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Packaging — Transport packages for dangerous goods — Test methods for large packagings

Emballages — Emballages de transport pour marchandises dangereuses — Méthodes d'essai pour gros emballages

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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 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 16883 was prepared by Technical Committee ISO/TC 122, *Packaging*, Subcommittee SC 3, *Performance requirements and tests for means of packaging, packages and unit loads*.

Introduction

This International 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 UN large packaging mark. 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 following:

— 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 (worldwide) [4].

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

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 International 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 large packaging for any dangerous goods. There are other regulatory provisions that have to be taken into account in each instance.

This International Standard is based on Revision 14 of the UN Recommendations.

Packaging — Transport packages for dangerous goods — Test methods for large packagings

1 Scope

This International Standard specifies the design type test requirements for large packagings (see definition 3.2) intended for use in the transport of dangerous goods.

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 amendment).

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

3 Terms and definitions

For the purposes of this document, 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 this International Standard

3.2
large packaging
packaging consisting of an outer packaging that contains article(s) or inner packaging(s), and that

— are designed for mechanical handling, and

— exceed 400 kg net mass or 450 l capacity but have a volume of not more than 3 m^3

3.3
large packaging design type
large packaging of one design, size, material and thickness, manner of construction and packing, which may include various surface treatments, together with large packagings which differ from the design type only in their smaller design height

3.4
inner packaging
packaging for which an outer packaging is required for transport

3.5
liquids
dangerous goods which at 50 °C have a vapour pressure of not more than 300 kPa (3 bar), which are not completely gaseous at 20 °C and at a pressure of 101,3 kPa, and which have a melting point or initial melting point of 20 °C or less at a pressure of 101,3 kPa

NOTE An expansion of this definition is given in Annex A.

3.6
solids
dangerous goods, other than gases, that do not meet the definition of liquids

3.7 Capacity

3.7.1
brimful capacity
maximum volume of water, in litres, held by the inner or outer packaging when filled through the designed filling orifice to the point of overflowing in its normal position of filling

3.7.2
nominal capacity
capacity, in litres, which, by convention, is used to represent a class of packagings of similar brimful capacities

3.7.3
maximum capacity
maximum inner volume of receptacles or packagings, expressed in litres

NOTE This may be either the brimful capacity or the capacity calculated from the interior measurements.

3.8
packing groups
group to which substances and articles of most classes of dangerous goods are assigned according to the degree of danger presented:

— packing group I: high danger

— packing group II: medium danger

— packing group III: low danger

NOTE The severity of a large packaging test (e.g. the drop height) varies with the packing group of the substance. The allocation of packing groups to substances and articles may be found in the dangerous goods list of the UN Recommendations [1].

3.9
maximum net mass
maximum combined mass of the inner packagings and the contents thereof, expressed in kilograms

3.10
maximum permissible gross mass
mass of the large packaging and any service or structural equipment, together with the maximum net mass

3.11
rigid large packaging
metal, rigid plastics, rigid fibreboard or wooden large packaging

3.12
flexible large packaging
large packaging with a flexible outer packaging made from paper or plastics material

4 Test requirements

4.1 General

Before a large packaging is used for dangerous goods, tests shall be carried out successfully on each large packaging design type (see 3.3), which may lead to the issuing of a UN large packaging mark. Tests shall be repeated after any modification that alters the design, material or manner of construction of large packagings. All large packagings for dangerous goods shall be tested in accordance with Table 1 and shall meet the requirements contained in 4.2 to 4.5.

Table 1 — Design type tests required

Test	Is test required?	Requirement clause	Testing clause
Bottom lift	Yes [a]	4.2	7.2
Top lift	Yes [b]	4.3	7.3
Stacking	Yes [c]	4.4	7.4
Drop	Yes	4.5	7.5

[a] When large packagings are fitted with means of lifting from the base.

[b] When large packagings are intended to be lifted from the top and fitted with means of lifting.

[c] When large packagings are designed to be stacked on each other during transport.

4.2 Criteria for passing the bottom lift test

When tested in accordance with 7.2, there shall be no permanent deformation which renders the large packaging unsafe for transport, and no loss of contents.

4.3 Criteria for passing the top lift test

4.3.1 For rigid large packaging

When tested in accordance with 7.3, there shall be no permanent deformation which renders the large packaging, including the base pallet if any, unsafe for transport, and no loss of contents.

4.3.2 For flexible large packaging

When tested in accordance with 7.3, there shall be no damage to the flexible large packaging or its lifting devices which renders the large packaging unsafe for transport or handling, and no loss of contents.

4.4 Criteria for passing the stacking test

4.4.1 For all types of large packagings other than flexible large packagings

When tested in accordance with 7.4, there shall be no permanent deformation which renders the large packaging, including the base pallet if any, unsafe for transport, and no loss of contents.

4.4.2 For flexible large packaging

When tested in accordance with 7.4, there shall be no deterioration of the body which renders the flexible large packaging unsafe for transport, and no loss of contents.

4.5 Drop test

When tested in accordance with 7.5

a) the large packaging shall not exhibit any damage liable to affect safety during transport (see Note),

b) there shall be no leakage of the filling substance from inner packaging(s) or article(s),

c) no rupture is permitted in large packagings for articles of Class 1 which would permit the spillage of loose explosive substances or articles from the large packaging,

d) the sample passes the test if the entire contents are retained, even if the closure is no longer siftproof.

NOTE For example, for a), the large packaging cannot be moved without leaking.

4.6 Test report

All large packagings tested for conformity with this International Standard shall be the subject of a test report and specification check prepared in accordance with Annexes B and C. It shall be possible to specifically identify the large packaging relative to each test report, either by the retention of uniquely referenced large packagings or by the inclusion of sufficient photographs and/or drawings with unique references to enable identification of the large packaging and all its components. Large packagings tested for use with goods of Class 1 (explosives) shall be identified as such in the test report.

Each test report should be available to the users of the large packaging.

NOTE The competent authority may have established procedures for the retention and/or disposal of test items.

5 Selection and preparation of large packagings for test

5.1 Selection of large packagings

Sufficient large packagings per design type

a) shall be submitted for testing in accordance with Table 1,

b) shall be marked with a test reference (identification) which shall also be entered on the test record and later used in the test report,

c) shall be individually weighed to establish the tare or filled mass (see Note 1), and

d) shall be examined for damage which might invalidate the tests, in which event the large packaging shall be replaced.

NOTE 1 The form of weighing may be varied to correspond with whether the large packagings have been supplied full or empty to the test station. Where the tare masses of individual large packagings are recorded, it is necessary to record only a typical filled mass (or vice-versa).

NOTE 2 The competent authority may permit selective testing of large packagings.

5.2 Information to be provided with large packagings

5.2.1 General

Each large packaging type shall be accompanied by specification(s) for that design type containing the information set out in Annex C and by the additional information specified in 5.2.2 to 5.2.6, as relevant.

5.2.2 Water and other non-dangerous substances as test contents

Where the tests are to be carried out using water or other non-dangerous substances, a statement of the packing group for which the large packaging is to be tested shall be provided, together with data enabling appropriate selection of inert test contents and test levels. For liquids, such data shall include the required maximum relative density and viscosity for the tests. For solids, such data shall include those relevant characteristics (e.g. mass, grain size, bulk density, angle of repose, etc.) that clearly show equivalence of physical characteristics.

5.2.3 The dangerous substance as test contents

Where the tests are to be carried out using the dangerous substance(s) to be transported, a statement of their packing group and their physical characteristics shall be provided. Liquids shall be defined by their relative density, together with viscosity and the method of determination. Solids shall be defined by those relevant characteristics (e.g. mass, grain size, bulk density, angle of repose, etc.) to ensure that physical characteristics are sufficiently identified and included. These data shall be recorded in the test report (see Annex B).

NOTE Where tests are carried out using the actual substance to be transported, the test report is then applicable to other substances having the same or equivalent characteristics.

5.2.4 Test contents: using articles

Where the large packaging is intended for the transport of article(s), a statement of the packing group, an appropriate description and drawing(s) of the article(s) and or photographs, and details of the way in which dummy articles were filled for the purpose of testing shall be provided.

5.2.5 Special instructions

Any special filling or closing instructions including, where relevant, the closure torque for example, shall be provided.

5.2.6 Handling characteristics

Each large packaging design type shall be accompanied by a statement of its mechanical handling characteristics. This shall relate to bottom lift, top lift or both, as applicable, and the number of large packagings to be stacked during transport.

NOTE The number of large packagings to be stacked during transport may be zero if, for example, the large packaging design type is not designed for stacking.

5.3 Selection of contents and filling of large packagings prior to testing

5.3.1 General

Inner packagings of large packagings shall be filled for testing to not less than

— 98 % of brimful capacity for liquids, and

— 95 % of brimful capacity for solids.

Inner packagings for liquids, or those capable of containing them, shall have their capacity determined as in 5.3.3. Otherwise the capacity shall be determined by other suitable means (e.g. by calculation).

5.3.2 Test contents

Where non-dangerous substances are to be used as test contents, they shall be selected to accord with the data referred to in 5.2.2. Water or a water/anti-freeze mixture may be used to represent any liquid.

For solids, additives such as bags of lead shot may be used to adjust the mass if required but, if used, they shall be placed in such a manner that the test results are not affected. Dangerous articles shall be replaced by dummy articles and these shall be of the same size, shape, mass and centre of gravity as the articles to be transported.

The test contents used shall be recorded in the test report.

5.3.3 Large packagings containing inner packagings to contain liquids

5.3.3.1 Determination of brimful capacity

The inner packaging of a large packaging intended to contain liquids shall be filled to not less than 98 % of the brimful capacity. The brimful capacity is determined, for example, by weighing the empty inner packaging including closures [mass empty (m) in kg] and weighing the inner packaging full [mass brimful (W) in kg]. The inner packaging shall be filled with water until the water just overflows and then the closure shall be fitted and any surplus mopped up. No steps shall be taken, such as tilting or tapping the inner packaging, to enable water to penetrate into a hollow handle or other design feature above the closure.

$$b = \frac{W - m}{\rho}$$

where

b is the brimful capacity, in litres;

W is the mass, in kilograms, of the inner packaging when brimful with water;

m is the mass, in kilograms, of the empty inner packaging;

ρ is the density of water (= 1), in kilograms per litre.

5.3.3.2 Filling of the inner packaging

When filling test inner packagings with liquids, at least one inner packaging shall have its capacity and filling level determined, for example as below. Further inner packagings of that design type shall be filled using a dipstick calibrated on the first inner packaging or, in the case of small inner packagings, by mass or volume. When the capacity of the inner packaging is established with a liquid other than water (e.g. anti-freeze solution), the density of that liquid shall be taken into account, in order to obtain the correct volume of fill (at least 98 % of brimful capacity).

The calculation of required volume of liquids for testing shall be

$$V = \frac{b \times 98}{100}$$

where

V is the required volume of liquid, in litres;

b is the brimful capacity, in litres.

5.3.4 Rigid inner packagings to contain solids

The rigid inner packaging of a large packaging intended to contain solids shall be filled to not less than 95 % of the brimful capacity. Where the rigid inner packaging is capable of containing liquids, the capacity shall be determined as in 5.3.3.1.

The calculation of required mass of solids for testing shall be

$$M = \frac{(b \times \rho) \times 95}{100}$$

where

M is the required mass, in kilograms, of solids;

b is the brimful capacity, either measured or calculated in litres;

ρ is the bulk density of the test contents, in kilograms per litre.

Alternatively, for an inner packaging, the level of fill required to fill the packaging to at least 95 % of its brimful capacity shall be calculated from its internal height, taking into account any reduction in height caused by the fitting of the closure.

This procedure is not suitable for flexible inner packagings (see 5.3.5).

5.3.5 Flexible inner packagings to contain solids

Flexible inner packagings (bags) of a large packaging intended to contain solids shall be filled to the required testing mass at which the designer of the inner packaging intends it to be used or, if known, to the capacity which the user intends to employ, using either the substance to be transported or solids of similar characteristics in respect of mass, grain size and flow characteristics. The test contents used shall be recorded in the test report.

Bags do not have a capacity which is measured in the same way as for rigid inner packagings. The test report should therefore specify the quantity by mass and bulk density of that solid substance, as tested, for which the bag may be used.

5.3.6 Large packagings designed to contain articles

Large packagings shall be filled with articles prepared as for transport. The substance in an article or the article may be replaced by other materials or articles except where this would invalidate the results of the tests. Articles used for the tests shall have the same physical characteristics (mass, etc.) as the article to be carried. It is possible to use additives, such as bags of lead shot, to achieve the requisite total gross mass, so long as they are placed so that the test results are not affected.

5.4 Closing large packagings

Large packagings and any inner packagings shall be closed as for transport and in accordance with any special instructions.

5.5 Conditioning

Large packagings made of fibreboard shall be conditioned before test for at least 24 h in an atmosphere having a controlled temperature and relative humidity (rh). There are three options, one of which shall be chosen. The preferred atmosphere is (23 ± 2) °C and (50 ± 2) % rh. The two other options are (20 ± 2) °C and (65 ± 2) % rh, and (27 ± 2) °C and (65 ± 2) % rh.

Average values should fall between these limits. Short-term fluctuations and measurement limitations may cause individual measurements to vary by up to ± 5 % rh without significant impairment of test reproducibility.

NOTE The purpose of conditioning in this way is not to replicate any ambient condition likely to be met during actual transport. The purpose is to standardize the tests and enable them to be reproducible by stabilizing the moisture content of the fibreboard.

It is further noted that

a) the large packaging should be relatively dry before being placed in the controlled atmosphere,

b) the minimum of 24 h may be insufficient to stabilize the moisture content of thick material even if the large packaging is open so that moisture can be transferred via outer and inner faces, and

c) the moisture content of the fibreboard can be significantly affected by the moisture content and temperature of the test contents.

5.6 Check of large packaging specification against constructional requirements

Following receipt of the sample(s) and their specification (see 5.2.1), a check shall be made to ensure that the design type corresponds with the definition of a large packaging and the constructional requirements set out for that type of large packaging in the UN Recommendations.

5.7 Check of large packaging specification against sample

The specification of the large packaging to be tested shall be checked by visual inspection and actual measurements as detailed in Annex C. Aspects such as external dimensions shall be checked at this preparatory stage. A record of each specification check shall be included in the test report.

NOTE Aspects (other than external dimensions), such as measurement of material thickness requiring sectioning, may be carried out on completion of the test(s).

6 Facilities for testing

6.1 General requirements

Tests shall be carried out at a testing facility capable of meeting the operational provisions of ISO/IEC 17025.

NOTE This does not imply a requirement for third-party certification or accreditation but, if appropriate, such external approval may be obtained from either a national accreditation body or from the competent authority.

Testing staff should have a knowledge of the principles of the dangerous goods regulations as set out in the UN Recommendations.

6.2 Accuracy of measurement equipment

The accuracy of measuring equipment shall be more precise than the accuracy of the measurements in testing, as specified in 6.3, unless otherwise approved by the competent authority. The measuring equipment shall be calibrated in accordance with the relevant provisions of ISO/IEC 17025.

6.3 Accuracy of measurements in testing

Measurement equipment shall be selected such that individual measurement results including errors in reading and calibration shall not exceed the following tolerances:

Mass, in kilograms (kg):	± 2 %
Distance/length, in millimetres (mm):	± 2 %
Temperature, in degrees Celsius (°C):	± 1 °C
Humidity, in percent (%):	tolerances shall be as specified in the agreed test methods
Time, in minutes (min):	± 3 %
Torque, in newton metres (N·m):	± 3 N·m or 10 % whichever is the greater

NOTE For some measurements, the tolerances may be lower in order to have meaningful measurements, e.g. when measuring masses or dimensions of empty large packagings.

6.4 Climatic conditions

There shall be adequate climatic facilities to meet the requirements of 5.5 and Clause 7.

6.5 Impact surfaces for drop tests

The drop test area impact surface shall be horizontal and flat, massive enough to be immovable and rigid enough to be non-deformable under test conditions. It shall be sufficiently large to ensure that the test large packaging falls entirely upon the surface.

7 Testing procedures

7.1 Applicability

For the applicability of these tests, see Table 1.

7.2 Bottom lift test

7.2.1 Special preparation of large packagings for the test

The large packaging shall be filled as for transport. A load shall be added and evenly distributed. The mass of the filled large packaging and the load shall be 1,25 times its maximum permissible gross mass.

7.2.2 Method of testing

The large packaging shall be raised and lowered twice by a fork-lift truck with the forks centrally positioned and spaced at three quarters of the dimension of the side of entry (unless the points of entry are fixed). The forks shall penetrate to three-quarters the depth of the large packaging in the direction of entry. The test shall be repeated from each possible direction of entry.

NOTE Failure, when it occurs, often takes place during the initial acceleration of a lift. Neither the height nor the rate of elevation is specified. It is normally adequate (taking safety into account) to raise the large packaging for a distance of some 200 mm. A convenient rate of lifting results in a 200 mm lift being completed in between 5 s and 10 s.

It is recommended that, after the final test, the large packaging should then be lowered, the forks placed fully underneath it and the large packaging lifted to a convenient height for examination of the base.

When a design of rectangular pallet can be entered from each of four sides, a total of eight elevations and lowerings should be undertaken.

7.3 Top lift test

7.3.1 Top lift test for rigid large packagings

7.3.1.1 Special preparation of the rigid large packaging for the test

The large packaging shall be filled as for transport and then be loaded to a total of twice its maximum permissible gross mass, the load being evenly distributed.

7.3.1.2 Method of testing

The rigid large packaging shall be lifted in the manner for which it is designed until clear of the floor, then maintained in that position for 5 min.

7.3.2 Top lift test for flexible large packagings

7.3.2.1 Special preparation of the large packaging for the test

The flexible large packaging shall be filled to six times its maximum permissible load, the load being evenly distributed.

NOTE When using this method rather than an equivalent one, primary attention often needs to be directed towards obtaining test contents of sufficient bulk density; it may not be possible to fully take account of other important characteristics such as the angle of repose of dangerous solids to be transported. The filling level cannot normally be controlled.

7.3.2.2 Method of testing

The flexible large packaging shall be lifted in the manner for which it is designed until clear of the floor, then maintained in that position for 5 min.

NOTE With the approval of the competent authority, an equivalent method related to national standards and international industry standards may be used. It may involve the use of a specialized tensile or compression test machine. The method is described in Annex D.

7.4 Stacking test

7.4.1 Special preparation of the large packaging for the test

Large packagings shall be filled as for transport to their maximum permissible gross mass.

7.4.2 Method of testing

The large packaging shall be placed on its base on level hard ground and subjected to a uniformly distributed superimposed load.

The test load shall be calculated as 1,8 times the combined maximum permissible gross mass of the number of similar large packagings that may be stacked on top of the large packaging during transport.

The test load shall be applied by any one of the following:

a) one or more large packagings of the same type filled to the maximum permissible gross mass and stacked on the test large packaging;

b) appropriate weights loaded on to either a flat plate or a reproduction of the base of the large packaging, which is stacked on the test large packaging;

c) an appropriate compression test machine.

7.4.3 Duration of test

Large packagings of wood, fibreboard or plastics materials shall be stacked for 24 h. All other types of large packaging shall be stacked for at least 5 min.

7.5 Drop test

7.5.1 Conditioning

Testing of large packagings made of plastics materials and large packagings containing inner packagings of plastics materials, other than bags intended to contain solids or articles, shall be carried out when the temperature of the test sample and its contents has been reduced to −18 °C or lower. Test liquids shall be kept in the liquid state, if necessary by the addition of antifreeze.

Where the large packaging to be tested has an outer packaging of fibreboard and is prepared in this way, the conditioning specified in 5.5 may be waived.

Where climatic conditions are critical to the performance of the materials or to the application of the large packaging, the tests shall be carried out in conditions identical to those used for conditioning. In other circumstances, the tests shall be carried out in atmospheric conditions which approximate to those used for conditioning. The elapsed time between the removal of the large packaging from conditioning and its submission to the test shall be kept as short as possible and, in any event, not more than 5 min.

7.5.2 Drop heights

7.5.2.1 For solids and liquids

For solids and liquids, if the test is performed with the solid or liquid to be carried or with another substance having similar characteristics, the drop height shall be that specified below:

Packing group I	**Packing group II**	**Packing group III**
1,8 m	1,2 m	0,8 m

7.5.2.2 For liquids if the test is performed with water

7.5.2.2.1 Relative density not exceeding 1,2

For liquids, if the test is performed with water and where the substances to be transported have a relative density not exceeding 1,2, the drop height shall be that specified below:

Packing group I	**Packing group II**	**Packing group III**
1,8 m	1,2 m	0,8 m

NOTE The term water includes water/antifreeze mixtures for testing at −18 °C or lower.

7.5.2.2.2 Relative density exceeding 1,2

Where the substances to be transported have a relative density exceeding 1,2, the drop height shall be calculated on the basis of the relative density (d) of the substance to be carried, rounded up to the nearest first place of decimals. The drop height shall be as follows:

Packing group I	**Packing group II**	**Packing group III**
$d \times$ 1,5 m	$d \times$ 1,0 m	$d \times$ 0,67 m

7.5.2.3 Corrections to the drop height for packagings with the density of solids

There shall be no correction of drop height with density of solids.

7.5.2.4 Corrections to the drop height for large packagings with various densities

Where the inner packagings contain liquid substances of various densities the drop test shall be based on the most severe packing group (of the liquid substances to be transported) and the average density. The average density, $\bar{d}$, shall be calculated by multiplying the fill volume of each inner packaging by the relative density of the contents of that inner packaging, aggregating the results and dividing by the sum of the volumes. 7.5.2.2 shall then be applied. This may be expressed as follows:

$$\bar{d} = \frac{(V_1 \times d_1) + (V_2 \times d_2) + \ldots + (V_n \times d_n)}{V_1 + V_2 + \ldots + V_n}$$

where

V_1 is the fill volume of the first inner packaging;

V_2 is the fill volume of the second inner packaging, and so on;

d_1 is the relative density of the product to be shipped in the first inner packaging;

d_2 is the relative density of the product to be shipped in the second inner packaging, and so on.

The result of the equation should be applied to 7.5.2.2.1 or 7.5.2.2.2 as appropriate.

7.5.3 Method of testing

Large packagings shall be dropped on an impact surface as defined in 6.5, once on to their base in such a manner as to ensure that the point of impact is on that part of the base considered to be most vulnerable.

7.5.4 Method of assessment

Following each drop, assess the result. At the time of impact, observe the large packaging for discharge.

NOTE 1 For inner packagings or articles containing liquids, discharge might appear as dampness in the drop test area, or on the outer packaging (e.g. a stain).

NOTE 2 For inner packagings or articles containing solids, discharge might appear as loose solid in the drop test area or within the outer packaging.

Visually examine the large packaging for leakage and rupture (e.g. escape of the inner packagings/articles).

If there is dampness in the dropping area, the large packaging shall be moved carefully to a suitable place for examination of any leakage that may occur (e.g. moved so that it is on a surface such as clean fibreboard where drips will be apparent). Examination shall continue for a period of 5 min to 10 min.

Where a large packaging undergoes a drop test at −18 °C or lower, immediately after dropping the large packaging, check the temperature of the large packaging and/or its contents and record this in the test report.

7.6 Re-assessment when failure occurs

If failure occurs, the tests on the large packagings submitted shall be ended unless one of the re-assessment procedures set out below is used.

a) The tests shall be repeated at a lower level of intensity. For example, if a large packaging fails the drop test at 1,2 m, but passes the bottom lift, top lift and stack tests, then an additional large packaging may be dropped from 0,8 m and the design type shall be regarded as having passed at the latter level.

b) Where one large packaging fails on one test, that test shall be repeated on twice the normal number of identical large packagings for that test. If they all pass, the design type shall be regarded as meeting the test requirements;

The use of this procedure can be illustrated as follows. Where a large packaging fails the top lift test, but all the other tests have been successfully completed, then two large packagings shall be subjected to a further top lift.

7.7 Recording of re-assessment

Where a re-assessment procedure is used, this shall be fully recorded in the test report.

Annex A
(informative)

Guidance on liquids and solids

Unless there is an explicit or implicit indication to the contrary in the UN Recommendations, liquids are defined as dangerous goods when they have the following properties:

— a vapour pressure of not more than 300 kPa (3 bar) at 50 °C,

— not completely gaseous at 20 °C at a pressure of 101,3 kPa, and

— a melting point or initial melting point of 20 °C or less at a pressure of 101,3 kPa.

A viscous substance for which a specific melting point cannot be determined should be subjected to the ASTM D-4359 test, or to the test for determining fluidity (penetrometer test) prescribed in the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), Annex A, Appendix A.3, with the modifications that the penetrometer conforms to ISO 2137, and that the test should be used for viscous substances of any class. Solids are dangerous goods, other than gases, that do not meet the definitions of liquids.

The substances packed in large packagings include free-flowing liquids, pastes, viscous substances, powders and granules. The choice of tests for any large packaging depends crucially on whether the design type is to be tested for liquids or solids; however, there is no simple, absolute and natural distinction between the two. Moreover, some substances which are solids at, say, 20 °C become liquid at 55 °C, which is the reference temperature for that which may be experienced in transport.

As indicated, the UN Recommendations and the international agreements contain definitions making the distinction between liquids and solids from measurements of specific melting point or by penetrometer testing. Such measurements are rarely necessary in relation to large packaging testing; also the tests may be carried out in a facility not equipped to make such measurements. In most instances, there will be little difficulty in choosing between testing for liquid or for solid contents. In many instances, a large packaging will be designed for liquids and tested using water as contents without reference to any specific dangerous liquid to be carried. Similarly, a large packaging will be designed for solids and tested using, for example, a mixture of plastics granules and fine powder without reference to any specific dangerous solid to be carried. In such circumstances, it is appropriate for each user of the large packaging to check that the testing has been suitable for the dangerous substance. In other instances, however, the design type tests for a large packaging will be undertaken in relation to a specific dangerous substance. Should that substance be borderline between a liquid and a solid, then it is recommended that the appropriate data on it be obtained before tests are selected and commenced.

Annex B
(normative)

Test report

B.1 Introduction

Every test shall be accompanied by a test report, the minimum contents of which are set out as follows.

B.2 Test facility (name and address)

This shall be the organization that undertook the actual testing. The front page of the report shall be on the headed paper of the test facility. If headed paper is not available, the report shall be clearly traceable to its author and the test facility.

B.3 Applicant (name and address)

The applicant may be the manufacturer, the user of the large packaging, or any person in the packaging chain.

NOTE In some instances, the address of the test facility and the applicant may be the same.

B.4 Report number

This shall be a number which enables full traceability back to the original working documents that refer to the original test. The number shall appear on every page of the report and any annexes. Any subsequent amendments shall include the number and clearly show it is an amendment or addition to the original report.

B.5 Date

This shall be the date the report was completed, rather than the date that testing was completed. The report shall also include the dates of the receipt of test samples, the start of the tests and their completion.

B.6 Manufacturer

Because large packaging specifications (see Annex C) are a part of the report, the manufacturer's name in the body of the test report is not necessary, provided this is clearly stated in one of the annexes that can be clearly linked to the main report.

B.7 Description of large packaging

A large packaging design type is defined by the design, size, material and thickness, manner of construction and packing, but may include various surface treatments. The description should also include details of dimensions, closures and, where appropriate, lifting devices.

The main report shall include a general description of the large packaging. Full details of its components and material shall be included either in the specification (see Annex C) (provided there is a clear link between it

and the main report) or in the main report. A check for conformity with the relevant definition in the regulations shall be included.

NOTE It may also include drawings and photographs.

B.8 Capacities

For rigid large packagings, the report shall include the nominal capacity and the maximum capacity or brimful capacity, as defined in 3.7, for the outer and inner packaging, as relevant, in either litres or cubic metres.

The specifications for large packagings shall include the maximum permissible gross mass in kilograms.

B.9 Test contents

The report shall include the characteristics of the test contents. These may include, for example, viscosity and relative density for liquids; bulk density, particle size and angle of repose for solids; and the number and description of articles or inner packagings.

B.10 Test description and results

The report shall identify the number of large packagings. Each large packaging shall have its own identification number. At least one large packaging shall be weighed full or empty.

The sequence and performance of tests undertaken on each large packaging shall be clearly described.

A description of each test and how it was performed shall be included.

The report shall include a conclusion clearly indicating the packing group to which the tests belong and the test levels achieved.

Where a competent authority has agreed to deviations from the standard methods set out in this International Standard, reference to such authorization shall be included in the test report.

B.11 Signature

The test report shall be signed with the name and status of the signatory.

The person who was responsible for the testing shall sign the report against his or her typed name and position in the test facility.

NOTE That person might be the tester or his or her supervisor.

The test report shall include statements that the large packaging, prepared as for transport, was tested in accordance with the appropriate provisions of Chapter 6.6 of the UN Recommendations [1], and that the use of other packing methods or components shall render it invalid.

NOTE The competent authority may require the test report to be retained for a specified period of time.

Annex C
(normative)

Large packaging specifications

C.1 Specification data

To assist in the identification of a packaging as inner packaging of a large packaging, following the issue of a test report, it is necessary to have a detailed specification.

Tables C.1 to C.8 correlate the different inner and outer packaging types with data which are necessary for the identification of large packagings by users, test facilities and competent authorities:

a) drums, jerricans, bottles, jars, etc.: Tables C.1 and C.2;

b) boxes: Tables C.3 and C.4;

c) bags: Tables C.5 and C.6;

d) inner packagings of large packagings: Tables C.7 and C.8.

The tables are of two types. The first type (Tables C.1, C.3, C.5, C.7 and C.8) is applicable to all inner packagings in that category. The second type (Table C.2, C.4 and C.6) is applicable only to particular packaging material type when indicated by an “S”.

Each item in the table is numbered, and in C.2 there are explanatory notes for many of the numbers to assist in interpretation.

The following symbols relate to procedures in relation to checking specifications on completion of testing by the test laboratory:

* = item to be checked;

A = thickness only;

B = combined grammage;

S = technical data.

The specification check shall be done visually and, where relevant, by measuring main dimensions and thicknesses.

The specification check data as measured on the test samples shall be recorded and compared with the design type specification including manufacturing tolerances. The measured data of the test samples should be within the stated tolerances.

Table C.1 — Drums, jerricans, bottles and jars, etc., as inner packagings of a large packaging — Packaging specification detail applicable to all

No.	Item		No.	Item	
1	Packaging description (code and trade name)		17	Closure(s), [or neck(s)] position(s)	*
2	Manufacturer's name and address		18	Closure(s), material(s) and grade	
3	Method of construction		19	Closure(s), type, identification	*
4	Nominal capacity		20	Closure(s), thread, type and pitch	*
5	Brimful capacity	*	21	Closure(s) mass	*
6	Diameter, nominal (cylindrical) internal		22	Closure manufacturer's name and address	
7	Diameter, external at widest point	*	23	Closure torque(s)	
8	Nominal diameters (conical, i.e. pails)		24	Type of overseal	*
9	Body/section dimensions (non-round)	*	25	Closure(s) seal, material	*
10	Recess of ends	*	26	Neck internal diameter	*
11	Height overall	*	27	Height to neck face	*
13	End seams type	*	28	Neck height (external)	*
14	Side seam type	*	29	Neck thread, type and pitch	*
15	Handles, material type, number and position	*	30	Neck thread number of starts	*
16	Closure(s), diameter(s) and design	*	31	Tare mass	*
* = Required for specification check.					

Table C.2 — Drums, jerricans, bottles and jars, etc. as inner packagings of a large packaging — Packaging specification detail applicable as indicated

No.		Specification check requirement	Non-removable head metal	Removable head metal	Non-removable head plastics	Removable head plastics	Fibreboard	Plywood	Glass and other materials
32	Nominal thickness and material type and grade head or lid	*A	S	S			S	S	S
33	Nominal thickness and material type and grade body	*A	S	S			S	S	S
34	Nominal thickness and material type and grade base	*A	S	S		S	S	S	
35	Material type, grade (polymer) body				S	S			
36	Material type, grade (polymer) base				S	S			
37	Material type, grade (polymer) lid/head				S	S	S		S
38	Material lid gasket			S		S	S	S	S
39	Body corrugations, number	*	S	S					
40	Body corrugation, heights	*	S	S					
41	Rolling hoops, number, height and location	*	S	S	S	S	S	S	
42	Closing ring type	*		S		S	S	S	
43	Closing ring material			S		S	S	S	
44	Thickness closing ring	*		S		S	S	S	
45	Number of plies (body)	*					S		
46	Grammage per ply body, and combined	*B					S		
47	Inner lining or coating material						S		
48	Chime reinforcement		S	S			S	S	
49	Method of lid retention (other than closing ring)			S		S	S	S	S
50	Mass body	*			S	S			S

* = required for specification checks (see C.1).
A = thickness to be measured for specification check (see C.1).
B = combined grammage shall be checked (see C.1).
S = required data for that packaging type.

Table C.3 — Packaging specification detail large packagings 50A, 50B, 50C, 50D, 50F, 50G, 50H, 50N in the form of a box and all boxes as inner packagings — Applicable to all

No.	Item	
1	Packaging description (code and trade name)	
2	Manufacturer's name and address	
51	Design standard, drawing, or style	*
3	Method of construction	*
31	Mass empty box	*
52	Dimension external (length, breadth, height)	*
9	Dimension internal (length, breadth, height)	
15	Handles, material type, number and position	*
53	Closures, number, type, position and materials	*
54	Reinforcements, type, position and materials	*
* Required for specification check.		

Table C.4 — Packaging specification detail large packagings 50A, 50B, 50C, 50D, 50F, 50G, 50H, 50N in the form of a box and all boxes as inner packagings — Applicable to all

No.		Specification check requirement	Metal	Natural wood	Plywood and reconstituted wood	Fibreboard	Expanded plastics	Plastics
38	Material lid gasket		S				S	S
55	Material ends				S	S		
32	Nominal thickness, material type and grade head or lid	*A	S	S	S	S	S	
33	Nominal thickness, material type and grade side walls	*A	S	S	S	S	S	
34	Nominal thickness, material type and grade base	*A	S	S	S	S	S	
56	Method of joining panels	*		S	S			
57	Manufacturer's join body	*				S		
58	Grammage by paper and paper type	*				S		
59	Corrugated flute type	*				S		
60	Corrugated combined grammage	*				S		
61	Corrugated edgewise crush resistance	*				S		
62	Burst strength	*				S		
91	Puncture resistance	*				S		
35	Material type, grade (polymer) body							S
36	Material type, grade (polymer) base							S
37	Material type, grade (polymer) lid							S
63	Density	*					S	
64	Inner top flap gap					S		
65	Outer top flap gap or overlap					S		
66	Inner bottom flap gap					S		
67	Outer bottom flap gap or overlap					S		

* = required for specification checks (see C.1).
A = thickness to be measured for specification check (see C.1).
S = required data for that packaging type.

Table C.5 — Specification detail large flexible packagings 51H, 51M and all bags as inner packagings — Applicable to all

No.	Item	
1	Packaging description (code and trade name)	
2	Manufacturer's name and address	
4	Nominal capacity	
51	Design standard or drawing	
3	Method of construction	*
68	Style	
52	Dimensions flat unopened	*
69	Gusset, open width	*
70	Bottom width, flat unopened	*
71	Valve width	*
73	Closure method (top, base, side)	*
74	Perforations	
75	Sewing, style and density of stitches	*
76	Type of thread and minimum breaking load	
77	Filter cord	
78	Adhesive type	
* = Required for specification check.		

Table C.6 — Specification detail large flexible packagings 51H, 51M and all bags as inner packagings — Applicable as indicated

No.	Item	Specification check requirement	Unlined/uncoated woven plastics	Other woven plastics	Plastics film	Unlined/uncoated textile[x]	Other textile[x]	Paper
32	Material type and grade		S	S		S	S	S
35	Type of film grade				S			
33	Nominal thickness, material type and grade	*A			S			
79	Fabric (warp/weft), tapes per 100 mm	*	S	S		S	S	
82	Coating, material, thickness/mass			S			S	S
83	Liner, material, thickness	*		S			S	S
45	Number of plies	*						S
46	Grammage of plies	*	S	S				S
84	Material strength elongation		S	S	S			
85	Material strength tensile (energy absorption)							S

* = required for specification checks (see C.1).
A = thickness to be measured for specification check (see C.1).
S = required data for that packaging type.

Table C.7 — Inner packaging of large packaging specification detail — Removable fittings

No.	Item	
30	Material type (and grade)	
1	Description	*
51	Design standard or drawing	
87	Quantity or number	*
52	Dimensions	*
27	Tare mass	*
32	Nominal thickness	*
58	Grammage by paper and paper type	*
60	Corrugated combined grammage	*B
90	Orientation and arrangement of inner packagings	

* = Required for specification checks (see C.1).
B = combined grammage shall be checked (see C.1)

Table C.8 — Inner packaging of large packaging specification detail — Permanent fittings

No.	Item	
1	Description	
30	Material type and grade	
51	Design standard or drawing	
87	Number	*
88	Location(s)	*
89	Means of fixing to packaging	*
* = Required for specification checks (see C.1).		

C.2 Notes to packaging specification detail applicable to Tables C.1 to C.8

1. Packaging description i.e. steel drum, code where appropriate i.e. 50D and trade name.
2. Name and address of manufacturer of packaging or appropriate component.
3. Method of construction i.e. welded; glued and stitched; nailed, etc.
4. Nominal capacity: see ISO 16104.
5. Brimful capacity: see ISO 16104.
8. Smallest and largest for conical shaped packagings.
9. For non-circular packagings.
10. Usually found on drums.
11. From ground to highest point, however the dimensions may be less than that specified in the test report.
13. Where applicable.
14. Where applicable.
15. Also indicate if an optional extra.
16. Required for each closure and variant.
17. Position on drum.
18. Required for each one and variant, including plastics polymer details.
19. May include trade name and any features or marks on closure.
21. Mass of individual closure with gasket/wad.
22. For each closure.
23. For each closure.
24. If fitted.
25. Gasket details.
31. Mass of container and closures and associated fittings.
32. All materials other than plastics.
33. All materials other than plastics.
34. All materials other than plastics.
35. Plastics materials only.
36. Plastics materials only.
37. Plastics materials only.

38. When lid or head fitted with gasket, washer or seal.

46. Combined grammage will include an allowance for the glues between the paper plies.

49. To allow for large screw caps, pill box lids, etc.

50. Particularly plastics.

51. Include FEFCO/ESBO code for fibreboard boxes if applicable.

53. This is to include taping patterns and any additional means of closing such as straps.

54. Battens, corner posts, etc.

68. Valved, gusseted etc., Some of this may be covered by 1.

Annex D
(informative)

Top lift test for flexible large packagings using specialized apparatus

D.1 Principle

The filled flexible large packaging is suspended by its lifting devices with a flat pressure plate positioned on top of the test contents. A force is effectively applied to the pressure plate in one of two ways:

a) the fixed pressure plate is restrained either from above or below; the flexible large packaging is suspended from a movable frame to which an upward force is applied progressively against the resistance of the pressure plate; or

b) the flexible large packaging is suspended from a frame fixed at the time of test and a downward force is applied progressively to the pressure plate.

The total force on the lifting devices of the flexible large packaging shall be at least 6 times the maximum permissible load. This total force is made up of two components: firstly, the mass of the filled flexible large packaging, and secondly, the force on the pressure plate. The total force shall be exerted for a period of at least 5 min.

D.2 Apparatus

D.2.1 Flat pressure plate, of such a size that it covers between 60 % and 80 % of the surface area of the cross section of the flexible large packaging. The pressure plate (and any restraint) shall be capable of resisting the forces applied during the test with minimal deformation.

NOTE Flanges may be fitted to the underside of the pressure plate for prevention of lateral displacement.

D.2.2 Suspension frame, such that the filled flexible large packaging can be suspended clear of the ground with its lifting devices positioned as recommended by its manufacturer. The suspension frame shall have a rectangular cross-section. The upper edges shall have a radius of 1 mm with a tolerance of $^{+0,5}_{0}$ mm. The horizontal dimension of the cross-section shall be 25 mm with flexible large packaging designed for one- or two-point lifting; and 50 mm with flexible large packaging designed for four-point lifting. The tolerance shall be in both instances. The suspension frame shall be capable of resisting the forces applied during the test with $^{+0,5}_{0}$ mm minimal deformation.

D.2.3 Means of applying the force (upward or downward):

— capable of at least the required test load;

— capable of being operated at a rate of (70 ± 20) kN/min;

— fitted with means for registering the mass of the flexible large packaging when suspended and of registering the total applied force.

D.2.4 Rods with screw connections, as a suitable means of restraint from above or below the flat plate when the apparatus is set up and an upward force is applied to the plate. When restraint is from below, the rods pass through the body of the flexible large packaging and its test contents. Considerable care should be taken to ensure that, with woven fabrics, threads are separated rather than cut. Rods shall not pass through the base within 20 mm of a seam or join and a multiplicity of rods may be needed to ensure this.

When a rod is passed through fabric, it is recommended that a conical adapter be screwed to the end and removed once the flexible large packaging is in position for the test. It is also recommended that nuts be used to connect the rod(s) to the pressure plate and to a restraint.

D.3 Procedure

D.3.1 Fill the flexible large packaging to the height recommended by the manufacturer. Plastics granules with a bulk density of 1 g/cm^3 are typically used. Record details of the filling height and the contents used in the test report.

NOTE The total downwards force on the flexible large packaging is made up of two components. Firstly, there is the force of gravity acting on the test contents. Secondly, there is the force applied to the test contents by the flat plate. The mass of the contents therefore, in itself, is not critical; if it is less than the maximum permissible load, this will be made up by an additional force from the flat plate.

D.3.2 Suspend the filled flexible large packaging from the frame of the test apparatus. Select an appropriate size of pressure plate and place on top of the test contents such that during the test there will be no contact between the edge of the plate and the material of the flexible large packaging. When an upward force is to be used, restrain the plate from above or below.

NOTE Any top panel not designed to contribute to the overall strength of the flexible large packaging may be removed to allow passage of connecting rods when an upward force is used with restraint from above, or of the entry of the plate when a downward force is used. The area removed is the minimum commensurate with efficient operation.

D.3.3 Apply an upward or downward force at a rate of (70 ± 20) kN/min until a total force equivalent to 6 times the maximum permissible load has been achieved. Maintain the force constantly for a period of 5 min. Assess the results against the criteria in 4.3.

NOTE Following the assessment, there is no objection to the force being increased until failure of the flexible large packaging occurs.

Bibliography

[1] The United Nations Recommendations on the Transport of Dangerous Goods — Model regulations. ST/SG/A.C.10/1/Rev. 14, United Nations, Geneva [1)]

[2] The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), United Nations, Geneva (ISBN 92-1-139071-0)

[3] Regulations concerning the International Carriage of Dangerous Goods by Rail (RID), Organization intergouvernmentale pour les transports ferroviaires (OTIF), Berne, 2001

[4] The International Maritime Dangerous Goods (IMDG) Code, International Maritime Organization, London (ISBN 92-801-5090-1)

[5] Technical Instructions for the Safe Transport of Dangerous Goods By Air (ICAO). I DOC 9284. AN/905. International Civil Aviation Organization, Montreal, 2001

[6] Council Directive 94/55EC on the approximation of the laws of the Member States with regard to the transport of dangerous goods by road (OJL319) [2)]

[7] Council Directive 96/49EC on the approximation of the laws of the Member States with regard to the transport of dangerous goods by rail [2)]

[8] ASTM D-4359, Test methods for determining whether a material is a liquid or a solid

[9] ISO 2137, *Petroleum products — Lubricating grease and petrolatum — Determination of cone penetration*

[10] ISO 16104, *Packaging — Transport packaging for dangerous goods — Test methods*

1) For References [1] to [5], each edition is revised regularly and the latest one should be used. Test facilities should be in possession of at least one of the documents or, alternatively, their national regulation where it includes the relevant UN provisions.

2) Directives of the European Community require member states to apply the provisions of RID/ADR to all dangerous goods traffic in their territories.

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