INTERNATIONAL STANDARD

ISO 8611-2

First edition
2011-05-15

Pallets for materials handling — Flat pallets —

Part 2: Performance requirements and selection of tests

Palettes pour la manutention — Palettes plates —

Partie 2: Exigences de performance et sélection des essais

Reference number
ISO 8611-2:2011(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 8611-2 was prepared by Technical Committee ISO/TC 51, *Pallets for unit load method of materials handling*.

This first edition of ISO 8611-2 cancels and replaces ISO/TS 8611-2:2005, which has been technically revised.

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*

— *Part 3: Maximum working loads*

Introduction

The forces to which pallets are exposed during use vary significantly. The test procedures described in ISO 8611-1 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, the results of tests might not always reflect the user's perception of pallet performance in use.

The nominal load might 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,

— ISO 8611-1 describes the test methods,

— this part of ISO 8611 describes the performance requirements and selection of tests, and

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

ISO 8611-1 and this part of ISO 8611 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).

ISO 8611-1, this part of ISO 8611 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 ISO 8611-1 and the performance requirement is established from criteria in this part of ISO 8611.

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 4.2, 4.3 and 4.4 of ISO 8611-3:2011) established in ISO 8611-1 and this part of ISO 8611. 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 Annex A of ISO 8611-3:2011 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 ISO 8611-1.

Pallets for materials handling — Flat pallets —

Part 2: Performance requirements and selection of tests

1 Scope

This part of ISO 8611 specifies the performance requirements to establish nominal loads for new flat pallets.

It also specifies the tests required for new flat pallets in various handling environments and the performance requirements for tests with payloads. It is not intended to 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.

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 8611-1, *Pallets for materials handling — Flat pallets — Part 1: Test methods*

ISO 8611-3, *Pallets for materials handling — Flat pallets — Part 3: Maximum working loads*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 445 and the following apply.

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

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

[ISO 445:2008, definition 2.3]

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

NOTE 1 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 (see, for example, Clauses 4 and 6 and see also ISO 8611-3).

NOTE 2 Adapted from ISO 445:2008, definition 2.7.

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

NOTE 1 "Specified support conditions" refers to the range of conditions of use in 7.1 of this part of ISO 8611.

NOTE 2 Nominal load does not represent an actual payload on a pallet in use. The nominal load is used for comparing the performance of different pallets.

NOTE 3 Adapted from ISO 445:2008, definition 2.2.

3.5
payload
Q
load carried by the pallet in use

[ISO 445:2008, definition 2.8]

NOTE This can be above, identical to or below the nominal load.

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

[ISO 445:2008, definition A.3.1]

3.8
safety factor
ratio of the ultimate load to the nominal load

NOTE In ISO 8611 (all parts), this ratio is at least 2,0.

3.9
solid load
single, compact, rigid, homogeneous load, supported by all the blocks and/or stringers (bearers) of the pallet

NOTE Adapted from ISO 445:2008, definition 2.6.

3.10
stacking
placing of pallets with unit loads one upon the other without recourse to intermediate shelves or racking

NOTE Adapted from ISO 445:2008, definition A.2.1.

3.11
stiffness
relative deformation of a pallet or component under load

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

3.12
test load
P
load applicators, the load board or load box and the applied load itself

3.13
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, or when displacement, deformation or deflection becomes excessive

NOTE See Table 1.

3.14
uniformly distributed bonded load
load spread evenly across the full surface of the pallet top deck, where the pattern of each single layer changes, so that the packages are interlocked

3.15
uniformly distributed unbonded load
load spread evenly across the full surface of the pallet top deck where the packages are not interlocked, bound or connected

4 Test conditions

4.1 General

Test conditions shall be determined based on the pallet material in accordance with 4.2 to 4.6 and shall be maintained throughout the test. If the pallet comprises several different types of material, the moisture and temperature conditions shall be in accordance with the material that is most sensitive to changes in conditions.

4.2 Wooden pallets

The reference moisture content is (20 ± 2) %. If the pallets are used at a higher moisture content, they shall be tested at this higher moisture content and the moisture content shall be recorded in the test results.

NOTE The measurement can be carried out in accordance with EN 13183-2[2].

4.3 Metal pallets

Conditioning shall not be used for metal pallets.

4.4 Plastic pallets

The test conditions for nominal load, maximum working load and durability tests for plastic pallets shall be the following:

— tests 1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b, 6a, 6b, 8, 9, 10, 11, 12 and 13: (23 ± 2) °C

— maximum working load tests supporting the payload: (40 ± 2) °C

— test 9: (23 ± 2) °C and (–10 ± 2) °C

For maximum working loads and test 9, wherever plastic pallets are used in controlled or more extreme conditions, the test conditions shall be agreed between the supplier and purchaser.

4.5 Paper pallets

The test conditions for nominal load, maximum working load and durability tests for paper pallets shall be the following:

— tests 1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b, 6a, 6b, 8, 9, 10, 11, 12 and 13: (23 ± 2) °C and (50 ± 5) % RH

— maximum working load tests supporting payload: (23 ± 2) °C and (90 ± 5) % RH

For maximum working loads and test 9, wherever paper pallets are used in controlled or more extreme conditions, the test conditions shall be agreed between supplier and purchaser.

4.6 Wood-based composite pallets

The test conditions for nominal load, maximum working load and durability tests for wood-based composite pallets shall be the following:

— tests 1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b, 6a, 6b, 8, 9, 10, 11, 12 and 13: (23 ± 2) °C and (50 ± 5) % RH

— maximum working load tests: (23 ± 2) °C and (90 ± 5) % RH

If it is intended that the pallet be exposed to water in the distribution environment, the pallet shall be immersed in water just below the surface for 24 h at a temperature of (20 ± 5) °C.

Blocks of wood-particle board, which can be shown to have been tested according to nationally recognized standards (for example, see EN 1087-1), are exempt from conditioning.

For maximum working loads and test 9, when wood-based composite pallets are used in controlled or more extreme conditions, the test conditions shall be agreed between the supplier and purchaser.

5 Number of replicates

For each test, at least three untested pallets shall be used.

6 Performance requirements

Performance requirements for tests 1, 2, 3, 4, 5, 6 and 9 in ISO 8611-1 are given in Table 1. The maximum observation from the tests shall be compared with the performance requirements in Table 1.

Performance requirements for tests 8, 10, 11, 12, 13 and 14 in ISO 8611-1 are not included in Table 1, pending more experience with these tests.

Table 1 — List of tests

Test no.	Test measurement	Handling activity or purpose of the test	Test load level	Performance limits	ISO 8611-1:2011 subclause ref.
Nominal load tests					
1	**Bending tests**	Racking			8.1
1a	Bending strength[ad]		Ultimate load (U_1) or a load causing 6 % of L_1 (L_2) deflection		8.1.3.1
1b	Bending stiffness[bd]		⩽50 % of U_1	2 % of L_1 (L_2) under load 0,7 % of L_1 (L_2) after relaxation period	8.1.3.2
2	**Forklifting tests**	Lifting with forklift and pallet trucks			8.2
2a	Bending strength[a]		Ultimate load, U_2		8.2.3.1
2b	Bending stiffness[b]		⩽50 % of U_2	20 mm or bend angle of less than 4,5[g], whichever is the lesser deflection, under load 7 mm after relaxation period	8.2.3.2
3	**Compression tests for blocks or stringers**	Any activity that compresses blocks or stringers, including stacking			8.3
3a	Blocks or stringers strength		Ultimate load, U_3, per block or load causing 10 % of y deflection		8.3.3.1
3b	Blocks or stringers stiffness[c]		⩽50 % of U_3 per block	4 mm under load 1,5 mm after relaxation period	8.3.3.2
4	**Stacking tests**[f]	Stacking	Payload		8.4
4a	Decks strength test		Ultimate U_4 top deck and ultimate U_4 bottom deck or a load causing 6 % of deflection L_1 (L_2)		8.4.3.1
4b	Deck stiffness test[b]		⩽50 % of U_4	2 % of L_1 (L_2) under load 0,7 % of L_1 (L_2) after relaxation period	8.4.3.2
5	**Bottom deck bending tests**	Twin track conveyors			8.5
5a	Bending strength[ae]		Ultimate load (U_5) or a load causing 6 % of L_1 (L_2) deflection		8.5.3.1
5b	Bending stiffness[be]		⩽50 % of U_5	15 mm under load, 7 mm after relaxation time	8.5.3.2

Table 1 (*continued*)

Test no.	Test measurement	Handling activity or purpose of the test	Test load level	Performance limits	ISO 8611-1:2011 subclause ref.
6	**Wing pallet bending tests**	Lifting with slings			8.6
6a	Bending strength[a]		Ultimate load (U_6) or a load causing 6 % of L_1 (L_2) deflection		8.6.3.1
6b	Bending stiffness[b]		⩽50 % of U_6	2 % of L_1 (L_2) under load 0,7 % of L_1 (L_2) after relaxation period	8.6.3.2
Maximum working load tests — With payload or airbag					
1	**Bending test**	Racking			8.1
1b	Bending stiffness		Payload	Deflection shall not exceed the deflection at ½ U_1	8.1.3.2
7	**Airbag bending tests**	Racking			8.7
7a	Bending strength[a]		Ultimate load (U_1) or a load causing 6 % of L_1 (L_2) deflection		8.7.3.1
7b	Bending stiffness[b]		Airbag	Deflection shall not exceed the deflection at ½ U_1	8.7.3.2
2	**Forklifting tests**	Lifting with forklift and pallet trucks			8.2
2b	Bending stiffness[b]		Payload	Deflection shall not exceed the deflection at ½ U_2	8.2.3.2
4	**Stacking tests**[f]	Stacking			8.4
4b	Deck stiffness test		Payload	Deflection shall not exceed the deflection at ½ U_4	8.4.3.2
5	**Bottom deck bending tests**	Twin track conveyors			8.5
5b	Bending stiffness[be]		Payload	15 mm under load, 7 mm after relaxation time	8.5.3.2
6	**Wing pallet bending tests**	Lifting with slings			8.6
6b	Bending stiffness[b]		Payload	Deflection shall not exceed the deflection at ½ U_6	8.6.3.2
Durability tests					
8	**Static shear test**	Distortion resistance		Comparative testing	8.8

Table 1 (*continued*)

Test no.	Test measurement	Handling activity or purpose of the test	Test load level	Performance limits	ISO 8611-1:2011 subclause ref.
9	**Corner drop test**	Resistance to impacts	Empty pallet	$\Delta y \leqslant 4\ \%\ h = 0{,}5$ m No breakage or damage that limits the performance or functionality of the pallet	8.9
10	**Shear impact test**	Distortion resistance		Comparative testing	8.10
11	**Top deck edge impact test**	Resistance to fork arms		Comparative testing	8.11
12	**Block impact test**	Resistance to fork tip		Comparative testing	8.12
13	**Static coefficient of friction test**	Slip resistance on fork arms	Self weight, W_s	Comparative testing	8.13
14	**Slip angle test**	Slip resistance of loads	Self weight	Comparative testing	8.14

[a] The pallet shall be tested using the direction(s) in which it is intended to be racked (see also Annex A).

[b] The rate of deformation during stiffness tests shall be decreasing.

[c] Handling activities that compress blocks are stacking with or without superstructures or posts and heavy rigid loads.

[d] Wherever failure of the pallet occurs due to stress concentrations at the load applicator, the test shall be rejected and shall be repeated.

[e] The top deck of the pallet shall remain flat during the test.

[f] Test 4b shall be used for determining maximum working load of pallets as described in ISO 8611-3.

[g] The angle is measured between the line from the edge of the support beam in a horizontal plane to the edge of the pallet before loading and the line from the edge of the support beam to the same point after loading.

7 Selection of the tests

7.1 Intended use

Pallets shall be tested for the following four main types of intended use:

a) handling of loaded pallets with racking and stacking;

b) handling of loaded pallets with stacking, but without racking;

c) handling of loaded pallets without racking or stacking;

d) handling of loaded pallets in special situations (using conveyors or slings).

Tests required for intended use are shown in Table 2.

Table 2 — Tests required for intended use

Nominal load test					
Handling activity	Racking and stacking	Stacking without racking	Without racking or stacking	Special situation	
				Conveyor	Sling
Racking	1a and 1b[a]				
Forklift	2a and 2b[b]	2a and 2b[b]	2a and 2b[b]		
Compression	3a and 3b[c]	3a and 3b[c]	3a and 3b[c]		
Stacking	4a and 4b[d]	4a and 4b[d]			
Bottom deck support	5a and 5b[e]			5a and 5b[e]	
Sling under wings					6a and 6b[f]

[a] Bending tests.

[b] Forklifting tests.

[c] Compression tests for blocks or stringers.

[d] Stacking tests.

[e] Bottom deck bending tests.

[f] Wing pallet bending tests.

Additional performances can be required and this part of ISO 8611 gives some tests (lifting with slings, racking across the stringer or pallet skids, twin track conveyor use, resistance to impacts, friction, etc.). General-purpose pallets intended for use in handling and transportation situations shall be tested according to 7.2, and special-purpose pallets intended for use in a limited range of handling and transportation situations shall be tested according to 7.3 or 7.4.

Tests other than those listed in this clause might be relevant and should be used for additional measurement of pallet and design performance.

7.2 Handling of goods with racking and stacking

For pallets intended for use in racking and stacking, tests 1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b, 5a and 5b shall be used.

NOTE Tests 5a and 5b cover chain and skate roll conveyor support conditions.

7.3 Handling of goods with stacking without racking

For pallets intended for use in stacking but never racked, tests 2a, 2b, 3a, 3b, 4a and 4b shall be used.

NOTE The forklifting test is a necessary bending test because in certain pallet designs this condition of support can be limiting.

7.4 Handling of goods without racking or stacking

For pallets intended for handling of goods without racking and stacking, tests 2a, 2b, 3a and 3b shall be used.

7.5 Special applications

7.5.1 General

In addition to the tests specified in 7.2 to 7.4, some conditions of use might require additional tests, which are specified in ISO 8611-1.

7.5.2 Automatic handling or conveyors

For special applications involving, for example, chain and skate roll conveyors, the strength and stiffness of the bottom deck can be the weakest point of a pallet. In this case, tests 5a and 5b shall be used.

7.5.3 Lifting with slings

For pallets intended for lifting with slings, tests 6a and 6b shall be used. See Table 2 for basic tests.

7.5.4 Resistance to impact

Wherever additional knowledge is needed on durability of the pallets in specific conditions of use, tests 8, 9, 10, 11 and 12 may be used and adapted to end use.

7.5.5 Friction tests

Tests 13 and 14 can be used to compare different types of pallets and their interaction with transported goods or handling equipment.

8 Test load — Nominal load

8.1 Strength tests

With the exception of tests 10 and 11, the test load for the strength tests shall have no fixed value.

8.2 Ultimate load, U

Depending on the use condition described in Clause 7, the tests for determining the ultimate pallet load carrying capacity (tests 1a, 2a, 3a, 4a, 5a or 6a) shall be carried out and the ultimate loads, U_1, U_2, U_3, U_4, U_5 or U_6, respectively, shall be determined.

8.3 Stiffness tests

The test load, P, for the stiffness tests 1b, 2b, 3b, 4b, 5b and 6b (where applicable) shall be 50 % of the ultimate load (safety factor 2) or a lower load, which reaches the deflection limits.

8.4 Nominal load

The lowest value of all test loads, P, from successful stiffness tests shall be the nominal load, R, of the pallet, for the conditions of use selected from Clause 7.

EXAMPLE Intended use: racking and stacking.

An example of the determination of nominal load for use in racking and stacking using arbitrary data is given in Table 3. The nominal load, R, for this pallet is 1 250 kg.

Table 3 — Example of the determination of nominal load for use in racking and stacking

Determination of nominal load for use in racking and stacking	
Ultimate load of test 1a U_1 = 2 840 kg	50 % of U_1[a] leads to a nominal load of P_{1a} = 1 420 kg
Test 1b (2 % of L_1 max.)	Reached at P_{1b} = 1 250 kg
Ultimate load of test 2a U_2 = 3 500 kg	50 % of U_2[a] leads to a nominal load of P_{2a} = 1 750 kg
Test 2b (20 mm or 4,5° max.)	Passed with P_{2b} = 1 750 kg
Ultimate load of test 3a U_3 = 4 500 kg	50 % of U_3[a] leads to a nominal load of P_{3a} = 2 250 kg
Test 3b (4 mm max.)	Passed with P_{3b} = 2 250 kg
Ultimate load of test 4a U_4 = 4 420 kg	50 % of U_4[a] leads to a nominal load of P_{4a} = 2 210 kg
Test 4b (2 % of L_1 max.)	Passed with P_{4b} = 2 210 kg
Ultimate load of test 5a U_5 = 4 060 kg	50 % of U_5[a] leads to a nominal load of P_{5a} = 2 030 kg
Test 5b (15 mm max.)	Passed with P_{5b} = 2 030 kg
[a] The load safety factor is 2.	

9 Duration for static stiffness tests

The full load duration for the static stiffness tests 1b, 3b, 4b, 5b and 7b shall be as shown in Table 4. The test period and relaxation time for tests 6b and 2b shall be 30 min for all types of pallet.

Table 4 — Full load duration for static stiffness tests

Pallet material		Test period h	Relaxation time h
Unprocessed (sawn) timber with metal fastenings		2	1
All metal (welded or pressed construction)		2	1
Where plastics or plastic parts dictate overall performance	tests 4b	48	2
	all other tests	24	2
Paper-based and processed wood (for example particle board) where these materials dictate overall performance		24	1
Pallet assembled using adhesive to connect major components		24	1

NOTE The test durations can be shortened when reliable creep models are developed. This is expected to improve the efficiency of test evaluations. It is the intention of Technical Committee ISO/TC 51 to progress creep model development as a Technical Specification.

10 Number of impacts for dynamic tests

For each dynamic test, three impacts shall be carried out on each pallet surface or horizontal axis as specified in ISO 8611-1:2011, Clause 9. The result of each test shall be the average of these three impacts.

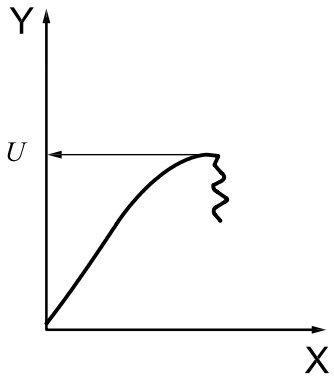
11 Test report

The test report shall be in accordance with Clause 9 of ISO 8611-1:2011.

Annex A
(informative)

Plots of typical force versus deformation from pallet tests showing the deformation of ultimate load, U

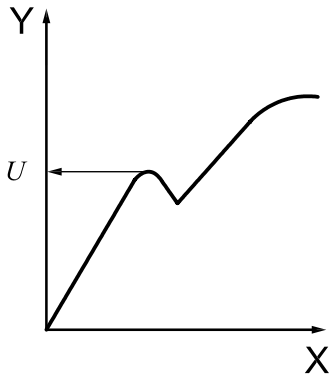
Plots of typical force versus deformation from pallet tests showing the deformation of ultimate load, U, are shown in Figures A.1, A.2 and A.3.



Key

X load
Y deformation
U ultimate load

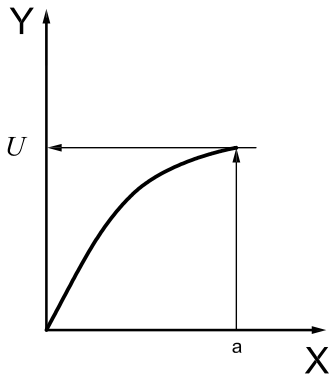
Figure A.1 — Force versus deformation plot indicating total pallet failure



Key

X load
Y deformation
U ultimate load

Figure A.2 — Force versus deformation plot indicating a component failure



Key

X load
Y deformation
U ultimate load
[a] 6 % of test span.

Figure A.3 — Force versus deformation plot indicating excessive deformation

Bibliography

[1] EN 1087-1, *Particleboards — Determination of moisture resistance — Part 1: Boil test*

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

ICS 55.180.20

Price based on 12 pages