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Annex F
(normative)

Drop test

F.1 Applicability

This is for all types of packaging, IBCs and large packaging.

F.2 Preparation

Samples for this test shall be prepared in accordance with the UN Recommendations and the relevant parts of Clause 5 of this International Standard.

The elapsed time between the removal of the packaging/IBC/large packaging from conditioning and performance of the test shall be kept as short as possible and in any event not more than 5 min.

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

For the cold drop test, the temperature of the test sample contents shall be taken immediately after the test.

Non-plastics packagings (such as fibreboard or metal packagings) with plastics closures are not required to undergo the cold drop test.

Packagings made of materials not specifically requiring a cold drop test may be considered for this test when the closures are made of plastics and greater than 7 cm.

F.3 Test method

F.3.1 General

The tests shall be carried out in accordance with ISO 2248:1985 except for 7.2, the drop heights, drop attitude and number of samples to be tested shall be determined from the UN Recommendations. For drops performed on packaging other than flat drops, the centre of gravity shall be vertically over the point of impact.

Prior to carrying out the test, ensure that the drop area is clean and dry.

ISO 2248:1985, 4.4, does not apply. Impact surfaces shall be in accordance with the UN Recommendations.

NOTE For packaging, a suitable impact surface can have a mass at least 50 times the mass of the test item and have a maximum length of 5 times of its thickness. This note does not apply to IBCs or large packaging.

F.3.2 Information drops for packaging

To assess the weakest point, information drops may be performed. Where such investigation drops are undertaken they may be done with packaging already used in other tests. Each packaging shall strike the target in an orientation designed to investigate the weakest part. The orientations to be taken into account vary with designs. Information drops should be used to seek an alternative orientation where the design is not a common design.

NOTE 1 Failure in an information drop does not constitute failure of the design type test.

NOTE 2 When packaging is available there is no objection to information drops being carried out on other packaging other than those used for the first drop.

NOTE 3 When packaging under test is of a new or significantly modified design, more than three investigatory drops can be conducted.

NOTE 4 The drop can take place on an area of the packaging not already tested.

NOTE 5 Where information drops have been undertaken they can be reported in the test records.

F.3.3 Corrections to the drop height for packaging/large packaging with inner packaging containing liquids of different densities

Where the inner packaging contains 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 shall be calculated by multiplying the filling volume of each inner packaging by the relative density of the contents to be transported in that packaging and aggregating the results. The correction for density should be applied using the aggregate result in accordance with UN recommendations.

F.4 Method of assessment

F.4.1 General

Following each drop, there shall be an assessment of the result. Single packaging/IBC containing liquids or solids shall be assessed according to procedures in F.4.2 and combination packaging, packaging containing articles or large packaging shall be assessed according to F.4.3.

F.4.2 Single packaging/IBC for liquids or solids

Observation should be made at the time of impact for discharge. If such a discharge is observed it shall be recorded in the test report.. The packaging/IBC shall be visually examined for leakage and rupture. Any packaging/IBC containing liquids shall have the internal pressure equalized with the atmospheric pressure, normally by loosening / retightening a closure, or by making a small hole in the body or end of the packaging/IBC. Impacted closures or closures suspected of leaking during the drop shall not be disturbed. When there is only one closure and it is suspected of leakage, pressure equalization shall be achieved by making a small hole in the body or end of the packaging/IBC. If there is dampness in the dropping area the packaging/IBC may be moved carefully to a suitable place and maintained in the same orientation for examination of any leakage which may occur (e.g. moved so that it is on a surface such as clean fibreboard where drips should be apparent). Examination shall start after equalization and last up to 5 minutes. Where a packaging/IBC for solids undergoes a drop test, the packaging/IBC shall pass the test if the entire contents are retained by an inner receptacle (e.g. a plastics bag), even if the closure is no longer sift proof. Where a packaging/IBC undergoes a cold drop test, immediately after dropping the first specimen the temperature of the packaging/IBC and/or its contents shall be checked and recorded in the test report. Subsequent packaging shall not need the temperature checked unless the first sample had not achieved the required temperature

F.4.3 Combination packaging, and large packaging

Observation should be made at the time of impact for discharge.

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

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

The combination packaging/large packaging shall be visually examined for leakage and rupture e.g. escapes of the inner packaging/articles. Where a combination packaging/large packaging containing

inner packaging or articles undergoes a drop test, the combination packaging/large packaging shall pass the test if the entire contents are retained by the inner packaging or inner receptacle (e.g. plastics bag) even if the closure is no longer sift proof. If there is dampness in the dropping area, the combination packaging/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 should be apparent). Examination shall last up to 5 minutes. Where a combination packaging/large packaging undergoes a cold drop test, immediately after dropping the first combination packaging/large packaging, the temperature of the package and/or its contents shall be checked and recorded in the test report. Subsequent packaging does not need the temperature checked unless the first sample had not achieved the required temperature.

Annex G
(normative)

Leakproofness test

G.1 Applicability

For all types of packaging intended to contain liquids, except the inner packaging of combination packaging and large packagings.

For all types of IBCs intended to contain liquids and all types of IBCs intended to contain solids filled or discharged by pressure.

G.2 Preparation

Samples for this test shall be prepared in accordance with the UN Recommendations and the relevant parts of Clause 5 of this International Standard.

The method of making pressure connections shall not affect the results of the test e.g. a connection through a closure shall not reinforce that part of the packaging or IBC. There are two methods as follows:

a) Drill two holes into each packaging or IBC. One hole shall be used to connect the packaging or IBC to an adequate air supply, the second hole shall be used to connect a pressure gauge reading the test pressure in the packaging or IBC; or

b) Drill one hole into each packaging or IBC. The gauge shall be connected to the air supply line between the source of the air supply and the packaging or IBC and as near as possible to the packaging or IBC; the gauge shall only be read under no flow conditions.

It shall be assured that the gauge is pressurized and that the supply line to the gauge is not blocked

NOTE In some cases an existing connection in a closure (e.g. a valve in an IBC) can be used for making the pressure connection.

Each packaging or IBC shall be closed according to any special instructions. When relevant, closures shall be tightened to the appropriate torque.

Vented closures shall be replaced with non-vented closures of the same specification or the vent shall be sealed. Pressure relief devices shall be removed and their apertures plugged, or shall be rendered inoperative.

The test shall be carried out on the complete packaging or IBC and before the fitting of any thermal insulation equipment.

For composite packaging or IBCs, any leakage from the inner receptacle shall be allowed to escape through the outer packaging or casing, e.g. by drilling a hole in the outer. In this case it is possible that entrapped air escapes, before any leakage can be detected.

Alternatively, for composite packaging and IBCs, the inner receptacle may be tested without the outer packaging, provided the test results are not affected. When the test is carried out on the inner receptacle in this way, this fact shall be recorded in the test report.

G.3 Test method

Each packaging or IBC shall be placed in a tank of water and shall be restrained just below the surface (the method of restraint shall not affect the test results). Air shall be applied continuously and gradually

up to the required pressure, which shall remain at or slightly above the predetermined level for the required period of time.

In order to take account of the hydrostatic test pressure, the packaging shall be turned regularly or the internal pressure increased to account for hydrostatic pressure.

NOTE Where turning is the desired option, turning is not necessary when the hydraulic pressure due to immersion, is negligible. Taking into account a maximum measurement tolerance of 3 %, which corresponds to 0.6 kPa (at 20 kPa overpressure), the maximum total depth of water, after immersion, for which turning is not required, would be 60 mm.

Alternatively, a correction factor shall be applied to the test pressure as illustrated in the following example:

EXAMPLE After immersion, if the lowest part of the test item is 2,5 m below the surface of the water then the test pressure should be increased with the hydraulic pressure, which is 25 kPa.

For packagings or IBCs, alternatively to placing the IBC in a tank of water, the seams and joints are covered with a suitable soap solution. It is also possible to surround part of the IBC with water (e.g. the bottom valve).Other alternative methods may also be acceptable.

When using this method it is desirable to take special care with closures and the connection between the closures and the IBC.

G.4 Method of assessment

Observation should be made for the escape of air bubbles throughout the test.

Air bubbles considered to arise from entrapped air (e.g. air held initially in seams or in the thread of closures) cannot be considered as leakage: these include any bubbles which do not appear regularly or produced at intervals exceeding 1 min. If necessary, the test period should be extended to allow entrapped air to be expelled.

Annex H
(normative)

Hydraulic pressure test

H.1 Applicability

For all types of metal, plastics and composite packaging intended to contain liquids except inner packaging of combination packaging and large packagings.

For all types of metal, plastics and composite IBCs used for liquids.

For all types of metal, plastics and composite IBCs used for solids filled or discharged under pressure.

H.2 Preparation

Samples for this test shall be prepared in accordance with the UN Recommendations and the relevant parts of Clause 5 of this International Standard.

Each packaging or IBC shall be completely filled with water and shall be closed according to any special instructions when relevant. Closures shall be tightened to the appropriate torque.

Vented closures shall be replaced with non-vented closures of the same specification or the vent shall be sealed. Pressure relief devices shall be removed and their apertures plugged, or shall be rendered inoperative

NOTE Steps can be taken to ensure that no air (or other gas) remains inside the packaging above the level of the closure by, for example, tilting the packaging when filling.

The test with IBCs shall be carried out before the fitting of any thermal insulation material.

H.3 Test method

The packaging and IBCs shall be pressurized continuously and gradually up to the required test pressure with water.

NOTE For packaging this can be done within the time of not less than 2 min and not more than 15 min. For IBCs this can be done within the time of not less than 5 min and not more than 30 min.

The test pressure in the packaging or IBCs shall be held continuously and evenly for the appropriate required test period, depending on the type of packaging and IBC. The test pressure in the packaging or IBCs shall remain at or slightly above the required level.

The manner in which packaging are supported shall not invalidate the test.

The IBCs shall not be mechanically restrained during the test.

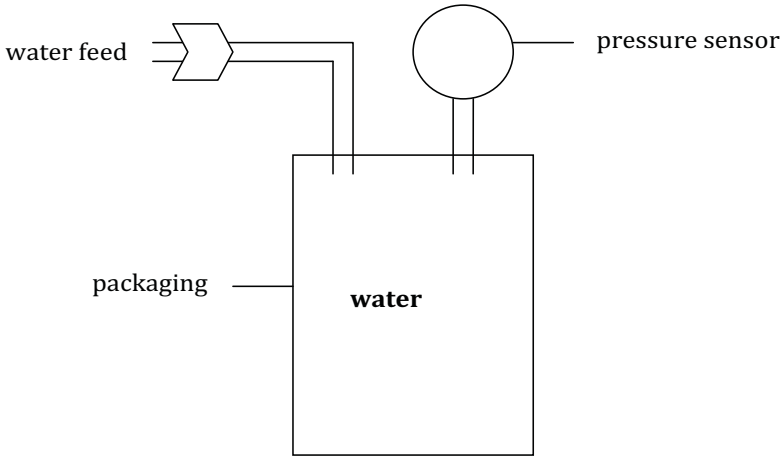

Figure H.1 — Schematic representation of the test arrangement

H.4 Test conditions for all plastics packaging and plastics IBCs, including all composite packaging and composite IBCs with inner plastics receptacles

The temperature of the water shall be a minimum of 12 °C.

Where the water temperature is above 12 °C the following correction factors may be applied:

Table H.1 — Water temperature adjustment factors for plastics packagings and plastics IBCs

Water temperature °C	Pressurization factor
12 + 2	1,000
≥14	0,976
15	0,964
16	0,952
17	0,940
18	0,928
19	0,917
≥20	0,906

The conditions of the test shall be recorded in the test report (applied pressure and water temperature).

NOTE The UN mark awarded in respect of hydraulic pressure is based on the actual pressure achieved.

H.5 Method of assessment

Observation should be made throughout the test for any leakage of water.

NOTE Water drops originating from water held initially in seams in the thread or in gaskets cannot be considered as leakage – as a guide not more than one drop of water every two minutes.

Annex I
(normative)

Stacking test

I.1 Applicability

For all types of packaging except for bags, and IBCs and large packaging intended for stacking during transport.

I.2 Sample Preparation

Samples for this test shall be prepared in accordance with the UN Recommendations and the relevant parts of Clause 5 of this International Standard.

NOTE For fibreboard packagings the stack test can be conducted in a conditioned environment meeting the UN Recommendations.

I.3 Calculation of the stacking load for packaging

I.3.1 General

In the following calculations, where the design type has an interstacking feature, an allowance shall be made. This usually takes the form of a small reduction in effective packaging height.

I.3.2 Solids, articles, or liquids to be transported

Where the contents are solids, articles, or the liquid to be transported, the stacking load to be superimposed on each packaging shall be calculated as follows:

$$M_1 = \left(\frac{H}{h} - 1 \right) \cdot M$$

where

M_1 is the stacking load in kilograms (kg) (with closure included; see Note);

M is the mass in kilograms (kg) of the complete, filled and closed packaging as prepared for transport;

H is the relevant stack height in millimetres (mm);

h is the overall height in millimetres (mm) of packaging to be tested, allowing for any interstacking features.

NOTE Newtons can be used as a unit of force.

I.3.3 Other liquids

Where any other liquid is used as test contents, the stacking load to be superimposed on each packaging shall be calculated from the following:

$$M_1 = \left(\frac{H}{h} - 1 \right) \cdot \left(C \cdot d \cdot n + m \right)$$

where

M_1 is the stacking load in kilograms (kg) (see NOTE);

H is the relevant stack height in millimetres (mm);

h is the overall height of the packaging in millimetres (mm), allowing for any interstacking features;

C is the volume of water in litres (l) required to occupy 98 % of the capacity where the packaging is brimful or, for a combination packaging, 98 % of the capacity of one inner packaging that is brimful;

d is the relative density of the substance to be transported;

m is the mass in kilograms (kg) of the empty packaging (including its closures) or, for a combination packaging, the mass of all the components of one package, including any empty inner packaging (see [1]);

n is the one or pieces of inner packaging (combination packaging only).

NOTE Newtons can be used as a unit of force.

I.4 Test method

I.4.1 Test methods for packaging

I.4.1.1 General

Any one of three methods shall be used by agreement between the test laboratory and the client:

a) A guided load on packaging(s);

b) An unguided load on an individual packaging;

c) An unguided load on three packaging forming one layer.

NOTE 1 Where b or c has been followed and the packaging did not pass the stacking test, the Guided load can be used, and if it passes this test, then the result can be valid.

NOTE 2 Where the packaging has an interstacking feature, the stack loading can be applied using a reproduction of the packaging base shape as the lowest component of the stack.

The method used shall be stated in the test report.

I.4.1.2 Guided load on packaging(s)

A suitable guided load rig shall be used. Such a rig shall take the form of

— a conventional compression testing machine with the facility of maintaining a constant load (as calculated in I.3) for the required period,

NOTE Such equipment can have short-term fluctuations of ± 4 % in accordance with ISO 12048:1994.

— a purpose-made rig, e.g. two frameworks with the upper framework being free to move vertically and with a minimum of friction in relation to the lower framework and to take the appropriate load.

For each test, the upper framework shall be loaded so that its total mass is as calculated in I.3. Except where the interstacking design is taken into account, the load shall be applied via a rigid top plate extending beyond the outermost edges of the pieces of packaging.

I.4.1.3 Unguided load on an individual packaging

The packaging shall be placed on a firm level surface. The predetermined load calculated in accordance with I.3 shall be placed centrally on the top for the period of time as required for the particular packaging type.

The load shall typically be made out of concrete or steel masses. Except where the interstacking design is taken into account, the load shall be applied via a rigid top plate extending beyond the outermost edges of the pieces of packaging.

The load shall be free to move when and if the packaging collapses.

NOTE For safety reasons, however, the load can have restricted movement, e.g. suspended by chains from overhead, but with sufficient slack in the chains not to affect the integrity of the test. Measurements of the deflection and angle of the plate with the horizontal level are normally made

a) immediately before and after placing the load on the plate,

b) where appropriate, at intervals throughout the duration of the test, and

c) on completion of the test.

I.4.1.4 Unguided load on three packaging forming one layer

The packaging shall be placed in the same direction on a firm level surface as illustrated in Figure I.1.

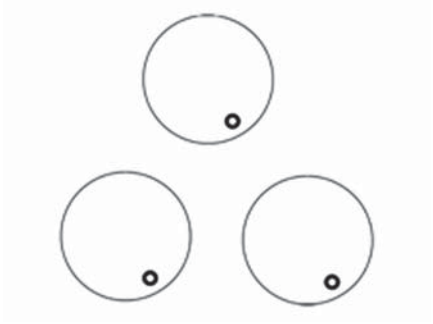

Figure I.1 — Plan view of drums stacked

The spacing between the packaging shall be as close as possible but separated to ensure that they cannot come into contact with one another when deformed.

A steel plate shall be placed over the pieces of packaging and its position shall be carefully checked. The load consists of the plate and suitable masses evenly distributed on it. The load shall have a mass three times as big as that calculated in 3 for one packaging ($M_1 \times 3$). Except where the interstacking design is taken into account, the load shall be applied via a rigid top plate extending beyond the outermost edges of the pieces of packaging.

NOTE Measurements of the deflection and angle of the plate with the horizontal level can be made

a) immediately before and after placing the load on the plate,

b) where appropriate, at intervals throughout the duration of the test, and

c) on completion of the test.

I.4.2 Test methods for large packaging and IBC

The IBC / 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 required by the regulations.

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

a) a number of samples of IBCs / large packaging of the same type;

b) appropriate weights loaded onto either a flat plate or a reproduction of the base of the IBC/large packaging, which is stacked on the IBC/large packaging being tested;

c) an appropriate compression test machine.

I.5 Method of assessment

Observation should be made for leakage and deformation of packaging, inner packaging, large packaging and IBCs (excluding flexible IBCs).

Observation should be made for deterioration of the body and leakage of flexible IBCs.

A suitable method for guided loads is as follows. The packagings are removed from the stack rig. For stackable packaging, two filled of the same type should be placed centrally on the tested packaging. For not individually stackable packaging the stacked samples may be arranged as Figure I.1 on which two identical layers are placed on top using intermediate plates of suitable material. In both cases the packaging should maintain their position for one hour.

Where unguided loads have been used, this may be assessed by the angle of the top plate An angle of 5° or more may be considered to show significant deformation. The 5° criterion has been found to accord with the UN requirements in relation to stack stability.