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Packaging — Material recycling — Report on requirements for substances and materials to prevent a sustained impediment to recycling

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National foreword

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Emballages - Recyclage matière - Rapport sur les exigences relatives aux substances et aux matériaux destinés à éviter tout obstacle durable en recyclage

Verpackung - Stoffliche Verwertung - Bericht über Anforderungen für Substanzen und Materialien zur Verhinderung einer andauernden Behinderung der stofflichen Verwertung

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Foreword

This document (CEN/TR 13688:2008) has been prepared by Technical Committee CEN/TC 261 “Packaging”, the secretariat of which is held by AFNOR.

This document supersedes CR 13688:2000.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This report has been prepared by CEN/TC 261 SC 4 WG 3 in support of the Standards Mandated in M200 Rev 3, in particular the Principal Standard EN 13430 "Packaging - Requirements for packaging recoverable by material recycling".

Introduction

The Packaging and Packaging Waste Directive states the essential requirements that must be satisfied for packaging to be placed on the market, and includes the requirements for that packaging to be considered recoverable. Recovery by material recycling is largely influenced by the materials used for packaging and the condition in which they arrive at the recycling operations. The materials and substances used in their manufacture and also the products contained can and will influence the collection, sorting and recycling operations. This report provides examples covering the main packaging materials and can be used as a guide for taking into account substances and materials that may be incorporated in packaging and which may, or do, inhibit subsequent operations related to recycling.

The Mandate M200 Rev 3 sets out the requirements for a number of principal standards and supporting reports. For Material Recycling, the mandate states the requirement for :

— the standard intended to give presumption of conformity with the essential requirements for packaging recoverable in the form of material recycling shall be in line with Annex 2, Clause 1, indent 1, 2 and 3 and Annex 2 Clause 3.(a) of the Directive.

— The requirements shall take into account :

  — substances or materials that are liable to create problems in the recycling process ;

  — materials, combinations of materials or designs of packaging, that are liable to create problems in collecting and sorting before material recycling ;

  — the presence of substances or materials that are liable to have a negative influence on the quality of the recycled material.

The standard EN 13430 sets out the basis on which packaging may be classified as recoverable by recycling. This is one of the routes for the recovery of used packaging, with the inter-relationship between the various routes being covered in the standard EN 13427.

The standard EN 13430 requires that the design, choice of materials and the manufacturing operations of packaging take into account the activities through which the used packaging will go when processed through the expected recovery operations. In particular that standard deals with the need to take into account the collection, sorting and recycling of the materials.

A good standard should be clear and unambiguous, readily and easily understood and enable the determination of whether the activity/product conforms to the requirements. As far as possible it must also be such that it has a longevity, by not being outdated by failing to cover all the issues that fall within its intended scope, or by the inevitable developments - technical and commercial - which are stimulated by the legal requirements, and even by the standard itself.

It is not appropriate for a standard to list "substances and materials that create problems...” as this will lead to the failure to satisfy the above requirement of a good standard, in that such a list may never be complete, and if a substance or material is not on the list it could justifiably be considered as fully acceptable. Also, technology is constantly being developed, and the so called problem materials may become no longer a problem.

A standard needs to avoid being prescriptive with the resultant fundamental principle that it is not the role of a standard to provide definitive lists, but rather to provide the basis on which any such defined lists are controlled/assessed or measured.

In practice, the recycling of used products is determined not only by the collection, sorting and recycling process, but also by the application in which the recycled material is expected to be used. The requirements of the application in which the recycled materials are to be used can have a far greater effect on the decision on whether a "substance or material" will cause a problem in the recycling process. Therefore the Mandate is right in requiring the standard to “take account of substances and materials that are liable to cause problems”, and not to establish a list, which for the above reasons could never be correct.

This report therefore provides some examples of the substances, materials and components that need to be considered in the design and control of the packaging as defined in the standard EN 13430.

1 Scope

This Report provides some examples of substances and materials that may cause a sustained impediment in the recycling activities, and is intended to assist in the assessment requirements set out in the standard EN 13430.

It describes substances or materials which cause problems or inhibit the recycling process, or which have a negative influence on the quality of recycled material, and for which it is considered that technological solutions will not be developed in the near future.

These examples are however qualified by the fact that the recycling operations can vary from region to region and state to state, that technology is constantly changing, and that the use to which the recycled material is put will also determine whether such substances and materials are a problem.

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.

EN 643, *Paper and board – European list of standard grades of recovered paper and board*

EN 13193, *Packaging – Packaging and the environment – Terminology*

EN 13427, *Packaging – Requirements for the use of European Standards in the field of packaging and packaging waste*

EN 13430, *Packaging – Requirements for packaging recoverable by material recycling*

EN 13437, *Packaging and material recycling – Criteria for recycling methods – Description of recycling processes and flow chart*

3 Definitions

For the purpose of this document, the terms and definitions given in EN 13193 apply.

4 Recycling

The European Standard EN 13437 provides a general description of the material flows from manufacture and use of packaging and the recovery by recycling for a reuse of the materials for either packaging or other applications. The document also provides a brief description of the main recycling operations for each of the main material sectors. The description underlines that recycling technology is being constantly developed with new techniques emerging, and recycling needs can vary significantly from country to country due to the form in which the packaging arrives in the waste stream, and also the applications in which the recycled materials will be used.

Whilst there may be similarities in packaging materials and recycling activities across the member states, there is no automatic and common position that can be predicted from one country to another. An example of this can be seen in the recycling of glass. The specification for the segregation of coloured glass varies. For example in the UK only very low levels of cross contamination of colour can be accommodated as the manufacture of new glass bottles is fairly evenly divided between clear (flint), amber and green. In France however, green bottles dominate, and as green is more tolerant of colour mixing, less segregation of colours in the collected waste is required. However, this position could be expected to change as collection and recycling increases to a level beyond that accommodated by the green fraction of new production.

Thus in presenting the data in this report, the information can only be considered as examples of the issues that should be considered in the design of packaging, and the need to take into account the effect that the materials and construction may have in the subsequent recycling operations.

In providing examples of substances and materials that may cause problem in recycling, a number of issues need to be considered. These include:

— the range of packaging materials ;

— the form in which the packaging exists ;

— the collection/sorting and recycling operations available in the location where the packaging completes its functional life ;

— the use to which the recycled material is to be put.

The following examples include data from current and typical specifications associated with used packaging supplied for recycling on a commercial and practical basis. It should be noted that these specifications can also vary from location to location.

The largest single classification of problem substances is not with the substances, materials and components that make up the packaging to be recovered, but with those associated with contamination of the packaging. This contamination comes from the residues of the contents, from other external contamination resulting from the use of the packaging, or from the collection and sorting processes. The contamination may usually be very small in quantity but, either through a hazardous nature of the contamination, or an inhibition in the use to which the recycled material can be put, can result in a disproportionate level of problem.

5 Material examples

Packaging is produced from a wide range of materials, and combinations of materials, selected according to the functional requirements of the packaging application. Though all these materials are readily recyclable, they can provide a major impediment to the recycling operation if they become mixed. Glass packaging in a plastic recycling operation, metals in a glass recycling operation, excessive plastic in a paper recycling operation, etc. are examples where fully acceptable materials and substances can lead to problems in recycling other materials.

In the following tables examples of materials and substances which cause problems in the recycling operations of each of the main packaging materials are given. These materials and substances may be integral with the packaging, they may arise from other packaging or other impurities becoming mixed in the collection operations, or from contamination associated with the contents, or externally from the use of the packaging.

The tables are as follows :

— Table 1 Aluminium ;

— Table 2 Glass ;

— Table 3 Paper and Board ;

— Table 4 Plastic ;

— Table 5 Steel ;

— Table 6 Wood.

Table 1 - Aluminium

Packaging recoverable by material recycling		
Reference to standard EN 13430		
B.2 Design Criteria **NOTE 3**	**Materials and substances integral with the packaging**	**Comments**
i) Separability of components	- Beverage and food cans require no separation as the lids, tabs and body are in similar alloying elements. - Composite containers should easily be separated to allow source separation by the user or separation during the collection and sorting stage. - Semi-rigid and flexible aluminium foil packaging can be separated at source by the user. - Foil laminates require specifically adapted separation and recovery processes which allow for material recycling and/or incineration with energy recovery.	The majority of aluminium rigid and semi-rigid packaging is single material of similar alloying elements, which ensures that closed loop (can-to-can recycling) or open loop recycling (into other aluminium products) is feasible. Non aluminium components or substances are effectively removed during the collection and sorting processes, at the input side to the recycling process, or during processing. Separation normally involves the recovery of the aluminium fraction using a thermal process which results in the destruction of the laminating ply, with an associated energy or by-product recovery. Small aluminium packaging items are increasingly collected and recycled from the bottom ashes in incinerators. New sorting techniques including optimised eddy current separation allow for the collection of even the smallest fraction.
ii) Compatibility of material compositions or material combinations with the recycling process.	- Material compositions are uniform in respect of the major aluminium components of the packaging/packaging system i.e. similar alloying elements. - Non-aluminium components, printing inks, lacquers and any sealants are accepted as easily removable during the recycling process.	
Acceptable tolerances for non-compatible elements or substances in the recycling process.	- Acceptable tolerances are determined by the individual recycling process plant and its design.	

"to be continued"

Table 1 – Aluminium (*continued*)

Packaging recoverable by material recycling		
B.5 Guidelines	**Materials and substances external to the packaging**	**Comments**
Compatibility with the collection and sorting systems.	Materials which require separation in the collection and sorting system, and are not acceptable in the recycling process. — Steel — Lead — Iron — Plastics — Paper — Sand — Glass — Dirt — Food residues — Grease — Any other foreign substances — Excessive moisture	No aluminium packaging is made of alloying elements including lead. However, occasionally lumps of lead can be found inside beverage cans to make these heavier and therefore more attractive for cash for cans weight-based collection schemes. Sorting centres either don't accept unspecified bales of used beverage cans or carry out extra controls to detect the lead with x-ray machines and subsequently remove it.

Table 2 - Glass

Packaging recoverable by material recycling		
Reference to standard EN 13430		
B.2 Design Criteria **NOTE 3**	**Materials and substances integral with the packaging**	**Comments**
i) Separability of components	Closures and capsules should be easily separable from the glass packaging to allow source separation by the user. Labels and sleeves of paper, plastics or aluminium foil, are generally accepted in the recycling process.	- The glass container industry in Europe lays great stress on a maximum separation at source as a key to cullet quality management. - A ban on lead containing capsules was introduced in EU 1993.
ii) Compatibility of material compositions or material combinations with the recycling process	The printing and glueing medium associated with labels etc. or polymer coatings are generally accepted in the recycling process.	Non-glass packaging components or substances are effectively removed in the processing of cullet (with the exception of ceramics and porcelain).
Acceptable tolerances for non-compatible elements or substances in the recycling process	**Processed cullet** Impurity : Indicative level Stones, ceramics, porcelain, pottery: < 50 g/t Magnetic metals: < 5 g/t Non-magnetic metals: < 5 g/t Organic matter: 500 g/t with min variability Plastics: < 100 g/t Grain size: > 5 cm 0 % < 0.5 cm max5 % Moisture: < 3 % Cullet Content Colour Green Amber Flint Green > 85 % < 5 % < 15 % Amber < 10 % > 82 % < 8 % Flint < 1 % < 1 % > 98 % Mixed national specification	**Unprocessed cullet** Recommended bulk density 350 kg/m^3 Container glass - minimum content : - today 95 % - target 2003 98 % Ceramics, porcelain, stones - maximum content: - < 10 mm < 100 g/t - in all < 2 500 g/t Unacceptable materials, not to be added - glasses as per list on following page - other (B.5 Guidelines)
	These guideline tolerances are indicative and subject to on-going review. Contractual specifications are negotiated directly between cullet suppliers and users in the various countries. These specifications may show variances from the guideline tolerances due to the differences in local conditions.	

"to be continued"

Table 2 – Glass (*continued*)

Packaging recoverable by material recycling		
B.5 Guidelines	**Materials and substances external to the packaging**	**Comments**
Compatibility with the collection and sorting systems	List of materials which are not to be added intentionally to container glass cullet 1. Types of glass : — screen glass (TV, computers, etc.) ; — lead crystal tableware ; — sheet glass ; — wired glass ; — coated glass ; — all forms of glass ceramics ; — car windshields and rear windows ; — mirrors ; — lamp glass (light bulbs, fluorescent ; tubes, etc.) — borosilicate glass (hard glass, ”Pyrex”, ovenware) ; — laboratory glass ; — pharmaceutical ampoule glass ; — quartz glass (some lamps, laboratory glass) ; — opal glass (white glass used for services and lamps ; — optical glass. 2. Other materials and products : — refractories (aluminous, zirconium, bearing, chromites, etc.) ; — residues from furnace tapping (which might be contaminated with refractories in particular) ; — earthenware, ceramics, porcelain, stones, concrete ; — metals, including closures and lead capsules ; — organic material which is not food residues ; — hazardous and small-scale chemical waste, for example : *glass with nail polish remover residues *glass with (photo) chemical residues — non-glass packaging materials.	This list is indicative and subject to on-going review.

Table 3 – Paper and board

Packaging recoverable by material recycling		
Reference to standard EN 13430		
B.2 Design Criteria **NOTE 3**	**Materials and substances integral with the packaging**	**Comments**
i) Separability of components	Non paper components not usually removed prior to delivery to the recycling operation include adhesive tapes, RFID tags, metal stitches, and other fasteners, non paper labels and various other packaging adjuncts.	Separation of these components can be effectively achieved either in the initial re-pulping process itself for the larger components, or in the initial screening of the pulp. It is unusual for the components described to disintegrate into particles small enough to interfere with the paper making process.
ii) Compatibility	Paper and board combinations with other materials including plastic laminations, wax or bitumen coating and wet strength treatment. Depending on the screening equipment and the plastic utilized, laminations of plastic below a certain weight per square meter could adversely affect the recycling process. Wax impregnations and particularly bitumen coatings are not usually effectively separated in basic or standard screening equipment and thus could adversely affect the recycled process.	Large volumes of plastic coated paper and board are recycled efficiently in increasingly numerous installations as technology to separate the plastic lamination from the pulp becomes widely available. The technique known as dispurging as part of the pulp screening process is available and is becoming widely used to remove waxy substances. It is particularly effective for relatively small quantities of waxed board in a batch and for removing hot melt glue.
Acceptable tolerances for non-compatible elements or substances in the recycling process	The European Standard EN 643 gives overall guidelines for qualities of used paper and board and includes a section on “unusable material”. However because of the widely differing nature of equipment used and the wide range of specifications for secondary fibre products, the individual recycling operations will normally set their own acceptance tolerance.	The diversity of operations and requirements means that even within organised collection schemes only general guidelines will apply.
B.5 Guidelines	**Materials and substances external to the packaging**	**Comments**
Compatibility with the collection and sorting systems	The list of non paper components in clause 2.2 of EN 643 includes materials and substances not part of the packaging but which may be unintentionally introduced. Thus paper and board packaging which has been in direct contact with the product may contain residues of that product.	EN 643 is for use by industry and organisations to assist in the buying and selling of this raw material. Many of the materials and substances named may be effectively removed by the screening and cleaning treatments in the recycling operation

Table 4 - Plastics[a]

Packaging recoverable by material recycling		
Reference to EN 13430		
B.2 Design Criteria **NOTE 3**	**Materials and substances integral with the packaging**	**Comments**
i) Separability of components	Components, such as closures, labels, sleeves etc. of different types of plastic, in particular those with similar densities, as well as other materials should be readily removable by the user or in the recycling process. For example, for facilities unable to sort them out automatically without regard to their density, it is better to use labels or sleeves material with density inferior at 1.	Normally, if paper labels are used, the use of solvent/contact adhesives should be avoided to enable separation in the pre-recycling preparation. However, when the labels are associated with packaging for dangerous substances, the permanence of the labels is essential. Separation of different types of plastics and other materials by 'sink/swim' floatation technology is widely used and the choice of materials for the packaging components should facilitate this principle.
ii) Compatibility of material compositions or material combinations with the recycling process	Minimisation of packaging weight achieved through laminates using different types of plastic, or with thin layers of other materials such as aluminium foil will demand excessive resources for traditional mechanical material recycling (shredding, separation, pelletisation). (In specific cases, new recycling technologies, based on dissolution /precipitation of one of the component, can perform such separation with a reduced energetic impact). Some mixed colours of the same form of packaging e.g. PET bottles, may be unacceptable for the applications of the secondary materials produced in the recycling process.	These limitations relate to the current and foreseeable developments of mechanical recycling processes for such optimised packaging. Development of the feedstock recycling technology (i.e. production of monomers or other chemicals by depolymerisation or thermal cracking) and also the use of used packaging as a reducing agent will increasingly be able to accommodate such combinations.

"to be continued"

Table 4 - Plastics[a] (*continued)*

Packaging recoverable by material recycling		
Acceptable tolerances for non-compatible elements or substances in the recycling process.	An example of typical acceptance tolerances for the input to the mechanical recycling processes : Intended plastic material 94 % min Other plastics 3-5 % max Impurities 3-5 % max The impurities usually are coming from sources other than the intended packaging. NOTE The minimum percentage of intended plastic material may depend on both the recycling technology and the economic viability. In some cases, this threshold may be significantly lower. Typical acceptance tolerances for the input to an olefin feedstock recycling process. Prepared agglomerates : Free flowing grain size 10mm max Fine grain less than 250 µ 1 % max Moisture 1 % max Bulk density 300kg/m^3 min Plastic content 90 % min of which polyolefines 70 % min and technical plastics 4 % max Chlorine 2 % max Moisture 1 % max Residue on ignition 4.5 % max of which metal 1 % max	These tolerances are based on the German collection system for domestic packaging and they can only be considered as information. The actual acceptance will depend on a number of factors : - type of packaging and the main material, i.e. film, bottles, mouldings, i.e. LDPE, PET, PS etc. ; - the specific recycling operation, whether equipped with additional sorting and washing facilities ; - the application in which the recycled material is to be used, e.g. fence posts, waste bags, carrier bags, textile fibres etc. Techniques to check the plastic content of agglomerates are being developed but currently are limited to spot checks and statistical analysis. Technology will continue to be developed which may widen the acceptance tolerances, but conversely, increasing the use of recycled materials will involve a demand for even higher standards of recycle specification, and tighten the indicated tolerances. Example: other plastics packaging that can not be removed by the process from the main stream.

"to be continued"

Table 4 - Plastics[a] (*continued)*

B.5 Guidelines	**Materials and substances external to the packaging**	**Comments**
Compatibility with the collection and sorting systems	List of materials which are not part of the packaging but may be unintentionally introduced into the waste stream through the collection systems and are deemed to be incompatible with the recycling processes : — metal ; — glass ; — paper ; — other materials such as : rubber, stones, wood, textiles. ; Composite carton materials, disposable nappies. Compostable waste such as food, garden waste Packaging with remnants of hazardous contents.	This is not an exhaustive list but provides a guide to the type of materials and substances that can find their way into the used plastic packaging sent for recycling.

[a] Applicable to the most common recycling technologies, i.e. mechanical recycling. Feedstock recycling (i.e. going back to chemicals) may, depending on the application targeted, be more flexible, See also :

— in the scope of this report, the comments on the evolution of recycling technologies ;
— CEN TR 15353 and EN 15342 to 15348 on characterisation of plastics waste and of plastic recyclates.

Table 5 - Steel

Packaging recoverable by material recycling		
Reference to EN 13430		
B.2 Design Criteria **NOTE 3**	**Materials and substances integral with the packaging**	**Comments**
i) Separability of components	— Metallic components of steel packaging (steel/aluminium) do not need to be separable. — Organic components (caps, sleeves) should preferably be easily separable by the user..	No limitation for packaging design. Most of steel packaging applications are mono-material. When aluminium is used in combination with steel in packaging design, it does not have any adverse effect on the steel recycling process.
ii) Compatibility of material compositions or material combinations with the recycling process.		No limitation for packaging design for organic materials (e.g. plastic closures & dispensing feature, paper labels, polymer coated material) as long as the metal part remains the dominant material of steel packaging.
Acceptable tolerances for non-compatible elements or substances in the recycling process.	Currently national or company-specific steel scrap specifications prevail. Eurofer/EFR EU steel packaging scrap specifications are currently being finalised	
B.5 Guidelines	**Materials and substances external to the packaging**	
Compatibility with the collection and sorting systems	— Magnetic separation and scrap upgrading guarantees specified cleanliness of collected and sorted packaging scrap. — Packaging should be emptied by the end user/consumer before it enters the packaging waste stream	

Table 6 - Wood

Packaging recoverable by material recycling		
Reference to EN 13430		
B.2 Design Criteria **NOTE 3**	**Materials and substances integral with the packaging**	**Comments**
i) Separability of components	Nails (boxes and Pallets) and staples (crates) are sorted by magnetic separators. Therefore nails and staples must be magnetic.	The first stage of the recycling process is to crush the wood / packaging. During this process the crushed wood passes through a magnetic separator.
ii) Compatibility of material compositions or material combinations with the recycling process.	No paint or lacquered woods - no impregnated wood. (e g CCA). In case of printing the inks must be free of any heavy metals. It is better to avoid the use of glued papers on packaging sides, an allowance is given for a stick-on label.	The proportion of inks used for the crates is less than 1/1000 of the total packaging weight. They are considered negligible for pallets and boxes.
Acceptable tolerances for non-compatible elements or substances in the recycling process.	No materials other than wood, and magnetic nails and staples. Papers, plastic films and complexes remaining after use must be sorted. No organic wastes. No trace of any added components including heavy metals or hazardous substances, including contamination by the users.	
NOTE Allowance of production for export purposes.	According to their own national regulations, some Southern hemisphere countries (and some states of USA) request CCA treated wood packaging (boxes and pallets).	As such wooden packaging is for export, it does not inhibit European recycling operations and its manufacture should be permitted.
B.5 Guidelines	**Materials and substances external to the packaging**	**Comment**
Compatibility with the collection and sorting systems	Wood is normally readily recognisable and for recycling it is essential that the wood is free from contamination, both from components and constituents in the packaging and from other materials in the waste stream. No materials other than wood, and magnetic components and constituents which can be separated by magnetic separators. No plastic, organic wastes or other chemical contamination.	This is not an exhaustive list but provides an indication of the materials and substances which will inhibit the acceptability of wood for recycling.

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[2] 2004/12/EC, Directive of the European parliament and of the Council of 11 February 2004amending Directive 94/62/EC on packaging and packaging waste.

[3] Mandate M 200 Rev 3, Mandate to CEN for standardisation and a study related to packaging and packaging waste.

[4] EN 15342, *Plastics - Recycled Plastics - Characterisation of polystyrene (PS) recyclates*

[5] EN 15343, *Plastics - Recycled Plastics – Plastics recycling traceability and assessment of conformity and recycled content*

[6] EN 15344, *Plastics - Recycled Plastics - Characterisation of Polyethylene (PE) recyclates*

[7] EN 15345, *Plastics - Recycled Plastics - Characterisation of Polypropylene (PP) recyclates*

[8] EN 15346, *Plastics - Recycled plastics - Characterisation of poly(vinyl chloride) (PVC) recyclates*

[9] EN 15347, *Plastics - Recycled Plastics - Characterisation of plastics wastes*

[10] EN 15348, *Plastics - Recycled plastics - Characterization of poly(ethylene terephthalate) (PET) recyclates*

[11] CEN/TR 15353, *Plastics - Recycled plastics - Guidelines for the development of standards for recycled plastics*

[12] Eurofer/EFR Steel packaging scrap specifications

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