Common Market for Eastern and Southern Africa

EDICT OF GOVERNMENT

COMESA 216 (2006) (English): Pallets for materials handling — Flat pallets — Part 1: Test methods

ISO INSIDE

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COMESA HARMONISED STANDARD

COMESA/FDHS 216:2006

Pallets for materials handling — Flat pallets — Part 1: Test methods

REFERENCE: FDHS 216:2006

Foreword

The Common Market for Eastern and Southern Africa (COMESA) was established in 1994 as a regional economic grouping consisting of 20 member states after signing the co-operation Treaty. In Chapter 15 of the COMESA Treaty, Member States agreed to co-operate on matters of standardisation and Quality assurance with the aim of facilitating the faster movement of goods and services within the region so as to enhance expansion of intra-COMESA trade and industrial expansion.

Co-operation in standardisation is expected to result into having uniformly harmonised standards. Harmonisation of standards within the region is expected to reduce Technical Barriers to Trade that are normally encountered when goods and services are exchanged between COMESA Member States due to differences in technical requirements. Harmonized COMESA Standards are also expected to result into benefits such as greater industrial productivity and competitiveness, increased agricultural production and food security, a more rational exploitation of natural resources among others.

COMESA Standards are developed by the COMESA experts on standards representing the National Standards Bodies and other stakeholders within the region in accordance with international procedures and practices. Standards are approved by circulating Final Draft Harmonized Standards (FDHS) to all member states for a one Month vote. The assumption is that all contentious issues would have been resolved during the previous stages or that an international or regional standard being adopted has been subjected through a development process consistent with accepted international practice.

COMESA Standards are subject to review, to keep pace with technological advances. Users of the COMESA Harmonized Standards are therefore expected to ensure that they always have the latest version of the standards they are implementing.

This COMESA standard is technically identical to ISO 8611-1:2004, *Pallets for materials handling — Flat pallets — Part 1: Test methods*.

INTERNATIONAL STANDARD

ISO 8611-1

First edition
2004-02-15

Pallets for materials handling — Flat pallets —

Part 1: Test methods

Palettes pour la manutention — Palettes plates —

Partie 1: Méthodes d'essai

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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 8611-1 was prepared by Technical Committee ISO/TC 51, *Pallets for unit load method of materials handling*.

This first edition, together with ISO 8611-2 and ISO 8611-3, cancels and replaces ISO 8611:1991.

ISO 8611 consists of the following parts, under the general title *Pallets for materials handling — Flat pallets*:

— *Part 1: Test methods*

— *Part 2: Performance requirements and selection of tests* (Technical Specification)

— *Part 3: Maximum working load* (Technical Specification)

Introduction

The 1991 edition of ISO 8611 described a system of sequential testing that relied upon a pallet passing every test in a series. This meant that one pallet could be near to failure in one particular test where another pallet might be substantially over-designed. Using the (earlier) deflection criteria, both pallets were presented as equals in terms of safety factor. The notched stringer pallet was a good example of this where it was typically very stiff, but frequently near fracture point in the (old) bending test. The new, three-part version of ISO 8611 redresses this in failing every specimen in order to establish a definite safety factor. Stiffness is dealt with as a separate series of measurements conducted during testing.

Conducting the tests requires experience in testing (including the load) and also some expertise of the materials under test. This part of ISO 8611, in conjunction with ISO/TS 8611-2 and ISO/TS 8611-3, has been expressly designed to cover all pallet materials either when used alone or used as composites. A further change over ISO 8611:1991 is that all pallets for materials handling are now covered and not just high quality through-transit, exchange or pool pallets.

This part of ISO 8611 cannot be used to evaluate a pallet to normative ISO requirements without the additional application of ISO/TS 8611-2 and ISO/TS 8611-3.

This part of ISO 8611 was designed to be coupled with ISO/TR 10232:1989 *General-purpose flat pallets for through transit of goods — Design rating and maximum working load* and ISO/TR 10233:1989 *General-purpose flat pallets for through transit of goods — Performance requirements*.

The changing of the title and the scope of ISO 6780 from *General purpose flat pallets for through transit of goods — Principal dimensions and tolerances*, to a wider scope of *Flat pallets for intercontinental materials handling — Principal dimensions and tolerances*, makes it necessary to amend ISO 8611:1991 and the Technical Reports ISO/TR 10232 and ISO/TR 10233. The test methods, performance requirements and design rating and maximum working load should now include not only “general purpose pallets” but also all other pallets for materials handling.

Pallets for materials handling — Flat pallets —

Part 1: Test methods

1 Scope

This part of ISO 8611 specifies test methods of existing and prototype flat pallets for materials handling (for all types of use).

NOTE Specific tests for determining load capacity do not replace the value of conducting field tests on specific pallet designs.

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

ISO/TS 8611-2:—[1)], *Pallets for materials handling — Flat pallets — Part 2: Performance requirements and selection of tests*

ISO 12777-1, *Methods of test for pallet joints — Part 1: Determination of bending resistance of pallet nails, other dowel-type fasteners and staples*

EN 13183-2, *Moisture content of a piece of sawn timber — Part 2: Estimation by electrical resistance method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 445 (some of which are repeated below for convenience) and the following apply.

3.1
test load
load applicators, the load board or load box and the applied load itself

1) To be published.

3.2
ultimate load
load at which compression, displacement or deflection is no longer contained, resulting in the destruction of the specimen or breaking of one component, or when displacement, deformation or deflection becomes excessive

NOTE See Table 1 of ISO/TS 8611-2:—.

3.3
stiffness
relative deformation of a pallet or component under load

NOTE High stiffness means small displacement, deflection or deformation, for a given load.

3.4
racking
storage of loaded pallets in drive-in or beam racks

3.5
stacking
placing of pallets with unit loads one upon the other without recourse to intermediate shelves or racking

3.6
payload
load carried by the pallet in use

4 Measurements

4.1 Pallets selected for testing shall be checked to ensure that materials, construction and dimensions conform to any associated written specification.

4.2 The mass and the material of each pallet shall be determined and recorded at the time of testing.

4.3 The moisture content of wooden pallets shall be measured and recorded in accordance with EN 13183-2 at the time of testing.

NOTE Clause 11 gives further details on what should be recorded during testing and in the written report.

5 Accuracy of tests and apparatus

5.1 Test apparatus shall satisfy the following requirements:

a) in the design of the test equipment, the tolerances on all dimensions shall be ± 2 %;

b) the accuracy of measuring equipment for tests shall be ± 0,5 mm;

c) the accuracy of positioning of every component, excluding the test load, shall be ± 2 mm, measurement gauges shall be positioned to ± 4 mm;

d) the accuracy of positioning of the centre of application of test load (where used) shall be ± 10 mm;

e) the total mass of the test load applied shall be within ± 3 % of the prescribed value.

5.2 No part of any test rig shall distort an amount greater than 3 mm when under maximum test load. Distortion of the test rig shall be taken into account in measuring deflections of the pallet.

NOTE Using heavy duty steel box sections in the construction of fixtures in tests 1 and 2 (see Table 1) will normally result in central distortions approaching the 3 mm given limit.

5.3 The inclined plane apparatus shall be constructed as specified in ISO 2244 and shall permit inclined travel distance to change by 250 mm increments from 250 mm to 1 250 mm, each increment to within ± 5 mm.

6 Test load

A general value for the test load is not fixed. The test load for each test is defined in ISO/TS 8611-2.

The test load shall be applied with hydraulic or air pressure or with dead load and shall increase continuously or in steps to the failure (for determination of ultimate load) or up to the fixed value (for qualification tests).

7 List of tests

The matrix of tests applicable to this document are as shown in Table 1.

For tests numbered 1, 2, 3, 4, 5 and 8, two tests (a and b) are necessary, which can be carried out in one test sample (first b and then a) or in two separate test samples. For tests numbered 1, 2, 3, 4, 5 and 8, testing shall always be conducted with new untested pallets.

Table 1 — List of tests

Test No.	Test Measurement	Characteristic	Handling activity or purpose of the test	Ref. No.
Static tests				**8**
1	**Bending tests**	Pallet length, width	Racking	**8.1**
1a	Bending strength			8.1.3.1
1b	Bending stiffness			8.1.3.2
2	**Wing pallet bending tests**	Pallet length, width	Lifting with slings	**8.2**
2a	Bending strength			8.2.3.1
2b	Bending stiffness			8.2.3.2
3	**Air bag bending tests**	Pallet length, width	Racking	**8.3**
3a	Bending strength			8.3.3.1
3b	Bending stiffness			8.3.3.2
4	**Fork lifting tests**	Top deck	Lifting with forklift and pallet trucks	**8.4**
4a	Bending strength			8.4.3.1
4b	Bending stiffness			8.4.3.2
5	**Compression tests for blocks or stringers**	Height of blocks, stringers	Any activity that compress blocks or stringers	**8.5**
5a	Blocks or stringers strength			8.5.3.1
5b	Blocks or stringers stiffness			8.5.3.2
6	**Stacking test**	Top and bottom deck	Stacking	**8.6**
7	**Dead-weight bending test**	Pallet length, width	Racking	**8.7**
8	**Bottom deck bending tests**	Bottom deck	Racking/stacking/ conveyors	**8.8**
8a	Bending strength			8.8.3.1
8b	Bending stiffness			8.8.3.2
9	**Static shear test**	Decks, blocks, stringer	Distortion resistance	**8.9**
Dynamic strength tests				**9**
10	**Corner drop test**	Diagonal rigidity	Resistance to impacts	**9.1**
11	**Shear impact test**	Decks, blocks, stringer	Distortion resistance	9.2.2
12	**Top deck edge impact test**	Top leading deckboard	Resistance to fork arms	9.2.3
13	**Block impact test**	Corner block, stringer	Resistance to fork tip	9.2.4
Friction tests				**10**
14	**Static coefficient of friction test**	Under deck/fork arms	Slip resistance on fork arms	**10.1**
15	**Slip angle test**	Top deck/payload	Slip resistance of loads	**10.2**

8 Static tests

8.1 Test No. 1 — Bending tests

8.1.1 Purpose

The purpose of these tests is to determine the bending strength (Test 1a) and bending stiffness (Test 1b) of the pallet in racking situations.

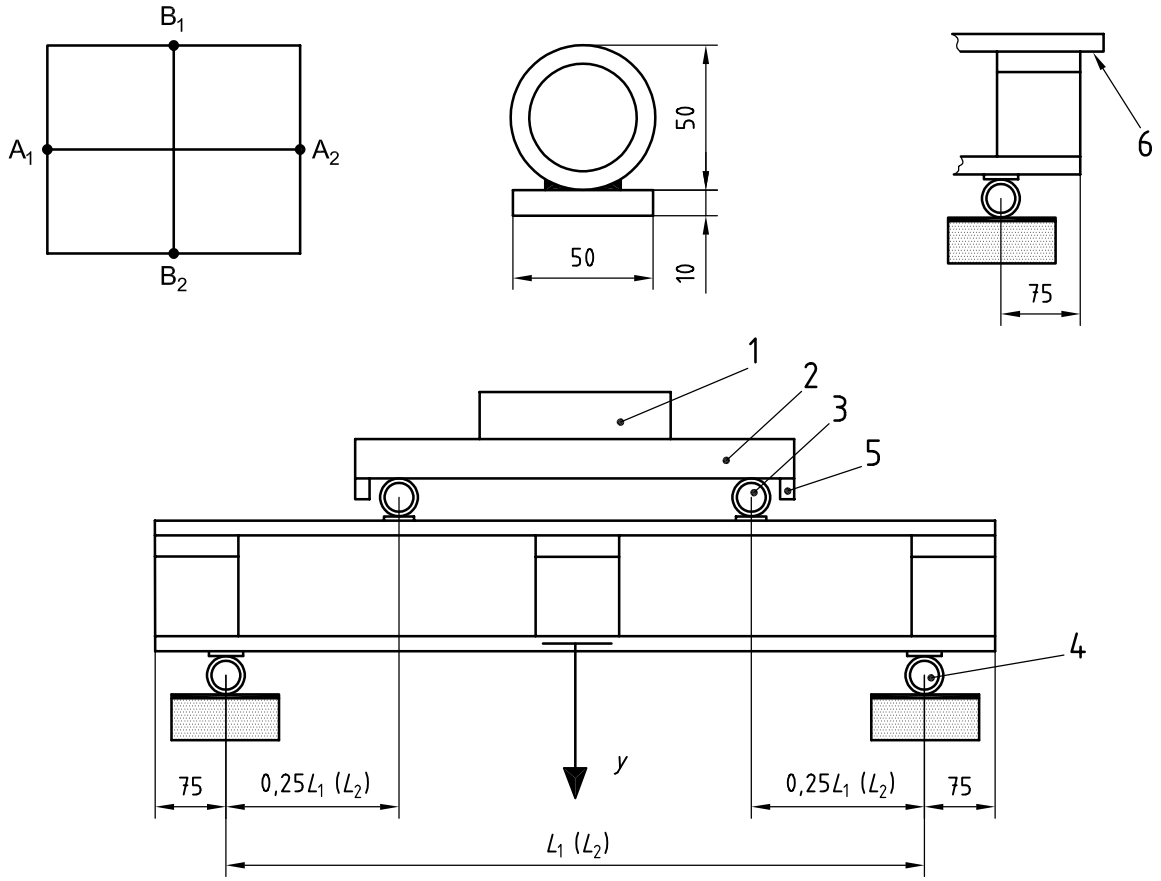
8.1.2 Procedure

8.1.2.1 In order to establish the weakest pallet support dimension, test one pallet across the length of the pallet and then a second pallet across the width of the pallet. There is no requirement for further tests on the stronger dimension unless the result was within 15 % of the weaker.

8.1.2.2 This having been established, place a fresh pallet across its weakest side, top deck uppermost, on pallet supports positioned with their centrelines 75 mm from the outer edges of the pallet. The load applicators shall be positioned at 0,25 L_1 or 0,25 L_2, when measured as shown, where L_1 or L_2 is the distance between the centre lines of the pallet supports (see Figure 1).

8.1.2.3 Load applicators and supports shall be flush with or project beyond the edges of the pallet. Edges shall be relieved with 2 mm ± 1 mm radii. Where load applicators coincide with gaps between deckboards, in-fill pieces of equal thickness to deckboards with 3 mm to 6 mm overall clearance on each shall be used. Place on the pallet deck the load applicators and the load board, then apply the rest of the test load.

Dimensions in millimetres



Key

1	test load	3	load applicator	5	safety stop
2	load board	4	support	6	lip

Figure 1 — Bending test

8.1.3 Measurements

8.1.3.1 Test No. 1a — Determination of bending strength

Place a load on the load board until breakage of one of the components of the pallet or until reaching an excessive deflection or deformation. Record the ultimate load.

8.1.3.2 Test No. 1b — Determination of bending stiffness

Depending on the support location, the deflection, y, shall be measured at points A [maximum of y at A_1 (B_1) and A_2 (B_2)]:

a) on the unloaded pallet;

b) after positioning of the load applicators and the load board;

c) immediately after full test load is applied;

d) at end of the full test load period;

e) after the relaxation period.

8.2 Test No. 2 — Wing pallet bending tests

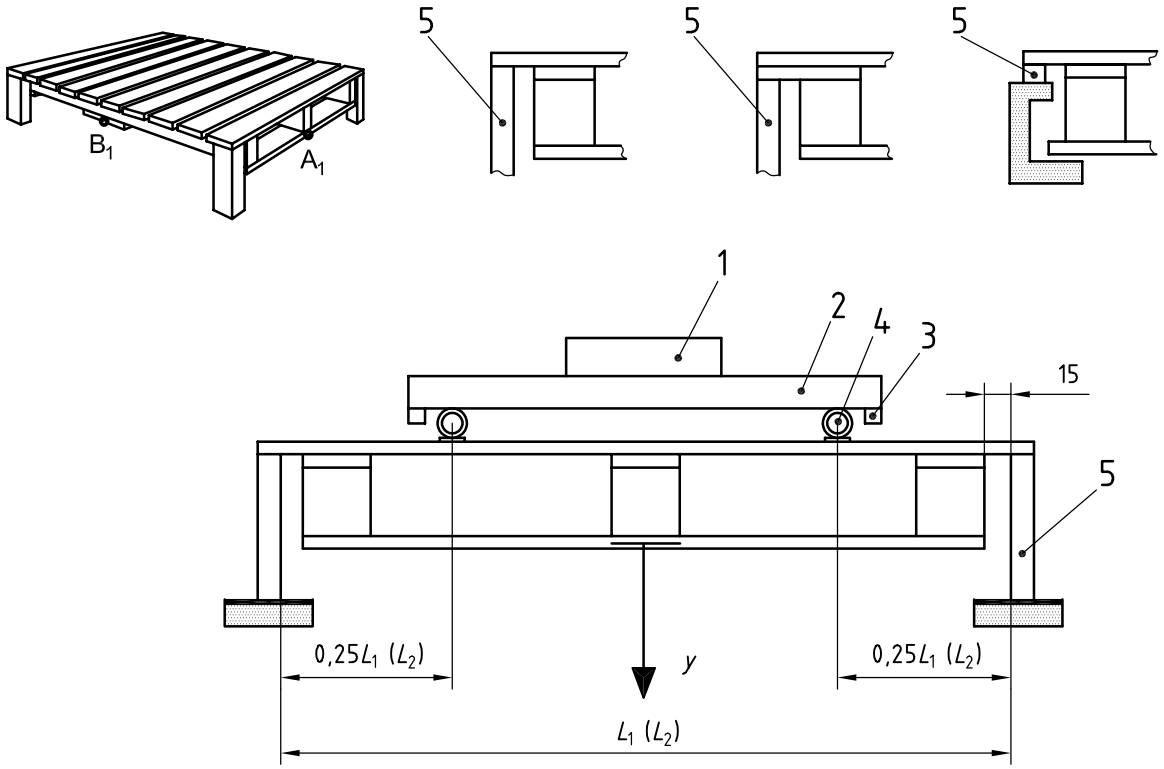
8.2.1 Purpose

The purpose of these tests is to determine the bending strength (Test 2a) and the bending stiffness (Test 2b) of winged pallet during lifting with slings

8.2.2 Procedure

Place the wing pallet, top deck uppermost, on four posts 50 mm $\times$ 50 mm positioned beneath the wings of the top deck flush with the ends of the pallet and 15 mm from the side of the block or the stringer. The supports shall be fixed at such a height that a space of at least 50 mm is between the underside of the bottom deck and the ground or test frame. Each load applicator shall be positioned such that the dimension from the inside edge of the support to the centre line of the load applicators shall be 0,25 L_1 as shown in Figure 2. Place the load board on the load applicators and then apply the rest of the test load.

Dimensions in millimetres



Key

1 test load
2 load board
3 safety stop
4 load applicator
5 support

Figure 2 — Wing pallet bending test

8.2.3 Measurements

8.2.3.1 Test No. 2a — Determination of bending strength

Place a load on the load board until breakage of one of the components of the pallet or until reaching an excessive deflection or deformation. Record the ultimate load.

8.2.3.2 Test No. 2b — Determination of bending stiffness

Depending on the support location, the deflection, y, shall be measured at points A [average of y at A_1 (B_1) and A_2 (B_2)]:

a) on the unloaded pallet;

b) after positioning of the load applicators and the load board;

c) immediately after the full test load is applied;

d) at end of the full test load period;

e) after the relaxation period.

8.3 Test No. 3 — Air bag bending tests

8.3.1 Purpose

The purpose of this form of bending test is to simulate, as near as is practically feasible, certain load applications as commonly encountered in the field. The load applicator used for this bending test is an analog for common uniform flexible loads often supported by pallets, such as cased or bagged goods.

This uniform flexible load analog is used when, under certain circumstances, the primary load applicators, as described in 8.1.2, cannot be used, or when the application of simulated uniform loads can aid the pallet designer in selecting the most appropriate pallet for a given use.

8.3.2 Procedure

8.3.2.1 In order to establish the weakest pallet support direction, test one pallet across the length of the pallet and then a second pallet across the width of the pallet. There is no requirement for further tests on the stronger dimension unless the result is within 15 % of the weaker.

8.3.2.2 The load applicator shall be a medium or low-pressure envelope air bag, commonly called a “lifting” or “dunnage” bag, shown schematically in Figure 3. Air bags of this type are specified by size (length and width), containment (maximum working pressure) and stroke (maximum unrestricted expansion in bag height).

8.3.2.3 The size of a bag shall be such that when inflated, the bag is in contact with the entire deck of the pallet. This is often possible with bags approximately 150 mm longer and wider than the top deck of the pallet to be tested.

8.3.2.4 When bag sides overhang the pallet by more than 75 mm on either edge or end, an air bag support beam is necessary to maintain the bag overhang at the same level as the upper pallet deck during testing.

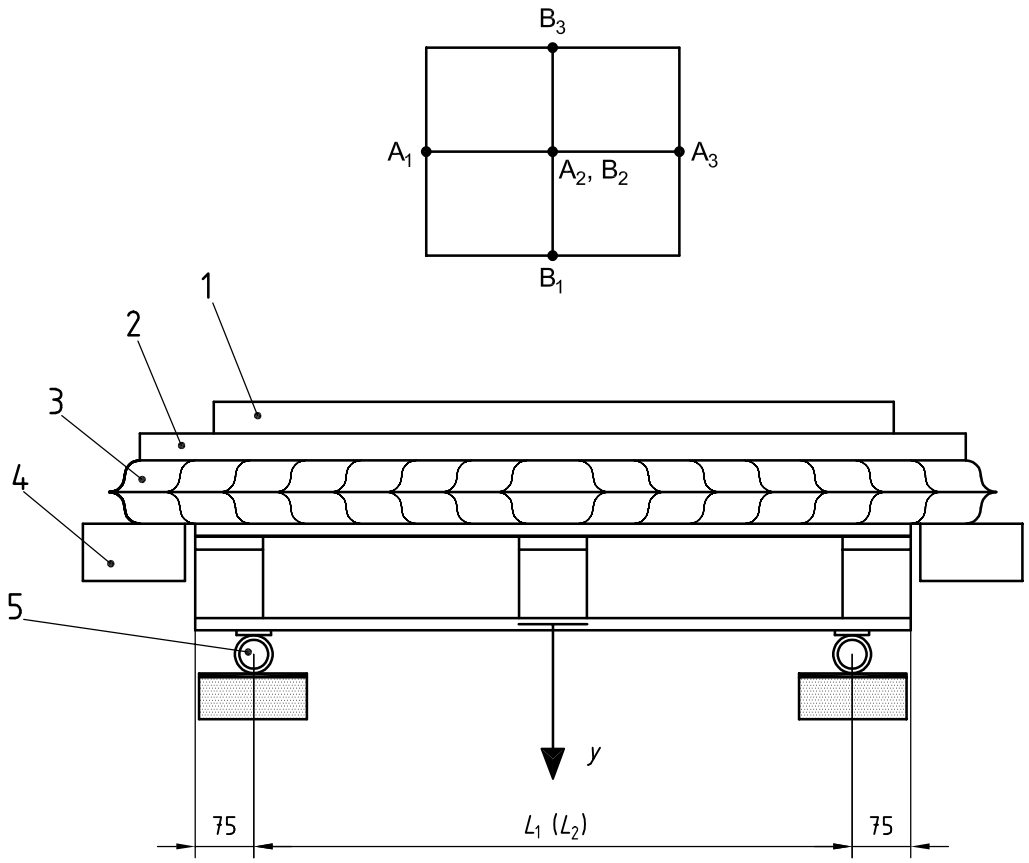
When the load applied to the pallet is measured above the pallet during the test, the supports shown in Figure 3 a) (4 in the key) shall not be used and the bag should fit the pallet as described in 8.3.2.3.

8.3.2.5 The containment or working pressure in the bag shall be adequate to structurally fail all pallets to be tested. Experience indicates that the working pressure shall be at least 0,07 N/mm^2 to 0,08 N/mm^2.

8.3.2.6 The stroke or level of expansion in bag height depends on the design of the testing apparatus. Where expansion varies along the centre or edges of the bag, the region of least expansion shall govern bag selection. In order to avoid the influence of bag stiffness on the test data, the bag expansion shall be at least twice that necessary to cause pallet failure. The pallet supports as described in Figure 1 shall be positioned with their centrelines 75 mm from the outer edges of the pallet.

8.3.2.7 Loading or testing rates shall be controlled by appropriately inflating the restrained air bag by pressing the inflated air bag onto the upper pallet deck.

Dimensions in millimetres

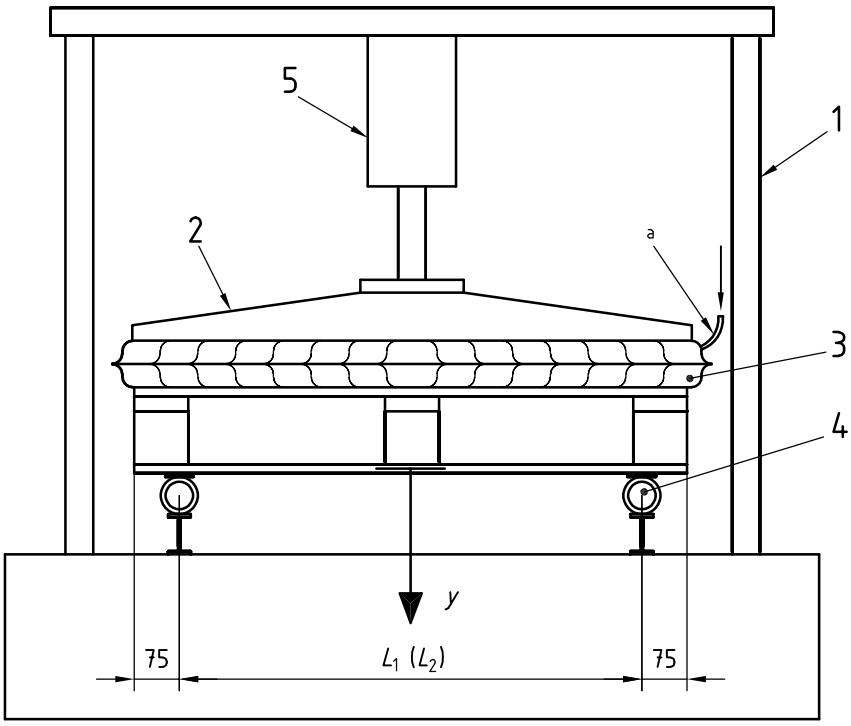


Key

1 dead weight
2 load board
3 air bag
4 air bag support beam
5 supports

a) Test using dead weight

Dimensions in millimetres



Key

1 test rig frame
2 load platen
3 air bag
4 supports
5 load applicator

[a] Load application via air pressure.

b) Test using test rig

Figure 3 — Air bag bending tests

8.3.3 Measurement

8.3.3.1 Test No. 3a — Determination of bending strength

Raise the pressure of the air bag until breakage occurs in one of the components of the pallet or until reaching an excessive deflection or deformation. Record the ultimate load.

8.3.3.2 Test No. 3b — Determination of bending stiffness

Depending on the support location, the deflection, y, shall be measured at points A (maximum of y at A_1, A_2, A_3) or B (maximum of y at B_1, B_2, B_3):

a) on the unloaded pallet;

b) after positioning of the air bag;

c) immediately after the full test load is applied;

d) at end of the full load period;

e) after the relaxation period.

8.4 Test No. 4 — Fork lifting tests

8.4.1 Purpose

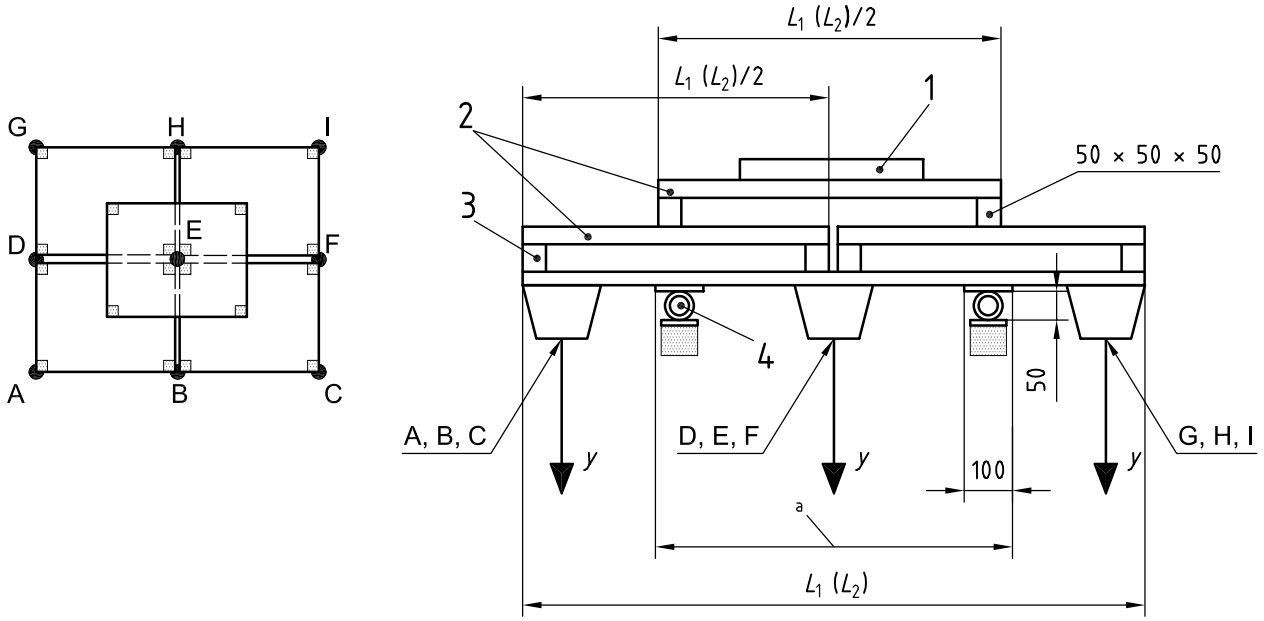
The limiting condition of use for non-rackable and non-stackable single or double-deck pallets is the bending of the pallet on fork arm supports under the top deck of the pallet.

8.4.2 Procedure

The fork lifting test is shown schematically in Figure 4. The test method permits flexibility of distribution of load in both the length and width of the pallet, but for use as determination of ultimate load the symmetry in Figure 4 shall be used. The supports shall conform to Figure 1, but their support plates are of double width. The support distances may be either 570 mm or 690 mm. The shorter of the two distances that occur during pallet use shall be used in the test.

NOTE Instead of the load applicators shown in Figure 4 the air bag load applicator in Figure 3 may be used with this support condition.

Dimensions in millimetres



Key

1 test load
2 load applicator
3 load board
4 support
5 load blocks

[a] 570 or 690

Figure 4 — Fork lifting test

8.4.3 Measurement

8.4.3.1 Test No. 4a — Determination of bending strength

Apply the test load until breakage occurs in one of the components of the pallet or until reaching an excessive deflection or deformation. Record the ultimate load.

8.4.3.2 Test No. 4b — Determination of bending stiffness

Depending on the support location, the deflection, y, shall be measured simultaneously at the centre of the pallet, at the middle of the two ends and sides and at the corners (maximum value of y at points A, B, C, D, E, F, G, H, I):

a) on the unloaded pallet;

b) after positioning of the load applicators;

c) immediately after full test load is applied;

d) at end of the full load period;

e) after the relaxation period.

8.5 Test No. 5 — Compression tests for blocks or stringers

8.5.1 Purpose

The purpose of this test is to determine the compression stiffness and strength of the blocks or stringers of the pallet. Blocks or stringers supporting superstructures or heavy rigid loads shall be tested.

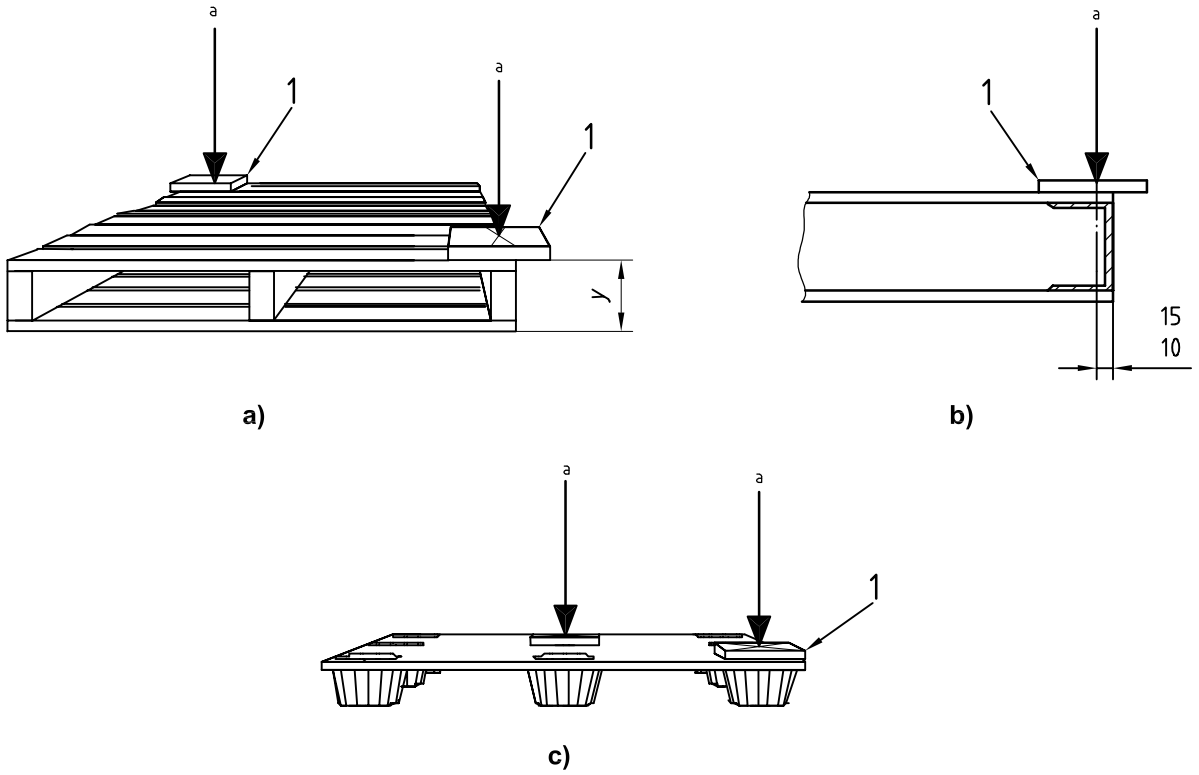
8.5.2 Procedure

Place the pallet in a normal position on a flat, hard, rigid and horizontal surface. Place a rigid load applicator of dimensions 300 mm $\times$ 300 mm $\times$ (25 mm $\pm$ 5 mm), over a block or a portion of a stringer (as shown in Figure 5).

Place the test load centrally on to the load applicator as shown by the arrows in Figures 5 a), 5 b) and 5 c). When the blocks or stringers differ in design, each design shall be tested.

Alternatively, the test may be carried out on several identical corners, blocks or stringers.

Dimensions in millimetres



Key

1 load applicator

a Test load.

Figure 5 — Corner compression test

8.5.3 Measurement

8.5.3.1 Test No. 5a — Determination of strength of blocks or stringers

Apply the load until breakage occurs in one of the blocks or stringers of the pallet or upon reaching an excessive deflection or deformation. Record the ultimate load.

8.5.3.2 Test No. 5b — Determination of stiffness of blocks or stringers

The deflection, y, shall be measured:

a) on the unloaded pallet;

b) after positioning of the load applicator;

c) immediately after the full test load is applied;

d) at end of the full test load period;

e) after the relaxation period.

8.6 Test No. 6 — Stacking test

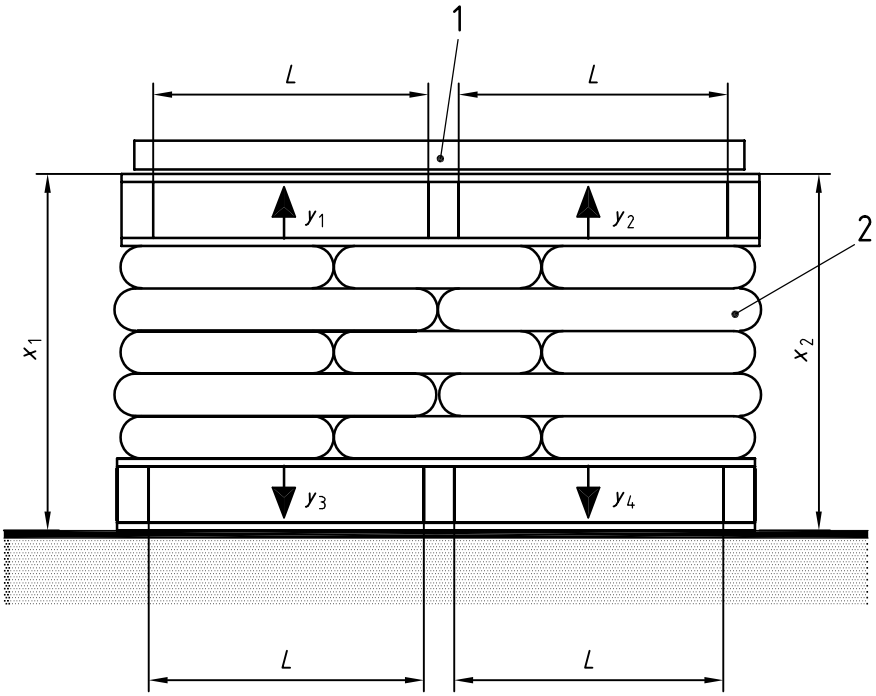
8.6.1 Purpose

The purpose of this test is to determine the ability of the pallet top and bottom decks to withstand the local effects of widely varying payloads on sub-spans of decks between blocks or stringers in a block stacking situation.

8.6.2 Procedure

Support the bottom pallet on a solid surface and place, on top, a load similar to the actual load the pallet will support, as shown in Figure 6. These may be blocks, sacks or flexible intermediate bulk containers (FIBC). Place a second pallet on top of the actual load. Using dead load or platens of a universal testing machine, apply the test load to the top pallet.

Warning: the results of this test will depend on the characteristics of the actual load used.



Key

1 test load or payload
2 rigid or compliant payload
3 solid support

Figure 6 — Stacking test

8.6.3 Measurement

Measure overall stability, x_1 and x_2, and maximum local deflections in bottom deck, y_1 and y_2, and in top deck, y_3 and y_4:

a) before test load application;

b) immediately after the full test load is applied;

c) at the end of the full load period,

d) after the relaxation period.

8.7 Test No. 7 — Dead-weight bending test

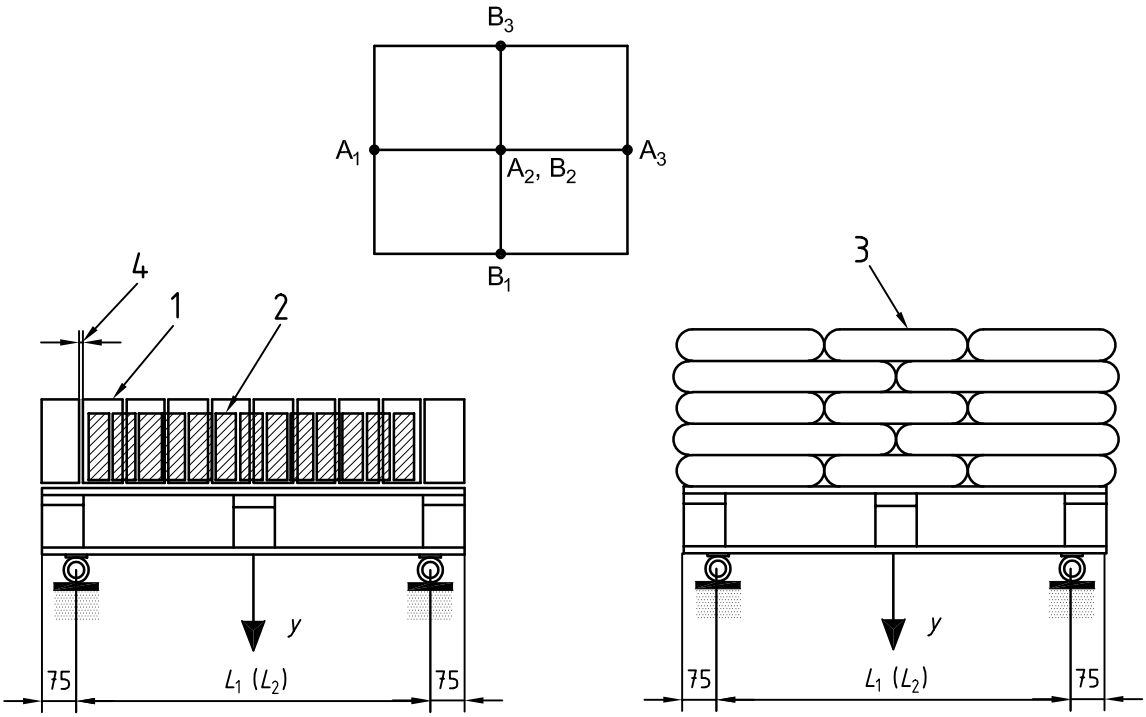
8.7.1 Purpose

This test is used to determine the effects of different loads, such as centrally placed loads (load type B), interlocked or not-interlocked blocks (load type A) and various patterns of sacks (load type C), etc. It is a practicable method of carrying out long-term creep measurements.

8.7.2 Procedure

Place the pallet, top deck uppermost as shown in Figure 7, on pallet supports as described in Figure 1, positioned with their centrelines 75 mm from the outer edges of the pallet, but with the load on the pallet deck conforming to end use. The gaps for non-bridging loads, as shown in Figure 7, shall be large enough such that the load weights do not touch when the pallets deform during testing.

Dimensions in millimetres



Key

1 applied load type A
2 applied load type B
3 applied load type C
4 gap for non-bridging load

Figure 7 — Dead-weight bending test

8.7.3 Measurement

The deflection y shall be measured at points A (maximum of y at A_1, A_2 and A_3), or B (maximum of y at B_1, B_2, and B_3):

a) on the unloaded pallet;

b) immediately after the full test load is applied;

c) at end of the full test load period,

d) after the relaxation period.

8.8 Test No. 8 — Bottom deck bending tests

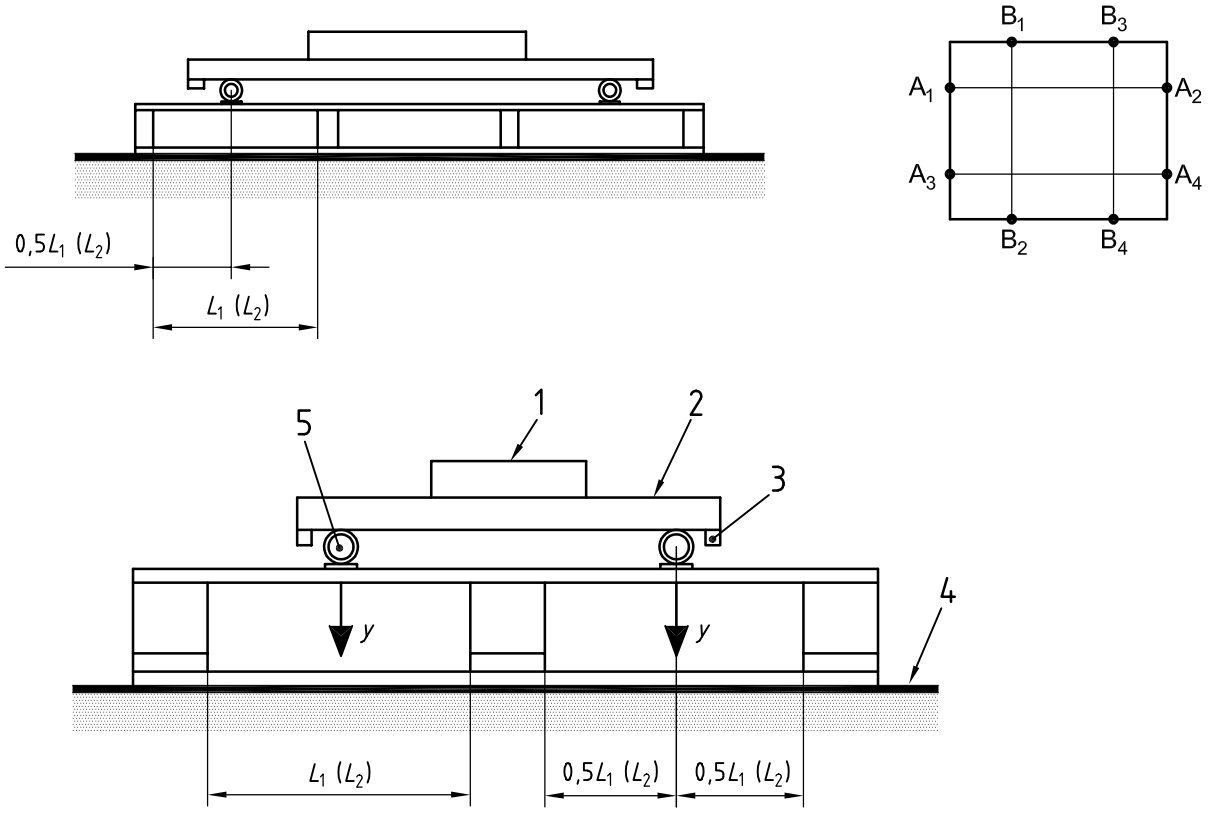
8.8.1 Purpose

The purpose of this test is to determine the strength and stiffness of the bottom deck between blocks or stringers when storing on rack beams or when handling on chain and skate roll conveyors.

8.8.2 Procedure

Place the top deck downwards, as shown in Figure 8, on a flat, hard, rigid horizontal surface and place two inverted applicators, as described in 8.1.2 and Figure 1, across the bottom boards so that the centres of the load applicators are midway between the blocks or the stringers (i.e. at 0,5 L_1 or 0,5 L_2). The load applicators shall project over or be flush with the edge of the pallet base and shall be symmetrically placed about the centreline of the pallet.

Apply the test equipment and then the rest of the test load. If dead-weight is used for the test load, it shall be symmetrically built up during loading. If the pallet has bottom boards in both directions the test shall be carried out in both the length and the width dimensions.



Key

1 test load
2 load board
3 safety stop
4 support
5 load applicator

Figure 8 — Bottom deck bending test

8.8.3 Measurement

8.8.3.1 Test No. 8a — Determination of bending strength

Place a load on the load board until breakage in one of the bottom boards occurs or until reaching an excessive deflection or deformation. Record the ultimate load.

8.8.3.2 Test No. 8b — Determination of bending stiffness

Depending on the orientation of the load applicators, the deflection, y, shall be measured at points A (maximum of y at A_1, A_2, A_3, A_4) or B (maximum of y at B_1, B_2, B_3, B_4):

a) on the unloaded pallet;

b) after positioning of the load applicators and the load board;

c) immediately after full test load is applied;

d) at end of the full load period;

e) after the relaxation period.

8.9 Test No. 9 — Static shear test

8.9.1 Purpose

The purpose of this test is to simulate the approximate forces induced through lateral deck shear.

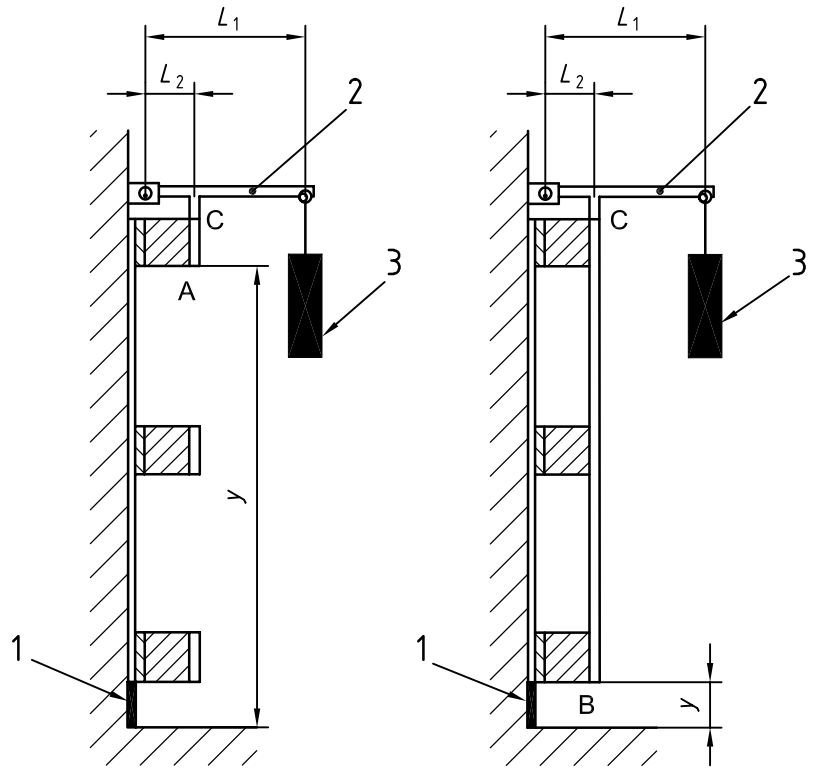
8.9.2 Procedure

Place the pallet vertically, top deck on the test frame, on a vertically positioned board with the same thickness as the deck boards. The length of the board shall be at least equal to the length or width of the tested pallet. See Figure 9. The load applicator at C touches the entire pallet length (or width) along the bottom deck. An alternative test method is to apply the same line load using a compression tester at point C, however when this method is used, then the loading point C platen shall be restrained from movement in any plane other than vertical with radius arm $L_2 > 150$ mm.

8.9.3 Measurement

The applied test load at C, F, resulting from the application of load W gives rise to the vertical distortion which shall be measured at A or B, depending upon whether the pallet has a continuous bottom board. Distortion (change in y) shall be measured after release of load and after a relaxation period.

$$F = \frac{L_1 \times W}{L_2}$$



Key

1 support
2 load applicator
3 load W

Figure 9 — Static shear test

9 Dynamic strength tests

9.1 Test No. 10 — Corner drop test

9.1.1 Purpose

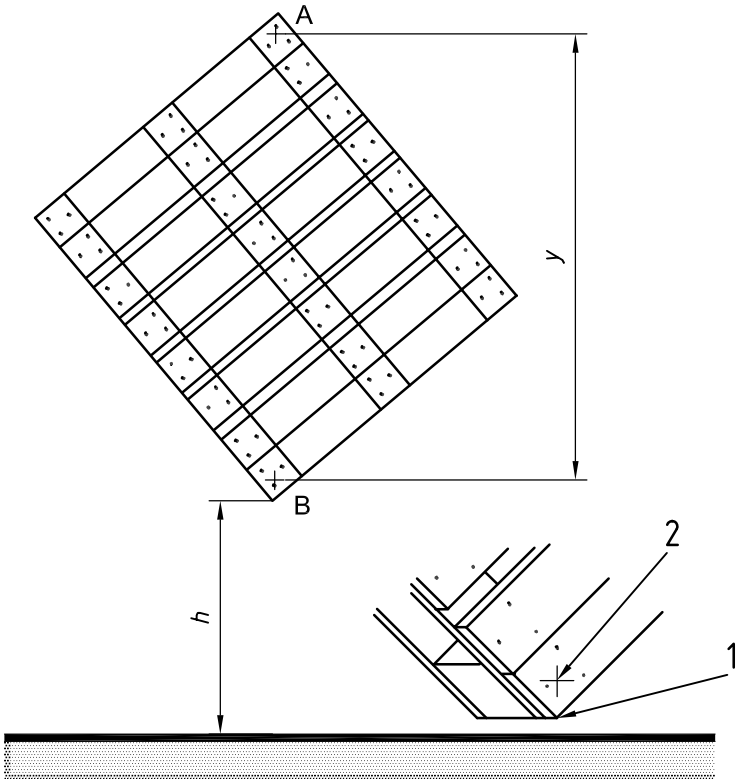
The purpose of this test is to determine the diagonal rigidity of the top deck of the pallet and its resistance to impact.

9.1.2 Procedure

Mark the two measuring points A and B as shown in Figure 10 at approximately 50 mm from the corners of the pallet. Whilst suspending the pallet as shown in Figure 10, drop the pallet freely on to its top deck corner edge from a height h onto a hard horizontal impact surface. The diagonal axis of the pallet shall stay vertical during the drop. Whenever possible, carry out the drop three times, always on the same corner and from the same height.

9.1.3 Measurement

The length of diagonal y shall be measured before the first and after the third drop. Any damage shall be noted.



Key

1 pallet corner

2 measuring point

Figure 10 — Corner drop test

9.2 Inclined plane impact tests

9.2.1 General

The test load comprises the dead load, a load-spreading sheet and a load box having a plan size of 600 mm × (800 mm ± 50 mm). Place the load within the box, which shall be placed in a position dependent upon the individual test requirements described in 9.2.2 to 9.2.4. The detachable supporting edges shall be at least as long as the pallet deck under test. The test load shall not include the mass of the dolly.

For each of the inclined plane tests, before release the dolly is raised a distance L up the incline from the point of impact.

Inclined plane tests are potentially hazardous in view of large masses travelling at high speeds. Design of such test rigs shall incorporate special safety features to reduce risks to both operators and observers.

9.2.2 Test No. 11 — Shear impact test

9.2.2.1 Purpose

The purpose of this test is to determine the resistance to side horizontal impacts of the assembly between the top deck, blocks, stringers, stringer boards and bottom deck.

9.2.2.2 Procedure

9.2.2.2.1 Secure a steel or high-density hardwood beam, 90 mm × (90 mm ± 10 mm) in nominal cross-section and at least as long as the longer dimension of the pallet, to the face of the backstop. The upper edge of the barrier shall be 15 mm above the bottom surface of the pallet (top surface of the dolly) when the dolly is in its lowest position (see Figure 11).

9.2.2.2.2 Place the pallet on the dolly of the inclined plane testing machine so that when the forward edge of the pallet is resting against the barrier, the dolly is 10 mm ± 5 mm clear of it.

9.2.2.2.3 The test load is distributed over the pallet deck surface with the exception of the leading 100 mm (which are left exposed) by means of a load-spreading sheet. This may conveniently comprise a sheet of strong plywood 18 mm × 25 mm which is cut to cover all but the exposed strip, as shown in Figure 11.

NOTE The load-spreading sheet is often a sheet of plywood which distributes load such that failures occur at the location of impact. This sheet is often necessary for testing paper pallets.

9.2.2.2.4 Attach the load box centrally on the pallet with rest of the test load such that loading is central to the axis of movement down the rails but biased towards the higher end of the pallet.

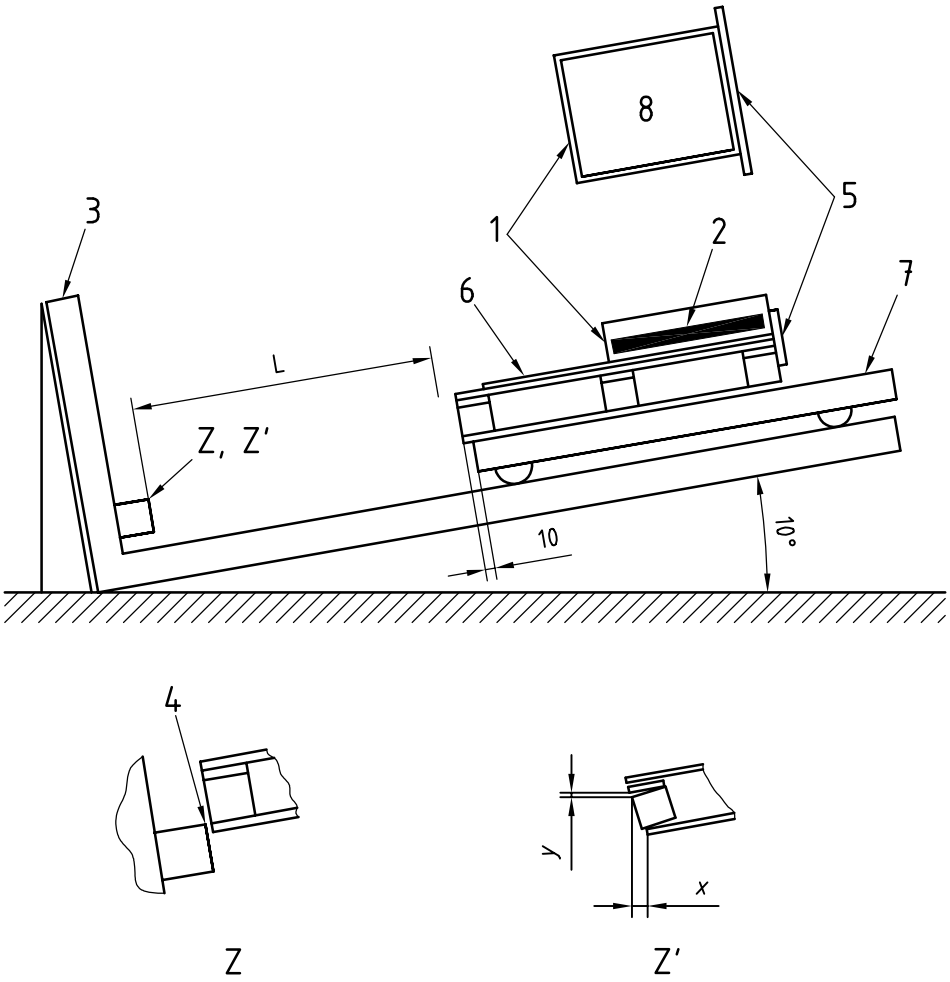
9.2.2.2.5 Bring the dolly and the loaded pallet up to a predetermined position on the incline at a distance L from the point of impact and release. Repeat as required

9.2.2.2.6 Carry out a similar sequence of impacts along the second horizontal axis of the pallet.

9.2.2.3 Measurement

The distortion in x and y planes and any damage shall be noted. The changes shall be recorded at a number of positions along the impacted surface.

Dimensions in millimetres



Key

1	load box	5	detachable support for load box
2	test load	6	load-spreading sheet
3	backstop	7	dolly
4	line of impact	8	top view

Figure 11 — Shear impact test

9.2.3 Test No. 12 — Top deck edge impact test

9.2.3.1 Purpose

The purpose of this test is to determine the resistance of the top deck edge to side horizontal impacts by the fork arms of a fork lift truck.

9.2.3.2 Procedure

9.2.3.2.1 The inclined plane tester described in 9.2.1 is used with the impact stops shown in Figures 12 and 13.

9.2.3.2.2 Place the pallet, the load box and the spreading sheet with the test load, on the dolly of the incline testing machine so that when the forward edge of the pallet is resting against the impact stops, the dolly is 25 mm ± 5 mm clear of it. The load shall be central to the axis of movement.

9.2.3.2.3 Align the impact stops with the fork openings of the pallet at a height that allows the leading edge to touch the stop surface of the blade at a point between 100 mm and 250 mm from the vertical face of the impact stops (see Figure 12). The points of impact shall be within this area for each impact. The impact stops shall be positioned at the midpoints between the blocks or stringers.

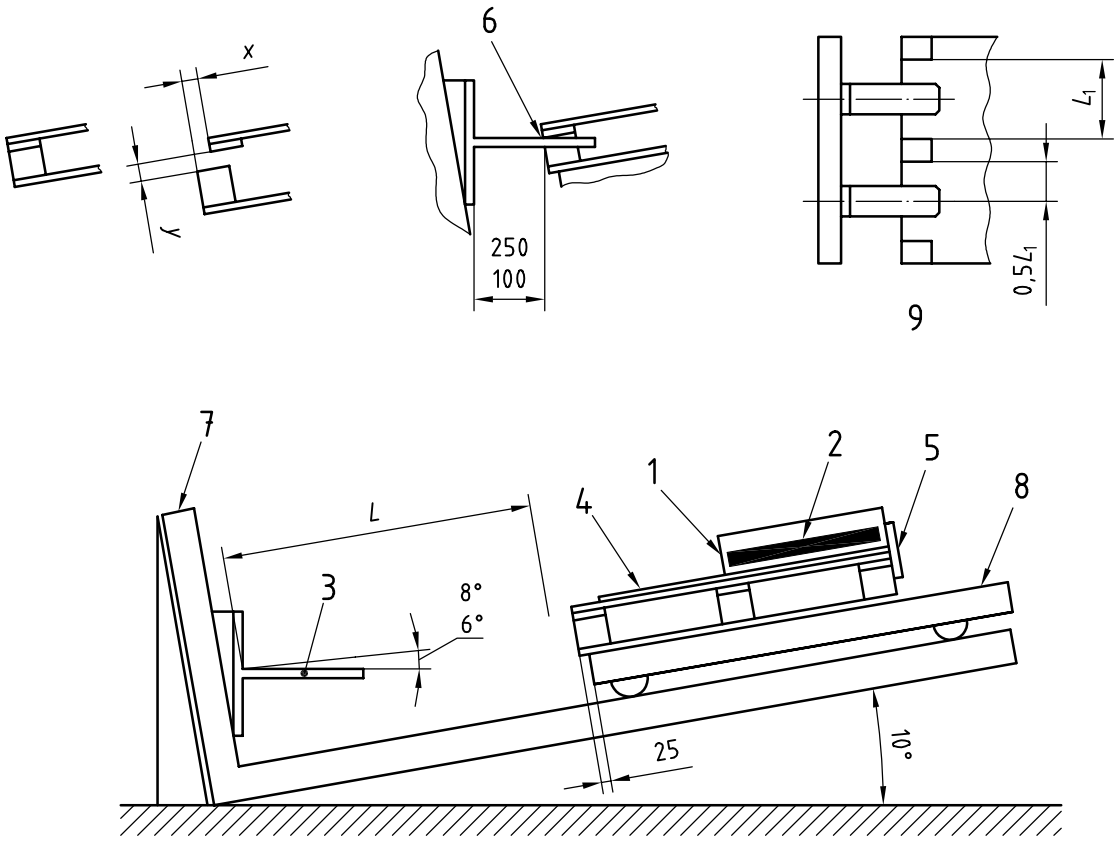
9.2.3.2.4 Raise the pallet with the dolly until the pallet is a distance L from the vertical face of the impact stop (see Figure 12) and release. Repeat as required.

9.2.3.2.5 Carry out a similar sequence of impacts along the second horizontal axis of the pallet.

9.2.3.3 Measurement

Deformation in x and y planes shall be recorded. The penetration depth and general damage at points of impact shall also be recorded.

Dimensions in millimetres



Key

1	load box	6	point of impact
2	test load	7	backstop
3	impact stop	8	dolly
4	load-spreading sheet	9	top view
5	detachable support for load box		

Figure 12 — Top deck edge impact test

9.2.4 Test No. 13 — Block impact test

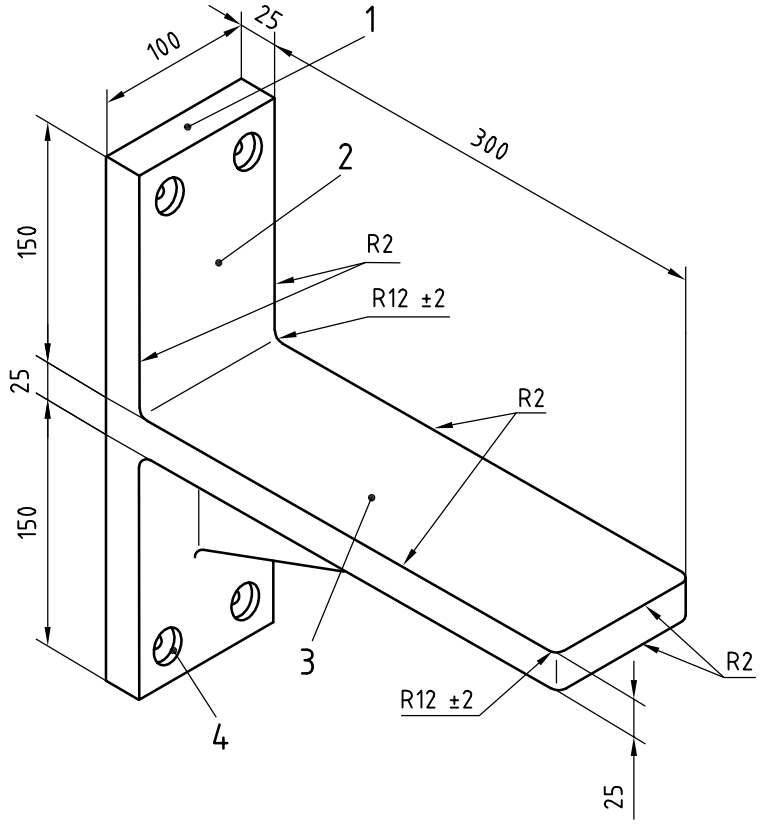
9.2.4.1 Purpose

The purpose of this test is to determine the resistance of blocks, stringers and connections to impact by the fork arm tips of fork lift trucks.

9.2.4.2 Procedure

9.2.4.2.1 The inclined plane tester described in 9.2.1 is used with the impact stop as shown in Figure 13.

Dimensions in millimetres



Key

1 shank
2 shank face
3 blade
4 counterbore

R is the radius of curvature.

Figure 13 — Impact stop for top deck edge and block impact tests.

9.2.4.2.2 Place the pallet and load box with the test load on the dolly of the incline test machine so that when the forward edge of the pallet is resting against the tip of the impact stops, the dolly is 25 mm ± 5 mm clear of it. The load shall be centered with respect to the sides or ends of the pallet.

9.2.4.2.3 Place the pallet so that lines parallel to the direction of travel shall be drawn from the edges of the impact stops through the points on the front face of the blocks D and E shown in Figure 14. The impact stops shall be positioned accordingly with the top of their leading edge blades 75 mm above the top surface of the dolly and offset 30 mm as shown in the inset to Figure 14.

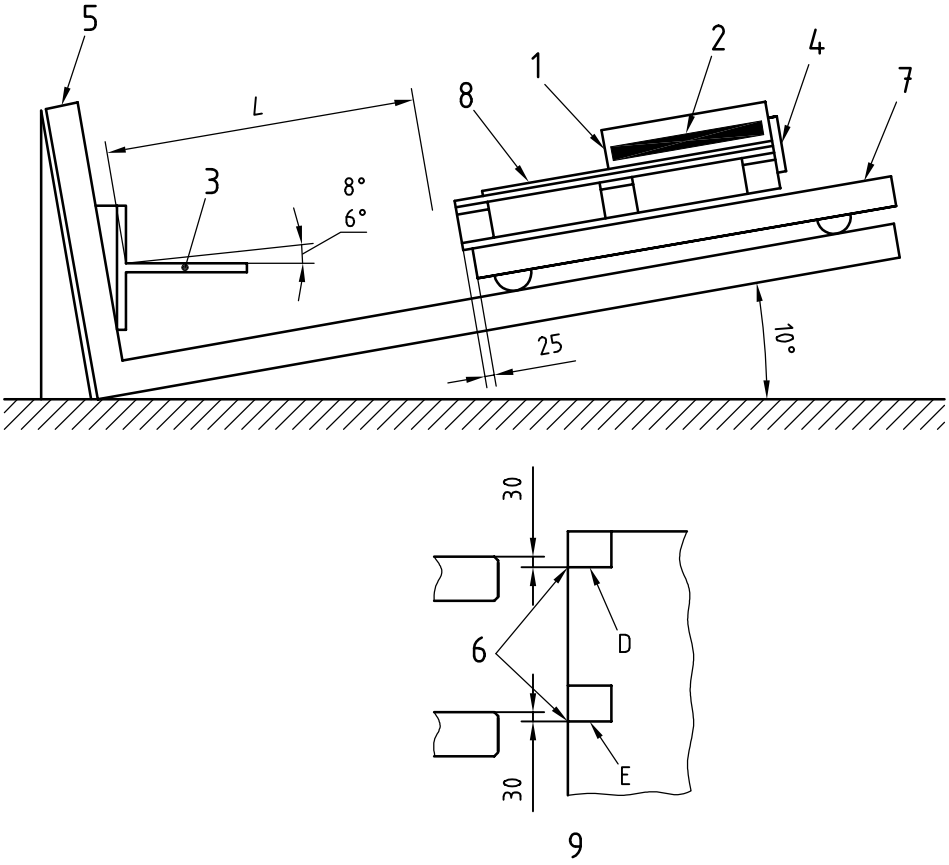
9.2.4.2.4 Raise the dolly and pallet so that they travel a distance L before impact then release. Repeat as required.

9.2.4.2.5 Carry out a similar sequence of impacts along the second horizontal axis of the pallet.

9.2.4.3 Measurement

Displacements shall be recorded after each impact, together with indentation depth. All other damage shall be noted.

Dimensions in millimetres



Key

1	load box	4	detachable support for load box	7	dolly
2	test load	5	backstop	8	load-spreading sheet
3	impact stop	6	points of impact	9	top view

Figure 14 — Incline block impact test

10 Friction tests

10.1 Test No. 14 — Static coefficient of friction test

10.1.1 Purpose

The purpose of this test is to determine the static coefficient of friction between the underside of the top deck and the forks of fork lift trucks.

NOTE The test is conducted using an unloaded pallet because this result can be used to predict the slip of large masses.

10.1.2 Procedure

Weigh the unloaded pallet, then place it on horizontally-positioned, grease-free, dry, steel forks with the level set to ± 1° as shown in Figure 15. The width of the arms shall be 100 mm.

The test shall be carried out at the openings parallel to the length and parallel to the width of the unloaded pallet. If rubber or high friction inserts are set into the bottom of the top deck, note whether these engage on the steel forks during the test.

10.1.3 Measurement

Gradually increase force until motion commences and record this maximum value, F_s.

$$\mu_s = \frac{F_s}{W_s}$$

where

μ_s is the static coefficient of friction;

F_s is the force required to commence movement;

W_s is the pallet mass.

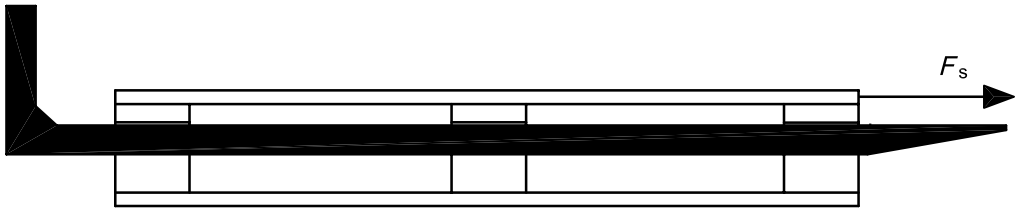


Figure 15 — Static coefficient of friction test

10.2 Test No. 15 — Slip angle test

10.2.1 Purpose

The purpose of this test is to determine the angle at which the test box commences to slip and thus compare pallet/load interface results for different pallets and construction materials.

10.2.2 Procedure

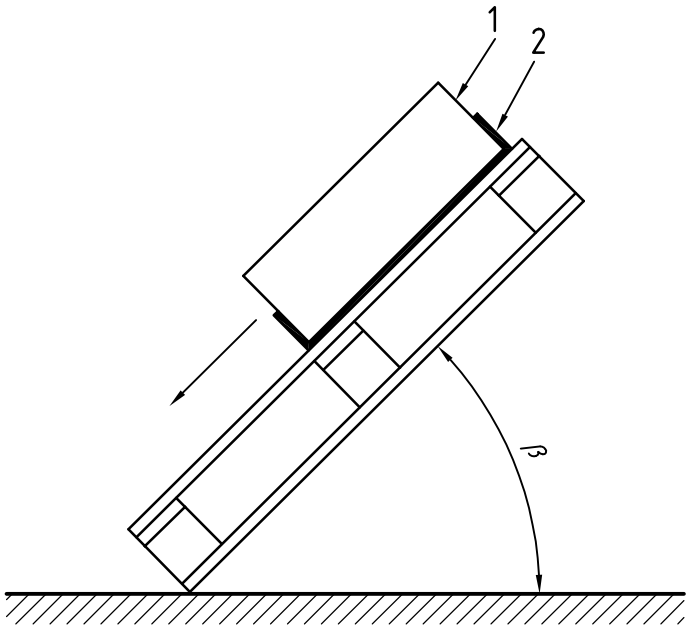
Load a box 400 mm × 600 mm, having a bottom contact surface faced with a grease-free, dry, steel surface, to 30 kg and tilt the pallet from the horizontal at a rate of (45° ± 10 %)/min as shown in Figure 16. Repeat on the length and width of the pallet.

Slip angle tests are potentially hazardous in view of masses travelling at speed. Design of such test rigs shall incorporate special safety features to reduce risks to both operators and observers and to ensure repeatability.

10.2.3 Measurement

Record the angle, β, at which the load commences to slip down the deck.

NOTE Steel has been chosen as the test surface for repeatability reasons. Care should be exercised when predicting from these tests, slip resistance for other packaging materials. It may be necessary to test each actual packaging material to confirm its slip resistance by using it as the friction material in this test.



Key
1 400 mm × 600 mm box
2 friction material

Figure 16 — Slip angle test

11 Test report

11.1 General information — all materials

a) Reference to this document, i.e. ISO 8611-1;

b) date of the test;

c) signature of the tester;

d) type and dimensions of the pallet (standard or description);

e) material of the pallet;

f) test apparatus used;

g) accuracy of applied loading as appropriate;

h) location of testing;

i) laboratory humidity and temperature at the time of test;

j) number of replicate tests performed;

k) test number and test results for each test performed.

11.2 Information for wooden and wood-based composite pallets

a) Species, if feasible, and the density of the components;

b) moisture content of wood specimens at assembly using electrical resistance method;

c) moisture content at time of testing;

d) grade and quality of components

e) elapsed time period between specimen assembly and testing if known;

f) fasteners used, with dimensions and shank profile;

g) fastener bending strength measured using ISO 12777-1;

h) any withdrawal of fasteners during test.

11.3 Information for plastic pallets

a) Compound, if feasible, from which the pallet is made;

b) reference number, serial number, product code, etc.

11.4 Information for pallets made of other materials

a) Fastening method;

b) characteristics of the material, if feasible, that will affect the pallet performance in these tests.

Bibliography

[1] ISO 509, *Pallet trucks — Principal dimensions*

[2] ISO 3130, *Wood — Determination of moisture content for physical and mechanical tests*

[3] ISO/TS 8611-3, *Pallets for materials handling — Flat pallets — Part 3: Maximum working load*

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