

Recyclability of plastic tubes

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01

Design of a standard PE tube



Standard design of a PE tube



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: sorting instructions extension in full swing

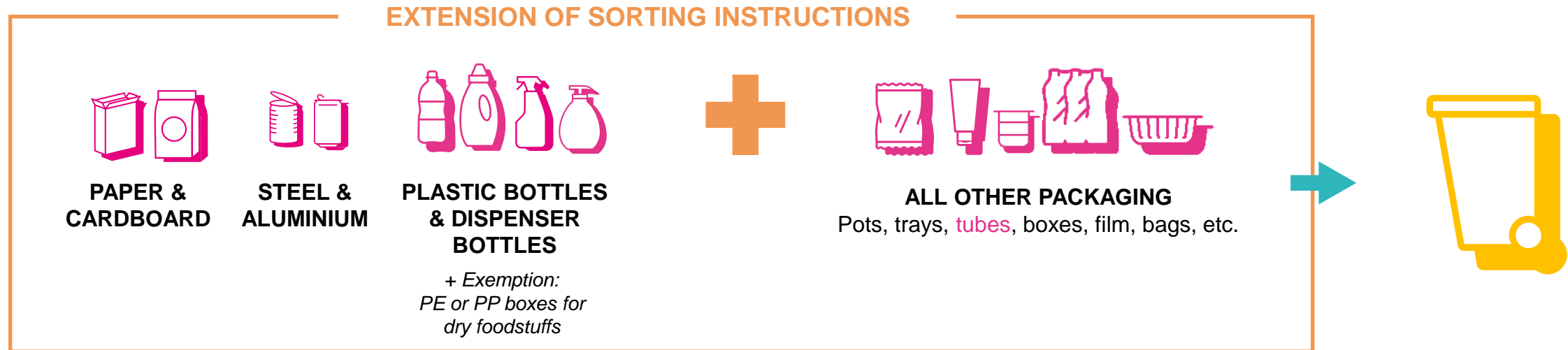
Historically, the **sorting instructions** for plastic packaging were restricted to **bottles and dispenser bottles**.



Context: sorting instructions extension in full swing

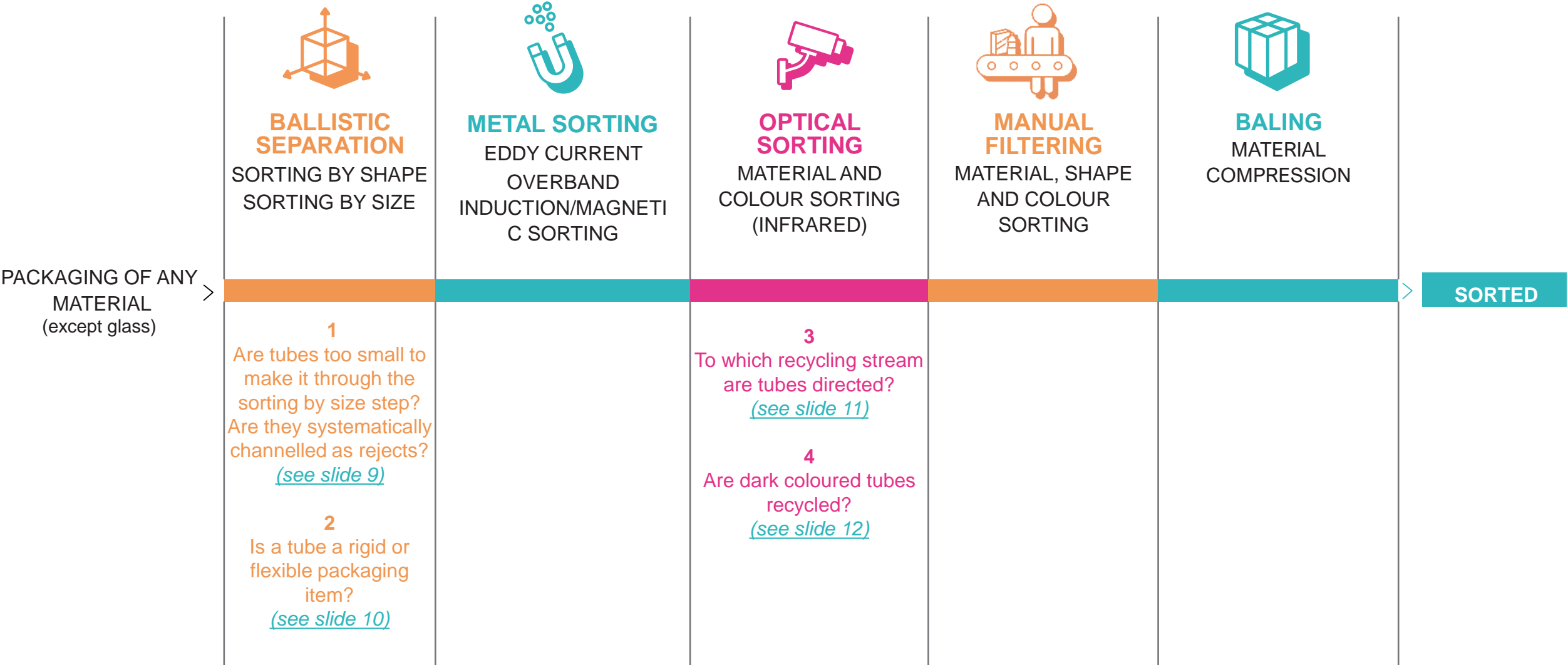
In 2011, Citeo, Valorplast and their partners launched a plan to **extend the sorting instructions** to all plastic packaging.

Simplifying the sorting process involves extending the sorting instructions so that people can **dispose of all types of packaging in the sorting bin** to maximise capture and develop the recycling of plastic packaging items that were previously not recycled, e.g. film, pots and trays, tubes, etc.



Progress is being made with the extension of sorting instructions in France. **Currently, 65% of French people** can sort all their packaging waste and **100% of French people will be covered** from 2023.

Tube potential at sorting centres – main stages





Tube potential at sorting centres

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.

** 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

3 | To which recycling stream are tubes directed?

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

In areas that have implemented the extended sorting guidelines, most 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

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 quantity** required to ensure functionality of your packaging.



✗ **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.

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 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:



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 - 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

- ✓ **Metal element (not bonded/sealed)**
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

Recommendation: replace the metal element with a **PE element** or possibly an element made of PP or plastic with a density > 1 .



- ✓ **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.

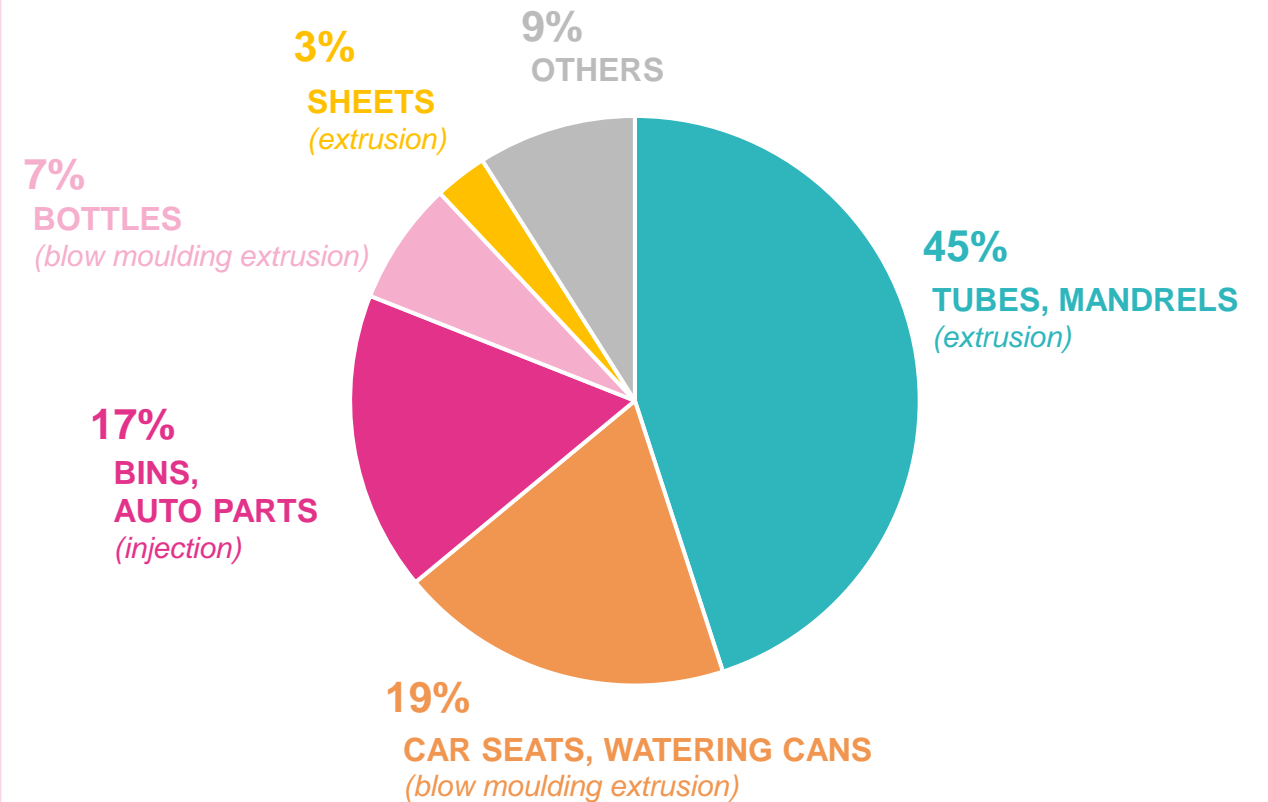
* However, COTREP is monitoring PP and EVOH content in rigid PE and may review its recommendations if this were to reach excessive levels in the overall tonnage.

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.

Distribution of recycled PE rigid tonnages



Source : Valorplast 2020 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.

Conclusion – eco-design recommendations for PE tubes

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 | | - 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

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 | - Metal - 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

3 - Designs

| | FULL COMPATIBILITY – IDEAL | PARTIAL COMPATIBILITY – TOLERATED | LIMITED COMPATIBILITY – CONDITIONAL | NON-COMPATIBLE AND/OR DISRUPTIVE |
|-----------------------------------|---|--|--|---|
| DIRECT MARKING ON PACKAGING | <ul style="list-style-type: none"> - Without printing - Laser marked - Production or expiry date mark | <ul style="list-style-type: none"> - Direct printing: not washable ink at room temperature | | <ul style="list-style-type: none"> - Direct printing: washable ink at room temperature - Metallic ink |
| LABEL ON TUBE | <ul style="list-style-type: none"> - PE with a water releasable adhesive (without covering conditions) - PP, OPP with a water releasable adhesive | <ul style="list-style-type: none"> - 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) | <ul style="list-style-type: none"> - Paper PSL with a not water releasable adhesive - PP, OPP with not water releasable adhesive | <ul style="list-style-type: none"> - PVC - Other plastics $d < 1$ - Other Plastic $d > 1$ with a not water releasable adhesive - Multilayer with aluminium layer (e.g. PP/AL) - RFID |
| ADHESIVE | <ul style="list-style-type: none"> - Water releasable at room temperature and without residue on pack | | | <ul style="list-style-type: none"> - Not water releasable at room temperature |
| INK | <ul style="list-style-type: none"> - Not washable at room temperature | | | <ul style="list-style-type: none"> - Washable at room temperature - Metallic inks |

Coverage

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