INTERNATIONAL STANDARD

ISO 18602

First edition
2013-01-15

Packaging and the environment — Optimization of the packaging system

Emballage et environnement — Optimisation du système d'emballage

Reference number
ISO 18602:2013(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 18602 was prepared by Technical Committee ISO/TC 122, *Packaging*, Subcommittee SC 4, *Packaging and environment*.

Introduction

Packaging plays a critical role in almost every industry, every sector and every supply chain. Appropriate packaging is essential to prevent loss of goods and, as a result, decrease impact on the environment. Effective packaging makes a positive contribution towards achieving a sustainable society by, (e.g.):

a) meeting consumers' needs and expectation for the protection of goods, safety, handling and information;

b) efficiently using resources and limiting environmental impact;

c) saving costs in the distribution and merchandising of goods.

An environmental assessment of packaging may include the manufacturing and distribution system, the wastage of packaging material and goods, the relevant collection systems, as well as recovery or disposal operations. This group of ISO standards and supporting reports provides a set of procedures which aim to:

d) reduce environmental impact;

e) support innovation in products, packaging and the supply chain;

f) avoid undue restrictions on the use of packaging;

g) prevent barriers and restrictions to trade.

Packaging is designed to provide a number of functions for users and producers such as: containment, protection, information, convenience, unitization, handling, delivery or presentation of goods. A major role of packaging is prevention of damage to or loss of goods. (See ISO 18601, Annex A for a list of the functions of packaging.)

ISO 18601 defines the interrelationships within the family of ISO standards which cover the environmental impact of packaging throughout its life cycle (see Figure 1). These standards will help define whether the selected packaging can be optimized and whether the packaging needs to be modified to ensure it can be reused or recovered after use.

Demonstration that the requirements of these standards are met can be performed by a first party (manufacturer or supplier), a second party (user or purchaser), or by the support of a third party (independent body).

Public claims on the environmental attributes of packaging may be addressed by different methods. Some of these are technical aspects on reuse or recovery, others relate to access by the population to reuse or recovery systems or the amount of packaging placed on the market for recovery. This series of standards addresses the technical aspects of the packaging. It does not address the requirements of ISO 14021 needed to support a claim or label.

This International Standard does not use the term "and/or" but, instead, the term "or" is used as an inclusive disjunction, meaning one or the other or both.

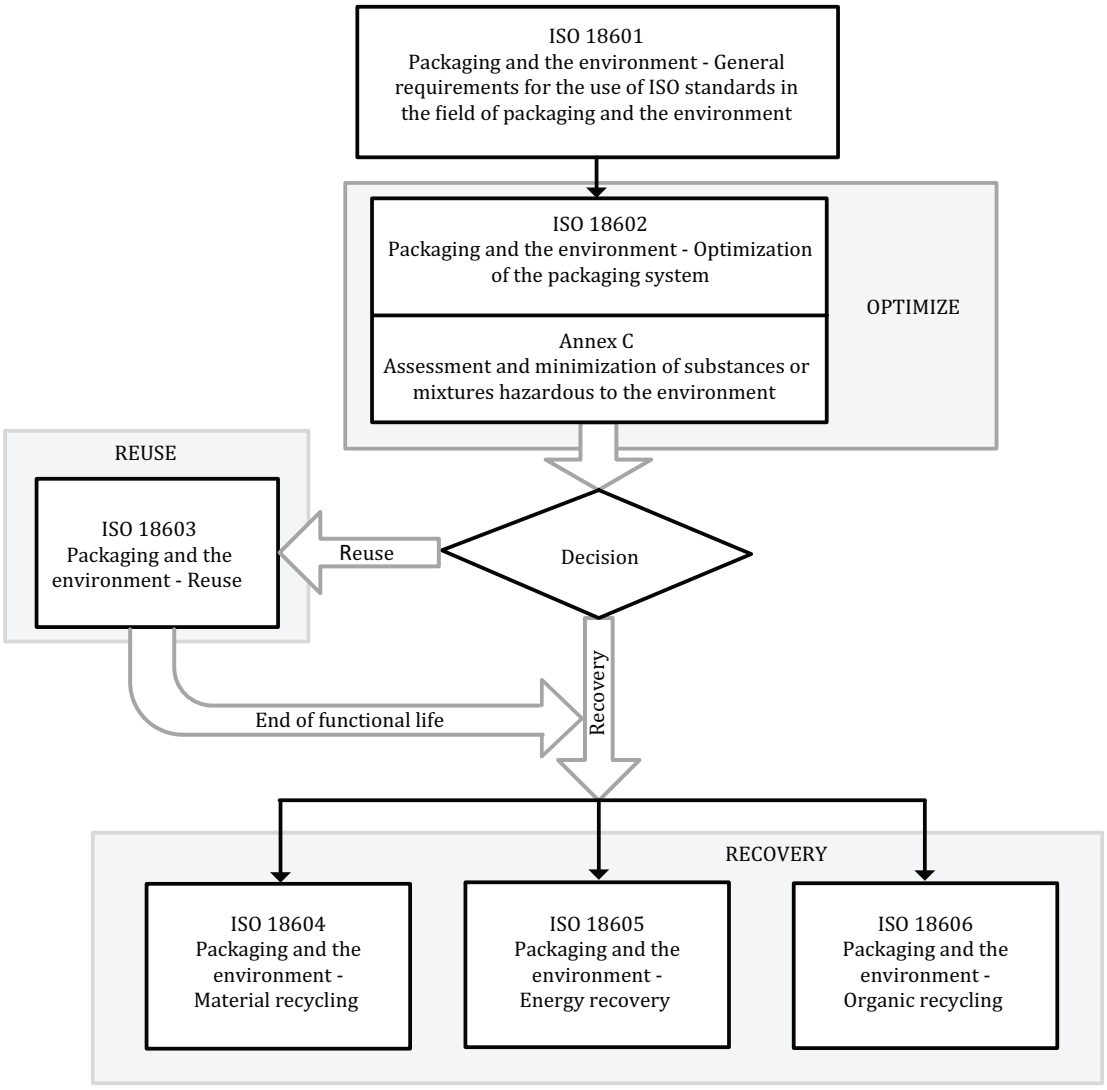


Figure 1 — Relationship of the Packaging and environment standards

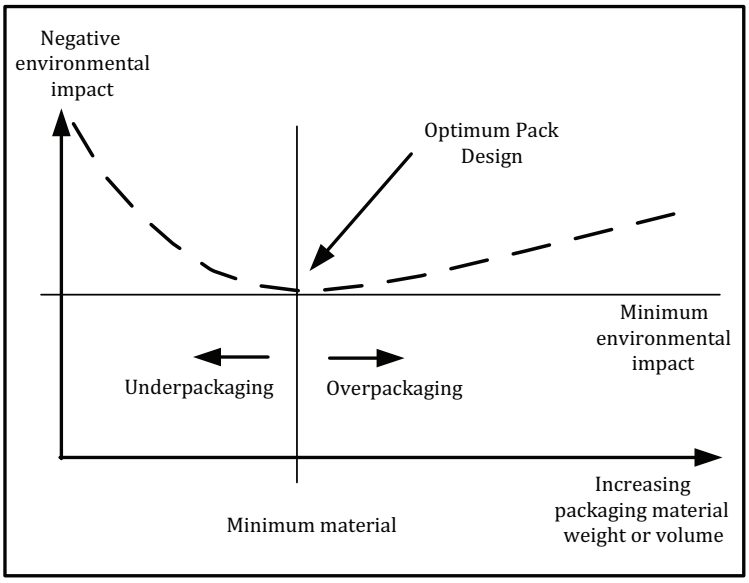


Figure 2 — Packaging optimization[32]

The model in Figure 2 illustrates how the environmental consquences of product losses caused by excessive packaging reduction are far greater than guaranteeing adequate protection through an incremental excess of packaging.

This International Standard presents a framework for self-assessment to determine whether the requirements of this standard have been met. Its approach is similar to that of systems standards such as the ISO 9000 series or an environmental management system such as ISO 14001.

Packaging and the environment — Optimization of the packaging system

1 Scope

This International Standard specifies requirements and a procedure for assessment of packaging to ensure that the weight or volume of its material content is optimized consistent with the functions of packaging. This is one of several options for reducing the impact of packaging on the environment.

This International Standard also provides methodologies and procedures for

a) determining the amount and minimization of substances or mixtures hazardous to the environment, and

b) determining the amount of four heavy metals (lead, cadmium, mercury, hexavalent chromium) in packaging.

The potential for such substances to be released into the environment is included in the assessment. The procedures are referenced in Annex C.

The process for packaging design, including material selection, is not part of this International Standard. The purpose is to help ensure and demonstrate that the packaging efficiently uses the selected material.

NOTE 1 For the purposes of this International Standard, the substitution of one packaging material by another is not a basis for packaging optimization.

NOTE 2 Packaging material optimization can include increasing the weight or volume of packaging in order to reduce loss of goods.

The procedure for applying this International Standard is contained in ISO 18601.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 18601, *Packaging and the environment — General requirements for the use of ISO standards in the field of packaging and the environment*

ISO 21067, *Packaging — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18601, ISO 21067 and the following apply.

3.1
packaging optimization
process for the achievement of a minimum adequate weight or volume (source reduction) for meeting the necessary requirements of primary or secondary or transport packaging, when performance and user/consumer acceptability remain unchanged or adequate, thereby reducing the impact on the environment

3.2
critical area(s)
specific performance criterion/criteria which prevents further reduction of weight or volume without endangering functional performance, safety, and user/consumer acceptability

3.3
supplier
entity responsible for placing packaging or packaged goods on the market

Note 1 to entry: The term "supplier" in normal usage can relate to various points in a supply chain. For the purpose of this document it relates to any point in the supply chain where a transaction relating to packaging or packaged goods takes place

[SOURCE: ISO 18601:2012, definition 3.22]

3.4
packaging component
part of packaging that can be separated by hand or by using simple physical means

[SOURCE: ISO 18601:2012, definition 3.11]

3.5
packaging constituent
part from which packaging or its components are made and which cannot be separated by hand or by using simple physical means

[SOURCE: ISO 18601:2012, definition 3.12]

3.6
packaging system
complete set of packaging for a packaged good, encompassing one or more of the following that are applicable (depending on the packaged goods): Primary packaging, Secondary packaging, Tertiary (distribution or transport) packaging

3.7
substances
chemical elements and their compounds in the natural state or obtained by any production process, including any additive necessary to preserve stability, and any impurity deriving from the production process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition

3.8
mixture
preparation or solutions composed of two or more substances

3.9
safety data sheet
documentation providing comprehensive information about a substance or mixture

Note 1 to entry: The UN Globally Harmonized System (3rd revised edition) — Part 1 and Annex 4 - requires that documentation should be provided to users of the substance or mixtures and to contain the required information.

3.10
used packaging
packaging that has been used by the final consumer or end user and which is destined for reuse or recovery

3.11
packaging waste
packaging that has been used by the final consumer or end user and which is discarded for final disposal and is not intended for reuse or recovery

3.12
substances hazardous to the environment
any substances classified as presenting an environmental hazard according to the UN Globally Harmonized System for Classification and Labelling of Chemicals and its amendments (GHS), 3rd revised edition, Part 4, while meeting the criteria of labeling with the environmental hazard pictogram

Note 1 to entry: This is a general classification of substances hazardous to the environment and cannot be taken as specifically relating to substances used in packaging.

4 Requirements

4.1 Application

The application of this International Standard to any particular packaging shall be as specified in ISO 18601, *Packaging and the environment — General requirements for the use of ISO standards in the field of packaging and the environment*.

4.2 Packaging assessment

4.2.1 Determination of critical area(s)

The supplier shall evaluate the complete list of relevant criteria in Clause 5 to determine the critical area[s] which will govern the achievable limit for packaging optimization. See Annex A for guidance.

The identification of at least one critical area shall be the basis of meeting the requirements of this International Standard for minimization. If no critical area has been identified the packaging does not meet the requirements of this International Standard and the potential for (further) packaging optimization is to be investigated.

NOTE As some of these critical areas can be interdependent, more than one area can, in some cases, be identified as critical for determining the minimum adequate amount of packaging.

4.2.2 Determination of presence of substances or mixtures hazardous to the environment

The supplier shall determine (with reference to the guidance provided in Annex C) whether there is a presence of substances or mixtures hazardous to the environment that are likely to be present in emissions, ash or leachate when packaging is incinerated or landfilled.

For example, the packaging manufacturer should receive from its supplier of substances or mixtures a safety data sheet as defined in 3.8.

The heading "composition/information on ingredients" should indicate the concentration or concentration range of substances or mixtures presenting an environmental hazard as outlined in Annex C.

NOTE The packaging manufacturer can calculate and so measure the presence of substances or mixtures hazardous to the environment in its packaging on the basis of information associated with the packaging formulation and manufacturing process.

4.2.3 Determination of the four named heavy metals

The supplier shall determine (with reference to the guidance provided in Annex C), by means of measurement, calculation or upstream information and data whether there is a presence of any of the four named heavy metals (lead, cadmium, mercury, and hexavalent chromium) in the packaging component.

NOTE The packaging manufacturer can calculate and so measure the presence of the four named heavy metals in its packaging on the basis of information associated with the packaging formulation and manufacturing process.

4.3 Demonstration that the requirements of this International Standard have been met

The supplier shall:

— prepare on request a statement that the requirements of 4.2.1, 4.2.2, and 4.2.3 have been met;

— document the relevant data or other information that has been used to develop the list of relevant performance criteria and in particular to establish the nature and effects of the critical elements;

— use a checklist (examples found in Annex B) or its own documentation to demonstrate that all critical areas listed in Clause 5 are covered;

— document that relevant safety data sheets and subsequent process information have been used to identify the possible presence of substances or mixtures hazardous to the environment in the packaging components and likely to be present in emissions, ash or leachate from waste management operations;

— if the presence of a substance or mixture hazardous to the environment has been identified document the relevant data and subsequent process information used to demonstrate that minimization has been achieved against the critical areas listed in Clause 5, with reference to the methodology provided in Annex C of this International Standard;

— determine that the aggregate presence of the four named heavy metals (lead, cadmium, mercury, and hexavalent chromium) in packaging components has been assessed as required by national or regional regulations where the packaging is intended to be used; Annex C provides guidance as to how this can be done;

— record the results with reference to the methodology in Annex C.

5 Critical areas to assess when determining the achievable level for packaging optimization

— protection of goods;

— packaging manufacturing process;

— packaging/filling process;

— logistics (including transport, warehousing and handling);

— presentation and marketing of goods;

— user/consumer acceptance;

— information;

— safety;

— legislation;

— other issues.

NOTE 1 Legislation and safety are examples of non-independent critical areas which have to be considered together.

NOTE 2 See Clause A.3 for description of critical areas.

Annex A
(informative)

Guidelines on the use of this International Standard for determining the achievable level for packaging optimization

A.1 Introduction

More detailed information is given in this Annex A in order to guide the person or persons using this International Standard. It can be used in the assessment of existing packaging or as an aid in the normal dialogue between supplier and customer in agreeing to a specification for new packaging.

Clause A.2 is about methodology, it describes the different phases of the assessment process.

Clause A.3 reviews the 10 critical area(s) and gives a few examples of important requirements which may be relevant to a given package.

Clause A.4 provides an example of a checklist layout to assist the assessment process and recording.

This process aims to achieve a minimum adequate weight or volume of a given package, and hence reduce the environmental impact, without increasing damage to or waste of goods, and respecting the critical area(s) to be met by the packaging. The assessment checklist may be used to record the major decisive findings of the packaging optimization process.

This is an ongoing process involving design and operational experience which will provide useful information to determine critical area(s).

Two examples of fully completed assessment checklists and their supporting reports together with explanatory documents which support the completion of the checklists can be found in Annex B.

A.2 Assessment methodology

The purpose of the assessment process, which may be documented by completion of a checklist (such as in A.4), is to ensure that:

— all opportunities within the same packaging material (refer to NOTE 1 of the Scope) for optimization have been identified and considered;

— minimization of the packaging material has been achieved while still meeting the necessary requirements of the packaging functions;

— important decisive references supporting the above statement are recorded.

The detailed requirements for packaging can vary from one application to another. In the packaging design process, during which packaging optimization is considered, the analysis of each of the requirements will impact on the overall specification of the packaging. The requirements may be classified in a checklist. As a first step of the assessment, the most important requirement(s), within each of the critical areas, may be listed in the second column of this checklist.

During the design process for packaging for a given application or group of similar applications, some of the requirements will determine the practical limitations for further reduction of the weight or volume of the packaging without endangering the necessary levels of safety, hygiene and user/consumer acceptability.

As a second step of the assessment process, the performance criterion/criteria limiting the ability to reduce weight or volume of the packaging will be identified. These are known as the “critical area(s)”. This identification should rely on any tests or studies performed to check validity of opportunities to achieve further optimization.

Documented practical experience from the market is also valid as a source of data regarding acceptable limits. The identified limiting area(s) should be recorded as critical.

A.3 Critical areas

A.3.1 General

The 10 performance criteria are reviewed in this clause. For each of them, a non-exhaustive list of typical requirements is provided. This list is intended to help any user of this International Standard to identify the important and decisive requirements.

NOTE As some of these critical areas can be interdependent, more than one area can, in some cases, be identified as critical for determining the minimum adequate amount of packaging.

A.3.2 Protection of goods

Goods should be protected against damage, loss and deterioration from the point of packaging until their use.

Requirements may consist of: protection against vibration, compression, humidity, light, oxygen, microbiological infection, pests, off-taste etc. Active and intelligent packaging may also contribute to the protection of goods.

Examples of requirements which can be important are:

— for fragile goods having to be stacked high: vertical load resistance;

— for fruit juice: UV light and oxygen barrier.

A.3.3 Packaging manufacturing process

The manufacturing processes operated by packaging manufacturers influence the range of characteristics of the packaging available to the designer.

Requirements may consist of shape of a container, thickness tolerances, size, feasibility of tooling, specifications minimizing waste in manufacturing, etc.

Examples of requirements which are often important:

— for a bottle: wall thickness distribution;

— for a corrugated box: flute orientation.

A.3.4 Packaging/filling process

The packaging/filling process influences the range of options available to the designer in order to minimize the waste of goods and packaging. Requirements may consist of: impact and stress resistance, mechanical strength, packing line speed and efficiency, stability in conveying, heat resistance, effective closing, minimum headspace, hygiene, etc.

Examples of requirements which are often important:

— for a metal can: stability during conveying, filling and retorting;

— for industrial fine powder (e.g. pigment) filled into a rigid drum: adequate headspace to avoid spillage before settlement.

A.3.5 Logistics (including transport, warehousing and handling)

The packaging (any combination of primary, secondary and transport packaging), should be suitable for the expected logistics, transport and handling systems and maintain adequate protection of goods and safety for those exposed to the handling and use of the packaged goods.

Requirements may consist of: dimensional co-ordination for optimum space utilization, compatibility with palletizing and depalletizing systems, handling and warehousing systems, and packaging system integrity during transport and handling, etc.

Examples of requirements which are often important:

— dimensional compatibility with standard pallets or crate systems;

— for high value goods (e.g. computer components), packaging should be free from any visible damage.

A.3.6 Presentation and marketing of goods

The packaging should enable proper identification of the packaged goods by the user/consumer as well as stimulate purchase. These requirements are linked to brand image, labelling, presentation, etc.

Requirements may consist of: identity and brand recognition, aesthetics, labelling, compatibility with retail display systems, compatibility with refill systems, pilfer resistance, etc.

Examples of requirements which are often important:

— for a branded fresh fruit juice: container with a specific shape;

— for high value small goods in self-service retail outlets: pilfer resistance.

A.3.7 User/consumer acceptance

The packaging should satisfy user/consumer needs and expectations in terms of unit size and convenience as well as ergonomics associated with handling, opening, reclosing, storing, disposal, etc.

Requirements may consist of: unit size, collation/multi-pack, handling ergonomics, tamper evidence, storage/shelf-life, ease of opening, dispensing and ability to empty, attractive presentation, etc.

Examples of requirements which are often important:

— for a large container: ease of carrying;

— for a single person household: portion packs small enough to be consumed before deterioration;

— for all containers: ease of opening.

A.3.8 Information

The packaging should be capable of providing any necessary information regarding use and care of goods as well as other useful instructions.

Requirements may consist of: providing information about the packaged goods, instructions for storage, application and use, bar codes, best before date, etc.

Examples of requirements which are often important:

— for a semi prepared meal: easy to read detailed instructions for cooking and serving on packaging separate from that used for cooking;

— for goods which are marked as dangerous: minimum size of label.

A.3.9 Safety

The packaging should be capable of meeting the requirements associated with user/consumer and product safety throughout the distribution system. Requirements may consist of: design for safe handling, child resistance, tamper evidence, hazard warnings, instructions relating to user/consumer and product safety, clear identification of content, safe opening device, pressure release closure, etc.

Examples of requirements which are often important:

— for baby food: tamper evidence to prevent/identify possible contamination;

— for industrial goods: unit size to be limited for safe lifting by operator.

A.3.10 Legislation

The packaging has to meet the issues covered by legislation, regulations and international trade agreements.

A large number of packaging requirements are regulated by national or international legislation and standardization. This fact concerns a number of important packaging areas such as for food, pharmaceuticals, dangerous and chemical goods. There are also legislative obligations concerning packaging used in certain modes of transport such as air, railways and sea.

The above will translate into the need for specific design or specific information on the packaging.

Legislation aimed at the protection of user/consumers and restricting the use of materials considered harmful to the environment is of particular importance in design, selection and use of packaging.

A.3.11 Other issues

If the relevant criterion for achieving minimum adequate weight/volume of the packaging is not covered by the preceding nine critical areas but is an existing quality requirement for packaging, it should be detailed under ”other issues”. These other issues may address economic, social or environmental implications.

A.4 Example of a checklist for demonstrating that the requirements of this International Standard have been met

PACKAGING Optimization of the packaging system Assessment Checklist		Packaging:	
Criterion	**Most important/relevant requirement**	**Critical Area(s)**	**References**
Protection of goods			
Packaging manufacturing process			
Packaging/filling process			
Logistics			
Presentation and marketing of goods			
User/consumer acceptance			
Information			
Safety			
Legislation			
Other issues			
In the light of the assessment results recorded above, this packaging meets the requirements of ISO 18602. Details of the supplier Name: Title: Organization: Mailing Address: City: Country: Date: Signature:			

Annex B
(informative)

Examples of the application of this International Standard using the checklist

B.1 General

The documents hereunder are only intended to facilitate the process of filling in this checklist. Example B.2 represents selection of a single critical area; example B.3 represents selection of multiple critical areas.

B.2 Example: Packaging for fresh fruit juice

B.2.1 General

The packaging is a non-returnable glass bottle for fresh fruit juice of 1 litre with tamper evident screw cap.

B.2.2 Protection of goods

To preserve the quality and flavor of the fruit juice the packaging shall provide an effective UV, oxygen and vapor barrier. The selected container and closure match these requirements due to their physical properties and by choosing a light-protective glass colour. There is no impact on the weight and volume of the glass bottle and hence no critical area.

B.2.3 Packaging manufacturing process

The state-of-the-art production technologies used in the manufacturing of the container ensure a homogenous glass distribution in the walls of the container, which is essential to achieve a minimum wall thickness (given the size, the shape and the required mechanical stability of the bottle). This is not a critical area.

B.2.4 Packaging/filling process

To prevent damages on the high speed conveying, filling and packing lines a defined mechanical stability is required. This is identified as a critical area, as the stability of the bottle is directly related to the wall thickness of the container and of the finish.

B.2.5 Logistics

With regard to the transport and handling conditions an adequate mechanical resistance of the glass container is required. Considering, however, the transport packaging usually used in the distribution chain these impacts are not expected to exceed the mechanical resistance required by the filling process. Thus logistics is not regarded as a critical area.

B.2.6 Presentation and marketing of goods

When designing the bottle, both the marketing strategy of the filler and the retailer's demands related to packaged goods presentation have to be considered. There appears to be two potential critical areas:

— the dimensions of the bottle were selected to facilitate a modular system for distribution and shelf display;

— the shape of the bottle was determined to support the brand identity.

However the design is not identified as a critical area as the chosen shape allowed a minimum wall thickness and hence a minimum weight of the bottle.

B.2.7 User/consumer acceptance

The screw cap facilitates the opening and reclosing of the bottle and also provides tamper evidence. The tamper evidence requirement is not a critical area as it has only a marginal impact on the weight or volume of the packaging.

B.2.8 Information

Information about the packaged goods is printed on the label. The information requirement is not corresponding to a critical area as the surface of the bottle gives space enough for labelling.

B.2.9 Safety

For safety reasons the bottle is sealed with a tamper evident screw cap. This is not a critical area as shown above under “user/consumer acceptance”.

B.2.10 Legislation

Not relevant.

B.2.11 Other issues

None identified.

EXAMPLE B.2

PACKAGING Optimization of the packaging system Assessment Checklist	Packaging:	1 litre, non-returnable, glass bottle
		Product reference : fresh fruit juice 026
		Packaging reference : BPSC/1L
		Checklist reference : 100117

Criterion	Most important/relevant requirement	Critical area(s)	References
Protection of goods	UV and oxygen tightness	No	
Packaging manufacturing process	Homogeneity of glass distribution	No	
Packaging/filling process	Impact resistance / mechanical stability	Yes	Stability tests and calculations
Logistics	Impact resistance / mechanical stability	No	
Presentation and marketing of goods	Modular dimensions / individual shape	No	
User/consumer acceptance	Tamper evidence / easy open & reclose	No	
Information		No	
Safety	Tamper evidence	No	
Legislation	Not relevant	No	

Other issues	None identified	No	
In the light of the assessment results recorded above, this packaging meets the requirements of ISO 18602. Name: Title: Organization: Mailing Address: City: Country: Date: Signature:			

B.3 Example: Packaging for computer

B.3.1 General

The computer is sold in 4 pieces of packaging:

— A plastic bag with a desiccant pack;

— A corrugated box with moulded insert cushioning.

B.3.2 Protection of goods

The computer requires two specific areas of protection:

— Protection against humidity: easily achieved with a plastic bag and desiccant pack with negligible impact on the weight and volume of the packaging. This is clearly not a critical area;

— Mechanical protection: testing demonstrates that the requirements for transport and handling systems (see B.3.5) adequately cover the protection of the computer. This is clearly not a critical area.

B.3.3 Packaging manufacturing process

Any type of corrugated box and cushioning could be manufactured to meet the requirements expected. There is no limitation from the point of view of manufacturing the box and the cushioning. This is clearly not a critical area.

B.3.4 Packaging/filling process

The moulded insert cushioning is used as a “carrier” tray through the production process to reduce damage and ease access for assembly. The cushioning could be produced to meet the two requirements (cushioning and carrier tray) at no extra weight or volume. This is clearly not a critical area.

B.3.5 Logistics

The packaging system (corrugated box + cushioning) is required to meet the usual transport and handling conditions. Drop tests were performed on different corrugated boxes to test the mechanical resistance. The conclusion is that the minimum acceptable board weight for the box is 400 g/m^2. Logistics is clearly identified as the critical area for this packaging.

B.3.6 Presentation and marketing of goods

For such a high value item, an undamaged package is important, especially for courier delivery. As the requirements for logistics (B.3.5) are higher, this is not a critical area.

B.3.7 User/consumer acceptance

Sometimes the hardware comes with a preloaded package of software chosen by the consumer. Therefore, the packaging needs adequate spare space to contain the software literature and discs. This is a critical area for volume.

B.3.8 Information

Information about the computer is not an issue. The large surface of the package is sufficient to allow all identifications and markings without any problem. Information requirements are clearly not corresponding to a critical area.

B.3.9 Safety

The packaging ensures that, in the event of severe damage to the contents, they will be fully contained and not pose a hazard to the handler. Safety requirements are clearly not corresponding to a critical area.

B.3.10 Legislation

Not relevant as no particular need is identified.

B.3.11 Other issues

For this high value item, a failure rate of less than 4 in a million is the target. This is addressed by the stringent requirements for B.3.5. It is not a critical area.

EXAMPLE B.3

PACKAGING Optimization of the packaging system Assessment Checklist	Packaging:	Plastic bag + desiccant pack + corrugated box + cushioning Product reference Computer 216/14 Packaging reference CB 16/PS27 Checklist reference 100127

Criterion	Most important/relevant requirement	Critical Area(s)	References
Protection of goods	Protection against humidity / mechanical protection	No	
Packaging manufacturing process		No	
Packaging/filling process	Cushioning used as a carrier during assembly	No	
Logistics	Suitable for transport and handling	Yes	Test report by XX Laboratory 11/09/10
Presentation and marketing of goods	No sign of damage on packaging	No	
User/consumer acceptance	Spare space for literature and disc if needed and handles	Yes (volume)	Dimensions of the computer and potential components
Information		No	
Safety		No	
Legislation		No	
Other issues	Less than 4 ppm failure in packaging	No	

In the light of the assessment results recorded above, this packaging meets the requirements of ISO 18602.
Name:
Title:
Organization:
Mailing Address:
City: Country:
Date: Signature:

B.4 Example of Laboratory Test Report

Different categories of corrugated cardboard boxes were tested upon the request of an electronics company.

The test selected was a standard vertical drop test (ISO 2248) from 0,75 m on to each face and one corner being representative of standard transport and handling conditions.

Prior to testing the boxes were conditioned for 48 hours at 20 °C and 65 % RH.

Twenty tests were performed for each reference of corrugated boxes after being filled with a plastic model simulating the computer. Failures were defined as having a permanent deformation of more than 5 mm in any place of the box.

Table B.1 — Result of test

Corrugated box reference / Board weight reference (g/m^2)	Number of failures (out of 20 tests)
200	8
250	4
300	1
350	0
400	0
450	0
500	0

Although the above table may indicate that the 350 g/m^2 board weight reference will resist damage, statistical interpretation determines that in order to achieve a less than 4 ppm ($4x10^{-6}$) failure, a 400 g/m^2 board weight reference is required.

Annex C
(informative)

Assessment and minimization of substances or mixtures hazardous to the environment

C.1 Introduction and scope

This Annex deals with the assessment of substances or mixtures hazardous to the environment that may be present in packaging and with the minimization of their use. Within this general scope, special attention is given to the possible presence of four heavy metals.

A simple and efficient assessment method is proposed, based preferentially on an 'upstream approach'. It is intended to be of practical use, and to enable efficient application, even for small and medium-sized companies in the packaging industry.

Both the presence of these substances in packaging and their likely release into the environment are addressed. Annex C is also intended to assist suppliers of packaging in meeting legislative requirements (where applicable).

Clause C.3 provides a recommended methodology and procedure for determining the presence in packaging, and minimizing the use, of substances or mixtures hazardous to the environment.

Clause C.4 provides additional guidance on determining the presence of heavy metals in packaging and their release to the environment. It deals with four heavy metals: lead, cadmium, hexavalent chromium (Cr^{VI}) and mercury, the control of which is the subject of legislation in several jurisdictions. This legislation was aimed at limiting the release of these metals or their compounds into the environment from packaging waste which is landfilled or incinerated.

For cases where the upstream approach cannot readily be applied, Clause C.4 also outlines and recommends test methods which can be applied to packaging and packaging components, for determining the presence and release of the substances concerned.

For information on concentration limits, users of this International Standard are referred to applicable legislation in the intended packaging markets or to relevant international standards.

C.2 References

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO Guide 30:1992, *Terms and definitions used in connection with reference materials*

ISO 3534-1:2006, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

ISO 7086 (all parts), *Glass hollowware in contact with food — Release of lead and cadmium*

ISO 10012:2003, *Measurement management systems — Requirements for measurement processes and measuring equipment*

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

ISO 17088, *Specifications for compostable plastics*

UN Globally Harmonized System of Classification and Labelling of Chemicals, 3rd revised edition

C.3 Identification and minimization of the use of substances or mixtures hazardous to the environment

C.3.1 Background to the proposed methodology and assessment approach

C.3.1.1 Packaging and its components and constituents

”Packaging component” and ”packaging constituent“ have been defined in Clause 3 of this International Standard. The proposed methodology in this Annex is built on an “upstream approach” where the assessment of an item of packaging is based on information from suppliers of components, constituents and raw/recycled materials. The chart below shows the Interrelationships.

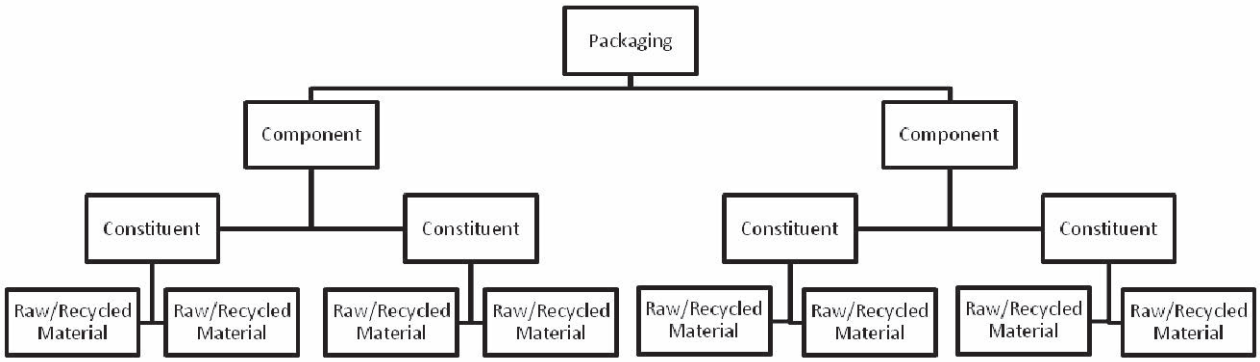


Figure C.1 — Interrelationships between packaging, packaging components and packaging materials

NOTE To facilitate understanding, some illustrative examples are given below.

a) “Packaging Component” (3.3)

   1) “Part of packaging that can be separated by hand or by using simple physical means.”

   EXAMPLE 1 Glass bottle, printed label, enameled glass, printed multilayer film, easy-open end, steel can body, cap.

b) “Packaging Constituent” (3.4)

   1) “Part from which packaging or its components are made and which cannot be separated by hand or by using simple physical means”.

EXAMPLE 2 for the component “printed label“, the constituents are: unprinted label - printing ink, including any solvents used;

EXAMPLE 3 for the component “enameled glass“ the constituents are: plain glass - enamels ready to use including the medium;

EXAMPLE 4 for the component “printed multi-layer film“, the constituents are: base film - tie coat - barrier - top film - printing ink.

C.3.1.2 The Upstream approach

The “Upstream Approach“ is recommended as the most effective means of establishing and verifying the use and potential presence of substances or mixtures hazardous to the environment in packaging or its components. Sources of raw materials and recycled materials, the characteristics of constituents,

and the manufacturing of the packaging and its components in all stages of the product life-cycle, are to be considered in this evaluation procedure.

In this way it can be ensured that the relevant information comes from the suppliers of raw materials and constituents, who are in the position to exert proper control over the levels, to test as appropriate and to be able to judge the need for testing and the appropriate test frequencies.

The upstream approach furthermore ensures that complete documentation on the concentration levels in packaging and its components is available. The evaluation of concentration levels in a packaging or in its components is normally performed by calculation. Identification of substances with environmental hazards by chemical analysis of materials is one method but, given the number and diversity of substances that may be considered as hazardous to the environment, it is not practically possible to test all materials and products for the presence of all substances that may be present. Except where required by legislation or regulation, the need for testing packaging components or packaging is limited to those cases where the producer or importer is not able to provide full documentation on concentrations in raw materials, constituents or components.

Safety Data Sheets are widely used in industry for conveying information on hazards and appropriate handling recommendations. The UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS), Part 4, provides a common international system for classification and identification of substances or mixtures hazardous to the environment; Part 1 and Annex 4 provide guidance on the content of Safety Data sheets. Based on these, manufacturers of materials and packaging can identify the potential use of substances or mixtures hazardous to the environment used for production and also the potential presence in a final packaging.

Once the presence of substances with environmental hazards has been identified, environmental impacts can be assessed and action to minimize their use can be taken.

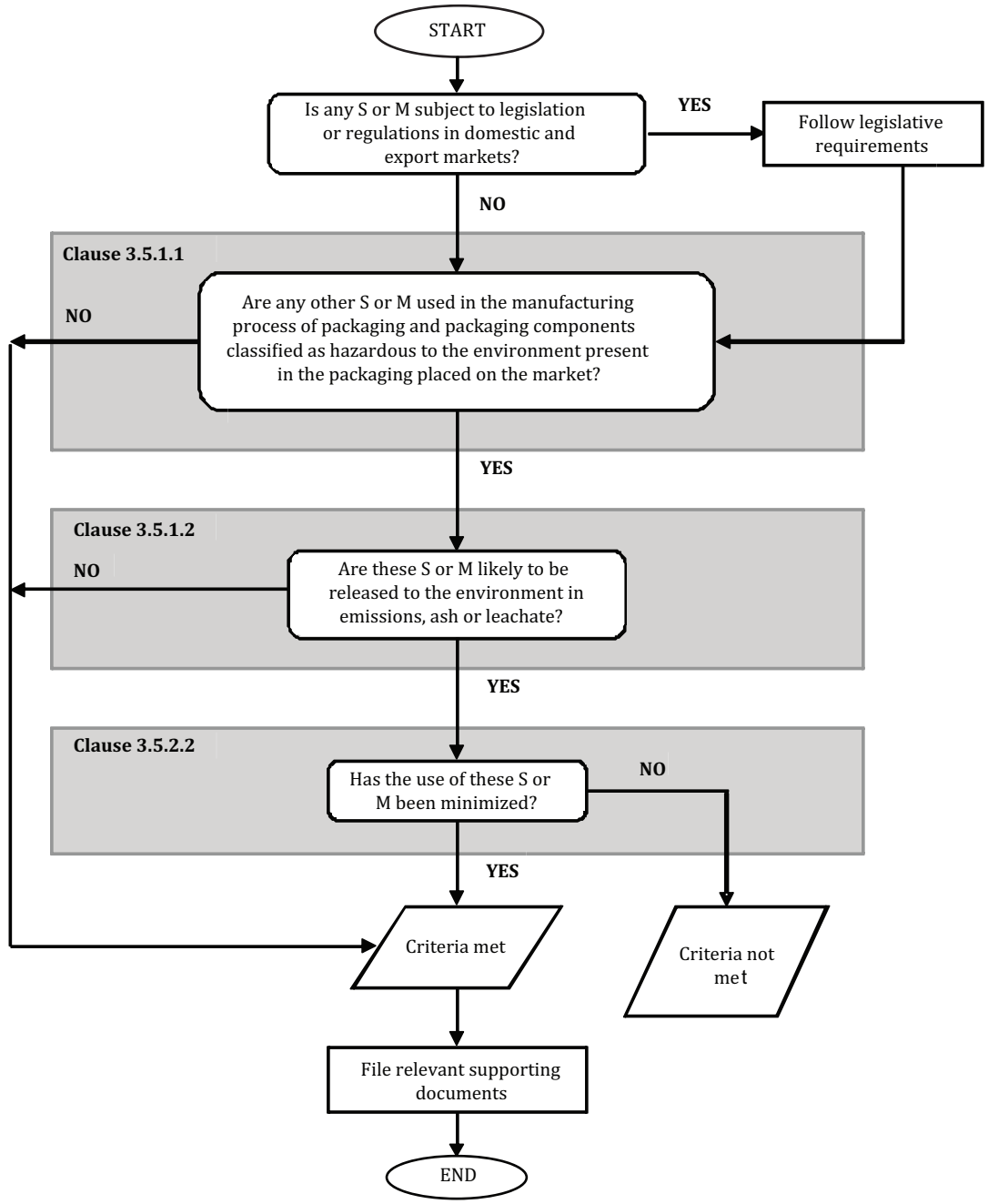
The approach proposed in this Annex is a methodology to minimize the use of substances or mixtures hazardous to the environment and their release into the environment, given their functional use in specific items of packaging. Restrictions defined by legislation applicable to specific goods always apply.

A restriction list, often based on legal requirements and substances relevant for certain types of goods, is an efficient and commonly used tool for limiting the use of substances with environmental hazards – provided that the number of substances to be checked is limited. Such a list would facilitate the identification of the substances or mixtures that may be considered as hazardous to the environment, relevant for a given packaging supplier, especially for small and medium-sized companies. However, considering the number and diversity of substances concerned, to cover a complete industry sector worldwide using a comprehensive restriction list would not be practical. Instead, the general approach of minimization based on functional use is proposed.

For packaging, the importance of safety, the protection of health and the hygiene of the packaged goods are emphasized. Substances or mixtures that are hazardous to the environment might be hazardous in other respects as well, e.g. for the health and safety of consumers. A possible consequence of this may be that considerations related to health and safety has already had the effect of minimizing or even eliminating the use of such substances in packaging.

C.3.2 Methodology for identification and minimization of substances or mixtures hazardous to the environment in packaging

The approach proposed in this Annex is a stepwise methodology visualized in the decision tree in Figure C.2.



Key

M mixture(s)
S substance(s)
NOTE Cut-off rules as defined in GHS.

Figure C.2 — Decision tree — Minimization of substances or mixtures hazardous to the environment

C.3.2.1 General principle

The individual or organization responsible for placing a specific packaging on the market should be able to demonstrate that only the minimum adequate amount of any substance or mixture hazardous to the environment has been used in the packaging or packaging component, with regard to its release into the environment, i.e. presence in emissions, ash or leachate from incineration or landfilling.

C.3.2.2 Identification

C.3.2.2.1 The 'Upstream approach' as the basic principle

A simple and efficient assessment method for the identification of substances or mixtures hazardous to the environment in packaging and packaging materials is needed. This International Standard proposes the 'upstream approach'.

The upstream verification in the sense of ISO 9000:2005 should be traceable by means of information from the suppliers of raw materials or constituents. The consultation of the relevant Safety Data Sheets is recommended for this purpose.

C.3.2.2.2 The Identification procedure

C.3.2.2.2.1 Substances hazardous to the environment - 1

Any substances classified as presenting an environmental hazard according to the UN Globally Harmonized System for Classification and Labelling of Chemicals and its amendments (GHS), 3rd revised edition, Part 4, while meeting the criteria of labelling with the environmental hazard pictogram.

NOTE 1 This is a general classification of substances hazardous to the environment and cannot be taken as specifically relating to substances used in packaging.

NOTE 2 Substances or mixtures meeting the criteria for being labelled with the environmental hazard pictogram are substances hazardous to the aquatic environment, classified as having

a) acute hazard category 1, or

b) chronic hazard categories 1 or 2.

C.3.2.2.2.2 The use of Safety Data Sheets for determining the presence of substances or mixtures hazardous to the environment - 2

For the purpose of substance identification, the packaging manufacturer or its upstream supplier should consult the relevant Safety Data Sheets received from the supplier. The Safety Data Sheets provide necessary information on substances or mixtures hazardous to the environment and enable the packaging manufacturer to verify their presence in packaging.

The following points in particular should be noted:

a) A Safety Data Sheet is documentation provided by any person who is responsible for placing a substance or mixture hazardous to the environment on the market, whether the manufacturer, importer or distributor. The safety data sheet information is principally intended for professional users and enables them to take the necessary measures as regards the protection of health, safety and the environment at the place of work. The safety data sheet may be supplied on paper or electronically.

b) Under GHS, the Safety Data Sheet contains 16 obligatory headings. Information on the composition of a mixture of hazardous substances is given in headings 2 and 3. Heading 12 (Ecological information) requires the description of the most important characteristic likely to have an effect on the environment due to the nature of the substance or mixture and likely methods of use. Information of the same kind should be supplied for substances hazardous to the environment arising from the degradation of substances or mixtures.

c) For the purpose of identification and verifying the presence of substances or mixtures hazardous to the environment the packaging manufacturer should receive from the supplier of hazardous substances or mixtures a Safety Data Sheet.

Heading 2, "composition/information on ingredients" should indicate the concentration or concentration range of substances presenting an environmental hazard if they are present in concentrations equal

to or greater than cut-off rules laid down in Table 1.5.1 in the UN Globally Harmonized System for Classification and Labelling of Chemicals.

The packaging manufacturer can calculate and so determine the presence of substances or mixtures hazardous to the environment in the packaging produced by him, on the basis of information associated with the packaging formulation and manufacturing process.

d) When safety data sheets for packaging components or packaging material constituents are not available, the packaging manufacturer should obtain relevant, corresponding, information to be able to perform risk assessment.

C.3.2.2.2.3 The use of recycled materials in packaging production - 3

Recycled materials are often used in the production of packaging, for environmental, regulatory or economic reasons. Two situations should be considered.

The first is when the composition of these materials can be accurately defined because their sources are known precisely: in most such cases, these sources are industrial and identifiable. If so, the upstream approach is usually applicable. This may also be the case when post-consumer waste is regenerated through an appropriate process.

The second situation arises when the composition, and notably the incidental presence of impurities, cannot be defined with precision. This typically arises in cases of recycling post-consumer packaging materials, which are collected and combined from vast numbers of households. Under these circumstances, it may be difficult to control with precision the possible addition of unwanted impurities at some point in the recycling loop. Safety Data Sheets for these materials will usually not be available.

In this second situation, where a reasonable expectation that a classified substance in these recycled materials exists at a level exceeding GHS cut-off rules, the packaging manufacturer should carry out an assessment of environmental risk, as described in C.3.5.1.2 below. This should take into account the relevant information available from suppliers about both the materials and the supply chain.

In cases where measurements of concentration are needed in order to assess the presence of impurities, reliance on statistical methods is necessary.

C.3.3 Release into the environment

C.3.3.1 In several jurisdictions, the presence of substances or mixtures hazardous to the environment in constituents of the packaging material, or in any of the packaging components, has to be minimized with regard to their presence in emissions, ash or leachate, when packaging or residues from management operations or packaging waste are incinerated or landfilled.

C.3.3.2 For the purpose of identification, only substances or mixtures identified as hazardous to the environment that are likely to be released into the environment have to be considered.

C.3.3.3 With regard to the number and diversity of substances or mixtures, which may be considered as hazardous to the environment, there are no currently available general standardized methods for the systematic measurement of their presence in emissions, ash or leachate, when packaging or residues from management operations or packaging waste are incinerated or landfilled.

The task of elaborating specific standardized methods for each substance and applicable in each practical case can be extremely complex.

Nevertheless, it is possible, in some cases, to demonstrate with sound evidence that even when a substance or mixture hazardous to the environment is present in the constituents, there is no risk of it being ultimately released into the environment.

Examples can be substances or mixtures hazardous to the environment of organic chemical nature, which are rendered non-hazardous by the combustion process. The risk of leaching into landfills can also be related to the chemical or physical nature of the material considered.

C.3.4 Minimization

C.3.4.1 If a constituent is identified to contain substances or mixtures hazardous to the environment which are likely to be released into the environment, then the principle of using only a minimum adequate amount of these substances should be applied.

C.3.4.2 The principle of using the minimum adequate amount has to be established in relation to the functional performance requirements of the substance being used (seeClause A.3 of this International Standard).

C.3.5 Assessment to meet requirements for substances or mixtures hazardous to the environment

The individual or organization responsible for placing a specific packaging on the market ('packaging supplier') should be able to demonstrate that only the minimum adequate amount of any substance or mixture hazardous to the environment has been used as a constituent of the packaging material or any of the packaging components, with regard to its presence in emissions, ash or leachate from incinerators or landfills. The steps taken in order to determine and demonstrate minimization are explained below and are shown in the decision tree detailed in Figure C.2.

C.3.5.1 Determination of substances or mixtures to be considered for minimization

C.3.5.1.1 The packaging supplier should first determine whether any substance or mixture hazardous to the environment used in the manufacturing process of the packaging or packaging components is present in the packaging placed on the market. This determination should be made using the Safety Data Sheets for the relevant substance or mixture.

If no such substances or mixtures have been identified the procedure is concluded. In this case proceed to C.3.5.2.1.

If such substances or mixtures are present, proceed to C.3.5.1.2.

C.3.5.1.2 The packaging supplier should evaluate the possibility that any of the substances or mixtures identified in C.3.5.1.1 are likely to be present in emissions, ash or leachate resulting from incineration or landfilling of the packaging or the packaging components after it has been used for its purpose as packaging.

— If the substances or mixtures identified are not likely to be released in emissions, ash or leachate, the procedure is concluded. In this case consideration of the substances or mixtures for minimization is not applicable. Proceed to C.3.5.2.1;

— If any substance or mixture identified is likely to be released in emissions, ash or leachate, the packaging supplier should meet the minimization requirement and proceed to C.3.5.2.2.

C.3.5.2 Meeting the minimization criteria

C.3.5.2.1 If no substance or mixture classified as hazardous to the environment has been identified or is likely to be present in emissions, ash or leachate, the packaging component meets the requirements. A record of the data should be retained.

C.3.5.2.2 If a substance or mixture hazardous to the environment has been identified according to the procedure described in C.3.5.1.2, the minimization requirement should be demonstrated.

For this purpose the packaging supplier should:

— document the relevant substances identified in C.3.5.1.1 and C.3.5.1.2; and

— document that only the minimum adequate amount of the relevant substances has been used with regard to their functional purpose, the performance criteria described in this International Standard, and to their likely presence in emissions, ash or leachate from incinerators or landfills.

C.4 Methods for determining the presence of four heavy metals in packaging and their release into the environment

C.4.1 Possible sources of heavy metals present in packaging

C.4.1.1 Natural sources

The four heavy metals covered in this Annex occur naturally with the exception of hexavalent chromium (Cr^{VI}). Cr^{VI} is the highest oxidation state of chromium. Cr^{VI} ions are very unstable especially after release in the environment, since they are readily reduced by both organic and inorganic matter. The other metals or their compounds can be found in raw materials, usually in very low concentrations.

C.4.1.2 Recycling

The levels of heavy metals can increase with extended use of recycled materials. The exception is for some industrial processes which separate heavy metals. The occurrence of heavy metals in recycled materials does not necessarily originate in packaging, but in other goods or materials introduced into the same loop as packaging materials. Examples include (non-packaging) lead-containing glasses or ceramic glazes. This can be a significant contributor to the occurrence of heavy metals in packaging, particularly where closed loop (packaging-to-packaging) recycling is involved.

C.4.1.3 Functional use

Examples of the intentional introduction of the four heavy metals in packaging are very few. In many cases, these applications have now been replaced by substitutes, but this is not always feasible. The principal known examples are: lead or cadmium in pigments used in some enamels; lead, cadmium or hexavalent chromium (Cr^{VI}) in pigments used in some plastic crates, pallets, and other plastic packaging; lead oxide used in lead crystal glass (although this is very rarely packaging), and lead and Cr^{VI} in some paints or lacquers used on steel drums. Chromium in its more stable trivalent state is more widely used but does not present the toxic properties of Cr^{VI}.

C.4.1.4 Hexavalent chromium in metallic materials

Cr^{VI} does not occur in metallic materials and would not be stable on the surface in those cases where surface treatments using chromium salts were applied.

No routine method is available for demonstrating the absence of Cr^{VI} in metallic materials but basic chemical principles argue against the presence of Cr^{VI} in metals.

C.4.2 Determining the concentration of the heavy metals in packaging or packaging components – two valid approaches

Three characteristics of packaging production are noted here. These are that:

— packaging production is a multi-stage process from the raw materials to the final packaging product;

— it is possible for heavy metals to be introduced - intentionally or as impurities - at any stage of the production process;

— information about the occurrence of heavy metals at the various stages differs from case to case.

In the light of these characteristics, two basic means of determining concentration levels in packaging or packaging components are recommended. Both means are considered as valid alternatives, depending on the information available:

a) Calculating the heavy metal content in packaging or its components on the basis of reliable information about the heavy metal content of individual constituents of packaging (the ‘upstream’ approach).

Calculation is recommended when reliable, documented 'upstream' information about heavy metals through the manufacturing process is available. For the purpose of calculation reliable information about the intermediate products ("constituents" from which packaging or its components are made) are of relevant interest.

b) Testing the heavy metal content in packaging or its components.

Tests are necessary in cases where no complete or reliable "upstream" information about heavy metals from earlier stages of the manufacturing process are available or where required by legislation or regulation.

For the purpose of practical implementation of the evaluation procedure, these alternatives are further described as follows:

c) Calculation based on "upstream information" on the constituents of packaging

   1) Collect certified information on the heavy metal contents of all constituents of packaging;

   2) Calculate the total heavy metal content of packaging or component by adding up the weighted heavy metal contents of the individual constituents (weighted with their proportion of the total weight of the packaging/component).

d) Testing of samples of packaging or its components

   1) Break down packaging into its components;

   2) Test the heavy metal content of each component with appropriate testing and analytical methods (see C.4.4).

Each of the two methods is consistent with the other since the evaluation should theoretically establish at any one time the same heavy metals concentration in packaging or in a component. In practice, the results may differ due to statistical uncertainties when using test methods.

C.4.3 Assessment approach to minimization of environmental impact

C.4.3.1 Introduction

One way of assessing the environmental impact of heavy metals present in packaging is to assess their likely presence in emissions, ash or leachate from waste management operations (i.e. incineration or landfilling).

— In some cases, a significant correlation between the content of heavy metals in packaging and the release of heavy metals into the environment may exist. This means that a low environmental impact can be achieved by means of minimizing the content.

— Alternatively, a significant correlation between the content of heavy metals in packaging and the release of heavy metals into the environment may not exist. Consequently a packaging component with higher heavy metal content may nevertheless induce only a low heavy metals' presence in emissions ash or leachate, depending on its chemical and physical properties.

C.4.3.2 Evaluation of the presence of heavy metals in emissions, ash and leachate from waste management operations

This section proposes an approach to the potential for minimization

— If a constituent containing heavy metals is used for a functional purpose, then the principle of using only the minimum adequate amount of this constituent will generally be applicable.

— If packaging or a packaging component contains heavy metals only as impurities, then minimization of content will not be realistic (for examples of sources of heavy metals as impurities, see C.4.1). In such cases, leaching tests can be used to determine the likely presence of heavy metals in emissions,

ash or leachate and to evaluate the degree of environmental impact, even though they do not represent the real conditions in incinerators or landfills.

NOTE In special circumstances, specific requirements related to the heavy metal content may apply (e.g. specific requirements for compostable plastics, ISO 17088)

C.4.4 Applicable test methods

In general, three kinds of test method can be envisaged:

a) Analytical methods, partly standardized, used by each industrial sector for internal control

b) General survey procedures for determining heavy metals, which can be used for analyses of packaging materials:

   1) Methods used by non-industrial laboratories;

   2) Standard methods or draft standard methods on soil and waste.

c) Leaching tests.

This International Standard prescribes no detailed testing methods for the determination of heavy metals. However the testing methods used should be validated by the testing laboratory in accordance with ISO/IEC 17025 or other appropriate recognized standard.

Where no applicable international standard test methods are available, reference should be made to relevant published national standards

C.4.4.1 Measuring the four heavy metals

This operation involves three main steps: - sampling - preparing the test portion - analysis of the test portion.

C.4.4.1.1 Sampling

The sampling method depends on the number, the kind and the size of packaging and packaging waste.

C.4.4.1.2 Preparing the test portion

The sample is to be cleaned before testing, except in cases where any residues it could contain are required to be included.

Preparing the test samples depends on kind, size, material constituting the packaging, and the analytical method which will be used. Sample preparation can be split into three steps:

— Separating the packaging into its components. Thereafter, each component will be treated separately. The analytical laboratory is responsible for ensuring that the results of heavy metals analyses represent the whole components.

— Cutting, grinding, and then mixing to obtain an average sample.

— Reducing the average sample to a test portion ready to be analysed by manual or mechanical means.

Where the aim is to determine composition using one of the analytical methods listed in C.4.4.1.3,.b) (below) the sample is first subject to digestion, usually using specified acid solutions or mixtures (examples include perchloric, nitric, sulphuric and hydrofluoric acid, and aqua regia). The aim is to dissolve the sample completely and obtain good reproducibility (low dispersion) of results. Sometimes other reagents (eg alkalis) are needed. The choice of reagent depends mainly on the material being tested and safety considerations. Acid digestion is not required for the other analytical methods mentioned.

C.4.4.1.3 Analysing the test portion

Three categories of tests can be considered:

a) X-ray fluorescence (XRF), spark emission, and DC arc emission spectrometric methods. The analysis will be carried out without any supplementary treatment of the sample;

b) Atomic absorption, inductively coupled plasma (ICP) emission spectrometric methods, polarography;

In these tests, the analysis should be carried out in two phases:

— Digestion: various methods have been standardized or published at national or regional level (see preceding clause on sample preparation);

— Analysis of the aqueous solutions after digestion: general procedures exist.

c) Leaching tests. These are used where it is desired to examine possible releases of substances from packaging or packaging components into the environment. The analysis should be carried out according to an existing or draft standard, without any supplementary treatment of the samples, except perhaps a special grinding or sieving step. (Example: ISO 7086 for glass in contact with food).

NOTE Except in leachates, the analytical methods do not permit the separation of hexavalent chromium from trivalent chromium.

Bibliography

[1] ISO Guide 30:1992, *Terms and definitions used in connection with reference materials*

[2] ISO 7086, *Glass hollowware in contact with food — Release of lead and cadmium*

[3] ISO 11014:2004, *Safety data sheet for chemical products — Content and order of sections*

[4] ISO 14001:2004, *Environmental management systems — Requirements with guidance for use*

[5] ISO 14040:2006, *Environmental management — Life cycle assessment — Principles and framework*

[6] ISO 14044:2006, *Environmental management — Life cycle assessment — Requirements and guidelines*

[7] ISO/IEC 17025:2005, *General requirements for the competence of testing and calibration laboratories*

[8] ISO 17088, *Specifications for compostable plastics*

[9] ISO 18603, *Packaging and the environment — Reuse*

[10] ISO 18604, *Packaging and the environment — Material recycling*

[11] ISO 18605, *Packaging and the environment — Energy recovery*

[12] ISO 18606, *Packaging and the environment — Organic recycling*

[13] ISO 3534-1:2006, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

[14] ISO 10012:2003, *Measurement management systems — Requirements for measurement processes and measuring equipment*

[15] ISO 9000:2005, *Quality management systems — Fundamentals and vocabulary*

[16] UN Globally Harmonized System of Classification and Labelling of Chemicals, 3rd revised edition

[17] WHO. *Lead and Cadmium Reference List*, 2008 www.who.int/ifcs/documents/standingcommittee/lyc_05.doc

[18] 67/548/EEC Council Directive of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances

[19] 91/155/EEC Commission Directive of 5 march 1991 defining and laying down the detailed arrangements for the system of specific information relating to dangerous preparations in implementation of Article 10 of Directive 88/379/EEC

[20] 1999/45/EC Directive of the European Parliament and of the Council of May 31 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations

[21] 2001/58/EC Commission Directive of 27 July 2001 amending for the second time Directive 91/155/EEC defining and laying down the detailed arrangements for the system of specific information relating to dangerous preparations in implementation of Article 14 of European Parliament and Council Directive 1999/45/EC and relating to dangerous substances in implementation of Article 27 of Council Directive 67/548/EEC (safety data sheets)

[22] 1999/177/EC Commission Decision of the 8th February 1999 establishing the conditions for a derogation for plastic crates and plastics pallets in relation to the heavy metal concentration levels established in Directive 943/62/EC on packaging and packaging waste

[23] 2001/171/EC Commission Decision of the 19th February 2001 establishing the conditions for a derogation for glass packaging in relation to the heavy metal concentration levels established in Directive 94/62/EC on packaging and packaging waste

[24] Commission Decision (2006/340/EC) of 8 May 2006 amending Decision 2001/171/EC of the European Parliament and of the Council for the purpose of prolonging the validity of the conditions for a derogation for glass packaging in relation to the heavy metal concentration levels established in Directive 94/62/EC

[25] Commission Decision (2009/292/EC) of 24 March 2009 establishing the conditions for derogation for plastic crates and plastic pallets in relation to the heavy metal concentration levels established in Directive 94/62/EC

[26] ASTM D 4057-6, *Standard practice for manual sampling of petroleum and petroleum products*

[27] ISO/TR 16218[1)], *Packaging and the environment — Chemical recovery*

[28] ISO/TR 17098[2)], *Packaging material recycling — Report on substances and materials which may impede recycling*

[29] CR 13910, *Packaging — Report on criteria and methodologies for life cycle analysis of packaging*

[30] CR 13695:2000, *Packaging — Requirements for measuring and verifying the four heavy metals and other dangerous substances present in packaging and their release into the environment (CEN reports, Parts I & II)*

[31] CLP-Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures

[32] Erlov L., Lofgren C., Soras A. *Packaging — A tool for the prevention of environmental impact*, Packforsk report 194, Stockholm 2000

1) To be published.

2) To be published.

ICS 55.020, 13.020.01
Price based on 27 pages