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ISO 8611-2

Third edition
2025-02

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

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Foreword

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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 document 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).

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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 8611-2:2021), which has been technically revised.

The main changes are as follows:

— the performance criteria for the Test 2 have been changed, and as a result, the data in the examples in the Table 3 has been modified accordingly.

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 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, 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,

— ISO 8611-1 describes the test methods,

— this document 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 document are recommended to be used in 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 document and ISO 8611-3 are recommended to be used in 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 document.

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

— 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 ISO 8611-1 and this document. 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 ISO 8611-1.

Pallets for materials handling — Flat pallets —

Part 2: Performance requirements and selection of tests

1 Scope

This document 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. 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.

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 8611-1:2025, *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.

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
breakage of one of the components
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, for example, Clauses 4 and 6 and see also 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 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
racking
storage of unit loads in drive-in or beam racks with free, unsupported spans

3.7
safety factor
ratio of the *ultimate load* (3.11) to the *nominal load* (3.4)

Note 1 to entry: In the ISO 8611 series, this ratio is at least 2,0.

3.8
stacking
placing of pallets with unit loads one upon the other without recourse to intermediate shelves or *racking* (3.6)

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 % 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 Table 1.

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.

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 and airbag: (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 and airbag: (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 supporting payload and airbag: (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 8611-1:2025 subclause ref.
Nominal load tests					
1	**Bending tests**	Racking			8.1
1a	Bending strength[a,d]		Ultimate load (U_1) or a load causing 6 % of L_1 (L_2) deflection		8.1.3.1
1b	Bending stiffness[b,d]		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 or Internal span: a load causing 6 % of a-200 mm deflection External span: 23 % of the (L-a)/2 span under load		8.2.3.1
2b	Bending stiffness[b]		50 % of U_2	**Internal span:** 2 % of a-200 mm under load, 0,7 % of a-200 mm after relaxation period **External span:** 7,8 % of the (L-a)/2 span under load, 2,7 % of the (L-a)/2 span 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]				8.4

Table 1 *(continued)*

Test no.	Test measurement	Handling activity or purpose of the test	Test load level	Performance limits	ISO 8611-1:2025 subclause ref.
4a	Decks strength test	Stacking	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 and narrow span beam racking			8.5
5a	Bending strength[a,e]		Ultimate load (U_5) or a load causing 6 % of L_1 (L_2) deflection		8.5.3.1
5b	Bending stiffness[b,e]		50 % of U_5	15 mm under load, 7 mm after relaxation time	8.5.3.2
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_7) 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

Table 1 *(continued)*

Test no.	Test measurement	Handling activity or purpose of the test	Test load level	Performance limits	ISO 8611-1:2025 subclause ref.
5	**Bottom deck bending tests**	Twin track conveyors and narrow span beam racking			8.5
5b	Bending stiffness[b,e]		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
9	**Corner drop test**	Resistance to impacts	Empty pallet	Δy u4 % 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] If failure of the pallet occurs due to stress concentrations at the load applicator, the test shall be rejected and 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.

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 (top and bottom deck)	4a and 4b[d]	4a and 4b[d]	4a and 4b top deck only		
Bottom deck support	5a and 5b[e,g]			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.
[g] Required only when pallets are being used on twin track conveyors or narrow span racking.

Additional performances can be required; and this document gives some tests such as Test 5 for twin track conveyor use, Test 6 for lifting with slings, Test 9, 10, 11, 12, 13 for resistance to impacts, and Test 14 for 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 can 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, 3b, 4a and 4b (top deck only) 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 can require additional tests, which are specified in ISO 8611-1.

7.5.2 Automatic handling or conveyors

For special applications involving chain and skate roll conveyors or narrow-span beam racking, 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 test load of P_{1a} = 1 420 kg
Test 1b (2 % of L_1 max.)	Reached at test load of P_{1b} = 1 250 kg
Ultimate load of test 2a U_2 = 3 500 kg	50 % of U_2[a] leads to a test load of P_{2a} = 1 750 kg
Test 2b **Internal span**: 2 % of a-200 mm **External span**: 7,8 % of the (L-a)/2 span	Passed with test load of P_{2b} = 1 750 kg
Ultimate load of test 3a U_3 = 4 500 kg	50 % of U_3[a] leads to a test load of P_{3a} = 2 250 kg
[a] The load safety factor is 2.	

Table 3 *(continued)*

Determination of nominal load for use in racking and stacking	
Test 3b (4 mm max.)	Passed with test load of P_{3b} = 2 250 kg
Ultimate load of test 4a U_4 = 4 420 kg	50 % of U_4[a] leads to a test load of P_{4a} = 2 210 kg
Test 4b (2 % of L_1 max.)	Passed with test load of P_{4b} = 2 210 kg
Ultimate load of test 5a U_5 = 4 060 kg	50 % of U_5[a] leads to a test load of P_{5a} = 2 030 kg
Test 5b (15 mm max.)	Passed with test load of P_{5b} = 2 030 kg
	Nominal load = P_{1b} = 1 250 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

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 8611-1:2025, Clause 9. The result of each test shall be the average of these three impacts.

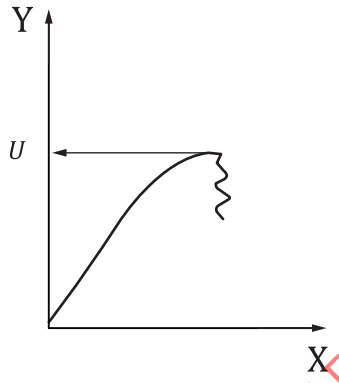
11 Test report

The test report shall be in accordance with ISO 8611-1:2025, Clause 9.

Annex A
(informative)

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

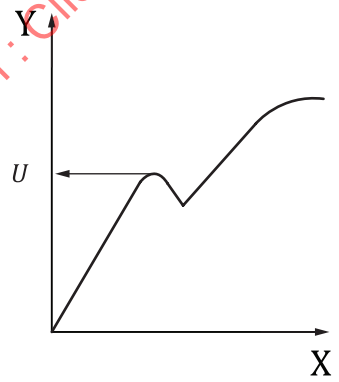
Plots of typical force versus deformation from pallet tests showing the deformation of ultimate load, *U*, are shown in Figures A.1, A.2 and A.3.



Key

X deformation
Y load
U ultimate load

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



Key

X deformation
Y load
U ultimate load

Figure A.2 — Force versus deformation plot indicating a component failure or the breakage of one of the components