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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

General-purpose flat pallets for through transit of goods — Test methods

Palettes plates d'usage général pour le transport de marchandises — Méthodes d'essai

Reference number
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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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General-purpose flat pallets for through transit of goods — Test methods

0 Introduction

The tests specified in this International Standard are particularly appropriate for testing pallet prototypes. They may also be valuable in point-of-manufacture, quality-assurance and field testing of pallets, but it is not intended that these tests be used for research purposes. Tests to establish data for pallet research will normally be considerably more comprehensive than those contained in this International Standard.

The majority of pallets are of conventional timber design. The tests specified in this International Standard are, to a large degree, applicable to such pallets. As new designs and materials, particularly plastics, are introduced, a pallet which meets the requirements for conventional timber designs may, however, be unfit for use in normal transit by virtue of undesirable properties. In such instances, the inclusion of special tests and special climatic conditioning prior to testing may have to be considered. Extension of the duration of the loading tests may also be desirable.

Suggested levels of performance in relation to the tests specified in this International Standard are not included but will be incorporated in a future Technical Report.

1 Scope and field of application

This International Standard specifies test methods for general-purpose flat pallets. The tests are principally intended for the evaluation of existing pallets or of new designs of pallet in relation to their designed load capacity.

Specific tests for wing pallets are not included. It is anticipated that such additional tests can be developed for inclusion in a future edition of this International Standard.

NOTE — The tests may also be of value in

a) testing individual pallet components;

b) development of prototype pallets;

c) research into basic pallet performance (though these tests are not as comprehensive as most research requires: see note in clause 10);

d) evaluation of pallets from in-use failure situations;

e) testing at point of manufacture (unconditioned).

2 References

ISO 445, *Pallets for materials handling — Vocabulary.*

ISO 2244, *Packaging — Complete, filled transport packages — Horizontal impact tests (horizontal or inclined plane test; pendulum test).*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 445 apply.

4 Measurement and checking of test pallets

4.1 Pallets selected for testing shall be checked to ensure that materials, construction and dimensions conform with any stated specification (see clause 10).

4.2 The mass of each pallet shall also be determined and recorded, together with the moisture content of individual components at the time of weighing (where appropriate).

5 Number of replicates and sequence of testing

When evaluating a pallet in relation to its designed load capacity, a minimum of three replicates shall be tested. The complete sequence of seven tests shall be carried out consecutively in the exact order laid down in this International Standard.

For each complete sequence of tests, the same pallet shall be used, including those tests where it is necessary to test the pallet across both of its horizontal axes.

6 Conditioning

6.1 Temperature and moisture are known to affect pallets of a number of materials both under test and in the field. Conditioning prior to testing takes account of the reaction of the pallet material to the test environment and ensures valid and repeatable test results.

A further purpose of conditioning is to predict the behaviour of identical pallets in the extreme conditions that may be encountered in transit while loaded with goods.

6.2 Table 1 includes details of conditioning environments relevant to pallet usage. They shall be applied as follows:

a) the moisture content of timber pallets should not be less than 18 %. If the moisture content is below this value, the test may proceed provided that the moisture content of critical components is recorded every 24 h until completion of the test programme;

b) at least one specimen of a plasics pallet shall be conditioned to environment A and a further pallet to environment B;

c) at least one specimen of paper-based and wood-based pallets shall be conditioned to environment C or D.

NOTE — Composite pallets consisting of two or more materials, for example hollow plastics blocks supporting plywood decks, may have to undergo more extensive conditioning.

6.3 Where conditioning is relevant and the whole test laboratory cannot be maintained at the required level, then tests shall commence within 1 h after the pallet has been removed from the conditioning chamber. When environments A and B apply, the tests shall commence immediately after the pallet has been removed from the conditioning chamber. Immediately after each individual test, specimens subjected to environments A or B shall be returned to the conditioning chamber for a minimum of 1 h.

6.4 For wood or wood-based materials, a record shall be made of the moisture content in selected components at the beginning of the full test programme.

7 Accuracy of test apparatus

7.1 Test apparatus described in clauses 8 and 9 shall satisfy the following requirements:

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

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

c) the accuracy of positioning of every component, excluding the test load, shall be ± 2 mm;

d) the accuracy of positioning of the centre of gravity of the test loads referred to in clause 8 shall be ± 20 mm;

e) the total mass of the test loads used shall be within ± 3 % of the predetermined value.

7.2 No part of any test rig shall deflect an amount greater than 2 mm when under maximum test load.

7.3 The inclined plane apparatus shall be constructed as specified in ISO 2244.

Table 1 — Conditioning environments

Conditioning environment	Atmosphere	Temperature °C	Relative humidity %	Time h	Pallet material
No conditioning required [see 6.2a)]					Unprocessed (sawn) timber with metal fastenings
A	Air	40 ± 2	—	24	Plastics
B	Air	− 25 ± 3	—		
C	Air	25 ± 5	90 ± 5	48	Paper-based and processed wood (for example plywood, particle board) [1]
D	Water	20 ± 5	—	24	
No conditioning required					All metal

1) Includes any pallet containing or assembled with adhesive.

8 Static tests

For all static tests described in 8.1 to 8.3, the test load applied shall include in all cases the mass of any load board and load applicators.

8.1 Stacking test

The purpose of this test is to determine the compression strength of the pallet or pallet corner block to localized vertical loads.

8.1.1 Deformation measurements

When tested in accordance with the method specified in 8.1.2, the change in the height, y, of the top deck at point A, as shown in figure 1, relative to the ground (or test frame) shall be recorded

a) at the datum load (see 8.1.2);

b) at the beginning and end of the full load period;

c) upon unloading, at the datum load (see 8.1.2), every 5 min until successive readings are identical (limited to a maximum period of 1 h).

The deflection at A is established by taking the mean value of measurements at points A_1 and A_2 (see figure 1).

Similar measurements shall be made relating to point B when the test is repeated on the diagonally opposite corner (see 8.1.2).

8.1.2 Procedure

Place the pallet in a normal position on a flat, hard, rigid, horizontal surface. Place a rigid load applicator of dimensions 200 mm × 200 mm × 25 mm, over an outer block [as shown in figure 1a)] or, in the case of a stringer pallet, over one end of a stringer [as shown in figure 1b)].

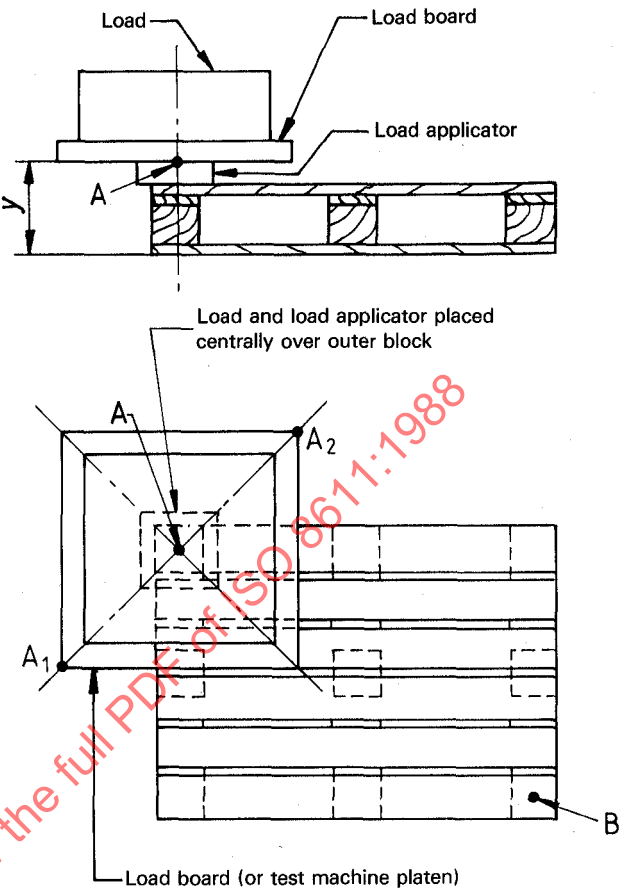
Gradually apply the test load at a uniform rate from 0 to 0,25 R where R is the designed load capacity of the pallet, assuming an evenly and uniformly distributed load. This shall be the datum for subsequent deflection measurements. Apply the full test load of 1,1 R, per loaded block, in not less than 1 min and not more than 5 min. If deadweight is used for the test load, it shall be symmetrically built up during loading. Keep the full test load in place for a period of 2 h or 24 h, depending on the pallet material (see table 2).

Reduce the test load to the datum load for the necessary period [see 8.1.1 c)].

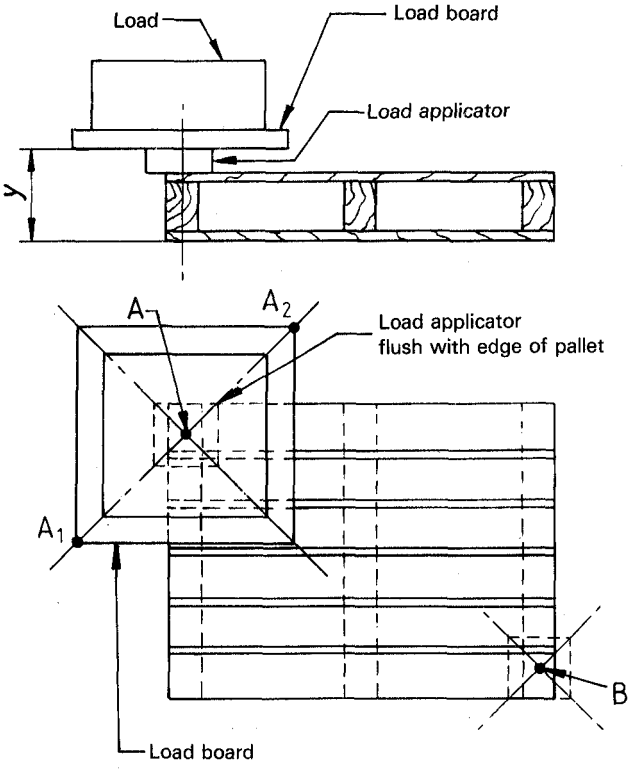
Take deflection measurements relating to point A (see 8.1.1).

Repeat the test at point B (see figure 1) so that the test shall have been carried out on two diagonally opposed corners of the pallet. Take a further set of deflection measurements relating to point B (see 8.1.1).

NOTE — Alternatively the test may be carried out on several corners simultaneously with an appropriate increase in full test load (i.e. 2,2 R on two corners or 4,4 R on four corners).



a) Load applicator over one outer block (deflection measured at points A_1 and A_2)



b) Load applicator over one end of a stringer (deflection measured at points A_1 and A_2)

Figure 1 — Stacking test

Deflection measurements shall be made at all the corners under test.

Table 2 — Test load duration for static tests

Pallet material	Test period h
Unprocessed (sawn) timber with metal fastenings	2
Plastics	24
Paper-based and processed wood (for example plywood, particleboard)	24
All metal	2
Composite containing plastic	24
Pallet assembled with adhesive	24

8.2 Bending test

The purpose of this test is to determine the stiffness and flexural strength of the complete pallet.

8.2.1 Deflection measurements

When tested in accordance with the method specified in 8.2.2, the deflection at points A and B, as shown in figure 2, when measured relative to the upper (or lower) surface of the top or bottom decks and the ground (or test frame), shall be recorded

a) at the datum load (see 8.2.2);

b) at the beginning and end of the full load period;

c) upon unloading, at the datum load (see 8.2.2), every 5 min until successive readings are identical (limited to a maximum period of 1 h).

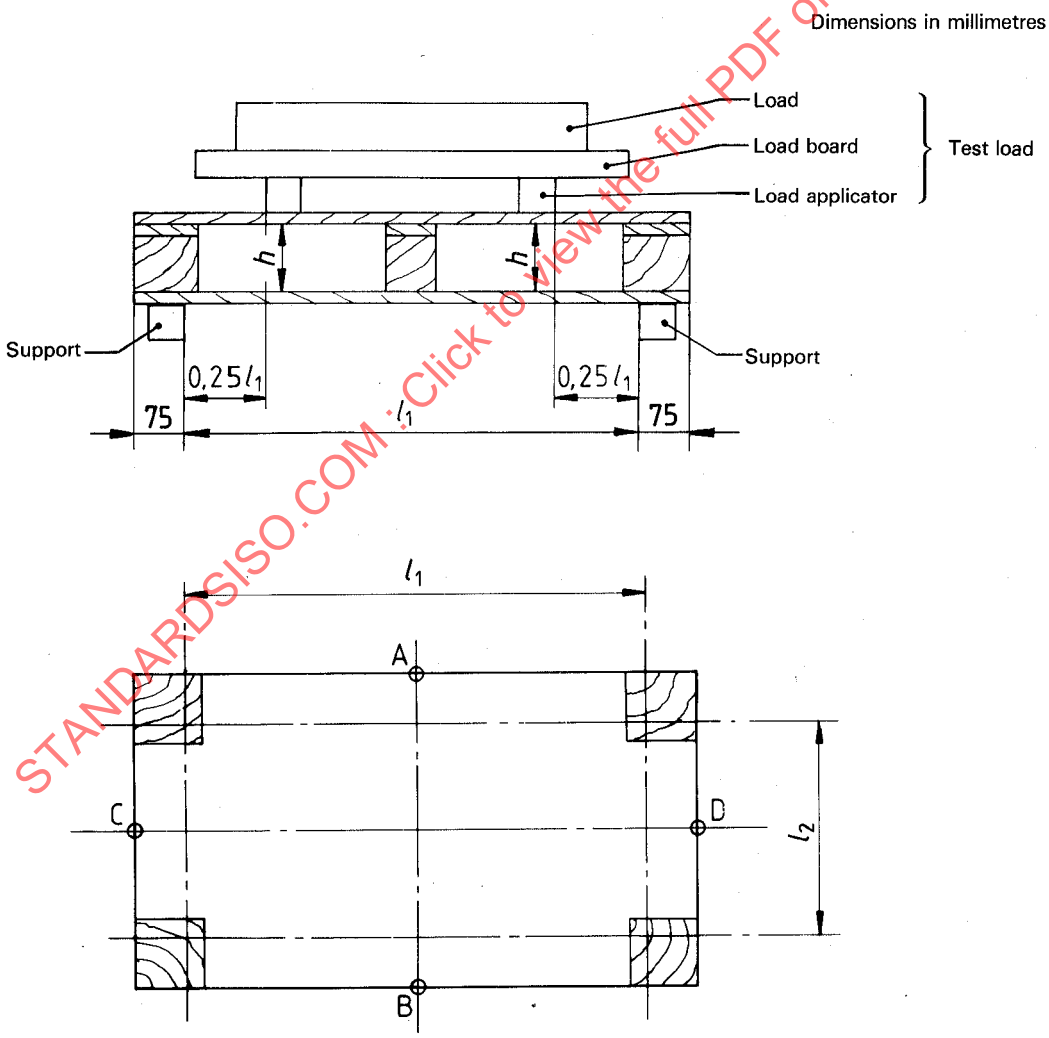


Figure 2 — Bending test using square supports and load applicators (see also figure 3)

The distance between the decks, h, directly under the load applicators shall be measured so that data on the minimum fork entry heights under full load can be obtained.

Similar measurements shall be made at points C and D and between the decks when the test is repeated along the second horizontal axis of the pallet (see 8.2.2).

8.2.2 Procedure

Place the pallet, top deck uppermost, on square (or semi-circular) section supports positioned with their inside edges (or centre lines) 75 mm from the outer edge of the pallet (see figure 2). The load applicators shall be positioned at $0{,}25\,l_1$ when measured as shown , where l_1 is the distance between the inside edges (square section) or centre lines (semi-circular section) of the pallet supports (see figure 2).

Load applicators and supports shall be flush with or project beyond the pallet. Edges shall be relieved with 2 mm radii as shown in figure 3.

Gradually apply the test load at a uniform rate from 0 to $0{,}1\,R$. This shall be the datum for subsequent deflection measurements. Apply the full test load of $1{,}25\,R$ in not less than 1 min and not more than 5 min. If deadweight is used for the test load, it shall be symmetrically built up during loading. Keep the full test load in place for a period of 2 h or 24 h depending on the pallet material (see table 2).

Reduce the test load to the datum load for the necessary period [see 8.2.1 c)].

Take deflection measurements at points A and B (see 8.2.1).

Repeat the test along the second horizontal axis of the pallet (i.e. both length and width are tested) with the load applicators positioned at $0{,}25\,l_2$ when measured as shown from the inside edges or centre lines of the pallet supports, where l_2 is the distance between inside edges or centre lines of the pallet supports (see figures 2 and 3).

A further set of deflection measurements shall be taken at points C and D (see 8.2.1).

8.3 Bottom deck test

The purpose of this test is to determine the stiffness and flexural strength of the bottom deckboards between support points.

8.3.1 Deflection measurements

When tested in accordance with the method specified in 8.3.2, the deflections at points A, B, C and D, as shown in figure 4, when measured relative to the upper or lower surface of the bottom deck and the ground (or test frame), shall be recorded

a) at the datum load (see 8.3.2);

b) at the beginning and end of the full load period;

c) upon unloading, at the datum load (see 8.3.2), every 5 min until successive readings are identical (limited to a maximum period of 1 h).

Similar measurements shall be made at points E, F, G and H, as shown in figure 4, when the test is repeated on the second horizontal axis of the pallet (see 8.3.2).

Dimensions in millimetres

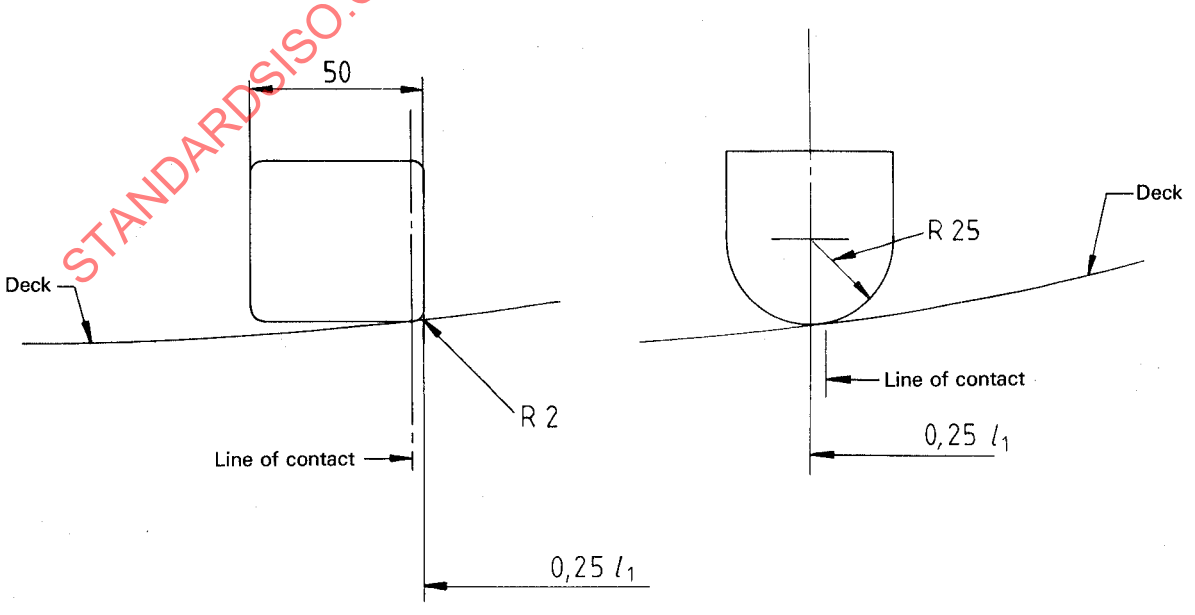
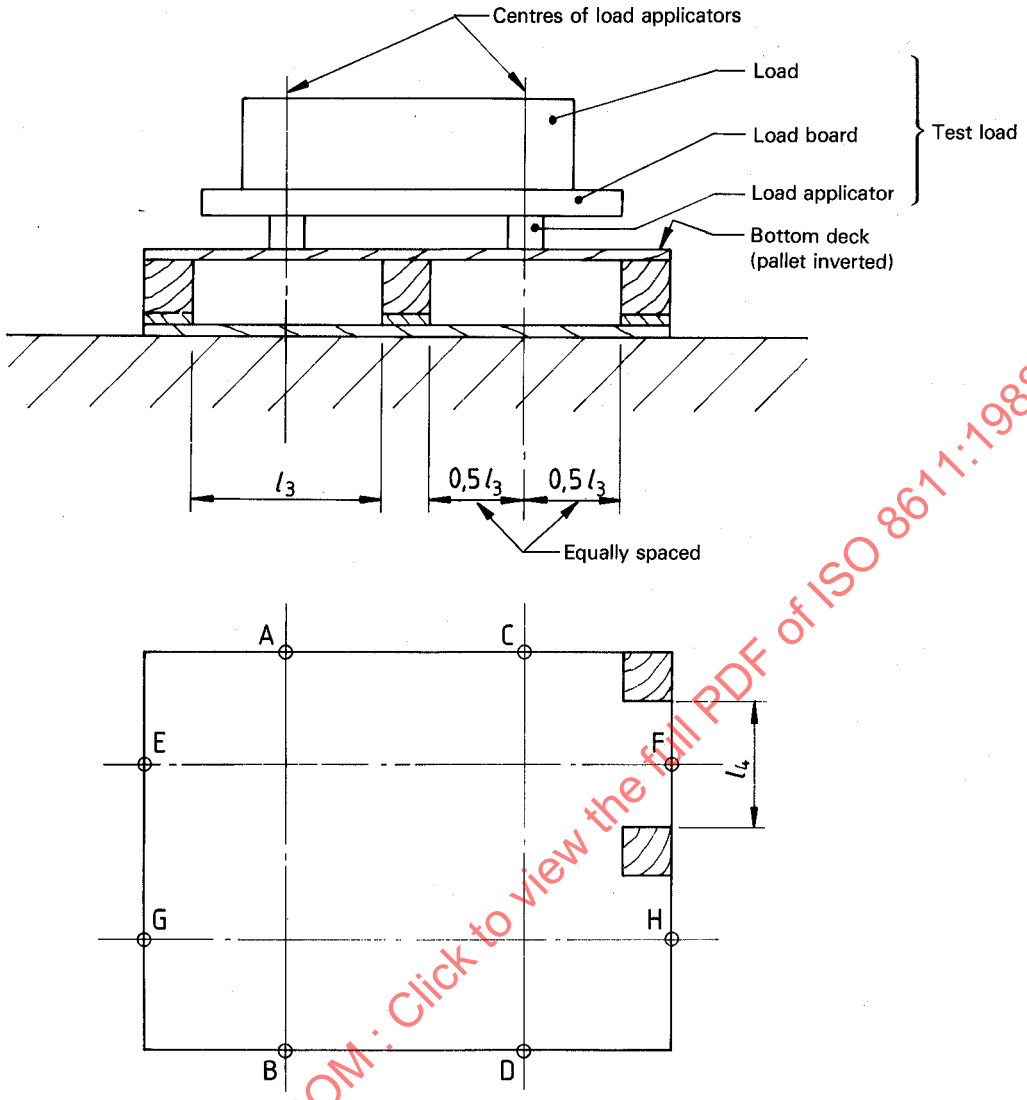
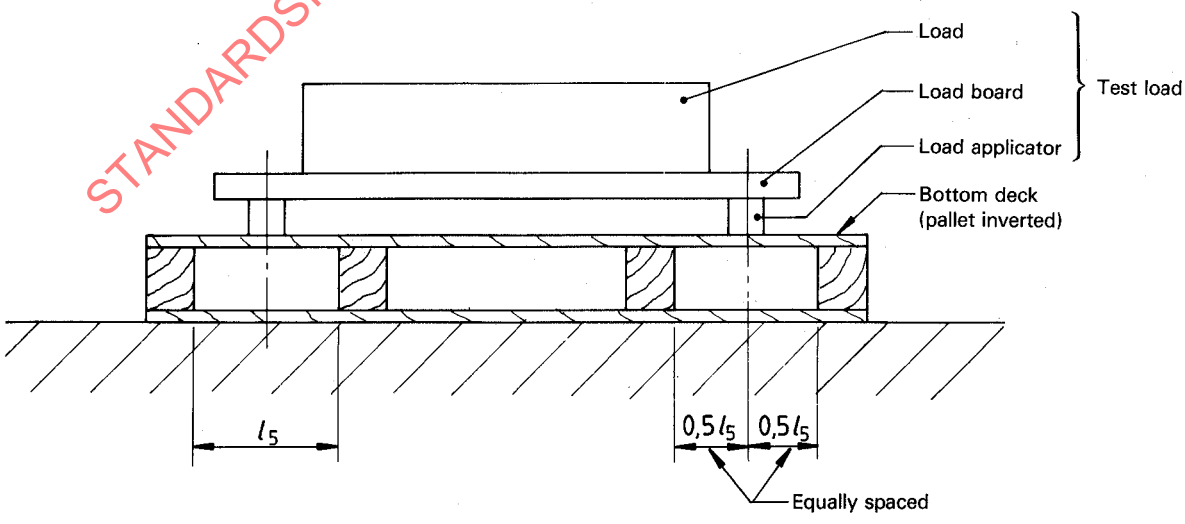


Figure 3 — Alternative pallet supports/load applicators



a) Three-stringer pallet (two-way or partial four-way entry) or nine-block pallet (four-way entry)



b) Four-stringer pallet

Figure 4 — Bottom deck test with pallet inverted

8.3.2 Procedure

Place the top deck of the pallet downwards on a flat, hard, rigid horizontal surface and place two square or semi-circular section load applicators, as shown in figure 4, so that the centres of the load applicators are midway between the blocks or the stringers (i.e. at $0{,}5\,l_3$, $0{,}5\,l_4$ or $0{,}5\,l_5$). The load applicators shall project over or be flush with the edge of the pallet base and shall be symmetrically placed about the centre line of the pallet.

Gradually apply the test load at a uniform rate from 0 to $0{,}1\,R$. This shall be the datum for subsequent deflection measurements. Apply the full test load of $1{,}15\,R$ in not less than 1 min and not more than 5 min. If deadweight is used for the test load, it shall be symmetrically built up during loading. Keep the full test load in place for a period of 2 h or 24 h depending on the pallet material (see table 2).

Reduce the test load to the datum load for the necessary period (see 8.3.1).

Take deflection measurements at points A, B, C and D (see 8.3.1).

For all except stringer pallets, repeat the test along the second horizontal axis of the pallet (i.e. both length and width shall be tested) with the centres of the load applicators placed midway between the blocks (i.e. at $0{,}5\,l_4$) [see figure 4a)].

A further set of deflection measurements shall be taken at points E, F, G and H (see 8.3.1).

9 Impact tests

The purpose of impact tests is to simulate normal levels of shock load which are typically transmitted to pallets in through-transit and to determine the resistance of the pallet to such loads.

9.1 Inclined plane tests

For all three inclined plane tests, the test load shall be $0{,}075\,R$. This test load comprises the load box having a plan size of 600 mm × 800 mm (see figure 5) plus the load in the box, which shall be placed in the box in a position dependent upon the individual test requirements described below. The detachable supporting edges shall be at least as long as the pallet under test. The test load shall not include the weight of the dolly.

For the first two inclined plane tests (see 9.1.1 and 9.1.2), the dolly is raised 1 000 mm up the incline. For the third test (see 9.1.3), it is raised only 750 mm from the point of impact before release. Each test requires three impacts.

9.1.1 Shear test

The purpose of this test is to determine the shear resistance between top and bottom decks.

9.1.1.1 Measurements

When tested in accordance with the method specified in 9.1.1.2, the deflection changes x and y shall be measured between points A and B and between points C and D where construction makes this possible (see figure 6). The changes shall be recorded at a number of positions along the impacted surface.

9.1.1.2 Procedure

Secure a steel or high-density hardwood barrier, 90 mm × 90 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 7).

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 75 mm ± 25 mm clear of it.

Attach the load box centrally on the pallet and load with ballast to $0{,}075\,R$ such that loading is central to the axis of movement down the rails but biased towards the higher end of the box.

Bring the dolly and the loaded pallet to a predetermined position up the incline 1 000 mm from the point of impact, and release. Repeat the procedure twice more, repositioning the

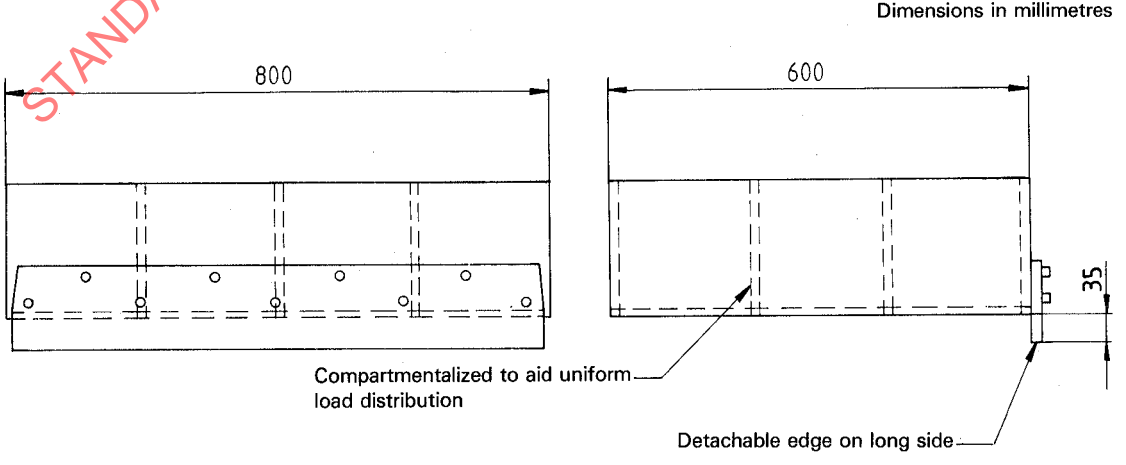


Figure 5 — Load box for inclined plane tests

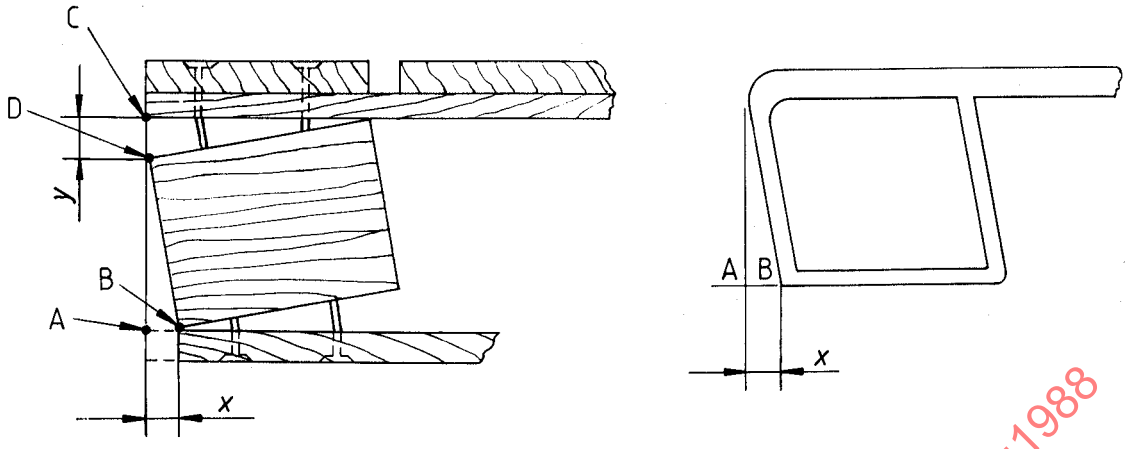


Figure 6 — Shear test — Points of measurement

pallet, load carrier and load before each impact and then take measurements as specified in 9.1.1.1.

Carry out a similar sequence of three impacts along the second horizontal axis of the pallet and then take the specified measurements.

9.1.2 Top deck edge impact test

The purpose of this test is to determine the shunting resistance of the top leading edge deckboard and, where applicable, the stringerboard.

9.1.2.1 Measurements

When tested in accordance with the method specified in 9.1.2.2, deformations x, y_1, y_2 and y_3 (see figure 8) shall be recorded. The penetration depth and general damage at points of impact shall also be recorded.

9.1.2.2 Procedure

The inclined plane tester described previously is used with the impact stop shown in figure 9.

Place the pallet and load box loaded to a mass of 0,075 R on the dolly of the tester. The load should be central to the axis of movement, but biased towards the lower end of the box.

Align the impact stops with the fork openings of the pallet at a height that allows the leading board to touch the top surface of the blade at a point between 100 mm and 250 mm from the shank face (see figure 10). The points of impact shall be within this area for each impact.

NOTE — Table 3 gives appropriate spacing for impact stops in order to enable the range of ISO pallets to be tested with minimum resetting.

Table 3 — Impact stop spacing

Dimensions in millimetres

Pallet size	W [1]
800	350
1 000 to 1 140	450
1 200	550

1) See figure 10.

Raise the pallet with the dolly until the pallet is 1 000 mm from the shank face (see figure 10) and release.

Repeat the procedure twice more, repositioning the pallet and load box before each impact, and then take measurements as specified in 9.1.2.1.

For four-way pallets, carry out a similar sequence of three impacts along the second horizontal axis of the pallet and then take the specified measurements.

9.1.3 Block impact test

NOTE — The test applies only to block pallets. Tests for other types, including stringer pallets, are being considered for a future edition of this International Standard.

The purpose of this test is to determine the resistance of pallet blocks to eccentric impacts at the corners.

9.1.3.1 Measurements

When tested in accordance with the method specified in 9.1.3.2, the displacements x, y and z and the angles α and β of blocks (see figure 11) shall be recorded after each impact, together with indentation depth.

For circular blocks, only displacements y and z and angle β shall be recorded.

9.1.3.2 Procedure

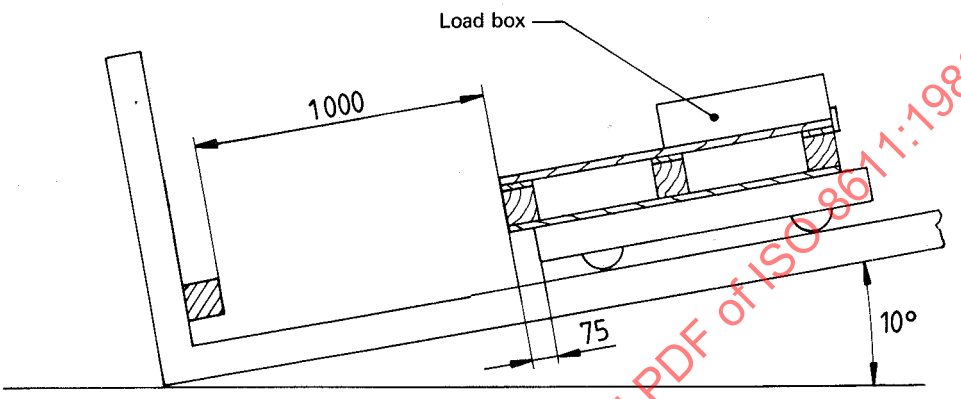
The inclined plane tester described previously is used with the impact stop shown in figure 9.

Place the pallet and load box loaded to 0,075 R on the dolly of the tester. The load should be central to the axis of movement, but biased to the upper end of the box.

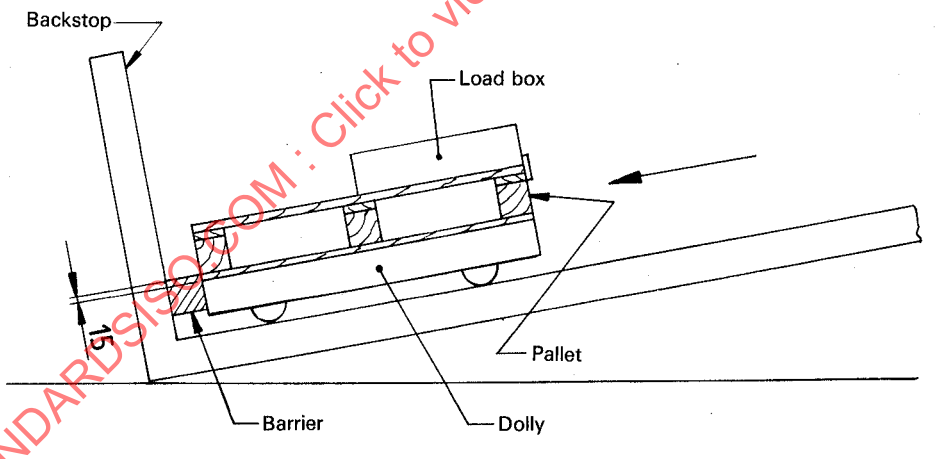
Place the pallet so that lines parallel with the direction of travel can be drawn from edges A of the impact stops through points on the front face of the blocks as shown in figure 12. The impact stops shall be positioned accordingly with the top of their leading edge blades 75 mm above the top surface of the dolly.

Raise the dolly and pallet so that they will travel 750 mm before impact, and release.

Dimensions in millimetres



a) **Position before release**



b) **Position at impact**

Figure 7 — Inclined plane shear test

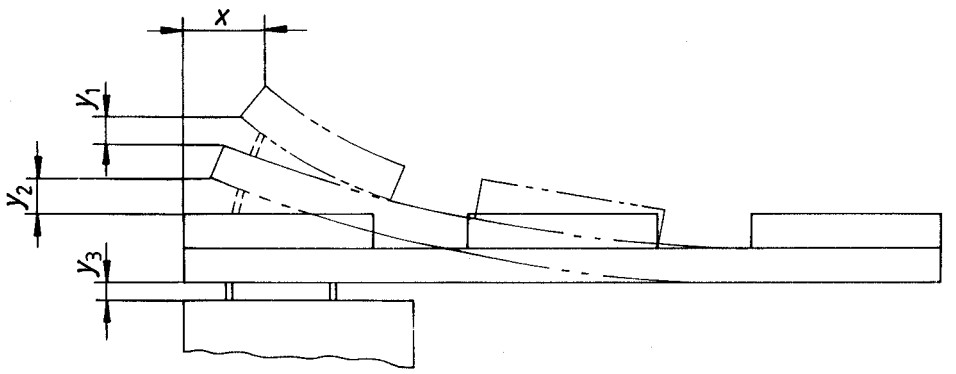


Figure 8 — Top deck edge impact test — Points of measurement

Dimensions in millimetres

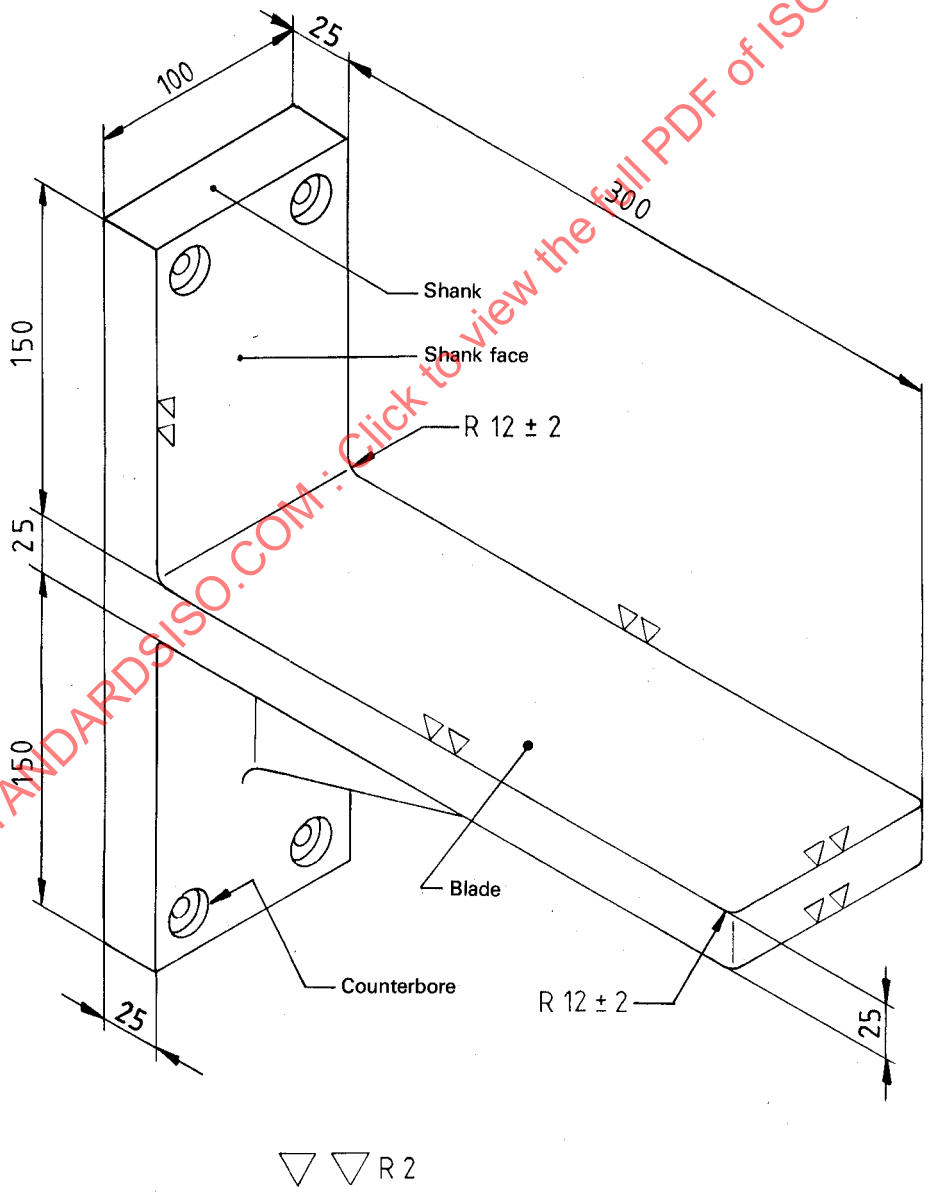


Figure 9 — Impact stop for top deck edge and corner impact test rigs