
**Packaging — Transport packaging for
dangerous goods — Rigid plastics and
plastics composite IBCs — Compatibility
testing**

*Emballages — Emballages de transport pour marchandises
dangereuses — Grands récipients pour vrac en plastique rigide et en
plastique composite — Essais de compatibilité*

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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 23667 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 261, *Packaging*, in collaboration with ISO Technical Committee 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).

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Introduction

This International Standard was developed to provide requirements and test procedures to meet the compatibility provisions for plastics Intermediate Bulk Containers (IBCs) to contain liquids as set out in:

- the *European Agreement concerning the International Carriage of Dangerous Goods by Road* (ADR) (covering most of Europe) ^[2]; and
- the *Regulations concerning the International Carriage of Dangerous Goods by Rail* (RID) (covering most of Europe, parts of North Africa and the Middle East) ^[5].

This procedure is an alternative option to that set out in the *UN Recommendations on the Transport of Dangerous Goods* ^[1].

Plastics IBC material can be attacked by the chemical contents of the package. Such effects are caused by different mechanisms such as environmental stress cracking (ESC), chemical degradation and swelling.

The UN recommendations and the associated modal regulations require that all IBCs shall be assessed for compatibility with the substances which they are to contain. The UN text makes special reference to plastics IBCs for liquids. The procedure therein contains details of testing for six months at ambient temperature with the liquid to be carried. RID/ADR permits as an alternative the use of standard liquids to which this document refers.

The UN recommendations are given legal entity not only to ADR and RID, but also to

- the *International Maritime Dangerous Goods Code* (IMDG Code) (worldwide) ^[4].

These modal rules do not refer to the standard liquid tests, but they may still be acceptable as the UN provisions do not make the six month test a mandatory requirement.

The application of this International Standard will need to take account of the requirements of these international agreements and the relevant national regulations ^{[6], [7]} for domestic transport of dangerous goods.

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Packaging — Transport packaging for dangerous goods — Rigid plastics and plastics composite IBCs — Compatibility testing

WARNING — The use of this International Standard may involve hazardous materials and equipment. This International Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies the requirements and test methods for compatibility testing of polyethylene-based plastics Intermediate Bulk Containers (IBCs) and composite IBCs with plastics inners containing liquids. The testing involves storage with the packaged substance, or with a standard liquid as defined in Annex A. Annex B describes small scale laboratory tests, which may be used to determine the assimilation of those products to be carried with the standard liquids.

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

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 amendments) applies.

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 1133, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics*

ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method*

ISO 1628-3, *Plastics — Determination of the viscosity of polymers in dilute solution using capillary viscometers — Part 3: Polyethylenes and polypropylenes*

ISO 1872-2, *Plastics — Polyethylene (PE) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*

ISO 2818, *Plastics — Preparation of test specimens by machining*

ISO 11403-3, *Plastics — Acquisition and presentation of comparable multipoint data — Part 3: Environmental influences on properties*

ISO 11542-2:1998, *Plastics — Ultra-high-molecular-weight polyethylene (PE-UHMW) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*

ISO 16467:2003, *Packaging — Transport packages for dangerous goods — Test methods for IBCs*

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

ISO 16770, *Plastics — Determination of environmental stress crackinge (ESC) of polyethylene — Full- notch creep test (FNCT)*

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 the Bibliography

3.2 plastics IBCs
rigid plastics intermediate bulk containers and composite intermediate bulk containers with inner plastics receptacles (where “plastics” refers to certain types of polyethylene)

NOTE Certain types of polyethylene are listed in A.3.

3.3 packaged substance (chemical product)
dangerous liquid with which the IBC is to be filled for transport

NOTE IBCs used for solid packaged substances, which can become liquid at temperatures encountered during transport, should also meet the requirements of IBCs for liquids.

3.4 standard liquids
defined liquids that are representative in their effect for a specific kind of interaction between a packaged substance and the plastics IBC

NOTE A full description of the standard liquids can be found in A.2.

4 Test requirements

4.1 General
Plastics IBCs selected in accordance with Clause 5 shall be conditioned with the packaged substance or a standard liquid with which it is to be assimilated. Annex C contains a list of substances assimilated to standard liquids.

For other chemicals not listed in Annex C, small scale laboratory tests (see Annex B) shall be used to prove assimilation with standard liquids. The standard liquid chosen shall be at least as aggressive as the substance to be transported. Where the packaged substance to be filled cannot be assimilated with one of the standard liquids, the packaged substance itself shall be used and its specification recorded. In the event that the effect is more aggressive than that of the standard liquids, the six month procedure shall be followed, as given in 7.1, or alternatively, and with the exception of nitric acid > 55 %, the accelerated procedure, as given in 7.2.

NOTE When the standard liquid is water, proof of chemical compatibility is not required.

4.2 Conditioning

Plastics IBCs shall be conditioned in accordance with Clause 7 of this International Standard.

4.3 Post-conditioning inspection

At the end of the conditioning period, the IBCs shall be inspected for leakage. Where no leakage is apparent, testing in accordance with Clause 7 of ISO 16467:2003 shall commence within 21 days of the end of the conditioning period (see 7.3).

4.4 Applicability

The tests referred to in 4.5 to 4.10 below may not be applicable to all types of IBCs. See Table 1.

The following tests are applicable, as shown in the sequence of testing required.

Table 1 — Applicability of tests

Test	Rigid plastics IBC	Composite IBC with plastics inner receptacle
4.5 Bottom lift test	1st ^a	1st ^a
4.6 Top lift test	2nd ^a	2nd ^a
4.7 Stacking test — 28 days at 40 °C containing standard liquid	3rd ^c	3rd ^{b, c}
4.7 Stacking test — 24 h at ambient temperature (minimum 15 °C — see 7.1)	not required ^f	3rd ^{c, e, f}
4.8 Leakproofness test	4th	4th
4.9 Hydraulic pressure test	5th	5th
4.10 Drop test at –18 °C	6th	6th ^d
NOTE When mechanical tests, in accordance with ISO 16467, have been successfully carried out, it is not necessary to carry out tests 4.5 (Bottom lift test), 4.6 (Top lift test) and 4.7 (Stacking test) for composite IBCs with plastics inner receptacle.		
<p>^a Where IBCs are designed for this method of handling.</p> <p>^b Not required where composite IBC has a non-plastics outer component that supports the stacking load.</p> <p>^c Where IBCs are designed to be stacked during transport.</p> <p>^d A second sample may be used for the drop test.</p> <p>^e Required where composite IBC has a non-plastics outer component that supports the stacking load.</p> <p>^f A second sample may be used for the stacking test.</p>		

4.5 Bottom lift test

When tested in accordance with 7.1 of ISO 16467:2003, there shall be no permanent deformation which renders the IBC, including base pallet, if any, unsafe for transport and no loss of contents.

4.6 Top lift test

When tested in accordance with 7.2 of ISO 16467:2003, there shall be no permanent deformation which renders the IBC including the base pallet, if any, unsafe for transport and no loss of contents.

4.7 Stacking test

When tested in accordance with 7.4 of ISO 16467:2003, there shall be no permanent deformation which renders the IBC, including the base pallet, if any, unsafe for transport and no loss of contents.

4.8 Leakproofness test

When tested in accordance with 7.5 of ISO 16467:2003, there shall be no leakage of air.

4.9 Hydraulic pressure test

When tested in accordance with 7.6 of ISO 16467:2003, there shall be no permanent deformation which renders the IBC unsafe for transport and leakage of liquid.

4.10 Drop test

When tested in accordance with 7.7 of ISO 16467:2003, there shall be no loss of contents. A slight discharge from a closure on impact shall not be considered as a failure of the IBC provided that no further leakage occurs.

4.11 Equivalent testing

The test methods described in this International Standard shall be considered to be the reference test methods.

Alternative methods may be used to demonstrate compliance with relevant regulations provided that:

- their equivalency to the reference method can be demonstrated;
- their use is recorded in the test report;
- prior approval is obtained from the competent authority.

4.12 Test report

All IBC tests in conformity with this International Standard shall be the subject of a test report and specification check in accordance with Annex C of ISO 16467:2003. It shall be possible to specifically identify the IBC relative to each test report, either by the retention of the uniquely referenced IBCs, or by inclusion of sufficient photographs and/or drawings with unique references to enable identification of the IBC and all its components.

5 Selection and preparation of test IBCs

5.1 Selection of IBCs

One or two IBCs of each design type, for each filling substance to be tested, shall be selected at random from a production batch and submitted for testing.

IBCs shall be

- a) at least 48 h old,
- b) marked with a test reference number which shall also be entered on the test record and later used on the test report,

- c) individually weighed to establish the tare or the filled mass,

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

- d) examined for damage, etc., which might invalidate the tests.

The tests set out below should be applied to every design type of IBC, by polymer type and grade.

NOTE For selective testing, see ISO 16467:2003, Annex D.

5.2 Information to be provided with IBCs

Each IBC type shall be accompanied by specification(s) for that design type (in the appropriate format set out in Annex C of ISO 16467:2003) and by the following additional information as relevant.

The IBC user (with the assistance, where appropriate, of the IBC manufacturer and the test laboratory) shall identify the packaged substance. In the first instance, this process shall consist of identifying the plastics material concerned and its possible interactions, such as swelling, environmental stress cracking (ESC) and molecular degradation.

The specification forms for plastics IBCs should identify the material by polymer type and grade.

NOTE Where tests are carried out using the packaged substance, the test report may be applicable for other substances having equivalent or lesser chemical effects.

5.3 Filling of IBCs prior to testing

5.3.1 General

IBCs shall be filled for testing as follows.

- a) For bottom and top lift tests, IBCs shall be prepared in accordance with 7.1 and 7.2 of ISO 16467:2003.
- b) For the stacking test, IBCs shall be prepared in accordance with 7.4 of ISO 16467:2003.
- c) For the leakproofness and hydraulic pressure tests, IBCs shall be prepared in accordance with 7.5 and 7.6 of ISO 16467:2003.
- d) For the drop test, IBCs shall be filled in accordance with 5.3.3.1 of ISO 16467:2003.

5.3.2 Filling of IBC prior to testing

Filling of IBCs shall be carried out in accordance with the following:

The IBC shall be filled to not less than 98 % of the brimful capacity. The brimful (overflow) capacity is determined by weighing the empty IBC including closures, filling the IBC with water until the water just overflows, fitting the closure and then weighing the IBC full. Any surplus water is mopped up. No steps shall be taken, e.g. by tilting or tapping the IBC, to enable water to penetrate into a hollow lifting feature or other design feature above the closure.

The following formula expresses the brimful capacity:

$$b = \frac{W - m}{d} \quad (1)$$

where

- b is the brimful capacity, in litres (l);
- W is the mass of the IBC when brimful with water, in kilograms (kg);
- m is the mass of the empty IBC, in kilograms (kg);
- d is the density of water (1,0 kg/l).

When the brimful capacity has already been determined by testing in accordance with ISO 16467, this procedure is not necessary.

The calculation of required volume for testing shall be:

$$C = \frac{b \times 98}{100} \quad (2)$$

where

- C is the required volume of water, in litres (l);
- b is the brimful capacity, in litres (l).

5.4 Closing IBCs

Screw type closures shall be tightened to the torque specified by the applicant where appropriate, which shall be recorded in the test report.

Closure torque shall not differ from one test to another in the test report. If it is necessary to revise a closure torque following a failure in one test, then all tests shall be completed using that torque setting.

All tests for a particular liquid shall be carried out at the same torque.

NOTE The closure torque may vary for different seals.

It is not necessary to apply the specified torque during the conditioning period if this affects the subsequent performance of the seal during the BC testing.

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 the test laboratory to have attained 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):	$\pm 2 \%$
Pressure, in kilopascals (kPa):	$\pm 3 \%$
Distance / length, in millimetres (mm):	$\pm 2 \%$
Temperature, in degrees Celsius ($^{\circ}\text{C}$):	$\pm 1 \text{ }^{\circ}\text{C}$
Time, in minutes (min):	$\pm 3 \%$
Torque, in newton-metres (Nm):	$\pm 3 \text{ Nm}$ or 10% , whichever is the greater

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

Where only maximum or minimum values are specified in the text, tolerances are one sided, e.g. in 7.2 the conditioning temperature may exceed $40 \text{ }^{\circ}\text{C}$, but shall not be less.

6.4 Climatic conditions

There shall be adequate climatic facilities to meet the requirements in Clause 7 of ISO 16467:2003.

6.5 Impact surfaces for drop tests

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

7 Conditioning procedures

7.1 Six months ambient conditioning

This test shall be carried out at ambient temperature for a period of 6 months.

For the purposes of this International Standard, ambient temperature, which shall be monitored and recorded, is considered to be not less than $15 \text{ }^{\circ}\text{C}$.

NOTE The competent authority may, however, allow an extended period of test for temperatures below $15 \text{ }^{\circ}\text{C}$.

7.2 Accelerated conditioning procedure

The IBCs for test shall be conditioned for 21 days at a minimum temperature of $40 \text{ }^{\circ}\text{C}$ with each standard liquid required.

The procedure shall be applied for polyethylene types as defined in A.3.1 and A.3.2. For other types of polyethylene such as defined in A.3.3 and A.3.4, the approval of the competent authority shall be obtained.

7.3 Procedure at the end of the conditioning period

At the end of the conditioning period, all IBCs, except those intended to withstand the stack test for 28 days at $40 \text{ }^{\circ}\text{C}$ (see Table 1), shall be emptied, rinsed, inspected for damage and prepared for test in accordance with the test procedures for plastics IBCs for liquids (ISO 16467). Testing shall commence within 21 days of the end of the conditioning period. If emptied the packaging shall be kept closed until testing commences.

IBCs which have been conditioned with standard liquid, *n*-butyl acetate, shall be emptied and refilled with a mixture of 1 % to 10 % aqueous wetting agent solution and 2 % *n*-butyl acetate for the stacking test.

NOTE For substances presenting a danger at 40 °C, it may be necessary to replace the filling substance by another substance where at least the same chemical interaction has been demonstrated and the agreement of the competent authority has been obtained.

The same closures and gaskets used during the conditioning of the IBCs shall be used for the rest of the tests, i.e. gaskets and closures shall not be replaced.

7.4 Reuse of standard liquids

The standard liquids shall be checked periodically in accordance with Table 2 as their effectiveness can be reduced over a period of time.

Table 2 — Reuse of standard liquids

Standard Liquid	Specification
Wetting solution	New solution for each test or check surface tension (see Annex A)
Acetic acid	Concentration (99 ± 1) %
Normal butyl acetate	≥ 98 % ^a
Mixture of hydrocarbons	16 % to 21 % aromatic content ^a
Nitric acid	Concentration ≥ 55 %

^a It is recommended that the absorption of these standard liquids is periodically checked with a control specimen of polyethylene of defined type and grade, in accordance with B.4.1. The used standard liquid is no longer fit for purpose when the determined absorption deviates by more than 5 % from the original determined value.

Tests to monitor the quality of the standard liquids shall be done by appropriate means at intervals according to the frequency of usage.

Annex A (normative)

Standard liquids and applicability to polyethylene types

A.1 Introduction

The standard liquid system has been developed for the investigation of the compatibility of high molecular weight high density polyethylene, but it can also be applied to medium molecular weight polyethylene and to IBCs produced from the above polyethylene types where the surface or surfaces have been fluorinated.

When closures or closure elements are manufactured from materials other than those referred to in A.3, alternative suitable methods to investigate compatibility may be employed.

A.2 Definitions and applicability of standard liquids

A.2.1 Wetting solution

Wetting solution shall be used for substances causing severe cracking in polyethylene under stress, in particular for all solutions and preparations containing wetting agents.

An aqueous solution of 1 % to 10 % of a wetting agent shall be used. The surface tension of this solution shall be $(31 \text{ to } 35) \times 10^{-3} \text{ N/m}$ at 23 °C.

The stacking test shall be carried out on the basis of a relative density of not less than 1,2.

If adequate chemical compatibility is proved with a wetting solution, a compatibility test with acetic acid is not required.

In the case of filling substances, however, which cause polyethylene to stress crack more than wetting solution, adequate chemical compatibility may be proved after preliminary storage for 21 days at 40 °C in accordance with 7.2, using the original filling matter.

A.2.2 Acetic acid

Acetic acid shall be used for substances and preparations causing cracking in polyethylene under stress, in particular for monocarboxylic acids and monovalent alcohol, acetic acid of 98 % to 100 % concentration shall be used with a relative density equal to 1,05.

The stacking test shall be carried out on the basis of a relative density not less than 1,1.

In the case of filling substances causing polyethylene to swell more than acetic acid, and to such an extent that the polyethylene mass is increased by up to 4 %, adequate chemical compatibility may be proved after preliminary storage for 21 days at 40 °C, in accordance with 7.2, using the original filling matter.

A.2.3 Normal butyl acetate

Normal butyl acetate and normal butyl acetate-saturated wetting solution shall be used for substances and preparations that cause polyethylene to swell to such an extent that the polyethylene mass is increased by up to 4 % and, at the same time, causes cracking under stress, in particular for phyto-sanitary products, liquid paints and esters.

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Normal butyl acetate of 98 % to 100 % concentration shall be used for preliminary storage in accordance with 7.2.

For the stacking test, in accordance with 4.7, a test liquid consisting of a 1 % to 10 % aqueous wetting solution conforming to A.2.1 shall be used mixed with 2 % normal butyl acetate.

The stacking test shall be carried out on the basis of a relative density not less than 1,0.

In the case of filling substances causing polyethylene to swell more than normal butyl acetate, and to such an extent that the polyethylene mass is increased by up to 7,5 %, adequate chemical compatibility may be proved after preliminary storage for 21 days at 40 °C, in accordance with 7.2 using the original filling matter.

A.2.4 Mixture of hydrocarbons (white spirit)

A mixture of hydrocarbons (white spirit) shall be used for substances and preparations causing polyethylene to swell, in particular for hydrocarbons, esters and ketones.

A mixture of hydrocarbons having a boiling range of (160 to 220) °C, a relative density of 0,78 to 0,80, a flash point above 50 °C and an aromatics content of 16 % to 21 % shall be used.

The stacking test shall be carried out on the basis of a relative density of not less than 1,0.

In the case of filling substances causing polyethylene to swell to such an extent that the polyethylene mass is increased by more than 7,5 %, adequate chemical compatibility may be proved after preliminary storage for 21 days at 40 °C, in accordance with 7.2 using the original filling matter.

A.2.5 Nitric acid

Nitric acid shall be used for all substances and preparations having an oxidizing effect on polyethylene and causing molecular degradation identical to or less than 55 % nitric acid.

Nitric acid in a concentration of not less than 55 % shall be used.

The stacking test shall be carried out on the basis of a relative density of not less than 1,4.

In the case of filling substances more strongly oxidizing than 55 % nitric acid or causing degradation of the molecular mass, proceed in accordance with 7.1.

A.2.6 Water

Water shall be used for substances which do not attack polyethylene in any of the cases referred to under A.2.1 to A.2.5, in particular for inorganic acids and lyes, aqueous saline solutions, polyvalent alcohols and organic substances in aqueous solution.

The stacking test shall be carried out on the basis of a relative density of not less than 1,2.

If the testing has been carried out satisfactorily with at least one of the aqueous-based standard liquids, wetting solution or 55 % nitric acid, it is not necessary to carry out the testing with water, for the same test levels (packaging group, relative density, hydraulic pressure).

A.3 Definitions of polyethylene types

A.3.1 High molecular weight high density polyethylene (PE-HD-HMW)

The natural relative (non-pigmented) density at 23 °C after annealing at 100 °C for 1 h shall be $\geq 0,940 \text{ g/cm}^3$ in accordance with ISO 1183-1.

The melt flow rate at 190 °C per 21,6 kg load shall be $\leq 12 \text{ g}$ per 10 min in accordance with ISO 1133.

A.3.2 Medium molecular weight high density polyethylene (PE-HD-MMW)

The natural relative (non-pigmented) density at 23 °C after annealing at 100 °C for 1 h shall be $\geq 0,940 \text{ g/cm}^3$ in accordance with ISO 1183-1.

The melt flow rate at 190 °C per 2,16 kg load shall be $\leq 0,5 \text{ g}$ per 10 min and $\geq 0,1 \text{ g}$ per 10 min in accordance with ISO 1133.

Alternatively, the melt flow rate at 190 °C per 5 kg load shall be $\leq 3,0 \text{ g}$ per 10 min and $\geq 0,5 \text{ g}$ per 10 min in accordance with ISO 1133.

A.3.3 Cross-linked polyethylene (PE-X)

PE-X is polyethylene having a changed chemical structure in which the major proportion of polymer chains are chemically connected with each other to form a three-dimensional network.

A.3.4 Linear medium density polyethylene

The natural relative (non-pigmented) density at 23 °C after annealing at 100 °C for 1 h shall be $\geq 0,927 \text{ g/cm}^3$ and $\leq 0,937 \text{ g/cm}^3$ in accordance with ISO 1183-1.

The melt flow rate at 190 °C per 2,16 kg load shall be $\geq 5,0 \text{ g}$ per 10 min and $\leq 10,0 \text{ g}$ per 10 min in accordance with ISO 1133.

Annex B (normative)

Small scale laboratory tests to assess packaged substances against standard liquids

B.1 Introduction

The small scale laboratory tests listed as follows shall be used to assess whether a packaged substance can be assimilated to a standard liquid for specific grades of polyethylene (high molecular weight high density polyethylene and medium molecular weight high density polyethylene, additionally cross-linked polyethylene and linear medium density polyethylene).

For the cross-linked polyethylene and linear medium density polyethylene, the prior agreement of the competent authority shall be obtained.

Three tests cover specific interactions between the packaged substance and the plastics material. These are:

- Method A: absorption (one procedure);
- Method B: environmental stress cracking (three procedures);
- Method C: molecular degradation (three procedures).

NOTE Where alternative procedures are described, each procedure may be regarded as equivalent.

B.2 Requirements

B.2.1 Resistance to absorption (swelling)

For Method A (B.4.1), the percentage weight increase when tested with the packaged substance to be carried shall be equal or less than that figure obtained when tested with the applicable standard liquid.

B.2.2 Resistance to environmental stress cracking

For Procedure B1 (B.4.2.2), the results shall demonstrate that, with the packaged substance, there is a lesser or equal effect than with the standard liquid used as a control.

For Procedure B2 (B.4.2.3) and Procedure B3 (B.4.2.4), the results shall demonstrate that, with the packaged substance, there is a time interval to failure equal to or greater than with the standard liquid used as a control.

B.2.3 Resistance to molecular degradation

For Procedure C1 (B.4.3.3), the melt flow rate of the specimen of the material in contact with the packaged substance shall not exceed that of the same material in contact with 55 % nitric acid.

For Procedure C2 (B.4.3.4), the viscosity number of the sample of the material in contact with the packaged substance shall not be less than that of the same material in contact with 55 % nitric acid.

For Procedure C3 (B.4.3.5), the elongation at break of the sample in contact with the packaged substance shall not be less than that with the same material with 55 % nitric acid.

B.2.4 Test report

A test report shall be prepared. The report shall include a full description of the packaged substance under test and the plastics material.

B.3 Selection and preparation of test specimens

B.3.1 A representative complete IBC (at least 48 h old) shall be supplied to the testing laboratory. Test specimens shall be prepared from material cut from this IBC.

By agreement with the competent authority, the tests may also be carried out on test specimens prepared from compression moulded or extruded sheet produced from a specific polymer grade and specified thickness.

B.3.2 Each test specimen shall have a means of identification.

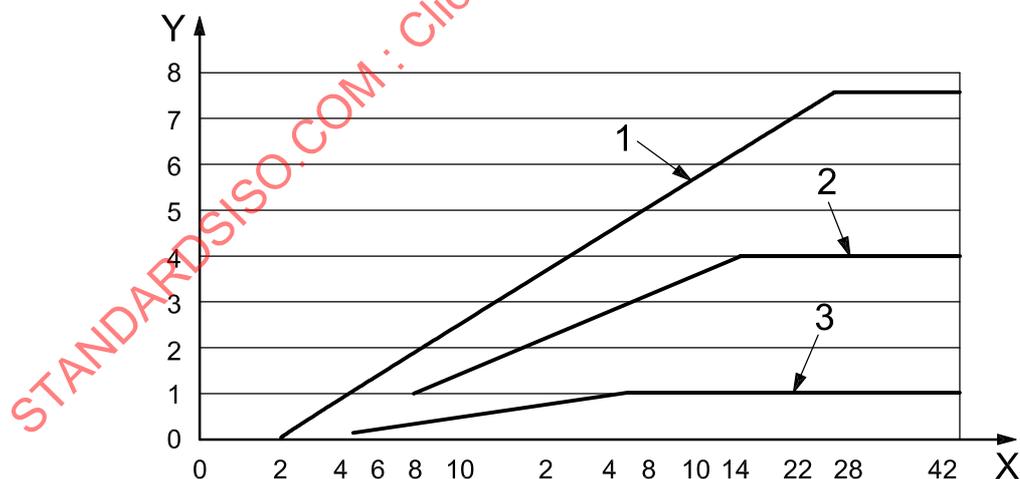
B.3.3 Each test specimen shall be examined for damage, etc., which could invalidate the tests, e.g. surface imperfection or contamination.

B.3.4 For cross-linked polyethylene, only test specimens taken from the IBCs shall be used.

B.4 Test procedures

B.4.1 Resistance to absorption (Method A)

B.4.1.1 This method details the determination of the resistance to absorption of the plastics packaging when in contact with a packaged substance (see Figure B.1).



Key

- X storage period, days
- Y increase in mass due to swelling, %
- 1 mixture of hydrocarbons (white spirit)
- 2 normal butyl acetate
- 3 acetic acid

Figure B.1 — Determination of the absorption (increase in mass) of the samples immersed in the product at 40 °C

B.4.1.2 Cut at least three test specimens of area not less than 450 mm² from the centre of the container sidewall or from a compression moulded or extruded sheet.

B.4.1.3 Record the initial mass of each of the test specimens (W_0).

B.4.1.4 Keep the test specimens fully immersed in the packaged substance in a suitable receptacle.

B.4.1.5 Immerse the test specimens until absorption is complete, i.e. constant mass is reached. For normal test conditions with specimen thickness 2,0 mm or less and test temperature 40 °C, this is typically achieved within a test period of 28 days.

B.4.1.6 At the end of the test period or at appropriate test intervals, remove the test pieces, remove all traces of surface liquid, and record the mass of each test piece (W_1).

B.4.1.7 Use test specimens only once.

B.4.1.8 Results: Record the mean of three results to two significant figures.

The % mass increase, ΔW , is:

$$\Delta W = 100 (W_1 - W_0) / W_0$$

where

W_0 is the initial mass;

W_1 is the mass at end of test period.

B.4.1.9 Criteria for assessment: The percentage mass increase, when tested with the packaged substance, shall be less than or equal to that obtained when tested with the appropriate standard liquid.

NOTE This can be expected to be:

- up to 1 % for water, wetting agent solution, acetic acid, or nitric acid;
- approximately 4 % for *n*-butyl acetate;
- approximately 7,5 % for mixture of hydrocarbons (white spirit).

B.4.2 Resistance to environmental stress cracking (Method B)

B.4.2.1 General

One of the following three alternative procedures shall be used to determine environmental stress cracking:

- a) pin impression test (see B.4.2.2);
- b) bent strip test (see B.4.2.3);
- c) full notch creep test (see B.4.2.4)

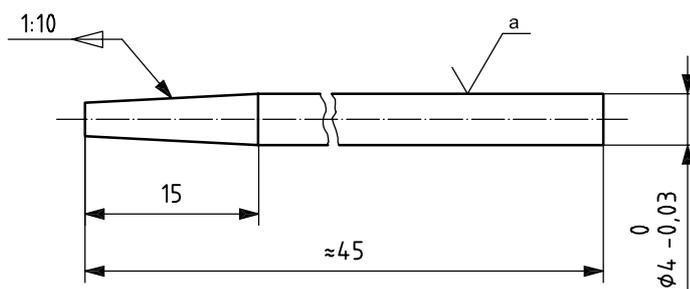
B.4.2.2 Pin impression test (Procedure B1)

B.4.2.2.1 Special equipment required for test

B.4.2.2.1.1 Polished pins, made from material resistant to the product under test, e.g. stainless steel, glass, as specified in Figure B.2.

B.4.2.2.1.2 Tool for notching specimen to the required dimensions, as shown in Figure B.3. The notch radius shall be $\leq 0,05$ mm.

Dimensions in millimetres



a Polished.

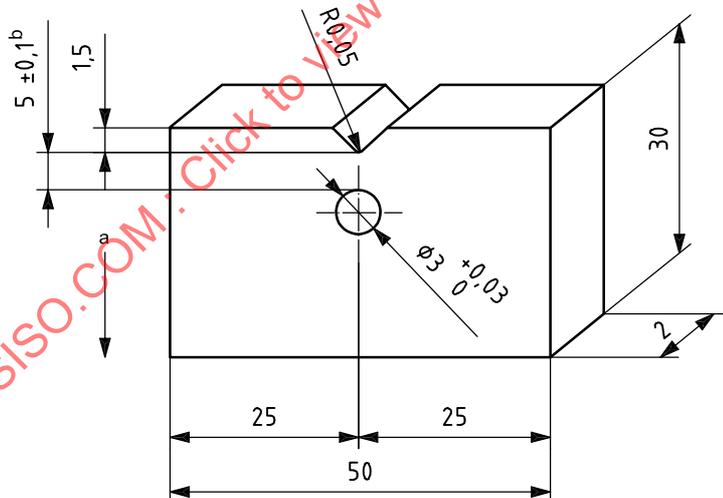
Figure B.2 — Polished pins for pin impression test

B.4.2.2.2 Preparation of test specimens

Cut at least 70 specimens from the packaging, or from a compression moulded or extruded sheet. Each test specimen shall be not less than 50 mm long, 30 mm wide and 2 mm or greater in thickness. The test specimen shall be notched and a hole drilled (3 mm in diameter) in accordance with Figure B.3.

The distance between the bottom of the notch and the edge of the hole shall be $(5 \pm 0,1)$ mm or $(4 \pm 0,1)$ mm, the latter being used to shorten the testing time with certain grades of polyethylene.

Dimensions in millimetres



a Direction of extrusion.

b The 5 mm dimension may be 4 mm where appropriate, in which case, the 1,5 mm dimension is increased to 2,5 mm.

Figure B.3 — Test specimen for pin impression test

B.4.2.2.3 Preconditioning procedure

Immerse test specimens in both the packaged substance and the standard liquid for a period of 21 days at either (40 ± 1) °C or a higher specified temperature controlled to ± 1 °C, the latter being used to shorten the test time with certain grades of polyethylene.

Where it has been shown that this pre-conditioning effect has no effect on test liquids and assimilated products, this step may be eliminated.

B.4.2.2.4 Stress cracking test

Immerse an equal number of specimens in both the packaged substance and the standard liquid; normally, this is wetting solution or acetic acid.

n-Butyl acetate may be used where it is intended to show the combined effect of stress cracking and absorption. This depends on the results of Method A (see B.4.1).

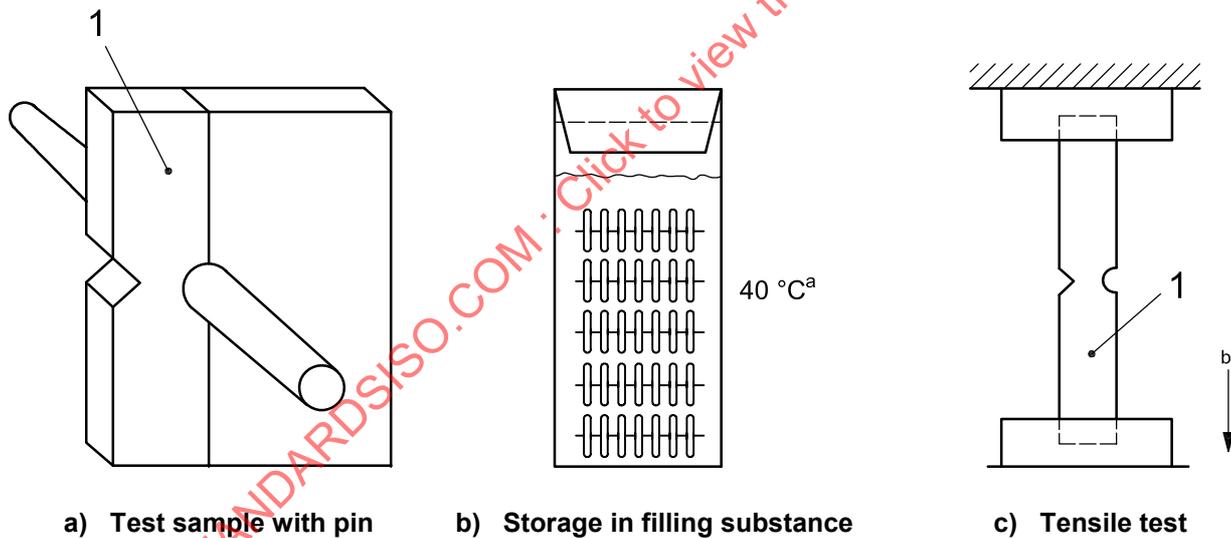
At the end of the storage period, remove the test pieces, and put aside 10 specimens. Insert the polished pin (B.4.2.2.1.1) into the 3 mm hole in each of the remaining specimens. The pin shall penetrate the test piece until the parallel section of the pin is inserted into the hole.

Return these pinned pieces to the liquids and immerse as in B.4.2.2.3, except for *n*-butyl acetate where the stress cracking test is performed in a mixture of 1 % to 10 % aqueous wetting agent solution mixed with 2 % *n*-butyl acetate (see B.2.2).

At appropriate intervals, remove 10 pieces and allow them to cool to room temperature. Remove the pins carefully. Cut each across the 3 mm hole parallel to the notched edge (see Figure B.4). Carry out a tensile test on the notched part of each of the test pieces no longer than 8 h after removal from the test liquid.

Determine the tensile strength in accordance with ISO 527-2 at (23 ± 2) °C with a testing speed of 20 mm/min.

Calculate the mean tensile strength of each set of test pieces. Graphically plot the residual tensile strength as a percentage of the tensile strength of the original 10 test pieces which were put aside after pre-storage.



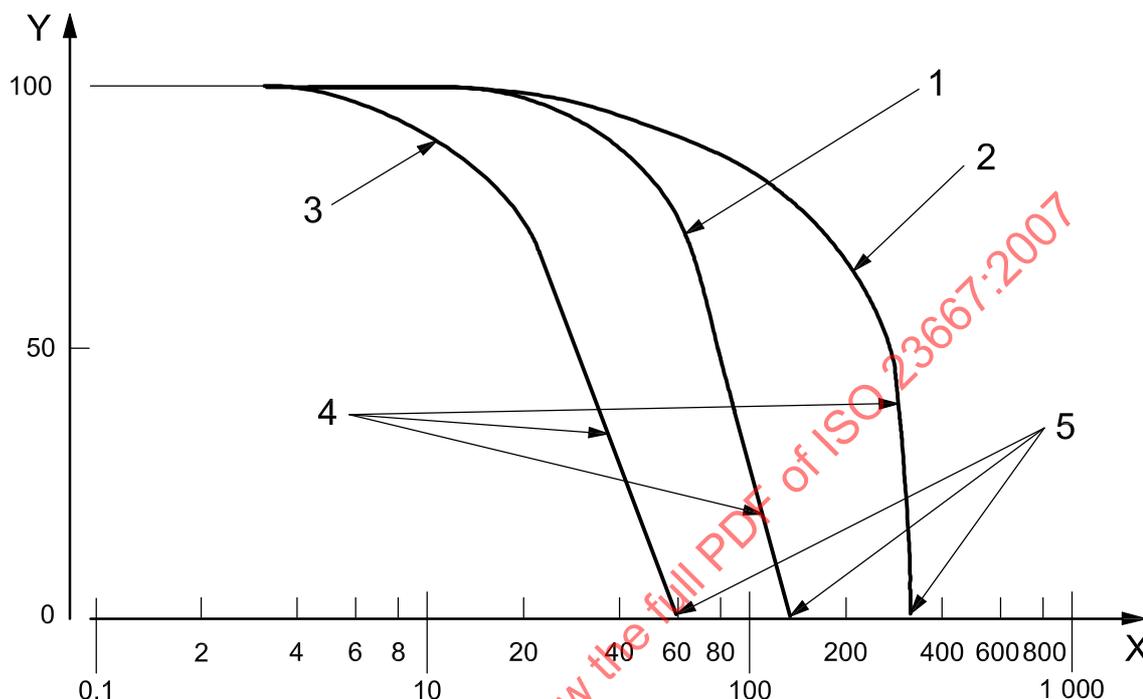
Key

- 1 test sample section A
- a 40 °C or 50 °C where appropriate.
- b Testing speed, $v = 20$ mm/min.

Figure B.4 — Pin impression test: specimen preparation, storage and testing

B.4.2.2.5 Criteria for assessment

Compare the curves to determine whether the packaged substance has a stronger or weaker effect than the standard liquid, as shown, e.g. in Figure B.5.



Key

- X storage period, days
- Y residual tensile strength, σ_{max} , %
- 1 standard liquid
- 2 filling substance 2 (less aggressive than standard liquid)
- 3 filling substance 1 (more aggressive than standard liquid)
- 4 residual tensile strength curves
- 5 time standing until test sample is cracked through

Figure B.5 — Pin impression test

An alternative visual method of assessment of specimen failure times may be used.

15 samples as in B.4.2.2.2 are preconditioned as per B.4.2.2.3 and subjected to the stress cracking method as in B.4.2.2.4. By visual checks, the time for cracking is determined for each pinned test sample (the crack usually propagates from the tip of the notch to the pin). The criterion for assessment is based on the time for 8 of the 15 specimens in the standard liquid to have failed (T). For the packaged substance, this time shall not be less than T .

This alternative method may be used with the approval of the competent authority.

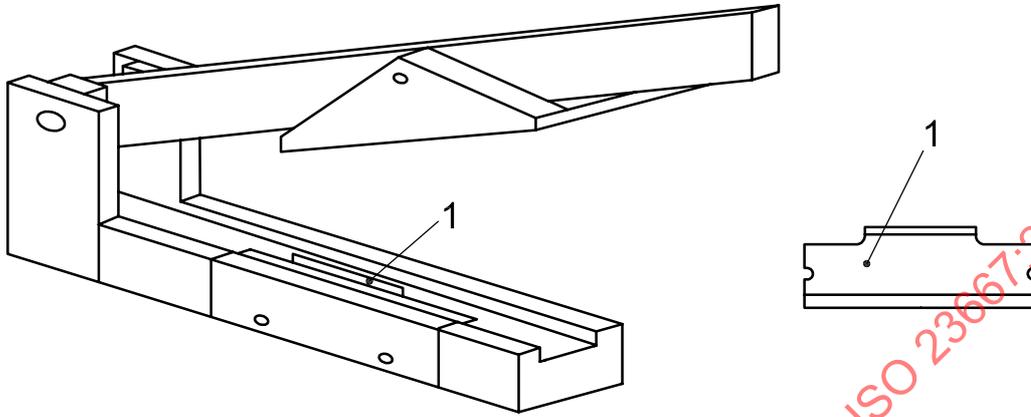
B.4.2.3 Bent strip test — “Bell telephone test” (Procedure B2)

B.4.2.3.1 Principle

This procedure uses specimens with a controlled imperfection (notch) in accordance with ASTM D 1693-00.

B.4.2.3.2 Special equipment

Slot notching tool, transfer tool, bending tool, see Figures B.6, B.7 and B.8.



Key
1 blade

Figure B.6 — Slot notching tool

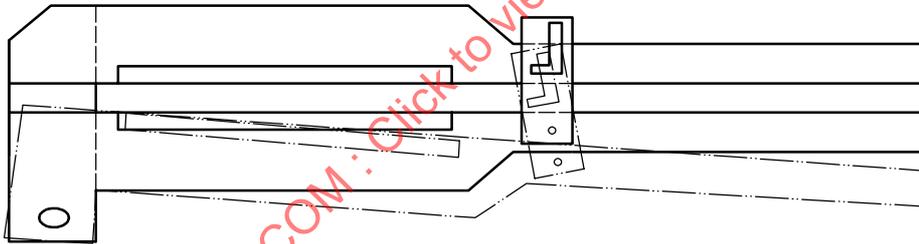
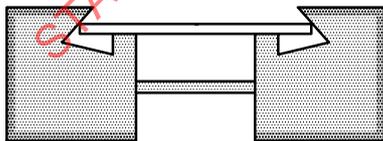
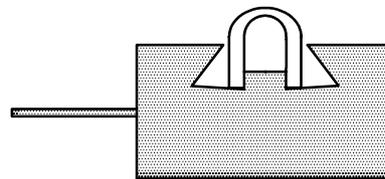


Figure B.7 — Transfer tool



a) Clamp open with flat specimen



b) Clamp closed with bent specimen

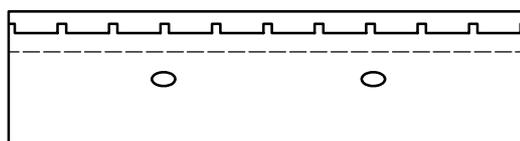


Figure B.8 — Specimen bending tool

B.4.2.3.3 Preparation of test specimens

Cut a suitable number of test specimens from the packaging side wall, or from a compression moulded or extruded sheet. Test specimens cut from the container shall be subsequently compression moulded, using a specified moulding temperature and cooling rate in accordance with ISO 1872-2 Method B.

The finished thickness shall be $(1,875 \pm 0,125)$ mm.

Cut out 10 test specimens of dimensions $(38,0 \pm 2,5)$ mm \times $(13,0 \pm 0,8)$ mm from the moulded sheet with a sharp cutting die. Do not cut test specimens from within 10 mm of the edge of the moulded sheet. Check that all the test pieces are within the specified thickness tolerances.

Using a sharp blade and jig, notch each test specimen centrally over a length of $(19,05 \pm 0,15)$ mm and a depth of $(0,35 \pm 0,05)$ mm.

B.4.2.3.4 Pre-conditioning procedure

Immerse the test specimens in the product under evaluation for 21 days at 40 °C or a higher specified temperature controlled to $\pm 1,0$ °C.

Where it has been shown that this pre-conditioning has no effect on test liquids and assimilated products, this step may be eliminated.

B.4.2.3.5 Stress cracking test

Place the test specimens, notch side upwards in a bending clamp and, using a vice, close the clamp over a period of approximately 30 s.

Using a transfer tool, carefully remove the test specimens from the clamp and place them in the specimen holder, a channel of length 165 mm, depth 10 mm, and internal width $(11,75 \pm 0,05)$ mm. Gently press down the test specimens to ensure that they are all firmly against the base of the channel, see Figure B.9.

Place the channel in a suitable receptacle and cover it with the product under evaluation. Store at a temperature of 40 °C or a higher specified temperature controlled to ± 1 °C.

Inspect each test piece at suitable test intervals (normally daily) and record as a failure any test piece that shows a visible defect, usually a crack running at right angles to the notch.

The test shall be terminated when all specimens have failed or after 1 000 h.

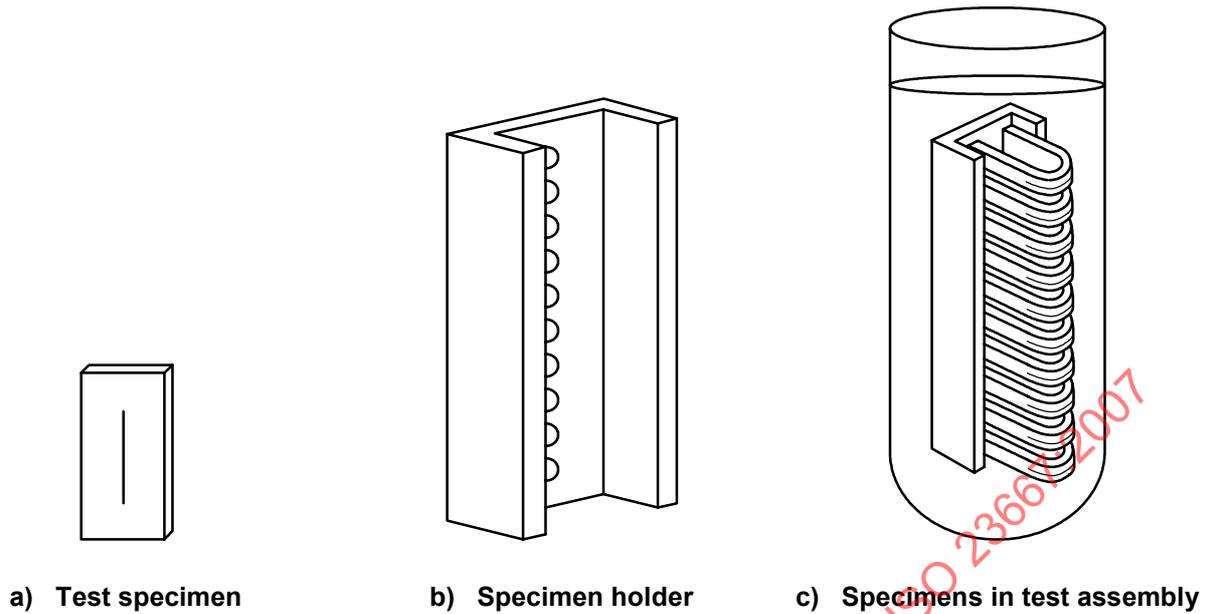


Figure B.9 — Bent strip test: Test specimen, holder and assembly

B.4.2.3.6 Criteria of acceptance

The time for 50 % of specimens to fail (f_{50} value) in the packaged substance shall be $\geq f_{50}$ in the standard liquid.

B.4.2.4 Full notch creep test (FNCT) (Procedure B3)

B.4.2.4.1 Principle

A test specimen in the form of square section bar with coplanar notches in each face at the centre is subjected to a static tensile load in a temperature controlled environment in accordance with ISO 16770. The geometry of the test specimen is such that plane conditions are obtained and brittle failure occurs under appropriate load and temperature conditions. The time for this brittle failure to occur after loading is recorded.

B.4.2.4.2 Terms and definitions

B.4.2.4.2.1

failure

generally, complete separation of the two halves of the test specimen

B.4.2.4.2.2

brittle failure

failure where the fracture surface exhibits no permanent material deformation to the naked eye, e.g. stretching, elongation or necking down

See Figure B.10 a).

NOTE In tougher materials, an extended ligament may form in the centre, see Figure B.10 b).

B.4.2.4.2.3

ductile failure

failure where the fracture surface clearly exhibits permanent material deformation with stretching, elongation and necking down

See Figure B.10 c).

B.4.2.4.2.4**ligament area**

remaining cross-sectional area after notching

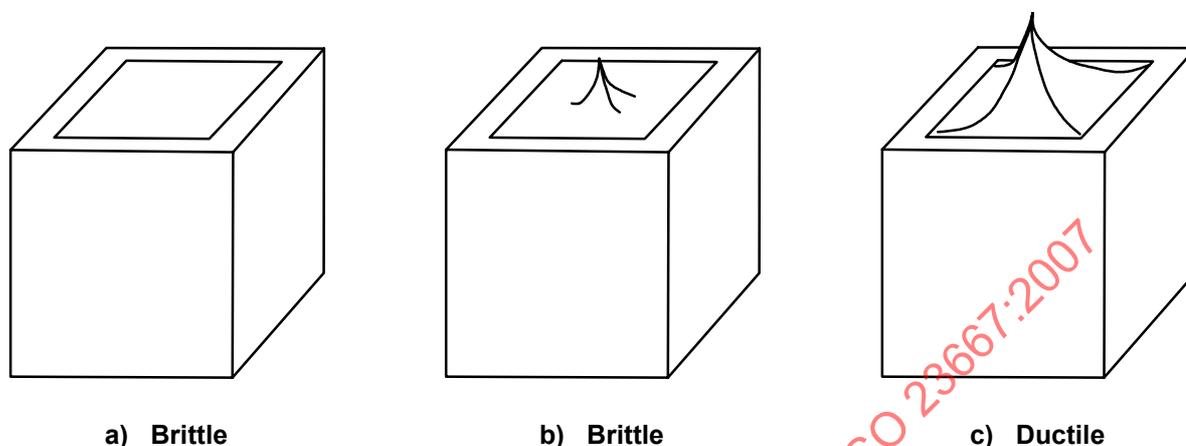


Figure B.10 — Fracture surfaces

B.4.2.4.3 Apparatus**B.4.2.4.3.1 Loading device**

A suitable device for applying the load is a lever arm loading machine with an arm ratio between 4:1 and 10:1. A typical example of such a device is shown in Figure B.11. The lever arm ratio R is equal to l_1 / l_2 . When the lever arm is fitted with the top specimen grip and the weight carrier, it shall be horizontal, i.e. balanced.

The specimen grips shall be designed to prevent slippage of the test specimen and ensure that the load is transmitted axially through the test piece, e.g. via a low friction universal coupling to prevent bending of the test specimen during the test. A typical test specimen grip assembly is shown in Figure B.12.

In addition to the above example, the tensile load may be applied directly using dead weights or any other means for producing a constant load.

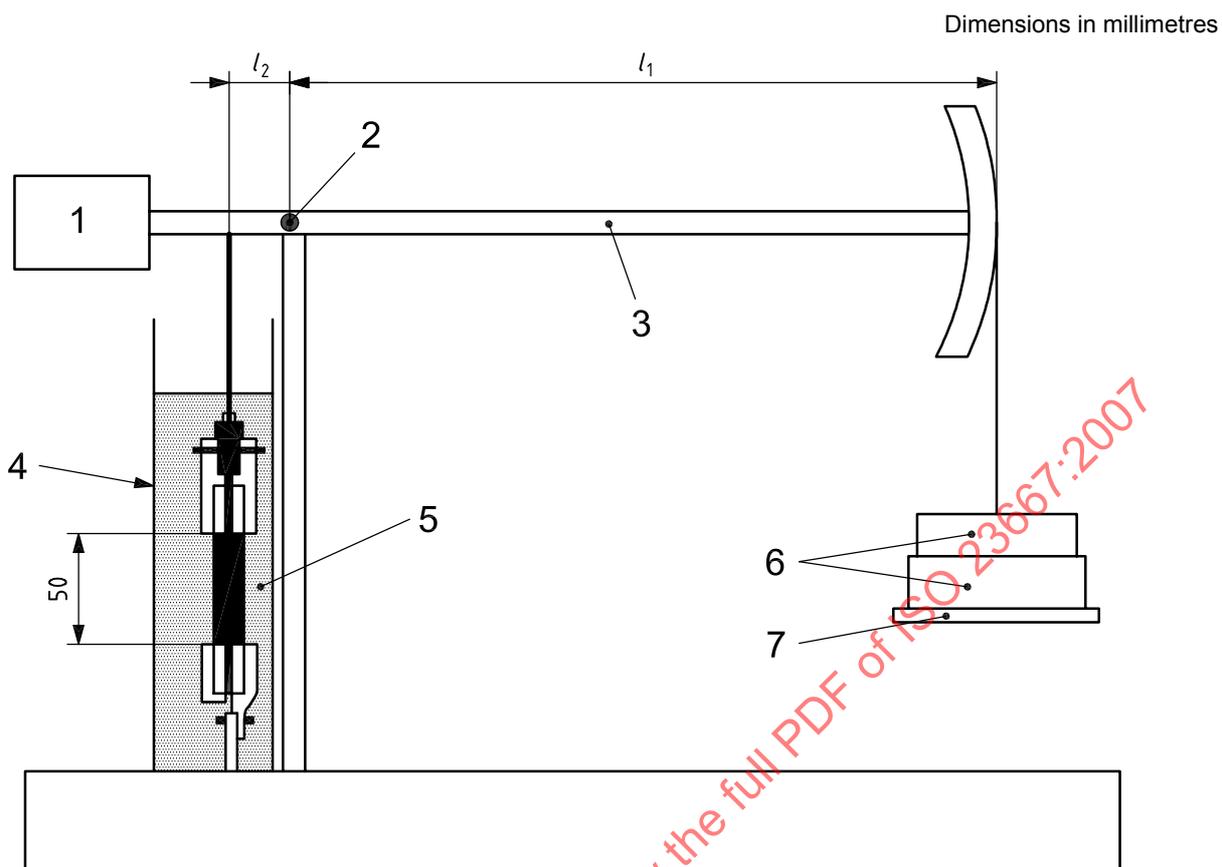
The loading device should be capable of applying the load to an accuracy of $\pm 1,0\%$.

NOTE 1 The balanced loading apparatus as described in ISO 6252 has also been used satisfactorily.

The functioning and calibration of the equipment shall be checked on a regular basis because the applied load is a critical parameter. The calibration of a lever arm machine can be checked by hanging a series of known weights on the specimen side of the lever arm and counterbalancing these in turn with weights on the weight hanger. The ratio of the former to the latter provides a direct measure of the arm ratio and hence a check on the operation of the machine.

In the case of multiple specimen testing, care shall be taken to avoid undue disturbance of the remaining test specimens, when one or more of the other test specimens fail.

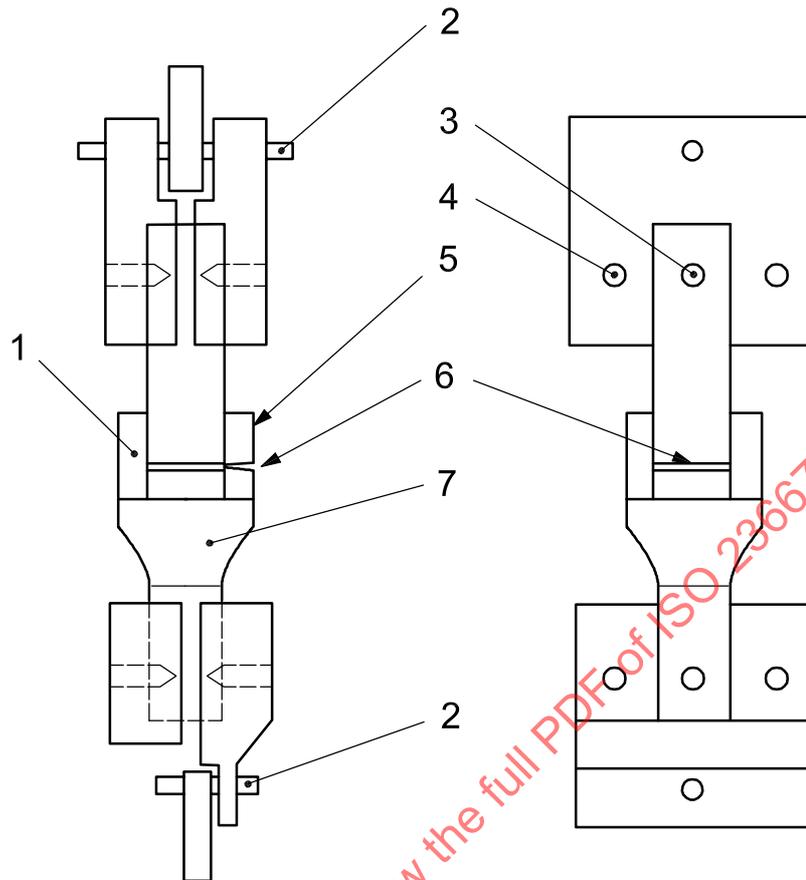
NOTE 2 Measurement of the extension of the test piece or movement of the lever arm provides useful information. The rate of extension of the test specimen will increase when the initiation of the crack from the notch has occurred and will increase rapidly when failure is imminent.



Key

- 1 counterweight
- 2 low friction roller or knife edge
- 3 balance lever arm
- 4 example of environmental chamber
- 5 environment
- 6 weights
- 7 weight hanger

Figure B.11 — Loading device

**Key**

- 1 small environmental chamber
- 2 coupling pin
- 3 grub screws to prevent slipping
- 4 clamp bolts
- 5 glass tube
- 6 notch
- 7 heat shrink tube

Figure B.12 — Specimen grip assembly

B.4.2.4.3.2 Thermostatically controlled environment

A suitable chamber shall be designed to contain the environment and ensure full immersion of the test specimen(s). The chamber shall be constructed of material(s) which shall not effect the environment or vice versa. The temperature of the environment shall be controlled to maintain the test specimens within $\pm 1,0$ °C of the specified test temperature. Where the environment is aggressive, the chamber can be very small as shown in Figure B.12 with the test specimen grip assembly.

NOTE When the environment is likely to separate, constant agitation is required.

B.4.2.4.3.3 Temperature measuring device

A calibrated thermometer, thermocouple or thermistor with an accuracy of $\pm 1,0$ °C is suitable.

B.4.2.4.3.4 Timing device

This shall automatically stop or record the point when the test specimen fails by either fracture or excessive displacement of the grips. The accuracy of the timing equipment shall be ± 1 min.

B.4.2.4.3.5 Notching apparatus

The machine shall be designed so that the notches are coplanar and the plane of notching is perpendicular to the tensile axis of the test specimen. The machine shall have a device to ensure that the notches are placed in the centre of the test specimen. Razor blades shall be used provided their notch tip radius is less than 10 μm . A cutting machine with a tool, like a broaching device, is also acceptable as an alternative, provided the notch tip radius is also less than 10 μm .

NOTE A device, appropriately dimensioned, as illustrated in ISO 11542-2:1998, Figure B.1 would be satisfactory.

B.4.2.4.3.6 Microscope

A microscope is required to allow accurate measurement of the actual ligament dimensions (distance between the tips of the notches) after failure. It shall be read to an accuracy of ± 100 μm .

B.4.2.4.4 Preparation of test specimens

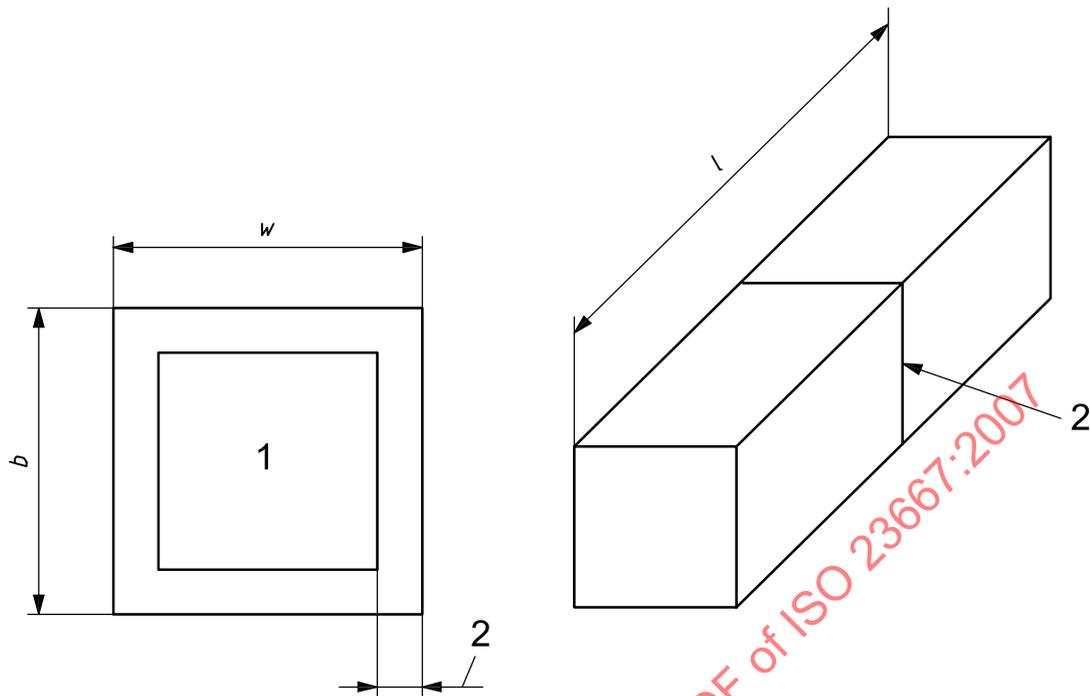
B.4.2.4.4.1 Test specimen geometry

Typical test specimen geometries are given in Table B.1. If other specimens are used, these should be made such that the ligament area is approximately 50 % of the total cross-sectional area of the specimen (see Figure B.13). This is to make sure that specimen failure will occur under the specified conditions.

Table B.1 — Test specimen geometry

Test specimen	Specimen dimensions mm length \times width \times breadth	Notch depth mm	Stress MPa	Temperature $^{\circ}\text{C}$
A	100 \times 10 \times 10	1,60	4,00 or 6,00	80
B ^a	90 \times 6 \times 6	1,00	9,00	50
C	90 \times 6 \times 6	1,00	12,00	23

^a Test specimen B, 90 mm \times 6,0 mm \times 6,0 mm, with a 1,0 mm notch depth is recommended.

**Key**

- w* width
- l* length
- b* breadth
- 1 ligament area
- 2 notch

Figure B.13 — Test specimen showing notch and ligament area

B.4.2.4.4.2 Test specimen preparation

Prepare test specimens for material testing from compression moulded sheet. ISO 1872-2 (Method B) or ISO 11542-2:1998 (Table 1) shall be used as appropriate. (These International Standards specify moulding and cooling conditions.) Machine the test specimens to size from the moulded sheet in accordance with ISO 2818. Trim the specimen edges of any remaining swarf left after machining. Test specimens cut from extruded or moulded finished goods shall be machined according to ISO 2818.

B.4.2.4.4.3 Test specimen notching

Notch specimens at room temperature. Take due care to avoid blunting the notch during manufacture, e.g. use of excessive speed/force, as this will invalidate the results. If a razor blade is used, it shall be used for notching no more than one hundred notches. Whichever device is used for notching, the tolerance on the required notch depth is $\pm 0,1$ mm. Notch integrity shall be inspected microscopically.

B.4.2.4.4.4 Conditioning of test specimens

Store notched specimens at (23 ± 2) °C according to ISO 291. When they are required for use at other temperatures, they shall be conditioned in the environment at the test temperature for 1,0 h after clamping in the loading apparatus, prior to loading.

NOTE If other than the recommended test specimens (90 × 6,0 × 6,0) mm specimens are used, for thicker section specimens a longer conditioning period may be required.

B.4.2.4.5 Test procedure

B.4.2.4.5.1 Choice of stress and temperature

Select a stress and temperature from Table B.1 which will cause brittle failure of the test specimens. It is advisable to test a number of specimens, say 4, with nominal stresses above and below the selected value; this is to compensate for variability in ligament area introduced during the notching operation. For example, at a selected stress of 9 MPa, a series of nominal stress values such as 8,25, 8,75, 9,25 and 9,75 MPa could be used.

A stress of 9,0 MPa at 50 °C using Specimen B (90 × 6,0 × 6,0) mm with 1,0 mm notch depth, is recommended.

B.4.2.4.5.2 Calculation of test load

The test load is calculated from the formula:

$$M = \frac{A_n \sigma}{9,81 R} \tag{B.1}$$

where

M is the applied mass, in kilograms (kg);

A_n is the nominal ligament area, in square millimetres (mm²);

σ is the required tensile stress, in megapascals (MPa);

R is the lever arm ratio (Figure B.11), which equals one for a dead weight system.

B.4.2.4.5.3 Application of load to test specimen

Place the notched test specimen in the grips of the lever loading machine (Figures B.11 and B.12), taking care to avoid bending and twisting the specimen. Position the test specimen with half its length free between the grips with the notch plane located in the centre. The whole specimen located in the grips shall be immersed in the environment and conditioned to the temperature specified in Table B.1. After conditioning, gradually apply the calculated load to the lever arm avoiding shock loading of the test specimen. At the same time, activate the clock or timing device.

NOTE 1 It has been found convenient to lower the weight carrier using a suitable jack or other means.

NOTE 2 Lower temperatures will increase the time to failure of the test specimen. Higher temperatures will decrease the time to failure, but if too high a temperature is used, changes in crystallinity and possible oxidative ageing may occur. The same will apply when different environments are used.

B.4.2.4.5.4 Calculation of results

The fracture surface of each test specimen is examined to ensure that it is of the brittle type (see Figure B.10). The dimensions of the ligament are measured using a travelling microscope and the ligament area is calculated.

The applied stress, *σ_L*, is given by the following formula:

$$\sigma_L = \frac{9,81RM}{A_L} \tag{B.2}$$

where

σ_L is the corrected tensile stress, in megapascals (MPa);

A_L is the measured ligament area, in square millimetres (mm²);

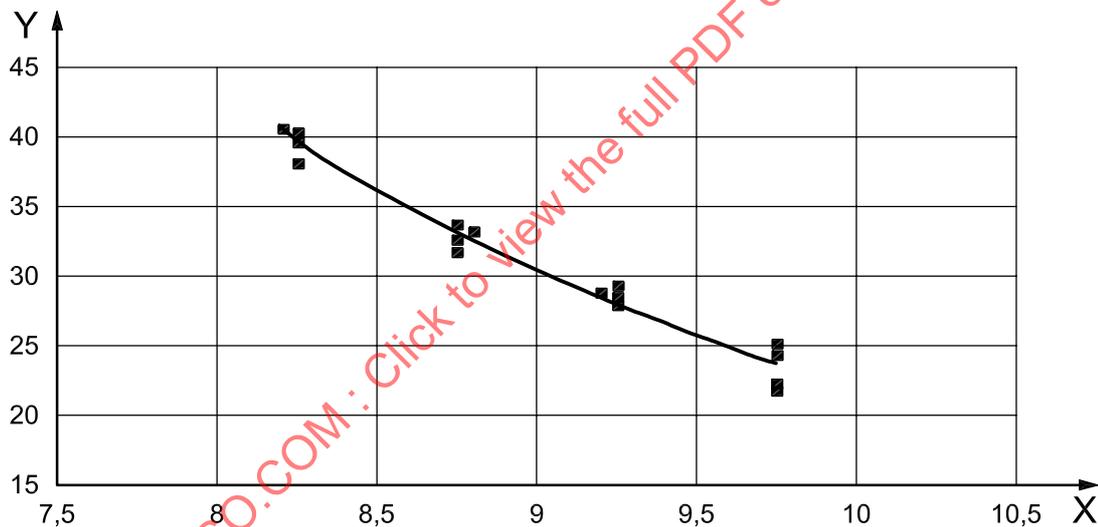
M is the applied mass, in kilograms (kg);

R is the lever arm ratio (Figure B.11) which equals one for a dead weight system.

The time to failure is plotted against the actual applied stress and the failure time at the reference stress interpolated from the graph.

B.4.2.4.6 Precision and reproducibility

At the present time, there is no international agreement on precision and reproducibility. The precision of this test method is not known and an indication of repeatability is given in Figure B.14. A full precision statement will be given in the next revision of ISO 16770. For a reference stress of 9 MPa, the failure time is given as 30,5 h with 95 % confidence limits of $\pm 0,5$ h. The standard deviation from the regression line is 1 h.



Key

X applied stress, MPa

Y time, h

Figure B.14 — Indication of repeatability

The major sources of error are:

- the load is applied too quickly, blunting of the notch may occur rendering the results invalid;
- the notch is too blunt after notching;
- the notches are not co-planar;
- the tolerances on environment temperature are not met;
- the environment has aged or has not been stirred.

B.4.2.4.7 Criteria of acceptance

The time to failure in the packaged substance shall be greater than the time to failure in the standard liquid.

B.4.2.4.8 Test report

The test report shall include the following information:

- a) reference to this International Standard;
- b) all details necessary for complete identification of the test material, e.g. manufacturer, production data, etc.;
- c) all details necessary for the identification of the test specimen, e.g. cut from compression moulded sheet, or from a container;
- d) the actual stress, based on the ligament area, used on the test specimen;
- e) time to failure in comparison to the standard liquid or duration of test if failure has not occurred;
- f) specimen dimensions as given in Table B.1;
- g) environment temperature and concentration;
- h) full details of the environment used;
- i) any variations introduced not in the standard, e.g. notching procedure;
- j) date and time for start and end of the test;
- k) method of notching, i.e. razor blade or broach.

B.4.3 Resistance to molecular degradation (Method C)

B.4.3.1 General

One of the three alternative procedures shall be used for determining the resistance to molecular degradation:

- Procedure C1: measuring melt mass-flow rate (MFR);
- Procedure C2: measuring viscosity number;
- Procedure C3: measuring elongation to break.

B.4.3.2 Applicability of method

- a) If the packaged substance causes absorption $< 1\%$, in accordance with the procedure in B.4.1, the specimen shall be dried (e.g. in a vacuum storage oven at $50\text{ }^{\circ}\text{C}$) until the mass remains constant to a level $< 1\%$ before measuring the MFR.
- b) If the packaged substance causes higher absorption ratios after drying, this implies that Procedure C1 is not applicable, and in this case, Procedure C2 or Procedure C3 shall be used.
- c) If the packaged substance (e.g. organic peroxide) penetrates into the PE specimen and leads to cross-linking at elevated temperatures (MFR measurement conditions), Procedure C3 shall be used. Procedure C1 and C2 are not applicable.
- d) For cross-linked PE (PE-X), Procedure C3 shall be used. Procedures C1 and C2 are not applicable.

B.4.3.3 Melt mass-flow rate (Procedure C1)

B.4.3.3.1 Cut a suitable number of test specimens of an area not less than 450 mm² from the packaging sidewall or from a compression moulded or extruded sheet. Identical specimen dimensions shall be used for the samples to be immersed in both the packaged substance under evaluation and the standard liquid 55 % nitric acid.

B.4.3.3.2 Determine the initial MFR of a minimum of three test specimens in accordance with ISO 1133.

B.4.3.3.3 For each evaluation, place a minimum of three test specimens per test interval as specified in B.4.3.3.4 in a suitable receptacle and immerse them in the product under evaluation. Store the receptacle at 40 °C or a higher specified temperature controlled to $\pm 1,0$ °C.

B.4.3.3.4 After 21 days, and subsequently at 7-day intervals for a total storage period of up to 42 days, remove a set of at least three pieces. Carefully wash and dry the specimens, and condition them in a vacuum oven under conditions sufficient to remove residual product, until the mass of the specimen remains constant to a level < 1 %.

B.4.3.3.5 Measure the MFR of each set of test specimens in accordance with ISO 1133.

B.4.3.4 Viscosity number (VN) (Procedure C2)

B.4.3.4.1 Cut a suitable number of test specimens of an area not less than 450 mm² from the centre of a container side wall or from a compression moulded or extruded sheet. Identical specimen dimensions shall be used for the samples to be immersed in both the packaged substance under evaluation and the standard liquid 55 % nitric acid.

B.4.3.4.2 Determine the initial VN of a minimum of three test specimens in accordance with ISO 1628-3.

B.4.3.4.3 For each evaluation, place a minimum of three test specimens per test interval in a suitable receptacle and immerse them in the product under evaluation. Store the receptacle at 40 °C or a higher specified temperature controlled to $\pm 1,0$ °C.

B.4.3.4.4 After 21 days, and subsequently at 7-day intervals for a total storage period of up to 42 days, remove a set of at least three specimens. Carefully wash and dry them and condition them in a vacuum oven under conditions sufficient to remove any residual products.

B.4.3.4.5 Measure the VN of each set of test specimens in accordance with ISO 1628-3.

B.4.3.5 Elongation to break (Procedure C3)

B.4.3.5.1 Cut a suitable number of test specimens to ISO 527-2 Type 5 or 1B, in accordance with ISO 11403-3 from the centre of a packaging side wall in the extrusion direction. Identical specimen dimensions shall be used for the samples to be immersed in both the packaged substance under evaluation and the standard liquid 55 % nitric acid.

B.4.3.5.2 In accordance with ISO 527-2, use a tensile testing machine to determine the initial percentage elongation to break of 5 specimens at an elongation rate of $v = 100$ mm/min.

B.4.3.5.3 For each evaluation, place a minimum of 5 test specimens per test interval in a suitable receptacle and immerse them in the product under evaluation. Store the receptacle at 40 °C or a higher specified temperature controlled to $\pm 1,0$ C.

B.4.3.5.4 After 21 days, and subsequently at 7-day intervals for a total storage period of up to 42 days, remove a set of at least 5 specimens. Carefully wash and dry them and allow them to reach equilibrium at (23 ± 1) °C prior to testing.

NOTE Other periods of testing may be applied where prior experience has shown them to be suitable, provided they are stated in the test report.

B.4.3.5.5 Measure the percentage elongation to break of each set of test specimens in accordance with ISO 527-2.

B.4.3.6 Criteria of assessment

The packaged substance shall be assimilated to the standard liquid 55 % nitric acid if it causes equal or less damage, i.e. the specimens show in any of the following tests:

- Procedure C1: equal or lower increase in melt flow rate (MFR);
- Procedure C2: equal or lower decrease in viscosity number (VN);
- Procedure C3: equal or less reduction in elongation to break.

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Annex C (informative)

Assimilation of packaged substance to standard liquids

C.1 Introduction

The chemical compatibility of the plastics material with dangerous liquids may be verified with standard liquids (see Annex A and 6.1.5.2.6 RID/ADR ^{[5], [2]}), which are representative of the damaging effect of various substances on plastics packagings manufactured from high or medium molecular mass polyethylene. The filling substances assimilated to the standard liquids are listed in 6.1.6.2 of RID/ADR. They may be accepted for carriage without further testing, provided the particular packaging design types have been successfully tested with the relevant standard liquid(s) (see Annex A) and provided that the density and vapour pressure of the filling substance is covered by the test level of the particular standard liquids.

The substance list in 6.1.6.2 of RID/ADR represents the best knowledge existing around 1980. The new RID/ADR structure has revealed some omissions and on the basis of input from experts representing plastics manufacturers, plastics converters and plastics packagings users a new assimilation list has been prepared based on

- the existing list of substances in 6.1.6.2 of RID/ADR;
- new substances where proof of the chemical compatibility is available.

NOTE The list will be reviewed and updated periodically on the basis of new test results.

In preparing this new list, the following principles have been applied.

- a) Substances included in the new assimilation list are based on test results that prove the substance is assimilated to the appropriate standard liquid and its effect on plastics material is no worse than the standard liquids (see Annexes A and B).
- b) Substances not meeting this condition are not included in the assimilation list.
- c) Some specific substances of the existing list of RID/ADR have been omitted from the new assimilation list.

EXAMPLE 1 According to the existing list UN 1147 Decahydronaphthalene is assimilated to White Spirit (mixture of hydrocarbons). Actually, it causes greater absorption.

- d) Furthermore, the assimilation to standard liquids has changed for some specific substances.

EXAMPLE 2 UN 2914 hydrogen peroxide is assimilated to water, yet it causes molecular degradation and should be assimilated to nitric acid.

- e) Collective entries as defined in the regulations for the transport of dangerous goods are included in the assimilation list, provided that:
 - 1) they describe well-defined chemical groups of substances, and there is confidence that test results of specific members of a chemical group of substances can be assigned to the whole group; or
 - 2) they can be subjected to the new "Rule for collective entries" (see C.3.6).

C.2 Explanation of the assimilation list

C.2.1 Structure

The list of assimilated substances in Table C.1 are shown in the same order as they appear in Table A of Chapter 3.2 of RID/ADR.

C.2.2 Explanatory notes for each column

Column 1	UN No.	Contains the UN number from Chapter 3.2 Table A of RID/ADR.
Column 2	Name	This contains the name as shown in Table A of RID/ADR in bold type. Other common isomers and synonyms are included.
Column 3	Description	Contains a descriptive text after the name to clarify the scope of the entry.
Column 4	Class	Contains the number of the class, assigned by RID/ADR.
Column 5	Classification code	Contains the classification code of the dangerous substance in accordance with the procedures and criteria of Part 2 of RID/ADR.
Column 6	Packing group	Contains the packing group number (I, II or III) assigned to the dangerous substance. Certain substances are not assigned to packing groups.
Column 7	Standard liquid	Contains either the standard liquid(s) (as defined in Annex A) to which the entry is assimilated or a reference to an assimilation procedure (see C.3.6).

C.3 Use of the assimilation list

C.3.1 General requirements

The chemical compatibility can be influenced by non-dangerous components, e.g. wetting agents in detergents and disinfectants. Therefore all components of a solution, mixture or preparation have to be included in the assimilation procedure. If not specifically provided in the assimilation list (see, e.g. UN 1791 Hypochlorite, aqueous solution), the chemical compatibility for additional components in solutions or mixtures is not covered except for those cases as indicated in C.3.5.

The proof of the chemical compatibility of design types of plastics packagings manufactured from HDPE not only depends on successfully performed design type tests with the relevant standard liquid(s) itself, but is also dependent on the applied test level in connection with the density and vapour pressure of the dangerous substance intended for carriage.

EXAMPLE UN 1736 Benzoyl chloride is assimilated to standard liquids "Mixture of hydrocarbons and wetting solution". Benzoyl chloride has a vapour pressure of 0,34 kPa at 50 °C and a density of approximately 1,2 kg/l. Design type tests were frequently performed at the minimum required test level. In practice, this means that the stacking test is performed with stacking loads considering a density of 1,0 for the mixture of hydrocarbons and a density of 1,2 for the wetting solution. As a consequence, the proof of the chemical compatibility of such tested design types would not be covered for benzoyl chloride by reason of the inadequate test level of the standard liquid "mixture of hydrocarbons" for the intended carriage of benzoyl chloride. (Due to the fact that the inner hydraulic test pressure in the most cases is 100 kPa at the minimum, the vapour pressure of the benzoyl chloride would be covered by such test level.)

C.3.2 Classification according to RID/ADR

In order to undertake a compatibility test, it is necessary to classify the substance in accordance with the provisions of RID/ADR. The procedures for classification can be found in Part 2 of RID/ADR. It should be noted that where one of the collective entries of RID/ADR is used (see RID/ADR 2.1.1.2) then it is required that the most specific entry for that substance is used (see RID/ADR 2.1.2.4).

C.3.3 Substances not listed in the assimilation list

When a dangerous substance has not been assimilated to a standard liquid in the list included in this annex, then chemical compatibility should be proven by other methods. Design type tests successfully performed with the dangerous substance in accordance with this standard and small scale laboratory tests against standard liquids (see Annex B) are two possible procedures proving the chemical compatibility.

C.3.4 Substances listed in the assimilation list

For the assimilation of listed substances and groups of substances mentioned by name (either assigned to single entries or collective entries as defined in RID/ADR 2.1), the following steps should be undertaken.

Look for the UN number determined according to C.3.2 in Column 1 of the assimilation list.

Select the correct row by means of the name, description and/or packing group given in Columns 2, 3 and 6. If there is more than one entry for the particular UN number in the assimilation list, select the row that most corresponds to the substance being assimilated, e.g. in terms of concentration, flashpoint, etc.

EXAMPLE 3-Methyl-1-heptene is not indicated as a specific isomer mentioned by name among the entries of UN Number 1216 in the assimilation list. In such case, the row with the name Isooctenes may be selected, if the properties of the isomer are in accordance with the criteria of class 3, classification code F1 and packing group II, even if the entry "isomeric mixture" is indicated in cell of the column "Description".

Chemical compatibility is proven when the packaging design type has been approved for the standard liquids(s) shown in Column 7.

Apply the rule for collective entries (as described in C.3.6), if this is indicated in Column 7 of the selected row the "Rule for collective entries" against this substance.

C.3.5 Aqueous solutions of substances

Aqueous solutions of substances and groups of substances assimilated to specific standard liquid(s) may also be assimilated to that/those standard liquids, provided the following conditions are met:

- a) the aqueous solution shall be assigned to the same UN number as the listed substance in accordance with the criteria of 2.1.3.3 of RID/ADR; and
- b) the aqueous solution is not specifically mentioned by name either in Table A of RID/ADR or otherwise in the assimilation list; and
- c) there is no chemical reaction between the dangerous substance and the solvent water.

EXAMPLE Aqueous solutions of UN 1120 *tert*-Butanol may be assimilated to the standard liquid acetic acid.

Reasons:

- Pure *tert*-Butanol itself is assimilated to the standard liquid acetic acid in the assimilation list.
- Aqueous solutions of *tert*-Butanol can be classified under the entry UN 1120 BUTANOLS in accordance with 2.1.3.3 of RID/ADR, because the aqueous solution of *tert*-Butanol does not differ from the entries of the pure substances relating to the class, the packing group(s) and the physical state. Furthermore, the entry 1120 BUTANOLS is not explicitly limited to the pure substances, and aqueous solutions of these substances are not specifically mentioned by name otherwise in Table A of Chapter 3.2 of RID/ADR.
- UN 1120 BUTANOLS do not react with water under the normal conditions of transport.

C.3.6 Rule for collective entries

The following steps should be made.

- a) Undertake the assimilation procedure for each specific component of the particular solution, mixture or preparation in accordance with C.3.2, C.3.3 and C.3.4, taking into account the general requirements of C.3.1. If there are components that are known to have no effect on HDPE, then these can be ignored (e.g. solid pigments in UN 1263 PAINT or PAINT RELATED MATERIAL).
- b) A solution, mixture or preparation cannot be assimilated to a standard liquid if:
 - 1) the UN number and packing group of one or more of the components does not appear in the list to this Annex; or
 - 2) the classification code of one or more of its dangerous components differs from the classification code for the solution, mixture or preparation itself; or
 - 3) the phrase "Rule for collective entries" for one or more of the components appears in Column 7 of Table C.1.

In any of these instances, chemical compatibility should be proven by other methods (see C.3.3).

If all the entries in Column 5 are allocated to the same classification code as the entry for the solution, mixture or preparation itself, and if all dangerous components are assimilated to the same standard liquid or the same combination of standard liquids given in Column 7, chemical compatibility may be regarded as proven, provided the particular packaging design type is approved for the standard liquid or combination of standard liquids.

If there is indicated in Column 5 of all selected rows for the dangerous components, the same classification code as the entry of the solution, mixture or preparation itself, and if the dangerous components are assimilated to different standard liquids given in Column 7, chemical compatibility may be regarded as proven, provided the assimilation of the individual components meets one of the following combinations of standard liquids and the particular packaging design type is approved for that indicated combination of standard liquids:

- a) water/nitric acid 55 % (except when an inorganic acid of classification code C1 has been assimilated to water);
- b) water/wetting solution;
- c) water/acetic acid;
- d) water/mixture of hydrocarbons;
- e) water/*n*-butyl acetate — *n*-butyl acetate-saturated wetting solution.

In the scope of this rule, chemical compatibility of solutions, mixtures and preparations is not proven, if there results another combination of standard liquids from the assimilation process. The chemical compatibility has to be proved by other means.

EXAMPLE 1 Mixture of UN 1940 thioglycolic acid (50 %) and UN 2531 methacrylic acid, stabilized (50 %); classification: UN 3265 corrosive liquid, acidic, organic, n.o.s.¹⁾; this n.o.s. entry and both components show the same classification code: C3; step 2 is met. According to the assimilation list, UN 1940 thioglycolic acid is assimilated to standard liquid "acetic acid" and UN 2531 methacrylic acid, stabilized to "*n*-butyl acetate/*n*-butyl acetate-sat. wetting solution", one of the not acceptable combinations of standard liquids according to step 4. As a consequence this mixture has to be tested itself according to the small scale laboratory tests.

EXAMPLE 2 Mixture of UN 1793 isopropyl acid phosphate (50 %) and UN 1803 phenolsulfonic acid (50 %); classification: UN 3265 corrosive liquid, acidic, organic, n.o.s.; this n.o.s. entry and both components show the same classification code: C3; step 2 is met. According to the assimilation list, UN 1793 isopropyl acid phosphate is assimilated

1) n.o.s. = not otherwise specified.

to standard liquid "wetting solution" and 1803 phenolsulfonic acid is assimilated to standard liquid "water", one of the acceptable combinations of standard liquids according to step 4. As a consequence, this mixture can be assimilated to standard liquids "wetting solution and water", if all general requirements mentioned above are met.

C.3.7 Scheme for the assimilation of substances to standard liquids

For details on Figure C.1, see C.3.1 to C.3.6.

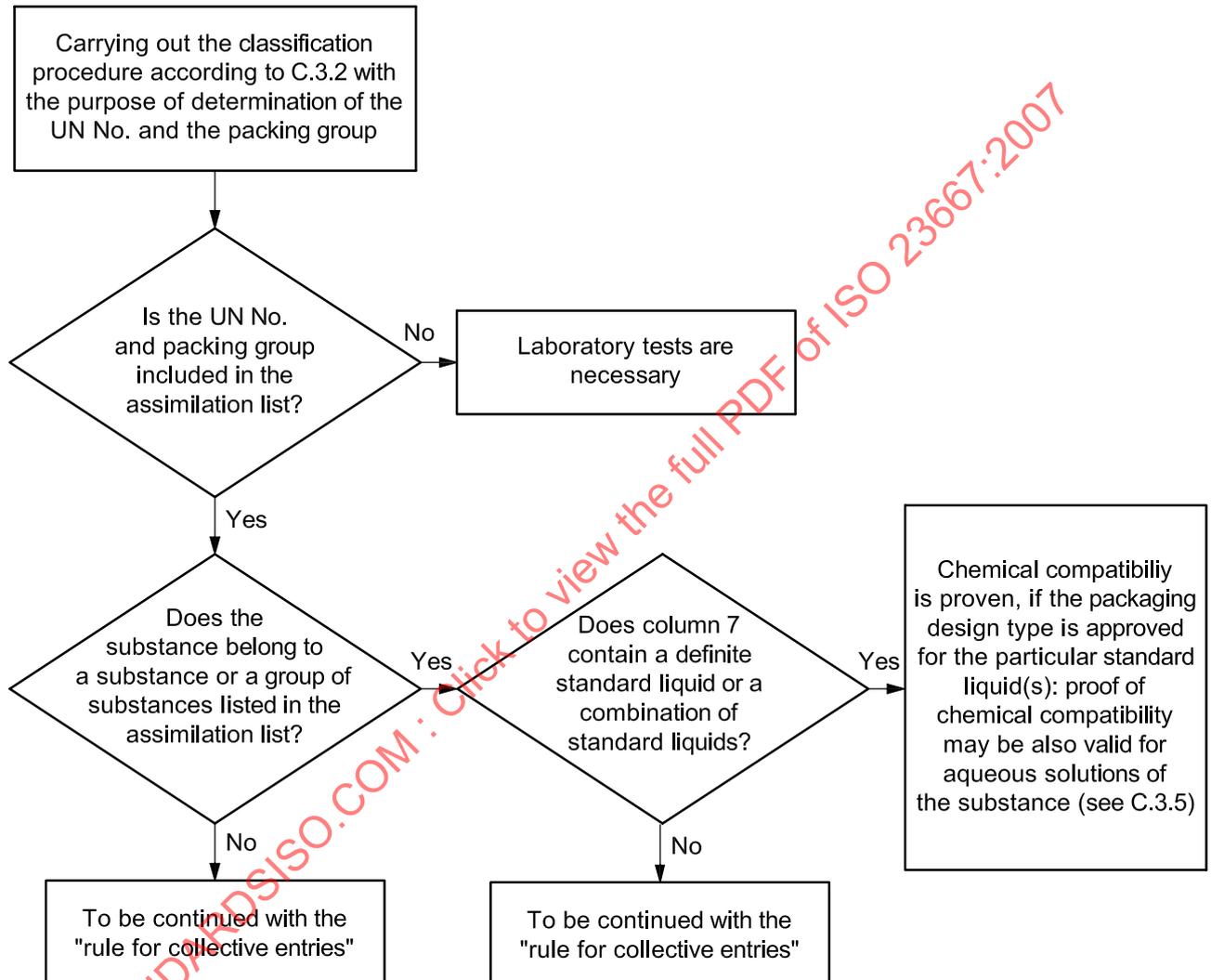


Figure C.1 — Scheme for the assimilation of substances to standard liquids

For more information on Figure C.2, see C.3.6.

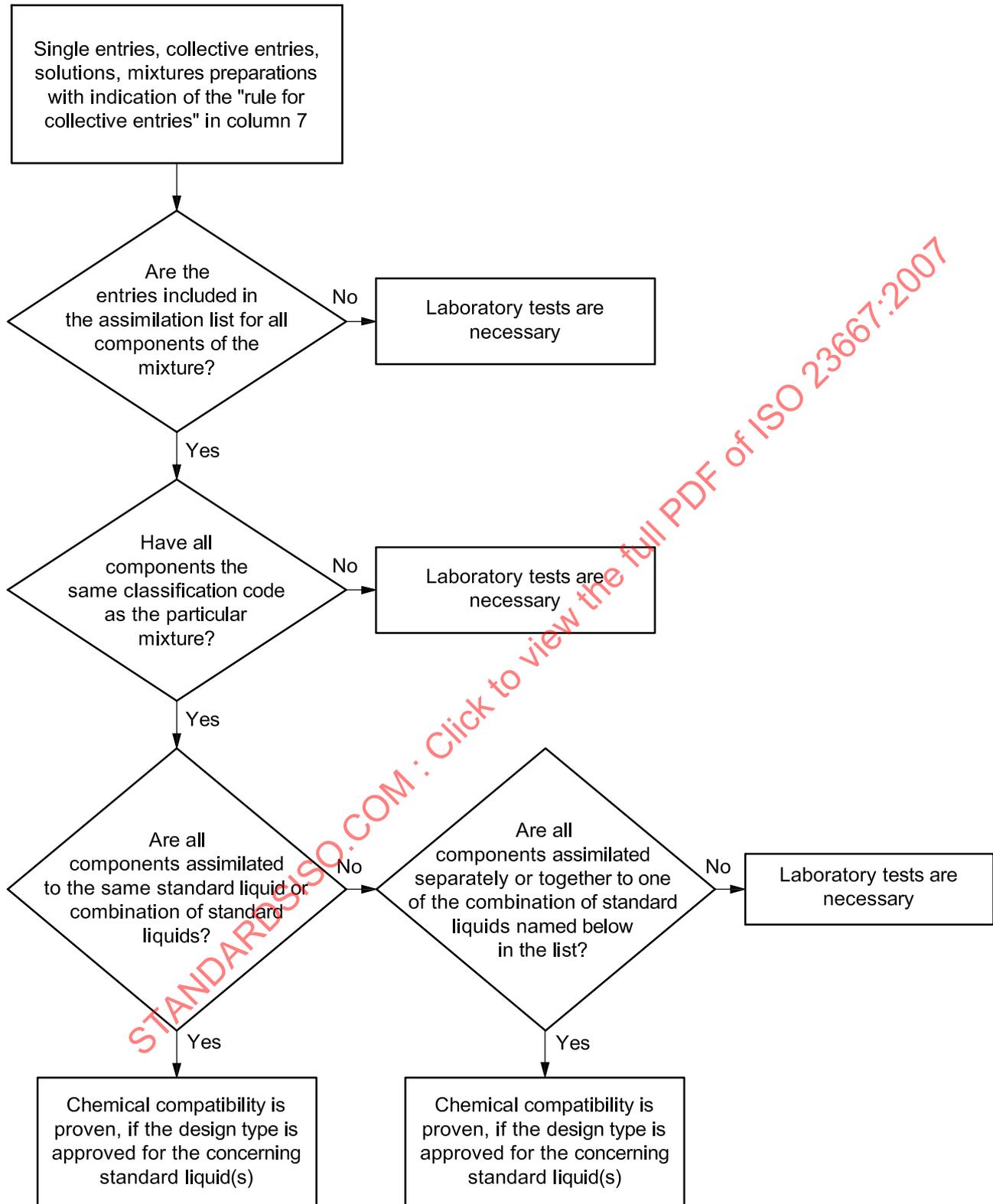


Figure C.2 — Rule for collective entries

List of combinations of standard liquids:

- water/nitric acid (55 %) (except when an inorganic acid of classification code C1 has been assimilated to water);
- water/wetting solution;
- water/acetic acid;
- water/mixture of hydrocarbons;
- water/*n*-butyl acetate — *n*-butyl acetate /saturated wetting solution.

NOTE Clause references in column 3 of Table C.1 refer to the European agreement concerning the international carriage of dangerous goods by road (ADR)^[2].

Table C.1 — List of substances assimilated to standard liquids

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1090	Acetone		3	F1	II	Mixture of hydrocarbons Remark: applicable only if it is proved that the permeability of the substance out of the package intended for carriage has an acceptable level
1093	Acrylonitrile	stabilized	3	FT1	I	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1104	<i>n</i> -Amyl acetate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1104	sec-Amyl acetate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1104	Isoamyl acetate	mixture of 2- and 3-methylbutyl acetate	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1104	Isoamyl acetate	pure	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1104	Amyl acetates	isomeric mixture	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1105	2-Methyl-2-butanol		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1105	Pentanol	synthetic isomeric mixture, flashpoint below 23 °C	3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1105	<i>n</i> -Pentanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1105	2-Pentanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1105	3-Pentanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1105	Isoamyl alcohol	containing 2,2-Dimethyl-1-propanol	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1105	2-Methyl-1-butanol	active alcohol of fermentation	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1105	3-Methyl-1-butanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1105	3-Methyl-2-butanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1105	Pentanol	primary, mixture of 1-pentanol and 2-methyl-1-butanol	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1105	Pentanol	synthetic isomeric mixture, flashpoint between 23 °C and 60 °C	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1106	<i>n</i> -Amylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1106	2,2-Dimethyl-1-propylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1106	2-Methyl-2-butylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1106	2-Methylbutylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1106	3-Methylbutylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1106	3-Pentylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1106	Amylamines	isomeric mixture, flashpoint below 23 °C	3	FC	II	Mixture of hydrocarbons and wetting solution
1106	<i>sec</i> -Amylamine		3	FC	III	Mixture of hydrocarbons and wetting solution
1106	Amylamines	isomeric mixture, flashpoint between 23 °C and 60 °C	3	FC	III	Mixture of hydrocarbons and wetting solution
1109	<i>n</i> -Amyl formate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1109	Isoamyl formate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1109	Amyl formates	isomeric mixture	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1120	<i>sec</i> -Butanol		3	F1	II	Acetic acid
1120	<i>tert</i> -Butanol		3	F1	II	Acetic acid
1120	Butanols	isomeric mixture, flashpoint below 23 °C	3	F1	II	Acetic acid
1120	<i>n</i> -Butanol		3	F1	III	Acetic acid
1120	<i>sec</i> -Butanol	flashpoint between 23 °C and 35 °C	3	F1	III	Acetic acid
1120	Butanols	isomeric mixture, flashpoint between 23 °C and 60 °C	3	F1	III	Acetic acid
1123	<i>sec</i> -Butyl acetate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1123	<i>tert</i> -Butyl acetate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1123	Butyl acetates	isomeric mixture, flashpoint below 23 °C	3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1123	<i>n</i> -Butyl acetate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1123	Butyl acetates	isomeric mixture, flashpoint between 23 °C and 60 °C	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1125	<i>n</i> -Butylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1128	<i>n</i> -Butyl formate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1129	Butyraldehyde		3	F1	II	Mixture of hydrocarbons
1133	Adhesives containing flammable liquid	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1133	Adhesives containing flammable liquid	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1133	Adhesives containing flammable liquid	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1133	Adhesives containing flammable liquid	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1133	Adhesives containing flammable liquid	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1133	Adhesives containing flammable liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries
1133	Adhesives containing flammable liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1133	Adhesives containing flammable liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1139	Coating solution (includes surface treatments or coatings used for industrial or other purposes such as vehicle under coating, drum or barrel lining)	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1139	Coating solution (includes surface treatments or coatings used for industrial or other purposes such as vehicle under coating, drum or barrel lining)	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1139	Coating solution (includes surface treatments or coatings used for industrial or other purposes such as vehicle under coating, drum or barrel lining)	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1139	Coating solution (includes surface treatments or coatings used for industrial or other purposes such as vehicle under coating, drum or barrel lining)	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1139	Coating solution (includes surface treatments or coatings used for industrial or other purposes such as vehicle under coating, drum or barrel lining)	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1139	Coating solution (includes surface treatments or coatings used for industrial or other purposes such as vehicle under coating, drum or barrel lining)	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4 vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1139	Coating solution (includes surface treatments or coatings used for industrial or other purposes such as vehicle under coating, drum or barrel lining)	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1139	Coating solution (includes surface treatments or coatings used for industrial or other purposes such as vehicle under coating, drum or barrel lining)	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1145	Cyclohexane		3	F1	II	Mixture of hydrocarbons
1146	Cyclopentane		3	F1	II	Mixture of hydrocarbons
1153	Ethylene glycol diethyl ether		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution and mixture of hydrocarbons
1154	Diethylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1158	Diisopropylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1160	Dimethylamine	aqueous solution	3	FC	II	Mixture of hydrocarbons and wetting solution
1165	Dioxane		3	F1	II	Mixture of hydrocarbons
1169	Extracts, aromatic, liquid	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1169	Extracts, aromatic, liquid	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1169	Extracts, aromatic, liquid	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1169	Extracts, aromatic, liquid	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1169	Extracts, aromatic, liquid	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1169	Extracts, aromatic, liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1169	Extracts, aromatic, liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1169	Extracts, aromatic, liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1170	Ethanol		3	F1	II	Acetic acid
1170	Ethanol	aqueous solution, flashpoint below 23 °C	3	F1	II	Acetic acid
1170	Ethanol	aqueous solution containing more than 24 % alcohol by volume, flashpoint between 23 °C and 60 °C	3	F1	III	Acetic acid
1171	Ethylene glycol monoethyl ether		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution and mixture of hydrocarbons
1172	Ethylene glycol monoethyl ether acetate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution and mixture of hydrocarbons
1173	Ethyl acetate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1177	2-Ethylbutyl acetate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1178	2-Ethylbutyraldehyde		3	F1	II	Mixture of hydrocarbons
1180	Ethyl butyrate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1188	Ethylene glycol monomethyl ether		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution and mixture of hydrocarbons
1189	Ethylene glycol monomethyl ether acetate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution and mixture of hydrocarbons
1190	Ethyl formate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1191	<i>n</i> -Octyl aldehyde		3	F1	III	Mixture of hydrocarbons

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1191	2-Ethylhexaldehyde		3	F1	III	Mixture of hydrocarbons
1191	3-Ethylhexaldehyde		3	F1	III	Mixture of hydrocarbons
1191	Ethylhexaldehydes	isomeric mixture	3	F1	III	Mixture of hydrocarbons
1191	Isooctaldehyde		3	F1	III	Mixture of hydrocarbons
1191	Octyl aldehydes	isomeric mixture	3	F1	III	Mixture of hydrocarbons
1192	Ethyl lactate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1195	Ethyl propionate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1197	Extracts, flavouring, liquid	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1197	Extracts, flavouring, liquid	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1197	Extracts, flavouring, liquid	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1197	Extracts, flavouring, liquid	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1197	Extracts, flavouring, liquid	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1197	Extracts, flavouring, liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries
1197	Extracts, flavouring, liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1197	Extracts, flavouring, liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1198	Formaldehyde	aqueous solution , flashpoint between 23 °C and 60 °C	3	FC	III	Acetic acid
1202	Diesel fuel	flashpoint not more than 100 °C	3	F1	III	Mixture of hydrocarbons
1202	Diesel fuel EN 590		3	F1	III	Mixture of hydrocarbons

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1202	Gas oil	flashpoint not more than 100 °C	3	F1	III	Mixture of hydrocarbons
1202	Heating oil, extra light		3	F1	III	Mixture of hydrocarbons
1202	Heating oil	flashpoint not more than 100 °C	3	F1	III	Mixture of hydrocarbons
1202	Heating oil, light		3	F1	III	Mixture of hydrocarbons
1203	Motor spirit	Super Plus EN 228, unleaded	3	F1	II	Mixture of hydrocarbons
1203	Motor spirit	Super EN 228, unleaded	3	F1	II	Mixture of hydrocarbons
1203	Motor spirit	Normal EN 228, unleaded	3	F1	II	Mixture of hydrocarbons
1206	<i>n</i> -Heptane		3	F1	II	Mixture of hydrocarbons
1206	2,2-Dimethylpentane		3	F1	II	Mixture of hydrocarbons
1206	2,3-Dimethylpentane		3	F1	II	Mixture of hydrocarbons
1206	2,4-Dimethylpentane		3	F1	II	Mixture of hydrocarbons
1206	2,2,3-Trimethylbutane		3	F1	II	Mixture of hydrocarbons
1206	3,3-Dimethylpentane		3	F1	II	Mixture of hydrocarbons
1206	3-Ethylpentane		3	F1	II	Mixture of hydrocarbons
1206	2-Methylhexane		3	F1	II	Mixture of hydrocarbons
1206	3-Methylhexane		3	F1	II	Mixture of hydrocarbons
1206	Heptanes	isomeric mixture, flashpoint below 23 °C	3	F1	II	Mixture of hydrocarbons
1207	<i>n</i> -Hexaldehyde		3	F1	III	Mixture of hydrocarbons
1208	<i>n</i> -Hexane		3	F1	II	Mixture of hydrocarbons
1208	2,2-Dimethylbutane		3	F1	II	Mixture of hydrocarbons
1208	2-Methylpentane		3	F1	II	Mixture of hydrocarbons
1208	3-Methylpentane		3	F1	II	Mixture of hydrocarbons
1208	Hexanes	isomeric mixture	3	F1	II	Mixture of hydrocarbons
1210	Printing ink , flammable or Printing ink related material flammable (including printing ink thinning or reducing compound)	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1210	Printing ink , flammable or Printing ink related material flammable (including printing ink thinning or reducing compound)	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1210	Printing ink , flammable or Printing ink related material flammable (including printing ink thinning or reducing compound)	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1210	Printing ink , flammable or Printing ink related material flammable (including printing ink thinning or reducing compound)	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1210	Printing ink , flammable or Printing ink related material flammable (including printing ink thinning or reducing compound)	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1210	Printing ink , flammable or Printing ink related material flammable (including printing ink thinning or reducing compound)	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries
1210	Printing ink , flammable or Printing ink related material flammable (including printing ink thinning or reducing compound)	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1210	Printing ink , flammable or Printing ink related material flammable (including printing ink thinning or reducing compound)	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1212	Isobutanol		3	F1	III	Acetic acid
1213	Isobutyl acetate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1214	Isobutylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1216	2,3-Dimethyl-2-hexene		3	F1	II	Mixture of hydrocarbons
1216	2,5-Dimethyl-2-hexene		3	F1	II	Mixture of hydrocarbons
1216	2-Ethyl-1-hexene		3	F1	II	Mixture of hydrocarbons
1216	2-Methyl-1-heptene		3	F1	II	Mixture of hydrocarbons
1216	2-Methyl-2-heptene		3	F1	II	Mixture of hydrocarbons
1216	2,3,4-Trimethyl-1-pentene		3	F1	II	Mixture of hydrocarbons
1216	3,4,4-Trimethyl-2-pentene		3	F1	II	Mixture of hydrocarbons
1216	Isooctenes	isomeric mixture	3	F1	II	Mixture of hydrocarbons
1219	Isopropanol		3	F1	II	Acetic acid
1220	Isopropyl acetate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1221	Isopropylamine		3	FC	I	Mixture of hydrocarbons and wetting solution

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1223	Kerosene		3	F1	III	Mixture of hydrocarbons
1224	3,3-Dimethyl-2-butanone		3	F1	II	Mixture of hydrocarbons
1224	Ketones	liquid, n.o.s. , vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1224	Ketones	liquid, n.o.s. , vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1224	Ketones	liquid, n.o.s. , flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1230	Methanol		3	FT1	II	Acetic acid
1230	Methanol	aqueous solution, with more than 50 % methanol	3	FT1	II	Acetic acid
1231	Methyl acetate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1233	Methylamyl acetate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1235	Methylamine	aqueous solution	3	FC	II	Mixture of hydrocarbons and wetting solution
1237	Methyl butyrate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1247	Methyl methacrylate	monomer, stabilized	3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1248	Methyl propionate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1262	<i>n</i> -Octane		3	F1	II	Mixture of hydrocarbons
1262	2,2-Dimethylhexane		3	F1	II	Mixture of hydrocarbons
1262	2,3-Dimethylhexane		3	F1	II	Mixture of hydrocarbons
1262	2,4-Dimethylhexane		3	F1	II	Mixture of hydrocarbons
1262	2,5-Dimethylhexane		3	F1	II	Mixture of hydrocarbons
1262	3,3-Dimethylhexane		3	F1	II	Mixture of hydrocarbons
1262	3,4-Dimethylhexane		3	F1	II	Mixture of hydrocarbons
1262	Isooctane		3	F1	II	Mixture of hydrocarbons
1262	2-Methyl-3-ethylpentane		3	F1	II	Mixture of hydrocarbons
1262	3-Methyl-3-ethylpentane		3	F1	II	Mixture of hydrocarbons
1262	2-Methylheptane		3	F1	II	Mixture of hydrocarbons
1262	3-Methylheptane		3	F1	II	Mixture of hydrocarbons
1262	4-Methylheptane		3	F1	II	Mixture of hydrocarbons

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1262	3-Ethylhexane		3	F1	II	Mixture of hydrocarbons
1262	2,2,3-Trimethylpentane		3	F1	II	Mixture of hydrocarbons
1262	2,3,3-Trimethylpentane		3	F1	II	Mixture of hydrocarbons
1262	2,3,4-Trimethylpentane		3	F1	II	Mixture of hydrocarbons
1262	Octanes	isomeric mixture	3	F1	II	Mixture of hydrocarbons
1263	Paint (including paint, lacquer, enamel, stain, shellac, varnish, polish, liquid filler and liquid lacquer base) or Paint related material (including paint thinning and reducing compound)	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1263	Paint (including paint, lacquer, enamel, stain, shellac, varnish, polish, liquid filler and liquid lacquer base) or Paint related material (including paint thinning and reducing compound)	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1263	Paint (including paint, lacquer, enamel, stain, shellac, varnish, polish, liquid filler and liquid lacquer base) or Paint related material (including paint thinning and reducing compound)	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1263	Paint (including paint, lacquer, enamel, stain, shellac, varnish, polish, liquid filler and liquid lacquer base) or Paint related material (including paint thinning and reducing compound)	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1263	Paint (including paint, lacquer, enamel, stain, shellac, varnish, polish, liquid filler and liquid lacquer base) or Paint related material (including paint thinning and reducing compound)	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1263	Paint (including paint, lacquer, enamel, stain, shellac, varnish, polish, liquid filler and liquid lacquer base) or Paint related material (including paint thinning and reducing compound)	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1263	Paint (including paint, lacquer, enamel, stain, shellac, varnish, polish, liquid filler and liquid lacquer base) or Paint related material (including paint thinning and reducing compound)	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1263	Paint (including paint, lacquer, enamel, stain, shellac, varnish, polish, liquid filler and liquid lacquer base) or Paint related material (including paint thinning and reducing compound)	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1265	<i>n</i> -Pentane		3	F1	II	Mixture of hydrocarbons
1266	Perfumery products with flammable solvents	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1266	Perfumery products with flammable solvents	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1266	Perfumery products with flammable solvents	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1266	Perfumery products with flammable solvents	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1266	Perfumery products with flammable solvents	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1266	Perfumery products with flammable solvents	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries
1266	Perfumery products with flammable solvents	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1266	Perfumery products with flammable solvents	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1268	Petroleum distillates or Petroleum products	n.o.s. , vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1268	Petroleum distillates or Petroleum products	n.o.s., vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1268	Coal tar naphtha	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Mixture of hydrocarbons
1268	Petroleum distillates or Petroleum products	n.o.s., vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1268	Petroleum distillates or Petroleum products	n.o.s., flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1274	n-Propanol	pure	3	F1	II	Acetic acid
1274	n-Propanol	technical, flashpoint between 23 °C and 60 °C	3	F1	III	Acetic acid
1275	Propionaldehyde		3	F1	II	Mixture of hydrocarbons
1276	n-Propyl acetate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1277	n-Propylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
1281	Isopropyl formate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1281	<i>n</i> -Propyl formate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1281	Propyl formates	isomeric mixture	3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1282	Pyridine	pure	3	F1	II	Mixture of hydrocarbons
1282	Pyridine	technical, with additions of Methylpyridines	3	F1	II	Mixture of hydrocarbons
1286	Rosin oil	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1286	Rosin oil	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1286	Rosin oil	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1286	Rosin oil	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1286	Rosin oil	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1286	Rosin oil	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries
1286	Rosin oil	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1286	Rosin oil	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1287	Rubber solution	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1287	Rubber solution	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1287	Rubber solution	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1287	Rubber solution	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1287	Rubber solution	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1287	Rubber solution	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries
1286	Rubber solution	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1286	Rubber solution	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1296	Triethylamine		3	FC	II	Mixture of hydrocarbons <u>and</u> wetting solution

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1297	Trimethylamine	aqueous solution, not more than 50 % trimethylamine, by mass	3	FC	I	Mixture of hydrocarbons and wetting solution
1297	Trimethylamine	aqueous solution, not more than 50 % trimethylamine, by mass	3	FC	II	Mixture of hydrocarbons and wetting solution
1297	Trimethylamine	aqueous solution, not more than 50 % trimethylamine, by mass	3	FC	III	Mixture of hydrocarbons and wetting solution
1301	Vinyl acetate	stabilized	3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1306	Wood preservatives, liquid	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1306	Wood preservatives, liquid	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1306	Wood preservatives, liquid	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1306	Wood preservatives, liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries
1306	Wood preservatives, liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1306	Wood preservatives, liquid	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1547	Aniline		6.1	T1	II	Acetic acid
1590	2,3-Dichloroaniline	liquid	6.1	T1	II	Acetic acid
1590	2,6-Dichloroaniline	liquid	6.1	T1	II	Acetic acid
1590	Dichloroanilines	isomeric mixture, liquid	6.1	T1	II	Acetic acid
1602	Dye or Dye intermediate	liquid, highly toxic, n.o.s., flashpoint more than 60 °C	6.1	T1	I	Rule for collective entries
1602	Dye or Dye intermediate	liquid, toxic, n.o.s., flashpoint more than 60 °C	6.1	T1	II	Rule for collective entries

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1602	Dye or Dye intermediate	liquid, slightly toxic, n.o.s., flashpoint more than 60 °C	6.1	T1	III	Rule for collective entries
1604	Ethylenediamine		8	CF1	II	Mixture of hydrocarbons and wetting solution
1715	Acetic anhydride		8	CF1	II	Acetic acid
1717	Acetyl chloride		3	FC	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1718	Butyl acid phosphate		8	C3	III	Wetting solution
1719	Caustic alkali liquid	n.o.s., inorganic, flashpoint more than 60 °C	8	C5	II	Rule for collective entries
1719	Hydrogen sulfides	aqueous solution	8	C5	III	Acetic acid
1719	Caustic alkali liquid	n.o.s., inorganic, flashpoint more than 60 °C	8	C5	III	Rule for collective entries
1730	Antimony pentachloride	liquid, pure	8	C1	II	Water
1736	Benzoyl chloride		8	C3	II	Mixture of hydrocarbons and wetting solution
1750	Chloroacetic acid	aqueous solution	6.1	TC1	II	Acetic acid
1750	Chloroacetic acid	solution, mixtures of mono- and dichloroacetic acid	6.1	TC1	II	Acetic acid
1752	Chloroacetyl chloride		6.1	TC1	I	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1755	Chromic acid	aqueous solution with not more than 30 % chromic acid, corrosive	8	C1	II	Nitric acid (55 %)
1755	Chromic acid	aqueous solution with not more than 30 % chromic acid, slightly corrosive	8	C1	III	Nitric acid (55 %)
1760	Corrosive liquid	n.o.s., flashpoint more than 60 °C, highly corrosive	8	C9	I	Rule for collective entries
1760	Cyanamide	aqueous solution with not more than 50 % cyanamide	8	C9	II	Water
1760	O,O-Diethyl-dithiophosphoric acid		8	C9	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1760	O,O-Diisopropyl- dithiophosphoric acid		8	C9	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1760	O,O-Di- <i>n</i> -propyl- dithiophosphoric acid		8	C9	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1760	Corrosive liquid	n.o.s., flashpoint more than 60 °C, corrosive	8	C9	II	Rule for collective entries
1760	Corrosive liquid	n.o.s., flashpoint more than 60 °C, slightly corrosive	8	C9	III	Rule for collective entries
1761	Cupriethylenediamine	aqueous solution , corrosive	8	CT1	II	Mixture of hydrocarbons and wetting solution
1761	Cupriethylenediamine	aqueous solution , slightly corrosive	8	CT1	III	Mixture of hydrocarbons and wetting solution
1764	Dichloroacetic acid		8	C3	II	Acetic acid
1775	Fluoroboric acid	aqueous solution with not more than 50 % fluoroboric acid	8	C1	II	Water
1778	Fluorosilicic acid		8	C1	II	Water
1779	Formic acid		8	C3	II	Acetic acid
1783	Hexamethylenediamine	aqueous solution, corrosive	8	C7	II	Mixture of hydrocarbons and wetting solution
1783	Hexamethylenediamine	aqueous solution , slightly corrosive	8	C7	III	Mixture of hydrocarbons and wetting solution
1787	Hydriodic acid	aqueous solution, corrosive	8	C1	II	Water
1787	Hydriodic acid	aqueous solution, slightly corrosive	8	C1	III	Water
1788	Hydrobromic acid	40 % aqueous solution	8	C1	II	Water
1788	Hydrobromic acid	48 % aqueous solution	8	C1	II	Water
1788	Hydrobromic acid	62 % aqueous solution	8	C1	II	Water
1788	Hydrobromic acid	aqueous solution, corrosive	8	C1	II	Water
1788	Hydrobromic acid	aqueous solution, slightly corrosive	8	C1	III	Water
1789	Hydrochloric acid	not more than 38 % aqueous solution, corrosive	8	C1	II	Water
1789	Hydrochloric acid	aqueous solution, slightly corrosive	8	C1	III	Water
1790	Hydrofluoric acid	with not more than 60 % hydrofluoric acid	8	CT1	II	Water the permissible period of use: not more than 2 years
1791	Potassium hypochlorite	aqueous solution, corrosive	8	C9	II	Nitric acid (55 %) ^a
1791	Sodium hypochlorite	aqueous solution, corrosive	8	C9	II	Nitric acid (55 %) ^a

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1791	Hypochlorite	aqueous solutions , corrosive, containing wetting agents as customary in trade	8	C9	II	Nitric acid (55 %) and wetting solution ^a
1791	Hypochlorite	aqueous solution , corrosive	8	C9	II	Nitric acid (55 %) ^a
1791	Potassium hypochlorite	aqueous solution, slightly corrosive	8	C9	III	Nitric acid (55 %) ^a
1791	Sodium hypochlorite	aqueous solution, slightly corrosive	8	C9	III	Nitric acid (55 %) ^a
1791	Hypochlorite	aqueous solutions , slightly corrosive, containing wetting agents as customary in trade	8	C9	III	Nitric acid (55 %) and wetting solution ^a
1791	Hypochlorite	aqueous solution , slightly corrosive	8	C9	III	Nitric acid (55 %) ^a
^a For UN 1791: Test to be carried out only with vent. If the test is carried out with nitric acid as the standard liquid, an acid-resistant vent and gasket shall be used. For hypochlorite solutions, vents and gaskets of the same design type, resistant to hypochlorite (e.g. of silicone rubber), but not resistant to nitric acid, are also permitted.						
1793	Isopropyl acid phosphate		8	C3	III	Wetting solution
1802	Perchloric acid	aqueous solution with not more than 50 % acid, by mass	8	CO1	II	Water
1803	<i>para</i> -Phenolsulfonic acid	65 % aqueous solution	8	C3	II	Water
1803	Phenolsulfonic acid	isomeric mixture, liquid	8	C3	II	Water
1805	Phosphoric acid	liquid	8	C1	III	Water
1814	Potassium hydroxide	aqueous solution , corrosive	8	C5	II	Water
1814	Potassium hydroxide	aqueous solution , slightly corrosive	8	C5	III	Water
1824	Sodium hydroxide	aqueous solution , corrosive	8	C5	II	Water
1824	Sodium hydroxide	aqueous solution , slightly corrosive	8	C5	III	Water
1830	Sulfuric acid	with more than 51 % pure acid	8	C1	II	Water
1832	Sulfuric acid, spent	chemical stable	8	C1	II	Water
1833	Sulfurous acid		8	C1	II	Water
1835	Tetramethylammonium hydroxide	aqueous solution, flashpoint more than 60 °C	8	C7	II	Water
1840	Zinc chloride	aqueous solution	8	C1	III	Water
1848	Propionic acid		8	C3	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1862	Ethyl crotonate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1863	Fuel, aviation, turbine engine	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Mixture of hydrocarbons
1863	Fuel, aviation, turbine engine	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Mixture of hydrocarbons
1863	Fuel, aviation, turbine engine	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Mixture of hydrocarbons
1863	Fuel, aviation, turbine engine	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Mixture of hydrocarbons
1863	Fuel, aviation, turbine engine	flashpoint between 23 °C and 60 °C	3	F1	III	Mixture of hydrocarbons
1866	Resin solution, flammable	vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1866	Resin solution, flammable	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1866	Resin solution, flammable	vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1866	Resin solution, flammable	vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1866	Resin solution, flammable	flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1866	Resin solution, flammable	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries
1866	Resin solution, flammable	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1866	Resin solution, flammable	having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
1902	Diisooctyl acid phosphate		8	C3	III	Wetting solution
1906	Sludge acid		8	C1	II	Nitric acid (55 %)
1908	Sodium chlorite	aqueous solution, corrosive	8	C9	II	Acetic acid

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1908	Chlorite	aqueous solutions , corrosive	8	C9	II	Acetic acid
1908	Sodium chlorite	aqueous solution, slightly corrosive	8	C9	III	Acetic acid
1908	Chlorite	aqueous solutions , slightly corrosive	8	C9	III	Acetic acid
1914	Butyl propionates		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1915	Cyclohexanone		3	F1	III	Mixture of hydrocarbons
1917	Ethyl acrylate	stabilized	3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1919	Methyl acrylate	stabilized	3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1920	<i>n</i> -Nonane		3	F1	III	Mixture of hydrocarbons
1920	2,3-Dimethylheptane		3	F1	III	Mixture of hydrocarbons
1920	2,5-Dimethylheptane		3	F1	III	Mixture of hydrocarbons
1920	3,4-Dimethylheptane		3	F1	III	Mixture of hydrocarbons
1920	3,5-Dimethylheptane		3	F1	III	Mixture of hydrocarbons
1920	4-Ethylheptane		3	F1	III	Mixture of hydrocarbons
1920	3-Ethyl-2-methylhexane		3	F1	III	Mixture of hydrocarbons
1920	3-Ethyl-3-methylhexane		3	F1	III	Mixture of hydrocarbons
1920	3-Ethyl-4-methylhexane		3	F1	III	Mixture of hydrocarbons
1920	2-Methyloctane		3	F1	III	Mixture of hydrocarbons
1920	3-Methyloctane		3	F1	III	Mixture of hydrocarbons
1920	4-Methyloctane		3	F1	III	Mixture of hydrocarbons
1920	2,3,3-Trimethylhexane		3	F1	III	Mixture of hydrocarbons
1920	2,3,4-Trimethylhexane		3	F1	III	Mixture of hydrocarbons
1920	3,3,4-Trimethylhexane		3	F1	III	Mixture of hydrocarbons
1920	Nonanes	isomeric mixture, flashpoint between 23 °C and 60 °C	3	F1	III	Mixture of hydrocarbons
1935	Cyanide solution	n.o.s. , inorganic, highly toxic	6.1	T4	I	Water
1935	Cyanide solution	n.o.s. , inorganic, toxic	6.1	T4	II	Water
1935	Cyanide solution	n.o.s. , inorganic, slightly toxic	6.1	T4	III	Water
1940	Thioglycolic acid		8	C3	II	Acetic acid
1986	Alcohols, flammable, toxic	n.o.s.	3	FT1	I	Rule for collective entries
1986	Alcohols, flammable, toxic	n.o.s.	3	FT1	II	Rule for collective entries
1986	Alcohols, flammable, toxic	n.o.s. , flashpoint between 23 °C and 60 °C, slightly toxic	3	FT1	III	Rule for collective entries

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1987	Alcohols	n.o.s., vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1987	Alcohols	n.o.s., vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1987	Cyclohexanol	technical pure	3	F1	III	Acetic acid
1987	Alcohols	n.o.s., flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1988	Aldehydes, flammable, toxic	n.o.s.	3	FT1	I	Rule for collective entries
1988	Aldehydes, flammable, toxic	n.o.s.	3	FT1	II	Rule for collective entries
1988	Aldehydes, flammable, toxic	n.o.s., flashpoint between 23 °C and 60 °C, slightly toxic	3	FT1	III	Rule for collective entries
1989	Aldehydes	n.o.s., vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1989	Aldehydes	n.o.s., vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1989	Aldehydes	n.o.s., vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries
1989	Aldehydes	n.o.s., vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1989	Aldehydes	n.o.s., flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1992	Flammable liquid, toxic	n.o.s.	3	FT1	I	Rule for collective entries
1992	Flammable liquid, toxic	n.o.s.	3	FT1	II	Rule for collective entries
1992	2,6- <i>cis</i> -Dimethyl-morpholine		3	FT1	III	Mixture of hydrocarbons
1992	Flammable liquid, toxic	n.o.s., flashpoint between 23 °C and 60 °C, slightly toxic	3	FT1	III	Rule for collective entries
1993	Flammable liquid	n.o.s., vapour pressure at 50 °C more than 175 kPa	3	F1	I	Rule for collective entries
1993	Flammable liquid	n.o.s., vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	I	Rule for collective entries
1993	Flammable liquid	n.o.s., vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	II	Rule for collective entries

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
1993	Propionic acid vinyl ester		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1993	Flammable liquid	n.o.s. , vapour pressure at 50 °C not more than 110 kPa	3	F1	II	Rule for collective entries
1993	(1-Methoxy-2-propyl) acetate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
1993	Flammable liquid	n.o.s. , flashpoint between 23 °C and 60 °C	3	F1	III	Rule for collective entries
1993	Flammable liquid	n.o.s. , having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 175 kPa	3	F1	III	Rule for collective entries
1993	Flammable liquid	n.o.s. , having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	F1	III	Rule for collective entries
1993	Flammable liquid	n.o.s. , having a flashpoint below 23 °C and viscous according to 2.2.3.1.4, vapour pressure at 50 °C not more than 110 kPa	3	F1	III	Rule for collective entries
2014	Hydrogen peroxide	aqueous solution , with not less than 20 %, but not more than 60 % hydrogen peroxide, stabilized as necessary	5.1	OC1	II	Nitric acid (55 %)
2022	Cresylic acid	liquid mixture containing cresols, xylenols and methyl phenols	6.1	TC1	II	Acetic acid
2030	Hydrazine	aqueous solution with not less than 37 %, but not more than 64 % hydrazine, by mass	8	CT1	II	Water
2030	Hydrazine hydrate	aqueous solution with 64 % hydrazine	8	CT1	II	Water
2031	Nitric acid	other than red fuming, with not more than 55 % pure acid	8	CO1	II	Nitric acid (55 %)
2045	Isobutyraldehyde		3	F1	II	Mixture of hydrocarbons
2050	Diisobutylene	isomeric compounds	3	F1	II	Mixture of hydrocarbons
2053	Methyl isobutyl carbinol		3	F1	III	Acetic acid
2054	Morpholine		3	CF1	I	Mixture of hydrocarbons
2057	Tripropylene	flashpoint below 23 °C	3	F1	II	Mixture of hydrocarbons

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
2057	Tripropylene	flashpoint between 23 °C and 60 °C	3	F1	III	Mixture of hydrocarbons
2058	2,2-Dimethylpropanal		3	F1	II	Mixture of hydrocarbons
2058	Isovaleraldehyde		3	F1	II	Mixture of hydrocarbons
2058	2-Methylbutanal		3	F1	II	Mixture of hydrocarbons
2058	<i>n</i> -Valeraldehyde		3	F1	II	Mixture of hydrocarbons
2058	Valeraldehydes	isomeric mixture	3	F1	II	Mixture of hydrocarbons
2059	Nitrocellulose solution, flammable	with not more than 12,6 % nitrogen, by dry mass, and not more than 55 % nitrocellulose, vapour pressure at 50 °C more than 175 kPa	3	D	I	Rule for collective entries: Deviating from the general procedure this rule may be applied to solvents of classification code F1
2059	Nitrocellulose solution, flammable	with not more than 12,6 % nitrogen, by dry mass, and not more than 55 % nitrocellulose, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	D	I	Rule for collective entries: Deviating from the general procedure this rule may be applied to solvents of classification code F1
2059	Nitrocellulose solution, flammable	with not more than 12,6 % nitrogen, by dry mass, and not more than 55 % nitrocellulose, vapour pressure at 50 °C more than 110 kPa, but not more than 175 kPa	3	D	II	Rule for collective entries: Deviating from the general procedure this rule may be applied to solvents of classification code F1
2059	Nitrocellulose solution, flammable	with not more than 12,6 % nitrogen, by dry mass, and not more than 55 % nitrocellulose, vapour pressure at 50 °C not more than 110 kPa	3	D	II	Rule for collective entries: Deviating from the general procedure this rule may be applied to solvents of classification code F1
2059	Nitrocellulose solution, flammable	with not more than 12,6 % nitrogen, by dry mass, and not more than 55 % nitrocellulose, flashpoint between 23 °C and 60 °C	3	D	III	Rule for collective entries: Deviating from the general procedure this rule may be applied to solvents of classification code F1
2075	Chloral	anhydrous, stabilized	6.1	T1	II	Wetting solution
2076	<i>meta</i> -Cresol	liquid	6.1	TC1	II	Acetic acid
2076	<i>ortho</i> -Cresol	liquid	6.1	TC1	II	Acetic acid
2076	<i>para</i> -Cresol	liquid	6.1	TC1	II	Acetic acid
2076	Cresols	isomeric mixture, liquid	6.1	TC1	II	Acetic acid
2078	Toluene diisocyanate	liquid	6.1	T1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2079	Diethylenetriamine		8	C7	II	Mixture of hydrocarbons

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
2209	Formaldehyde	aqueous solution with 37 % Formaldehyde, methanol content: 8 % to 10 %	8	C9	III	Acetic acid
2209	Formaldehyde	aqueous solution , with not less than 25 % formaldehyde	8	C9	III	Water
2218	Acrylic acid	stabilized	8	CF1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2227	<i>n</i> -Butyl methacrylate	stabilized	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2235	<i>para</i> -Chlorobenzyl chloride	liquid	6.1	T2	III	Mixture of hydrocarbons
2241	Cycloheptane		3	F1	II	Mixture of hydrocarbons
2242	Cycloheptene		3	F1	II	Mixture of hydrocarbons
2243	Cyclohexyl acetate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2244	Cyclopentanol		3	F1	III	Acetic acid
2245	Cyclopentanone		3	F1	III	Mixture of hydrocarbons
2247	<i>n</i> -Decane		3	F1	III	Mixture of hydrocarbons
2248	Di- <i>n</i> -butylamine		8	CF1	II	Mixture of hydrocarbons
2258	1,2-Propylenediamine		8	CF1	II	Mixture of hydrocarbons and wetting solution
2259	Triethylenetetramine		8	C7	II	Water
2260	Tripropylamine		3	FC	III	Mixture of hydrocarbons and wetting solution
2263	1,1-Dimethyl-cyclohexane		3	F1	II	Mixture of hydrocarbons
2263	<i>cis</i> -1,2-Dimethyl-cyclohexane		3	F1	II	Mixture of hydrocarbons
2263	<i>trans</i> -1,2-Dimethyl-cyclohexane		3	F1	II	Mixture of hydrocarbons
2263	1,2-Dimethyl-cyclohexane	<i>cis/trans</i> -mixture	3	F1	II	Mixture of hydrocarbons
2263	<i>cis</i> -1,3-Dimethyl-cyclohexane		3	F1	II	Mixture of hydrocarbons
2263	<i>trans</i> -1,3-Dimethyl-cyclohexane		3	F1	II	Mixture of hydrocarbons
2263	1,3-Dimethyl-cyclohexane	<i>cis/trans</i> -mixture	3	F1	II	Mixture of hydrocarbons
2263	<i>cis</i> -1,4-Dimethyl-cyclohexane		3	F1	II	Mixture of hydrocarbons
2263	<i>trans</i> -1,4-Dimethyl-cyclohexane		3	F1	II	Mixture of hydrocarbons
2263	1,4-Dimethyl-cyclohexane	<i>cis/trans</i> -mixture	3	F1	II	Mixture of hydrocarbons
2263	Dimethylcyclohexanes	isomeric mixture	3	F1	II	Mixture of hydrocarbons
2264	<i>N,N</i> -Dimethyl-cyclohexylamine		8	CF1	II	Mixture of hydrocarbons and wetting solution

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
2265	<i>N,N</i> -Dimethyl-formamide		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2266	Dimethyl- <i>N</i> -propylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
2269	3,3'-Imino-dipropylamine		8	C7	III	Mixture of hydrocarbons and wetting solution
2270	Ethylamine	aqueous solution, with not less than 50 %, but not more than 70 % ethylamine, flashpoint between 23 °C and 60 °C, corrosive or slightly corrosive	3	FC	II	Mixture of hydrocarbons and wetting solution
2275	2-Ethylbutanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2276	2-Ethylhexylamine		3	FC	III	Mixture of hydrocarbons and wetting solution
2277	Ethyl methacrylate	stabilized	3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2278	<i>n</i> -Heptene		3	F1	II	Mixture of hydrocarbons
2282	<i>n</i> -Hexanol	technical	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	2-Hexanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	3-Hexanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	2,3-Dimethyl-2-butanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	3,3-Dimethyl-1-butanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	3,3-Dimethyl-2-butanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	2-Methyl-1-pentanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	2-Methyl-3-pentanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	3-Methyl-1-pentanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
2282	3-Methyl-2-pentanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	3-Methyl-3-pentanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	4-Methyl-1-pentanol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2282	Hexanols	isomeric mixtures	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2283	Isobutyl methacrylate	stabilized	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2286	Pentamethylheptane		3	F1	III	Mixture of hydrocarbons
2287	Isoheptene		3	F1	II	Mixture of hydrocarbons
2288	Isohexene		3	F1	II	Mixture of hydrocarbons
2289	Isophoronediamine		8	C7	III	Mixture of hydrocarbons and wetting solution
2293	4-Methoxy-4-methyl-pentan-2-one		3	F1	III	Mixture of hydrocarbons
2296	Methylcyclohexane		3	F1	II	Mixture of hydrocarbons
2297	2-Methylcyclohexanone		3	F1	III	Mixture of hydrocarbons
2297	3-Methylcyclohexanone		3	F1	III	Mixture of hydrocarbons
2297	4-Methylcyclohexanone		3	F1	III	Mixture of hydrocarbons
2297	Methylcyclohexanones	isomeric mixture	3	F1	III	Mixture of hydrocarbons
2298	Methylcyclopentane		3	F1	II	Mixture of hydrocarbons
2302	5-Methylhexan-2-one		3	F1	III	Mixture of hydrocarbons
2308	Nitrosylsulfuric acid	liquid	8	C1	II	Water
2309	Octadiene		3	F1	II	Mixture of hydrocarbons
2313	α -Picoline		3	F1	III	Mixture of hydrocarbons
2313	β -Picoline		3	F1	III	Mixture of hydrocarbons
2313	γ -Picoline		3	F1	III	Mixture of hydrocarbons
2313	Picolines	isomeric mixture	3	F1	III	Mixture of hydrocarbons
2317	Sodium cuprocyanide	aqueous solution	6.1	T4	I	Water
2320	Tetraethylenepentamine		8	C7	III	Mixture of hydrocarbons and wetting solution
2324	Triisobutylene	mixture of C12-monoolefines, flashpoint between 23 °C and 60 °C	3	F1	III	Mixture of hydrocarbons
2326	Trimethylcyclohexylamine		8	C7	III	Mixture of hydrocarbons and wetting solution

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
2327	2,2,4-Trimethyl-hexamethylene diamine		8	C7	III	Mixture of hydrocarbons and wetting solution
2327	Trimethylhexa-methylenediamines	isomeric mixture	8	C7	III	Mixture of hydrocarbons and wetting solution
2330	Undecane		3	F1	III	Mixture of hydrocarbons
2336	Allyl formate		3	FT1	I	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2348	Butyl acrylates	stabilized	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2357	Cyclohexylamine	flashpoint not less than 23 °C to 60 °C	8	CF1	II	Mixture of hydrocarbons and wetting solution
2361	Diisobutylamine		3	FC	III	Mixture of hydrocarbons and wetting solution
2366	Diethyl carbonate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2367	<i>α</i> - Methylvaleraldehyde		3	F1	II	Mixture of hydrocarbons
2370	1-Hexene		3	F1	II	Mixture of hydrocarbons
2372	1,2-Di-(dimethylamino)-ethane		3	F1	II	Mixture of hydrocarbons and wetting solution
2379	1,3-Dimethylbutylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
2383	Dipropylamine		3	FC	II	Mixture of hydrocarbons and wetting solution
2385	Ethyl isobutyrate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2393	Isobutyl formate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2394	Isobutyl propionate	flashpoint between 23 °C and 60 °C	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2396	Methacrylaldehyde	stabilized	3	FT1	II	Mixture of hydrocarbons
2400	Methyl isovalerate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2401	Piperidine		8	CF1	I	Mixture of hydrocarbons and wetting solution
2403	Isopropenyl acetate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
2405	Isopropyl butyrate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2406	Isopropyl isobutyrate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2409	Isopropyl propionate		3	F1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2410	1,2,3,6-Tetrahydropyridine		3	F1	II	Mixture of hydrocarbons
2427	Potassium chlorate	aqueous solution, oxidizing	5.1	O1	II	Water
2427	Potassium chlorate	aqueous solution, slightly oxidizing	5.1	O1	III	Water
2428	Sodium chlorate	aqueous solution, oxidizing	5.1	O1	II	Water
2428	Sodium chlorate	aqueous solution, slightly oxidizing	5.1	O1	III	Water
2429	Calcium chlorate	aqueous solution, oxidizing	5.1	O1	II	Water
2429	Calcium chlorate	aqueous solution, slightly oxidizing	5.1	O1	III	Water
2436	Thioacetic acid		3	F1	II	Acetic acid
2457	2,3-Dimethylbutane		3	F1	II	Mixture of hydrocarbons
2491	Ethanolamine		8	C7	III	Wetting solution
2491	Ethanolamine	aqueous solution	8	C7	III	Wetting solution
2496	Propionic anhydride		8	C3	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2524	Ethyl orthoformate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2526	Furfurylamine		3	FC	III	Mixture of hydrocarbons and wetting solution
2527	Isobutyl acrylate	stabilized	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2528	Isobutyl isobutyrate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2529	Isobutyric acid		3	FC	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2531	Methacrylic acid	stabilized	8	C3	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2542	Tributylamine		6.1	T1	II	Mixture of hydrocarbons

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
2560	2-Methylpentan-2-ol		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2564	Trichloroacetic acid	aqueous solution , corrosive	8	C3	II	Acetic acid
2564	Trichloroacetic acid	aqueous solution , slightly corrosive	8	C3	III	Acetic acid
2565	Dicyclohexylamine		8	C7	III	Mixture of hydrocarbons and wetting solution
2571	Ethylsulfuric acid		8	C3	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2571	Alkylsulfuric acids		8	C3	II	Rule for collective entries
2580	Aluminium bromide	aqueous solutions	8	C1	III	Water
2581	Aluminium chloride	aqueous solutions	8	C1	III	Water
2582	Ferric chloride	aqueous solution	8	C1	III	Water
2584	Methane sulfonic acid	with more than 5 % free sulfuric acid, liquid	8	C1	II	Water
2584	Alkylsulfonic acids	liquid , with more than 5 % free sulfuric acid	8	C1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2584	Benzene sulfonic acid	with more than 5 % free sulfuric acid, liquid	8	C1	II	Water
2584	Dodecylbenzene sulfonic acid	with more than 5 % free sulfuric acid, liquid	8	C1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2584	<i>para</i> -Toluene sulfonic acid	liquid, with more than 5 % free sulfuric acid	8	C1	II	Water
2584	Toluene sulfonic acids	liquid, with more than 5 % free sulfuric acid	8	C1	II	Water
2584	Arylsulfonic acids	liquid , with more than 5 % free sulfuric acid	8	C1	II	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2586	Methane sulfonic acid	with not more than 5 % free sulfuric acid, liquid	8	C1	III	Water
2586	Alkylsulfonic acids	liquid , with not more than 5 % free sulfuric acid	8	C1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2586	Benzene sulfonic acid	with not more than 5 % free sulfuric acid, liquid	8	C1	III	Water
2586	Dodecylbenzene sulfonic acid	with not more than 5 % sulfuric acid, liquid	8	C1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2586	<i>para</i> -Toluene sulfonic acid	with not more than 5 % free sulfuric acid, liquid	8	C1	III	Water
2586	Toluene sulfonic acids	liquid, with not more than 5 % free sulfuric acid	8	C1	III	Water

Table C.1 (continued)

UN No. (1)	Name (2)	Description (3)	Class (4)	Classification code (5)	Packing group (6)	Standard liquid (7)
2586	Arylsulfonic acids	liquid, with not more than 5 % free sulfuric acid	8	C1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2610	Triallylamine		3	FC	III	Mixture of hydrocarbons and wetting solution
2614	Methallyl alcohol		3	F1	III	Acetic acid
2617	2-Methylcyclohexanol	<i>cis/trans</i> -mixture, flashpoint between 23 °C and 60 °C	3	F1	III	Acetic acid
2617	<i>cis</i> -2-Methyl-cyclohexanol		3	F1	III	Acetic acid
2617	<i>trans</i> -2-Methyl-cyclohexanol		3	F1	III	Acetic acid
2617	Methylcyclohexanols	isomeric mixture, flashpoint between 23 °C and 60 °C	3	F1	III	Acetic acid
2619	Benzyldimethylamine		8	CF1	II	Mixture of hydrocarbons and wetting solution
2620	<i>n</i> -Amyl butyrate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2620	Isoamyl butyrate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2620	<i>tert</i> -Amyl butyrate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2620	Isoamyl butyrate		3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2620	Amyl butyrates	isomeric mixture, flashpoint between 23 °C and 60 °C	3	F1	III	<i>n</i> -Butyl acetate/ <i>n</i> -butyl acetate-saturated wetting solution
2622	Glycidaldehyde	flashpoint below 23 °C	3	FT1	II	Mixture of hydrocarbons
2626	Chloric acid	aqueous solution with not more than 10 % chloric acid	5.1	O1	II	Nitric acid (55 %)
2656	Quinoline	flashpoint more than 60 °C	6.1	T1	III	Water
2672	Ammonia solution	relative density between 0,880 and 0,957 at 15 °C in water, with more than 10 %, but not more than 35 % ammonia	8	C5	III	Water
2683	Ammonium sulfide	aqueous solution, flashpoint between 23 °C and 60 °C	8	CFT	II	Acetic acid
2684	Diethylaminopropylamine		3	FC	III	Mixture of hydrocarbons and wetting solution