RIGID PLASTIC PACKAGING

DESIGN TIPS FOR RECYCLING

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THE UK PLASTICS PACT

wrap

RECOUP

INTRODUCTION

The primary role of packaging is to protect the product and help eliminate product waste. This is paramount, since the carbon impact of the product generally far outweighs that of the packaging. However, wherever possible, packaging should be designed in a way that minimises environmental impact, uses the minimum amount of resources possible, and is recyclable. Recycling is a critical part of a circular economy, ensuring that resources are valued not wasted, or ending up in our natural environment.

Increasing recycling rates requires effort from the whole supply chain; from those producing and specifying the plastic packaging used, through to collectors, sorters and reprocessors. The actions of citizens also play a part in improving recycling.

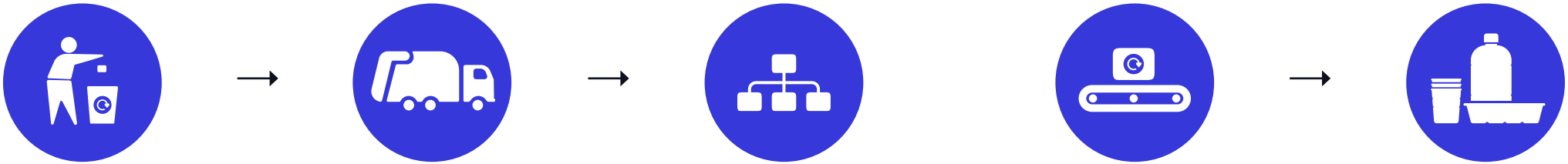
It is important to remember that recycling is fundamentally about generating a raw material that can be used in place of new (virgin) material. For this to happen it needs to be of equal quality and be cost effective to produce. Poor design, from a recyclability perspective, can have a huge impact on this.

For over 10 years RECOUP has provided detailed technical guidance on designing packaging for maximum recyclability. This document provides a summary of this guidance, highlights priority issues reported to WRAP and RECOUP by those sorting and reprocessing rigid plastic packaging, and provides alternative solutions.

The scope of the document is rigid plastic packaging i.e. bottles and pots/tubs/trays. It does not cover sustainability more widely.

PACKAGING SHOULD BE DESIGNED IN A WAY THAT MINIMISES ENVIRONMENTAL IMPACT

UNDERSTANDING THE RECYCLING CHAIN



1. Consumer disposal
2. Collection
3. Sorting
4. Reprocessing
5. Recycled

This guide aims to present considerations for recycling by illustrating some of the common issues, as reported by the recycling industry.

To understand some of the issues, it is helpful to understand all aspects of the plastic recycling chain. This can seem complicated, but it may help to remember the following rule – for packaging to be recycled it must pass through 5 stages of the recycling chain above.

At the sorting stage, material recovery facilities (MRFs) will separate materials into individual streams e.g. plastics, metals, glass, paper and cardboard. These materials are then usually baled for transport and sent for reprocessing. Plastics are sorted into polymer type and by colour (typically clear/natural and mixed colours ('jazz')) at MRFs, or at more specialised plastics sorting facilities (PRFs).

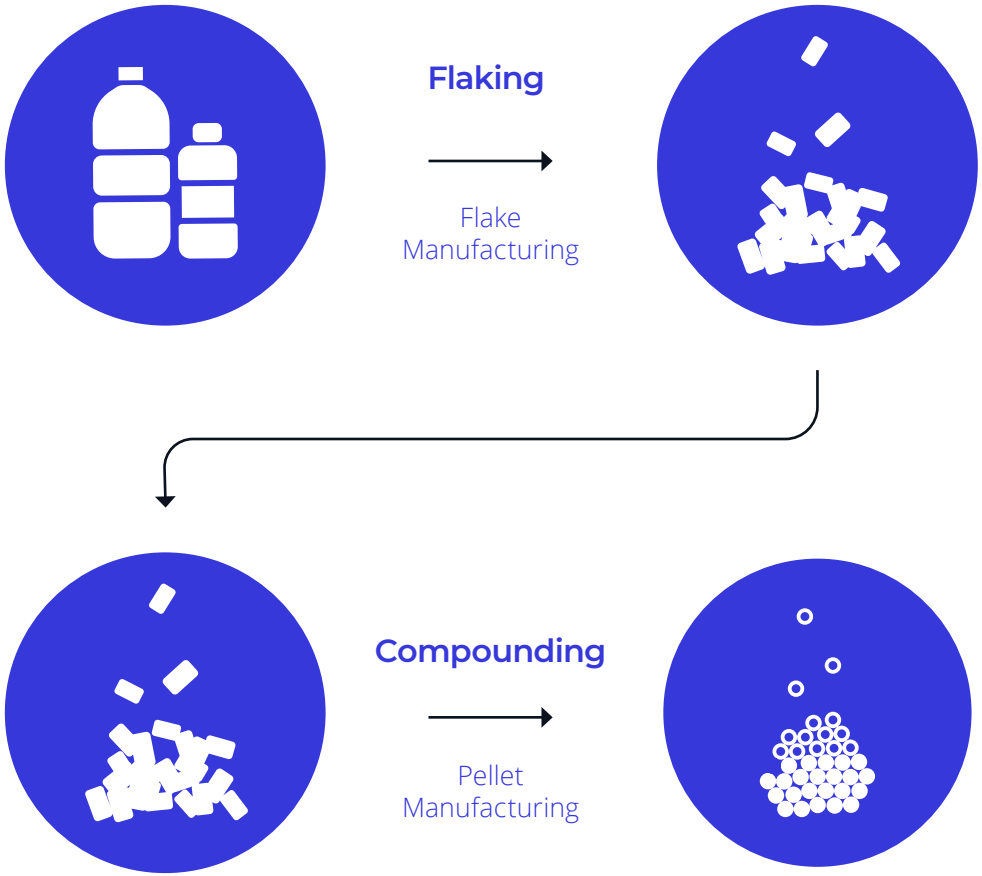
Many pitfalls could occur at the sorting or reprocessing stage. To assist the machinery and manual sorting, the use of single types of material (or easily separated components) are preferred. This enables the various components to be sorted and processed accurately. This helps the next stage of the chain (reprocessing) to produce material of a high quality, suitable for use by plastic product manufacturers.

Reprocessing

The reprocessor will wash and separate the sorted plastic material. Dirt, adhesives, labels and other residues are removed, and the plastic is granulated to create a substance known as ‘flake’. The flake is then further sorted into the different polymer streams.

Clean and sorted flake material is then heated, processed through a machine, cooled and chopped into pellets for sale and use in new products.

The issues which are outlined in this document occur in the sorting or reprocessing stages of the recycling chain.



PACKAGING DESIGNS TO AVOID

The following are the top issues of plastic packaging with regard to recyclability (not ranked), as reported by waste management companies and plastic reprocessors in the UK.

ALUMINIUM/METAL CLOSURES AND COMPONENTS

NON-DETECTABLE BLACK PLASTIC

COLOURED OPAQUE PET BOTTLES

COMPOSTABLE, BIODEGRADABLE AND OXO-DEGRADABLE PLASTICS

SLEEVES WITH MORE THAN 60% SURFACE AREA COVERAGE

MULTI-LAYER LAMINATES AND PE SEALING LAYERS

NON-REMOVABLE FILM LIDS

PVC SLEEVES AND COMPONENTS

SILICONE VALVES USED WITH PET BOTTLES

You can click to navigate this document

ALUMINIUM/METAL CLOSURES AND COMPONENTS

WHY IS THIS A PROBLEM?

Metal components are more difficult and more costly to remove compared to plastic closures.

Automatic sorting equipment can remove metal closures from recovered plastic, however not all reprocessors have this specialist equipment and small amounts of metals may remain, which can cause problems. In addition to this, most reprocessors use a caustic wash, which converts aluminium residue into aluminium hydroxide, which contaminates the recycled material and prevents its suitability as a food grade material (in the case of PET).

WHAT ARE THE ALTERNATIVES?

Replace aluminium/metal closures with a plastic alternative. The appropriate compatible plastic to use is listed in the Materials guidelines section at the end of this document.

NON-DETECTABLE BLACK PLASTIC

WHY IS THIS A PROBLEM?

The Near Infra-Red (NIR) detection machinery used in the sorting stage of the recycling process struggles to detect the carbon black pigment that is widely used to colour black plastic, as the pigment absorbs the infra-red light. This has resulted in black plastic being classed as waste in the sorting facility.

However, black is a useful colour for packaging as it masks high levels of coloured plastic enabling a high level of recycled content back into plastic packaging. Due to this, the waste management industry has trailed alternative methods of recognising black plastic within sorting facilities.

WHAT ARE THE ALTERNATIVES?

While there are options to solve the issues of black plastic, the simple solution is to avoid carbon black pigment. Clear material has a higher value than coloured, so should always be the first choice.

For amorphous polyethylene terephthalate (APET), using clear plastic is better as not only will it be detected, but clear materials have a greater opportunity to be recycled into new products or packaging.

For high-density polyethylene (HDPE) and polypropylene (PP), try to use colours which do not contain carbon black pigment. Another option would be to use an alternative detectable black pigment.

For crystalline polyethylene terephthalate (CPET), which does not have a clear alternative, you could use colours which do not contain carbon black pigment, including NIR detectable black. Alternatively, there are ‘no pigment added’ alternatives available on the market.

COLOURED OPAQUE PET BOTTLES

WHY IS THIS A PROBLEM?

Uncoloured, unpigmented PET has the highest value, the highest recovery rate and the widest variety of end markets. For these reasons, tinted (other than light blue tints) or opaque PET bottles are not desirable to many PET recyclers. White PET is particularly problematic as it can enter and contaminate the clear PET stream.

WHAT ARE THE ALTERNATIVES?

Use clear PET as much as possible. Where use of colour is required, consider alternative plastics like HDPE or PP instead. Although unpigmented polymers have the highest recycling value and the widest variety of end uses, there are relatively stable end markets for coloured HDPE and PP.

COMPOSTABLE, BIODEGRADABLE AND OXO-DEGRADABLE PLASTICS ENTERING THE RECYCLING STREAM

WHY IS THIS A PROBLEM?

Compostable, biodegradable and oxo-degradable plastics are designed to break down rather than be recycled. They therefore must be separated from conventional plastics otherwise they can cause problems and compromise the quality of the resulting recycled plastic.

Oxo-degradable plastics that lead to micro-plastics and, within the UK Plastics Pact, are targeted for elimination in alignment with the definition of oxo-degradable plastics under the EU Single Use Plastics Directive.

The concern is that manufacturers of some products (particularly polythene films and membranes), may revert to using 100% virgin materials in order to avoid running the risk of using contaminated recycled plastic.

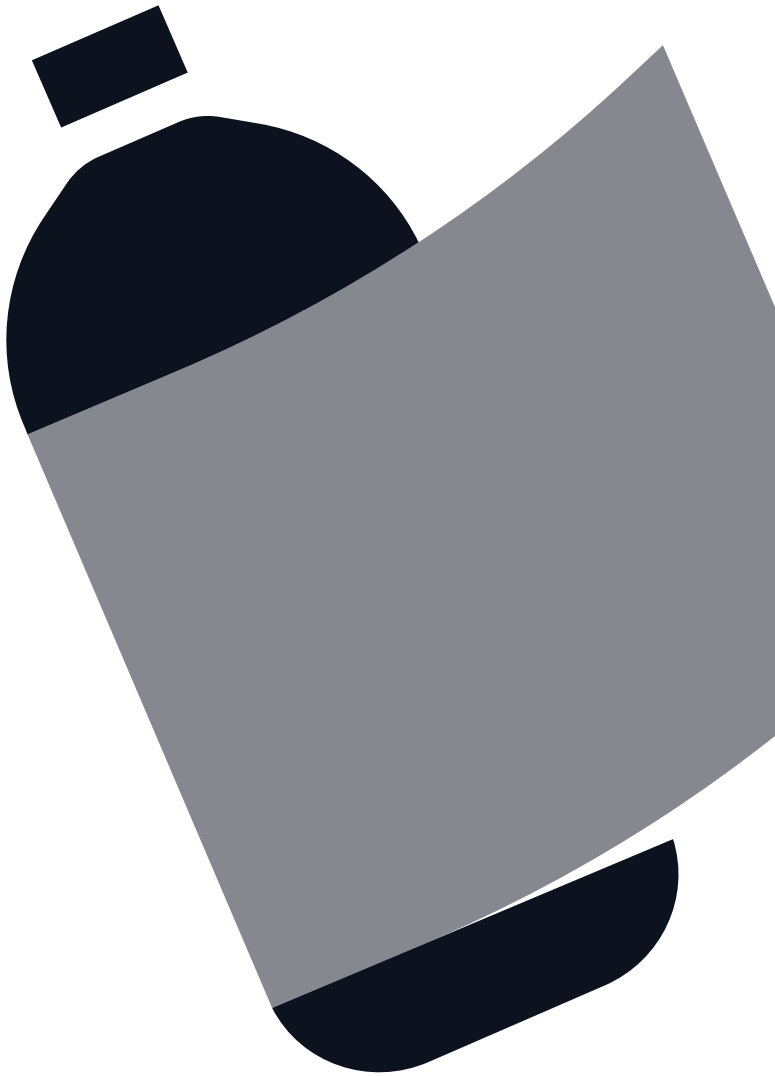
WHAT ARE THE ALTERNATIVES?

Use conventional plastics that can be collected together. A list of preferred alternative polymers is shown in the Material guidelines section at the end of this document. These are suitable for recycling and have established end markets in place.

Compostable plastics that are compliant with EN13432 could be collected separately for composting purposes. These materials should be clearly labelled to ensure that consumers are clear where they need to dispose of them (i.e. composting), this will ensure they do not contaminate the conventional plastics recycling stream.

WRAP's 'Considerations for Compostable plastic packaging' clarifies the differences between different types of packaging. For specific information on the concerns regarding oxo-degradable plastics, you can explore the full RECOUP guidance document.

SLEEVES AND LABELS WITH MORE THAN 60% SURFACE AREA COVERAGE



WHY IS THIS A PROBLEM?

Full sleeves, or sleeves that cover more than 60% of the container can lead to an error in the identification of the material used for the container itself and can also cause quality issues. If the bottle and the sleeve are different polymers, then it can result in it being mis-read by sorting equipment, leading to it either contaminating another plastics stream or being rejected for disposal. If the sleeve is the same polymer as the bottle it may cause issues with the quality of the recyclate, particularly if the sleeve is coloured.

In addition to this, the greater the proportion of non-recyclable components, the greater the 'yield loss' to the reprocessor. Packaging design should aim to maximise the proportion of recyclable material.

WHAT ARE THE ALTERNATIVES?

In bottles, it is preferred that the sleeve labels should cover no more than 40% of the surface area.

In pots, tubs and trays (and other plastic packaging), a label should not cover more than 60% of the surface.

If card sleeves are used on pots, tubs and trays then they should be readily removable by the consumer, e.g. with a perforation line, so they can be easily recycled. Water soluble adhesives should be used to ensure they wash off easily in the process, should they enter the plastics recycling stream.

MULTI-LAYER LAMINATES AND PE SEALING LAYERS

WHY IS THIS A PROBLEM?

PET pots, tubs and trays represent a significant proportion of the domestic plastic recycling stream. One difficulty is the use of PET/PE multi-layers e.g. in PET/PE trays in the processed meat sector.

Use of single materials are the preferred choice for recycling. Mixed plastic types are more difficult to separate and will cause problems with reprocessing. If PE is processed with PET, for example, the lower melt point will cause imperfections in the finished product.

WHAT ARE THE ALTERNATIVES?

Recognising the need to change; the packaging industry has worked to ensure that mono-material alternatives that follow the 'Polymer Choice and Recyclability Guidance' are available for most applications.

As the primary role of packaging is to protect the product and help eliminate product waste, it is recognised that there will be instances where multi-layer materials may have a separate benefit, for example in extending shelf life. This should also be considered before making any changes.

NON-REMOVABLE FILM LIDS

WHY IS THIS A PROBLEM?

Top film, which is difficult to remove, should be avoided if possible as it could cause defects and issues with the quality of the resulting recycled material.

WHAT ARE THE ALTERNATIVES?

Film lids should be designed to be easily removable by the consumer and leave no residue.

Where this is not possible, ensure the top film is compatible with the tray.

As the primary role of packaging is to protect the product and help eliminate product waste, it is recognised that there will be instances where it is difficult to design the pack for the film lid to be readily removed and without leaving residue.

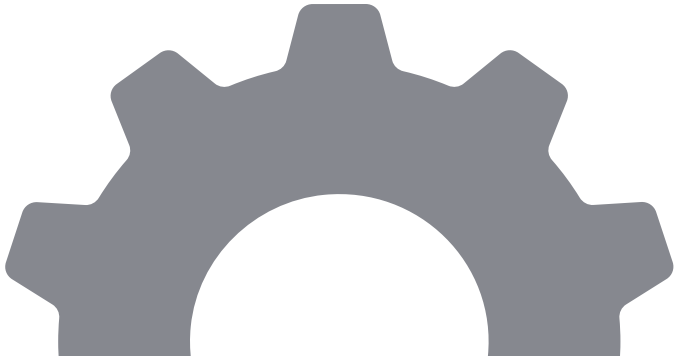
PVC SLEEVES AND COMPONENTS

WHY IS THIS A PROBLEM?

PVC contamination is a major problem to PET recycling as the similar appearance and overlapping range of densities make the two polymers difficult to separate. Contaminants such as PVC generate acidic compounds during reprocessing which go on to cause problems when recycling.

WHAT ARE THE ALTERNATIVES?

Avoid the use of PVC components. This includes closures, closure liners, labels, sleeves and safety seals. Instead use polymers for which end markets are generally strong or stable: PET, PP or HDPE and do not contaminate plastics recycling.



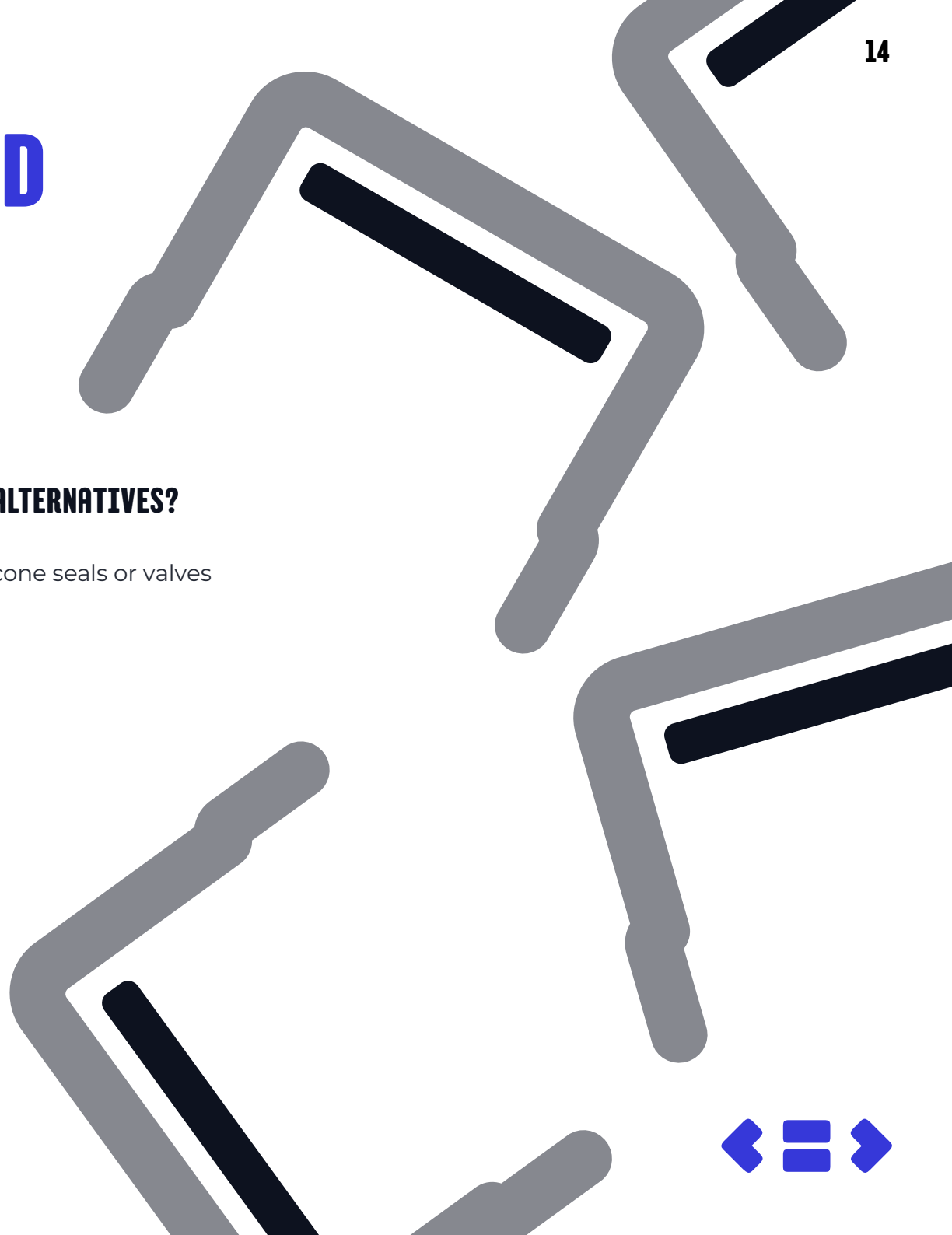
SILICONE VALVES USED WITH PET BOTTLES

WHY IS THIS A PROBLEM?

Conventional silicone seals are a contaminant. Seals with a density of greater than 1g/cm^3 are not compatible with PET reprocessing or easily separable. Seals with a lower density are incompatible with PE/PP reprocessing.

WHAT ARE THE ALTERNATIVES?

Avoid use of silicone seals or valves where possible.



MATERIAL GUIDELINES

The following tables provide an indication of the better alternatives to use to improve the recyclability of rigid plastics, as well as a summary of key issues to consider by polymer and format.

More detailed guidance is available in the RECOUP 'Recyclability By Design'.

PET BOTTLES

PET Bottles		NOT SUITABLE for plastics recycling	PREFERRED ALTERNATIVES for plastics recycling
Body	Colour	Colours containing carbon black pigment	Clear/Light-blue
	Barrier/Coatings	EVOH/PA monolayer blends	Clear plasma coating
Closure	Caps	Steel/Aluminium PS/PVC	PP HDPE/LDPE
	Seals	PVC/Aluminium Silicone	PE/PP
Decoration	Direct Printing		None/Embossed Minimal direct printing, e.g. production or expiry date
	Plastic Labels	PVC PET Full body sleeves	PP/OPP HDPE/LDPE Less than 40% coverage
	Sleeves (incl. tamper	PVC Full body sleeves	PE/PP/OPP

PET POTS, TUBS AND TRAYS

PET Trays		NOT SUITABLE for plastics recycling	PREFERRED ALTERNATIVES for plastics recycling
Body	Colour	Colours containing carbon black pigment	Clear (APET/rPET)
	Barrier/Coatings	PE seal layer	None; No residue after removal by consumer
Closure	Lidding film		No residue after removal by consumer or; as main polymer (PET)
Decoration	Direct Printing		None/Embossed Minimal direct printing, e.g. production or expiry date
	Plastic Labels	PVC over 60% coverage on face	PP/OPP HDPE/LDPE less than 60% coverage on face

HDPE BOTTLES

HDPE Bottles		NOT SUITABLE for plastics recycling	PREFERRED ALTERNATIVES for plastics recycling
Body	Colour	Colours containing carbon black	Milk/Dairy: Natural Other non-food bottles: Colours with no Carbon Black pigment
	Barrier/Coatings	PVDC	None / EVOH
	Additives	Talc/$CaCO_3$/other fillers that increase the density of HDPE above 0.995g/cm^3	None
Closure	Caps	Steel/Aluminium/PS/PVC	HDPE/LDPE/PP
	Liner	PS/PVC/EVA with aluminium	HDPE/LDPE/PE+EVA/PP
	Seals	PVC/Silicone	PE/PP/OPP
Decoration	Direct Printing	Excessive direct printing	Minimal or moderate direct printing, e.g. production or expiry date
	Labels	PVC/Aluminium/Metalised PET over 60% coverage on face	PP/OPP HDPE/MDPE/LDPE/LLPE less than 60% coverage on face
	Sleeves (incl. tamper resistance)	PVC/PS	PE/PP

PP BOTTLES, POTS, TUBS AND TRAYS

PP		NOT SUITABLE for plastics recycling	PREFERRED ALTERNATIVES for plastics recycling
Body	Colour	Carbon Black	Clear/Natural Colours with no Carbon Black pigment
	Barrier/Coatings	PVDC	None / EVOH
Closure	Caps	PS/Thermoset plastics/ Aluminium/Steel/PVC	HDPE/LDPE/PP
	Lidding film		No residue after removal by consumer or; as main polymer (PP)
Decoration	Direct Printing	Excessive direct printing	Minimal or moderate direct printing, e.g. production or expiry date
	Plastic Labels	PVC/Metalised PET over 60% coverage on face	HDPE/MDPE/LDPE/LLDPE PP/OPP less than 60% coverage on face
	Sleeves (incl. tamper resistance)	PET/PVC	PP/PE

THANK YOU

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The UK Plastics Pact is led by WRAP with the support of the Ellen MacArthur Foundation. The UK Plastics Pact was co-created by the Ellen MacArthur Foundation and WRAP to accelerate the transition to a circular economy for plastics in the UK and is one of the Ellen MacArthur Foundation's national and regional implementation initiatives around the world. The opinions expressed, and materials made available, by WRAP or EMF or The UK Plastics Pact signatories do not necessarily reflect the views of the other parties who are not responsible for the same.

Design tips for making rigid plastic packaging more recyclable
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