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**Packaging — Complete, filled transport packages and unit loads — Stacking tests using a static load**

*Emballages — Emballages d'expédition complets et pleins et charges unitaires — Essais de gerbage utilisant une charge statique*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 2234 was prepared by Technical Committee ISO/TC 122, *Packaging*, Subcommittee SC 3, *Performance requirements and tests for means of packaging, packages and unit loads (as required by ISO/TC 122)*.

This third edition cancels and replaces the second edition (ISO 2234:1985), which has been technically revised.

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## Introduction

It is the responsibility of the user of this International Standard to establish appropriate health and safety practice in accordance with relevant legislation.

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# Packaging — Complete, filled transport packages and unit loads — Stacking tests using a static load

## 1 Scope

This International Standard specifies three methods for carrying out a stacking test on a complete, filled transport package, or on a unit load, using a static load. Whichever method is employed, the test may be used to assess the performance of a package or a unit load, in terms of its strength or the protection that it offers to its contents when it is subjected to stacking. It may be performed either as a single test to investigate the effects (deformation, creep, collapse or failure) of stacking or as part of a sequence of tests designed to measure the ability of a package or a unit load to withstand a distribution system that includes a stacking hazard.

The test may also be used to investigate performance under particular conditions of loading, as, for example, when the bottom package in a stack rests on an open-decked pallet; or when the profile of the superimposed load is eccentric, as when it is supported on the bearers of a single-decked pallet which rests on a container. For such purposes, one of the three methods of carrying out the test may be more suitable than the others.

NOTE A method for carrying out a stacking test using a compression tester is given in ISO 12048<sup>1)</sup>.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2206, *Packaging — Complete, filled transport packages — Identification of parts when testing.*

ISO 2233, *Packaging — Complete, filled transport packages and unit loads — Conditioning for testing.*

## 3 Term and definition

For the purposes of this International Standard, the following term and definition applies.

### 3.1

#### test item

a complete filled transport package or unit load

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1) ISO 12048, *Packaging — Complete, filled transport packages — Compression and stacking tests using a compression tester.*

## 4 Principle

The test item is placed on a flat, horizontal surface and subjected to an evenly distributed load applied from above, using one of three methods. The load, atmospheric conditions, period of time under load and attitude of the test item are predetermined.

NOTE The top-to-bottom or the side-to-side deflection of the test item during the test may be measured, if appropriate.

## 5 Apparatus

**5.1 Horizontal surface**, which is flat (the difference in height between the highest and lowest points not exceeding 2 mm) and rigid. A concrete floor at least 150 mm thick is suitable.

**5.2 Means of loading**, which, according to the method chosen (1, 2 or 3) is as described in 5.2.1 to 5.2.3.

**5.2.1 Method 1:** stack of test items, each item being identical with the item under test. The number of test items is such that their total mass forms an appropriate load.

**5.2.2 Method 2:** loading platform, free to tilt to an equilibrium position on the test item, together with an appropriate load.

The loading platform, when placed centrally on top of the test item, shall be large enough to extend at least 100 mm over all sides of the top surface of the test item and rigid enough to support the load completely without deformation.

NOTE This type of load is sometimes referred to as "free load".

**5.2.3 Method 3:** loading platform, such that the lower surface of the platform is constrained to remain horizontal, together with an appropriate load.

The loading platform, when placed centrally on top of the test item, shall be large enough to extend at least 100 mm over all sides of the top surface of the test item and rigid enough to support the load completely without deformation.

NOTE 1 This type of load is sometimes referred to as a "guided load".

NOTE 2 If guides are used to ensure that the loading platform remains horizontal, they should not cause friction that could affect the test results.

**5.3 Means of measuring deflection** (if necessary), accurate to  $\pm 1$  mm and capable of indicating either an increase or a decrease in dimensions. In addition, the apparatus shall meet the requirements and tolerances of clause 8.

NOTE Stable and safe loading during the test is dependent on the friction between the top surface of the test item and the bottom surface of the loading platform, as well as the ability of the test item to resist deformation. Means therefore, should be provided to produce a stable test assembly and to ensure that, if failure occurs, the load is restrained and does not cause danger to personnel in the vicinity.

## 6 Test item preparation

Fill the test item with its intended contents and ensure that it is closed normally, as if ready for distribution.

NOTE Simulated or substituted contents may be used, on condition that the dimensions and physical properties of such contents should be as close as possible to those of the intended contents. However, the closure should be the same as for distribution.

## 7 Conditioning

The test item shall be conditioned in accordance with one of the conditions described in ISO 2233.

## 8 Procedure

**8.1** Wherever possible the test shall be carried out in atmospheric conditions identical to those used for conditioning, and particularly where this is critical to the materials or application of the test item. In other circumstances, the test shall be carried out in atmospheric conditions which approximate those used for conditioning, as closely as is practicable.

**8.2** Position the stack of test item (5.2.1) or, alternatively, the loading platform (5.2.2 or 5.2.3) centrally over the test item which has been placed on the flat, horizontal surface (5.1).

**8.2.1** If methods 2 and 3 are being used, place the masses making up the load on the loading platform without impact, ensuring that they are in full contact with the loading platform before being released. The masses shall be distributed uniformly over that portion of the surface of the loading platform in direct contact with the test item to ensure that the centre of gravity of the load is immediately above the centre of the top surface of the test item. The mass of the total load, including the mass of the loading platform, shall be within 2 % of the predetermined value. The distance of the centre of gravity of the load above the loading platform shall not exceed 50 % of the height of the test item.

**8.2.2** In methods 2 and 3, if measurements are taken, this shall be done between the two surfaces exerting compression on the test item after the application of a pre-load sufficient to assure a good contact between the loading platform and the test item.

**8.3** Apply the load for the required period of time (usually 24 h, according to the material) or until collapse.

**8.4** Remove the load and examine the test item.

NOTE 1 At any time during the test it may be necessary to measure dimensions.

NOTE 2 Appropriately profiled inserts to represent particular loading conditions may be placed above or below the test item or both above and below, as required.

NOTE 3 In the case of test items stored on pallets or in stacks, the test should be carried out on several test items side by side or using an actual stacking pattern.

## 9 Test report

The test report shall include:

- a) a reference to this International Standard;
- b) the name and address of the testing laboratory and the name and address of the customer;
- c) a unique identification of the report;
- d) the date of receipt of the test items and the date(s) of performance of the test;
- e) the name, title and signature of persons accepting test responsibility for the test report;
- f) a statement to the effect that the test results relate only to the items tested;

- g) a statement that the report shall not be reproduced except in full without the written approval of the testing laboratory;
- h) the number of replicate test items tested;
- i) a full description, including dimensions, structural and material specifications of the test item and its fittings, cushioning, blocking, closure or reinforcing arrangements, gross mass of the test item and mass of the contents in kilograms;
- j) a description of contents, if simulated or substituted contents were used, full details shall be given;
- k) the relative humidity, temperature and the time of conditioning; the temperature and relative humidity of the test area at the time of test; whether these values comply with the requirements of ISO 2233;
- l) the attitudes in which the test item was tested, using the method of identification given in ISO 2206;
- m) the mass, in kilograms, of the total load, including the mass of the loading platform, and the period of time during which the test item was under load, the means of loading used, i.e. method 1, 2 or 3, whether guides were used, and if so, their design; the test item pattern under test;
- n) the location of deflection measurement points on the test item and the stage of test at which deflection measurements were made;
- o) the design and dimensions of any profiles used;
- p) the type of apparatus used;
- q) any deviations from the test methods described in this International Standard;
- r) a record of the results, including observations which assist in the correct interpretation of the results.

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