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Packaging — Transport packaging for dangerous goods — Test methods

Emballage — Emballage de transport pour marchandises dangereuses — Méthodes d'essai

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Foreword

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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 16104 was prepared by the European Committee for Standardization (CEN) in collaboration with 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), in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

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Foreword

This document (EN ISO 16104:2003) has been prepared by Technical Committee CEN/TC 261, "Packaging", the secretariat of which is held by AFNOR, in collaboration with Technical Committee ISO/TC 122 "Packaging".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2003, and conflicting national standards shall be withdrawn at the latest by November 2003.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland and the United Kingdom.

This European Standard has been submitted for reference into the RID and/or in the technical annexes of the ADR. Therefore in this context the standards listed in the normative references and covering basic requirements of the RID/ADR not addressed within the present standard are normative only when the standards themselves are referred to in the RID and/or in the technical annexes of the ADR.

Annexes A, B, D and F are informative.

Annexes C, E and G are normative.

This standard includes a Bibliography.

Introduction

This Standard was developed to provide requirements and test procedures to meet the multi-modal United Nations Recommendations on the Transport of Dangerous Goods [1] and successful passing of the tests may lead to the allocation of an appropriate packaging mark (e.g. UN, RID/ADR). The UN Recommendations have been developed by the United Nations Committee of Experts on the Transport of Dangerous Goods as a "model regulation" (referred to in this document as the UN Recommendations) in the light of technical progress, the advent of new substances and materials, the exigencies of modern transport systems and, above all, the need to ensure the safety of people, property and the environment. Amongst other aspects, the UN Recommendations cover principles of classification and definition of classes, listing of the principal dangerous goods, general packing requirements, testing procedures, marking, labelling or placarding, and shipping documents. There are in addition special recommendations related to particular classes of goods.

The UN Recommendations are given legal entity by the provisions of a series of international modal agreements and national legislation for the transport of dangerous goods. The international agreements include:

- The European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) (covering most of Europe). [2]
- Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) (covering most of Europe, parts of North Africa and the Middle East). [3]
- The International Maritime Dangerous Goods Code (IMDG Code) (worldwide). [4]
- The International Civil Aviation Organization's Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO TIs) (worldwide). [5]

The application of this Standard will need to take account of the requirements of these international agreements and the relevant national regulations for domestic transport of dangerous goods.

Occasionally during adoption as a modal regulation the text has been modified; RID/ADR permit some variations to tests for light gauge metal packagings and these are included in annex A.

The cross references between this Standard, the UN Recommendations and the International Agreements are summarized in annex B.

It is important to note that there will be certain modal differences from the UN Recommendations and that the schedule for revision of the Recommendations and modal provisions may lead to temporary inconsistencies with this Standard, which is regularly updated to the latest version of the UN Recommendations.

It is noted that success in the tests and the allocation of an official UN mark do not on their own authorize the use of a packaging for any dangerous goods, which are subject to the packing instructions published in the various modal regulations.

This Standard is based on Revision 12 of the UN Recommendations.

1 Scope

This Standard specifies the design type test requirements for packagings as described in 3.6 of this standard and intended for use in the transport of dangerous goods.

NOTE This Standard should be used in conjunction with one or more of the international regulations set out in the Bibliography.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 22206, *Packaging — Complete filled transport packages — Identification of parts when testing (ISO 2206:1987)*

ISO 2137, *Petroleum products — Lubricating grease and petroleum — Determination of cone penetration*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

EN ISO 2431, *Paints and varnishes - Determination of flow time by use of flow caps (ISO 2431:1993, including Technical Corrigendum 1:1994)*

3 Terms and definitions

For the purposes of this European Standard the following terms and definitions apply.

3.1
competent authority

any national regulatory body or authority designated or otherwise recognized as such for any purpose in connection with the regulations specified in the Bibliography

3.2
packaging design type

packaging of one design, size, material and thickness, manner of construction and packing, but may include various surface treatments together with packagings which differ from the design type only in their lesser design height

3.3
liquids and solids

(see annex B)

3.4
capacity

3.4.1
brimful (overflow, maximum) capacity
maximum volume of water in litres held by the packaging when filled through the designed filling orifice to the point of overflowing in its normal position of filling

3.4.2
nominal capacity
capacity in litres which, by convention, is used to represent a class of packagings of similar brimful capacities

3.5
packing group
group to which substances and articles of most classes of dangerous goods are assigned according to the degree of danger presented:

Packing group I	**Packing group II**	**Packing group III**
High danger	medium danger	low danger

NOTE The severity of a packaging test (e.g. the drop height) varies with the packing group of the substance or article. The allocation of packing groups to substances and articles may be found in the dangerous goods list of the UN Recommendations.

3.6
packaging
receptacle and any other components or materials necessary for the receptacle to perform its containment function and are:

- designed to contain a net mass not exceeding 400 kg;
- designed with a capacity not exceeding 450 l;
- not intended to transport most gases;
- not intended to transport most infectious substances;
- not intended to transport most radioactive materials;
- not Intermediate Bulk Containers as defined in the UN Recommendations 6.5.

NOTE 1 Other definitions relevant to this standard may be found in 1.2.1 of the UN Recommendations.

NOTE 2 Annex B contains useful data on packaging types and other identifying codes with references to the regulations.

NOTE 3 Unless otherwise stated both the 400kg and 450 litre limits apply to all packages irrespective of the contents.

3.7
"V"-marked packaging
outer packaging conforming to the appropriate requirements from the UN Recommendations 6.1.5.1.7 (see annex C)

3.8
special packagings
collective term for V-marked packaging and salvage packagings (defined in the UN Recommendations 1.2.1)(see annex C)

3.9
single packaging
means of packaging that does not require an inner packaging to be capable of performing its containment function and it includes composite packaging

3.10
light gauge metal packaging - (see annex A)
NOTE Other definitions that may be relevant to this standard may be found in the UN Recommendations.

4 Test requirements

4.1 General

Before the packaging is used for dangerous goods, tests shall be carried out successfully on each packaging design type (see 3.2), which may lead to the issuing of a UN packaging mark. The tests shall be successfully repeated after any modification which alters the packaging design type. With the exception of special packagings (see 3.8), all packagings for dangerous goods shall be tested in accordance with Table 1 and shall meet the requirements contained in 4.2 to 4.6. Special packagings shall meet the requirements set out in annex C.

Where an inner treatment or coating is applied for safety reasons it shall retain its protective properties even after tests.

NOTE Provided the validity of the test results is not affected and with the approval of the competent authority, several tests may be made on one packaging. This may be necessary, for example, with very costly or scarce packagings. This may be accomplished by:

a) using one set of packagings for more than one of the tests. For example five tests are required on a drum for liquids, each requiring a set of three packagings, namely first drop, second drop, leakproofness, internal pressure and stack. Subjecting one set to more than one of the five tests is considered equivalent;

b) using one packaging for the tests. For example using one fibreboard box for all five drops is considered equivalent to carrying out 1 drop on each of five boxes.

Approval should be sought from the competent authority before employing method a) or when subjecting any one packaging to more than two tests (including investigatory drops) under method b).

The use of smaller numbers should be indicated in the test report. This is normally apparent from the serial numbers of the packagings used for the various tests but explanatory text is also desirable.

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Table 1 — Allocation of test conditions to packaging types

Drop test								Stacking test (see annex D for variations)					Leakproofness test		Hydraulic pressure test		
Table 1	Contents	Inner packaging			Temperature			Temperature									
Packaging type	Liquid/ Other	Plastics	Other or none	No. of packagings	Ambient	23°C / 50 % rh	-18 °C	No. of packagings	Time	Ambient	23°C / 50 % rh	40° C	No. of packagings	Time	No. of packagings	Time	Total no. of packagings
Table footnotes		h	h			a	be		d		a	c		d		d	
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)
1. Metal packagings [k]	Liquid			6	Y			3	24 h	Y			3	5m	3	5m	15
2. Metal packagings [k]	Solid		Y	6	Y			3	24 h	Y			0		0	0	9
3. Metal packagings [k]	Solid	Y		6			Y	3	24 h	Y			0		0	0	9
4. Plastics packagings [k]	Solid		Y	6			Y	3	24 h	Y			0		0	0	9 [g]
5. Plastics packagings [k]	Solid	Y		6			Y	3	24 h	Y			0		0	0	9 [g]
6. Plastics packagings [k]	Liquid			6			Y	3	28 d			Y	3	5m	3	30m	15 [g]
7. Composite packagings — plastics [m]	Solid	Y	Y	6			Y	3	24 h [i]	Y [l]			0		0	0	9 [g]
8. Composite packagings plastics [m]	Liquid			6			Y	3	24 h [i]	Y [l]			3	5m	3	30m [j]	15 [g]
9. Composite packagings — glass, stoneware and porcelain [m]	Liquid			6		Y [l]	Y	3	24 h [i]	Y [l]			3	5	3	5	15

Drop test								Stacking test (see annex D for variations)					Leakproofness test		Hydraulic pressure test		
Table 1	Contents	Inner packaging			Temperature			Temperature									
Packaging type	Liquid/ Other	Plastics	Other or none	No. of packagings	Ambient	23°C / 50 % rh	-18 °C	No. of packagings	Time	Ambient	23°C / 50 % rh	40° C	No. of packagings	Time	No. of packagings	Time	Total no. of packagings
Table footnotes		h	h			a	be		d		a	c		d		d	
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)
9a. Composite packagings – glass, stoneware and porcelain [m]	Solid	Y		6				3	24 h [i]	Y [l]			0		0		9
9b. Composite packagings – glass, stoneware and porcelain [m]	Solid		Y	6	Y			3	24 h [i]	Y [l]			0		0		9
10. Fibre/ plywood drums	Solid		Y	6		Y [l]		3	24 h	Y [l]			0		0	0	9
11. Fibre/ plywood drums	Solid	Y		6			Y	3	24 h	Y [l]			0		0	0	9
12. Plastics boxes	Solid	Y	Y	5			Y [f]	3	24 h	Y			0		0	0	8 [g]
13. Fibreboard boxes	Solid	Y		5			Y	3	24 h		Y		0		0	0	8
14. Fibreboard boxes	Solid		Y	5		Y		3	24 h		Y		0		0	0	8
15. Other boxes	Solid	Y		5			Y	3	24 h	Y			0		0	0	8
16. Other boxes	Solid		Y	5	Y			3	24 h	Y			0		0	0	8
17. Bags (paper)	Solid		Y	3		Y		0	0				0		0	0	3
18. Bags (other)	Solid		Y	3	Y			0	0				0		0	0	3

NOTE 1 Annex B Table B.2 shows the relationship between this table and UN packaging codes.

NOTE 2 Y indicates a requirement

[a] Column (G) and (L): Paper or fibreboard packagings shall be conditioned for at least 24 h in an atmosphere having a controlled temperature and relative humidity (r.h.) unless -18 °C conditioning for plastics inner packagings or receptacles takes precedence. The preferred atmosphere is 23 °C ± 2 °C and 50 % ± 2 % r.h.

NOTE 1 The two other options are 20 °C ± 2 °C and 65 % ± 2 % r.h. or 27 °C ± 2 °C and 65 % ± 2 % r.h

NOTE 2 Average values should fall within these limits. Short term fluctuations and measurement limitations may cause individual measurements to vary by up to ± 5 % relative humidity without significant impairment of test reproducibility.

NOTE 3 Conditioning may be carried out immediately before, or after filling the package with the test contents provided such a procedure would not affect the test results.

[b] Column (H):

1) The following plastics packagings shall undergo the cold drop test:

- -plastics drums and jerricans;
- -plastics boxes other than expanded polystyrene boxes;
- -composite packagings (plastics materials);
- -combination packagings with plastics inner packagings other than plastics bags intended to contain solids or articles;

2) The temperature shall be -18 °C or lower as measured immediately after the drop test;

3) Test liquids shall be kept in the liquid state by the addition of antifreeze if necessary;

NOTE Temperatures outside the range -18° to -22 °C should be pre-arranged and recorded in the test report;

[c] Column (M): The temperature shall be at least 40ºC.

NOTE Temperatures outside the range 40ºC to 44 °C should be pre-arranged and recorded in the test report.

[d] h = hours d = days m = minutes

[e] Column (H): Metal packagings with plastics closures not exceeding 7 cm shall not undergo the drop test at -18 °C as required for plastics packagings.

[f] Column (H): Expanded polystyrene boxes, unless inner packagings are of plastics material, shall not undergo a drop test at -18 °C; the drop shall be at ambient.

[g] Column (R): Packagings shall be at least 48 h old.

[h] Contents of inner packagings can be solid or liquid.

[i] Column (J):

— Composites with plastics outers shall be tested for 28 days at 40 °C;

— Composites with outers other than plastics shall be tested for 24 h at ambient temperature.

[j] Column (Q): Plastics packagings and Composite packagings (plastics materials) shall be tested for 30 min. Other composites shall be tested for 5 min.

[k] Column (A): Other than boxes.

[l] Column (G) and (K): where the outer is fibre/fibreboard the drop and stacking test shall be undertaken following conditioning at 23 °C ± 2 °C and 50 % ± 2 % r.h.

[m] Column (A): where a composite packaging (plastics materials) is in the shape of a box only 5 samples are required for the drop test which shall be carried out in accordance with the procedures for boxes see Table 2.

4.2 Drop test

When tested in accordance with 7.1:

a) the packaging shall be leakproof subsequent to any slight discharge from the closure(s) that may be apparent at the moment of impact and, in the case of packaging containing liquids, subsequent to the equalization of internal and external pressures (except for inner packagings of combination packagings when it is not necessary for the pressure to be equalized);

b) the packaging shall not exhibit any damage liable to affect safety during transport, for example the package cannot be moved without leaking;

c) the packagings that are to be tested for use with goods of Class 1 (explosives) shall be identified as such in the test report. When tested, they shall not display any rupture that would permit the spillage of loose explosive substances or articles from the outer packaging;

d) the outer ply of a bag shall not exhibit damage liable to affect safety during transport;

e) the outer of a combination packaging shall not exhibit damage liable to affect safety during transport.

4.3 Stacking test

When tested in accordance with 7.2 the packaging shall not:

a) show any sign of leakage (this includes inner packaging and any inner receptacle);

b) show any deterioration which could adversely affect transport safety nor any distortion liable to reduce its strength or reduce stability in stacks of packages.

4.4 Leakproofness test

When tested in accordance with 7.3, packagings intended to contain liquids (except inner packagings of combination packagings) shall be leakproof.

4.5 Hydraulic pressure test

When tested in accordance with 7.4, packagings intended to contain liquids (except inner packagings of combination packagings) shall not leak.

Inner packagings of combination packagings containing liquids, which are likely to be shipped by air, shall be capable of withstanding an internal pressure without leakage (see UN Recommendations 4.1.1.4.1.)

4.6 Test report

All packaging tests performed in conformity with this standard shall be the subject of a test report and will include a specification check prepared in accordance with annex E. It shall be possible to specifically identify the packaging relative to each test report, either by the retention of uniquely referenced packagings or by inclusion of sufficient photographs and/or drawings with unique references to enable identification of the packaging and all its components.

The test report shall be available to the users of the packaging.

NOTE The complete test report may not be required by the user. Manufacturers and subsequent distributors of packagings should provide information regarding procedures to be followed and a description of the types and dimensions of closures (included required gaskets and any other components needed to ensure that packages as presented for transport are capable of passing the applicable tests).