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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 51, *Pallets for unit load method of materials handling*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 261, *Packaging*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 8611-1:2011), which has been technically revised.

The main changes are as follows:

— The use of the deflection at the datum load was clarified.

— It was clarified that the average of the maximum deflections recorded for each replicate will need to be reported.

— It was clarified that test 5 applies for both twin track conveyors and narrow span beam racking.

— It was clarified that the minimum of the ultimate load recorded for each replicate needs to be reported.

— For test 11, the point where the leading edge of the pallet needs to touch the blade was changed from 100 mm to 250 mm ± 25 mm to 200 mm ± 25 mm.

A list of all parts in the ISO 8611 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The forces to which pallets are exposed during use vary significantly. The test procedures described in this document are approximate simulations of pallet use. These tests help the pallet designer to establish an initial acceptable balance between the cost and the performance of a pallet design. It is intended that all results of tests performed using this protocol be confirmed and verified using field trials before publication of performance or the commercial implementation of a new pallet design.

The nominal load, determined according to this test protocol, does not represent a payload and cannot be verified using field trials. The nominal load is a minimum payload level for use in determining maximum working load according to the procedures in ISO 8611-3. The maximum working load can be verified for a specified payload and intended use, using field trials. It is intended that the publication of the maximum working load include a description of the payload and the intended modes of use of the pallet.

It is essential to exercise care when comparing the results of tests with historic experience using existing pallet designs. User expectations of pallet performance vary. Some require greater and some accept lower levels of performance. Users are accepting different levels of risk when using pallets. Because of the varied performance expectations of pallet users, it is possible that the results of tests do not always reflect the user's perception of pallet performance in use.

It is possible that the nominal load does not reflect users' perception of pallet performance because the nominal load does not represent a payload. It is intended that maximum working loads be used to compare with the historic performance of existing pallet designs.

Regarding the use of the ISO 8611 series,

— this document describes the test methods;

— ISO 8611-2 describes the performance requirements and selection of tests;

— ISO 8611-3 describes tests for determining maximum working loads for known payloads.

This document and ISO 8611-2 are required for determining nominal load. The nominal load is the lowest safe load value for the specified support conditions, independent of the type of load (excluding concentrated loads).

This document, ISO 8611-2 and ISO 8611-3 are required for determining maximum working loads for known payloads.

The nominal load for the intended use is established by the selection of tests in this document; and the performance requirement is established from criteria in ISO 8611-2.

The following three types of intended use with specified support conditions are defined:

— handling of loaded pallets with racking and stacking;

— handling of loaded pallets without racking;

— handling of loaded pallets without racking or stacking.

To determine the maximum working load through testing given in ISO 8611-3, the deflection under the known payload cannot exceed the limiting deflection (see ISO 8611-3:2011, 4.2, 4.3 and 4.4) established in this document and ISO 8611-2. The maximum working load is the greatest payload that a pallet can be permitted to carry in a specific loading and support condition.

Guidance is given in ISO 8611-3:2011, Annex A as to the general effect on performance of different load types and stabilization methods. These can only give guidance as to the likely result from tests with the known payload.

Other tests for durability evaluation are specified in this document.

Pallets for materials handling — Flat pallets —

Part 1: Test methods

1 Scope

This document specifies the test methods available for evaluating new flat pallets for materials handling.

The test methods are split into groups for:

— nominal load testing;

— maximum working load testing;

— durability comparison testing.

This document does not apply to pallets 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.

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 documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 8611-2:2021, *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 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
breaking of one component
fracture of a structural element which significantly affects the strength, *stiffness* (3.9) or functionality of a pallet

3.2
concentrated load
load concentrated over an area of less than 50 % of the pallet top deck

3.3
maximum working load
greatest *payload* (3.5) that a pallet is permitted to carry in a specific loading and support condition

Note 1 to entry: This varies according to the type, distribution, arrangement and means of stabilization of the load and the system of support, and can be lower or higher than the *nominal load* (3.4) (see ISO 8611-2 and ISO 8611-3).

3.4
nominal load
R
lowest *test load* (3.10) value for the specified support conditions, independent of the type of load (excluding *concentrated loads* (3.2))

Note 1 to entry: "Specified support conditions" refers to the range of conditions of use in ISO 8611-2:2021, 7.1.

Note 2 to entry: Nominal load does not represent an actual *payload* (3.5) on a pallet in use. The nominal load is used for comparing the performance of different pallets.

3.5
payload
Q
load carried by the pallet in use

Note 1 to entry: This can be above, identical to or below the *nominal load* (3.4).

3.6
platen
solid, rigid surface on a test machine used for applying a load to test a sample pallet

3.7
racking
storage of unit loads in drive-in or beam racks with free, unsupported spans

3.8
stacking
placing of pallets with unit loads one upon the other without recourse to intermediate shelves or *racking* (3.7)

3.9
stiffness
relative deformation of a pallet or component under load

Note 1 to entry: High stiffness means small displacement, deflection or deformation for a given load.

3.10
test load
P
load applicators, the load board or load box and the applied load itself including the datum load (1,5 % ± 0,5 % of the *ultimate load* (3.11))

3.11
ultimate load
U
load at which compression, displacement or deflection is no longer contained, resulting in the destruction of the specimen or *breaking of one component* (3.1), or when displacement, deformation or deflection becomes excessive

Note 1 to entry: See ISO 8611-2:2021, Table 1.

4 Measurements

Pallets selected for testing shall be measured to ensure that materials, construction and dimensions conform to their associated written specification.

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

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

The recorded deflection at each location in the test is the deflection at the end of the full test load period (or relaxation period) minus the deflection after positioning the datum load. The average of the maximum deflections recorded for each replicate shall be reported and used for further analysis.

Clause 9 gives further details on what should be recorded during testing and in the written report.

5 Precision and accuracy of tests and apparatus

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.

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 1 Using heavy duty steel box sections in the construction of fixtures in tests 1 and 6 (see Table 1) normally results in central distortions approaching the 3 mm given limit.

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.

NOTE 2 Experience suggests that the interlaboratory test precision for conducting tests 1a and 7a is 16,7 %; and 19,8 % when conducting tests 1b and 7b.

6 Test load

A general value for the test load is not fixed. The test load for each test shall be determined in accordance with ISO 8611-2.

The test load shall be applied with a testing machine, 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

Table 1 provides a matrix of the tests (in this document) that shall be performed on flat pallets. Tests numbered 1, 2, 3, 4, 5, 6 and 7 shall be performed with new pallets. Tests 1, 2, 4, 5, 6 and 7 may be carried out on one test sample (first stiffness, then strength, when there is a declared nominal load) or on two separate samples.

NOTE 1 The tests are grouped into the three sections shown in Table 1. The selection of tests and evaluation of pallet performance are set out in ISO 8611-2 and ISO 8611-3.

8 Tests

8.1 Test 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.

Table 1 — List of tests

Test no.	Test measurement	Characteristic	Handling activity or purpose of the test	(Sub)clause ref.
Nominal load 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	**Forklifting tests**	Top deck	Lifting with forklift and pallet trucks	8.2
2a	Bending strength			8.2.3.1
2b	Bending stiffness			8.2.3.2
3	**Compression tests for blocks or stringers**	Height of blocks, stringers	Any activity that compresses blocks or stringers, including stacking	8.3
3a	Block or stringer strength			8.3.3.1
3b	Block or stringer stiffness			8.3.3.2
4	**Stacking tests**	Top and bottom deck	Stacking	8.4
4a	Deck strength test			8.4.3.1
4b	Deck stiffness test			8.4.3.2
5	**Bottom deck bending tests**	Bottom deck	Twin track conveyors and narrow span beam racking	8.5
5a	Bending strength			8.5.3.1
5b	Bending stiffness			8.5.3.2
6	**Wing pallet bending tests**	Pallet length, width	Lifting with slings	8.6
6a	Bending strength			8.6.3.1
6b	Bending stiffness			8.6.3.2
Maximum working load tests — With payload or airbag				
1	**Bending test**	Pallet length, width	Racking	8.1
1b	Bending stiffness			8.1.3.2

Table 1 *(continued)*

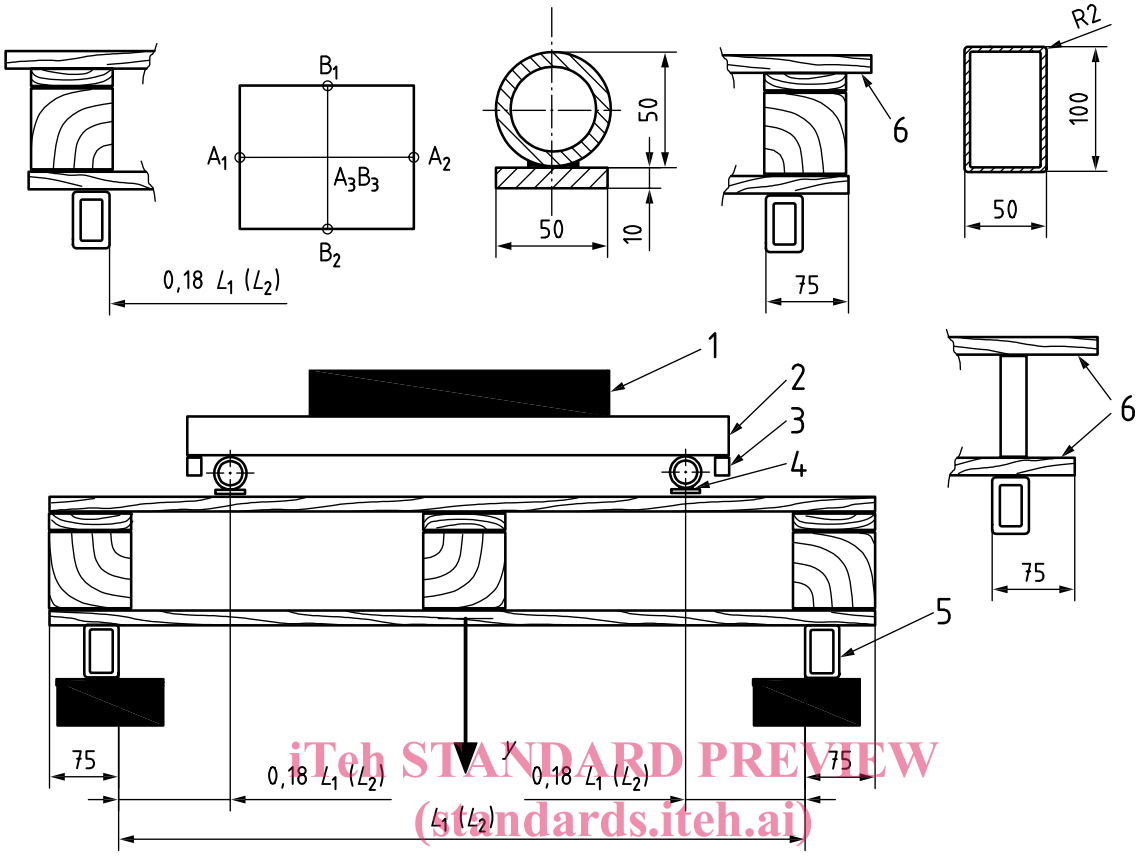
Test no.	Test measurement	Characteristic	Handling activity or purpose of the test	(Sub)clause ref.
7	**Airbag bending tests**	Pallet length, width	Racking	8.7
7a	Bending strength			8.7.3.1
7b	Bending stiffness			8.7.3.2
2	**Forklifting tests**	Top deck	Lifting with forklift and pallet trucks	8.2
2b	Bending stiffness			8.2.3.2
4	**Stacking tests**	Top and bottom deck	Stacking	8.4
4b	Deck stiffness test			8.4.3.2
5	**Bottom deck bending tests**	Bottom deck	Twin track conveyors and narrow span beam racking	8.5
5b	Bending stiffness			8.5.3.2
6	**Wing pallet bending tests**	Pallet length, width	Lifting with slings	8.6
6b	Bending stiffness			8.6.3.2
Durability tests				
8	**Static shear test**	Decks, blocks, stringers	Distortion resistance	8.8
9	**Corner drop test**	Diagonal rigidity	Resistance to impacts	8.9
10	**Shear impact test**	Decks, blocks, stringers	Distortion resistance	8.10
11	**Top deck edge impact test**	Top leading deckboard	Resistance to fork arms	8.11
12	**Block impact test**	Corner block, stringer	Resistance to fork tip	8.12
13	**Static coefficient of friction test**	Under deck/fork arms	Slip resistance on fork arms	8.13
14	**Slip angle test**	Top deck/payload	Slip resistance of loads	8.14

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 is 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 inside edges 75 mm from the outer edges of the pallet. The load applicators shall be positioned at 0,18 L_1 or 0,18 L_2, where measured as shown, where L_1 or L_2 is the distance between the pallet supports (see Figure 1).

Dimensions in millimetres



Key

1	test load	5	support
2	load board	6	wing
3	safety stop	*y*	deflection
4	load applicator		

Figure 1 — Bending test

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 ± 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.

8.1.3 Measurements

8.1.3.1 Test 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 and choose the minimum load among 3 replicates.

8.1.3.2 Test 1b — Determination of bending stiffness

Apply a datum load of (1,5 ± 0,5) % of the ultimate load determined in test 1a. Depending on the support location, the deflection, *y*, shall be measured at points A [maximum of *y* at A_1 (B_1), A_2 (B_2)A_3 B_3]:

a) after positioning of datum load;