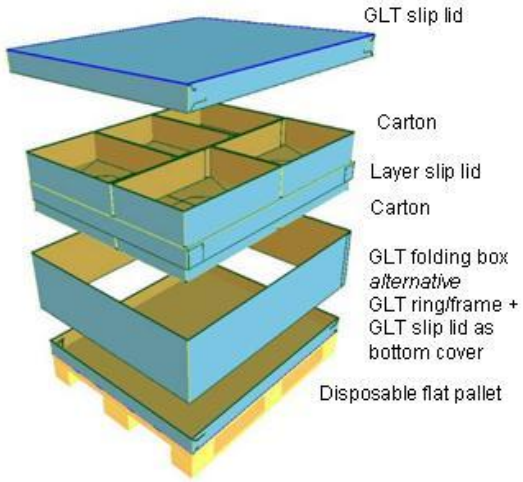


Corrugated KLTs with layer slip lid

Series B1



Series B2 and B3 without inner ring/frame



5.3 Load grading of loading units (LU) in container shipping:

In order to simplify use of the loading units, load grades have been specified. This means that the admissible gross weight and the resulting admissible stacking load on top of the unit have been specified. The two load grades are fixed at:

Load grade 1: 240/300 kg per loading unit (for 1140 x 790/1140 x 980 mm)

Load grade 2: 360/450 kg per loading unit (for 1140 x 790/1140 x 980 mm)

Break loading tests were carried out using these load grades. The maximum admissible stacking load listed in the table of the system elements was achieved using given material specifications (e.g. BCT values of ECT values) (safety factor ≥ 3.5). The admissible gross weights of the unit loads and admissible stacking loads for the given material specifications are set out in the list of system elements. If the given load limits are to be exceeded, this must be secured by corresponding tests as described in each case. The admissible stacking load can be increased by using additional inner structures (e.g. divider / pigeonholes) or the inner ring/frame of Series B3. It is recommended that the safety factor of ≥ 3.5 be always maintained with regard to the breaking load of the loading unit.

5.3.1 Load grade 1: 240/300 kg per loading unit

This load grade should be used for Series B1 in the KLT system and for Series L (light) in the GLT system. In these series, there is a maximum gross weight of 240 kg for pallet LT-1108 (1140 x 790 mm) and a maximum gross weight of 300 kg per unit load for pallet LT -1110 (1140 x 980 mm). GLT Series GLT-L can be combined with the KLT Series KLT-B2 and KLT-B3 assuming only the GLT carries the stackable load.

These limits resulted from the largest KLT of Series B1 (KLT-B1-5730). Twelve of these KLT can be packed on pallet LT-1108, and 15 KLTs on pallet LT-1110. If the weights of the packing materials are neglected in this consideration, at an assumed maximum gross weight of 20 kg per KLT, this results in a weight of 240 and 300 kg respectively per loading unit. In the smaller corrugated KLT the number of layers must be reduced according to the weight per KLT or the number of layers, so that the load limit is not exceeded.

In the corrugated cardboard KLT the maximum payload per corrugated KLT is limited to 15 kg for reasons of handling and to take into account the tare weights of the packing materials. The maximum, admissible gross weight per loading unit, as stated in the table of system elements, must always be observed.

5.3.2 Load grade 2: 360/450 kg per loading unit

This load grade is to be applied for Series H of the GLT. The GLT series GLT-H can be combined with the KLT Series KLT-B2 and KLT-B3. Here too it was assumed that only the GLT bear the stacking load on top.
This load grade resulted from the attempt to achieve the maximum possible stacking load with a standard triple wall corrugated. Here too, with different pallet sizes, different stacking loads result. The maximum weight of the loading unit is 360 kg for pallet LT-1108 (1140 x 790 mm). The corresponding weight for pallet LT-1110 (1140 x 980 mm) is 450 kg.

5.4 System elements and their specifications

5.4.1 Dimensions/overview

The dimensional series are described in more detail in the tables of the system elements. This section shows excerpts from the tables. The complete overviews of all system elements are attached to the recommendation as an annex.
All corrugated GLT systems are to be glued watertight.
Triple-wall corrugated is to be used for the corrugated GLTs (Double wall corrugated for GLT lids), the outer and inner covers of which are made of Kraftliner.
Kraftliner is to be used for the outer cover of the corrugated KLT system elements and, if needed, watertight glue.

Excerpt from the KLT Table

Module	Code	System element	Nominal dimension [mm]			External dimension [mm]			Internal dimension [mm]			Design (recommended variants) [3]	Quality					
			l	w	h	l	w	h	l	w	h	FEFCO	BCT_{ZFCSOS} min [N]	≈ Thickness of cardboard [mm]	ECT [kN/m]	Puncture resistance [J]	Bursting strength [kPa]	Wet bursting strength [kPa]
Covers	GLT-SD-1108	GLT-slip lid	1.140	790	80	1.140	790	87	1.128	765	80	FEFCO 0457		7	14,0	15		800
	GLT-SD-1110	GLT-slip lid	1.140	980	80	1.140	980	87	1.128	955	80							
	KLT-B1-SD1108	GLT-plywood lid	1.140	790	6	1.140	790	6				Plywood blank						
	KLT-B1-SD1110	GLT-plywood lid	1.140	980	6	1140	980	6				Plywood blank						
KLT B1	KLT-B1-5730	Carton	570	380	280	564	376	276	550	362	262*	FEFCO 0200 FEFCO 0200 with slot snap lock bottom	8.500	7	BCT mandatory, because cartons carry the weight during stacking (superimposed load), higher BCT possible to use standard corrugated cardboard qualities			Outer cover layer Kraft liner, if required wet strength glued
	KLT-B1-5715	Carton	570	380	140	564	376	144	550	362	130*		8.500					
	KLT-B1-57SD	Slip lid, 1 flute	570	380	50	570	380	52	564	377	50	FEFCO 0450 FEFCO 0453		1,5	5,5	4,5	1350	
	KLT-B1-3830	Carton	380	285	280	374	282	276	360	268	262*	FEFCO 0200 FEFCO 0200 with slot snap lock bottom FEFCO 0700 [1]	4.250	7	BCT mandatory, because cartons carry the weight during stacking (superimposed load), higher BCT possible to use standard corrugated cardboard qualities			
	KLT-B1-3815	Carton	380	285	140	374	282	144	360	268	130*		4.250					
	KLT-B1-38SD	Slip lid, 1 flute	380	285	50	380	285	52	374	282	50	FEFCO 0450 FEFCO 0453		1,5	5,5	4,5	1350	
	KLT-B1-2815	Carton	285	190	140	277	185	144	263	171	130*	FEFCO 0200 FEFCO 0700 [1]	2.125	7	BCT mandatory, because cartons carry the weight during stacking (superimposed load), higher BCT possible to use standard corrugated cardboard qualities			
	KLT-B1-28SD	Slip lid, 1 flute	285	190	50	283	188	52	277	185	50	FEFCO 0450 FEFCO 0453		1,5	5,5	4,5	1350	
	KLT-B1-LD1108	Layer slip lid, 2 flutes	1.140	790	55	1.140	774	55	1.130	754	50	FEFCO 0451 FEFCO 0452		5	7,0	6,5	1100	
	KLT-B1-LD1110	Layer slip lid, 2 flutes	1.140	980	55	1.140	961	55	1.130	941	50			5	7,0	6,5	1100	
KLT B2	KLT-B2-5730	Carton	540	360	293	533	357	291	519	343	277*	FEFCO 0200 FEFCO 0200 with slot snap lock bottom		7	8,0	7,5	1350	
	KLT-B2-5715	Carton	540	360	146	533	357	144	519	343	130*			7	8,0	7,5	1350	
	KLT-B2-57SD	Slip lid, 1 flute	540	360	60	540	360	60	534	357	58	FEFCO 0450 FEFCO 0453		1,5	5,5	4,5	1350	
	KLT-B2-3830	Carton	360	270	293	353	267	291	339 (343)	253 (257)	277* (281*)	FEFCO 0200 FEFCO 0200 with slot snap lock bottom FEFCO 0700 [1]		7 5	8,0	7,5	1350	
	KLT-B2-3815	Carton	360	270	146	353	267	144	339 (343)	253 (257)	130* (134*)			7 5	8,0	7,5	1350	
	KLT-B2-38SD	Slip lid, 1 flute	360	270	60	360	270	60	354	267	58	FEFCO 0450 FEFCO 0453		1,5	5,5	4,5	1350	
	KLT-B2-2815	Carton	270	180	146	263	177	144	253	167	134*	FEFCO 0200 FEFCO 0700 [1]		5	8,0	7,5	1350	
	KLT-B2-28SD	Slip lid, 1 flute	270	180	60	270	180	60	264	177	58	FEFCO 0450 FEFCO 0453		1,5	5,5	4,5	1350	
	KLT-B2-LD1108	Layer slip lid, 1 flute	1.140	790	60	1.076	724	62	1.073	718	60	FEFCO 0451 FEFCO 0452		1,5	5,5	4,5	1350	
	KLT-B2-LD1110	Layer slip lid, 1 flute	1.140	980	60	1.076	904	62	1.073	898	60			1,5	5,5	4,5	1350	
KLT B3	KLT-B3-5730 [2]	Carton	530	350	237	524	347	235	510	333	221*	FEFCO 0200 FEFCO 0200 with slot snap lock bottom		7	8,0	7,5	1350	
	KLT-B3-5715 [2]	Carton	530	350	104	524	347	102	510	333	88*			7	8,0	7,5	1350	
	KLT-B3-57SD	Slip lid, 1 flute	530	350	60	530	350	60	524	347	58	FEFCO 0450 FEFCO 0453		1,5	5,5	4,5	1350	
	KLT-B3-3830	Carton	346	258	237	340	255	235	326 (330)	241 (245)	221* (225*)	FEFCO 0200 FEFCO 0200 with slot snap lock bottom FEFCO 0700 [1]		7 5	8,0	7,5	1350	
	KLT-B3-3815	Carton	346	258	104	340	255	102	326 (330)	241 (245)	88* (92*)			7 5	8,0	7,5	1350	
	KLT-B3-38SD	Slip lid, 1 flute	346	258	60	346	258	60	340	255	58	FEFCO 0450 FEFCO 0453		1,5	5,5	4,5	1350	
	KLT-B3-2815	Carton	244	160	124	238	157	122	228	147	112*	FEFCO 0200 FEFCO 0700 [1]		5	8,0	7,5	1350	
	KLT-B3-28SD	Slip lid, 1 flute	244	160	60	244	160	60	238	157	58	FEFCO 0450 FEFCO 0453		1,5	5,5	4,5	1350	
	KLT-B3-LD1108	Layer slip lid, 1 flute	1.140	790	60	1.058	704	62	1.055	698	60	FEFCO 0451 FEFCO 0452		1,5	5,5	4,5	1350	
	KLT-B3-LD1110	Layer slip lid, 1 flute	1.140	980	60	1.058	889	62	1.055	883	60			1,5	5,5	4,5	1350	

GLT Table

Module	Code	System element	Nominal dimension [mm]			External dimension [mm]			Internal dimension [mm]			Design (options)	Quality [1]					LU - load grade	
			l	w	h	l	w	h	l	w	h	FEFCO	Breaking strength of LU [1] 23°C/50% [N]	≈ Thickness of cardboard [mm]	ECT (Edge Crush Resistance) [kN/m]	Puncture resistance [J]	Wet bursting strength [kPa]	Max. gross weight / LU [kg]	Max. superimposed load / LU, dyn. [kg]
GLT lid	GLT-SD-1108	GLT-slip lid 1.140*790	1.140	790	80	1.140	790	87	1.128	765	80	FEFCO 0457		7	14,0	15	800		
	GLT-SD-1110	GLT-slip lid 1.140*980	1.140	980	80	1.140	980	87	1.128	955	80								
GLT-L light	GLT-FK-089L	GLT-folding box 1.140*790*900	1.140	790	900	1.125	765	909	1.095	735	879+	FEFCO 0200 with loading flaps [2]	16800	12,5	18,0	22	1.200	< 240 kg	240 kg [3]
	GLT-FK-086L	GLT-folding box 1.140*790*600			600			616			586+	FEFCO 0200							480 kg
	GLT-FK-083L	GLT-folding box 1.140*790*300			300			323			293+								
	GLT-R-089L	GLT-ring/frame 1.140*790*900			900			893			879+	FEFCO 0501 with loading flaps [2]	16800	12,5	18,0	22	1.200	< 240 kg	240 kg [3]
	GLT-R-086L	GLT-ring/frame 1.140*790*600			600			600			586+	FEFCO 0501							480 kg
	GLT-R-083L	GLT-ring/frame 1.140*790*300			300			307			293+								
	GLT-FK-109L	GLT-folding box 1.140*980*900		980	900		955	909		925	879+	FEFCO 0200 with loading flaps [2]	21.000	12,5	18,0	22	1.200	< 300 kg	300 kg [3]
	GLT-FK-106L	GLT-folding box 1.140*980*600			600			616			586+	FEFCO 0200							600 kg
	GLT-FK-103L	GLT-folding box 1.140*980*300			300			323			293+								
	GLT-R-109L	GLT-ring/frame 1.140*980*900			900			893			879+	FEFCO 0501 with loading flaps [2]	21.000	12,5	18,0	22	1.200	< 300 kg	300 kg [3]
	GLT-R-106L	GLT-ring/frame 1.140*980*600			600			600			586+	FEFCO 0501							600 kg
	GLT-R-103L	GLT-ring/frame 1.140*980*300			300			307			293+								
GLT-H heavy	GLT-FK-089H	GLT-folding box 1.140*790*900		790	900		765	909		735	879+	FEFCO 0200 with loading flaps [2]	25200	12,5	24,0	30	1.800	< 360 kg	360 kg [3]
	GLT-FK-086H	GLT-folding box 1.140*790*600			600			616			586+	FEFCO 0200							720 kg
	GLT-FK-083H	GLT-folding box 1.140*790*300			300			323			293+								
	GLT-R-089H	GLT-ring/frame 1.140*790*900			900			893			879+	FEFCO 0501 with loading flaps [2]	25200	12,5	24,0	30	1.800	< 360 kg	360 kg [3]
	GLT-R-086H	GLT-ring/frame 1.140*790*600			600			600			586+	FEFCO 0501							720 kg
	GLT-R-083H	GLT-ring/frame 1.140*790*300			300			307			293+								
	GLT-FK-109H	GLT-folding box 1.140*980*900		980	900		955	909		925	879+	FEFCO 0200 with loading flaps [2]	31.500	12,5	24,0	30	1.800	< 450 kg	450 kg [3]
	GLT-FK-106H	GLT-folding box 1.140*980*600			600			616			586+	FEFCO 0200							900 kg
	GLT-FK-103H	GLT-folding box 1.140*980*300			300			323			293+								
	GLT-R-109H	GLT-ring/frame 1.140*980*900			900			893			879+	FEFCO 0501 with loading flaps [2]	31.500	12,5	24,0	30	1.800	< 450 kg	450 kg [3]
	GLT-R-106H	GLT-ring/frame 1.140*980*600			600			600			586+	FEFCO 0501							900 kg
	GLT-R-103H	GLT-ring/frame 1.140*980*300			300			307			293+								

1) **Min. Breaking strength that has to be achieved! Test has to be done with one pallet under the loading unit and one pallet on top! The values for breaking strength in the table have been achieved with the cardboard material with the stated data (ECT,...).**

2) **Loading flap at one long side, 750mm widthwise and a hight of 440mm. Crease line only 750mm widthwise, not over the complete length of the box!**
Cuttings of the loading flap have to be glued with reinforced adhesive tape!

3) **Loading units with this height can only be stacked 1+1 inside the container. Therefore only the superimposed load of one loading unit has to be guaranteed (at all times a safety factor ≥ 3,5 has to be guaranteed!).**

4) **Cardboard material with three flutes has to be used for the GLT (GLT lids two flutes), which are wet strength glued. The outer and inner cover layers have to consist of Kraft liner.**

5.4.2 Types of construction

5.4.2.1 *Pallets*

This recommendation describes two pallets with the specified basic dimensions (1140 x 980 and 1140 x 790 mm) with corresponding dimensions of the system elements (see Annex). If other pallets are used, the following specifications must be observed:

Material:

Solid timber, wood material (plywood, OSB, …) or segregated plastic. The required load capacity must be achieved. If wood is used, the applicable import regulations must be observed (see IPPC Standard ISPM No. 15 Phytosanitary Ruling: https://www.ippc.int)

Structure:

- Four-way pallet (with forklift pockets on 4 sides), minimum of 3 runners,
- Use of a Full Perimeter Pallet must be agreed bilaterally, as these cannot be picked up with hand lift trucks and thus cannot be used universally
- The use of form-pressed chipboard pallets is not admissible (spot loads on stacking).

Load-bearing capacity:

- Load-bearing capacity with large-area loading min. 500 kg per pallet
- Load-bearing capacity with large-area loading static min. 2000 kg in stack
- Suitable for high-rack storage with strip load min. 500 kg

DIN 15158-1 is to be observed for pallets. Tests are to be conducted to DIN EN ISO 8611-1. For pallets the safety factor 2 is to be maintained for stiffness tests (see DIN 15158-1).

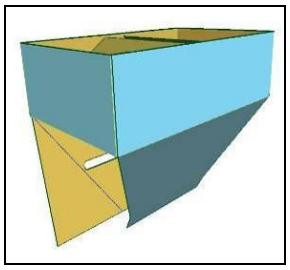
5.4.2.2 *Corrugated cardboard folding boxes (Corrugated cardboard KLT, GLT)*

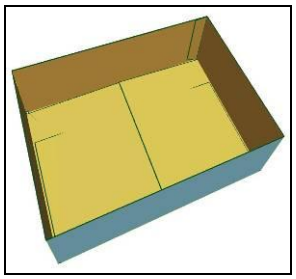
Corrugated folding boxes are intended as a substitute for the small load carriers (KLT) and large load carriers (GLT).

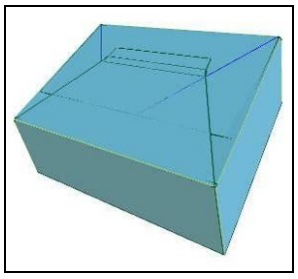
The base design of the corrugated folding boxes can be selected freely. Bottom flaps, automatic bases and insert bases by analogy with FEFCO (see Table of system elements) are possible.

As a matter of principle, corrugated folding boxes without lid flaps should be used. Slip lids for the corrugated folding boxes can be executed e.g. glued at four points, stapled (not for KLT) or rolled. It is not always necessary to have one lid per KLT per layer – depending on the agreements reached, one lid per layer can be used. Optimal designs that make it possible to observe the necessary dimensions are shown in the Table of system elements. The international FEFCO Code is used to describe the design: FEFCO Code (www.fefco.org)

Example of a preferred base design: KLT insert base/ bottom (slot snap lock bottom)







Corrugated:

Corrugated is a packing material made of paper and starch glue. Different paper webs (corrugated and cover papers) are glued together in one or more layers. Depending on the intended purpose and the load to be carried, single, double or triple wall corrugated is produced. There are different types of corrugation and paper.

The combination of types of corrugation and papers produces the corrugated quality. These requirements can be measured in defined terms and include for example:

Box compression resistance (BCT), edge crushing resistance (ECT), water absorbance, thickness, bursting strength (BST), wet bursting strength (for wet-tight gluing), flat crushing resistance, resistance to puncturing (PET), water tight gluing, weight per unit area.

Details are described in the standards DIN 55468-1 (Corrugated - requirements and tests) and DIN 55468-2 (Corrugated - watertight, requirements and tests).

This Recommendation describes the corrugated qualities using BCT, ECT, PET, thickness and BST or wet bursting strength (for wet-tight gluing). Particulars are described in the Table of system elements.

5.4.2.3 *Wooden cases (Wood KLT, GLT)*

Cases, load containers made of wood or wood materials, are not addressed in this Recommendation. Especially in the GLT segment, containers made of wood or wood materials can be an effective alternative for heavy loads (> load grade 2). As described for wooden pallets, the corresponding import regulations must be observed (see IPPC Standard ISPM No. 15 Phytosanitary Ruling: https://www.ippc.int). In the GLT segment, containers made of plywood that can carry large loads, depending on the structure and wood thickness, have proved successful. The advantages over solid timber in such cases are:

- Made of thin, very stable plywood (weight)
- Foldable (low space requirement)
- Special interlocking system, no need to nail together.

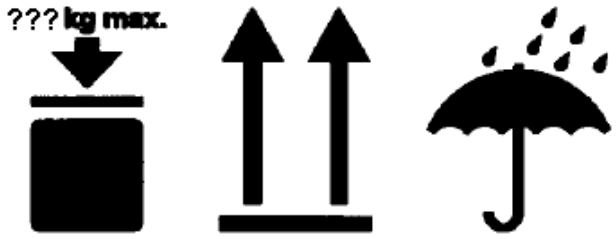
When determining the load bearing capacity, lower safety factors can be applied as moisture does not affect plywood in the same way as corrugated. However, the safety factor must be at least ≥ 2 here as well. An example is shown below:

6 Marking of loading units

Marking of loading units should always be in line with **DIN EN ISO 780**. The following is recommended.

Pictographs:

The **loading unit** is to be marked with pictographs No. 3 “top”, pictograph No. 6 “protect against wetting” and pictograph No. 13 “limit of stacking load”. The max. weight to be applied for pictograph No. 13 is to be taken from the Table of system elements (max. stacking load).



Sequence of pictographs: Nos. 13, 3 and 6

Attachment:

The application or attachment to the loading unit (package) is also described in DIN EN ISO 780. The pictographs can be applied by stencil or labels. In the GLT systems the pictographs can also be printed on directly by the manufacturers. It is not possible to print the pictograph No. 13 “limit of stacking load“ on KLTs as the stacking load varies from application to application (see Table of system elements). Pictograph No. 3 “top” and pictograph No. 6 “protect against wetting” can also be printed directly on the KLT.

Marks possible in addition to DIN EN ISO 780:

For better visualization, the following marks can also be printed on the KLT and GLT system elements:

- Max. useful load (15 kg for all KLTs, for GLTs as set out in the Table of system elements)
- Packing code
- Company logo

7 Definitions

CKD	Completely Knocked Down: in the automotive industry vehicles are transported to the recipient countries knocked down and finally assembled there
Eurocontainer	Sea container with useful inside width in accordance with the standard European truck
FEFCO	European Corrugated Cardboard Manufacturers Federation
Filament-reinforced adhesive tape	Adhesive tape reinforced with synthetic fibers
Full Perimeter Pallet	Pallet with runners all round.
ISPM No. 15 / IPPC	International Standards for Phytosanitary Measures – Regulation of wood packaging material in international trade / International Plant Protection Convention
Kraftliner	Sulfate pulp papers made from conifer fibers with high primary fiber component and defined strength properties
Unit load	A bound unit with one or more KLT and /or GLT on a pallet.
Column stacking	In column stacks, corrugated KLTs stack straight on top of one another. The stability of the individual cartons is used optimally.
Sea container (here also called container)	Internationally standardized transport container for the rational conveyance of goods
Testliner	Generally two-layer papers (duplex) made of different paper fiber substances on the basis of recycled paper
VDA-plastic GLT	Large load carrier, VDA standardized GLT acc. to VDA Recommendation 4520
VDA-Plastic –KLT	Small load carrier, VDA standardized KLT o VDA Recommendation 4500
Interlocking stack	Corrugated KLTs are placed in layers in different arrangements on a pallet in order to achieve better stability of the load through interlocking

8 Annex

Constituent parts of the Annex

- **A1 System element Pallet LT-1108**
  Drawing of the Pallet LT-1108
- **A2 System element Pallet LT-1110**
  Drawing of the Pallet LT-1110
- **A3 System elements GLT**
  Table of the system elements GLT
- **A4 System elements KLT**
  Table of the system elements of all KLT series