COTREP

Comité Technique pour le Recyclage
des Emballages Plastiques

Recyclability of plastic tubes

July 2025 (version 2.0)

Contents

01

Design of a standard PE tube

Standard design of a PE tube

Sleeve

Mix HDPE / LDPE / LLDPE
Standard thickness: approx. 450 µm

Options

- Barrier: EVOH, aluminium lamination, internal layer metallization, etc.
- Design: screen printing, offset, foil stamping/hot stamping, varnish, etc.

Different manufacturing processes

- Extrusion or co-extrusion
- Lamination:
  - ABL – Aluminium Barrier Laminate (multilayer PE/AL/PE)
  - PBL – Plastic Barrier Laminate (multilayer PE/EVOH/PE)

Cap

Often PP

Assembly

Screw-on or snap-on

Tube head

HDPE

Manufacturing process

Overmoulding

Please note:
- While this is the "standard" and therefore most common tube design on the market, other designs exist (e.g. those including a seal and other associated elements).
- This guide relates to PE tubes, which account for the vast majority of the market (as opposed to PP tubes).

02

Tube sorting

Context: collecting plastic tubes in France

Since 2023, following the extension of sorting instructions, **all household packaging, including tubes, goes in the sorting bin** throughout France.

EXTENSION OF SORTING INSTRUCTIONS

PAPER & CARDBOARD

STEEL & ALUMINIUM

PLASTIC BOTTLES & DISPENSER BOTTLES

+ Exemption: PE or PP boxes for dry foodstuffs

ALL OTHER PACKAGING
Pots, trays, tubes, boxes, film, bags, etc.

With the extension of sorting instructions and the sorting habits of local residents, the amount of other rigid plastics in the sorting bin is increasing. The packaging is then collected and sent to a **sorting centre**.

Tube potential at sorting centres – main stages

PACKAGING OF ANY MATERIAL
(except glass)

BALLISTIC SEPARATION
SORTING BY SHAPE
SORTING BY SIZE

METAL SORTING
EDDY CURRENT OVERBAND INDUCTION/MAGNETIC SORTING

OPTICAL SORTING
MATERIAL AND COLOUR SORTING (INFRARED)

MANUAL FILTERING
MATERIAL, SHAPE AND COLOUR SORTING

BALING
MATERIAL COMPRESSION

SORTED

1
Are tubes too small to make it through the sorting by size step? Are they systematically channelled as rejects?
(see slide 8)

2
Is a tube a rigid or flexible packaging item?
(see slide 9)

3
To which recycling stream are tubes directed?
(see slide 10)

4
Are dark coloured tubes recycled?
(see slide 11)

Tube potential at sorting centres

BALLISTIC SEPARATION

1 Is a tube too small to be recycled? Is it systematically sent to rejects?

No, the potential of a packaging item at a sorting centre is not binary: “sortable” or “non sortable”. Studies have demonstrated that small items are less likely to be captured, **but some small packaging items are captured**.

To date, the **size of a packaging item** and its **capture rate at sorting centres** are **not accounted for* in a packaging item's recyclability assessment**, particularly because some small packaging items are captured and to discourage inappropriate measures aiming to increase the size of packaging items to make them recyclable. Work is underway to make progress on the capture of small packaging at sorting centre.

** Discussions are being held regarding the possibility of accounting for capture rates at sorting centres.*

All packaging, even the smallest, must be recyclable

Tube potential at sorting centres

2 | Is a tube a rigid or flexible packaging item?

There is **no standardised definition** of a rigid or flexible packaging item.

Although the main element of rigid packaging is generally over 250-300 µm thick, tests performed at sorting centres have demonstrated that the **thickness of a packaging item is not a sufficient criterion** for classifying packaging items.

It is the **ballistic behaviour during sorting and recycling processes** that determines whether it “belongs” to the rigid or flexible packaging category.

Tubes behave in the same way as rigid packaging

Like bottles, dispenser bottles, pots, trays, boxes, etc.

Tube potential at sorting centres

OPTICAL SORTING

3 To which recycling stream are tubes directed?

Tubes behave in the same way as **rigid packaging**

PE tubes that are compliant with the recommendations of this guide are sorted and channelled to the **rigid PE items stream.**

Rigid PE stream
Bottles, dispenser bottles, pots and trays and other rigid packaging (including tubes)

Tube potential at sorting centres

OPTICAL SORTING

4 | Are dark coloured tubes recycled?

The use of certain **colorant solutions** in **dark, rigid plastic packaging**, e.g. certain solutions containing carbon black, can render dark packaging items **undetectable by optical sorting** at sorting centres. These undetected packaging items are channelled as rejects at the sorting centre and cannot be recycled.

Colours considered to be dark.
A specific detectable colorant must be used.

Colours considered detectable by near-infrared optical sorting equipment.

Recommendations:

- Opt for light coloured tubes
- Use a dark colorant solution that is detectable at sorting centres.

For further information

- Some available **tried-and-tested solutions**:

https://www.cotrep.fr/en/technical-study/ ("Technical Studies" section, then "Dark Packaging Sorting")

- A **standard testing method** for validating the detectability of your colorant solutions and/or dark packaging items:

https://www.cotrep.fr/en/technical study/ ("Tests Protocols" section)

- Further information is available at:

https://www.citeo.com/le-mag/emballages-sombres-en-plastique-comment-les-rendre-detectables-en-centre-de-tri-pour-mieux/

03

Tube recycling

Key PE tube regeneration stages

For further information, please refer to the COTREP guide on the "Recyclability of Plastic Packaging"

Recycling potential of PE tubes

Focus - Barriers in tubes

Incorporated as very thin intermediate layers into the sleeve, the **barriers used in tubes** can disrupt their sorting and regeneration:

✔ **EVOH** barrier

Compatible (tolerated) with PE tube recycling

Recommendation: use the appropriate proportion of EVOH, i.e. the **minimum rate** required to ensure functionality of your packaging.

✔ **METALLIZATION** barrier in internal layer

Compatible (tolerated) with PE tube recycling

✖ **ALUMINIUM** barrier **(lamination)**

Incompatible with PE tube recycling

Recommendation: consider the possibility of switching to a mono-PE tube. If a barrier is needed, opt for an EVOH barrier or metallization barrier in internal layer.

For further information

COTREP notice on the influence of EVOH on recycling of rigid HDPE packaging:
https://www.cotrep.fr/content/uploads/sites/3/2019/02/ag52-bottles-hdpe-evoh-barrier.pdf

NB: there is no maximum proportion of EVOH to be used for a single packaging item. However, COTREP is monitoring PP and EVOH content in rigid PE stream and may review its recommendations if this were to reach excessive levels in the overall tonnage.

Recycling potential of PE tubes

Focus - Fillers and density

All operators recycling plastic packaging in Europe **sort waste by density** on their regeneration lines: **PE tubes** must have a **density less than 1**.

The use of fillers may **raise the density of the tube** above 1 and prevent recycling:

Density of plastic resins

- EPS: 0.04
- PP: 0.9
- LDPE: 0.92
- HDPE: 0.94
- 1 – buoyancy limit in water
- PS: 1.05
- PLA: 1.24
- PET: 1.34
- PVC: 1.34 – 1.40

Mineral-filled PE or PP (d > 1) may sink and no longer be recyclable

Even if the density does not go over 1, the presence of **gases, blowing agents** and **mineral fillers** in the plastic could also have an **impact on the mechanical and rheological properties of the recycled material**. This impact on the properties of the recycled material has not been evaluated by COTREP to date.

Recycling potential of PE tubes

Focus – Metallic decors

Sorting tests have shown that packaging decorated with foil stamping or cold transfer on a surface area of less than 50% of the total surface area* of the packaging (body of the packaging + cap/lid/etc.) is correctly channelled into the main resin stream at the sorting centre.

After concluding that the correct orientation of such packaging depends on the degree of coverage of the foil stamping, COTREP wanted to check that PE rigid packaging decorated with foil stamping does not interfere with mechanical recycling and the quality of the recycled material. The results obtained during pilot-scale regeneration tests indicate that PE rigid packaging partially decorated with foil stamping and cold transfer does not interfere with regeneration.

Extrapolation to metallic inks (linked to the quantity of metal used) has shown that a coverage rate of less than 2% of the total surface area* is compatible with the sorting and recycling of PE tubes.

Recommendations:

- Foil stamping or vacuum metallization - Coverage rate < 50% of the total surface of the packaging
- Metallic inks - Coverage rate < 2% of the total surface of the packaging

*Total surface

The total surface of the tube corresponds to the tube body of the pack + closure system

For further information

COTREP report on the impact of foil stamping on the sorting and regeneration of rigid PE packaging:
https://www.cotrep.fr/content/uploads/2024/10/cotrep-ag80-foil-stamping-on-rigid-pe-packaging-in-pe-stream.pdf

Recycling potential of PE tubes

Focus - A few associated elements

A PE cap can maximise the quality of recycled PE.

A PP cap can be recycled in a blend with PE from the packaging body.*

Recommendation: **opt for a PE cap**

Steel balls are partially compatible with the recycling of the body of the PE packaging.

Aluminium or other metals

Although metal elements (d > 1) can be separated from PE (d < 1) by flotation, they risk:

- mainly, damaging the shredders
- to a lesser extent, preventing the tube being channelled to its recycling stream

Varnish

Two varnishes (epoxy-acrylate and thermodur) tested within the scope of a call for projects appeared not to affect the thermo-mechanical properties of PE.
To date, these varnishes are not classified as disruptive of recycling.

NB: as not all the varnishes have been tested yet, it is currently not possible to draw an overall conclusion on the impact of varnishes on recycling. Additional studies should be conducted by COTREP.

Recommendation: replace the aluminium or other metals **element with one made of PE**, or possibly PP
Alternatively, use **steel for the balls**.

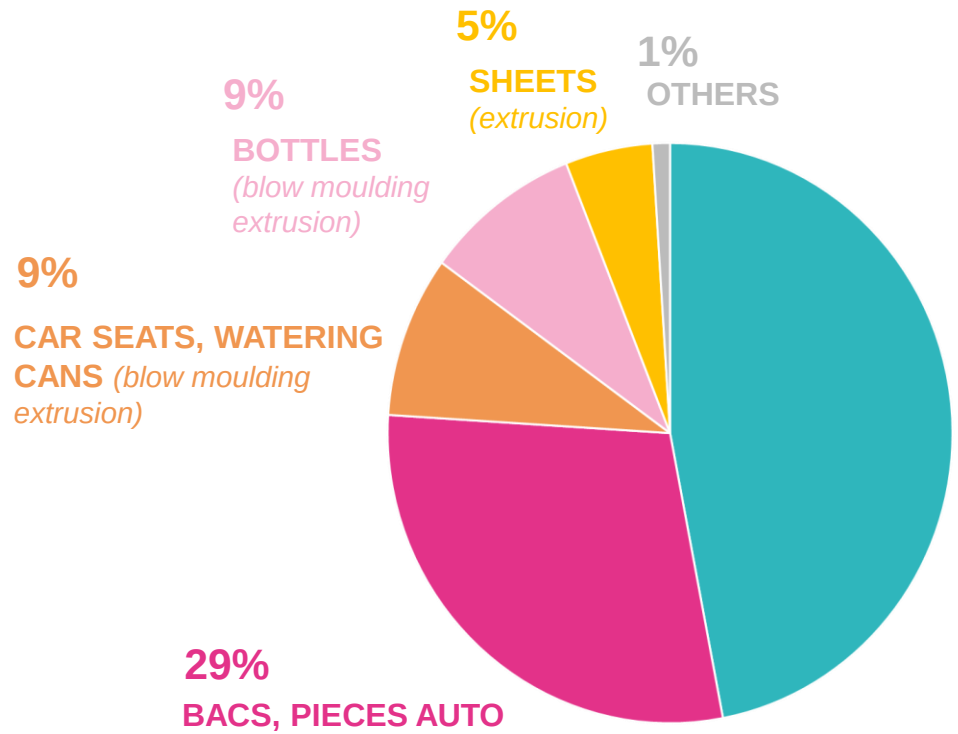
** However, COTREP is monitoring PP content in rigid PE stream and may review its recommendations if this were to reach excessive levels in the overall tonnage.*

Outlets: new applications for recycled material

Recycled material from **PE and PP rigid packaging is not suitable for food-contact use** based on current mechanical recycling solutions and according to current European regulations.

The generally dark grey recycled material produced is used to make items that are not subject to colour restrictions or not visible.

Répartition des tonnages de recyclé PE rigide



Source : Valorplast 2023 figures

04

Conclusion on eco-design recommendations

NB: the recommendations set out in subsequent slides are taken from the COTREP recommendations on rigid PE packaging; for up-to-date and complete information, please refer directly to the COTREP website.

Conclusion – eco-design recommendations for PE tubes
(COTREP state of knowledge, June 2025)

1 - PE tube body

	FULL COMPATIBILITY – IDEAL	PARTIAL COMPATIBILITY – TOLERATED	LIMITED COMPATIBILITY – CONDITIONAL	NON-COMPATIBLE AND/OR DISRUPTIVE
PACKAGING	- HDPE	- Other PE (e.g. LDPE, LLDPE) - Surlyn	- PE associated with PP	- Thermoset plastics - Multilayers HDPE (e.g. HDPE/PET) - PE associated to a non plastic material (wood, ceramics, etc.)
COLOUR (MASS-COLOURED)	- Colourless and all colours			- Not detectable black colorant in external layer
BARRIER		- EVOH with tie layer - Metallization in internal layer		- Aluminium - Other barriers and resins (multilayer, blends)
ADDITIVE AND DENSITY		- Expanded PE d<1 (gaz, blowing agent)		- Mineral-filled PE (fillers and other agents) with density > 1 - PE mineral-filled then expanded

NB: COTREP is monitoring PP and EVOH content in rigid PE and may review its recommendations if this were to reach excessive levels in the overall tonnage.

Conclusion – eco-design recommendations for PE tubes
(COTREP state of knowledge, June 2025)

2 – Closure system and associated elements

	FULL COMPATIBILITY – IDEAL	PARTIAL COMPATIBILITY – TOLERATED	LIMITED COMPATIBILITY – CONDITIONAL	NON-COMPATIBLE AND/OR DISRUPTIVE
CLOSURE SYSTEM (CAPS, VALVES, PUMPS) AND OTHER ASSOCIATED ELEMENTS	- PE	- PP - Plastic d >1 - Steel ball	- Aluminium - Other metals - Silicone or TPE d > 1	- Other plastic, silicone or TPE d < 1 - Thermoset plastics - PVC - Wood - Glass, ceramics
SEAL		- Seal d<1 in PE, PP, EVOH with tielayer, surlyn, coating ; peelable and/or with water releasable adhesive - Mono or multilayer seal* d > 1; peelable and/or with a water releasable adhesive	- Seal d<1 in PE, PP, EVOH with tielayer, surlyn*, coating ; not peelable and with a not water releasable adhesive - Peelable aluminium seal and/or with a water releasable adhesive	- Mono or a multilayer seal d < 1 - Mono or multilayer seal d > 1 not peelable and with a not water releasable adhesive - Not peelable aluminium seal and with a not water releasable adhesive

** Examples: plastic, plastic/paper, plastic with aluminium*

NB: COTREP is monitoring PP and EVOH content in rigid PE and may review its recommendations if this were to reach excessive levels in the overall tonnage.

Conclusion – eco-design recommendations for PE tubes
(COTREP state of knowledge, June 2025)

3a - Designs

	FULL COMPATIBILITY – IDEAL	PARTIAL COMPATIBILITY – TOLERATED	LIMITED COMPATIBILITY – CONDITIONAL	NON-COMPATIBLE AND/OR DISRUPTIVE
DIRECT MARKING ON PACKAGING	- Without printing - Laser marked - Production or expiry date mark	- Direct printing: not washable ink at room temperature - Foil stamping or vacuum metallization - Coverage rate < 50% of the total surface of the packaging - Metallic inks - Coverage rate < 2% of the total surface of the packaging - EuPIA good practices		- Direct printing: washable ink at room temperature - Metallic ink - Foil stamping or vacuum metallization - Coverage rate > 50% of the total surface of the packaging - Metallic inks - Coverage rate > 2% of the total surface of the packaging
LABEL ON TUBE	- PE with a water releasable adhesive (without covering conditions) - PP, OPP with a water releasable adhesive	- Paper PSL with a water releasable adhesive - PE with a not water releasable adhesive - Plastic d > 1 with a water releasable adhesive (e.g. PET, PETG, PS)	- Paper PSL with a not water releasable adhesive - PP, OPP with not water releasable adhesive	- PVC - Other plastics d < 1 - Other Plastic d > 1 with a not water releasable adhesive - Multilayer with aluminium layer (e.g. PP/AL) - RFID

Coverage

Labels should ideally cover < 50% of tubes to facilitate capture at sorting centres.

Conclusion – eco-design recommendations for PE tubes
(COTREP state of knowledge, June 2025)

3b - Designs

	FULL COMPATIBILITY – IDEAL	PARTIAL COMPATIBILITY – TOLERATED	LIMITED COMPATIBILITY – CONDITIONAL	NON-COMPATIBLE AND/OR DISRUPTIVE
ADHESIVE	- Water releasable at room temperature and without residue on pack			- Not water releasable at room temperature
INK	- Not washable at room temperature	- Foil stamping or vacuum metallization - Coverage rate < 50% of the total surface of the packaging - Metallic inks - Coverage rate < 2% of the total surface of the packaging		- Washable at room temperature - Foil stamping or vacuum metallization - Coverage rate > 50% of the total surface of the packaging - Metallic inks - Coverage rate > 2% of the total surface of the packaging