

Recommendations «Design for Recycling» Plastic Bottles



**Drehscheibe
Kreislaufwirtschaft**
by Swiss Recycling



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Created by Liane Jehle, REDILO GmbH

<https://www.circular-economy.swiss/design4recycling-plastics/flaschen/>

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1. Introduction

Overview Drehscheibe Kreislaufwirtschaft / Allianz Design for Recycling Plastics

A functioning recycling economy requires a holistic view and approach that takes into account the specific recycling possibilities according to the state of the art, the possible uses of the recycled material and the information and sensitization up to the consumer.

The key to successful implementation is cooperation across the entire packaging value chain. This is precisely why the Swiss «Drehscheibe Kreislaufwirtschaft» and the «Allianz Design for Recycling Plastics» are working closely together on various topics, exploiting synergies and offering the partners benefits through joint theme platforms, main topics and specific tools and services.

Objectives of the Recommendations and Procedure

Recyclability is the basis and the prerequisite for sensible separate collection - in general for a high-quality, clean and sustainable recycling management of plastics. In order to consider and ensure optimal recyclability already during packaging and product development, industry recommendations and specific technical guidelines are developed, continuously revised and thus kept up to date. This is done together with partners along the entire value chain.

Networking and contact

Wherever possible, these recommendations are based on internationally developed recommendations, standards and practical tests. A «Swiss isolated solution» is deliberately avoided. Nevertheless, the specific situation in Switzerland should be taken into account.

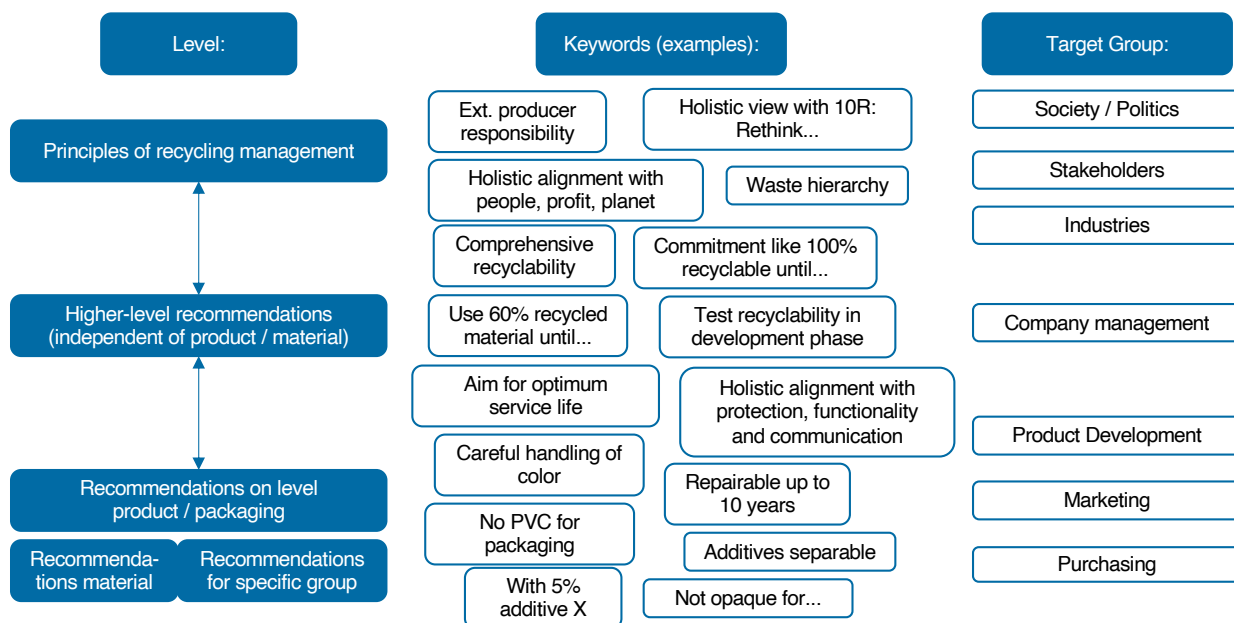
The recommendations considered here can be found on our website under the corresponding focus:

- Design for Recycling Guidelines, July 2020, RecyClass
- Circular Packaging Design Guideline, September 2020, FH Campus Wien
- Design Guidelines, 2019, EPBP
- Recyclability by Design, 2019, RECOUP
- Recyclability of Plastic Packaging, Dezember 2016, COTREP
- Design for Recycling Guidelines, July 2019, SUEZ.circpack
- Design 4 Recycling, September 2019, Der Grüne Punkt

Do you have questions about the recommendations or feedback? Mrs. Liane Jehle from REDILO GmbH is looking forward to your contact: jehle@redilo.ch

3. Specific Recommendations for Plastic Bottles

Development of Principles and Recommendations for Recycling Management



The recommendations are embedded in a landscape consisting of different actors. It is important that the communication is tailored to the target group. For example, it is the task of the company management to anchor the circular economy in its own organization. This anchoring helps to implement the recommendations on an operational level in the corresponding areas such as purchasing or product development. There are generally valid, superordinate rules for good recyclability, which are represented in the following table.

5 General Golden Rules «Design for Recycling»

Keyword	Details
Recyclable materials	Use of permanent or regenerative materials. Check recycled material content. Check new materials for compatibility with the existing infrastructure.
Monomaterial	Mono material results in a high recycled quality. Check material combinations for separability.
Minimization of additives	Careful use, e.g. printing ink or adhesives, check effects on the quality of the fractions as well as on processes.
100% recyclable	Tested and confirmed on the basis of state-of-the-art technology in the relevant region, including compatibility with the collection, processing and recycling infrastructure.
Cooperation	Commitment to the development and communication of the «Design for Recycling» recommendations within and outside the own organization. Early consideration of the recommendations in the development phase of a packaging.

3. Specific Recommendations for Plastic Bottles

Golden Rules «Design for Recycling» for Plastic Bottles

Stichwort	Details
Color	If possible, use of uncolored plastics
Dosing systems / other attachments	If dosing systems or other attachments are necessary, they should not impair the recyclability of the material to be recycled and should ideally be recyclable themselves, preferably in combination with the plastic of the main container
Closure systems	Closure systems that do not contain linings and do not leave any residual rings or fastenings when removed are ideal
Adhesive	Use of water-soluble adhesives
Sleeve	If a removable sleeve is used on a bottle, the instruction to remove the sleeve should be included on the label text. Otherwise, the sleeve should come off the package slightly during the sorting process

RECYCLABILITY according to this guideline

This guideline describes the material and physical requirements for the material / theoretical recyclability of the product or packaging to be fulfilled.

The guideline does not yet say anything about the actual recyclability, which, depending on the country, established collection structures, appropriate treatment and recycling processes according to the state of the art as well as the use of the recovered recycle.

The following definitions apply (source: <http://realcycle.ch/rezyklierbarkeit.html>):

Material recyclability of packaging components:

There is a process that can restore used material to its original state (e.g. melting process).

Theoretical recyclability of a product:

In addition to material recyclability, theoretical recyclability defines that a product consists of a mix of materials (including labels, lids, etc.) that can be recycled. If it is a composite product (i.e. composites such as multi-layer plastic packaging or multi-layer packaging made of several materials), it must be possible to disassemble it into the materials, whereby the material recyclability applies to all partial materials.

Actual recyclability of a product:

In addition to the theoretical recyclability, there is a collection and recycling system in which the materials can be turned into high-quality secondary raw material within a geographically reasonable radius.

The secondary raw material must make up >70% of the input material, must be of high quality (free of pollutants and with as similar physical properties like virgin material), and enable local loop closure.

Important:

If only the material and theoretical recyclability, i.e. the criteria of this guideline, are fulfilled, a product or packaging may not yet be advertised as «recyclable»!

Topic / Classification		Remarks	Material / theoretical recycling fulfilled	Material / theoretical recycling partially fulfilled	Material / theoretical recycling not fulfilled
Packaging	Material	1 2	LD-PE, LLD-PE, HD-PE, PP and polyolefin copolymers	Copolymer beyond polyolefins «Bioplastics» Multilayer packaging with the same material type	PVC, PLA, general biodegradable and oxo-degradable plastics, composites: PE or PP with PLA, PVC, PS, PET or PET-G other plastics
	Color	3 4	Nature (transparent), white, homogeneous colors	lighter, opaque colors	Black (carbon black), dark, opaque colors
Additives	Barriers	5	SiO _x , Al ₂ O ₃	EVOH (up to 5%) Black inner layer	EVOH (over 5%), metallization, PVDC, PA, fluorescent
	Other	6 7	Additives indispensable in processing (stabilizers, antioxidants, lubricants, possibly nucleating agents)	Fluorination, plasticizers, adhesion promoters, flame retardants, odor additives; Additives, if density remains <1 g/cm ³	density increasing additives (fibers, glass beads), density increasing masterbatches like CaCO ₃ , talcum etc., additives, if density >1 g/cm ³
Lid	Lid	8	PE (HDPE, LDPE, LLDPE, MDPE) PP	for PE-bottles: PP, PS, PET, PET-G for PP-bottles: HDPE, LDPE, LLDPE, MDPE, PET, PET-G	(Foamed) materials with density < 1 g/cm ³ PVC, EPS/PS, PLA, metals (e.g. aluminium, steel)
	Liner	9	PE, PE+EVA, PP		(Foamed) materials with density < 1 g/cm ³ PVC, EPS/PS, PLA, aluminium
	Seals / Valves	10 11	PE, PP, OPP		not completely removable seals; materials (e.g. silicones) with density < 1 g/cm ³
Decorations / Labels	Direct printing / printing ink	12 13	EUPIA-compliant printing inks (non-toxic); only minimal printing (date, product no.), inks that come off in the recycling process (e.g. laser printing)	Anything beyond minimal printing (date, product no.) with peeling colors (e.g. laser printing)	bleeding colors (bleeding), toxic or dangerous colors Metallized colors; colors that do not come off in the recycling process
	Labels / Sleeves	14 15	< 50% of the bottle surface, PE (HDPE, LDPE, LLDPE, MDPE) PP	> 50% of the bottle surface, Paper labels wet-strength, In-Mould-Labeling For PE bottles: PP/OPP, PET, PET-G, PS, PLA For PP bottles: PE, PET, PET-G, PS, PLA with water soluble glues	permanent adhesive labels Low-density PET < 0.95 g/cm ³ PVC, aluminium, general metallized, For PE bottles: PP/OPP, PET, PET-G, PS, PLA with non-water-soluble glues, For PP bottles: PE, PET, PET-G, PS, PLA with non-water-soluble glues
	Adhesives	16	water soluble (<40°C) hot alkali soluble (60-80°C)	hot melts (positive list, see references), pressure-sensitive	not water soluble, permanently adherent
Other	Attachments	17	Dosing systems (pumps, triggers) of the same material type		Dosing systems with metal or glass, RFID label (Foamed) materials with a density < 1 g/cm ³
	«Smart Packaging»	18		various functions (see remarks)	
	Content	19 20	Food, shampoo, detergents etc.; easily drained and water soluble no human- or ecotoxic chemicals	small residual contents; Chemicals with a human or ecotoxic potential	Hazardous goods container, residual contents «shakeable/swivelable» human- or ecotoxic chemicals

3.1 PE / PP

Explanations to the Technical Guideline Plastic Bottles PE / PP

Glossary	
Copolymer	Polymers, which are composed of at least 2 types of monomers.
Bioplastics	Either from fossil sources and degradable (additive) or from biogenic sources.
Bleeding	Unwanted dissolving of the printing ink, mostly in the washing water.
Coating	Material (usually liquid) used to apply a film to a surface.
Fluorination	Process for changing the surfaces of plastics, replacement of the H atoms by covalently bonded F atoms.
In-Mould-Labeling (IML)	Process for the application of inscription labels directly in the tool during the forming process.
Smart Packaging	Expected future developments in the packaging industry, especially equipment with sensors.

Remarks	
1	It is important that the individual plastics can be separated, which is difficult with copolymers beyond polyolefins.
2	Bioplastics equivalent to PE or PP are no problem. Other bioplastics can interfere with recycling, e.g. because of lower melting points.
3	Carbon black causes mis-sorting.
4	B2B is possible with both transparent and white bottles (e.g. with sleeve). The more homogeneous the color palette, the easier the sorting and thus a homogeneous color fraction.
5	Barriers are basically limiting, also because they can interact with each other in the recycling process.
6	Additives that are essential for functionality must be distinguished from "nice-to-have" additives, which should be avoided
7	The pollutant potential (human or ecotoxicity) should also always be taken into account.
8	Although fillers ostensibly improve the CO ₂ balance of the plastic, they make recycling more difficult or even impossible. Caps and accessories remain in the bottle material flow (PE, PP), must be recyclable with it and must not impair the quality of the recycled material. With PE bottles, care should be taken to ensure that the PP content does not exceed 5%. In addition, peelable mounting tapes should not be used. Do not use pump systems with glass or metal components.
9/10	In some cases also non-conforming material as seal, inliner. Sealing foils must be removable by the consumer without leaving any residues.
11	Silicone with a density of < 1 g/cm ³ (e.g. foamed silicone) is an interfering substance, therefore do without.
12	The printing inks must be checked for conformity (www.eupia.org).
13	Direct printing has advantages in terms of eliminating labels and glue. There are still some questions regarding the effects in the main stream (bleeding).
14	Sorting systems are better at identifying bottles with full-body sleeves. However, they require a minimum visibility of the bottle material.
15	IML is problematic, depending on the choice of material, because separation from bottle is not possible. PO bottles with labels of the same material type work.
16	The glues used must be removed in the recycling process, this is mainly done in a water bath. Glue should be tested for recycling.
17	Avoid additives of metal or gals.
18	The field of «Smart Packaging» will bring new challenges in recycling, which will have to be assessed on a case-by-case basis.
19	The less residual content is added to the collection, the better.
20	For ingredients and additives, human and ecotoxicological data should be known.

3.2 PET (non-beverage bottles)

Status November 2020

Thema / Einteilung		Remarks	Material / theoretical recycling fulfilled	Material / theoretical recycling partially fulfilled	Material / theoretical recycling not fulfilled
Packaging	Material	1 2	PET	Multilayers of the same material type	PET-G, C-PET, PLA, PVC, PS general materials with density >1 g/cm ³
	Color	3 4	clear, transparent	light transparent colors (e.g. blue, green)	Fluorescent, Metallization, TiO _x , Black (Carbonblack) dark and opaque colors
Additives	Barrieres	5	SiO _x , Al ₂ O ₃	EVOH (up to 5%)	EVOH (over 5%), Metallization, PVDC, PA
	Other	6 7		UV stabilizers, AA blockers, optical brighteners, oxygen absorbers	Density increasing additives (fibers, glass beads), TiO _x , Nanoparticles, bio-/ oxygen-/ light-degradable additives
Lid	Lid	8	PE, PP general materials with a density <1 g/cm ³		Material with density >1 g/cm ³ PVC, PS, PLA, metals (e.g. aluminum, steel)
	Liner	9	PE, PE+EVA, PP, foamed PET (all with density <1 g/cm ³)		Material with density >1 g/cm ³ PVC, PS, PLA, metals (e.g. aluminum)
	Seals / Valves	10 11	PE, PP, OPP; Seal completely removable	Silicone with a density <1 g/cm ³	Material (e.g. silicone) with density >1 g/cm ³ PVC, PS, PLA, rubber, metals (e.g. aluminum); not completely removable seals
Decorations / Labels	Direct printing / printing ink	12 13	EUPIA compliant (non-toxic) Only minimal printing (date, product no.), colors that come off in the recycling process (e.g. laser printing)	Anything beyond minimal printing (date, product no.) with peeling colors (e.g. laser printing)	Blutende Farben (bleeding), toxische Farben Metallisierte Farben; Farben, die sich nicht im Recyclingprozess ablösen
	Labels / Sleeves	14 15	< 50% of the bottle surface Material with a density <1 g/cm ³ (PE, PP, OPP, EPS, foamed PET; LD-PET with density <1 g/cm ³)	> 50% of the bottle surface, paper labels wet-strength, In-Mould Label made of PET, slightly metallized labels (density <1 g/cm ³)	PVC/PS/OPS/PET with density >1 g/cm ³ , Foamed PET-G (also with density <1 g/cm ³), metallized (>5 μm), full surface sleeve
	Adhesives	16	water soluble (<40°C) hot alkali soluble (60-80°C)	hot melts (Positiv-Liste, siehe Verweise), pressure-sensitive, self-adhesive labels	not water soluble, permanently adherent
Other	Attachments	17	Dosing systems (pumps, triggers) from the same material type; everything with density <1g/cm ³		Dosing systems with metal or glass, RFID label, Foamed PET-G (also with density <1 g/cm ³)
	«Smart Packaging»	18		various functions (see remarks)	
	Content	19 20	Food, shampoo, detergents etc.; easily drained and water soluble no human- or ecotoxic chemicals	small residual contents; Chemicals with a human or ecotoxic potential	Hazardous goods container, residual contents «shakeable/swivelable»; human- or ecotoxic chemicals

3.2 PET (non-beverage bottles)

Explanations to the Technical Guideline Plastic Bottles PET

Glossar	
Copolymer	Polymers, which are composed of at least 2 types of monomers.
Bioplastics	Either from fossil sources and degradable (additive) or from biogenic sources.
Bleeding	Unwanted dissolving of the printing ink, mostly in the washing water.
Coating	Material (usually liquid) used to apply a film to a surface.
Fluorierung	Process for changing the surfaces of plastics, replacement of the H atoms by covalently bonded F atoms.
In-Mould-Labeling (IML)	Process for the application of inscription labels directly in the tool during the forming process.
Smart packaging	Expected future developments in the packaging industry, especially equipment with sensors.

Bemerkungen	
1	It is important that the individual plastics can be sorted out, which is difficult with copolymers beyond polyolefins.
2	Bioplastics in the form of PE or PP are no problem. Other bioplastics can interfere with recycling, e.g. because of lower melting points.
3	Titanium dioxide can make recycling more difficult from a certain degree (product properties). Carbonblack causes incorrect sorting.
4	B2B is feasible with both transparent and white bottles (e.g. with sleeve). The more homogeneous the color palette, the easier the sorting and thus a homogeneous color fraction.
5	Barriers are basically limiting, also because they can interact with each other in the recycling process.
6	Additives that are essential for functionality must be distinguished from "nice-to-have" additives, which should be avoided
7	The pollutant potential (human or ecotoxicity) should also always be taken into account. Although fillers superficially improve the CO ₂ balance of the plastic, they make recycling more difficult or even impossible.
8	Caps and accessories remain in the bottle material flow (PET), must be recyclable (or separable) with it and must not impair the quality of the recycled material. Removable pull-on tapes should be avoided.
9	In some cases, non-compliant material should also be used as a seal, inliner.
10/11	Sealing films must be removable by the consumer without leaving any residues. Silicone (e.g. also foamed silicone) is an interfering substance which should therefore be avoided.
12	The printing inks must be checked for conformity (www.eupia.org).
13	Direct printing has advantages in terms of eliminating labels and glue. There are still some questions regarding the effects in the main stream (bleeding).
14	Sorting systems become better at recognizing bottles with full-body sleeves. However, they require a minimum visibility of the bottle material.
15	Depending on the choice of material, IML is problematic because it is not possible to separate from the bottle. PO-bottles with labels of the same material type works.
16	The glues used must be removed in the recycling process, this is mainly done in a water bath. Glues should be tested for recycling.
17	Avoid additives of metal or gals.
18	The field of «Smart Packaging» will bring new challenges in recycling, which will have to be assessed on a case by case basis.
19	The less residual content is added to the collection, the better.
20	For ingredients and additives, human and ecotoxicological data should be known.

4. Current Partners of the Theme Platform



This guideline was created and is continuously updated by the theme platform 1 «Flaschen» of the Allianz Design for Recycling Plastics.

Quotes

"Packaging is one of four strategic sustainability themes for Emmi. On the one hand, we want to reduce the consumption of packaging material in general, and on the other hand we want to use more ecological materials. In future, we are keen to use more packaging that can be recycled. Only by closing these material cycles we can comply with the «one-planet approach». For this reason, we welcome in principle the establishment of an HDPE recycling system, as long as this proves to be ecologically more sensible in an overall view.

In the field of packaging for dairy products, HDPE currently still has to overcome technical hurdles. They mainly concern the protection of the product from light and air. This must be ensured to avoid food waste. In cooperation with our packaging suppliers and other partners, we are trying to master these challenges and find future-oriented packaging solutions for our dairy products."

- Bendicht Zaugg, Head of Sustainable Packaging Projects Emmi Schweiz AG

"Swiss Recycling welcomes this pragmatic, voluntary implementation of the economy in terms of extended producer responsibility".

- Patrik Geisselhardt, Geschäftsführer Swiss Recycling

"These guidelines create an excellent basis for returning the raw materials used for plastic bottles back into the cycle. The sustainability of packaging and the conservation of resources are among the goals of the SVI, which is why we have given our full support to this project".

- Andreas Zopfi, Managing Director Swiss Packaging Institute SVI

5. Best Practices Examples

Semadeni Plastics Group

Fertilizer bottle made of 100% recycled PET

<https://www.semadeni.com/aktuell/showcase/detail/news/doppeltes-recycling-duenger-aus-urin-flasche-aus-rezyklat>

MIGROS

Syrup bottle made of 100% recycled PET

<https://generation-m.migros.ch/de/nachhaltige-migros/aktuelles/news-template/news/nachhaltigkeit/2019/migros-fuehrt-getraenkeflaschen-aus-recycling-pet-ein.html>

mibelle GROUP / MIGROS

Cleaning bottle made of 100% recycled PE

Trigger bottle made of 100% recycled PET

<https://www.mibellegroup.com/index.php/de/nachhaltigkeit/nachhaltige-innovationen/oekologische-verpackungen>

ALDI SUISSE

Dishwashing detergent in bottles of 100% recycled PET

<https://www.aldi-suisse.ch>

Semadeni Plastics Group

Trigger bottle made of 100% recycled PET

<https://www.semadeni.com/aktuell/showcase/detail/news/triggerflaschen-aus-100-rezykliertem-pet>

Rezyklat-Initiative Frosch

Transparent Frosch bottles made of 100% old plastic

www.initiative-frosch.de/

Lush Verpackungen

Use of 100% R-plastic in containers and bottles

www.agstg.ch/magazin/magazin-archiv/130-interview-mit-doris-trinkler-lush.html

Logo-Plastic Verpackungen

Use of 100% R-PET in standard PET containers

www.logoplastic.ch

EU Ecolabel

Label for fully recyclable packaging

www.eu-ecolabel.de/produktgruppen-kriterien.html?&no_cache=1&tx_ecolabelvergabe_pi1%5Bsorting%5D=7

All best practice examples can be found here

<https://www.circular-economy.swiss/best-practice/>

6. Appendix - Links

Association of Plastic Recyclers (APR)

www.plasticsrecycling.org/apr-design-guide/apr-design-guide-home

Comité Technique pour le Recyclage des Emballages Plastiques (COTREP)

www.cotrep.fr/en/notices-and-publications/

Der Grüne Punkt

<https://www.gruener-punkt.de/de/nachhaltige-verpackungen/ueber-design4recycling.html>

European Printing Ink Association (EUIA)

www.eupia.org

European Plastic Bottle Plattform (EPBP) Design Guidelines:

www.epbp.org/design-guidelines/products

FH Campus Wien

<https://www.fh-campuswien.ac.at/forschung/kompetenzzentren-fuer-forschung-und-entwicklung/kompetenzzentrum-fuer-sustainable-and-future-oriented-packaging-solutions/circular-packaging-design-guideline.html>

Liste Hot Melts (EPBP)

www.epbp.org/download/297/eupr-positive-glue-list

Pictograms for the Swiss market:

www.swissrecycling.ch/dienstleistungen/piktogramme/

RecyClass

<https://recyclclass.eu/recyclclass/design-for-recycling-guidelines/>

Plastics Recyclers Europe (PRE)

www.plasticsrecyclers.eu/guidelines-packagings

Recycling Of Used Plastics limited (Recoup):

www.recoup.org/

Suez

<https://www.suez.com/en/our-offering/businesses/what-are-you-looking-for/resources-management-consulting/circpack-together-we-make-your-packaging-recyclable>

Swiss Plastics Dossier

www.swissplastics.ch/

Swiss Recycling Dossier

www.swissrecycling.ch/wertstoffe/kunststoff

WEF Report

„The New Plastics Economy“

www3.weforum.org/docs/WEF_The_New_Plastics_Economy.pdf