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Box pallets — Principal requirements and test methods

Palettes boîtes — Exigences principales et méthodes d'essais

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13194 was prepared by Technical Committee ISO/TC 51, *Pallets for unit load method of materials handling*.

Introduction

This International Standard provides definitions and specifies principal requirements and test methods for box pallets, excluding tank and silo pallets as defined in ISO 445. It is performance-based, i.e. no minimum values are fixed. It reflects ISO 8611-1 in this respect. Box pallets are tested in accordance with the claimed performances.

This International Standard evaluates performances in relation to the load capacity of a box pallet carrying a uniformly distributed load used as test load and called the nominal load. However, it is recognized that the maximum working load for a box pallet could vary with the type of load carried and that, for a specific type of load, the maximum working load can be smaller or larger than the nominal load of a box pallet. Therefore, the allowable maximum load for a given design of box pallet varies according to the characteristics of the type of load carried.

Box pallets — Principal requirements and test methods

1 Scope

This International Standard specifies the definitions, principal requirements and test methods for box pallets of all materials. It applies to box pallets, including post pallets and cage pallets, but is not intended to apply to tank and silo pallets as defined in ISO 445. It also applies to box pallets which can be stacked and handled by forklift trucks or pallet trucks, but excludes other lifting devices.

This International Standard addresses the performance of the box pallet only, and not its contents.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 445, *Pallets for materials handling — Vocabulary*

ISO 6780, *Flat pallets for intercontinental material handling — Principal dimensions and tolerances*

ISO 8611-2:2011, *Pallets for materials handling — Flat pallets — Part 2: Performance requirements and selection of tests*

ISO 2206, *Packaging — Complete, filled transport packages — Identification of parts when testing*

ISO 2234, *Packaging — Complete, filled transport packages and unit loads — Stacking tests using a static load*

ISO 2244, *Packaging — Complete, filled transport packages and unit loads — Horizontal impact tests*

ISO 2247, *Packaging — Complete, filled transport packages and unit loads — Vibration tests at fixed low frequency*

ISO 2248, *Packaging — Complete, filled transport packages — Vertical impact test by dropping*

EN 13382, *Flat pallets for materials handling — Principal dimensions*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
pallet with superstructure
pallet with a fixed superstructure or a rigid, self-supporting container that can be mechanically attached to the pallet and which contributes to the strength of the pallet

3.2
box pallet
bulk container pallet
pallet with solid or close boarded sides, one or more of which can have hinged or removable gates for access as defined in ISO 445, whether fixed, collapsible or demountable

NOTE 1 See Figure 1.

NOTE 2 A box pallet can be fitted with a lid.

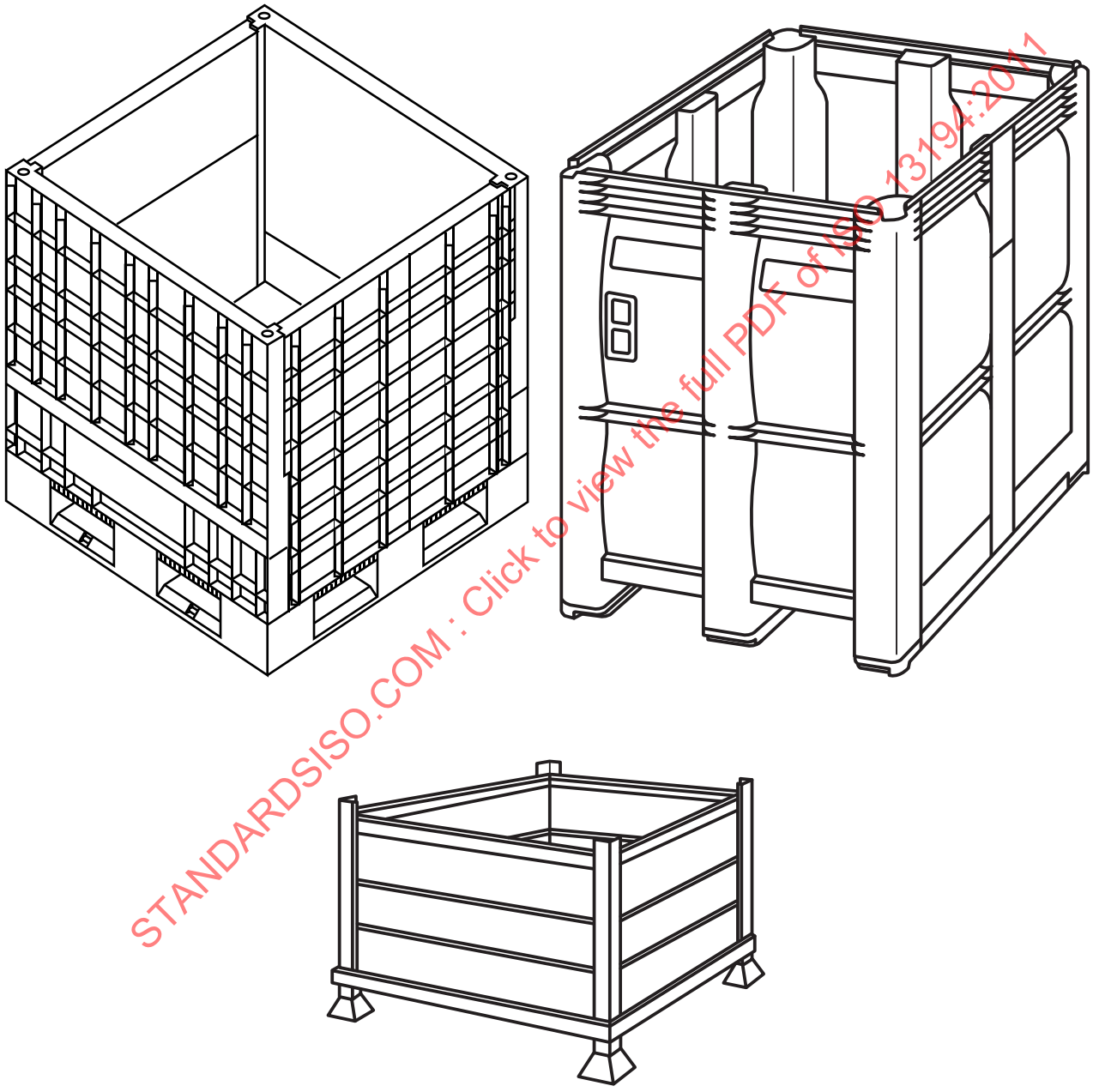


Figure 1 — Examples of box pallets

3.3
fixed box pallet
box pallet with sides permanently and rigidly fixed to the deck

3.4
collapsible box pallet
box pallet with sides hinged to the deck

NOTE See Figure 2.

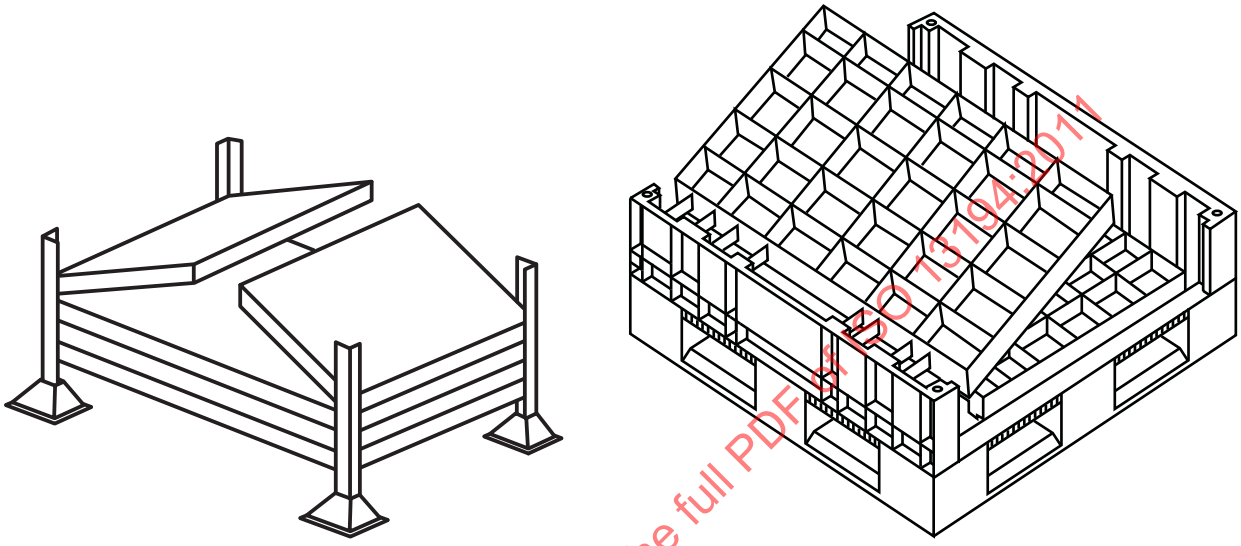


Figure 2 — Examples of collapsible box pallets

3.5
demountable box pallet
box pallet with removable sides

NOTE See Figure 3.

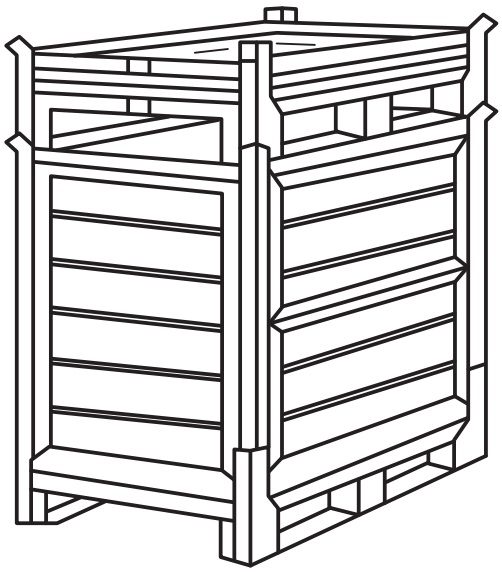


Figure 3 — Example of demountable box pallet

3.6
post pallet
pallet having posts to permit stacking, and fitted with either removable rails or gates

NOTE See Figure 4.

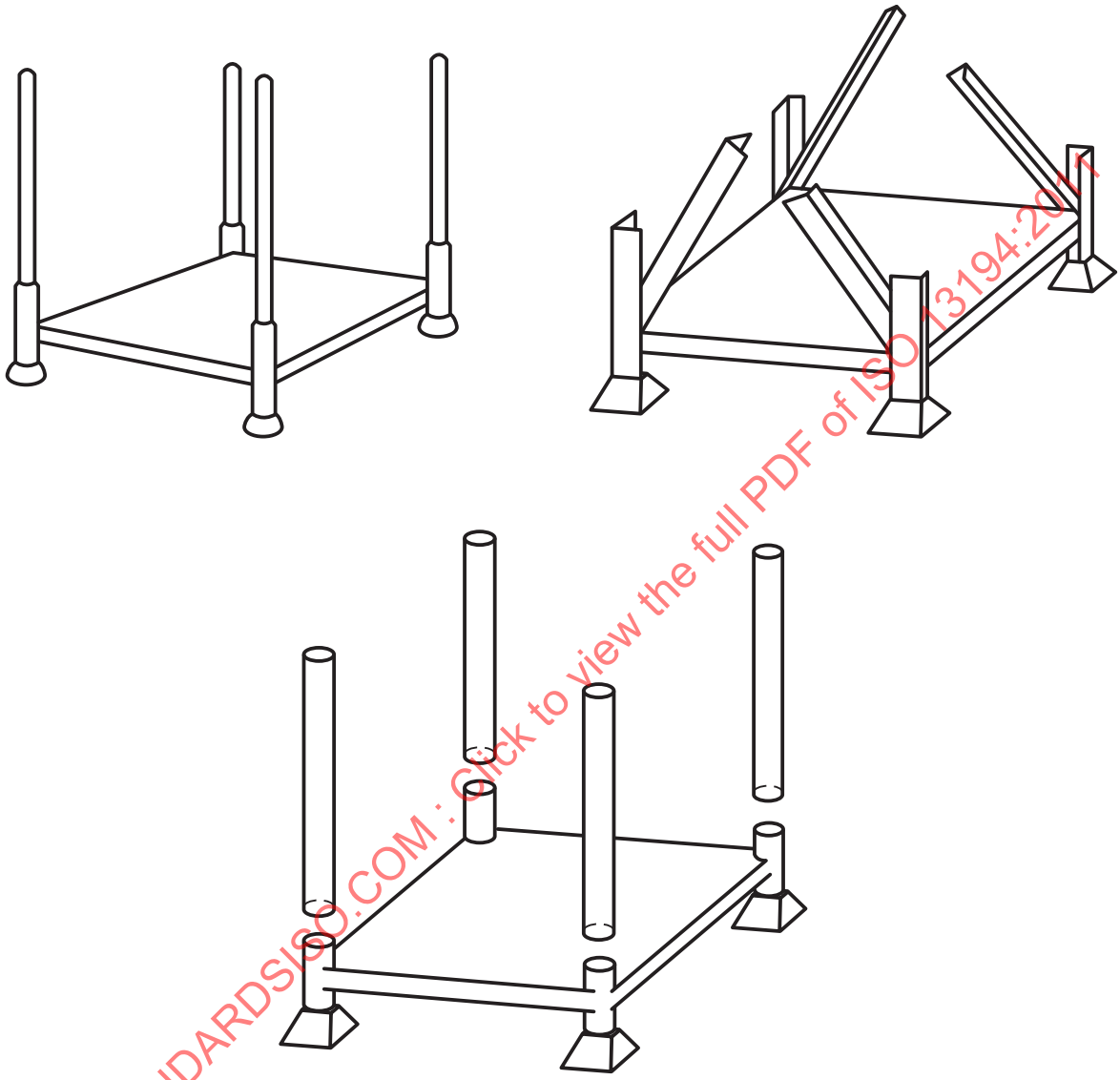


Figure 4 — Examples of post pallets

3.7
cage pallet
pallet with mesh, rodded or barred sides, one or more of which can have a hinged or removable gate for access

NOTE See Figure 5.

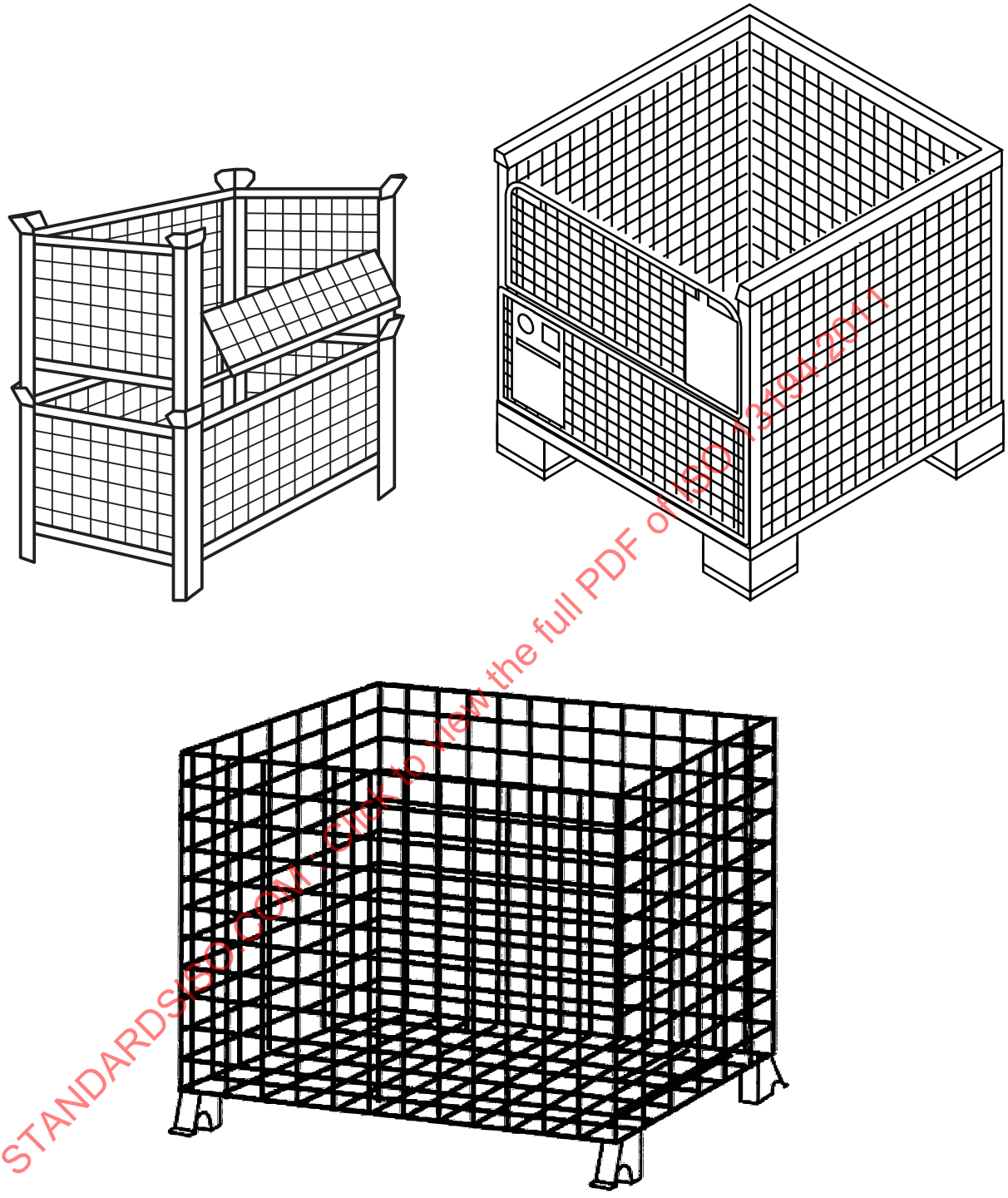


Figure 5 — Examples of cage pallets

3.8
nominal load
lowest safe load which may be permitted to carry in the box pallet, assuming a uniformly distributed load and expressed in kilograms

3.9
nominal stacking load
lowest safe load which can be placed in the box pallet resting on the ground

NOTE The nominal stacking load is expressed in kilograms and, if appropriate, in the number of box pallets which can be stacked on the one resting on the ground. In the latter case, the following abbreviation is used: 1/1 (stack of two box pallets), 2/1 (stack of three box pallets), etc. It assumes a uniformly distributed load.

3.10
test load
load applied during test in or on the box pallet in order to simulate storage and transport conditions

3.11
tare weight
weight of the box pallet without contents

3.12
ballast
either the actual product to be transported or a product having the same physical characteristics, in which case the test certificate is only valid for such product; or a dummy ballast of type 1, sand, or type 2, plastic granules

4 Symbols and abbreviated terms

F_l	Force applied parallel to the length of the box pallet in the lift truck stacking test, in newtons
F_w	Force applied parallel to the width of the box pallet in the lift truck stacking test, in newtons
F_s	Force required to commence movement
g	9,81 ms^{-2}
H	Height of the box pallet in metres
l	Length of the box pallet in metres
L	Length of free span in metres
n	Number of box pallets to be stacked on top of box pallet submitted to tests
w	Width of the box pallets in metres
W_s	Pallet weight in kilograms
μ_s	Coefficients of static friction

5 Requirements

5.1 Materials

The material from which a box pallet is made is not limited by this International Standard. The materials are typically metal, plastic, wood, composite, or paper-based materials. When a box pallet is constructed of multiple materials, the selection of conditioning and duration of test shall be based on that material which will govern the results of the test.

5.2 Dimensions, stacking load and test load

5.2.1 Stacking devices

Box pallets shall be designed or equipped in order to allow stacking.

5.2.2 Dimensions

The structure shall allow handling from the bottom using fork trucks and/or pallet trucks with entries conforming to ISO 6780 or EN 13382, as appropriate. In addition, the height of the box pallet shall not exceed twice the smallest base dimension to improve stability of the product.

5.2.3 Nominal load — Nominal stacking load

The value of the nominal load and the nominal stacking load shall be given in the manufacturer's specifications or marked on the product. The manufacturer may also stipulate a value before the test.

NOTE The maximum number of stacks will be varied depending on materials and designs of box pallets to ensure stability of stacked box pallets.

5.2.4 Test load

The test load may be the actual product to be transported or a simulation of this actual product, for example sand, plastic granules or fluids.

Unless otherwise specified, the test load, consisting of receptacles filled with type 1 or type 2 ballast, shall be spread uniformly and shall occupy more than 80 % of the capacity of the box pallet.

5.3 Conditioning and duration of test

5.3.1 Conditioning

When moisture or temperature conditioning is relevant, such conditions shall be maintained during the test. When several materials are used, the most sensitive condition shall be used. The detailed conditioning for all materials shall be in accordance with Clause 4 of ISO 8611-2:2011.

5.3.2 Duration of tests

The duration of tests shall be as set out in Table 1, which is in accordance with ISO 8611-2:2011, Table 4.

Table 1 — Full load duration for bending and stacking tests

Box pallet material		Test period (h)	Relaxation time (h)
Unprocessed (sawn) timber with metal fastening		2	1
All metal (welded or pressed construction)		2	1
Where plastics or plastic parts dictate overall performance	Stacking test	48	2
	Bending test	24	2
Paper-based and processed wood where these materials dictate overall performance		24	1
Pallet assembled using adhesive to connect major component		24	1

5.3.3 Number of replicates

The number of box pallets required for the tests is at least three for each test.

NOTE The full range of tests can be done on the same sample if the effects of the tests are clearly identified.

It is necessary to ensure that the box pallet subjected to the tests is complete and, when appropriate, fitted with the accessories (cover, toggle-fasteners, etc.) expected to be used as if it were ready for use.

6 Test methods

6.1 Test No. 1 — Bending test

6.1.1 Test purpose

The purpose of this test is to determine the bending stiffness of the box pallet in racking situations.

6.1.2 Test procedure

a) The test load shall be 1,5 times the nominal load.

b) Place the box pallet in position (see Figure 6).

c) Apply a load of 10 % of the test load uniformly distributed over the base of the box pallet, and apply up to the full test load.

d) The deflections, y, shall be measured at points A [maximum of y at A1 (B1), A2 (B2)] as shown in Figure 6.

e) Remove the test load from the box pallet.

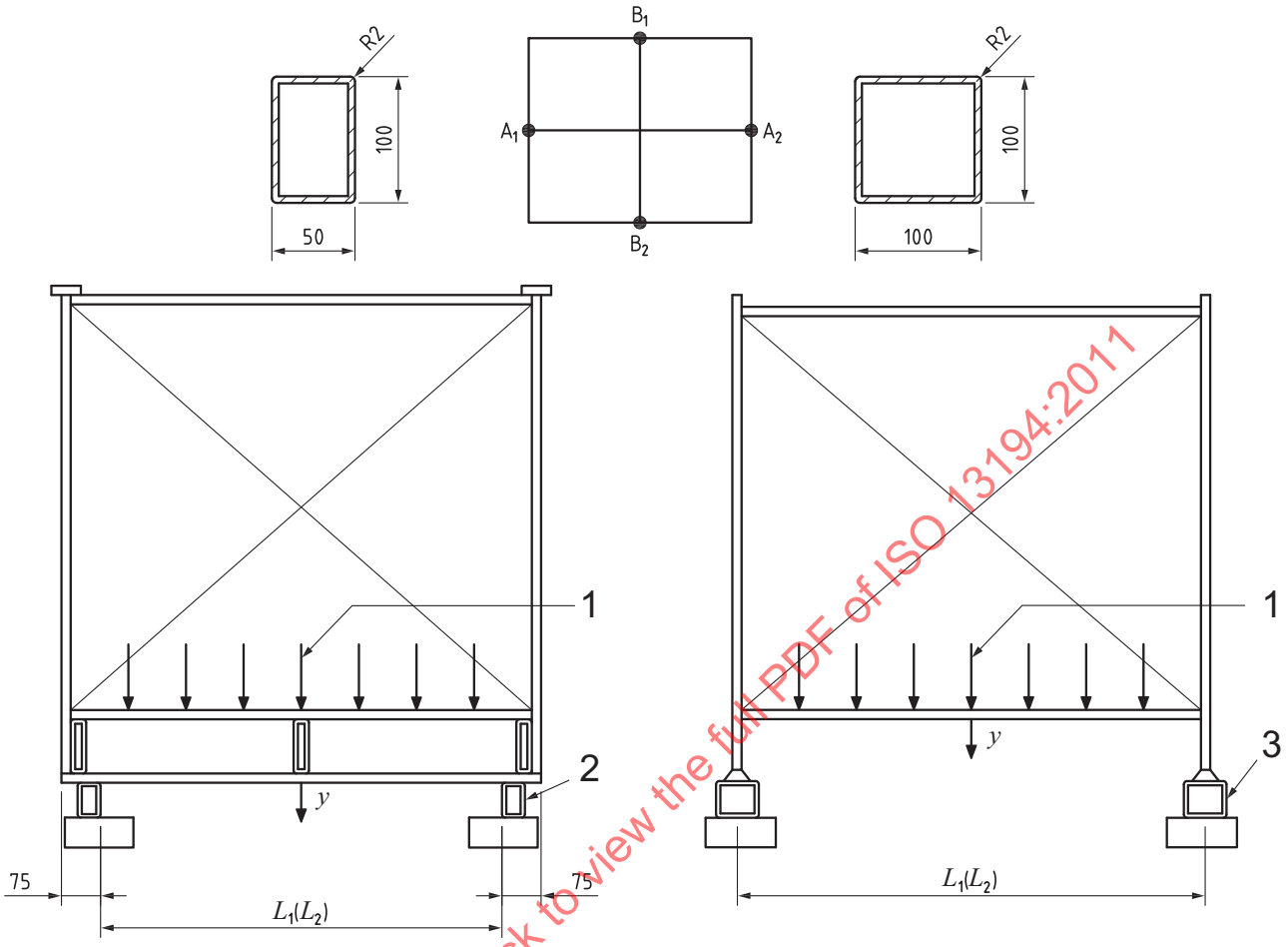
f) Allow relaxation of the test sample according to Table 1.

6.1.3 Performance requirements

a) Under the full load, the deflection measured shall be less than or equal to 2 % of the L_1 (L_2).

b) After the relaxation period, the deflection measured shall be less than or equal to 0,7 % of the L_1 (L_2).

Dimensions in millimetres



Key

1 test load
2 support 1
3 support 2

Figure 6 — Bending test for uniformly distributed load

6.2 Test No. 2 — Stacking test

6.2.1 Test purpose

The purpose of this test is to determine the ability of the box pallet to withstand the local effects of widely varying payloads in a block stacking.

6.2.2 Calculations

6.2.2.1 Standard calculation — Equation (1)

The test load shall be calculated in accordance with the following equation:

$$\text{test load} = 1{,}5 \times n \times (\text{tare weight} + \text{nominal load}) \quad (1)$$

where

n is the number of box pallets to be stacked on top of a box pallet.

6.2.2.2 Collapsible box pallets — Equation (2)

The test load for collapsible box pallets shall be calculated in accordance with the following equation:

$$\text{test load} = 1{,}5 \times n \times \text{tare weight} \quad (2)$$

where

n is the number of box pallets to be stacked on top of a box pallet.

NOTE Empty collapsible box pallets are usually stored in a collapsed position in high stacks. This situation can lead to damage of the collapsible parts with the product unable to fulfil its original use.

6.2.3 Test procedure

The test shall be performed in accordance with ISO 2234, using an unguided test load (see Figure 7). The test parameters for duration of the tests are in Table 1.

a) Place the first empty box pallet on a flat rigid surface and stack the second empty box pallet on the top of the first one.

b) Apply 10 % of the test load on the second box pallet and measure the height of the two stacked box pallets at all four corners as indicated in Figure 7 (1st measurement).

c) Apply 100 % of the test load for the time specified in Table 1. Then measure the height of the two stacked box pallets at all four corners as indicated in Figure 7 (2nd measurement).

d) Remove the test load from the box pallet.

e) Allow relaxation of the test sample according to Table 1.

f) Apply 10 % of the test load on the stacked box pallets. Measure the height of the two stacked box pallets at all four corners as indicated in Figure 7 (3rd measurement).

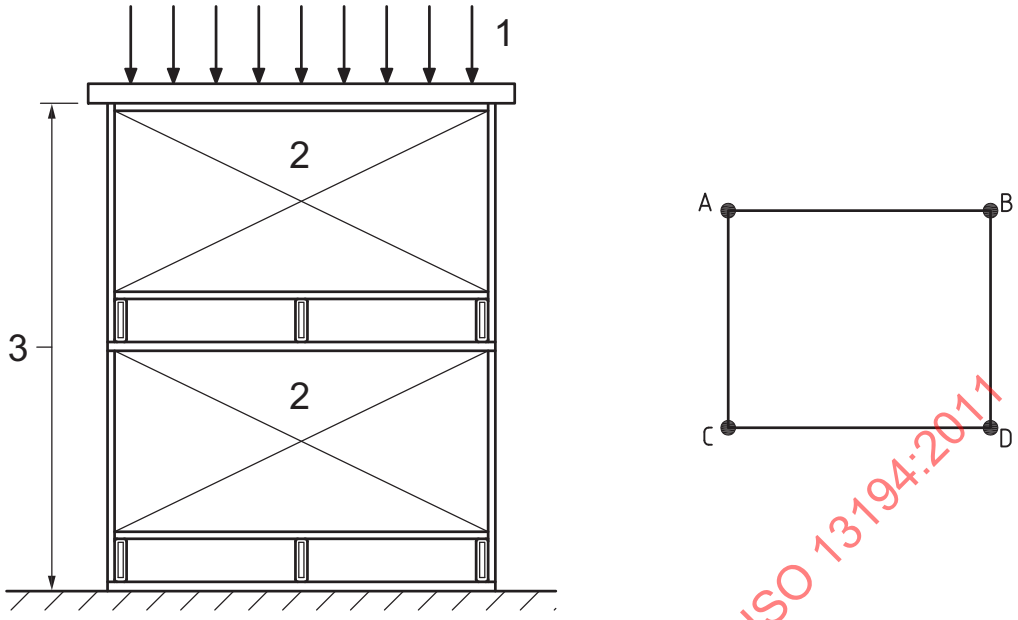
6.2.4 Performance requirements

6.2.4.1 There shall be no breakage or distortion resulting in the box pallet being unable to withstand further handling or affecting its stability during stacking.

6.2.4.2 Compression under full load (calculated as the average value of the 2nd measurement minus the 1st measurement at the four corners) shall be less than or equal to 2 % of the height of the stack.

6.2.4.3 After the relaxation period, the residual compression (calculated as the average value of the 3rd measurement minus the 1st measurement at the four corners) shall be less than or equal to 1 % of the height of the stack.

6.2.4.4 Other performance criteria may be taken into consideration in each individual test, by agreement between the manufacturer and the user.



Key

1 unguided test load
2 empty box pallet
3 height of the stack

Figure 7 — Stacking test for uniformly distributed load (top view of measurement points A to D shown on the right)

6.3 Test No. 3 — Vertical impact test by dropping

6.3.1 Test purpose

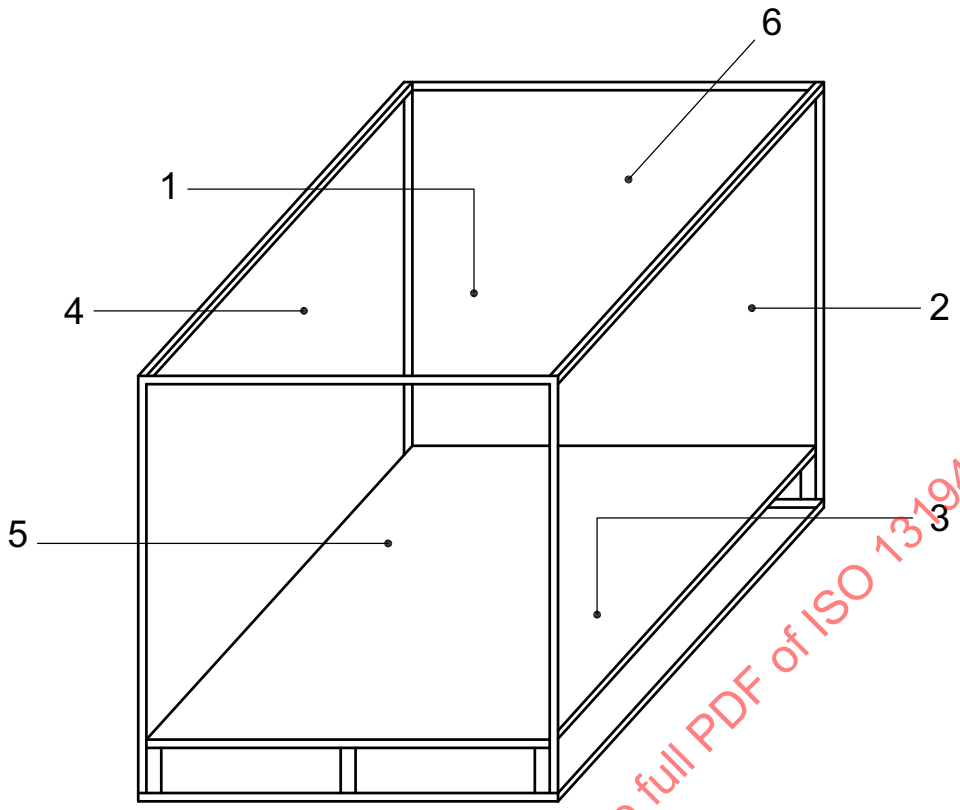
The purpose of this test is to determine the resistance to vertical impacts of the assembly between the pallet and its superstructure. This test shall be performed in accordance with ISO 2248. The box pallet shall be loaded with its nominal load. This test is not compulsory for metal box pallets.

6.3.2 Test procedure

6.3.2.1 Impact on a base

a) Load the box pallet with the appropriate ballast.

b) One impact test shall be done on surface 3 as defined in ISO 2206 (see Figure 8). With one edge of the box pallet supported by a hard, solid surface (e.g. concrete), raise the other end 100 mm and release to fall freely. See Figure 9.



Key

1 top
2 side
3 bottom
4 side
5 front
6 back

Figure 8 — Identification of the parts on box pallet

Dimensions in millimetres

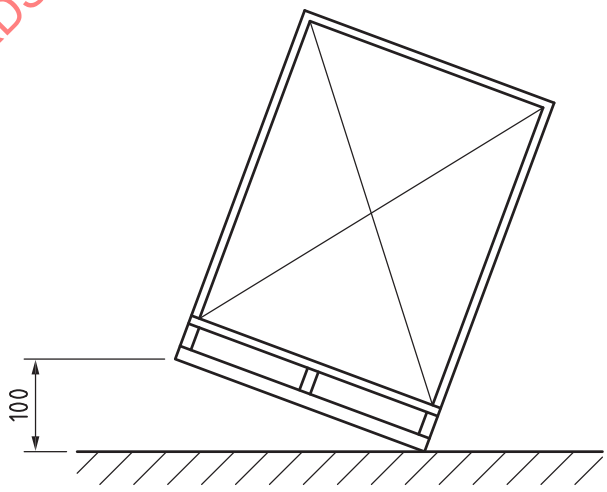


Figure 9 — Impact on base test

6.3.2.2 Impact on an edge and a corner

a) Load the box pallet with the appropriate ballast.

b) One impact test shall be done according ISO 2206 on edges 2-3 and 3-5 and on corner 3-2-5 as defined in ISO 2206 (see Figure 8). With the box pallet on a hard, solid surface (e.g. concrete), raise one end of the surface load and set upon a timber or other support 50 mm high so that the edge of the box pallet is at most 100 mm from the corner of the support [see Figure 10a)]. Raise the other end of the box pallet till the base of the box pallet is 100 mm above floor level [see Figure 10b)] and release the box pallet to fall freely. Where box pallets are tall or top-heavy, provision shall be made to prevent the box pallet from tipping over after the drop is made.

c) After the vertical impact test, do the other impact tests with the same product.

6.3.3 Performance requirements

6.3.3.1 There shall be no breakage or distortion resulting in the box pallet being unable to withstand further handling or affecting its stability during stacking.

6.3.3.2 Other performance criteria may be taken into consideration in each individual test, by agreement between the manufacturer and the user.

Dimensions in millimetres

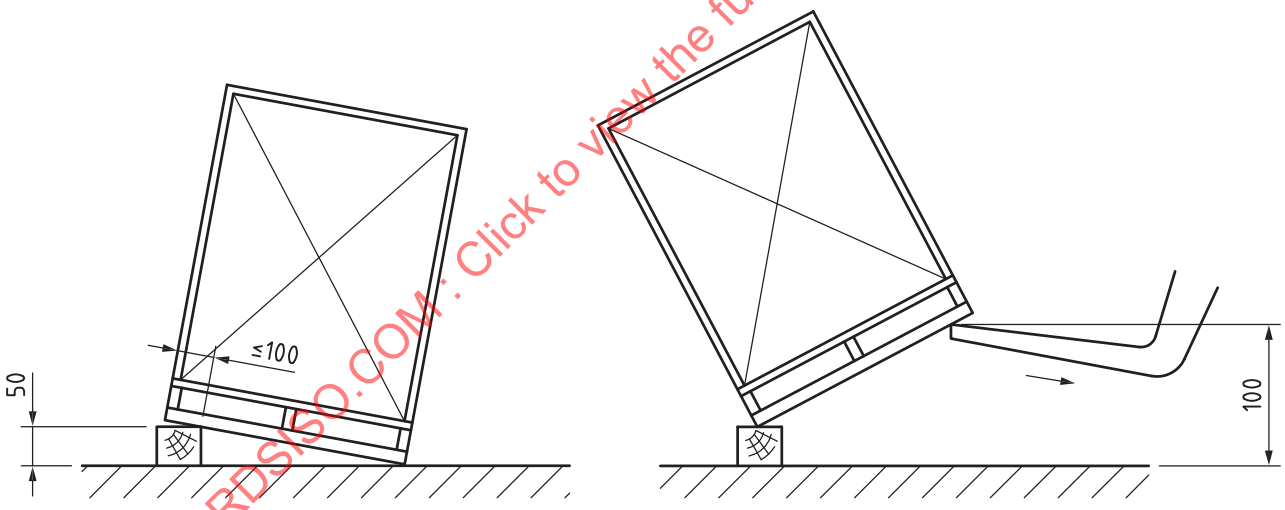


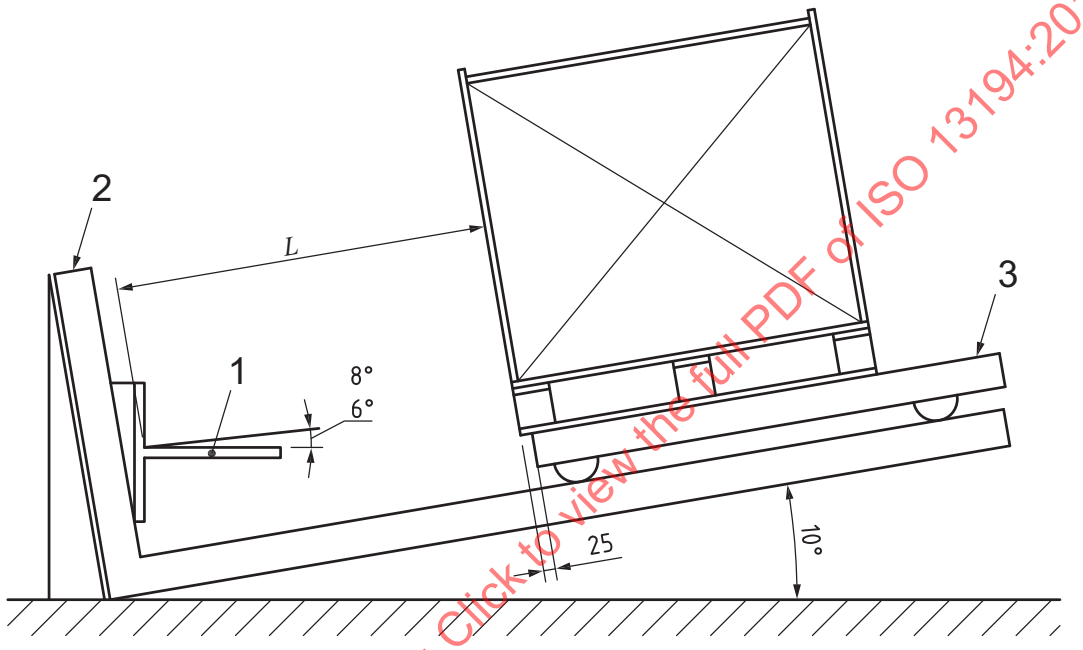
Figure 10 — Impact on an edge and a corner

6.4 Test No. 4 — Horizontal impact test

6.4.1 Test purpose

The purpose of this test is to determine the resistance to side horizontal impacts of the assembly between the pallet and its superstructure. Inclined plane shall be in accordance with ISO 2244 (see Figure 11). Impact stop is necessary, as shown in Figure 12, to concentrate the impact onto one part of the box pallet. The impact stop is mounted on the fixture forming an angle of (7 ± 1)° in relation to the contact plane of the dolly. The box pallet shall be loaded with its nominal load.

Dimensions in millimetres

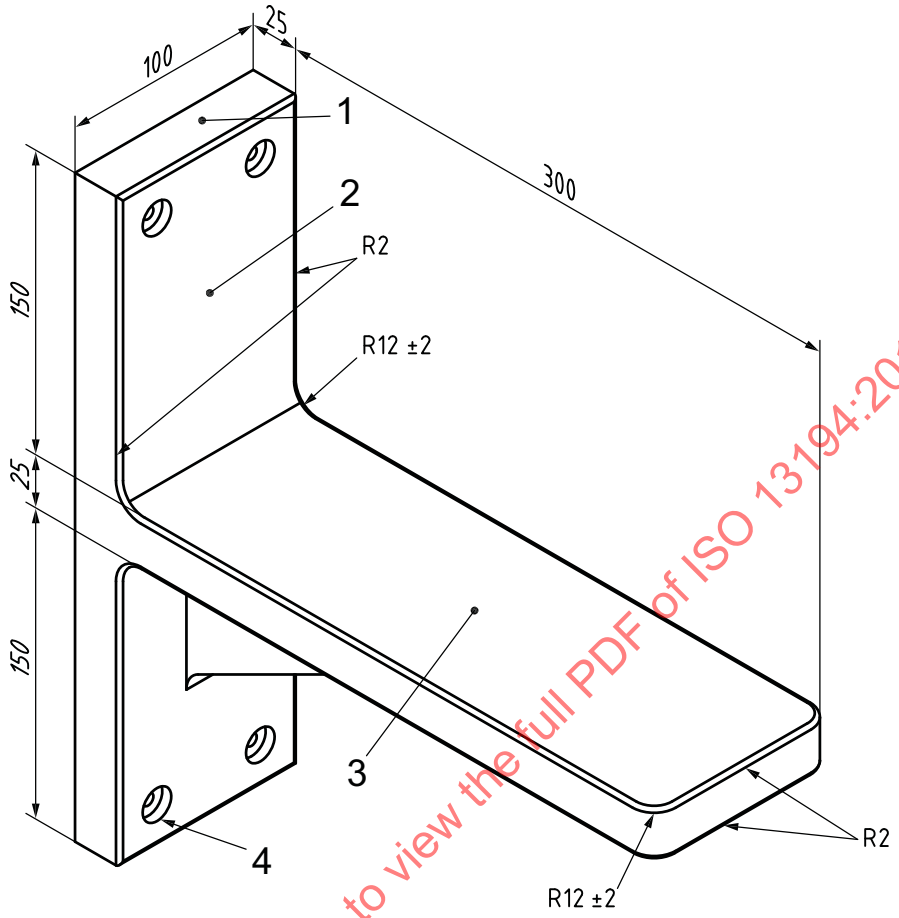


Key

1 impact stop
2 backstop
3 dolly

Figure 11 — Horizontal impact test

Dimensions in millimetres



Key

1 shank
2 shank face
3 blade
4 counterbore
R radius of curvature

Figure 12 — Impact stop

6.4.2 Test procedure

a) Place the box pallets onto the dolly to the distance L from the vertical face of the impact stop in contact with the part of the box pallet to be tested.

b) Load the box pallet with the appropriate ballast.

c) Set the testing equipment to reach the predetermined impact speed of 1,3 $ms^{-1} \pm 0{,}065$ ms^{-1}.

d) Carry out the impact test, three times per impact point.

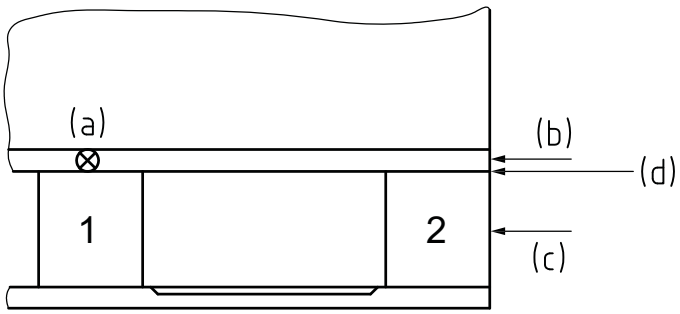
e) Points of impact are as follows (see Figure 13):

1) one on the long side of the deck (a);

2) one on the short side of the deck (b);

3) one on a block (c);

4) one on the junction of the corner block and the deck (d).



Key

1 centre block

2 corner block

(a), (b), (c), (d): points of impact

Figure 13 — Points of impact

6.4.3 Performance requirements

6.4.3.1 There shall be no breakage or distortion resulting in the box pallet being unable to withstand further handling or affecting its stability during stacking.

6.4.3.2 Other performance criteria may be taken into consideration in each individual test, by agreement between the manufacturer and the user.

6.5 Test No. 5 — Stacking deformation test

6.5.1 Test purpose

The purpose of this test is to simulate the loads induced by the deformation of the stacking device structure when a box pallet in metal is being placed on the top of a stack, and also when it is in place on the top of a stack. This test shall only be carried out on metal box pallets. There are three choices of test depending on the type of stacking devices as defined in ISO 445 when carrying out this test.

a) If a box pallet has cup foot or nesting conical foot, which is designed to facilitate stacking, then Test 5 shall be performed in accordance with Figure 14a).

b) If a box pallet has the upper locating device fitted to the top of the box pallet to facilitate stacking, then Test 5 shall be performed in accordance with Figure 14b).

c) If a box pallet has both the upper locating device and cup foot or nesting conical foot, then Test 5 shall be performed in accordance with both Figure 14a) and Figure 14b).

6.5.2 Test procedure

The box pallet shall be fixed in order to keep the legs in contact with the floor during the test as indicated either in Figure 14a) or Figure 14b), depending on the stacking devices. The forces F_l and F_w are applied to one structure top corner at the level of the stacking device. Forces F_l and F_w are respectively parallel to the length l and the width w. They are pointed towards the outside of the box pallets [see Figure 14a) or Figure 14b)]. If the box pallet is not designed to be lifted by forks introduced perpendicularly to the width, the test with the force F_l shall not be carried out. The test is carried out on one corner since the stacking is generally non-symmetric.

F_l and F_w shall be calculated according to the following equations:

$$F_w = [(\text{Tare weight} + \text{Nominal load}) \times g \times w] / (2 \times H);$$

$$F_l = [(\text{Tare weight} + \text{Nominal load}) \times g \times l] / (2 \times H).$$