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DEPARTMENT OF FORESTRY, FISHERIES AND THE ENVIRONMENT

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NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT, 2008 (ACT NO. 59 OF 2008)

PACKAGING GUIDELINE: RECYCLABILITY BY DESIGN FOR PACKAGING AND PAPER IN SOUTH AFRICA

I, Barbara Dallas Creecy, Minister of Forestry, Fisheries and the Environment, hereby publish the Packaging Guideline: Recyclability by Design for packaging and paper developed under section 6(1)(a) of the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008), for implementation as set out in the Schedule herein.

The Department of Forestry and Fisheries and the Environment developed the Packaging Guideline: Recyclability by Design for packaging and paper in South Africa, in collaboration with industry in terms of section 6(1)(a) of the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008).

The Packaging Guideline covers four (4) categories of packaging material streams namely metals, glass, paper and plastics. The main purpose of this Packaging Guideline is to reduce the volume of packaging ending up in landfill sites by improving product design, increasing quality of production practices and promoting waste prevention. One of the key objectives of this Packaging Guideline is to assist designers in all forms of packaging with a better understanding of the environmental implications of their design decisions, thus promoting good environmental practices without restricting choice.

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BARBARA DALLAS CREECY

MINISTER OF FORESTRY, FISHERIES AND THE ENVIRONMENT

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RECYCLABILITY BY DESIGN

for packaging and paper in South Africa

2022

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HOW TO USE THIS GUIDELINE

This is a guide targeted at packaging designers, policy developers, sustainability managers, line convertors, printers and students. It is thus not designed to be read from cover to cover, unless the reader wants a comprehensive understanding of all the elements of design for recycling.

Generally, the first choice the designer makes is what material is to be used for the primary container or product - i.e. should it be glass, paper, metal or plastic and if the latter, what polymer type.

1. INTRODUCTION

The objective of this guideline has been to produce a guidance document that is sufficiently detailed to assist designers in all forms of packaging and paper. It will provide packaging and print designers, in particular, with a better understanding of the environmental implications of their design decisions, thus promoting good environmental practices without unnecessarily restricting choice.

This guideline has been adapted from the 2009 publication by Recoup in the United Kingdom entitled 'Plastics packaging: recyclability by design." Packaging SA has obtained Recoup's permission to do this and has adapted it to include all materials in the packaging and paper industries, not just plastics. The text has also been amended to apply to South African conditions as some European solutions are not relevant to this country at this time.

The recycling industry has been extensively consulted as our objective is to maximize the value of recyclate. The layout will allow designers to understand those combinations that effectively make the recyclate either valuable or worthless. It is the intention to update this guideline from time to time as the packaging market is characterized by innovation, new markets for used packaging materials, changing regulations and developments in the areas of labels, glues and other packaging components. These guidelines focus on the design of packaging to facilitate recycling and represent a small but important aid for the journey to sustainable production and consumption.

Climate change and sustainability are two of the biggest issues facing society today. It is therefore increasingly important for companies to reduce their environmental impact of products and services through their whole life cycle. Companies failing to address environmental performance in product design and development will find it increasingly difficult to compete in the global market. Around the world product stewardship or extended producer responsibility has become the requirement for producers. In short this means that the producer (in the case of all packaging and paper this includes all sectors of the supply chain including retailers and consumers) take joint responsibility to deal with the product and all the waste it creates after its commercial life (cradle to cradle). The National Environmental Management Waste Act, 2008 (Act No. 59 of 2008 (NEM: WA), makes this a legal requirement for all.

NEM: WA was promulgated in South Africa in 2008. It defines the waste hierarchy which is:

1 2 3 4 5

Figure 1: The waste hierarchy according to the Waste Act, 2008

The Minister has the power, in terms of Section 14 and as discussed in paragraph 2.2 of this guideline, to declare any waste which may be problematic a priority waste. In this instance the Minister will decide what to do with it. The material could be banned, a minimum recycling level regulated or a deposit enforced on the container etc.

The circular economy aims to increase the efficiency of resource use by promoting the adoption of closing-the-loop production patterns within an economic system to achieve a better balance and harmony between economy, environment and society. In light of the aforesaid designers, manufacturers of packaging and brand owners should consider the possibility of including increasing percentages of recycled material in their packaging. The specification of recycled materials in the design of new products supports the recovery of material by providing a market for reprocessed materials and reduces reliance on virgin materials. Advantages include marketing benefits, revenue generation, secondary income streams, supporting of the informal economy, development of the green economy and reduced environmental impact.

The percentages of packaging material collected for recycling from 2014 to 2018 is indicated below:

Table 1: The percentage of packaging material collected for recycling from 2014 -2018

% PACKAGING MATERIAL COLLECTED FOR RECYCLING 2014 - 2018										
	2014		2015		2016		2017		2018	
Type	Consumption tonnes	% collected	Consumption tonnes	% collected	Consumption tonnes	% collected	Consumption tonnes	% collected	Consumption tonnes	% collected
Glass	735.4	38.9%	680.0	41.0%	686.5	41.5%	753.0	43.9%	853.0	45.7%
Metal	226.5	68.0%	216.8	70.2%	194.5	74.7%	183.2	75.8%	164.2	79.4%
Paper	1641.1	64.8%	1793.1	66.7%	2041.7	68.5%	1950.7	65.7%	1900.0	67.6%
Plastic	786.2	44.7%	800.2	45.6%	865.7	44.6%	873.3	45.2%	875.7	45.3%
TOTAL	**3389.2**	**54.7%**	**1992.1**	**57.1%**	**3788.4**	**58.4%**	**3760.2**	**57.1%**	**3794.8**	**58.0%**

Note:

1. Collected packaging materials – all paper and packaging material collected for recycling, export, reprocessing, energy recovery or any other conversion process employed as an alternative to direct disposal to landfill
2. Paper figures represent recovered paper as a % of recoverable paper. Paper (pack & print) includes liquid packaging (Elopak, SIG Combibloc, Tetra Pack)
3. Plastic Packaging includes PETCO, Polystyrene Association of South Africa, PolyCo and SAVA

According to a recent Incpen* study, packaging accounts for 8% on average of the carbon footprint of products consumed at home. From an environmental perspective therefore, the packaging should be "fit for purpose" and thus its functions include:

- Protect and preserve the contents so that the end user can safely consume the product in the quantity required. This is to ensure that the 92% energy consumed in the product that has been packaged is not wasted. Clearly any over packaging is a waste of resources but inadequate packaging is a far more serious problem.
- Attract and inform the consumer. If the product does not move off the shelf, then it will be discarded and become waste.

- The designer needs to have considered what can be done with the packaging after it has completed the functions referred to above. It could be re-used (extensively and effectively applied in the beverage sector in SA. The poorer communities also reuse rigid packaging containers for storage and drinking cups), recycled, converted into energy (depending on the nature of the packaging and the local solid waste infrastructure) or sent to landfill.
- It is recognised that the recycling of packaging is not always the most environmental or economically sound option and thus the intention is not necessarily to make every piece of packaging recyclable. Equally this guideline does not attempt to imply in any way which packaging is superior from an environmental perspective. It just helps to design for recycling.
- Packaging is an essential component of the final product and thus should contribute to an overall reduction in the environmental impact of the total product offering. It should not therefore be considered or measured as a separate entity. For a more comprehensive explanation please refer to an article entitled "Sustainable Packaging– Myth or Reality" which is posted on the PWC website www.pwc.co.uk

2. GENERAL GUIDELINES FOR PACKAGING IN ALL MATERIALS

2.1 Introduction

The guidelines have been compiled to help maximize the opportunity for packaging and paper to be mechanically recycled without unnecessarily restricting material choice and to help maximize the value of the post-use material.

It is recognised that in certain instances it is desirable to use multilayer materials for barrier properties etc. Many of these are currently not recyclable. It is important that the efforts of the Multilayer Forum are continued to develop markets for this used packaging.

The information contained within the guidelines implies no criticism of any raw material and merely seeks to point out that certain combinations should be avoided to maximize the recyclability of the packaging in question. The Plastics Compatibility Matrix summarizing material compatibilities is provided in the section on plastics.

2.2 Integration of environmental and legal aspects into the packaging design process

The design of packaging is a complex process and is often a key element of product change or new product introduction. If environmental and regulatory assessments are included with the wide range of inputs that have to be taken into account at the start of a project they can become part of the process of maximising the product opportunity. Where environmental considerations are an afterthought issues are invariably more difficult to resolve and can lead to significant on-costs and serious time delays.

It is recommended that companies adopt a new product innovation process that automatically includes an environmental assessment.

NEM: WA was promulgated in 2008 and came into effect in 2009 and was amended on 2 June 2014.

The Act includes, inter alia, the promotion of waste avoidance, waste minimization, re-use, recycling and recovery of waste and to achieve Integrated Waste Management Planning and to grow the contribution of the waste sector to the green economy. To achieve these goals, the Act provides a toolbox of waste management measures which also include the Declaration of Priority Wastes in section 14. Section 18(2)(g) of NEM: WA provides the requirements that must be complied with in respect of the design, composition or production of a product or packaging thereof which includes taking into account the volume or weight of the packaging. The designed packaging should be in a way that it can be reduced, re-used, recycled or recovered.

Section 14 of NEM: WA further allows for the Minister, by notice in the *Gazette*, to call for specific measures if there are reasonable grounds to believe that a waste carries a threat to health, well-being or the environment because of the quantity or composition of waste which require:

- That specific waste management measures in respect of the waste is required to address the threat; or
- That the imposition of specific waste management measures in respect on the waste may improve reduction, re-use, recycling and recovery rates or reduce health and environmental impacts.

Consultation with the Ministers responsible for Trade, Industry and Competition, and for Finance is required if the declaration of a priority waste is likely to have a significant impact on the national economy.

The measures provided for are indicated in Section 14(5) and includes:

- a requirement for identified persons falling within a category of persons to prepare an Industry Waste Management Plan (IndWMP) in terms of Section 28 in respect of the declared priority waste;
- the prohibition on the generation of the priority waste;
- the management of the priority waste;
- the minimization, storage, re-use, recycling and recovering, treatment and disposal of priority waste; and
- any other measures the Minister believes are necessary to manage a threat presented by the waste or to achieve the objects of the Act.

A consultative process in accordance with sections 72 and 73 should be followed. As a consequence, no person may import, manufacture, process, sell or export a priority waste or product that is likely to result in the generation of a priority waste unless it complies with the following conditions set out in Section 15:

- the waste management measures specified in the Government notice;
- an industrial waste management plan submitted in accordance with section 28 or 29;
- or any other requirement in terms of NEM: WA.

2.3 General principles for container or components

In an ideal world, use of mono materials or mixed materials of the same type is the preferred choice from a recycler's point of view. In this context, type means materials that for all intents and purposes act as if they were a homogeneous material, i.e. they are fully compatible, do

not downgrade the properties of the material being recycled and can be sorted and processed as if they were a single material.

It is recognised that to provide both the technical properties needed and to satisfy user needs, sometimes a combination of different types of material is required. The impact on these on the recycling of the primary material will be covered in this guideline.

For food contact applications, the additional specific requirements of traceability, guarantee of the use of qualified processes and producer responsibility for recyclates would ensure that specifiers use only food-approved additives to maintain the potential for the recyclate to be subsequently used in food applications.

2.4 Product residues

Food waste is becoming an important issue in light of population growth and global food security concerns. There is considerably more food waste than packaging waste. In South Africa a 2018 study of the Ekurhuleni and Johannesburg metro municipalities has indicated an average of per capita food waste disposal of about 8 kg and 12 kg per annum respectively. This results in between 25 198 tonnes and 51 462 tonnes of food waste, including inedible parts, from households per annum.

Part of this is product residue in discarded packs which are both an unnecessary waste and a contaminant for the recycler and should be minimised as far as possible.

To help ensure packs are emptied, packaging designers should carefully consider what good design features can be incorporated to aid the emptying of packs. For example:

- Design the pack with a wide neck.
- Avoid sharp corners where product residue has a tendency to collect.
- Consider using a pack that can be stood inverted to ease emptying.
- Investigate use of non-stick additives in the pack or product or smooth surfaces to reduce the cling of contents to the container to ease emptying.

Such additives should not however affect the ultimate recyclability of the pack.

2.5 Composite material or barrier layers

Where a composite material is necessary to provide the requisite properties (e.g. provide a barrier function) and cannot be designed in such a way that the different types of materials can be separated mechanically or are compatible with the recycling stream, consideration should be given to the use of thin layers (e.g. vapour deposition).

It should be recognized that in some cases, lightweight plastic laminates were engineered for specific properties and/or light weighting. As a result, these may be difficult to recycle. Energy recovery may be the better option.

2.6 Colour

Colour impacts on almost all packaging and paper recycling but as the effects differ, the subject will be covered in section four according to each material.

2.7 Labels

This subject will be covered in much detail later in this guideline but as a general comment, the use of a label or sleeve offers the opportunity to colour and decorate the surface of the container to a very high percentage whilst avoiding colour contamination of the main material. This helps to maximize the value of the recycled material.

Compatibility of the label with the package, from a recycling perspective, is very important and is covered under each material stream.

2.8 Other components

There may be requests from retailers for Radio Frequency Identification Devices (RFIDs) to be applied to packaging. Whilst these tags offer potential logistics and other benefits, they are in general undesirable from a recycling perspective at present as the adhesives and /or metals can reduce efficiencies and/or contaminate the recycling stream.

2.9 Closing the loop

Designers should consider the possibility of including recycled materials in their packaging for both environmental and commercial reasons, this would also be positive for waste reduction and mitigating climate change impacts. The specification of recycled materials in the design of new products supports recycling by providing a market for reprocessed material. Other advantages include a potential cost saving, marketing benefits and reduced environmental impact.

3. THE MEANING OF GUIDELINE TABLES

The compatibility matrices contained in the material specific guidelines are divided into green, orange and red columns and these are explained below.

Material specific guidelines

These are general guidelines that apply to all materials used for packaging. These material specific guidelines complement the general guidelines and should be used in conjunction with them where appropriate. In the unlikely event that the general and specific guidelines appear contradictory, the material specific guidelines should take precedence.

The compatibility matrices contained in the material specific guidelines are divided into three columns, namely:

PACKAGING DESIGNS/MATERIALS

YES | CONDITIONAL | NO

Table 2: Three material specific compatibility matrices

The meaning of these three columns is as follows:

 YES	 CONDITIONAL	 NO
Generally, the materials used in the packaging are compatible with or separable from the main material and is acceptable in industrialised recycling processes in large volumes and the recyclate thus has the highest value it can get. It is collected nationally.	Use of material could cause recycling issues if used in large volumes. Under certain specific conditions the material may be recyclable, but this would need to be confirmed with the appropriate recycling organisations and/or recyclers. In this instance the inclusion of the material will reduce the value of the used packaging or paper as further separation processes may be necessary.	Material is generally not compatible with or separable from the main material in current industrialised recycling processes and will therefore cause severe recycling issues / cause rejection of recyclate if present even at low volumes. It may currently be exported in small quantities.

4. GLASS RECYCLING

The local glass industry has invested substantially in highly sophisticated and automated equipment to increase the percentage of glass collected from 38.9% in 2014 to 45.7% in 2018.

South Africa has an efficient returnable bottle system and combined with the glass which is recycled approximately 82% of glass packaging placed in the market annually is diverted from landfill.

4.1 The recycling process

Glass can be recycled infinitely and retains its original characteristics in the process. Its performance never degrades and, by recycling glass, savings in energy and carbon emission reductions are achieved in the manufacturing process of new containers.

Waste glass is collected and broken, without further sorting at the collection source, to reduce transport costs and it is delivered in this mixed state to the glass factory cullet processing plants. Two are in Gauteng and one in Western Cape.

The in-plant separation systems extract contaminants such as metals, labels, ceramics and other foreign matter. The glass is automatically separated into the three colours –flint (clear), green and amber – as well as a fourth mixed component, which still contains a mix of all three colours. This separated cullet is then taken to storage silos, before being fed into the glass furnaces at predetermined ratios together with virgin raw materials, where it is melted at temperatures of 1450 - 1500 degrees C. Any residual flammable material is burned off.

4.2 Colour

One of the challenges going forward when recycling rates exceed 60% will be management of the colour distribution and collection, so that adequate volumes of the correct colour cullet from the reverse supply chains will approximately match regional colour production requirements.

All glass can and should be recycled. However, the cullet returns should ideally be in similar colour proportions to sales and manufacturing requirements, which they would normally be if it were not for the effect of glass exports and imports.

Green is the most flexible and recycling-friendly colour as all the other recycled colours can be used in its production.

4.3 Solid Print on Glass

There is no problem recycling bottles with applied ceramic label (ACL) decorating, but colour separation equipment is confused by certain permanent solid labels, which can result in perfect glass being rejected as foreign matter. Giving thought to the size of the label would be helpful; smaller labels equal less wastage. An applied detachable label is preferred and is more recycling friendly. The local industry has moved to lead free inks, so from that point of view, ACL applications are not environmentally harmful.

It is also expected that recyclable separation at source, when enforced, will go a long way to reducing the colour separation system rejections and waste.

4.4 Labels

Although pressure sensitive labels (PSL) are enjoying success and growing in market share, PSL labels present a challenge for efficient recycling. This is because they tend to hold the broken glass together which is then rejected by the automatic sorting equipment. This results in high wastage of good recyclable glass. The labels do not present a problem in glass manufacturing as the labels burn off; it is only in the cullet processing where wastage and inefficiency is caused. In an ideal world PSL labels would not stick so aggressively to bottles or would shear or tear with the glass when it is broken. The glass industry together with the

label manufacturers are working on solutions to this challenge. Equipment exists to overcome the current issues, but at significant cost.

4.5 Metals

Ferrous metals are separated using magnets and do not present a recycling problem. The use of nonferrous metals for closures and foils can present a problem as they cannot be separated by magnets. However, to this end Eddy Current technology has been implemented, but again at additional cost.

4.6 Coatings

Heavily coated bottles complicate recycling because colour separation becomes a problem. These bottles require manual sorting.

4.7 Other Glass Types

Finally, in the case of kitchenware, the difference between soda-lime glass (containers) and borosilicate glass (Pyrex) is not always clear. They are, however, two different products; borosilicate glass is not recyclable but it is generally well understood that Pyrex is not recyclable.

Window glass is technically recyclable by glass container manufacturers in a controlled environment, even though it has a different composition to container glass.

Table 3: Composition of glass

	Green guidelines	Orange guidelines	Red guidelines
Colour	All colours		
Decoration	Easily detachable/paper labels	100% Coated bottles • solid colours direct print on glass • heavily coated bottles	Heavy metal inks
Closure/Foils	Plastic, paper and metal (including aluminium)	Window glass	Boro-silicate (Pyrex)
Glass	Soda lime glass (bottles)		

5. METALS

5.1. Steel/tinplate

In 2016 MetPacSA-SA was formed to bring together the entire South African metal packaging value chain. MetPacSA-SA gives the metal packaging industry a unified voice and presents industry's views.

The Metal Recycling Industry has been at the forefront of minimizing the negative impact of used cans on the environment. As from 2012 the local beverage can manufacturer has started a process of converting all beverage cans from steel to aluminium.

The industry has subsequently been involved in the recovery of all scrap tinplate generated in the tinplate and can-making processes, including sludge, cut-offs (skeletons), misprints, sub-standard fills, and most importantly the recovery of used metal cans.

The focus is to facilitate the recovery of used aluminium beverage cans, although aerosol, aluminium, food, oil and paint cans can also be recovered, thereby addressing the "cradle-to-cradle" needs of the metal can industry.

While the focus has been on the recovery rate for used beverage cans, the overall metal packaging recovery rate has been estimated at 73% (2016).

The recovery rate for used beverage cans for Southern Africa has grown significantly from a modest 18% in 1993 to an estimated 85% in 2016.On receipt, cans are crushed into bales at Collect-a-Can's various branches which are then dispatched to steel mills where they are melted to produce "prime" steel. Used metal cans are 100% recyclable and can be recycled over and over without degradation. Collect-a-Can takes care of the conversion of used metal cans into steel briquettes that are used as a separation alloy in cobalt mining processes.

Used cans can be melted on their own or mixed in with other steel scrap. The paint layer on the outside of the cans burns away and the aluminium on the end of the can contributes to the steel melting process. Aluminium being an exothermic, contributes slightly to energy requirements of the steel making process. Aluminium is an integrated element in the steel making process to produce "clean" steel.

5.1.1 Tinplate scrap handling

While Collect-a-Can's most visible activity is the recovery of used metal cans, its other fields of operation include the recovery of plate scrap used in the manufacturing process of cans.

Collect-a-Can does not itself recycle steel. All cans recovered are sold on the open market to steel mills to produce new prime steel or by adding value by supplying a niche market with briquetted used beverage cans.

5.1.2 Steel drums

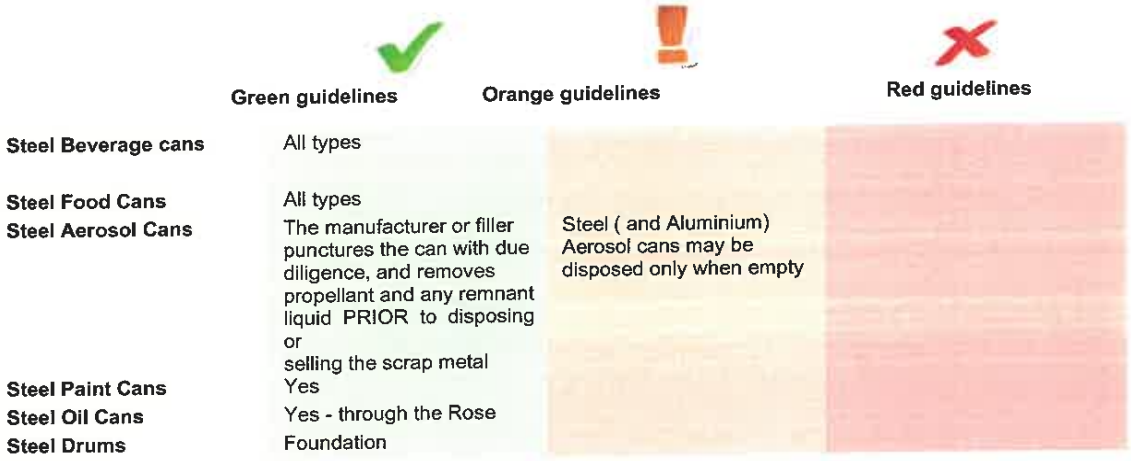
These are heavy duty containers made of mono materials and they are in great demand after the first trip either for re-use with the original product, or as a container for storage of other liquids or solids for recycling.

A number of applications of these drums are to contain hazardous liquids and thus these drums need to be cleaned under a controlled operation before they can safely be reconditioned and used again.

For further information on how to recondition please contact the South African Industrial Container Reconditioners Associations (SAICR).

Guideline table for Steel/Tinplate:

Table 4: The guideline table for steel and tinplate



	Green guidelines	Orange guidelines	Red guidelines
Steel Beverage cans	All types		
Steel Food Cans	All types		
Steel Aerosol Cans	The manufacturer or filler punctures the can with due diligence, and removes propellant and any remnant liquid PRIOR to disposing or selling the scrap metal	Steel (and Aluminium) Aerosol cans may be disposed only when empty	
Steel Paint Cans	Yes		
Steel Oil Cans	Yes - through the Rose Foundation		
Steel Drums			

5.2 Aluminium

Aluminium may be recycled indefinitely without degrading its inherent quality. The aluminium beverage can is the most recycled packaging item worldwide.

5.2.1 The process

There are two methods used to produce aluminium:

- Primary production in which an aluminium oxide compound called alumina is extracted from ore (bauxite) and then smelted and alloyed into a useable aluminium primary alloy.
- Secondary production in which collected aluminium scrap is melted and alloyed. If the scrap is segregated properly and the alloying done correctly, then there is no difference whatsoever between the aluminium ingot produced by primary or secondary (from scrap) production.

Aluminium recycling plants are designed to be able to use the energy in inks and lacquers and to process any residue in an environmentally safe manner. Plastics and paper in small amounts also generate energy for use in the melting and decorating process and so can be tolerated in small quantities. As the South African economy grows so does the amount of aluminium "end of life" scrap increase and become available for secondary production.

The properties of aluminium are tailored to different applications by alloying it with elements such as copper, zinc, manganese, silicon and magnesium. Because different applications require different performance characteristics, there are a variety of aluminium alloys that each have a unique combination of material properties such as strength, ductility, and formability.

In packaging applications there are three types of alloys that are most commonly used: the 3000-series, 5000-series and 1000-series. The 3000-series alloy, of which aluminium beverage can bodies are constructed, is the most common alloy type in recycled aluminium packaging. Manganese is the primary alloying element in the 3000-series alloy.

The second most common alloy in packaging, the 5000-series alloy, contains magnesium for hardness and is used to make beverage can lids, pull tabs, and other rigid containers. The 1000-series alloy is a high-purity aluminium containing less than 1% total alloying elements. It is used to make aluminium foil packaging applications.

5.2.2 Beverage cans

Structurally, the outside of the aluminium container consist of three parts: the bottom and walls, all made from a single piece of 3000-series alloy; the top, made from a punched-out circle of 5000-series alloy; and the pull tab, also made with the 5000-series alloy.

Aluminium beverage cans are highly recyclable and form the basis of the recycling system for aluminium packaging. They are collected in nearly every recycling program. Used Beverage Cans (UBCs) are a major category of aluminium scrap and are reprocessed to create new sheets of the 3000-series alloy used in aluminium beverage can construction. Most other collected aluminium packaging intermingled with a load of UBCs will be included in this reprocessing operation. As from 2012, the South African beverage can manufacturer has started a process of converting steel beverage cans to aluminium.

5.2.3 Bottles

Aluminium bottles are necked containers shaped similarly to glass bottles. They are formed from a single piece of aluminium sheet and use either re-sealable aluminium screw tops, plastic pumps, or pry-off crown closures. These are not currently produced in South Africa. They are recycled in the same way as beverage cans provided plastic parts are removed.

5.2.4 Rigid containers

An aluminium rigid container consists of a tray with raised walls and a removable lid. For food applications, the lid may be "peel back" style, in which case it will have a pull tab attached that punctures one edge of the lid to initiate its removal.

Alternatively, the lid may include a "church key" device that is used in lieu of an attached pull tab. For other applications the container may be given a screw lid or simply a fitted lid. Extensively used for sardines and ham, as examples.

5.2.5 Collapsible squeeze tubes

Aluminium collapsible squeeze tubes are not compatible with the aluminium recycling process. They are constructed from a 1000-series alloy, which, due to its high purity, permits the tube to flex and imparts a soft texture. While the 1000-series alloy is fully compatible with the aluminium reprocessing operation, the thin end sections of an aluminium squeeze tube may oxidize too quickly in a furnace and flash off instead of melting. However, the thicker sections near the tube opening probably contribute some of their aluminium to the melt. If an aluminium squeeze tube features a plastic closure, it should be removed before the tube is recycled.

5.2.6 Screw tops

Aluminium screw tops create some problems in the aluminium recycling process. The 5000-series alloy of which they are constructed is very similar to the alloy used in aluminium beverage can tops and pull tabs, so the reprocessing operation is designed to accommodate them. However, due to their small size, loose caps may be screened out of co-mingled recyclables and may never reach the reprocessing plant.

In addition, the plastic insert which aids cap sealing is seldom extracted and this "composite" nature creates problems in the control of the aluminium melting process.

5.2.7 Trays and foil containers

Aluminium trays are semi-rigid structures that are made from aluminium sheet by a type of impact extrusion process. They are usually designed for use in conjunction with a lid. They may be constructed for use with a plastic snap-on lid or a metalized piece of rigid paperboard as a lid. Because aluminium trays are usually made from a 1000-series or 3000-series alloy, they are metallurgically compatible with the aluminium reprocessing operation. However, because they are fairly flat and are susceptible to becoming flattened during the collection process, they are often mistakenly sorted with paper products.

Also, depending on the thickness of the tray, an aluminium tray may oxidize and reduce their contribution to a melted batch of recycled aluminium. Aerosol cans are compatible with the aluminium recycling process.

5.2.8 Foil wrappers and household foil

Aluminium foil is simply defined as any aluminium sheet that is less than two millimetres thick. Aluminium foil is made from the 1000-series alloy, which is entirely compatible with the reprocessing operation. Nevertheless, aluminium foil is too thin to melt in many furnaces. Because of this, some reprocessors are hesitant to buy bales of collected aluminium containing appreciable amounts of aluminium foil.

Furthermore, because aluminium foil is commonly used in contact with food, it may be rejected from recycling programs on the basis of health concerns. It is recommended that foil is wadded together in a ball of at least five centimetres before it is collected.

5.2.9 Composite blister packs

A composite blister pack consists of a flat thermoformed piece of plastic that contains a number of shallow, single-serving reservoirs, backed by a thin layer of aluminium foil. To dispense a serving, the user pierces the aluminium backing and peels it off, exposing one of the reservoirs. Blister packs are an excellent example of the use of aluminium with other materials to protect sensitive materials such as medicine but as they are so thin they cannot be effectively recycled.

5.2.10 Metallised film and paper

Metallizing is a process in which an extremely thin layer of vaporized aluminium is applied to a substrate (paper or polymer) in a vacuum using either the vacuum or the transfer metallizing process. For vacuum metallised paper, the aluminium is deposited onto paper treated with a thin coat of lacquer, and then sealed with a top coat of primer. Metallizing may also be applied on plastic film (oriented polypropylene [OPP] or polyester) to create metallised films.

Metallised films may commonly be referred to as met-poly film or OPP metallised film. Because the addition of aluminium to the polymer layer in these metallised films provides both barrier properties and enhanced decorative options, metallised films are frequently combined with paper packaging to form a laminate package. Multiple sandwiched layers of polymer film and aluminium are used in chocolate and sweet wrappers. This product cannot be effectively recycled.

5.2.11 Inks and lacquers on aluminium

Packaging

Most aluminium containers, and nearly all aluminium beverage containers, are labelled by applying different colours of ink directly to the metal surface. For aluminium beverage containers, inks and lacquers are typically applied to the walls of the container body and then baked on in a furnace. Clear protective lacquers are usually applied to both the inside and the outside of aluminium container.

Inks and lacquers are not problematic in aluminium recycling operations. After a load of collected aluminium scrap arrives at a reprocessing plant, it is shredded and then heated in a furnace to burn off the inks and lacquers. The inks and lacquers will in fact contribute energy to the de-coating process as they burn off. Any coating that does not burn off in the de-lacquering kiln will be separated from the aluminium melt in the melting furnace, where the coating will migrate to a layer of impurities that floats atop the metal. This layer, termed "black dross" once it solidifies, generally does not have any beneficial uses.

Radio frequency identification (RFID) tags

Radio frequency identification tags are affixed to packaging and used for automatic identification and data collection purposes. Similar in purpose to a bar code used to track inventory, a RFID tag consists of layers of paper, plastic (PET), and adhesive sandwiching a metal foil antenna or conductive ink (aluminium, copper or silver) and may even include a computer chip or battery.

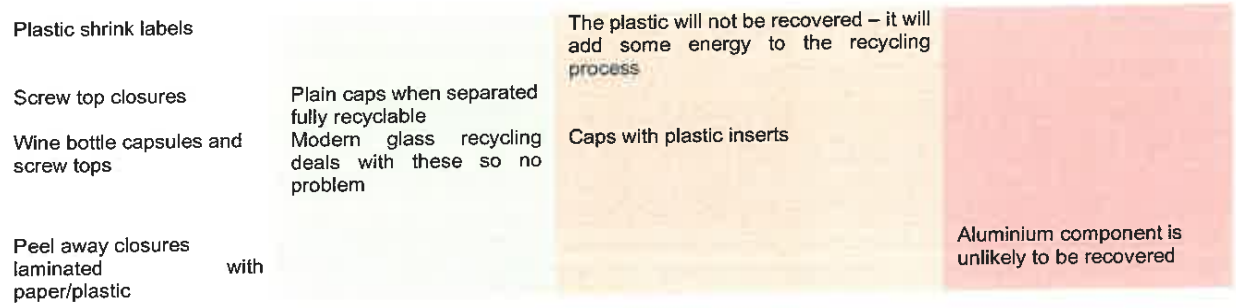
RFID tags should not be problematic in aluminium recycling. The antennae are typically made from aluminium or copper, which are metallurgically compatible with the 3000-series aluminium alloys (the 3000-series aluminium alloy uses copper as an alloying element). Any paper or plastic component of an RFID tag will be thin enough to flash off in the melting furnace.

Table 5: A guideline for aluminium products

Green guidelines	Orange guidelines	Red guidelines	
Beverage can	World's most recycled packaging	Must be processed and cleaned of excessive contaminants such as sand, stones, plastics, steel cans (including steel beverage cans), other free metals and foreign objects of any kind. Excessive levels of such contaminants are reason for rejection by recycling plants	
Bottle	As for beverage can	Closures should be removable and removed prior to recycling	
Rigid container (sardine type)	Recycles well even when mingled with beverage cans	Must not be overly contaminated with food waste, which is a reason for rejection by recycling plants on the grounds of health concerns	
Collapsible squeeze tubes **Aerosol can**	Recycles well even when mingled with beverage cans	If a plastic closure is used it should be removed prior to recycling Valve and caps must be removed and containers depressurised – if this is done it as "green" product	
Trays and foil containers	Recycles well	Must not be overly contaminated with food waste, which is a reason for rejection by recycling plants on the grounds of health concerns	
Foil wrappers and household foil	Recycle well in the heavier grades	Must not be overly contaminated with food waste, which is a reason for rejection by recycling plants on the grounds of health concerns	
Composite packaging types using aluminium – multi laminate cartons **Composite blister packs**		Refer to Product supplier as these products can only be recycled with dedicated facilities	
Metalized film and paper		Refer to Product supplier as these products can only be recycled with dedicated facilities	The aluminium component cannot be recovered in an aluminium recycling operation The aluminium component cannot be recovered in an aluminium recycling operation

Table 6: Guidance on labels, inks and components

	Green guidelines	Orange guidelines	Red guidelines
Inks and lacquers	No problem – aluminium is de-coated before melting and inks and lacquers contribute their own energy to the process		As the plastic is dominant it is sorted as plastic and the aluminium is unlikely to be recycled
Rigid plastic		Beer 'widgets', pumps, nozzles, resealable can closures should be used with caution as collection rates drop because of the lower price offered by dealers	



5.3 Aerosol Cans

Aerosol cans are used to contain and dispense a variety of different liquids, creams, and gases. Aerosol cans may be manufactured from tinplate, aluminium, glass or plastics (usually PET) although in South Africa they are most commonly manufactured from tin-plate or aluminium. The aerosol can is fitted with a spray valve, which is a composite piece comprised of a metal valve cup (most commonly made of tinplate), a stainless steel spring and an assortment of plastic components, that functions to regulate, direct, and dispense the contents. In the case of a limited number of aerosol products, the valve cup may be constructed from moulded aluminium. In order to force the contents out of the spray valve, aerosol cans are pressurized with a propellant, which may be one of several available types.

There are two general classes of propellants: flammable and non-flammable gases. Flammable propellant gases are hydrocarbon-based propellants such as liquefied propane/butane blends or less commonly used dimethyl ether. Non-flammable propellant gases may be compressed gases such as carbon dioxide and nitrogen or liquefied hydrogen fluorocarbons such as R134a. The propellant most commonly forms an integral part of the product which is expelled from the aerosol can along with the active product. In the case of certain aerosol products like pastes, gels or creams, the active product may be separated from the propellant in an inner bag, which is compressed by the propellant to expel the contents, or by a piston, which thrusts up the aerosol can, to expel the product, when the aerosol valve is activated.

Most aerosol cans are labelled by applying inks of different colours directly to the metal surface. The inks and lacquers are typically applied to the walls of the aerosol can body and then baked on in a furnace. Clear protective lacquers are may also applied to both the inside and the outside of the aerosol can.

Inks and lacquers are not problematic in aluminium recycling operations. For tinplate aerosol cans, the waste tinplate is first treated to recover the tin which was plated on the steel to provide the corrosion protection. This process effectively removes any can decoration. The recovered tin is reused separately, and the steel is then added to the bulk steel at the steel mills for recycling. In the case of aluminium aerosol cans, aafter a load of collected aluminium scrap arrives at a reprocessing plant, it is shredded and then heated in a furnace to burn off the inks and lacquers. The inks and lacquers will in fact contribute energy to the de-coating process as they burn off. Any coating that does not burn off in the de-lacquering kiln will be separated from the aluminium melt in the melting furnace, where the coating will migrate to a

layer of impurities that floats atop the metal. This layer, termed "black dross" once it solidifies, generally does not have any beneficial uses.

Aerosol cans may also be labelled by applying a pre-printed plastic shrink-sleeve to the aerosol can and applying heat or applying an adhesive pre-printed plastic label to the aerosol can. These two options have the added benefit that they can be done on the aerosol filling line using undecorated aerosol cans which may be common to number of different products. This reduces the necessary stockholding and avoids the need to produce large runs of specifically printed aerosol cans, which may result in the periodic writing off of unwanted printed aerosol cans.

Developments: Light weighting: ongoing review of resource utilisation

Trend to Smaller Sizes: especially in the shaving creams and ladies' deodorants categories

Product Diversion: Wet shampoos to dry shampoos cuts energy requirements for heating water – dry aerosol shampoos reflect a new environment friendly trend

Propellant Development: International solutions current going to market with either environment friendlier propellant (USA) or compressed air option (UK).

5.3.1 Tinplate cans

Tinplate aerosol cans are generally made from flat sheets of tinplate in three parts, a top dome, a cylindrical tube and a bottom dome. The top and bottom domes are punched from a sheet of tinplate and worked to produce the required shapes, the top dome having a wide mouth to which the aerosol valve will be affixed or crimped and the bottom dome having a moulded dome. The cylindrical tube is formed from a sheet of tinplate by moulding the sheet around a cylindrical mandrel and sealing the side of the tube with a series of spot welds down the resulting seam. The top and bottom domes are then attached to the cylindrical tube to produce the aerosol can.

Tinplate aerosol cans are compatible with the steel/tinplate recycling process, although they are not often included in recycling programs because of safety concerns. When steel/tinplate recyclables are compacted and baled at a material recovery facility (MRF), an aerosol can may rupture and allow any residual propellant to escape and expand rapidly. If a flammable propellant is used, it may accumulate in the compactor and ignite during this process. For these reasons, some recycling programs prohibit aerosol cans from collection systems and remove any aerosol cans that are unintentionally collected. However, aerosol cans collected in the consumer waste stream will tend to be depleted of most of the gas propellant so, provided that the compactor is placed in an elevated position relative to its surroundings and is well ventilated, the chances of such an ignition can be minimised.

Because most tin-plate aerosol cans are used for general household products that are intended for use around the home or workplace and not near or on a person's face, they usually contain flammable hydrocarbon-based propellants. Therefore, it is advisable that appropriate protective measures are put in place to avoid the accumulation of propellant gases and flame proofing of the compactor and any other electrical equipment.

The primary value of tin-plate recyclables is the recovery of the tin metal from the plated steel.

5.3.2 Aluminium aerosol cans

Aluminium aerosol cans are made using an impact extrusion process to create the can body from a single slug of aluminium. The size of the aluminium slug will determine the size of the aerosol can, that can be fabricated. The top of the container is given a wide mouth opening to which the spray valve is affixed.

Aerosol cans are compatible with the aluminium recycling process, although they are not often included in recycling programs because of safety concerns. When aluminium recyclables are compacted and baled at a material recovery facility (MRF), an aerosol can may rupture and allow the propellant to escape and expand rapidly. If a flammable propellant is used, it may ignite during this process. For these reasons, some recycling programs prohibit aerosol cans from collection systems and remove any aerosol cans that are unintentionally collected. However, aerosol cans collected in the consumer waste stream will tend to be depleted of most of the gas propellant so, provided that the compactor is placed in an elevated position relative to its surroundings and is well ventilated, the chances of such an ignition can be minimised. Furthermore, some aluminium reprocessors are hesitant to purchase a bale of aluminium scrap that contains aerosol cans, due to the safety concern of a pressurized aerosol can creating an explosion when added to the furnace.

Most aluminium aerosol cans are constructed from a 1000-series alloy and are compatible with the reprocessing operation in which 3000-series aluminium is created. It is very important that the valve and cap are removed from the aerosol can, as they usually contain plastic and steel components that would be problematic in the reprocessing operation.

5.3.3 Pre-consumer aerosol waste

The treatment of pre-consumer aerosol waste is ongoing and in compliance with relevant regulations. Consumers, the trade and local municipalities are currently being introduced to local assurance programme that confirms locally accredited extended producer responsibility.

Best practices for both pre-consumer and post-consumer aerosol waste disposal have been developed by the Aerosol Manufacturers' Association in conjunction with a local Gauteng Emergency Services unit.

Table 7: Guideline table for Aerosol Cans

	Green guidelines	Orange guidelines	Red guidelines
Tinplate Aerosol Cans	The manufacturer or filler punctures the can with due diligence, and removes propellant and any remnant liquid PRIOR to disposing or selling the scrap metal	Steel aerosol cans may be disposed only when empty	
Aerosol can		Valve and caps must be removed and containers depressurised – if this is done it as "green" product	

6. PAPER AND PAPER PACKAGING

6.1 General introduction

Paper is essentially divided into two distinct categories: paper and paperboard. Paper is usually lighter in basis weight or grammage, thinner, and more flexible than paperboard. Its primary uses are for printing, writing, wrapping, and hygiene purposes, although this is just a short list. Paperboard – as the suffix hints – is heavier, thicker and more rigid.

Without paper and board, many of us would not be able to read, teach or learn; convey messages or market our products. We would not be able to ship merchandise, or protect goods, nor improve our lives with personal hygiene products and tissue. Across the world, wood, paper and tissue products touch lives every day and in ways we rarely notice.

Paper was first produced in South Africa in 1920 using imported recycled paper. In 1936, the straw was first used. Today, paper products are made from virgin wood fibre or recycled paper fibre, and in cases using bagasse (sugar cane process waste).

In South Africa, the wood fibre for papermaking comes from sustainably managed commercial timber plantations. Species such as eucalyptus or pine are planted, harvested and replanted – much like farming. Only 6% of the total plantation area is harvested each year, and then replanted in the same year. This means that there are compartments maturing each year, with a sustainable supply of wood for generations to come.

This makes wood (and paper) a renewable resource which stores carbon. Paper is also recyclable, which not only keep the carbon stored for longer, but also provides paper manufacturers with an alternative source of fibre.

Today, wood fibre arrives at the mill as whole tree trunks, wood chips or paper pulp from other mills. Recycled or waste paper can also be used.

More than 12 million tonnes of paper and paper packaging have been recovered for recycling in South Africa over the past decade. In 2018, South Africa collected 71.7% of recoverable paper* and packaging, amounting to 1,285 million tonnes. (*Recoverable paper excludes paper which is unrecoverable or unsuitable for recycling. For example, toilet tissue and sanitary products, cigarette paper and archive material.)

6.2 The process

The types of raw materials used, and the process employed to make the paper will produce different kinds of paper, depending on what the paper or paper board will be used for.

Each grade of paper has a weight, a processing type and a finish. These factors determine its transparency, appearance, weight, thickness, level of opaqueness, feel and durability. For example, the lifecycle of a newspaper is short. It' s not going to sit on your bookshelf for years, whereas a coffee table will be referred to often and requires a better finish.

The type of printing technology will also determine the type of paper that should be used.

6.2.1 Fibre

Paper can be made from any fibrous material prepared such as wood, cotton, grasses, etc. Today however it is largely produced using wood. In South Africa, this wood comes from eucalyptus (hardwood) and pine (softwood) trees.

6.2.2 Pulping

At the pulp mill, the logs are debarked and are ground to release fibres for mechanical wood pulp or wood chips are processed for chemical pulp. The objective of pulping is to break down and dissolve the lignin, the natural 'glue' that holds the wood together.

Chemical pulping

Wood chips are "cooked" in a digester at high pressure with an appropriate solution of chemicals to dissolve the lignin and separate the cellulose fibre bundles into individual cellulose fibres. Since chemical processing is gentle on the fibre, chemical pulps tend to have longer fibres and make strong paper such as printing and writing papers and paperboard. (Lignin is what makes paper turn yellow after a while.)

Paper made from chemical pulp and coated to ensure a smooth surface for printing is called coated fine paper (or wood free paper) and used in the production of calendars, coffee table books, magazines and business reports.

Mechanical pulping

Chemicals are not used to remove lignin. Instead, wood chips are pressed against a refiner that mechanically separates the fibres. Mechanical pulps have shorter fibre lengths and produce papers which do not require as much strength.

Paper made with mechanical pulp is used for newsprint, speciality papers, tissue, paperboard and wallboard.

Thermomechanical pulping

This is similar to mechanical pulping but takes place under higher temperature and pressure. This softens the lignin even more than can be accomplished using frictional heat, and fibre separation is easier.

6.2.3 Finishing

Coated vs. uncoated paper – What's the difference?

Coated papers contain a layer of coating material on one or both sides. This "seals" the paper, restricting ink absorption by the paper. The ink can sit on top of the paper, in a crisp defined dot. The coating materials of pigments and fillers help to improve the printing surface of the paper.

Uncoated papers - not coated with a layer of pigment - usually include printing and writing papers made from bleached chemical pulp. They are used for general printing, photocopying and stationery. As they are more porous, the ink will soak into the paper creating a softer,

warmer appearance. Uncoated papers can be categorized by type: offset, opaque and text & cover.

6.2.4 Paper recycling

Paper recycling involves the reprocessing of paper products into new products. The feed stocks would either be *post-production/pre-consumer sources* (offcuts or rejects from the papermaking, conversion or printing phases) or *post-consumer sources*, i.e. after a consumer has used it.

Generally, recovered paper is used to make different grades of paper. Recyclable paper and board is separated into 16 different categories which are listed in the Appendix at the back of this section. Paper would be sorted and baled according to grade and processed depending on the type of "new paper" being made.

The recovered paper is fed onto conveyors where obvious contaminants (e.g. metals, rubber etc.) are removed. The paper is then fed into a pulper – a giant industrial blender - to process recycled paper into a pulp slurry. The pulp is then passed through a variety of screens to extract other contaminants before being delivered to the paper machine.

Paper fibre tends to shorten each time it is repulped and refined. Once paper fibres have been recycled 6 to 7 times, they will pass through the sieves and be classed as sludge. It is for this reason that virgin fibre will be added to "boost:" pulp recipes and add strength.

All manufactured paper is 100% recyclable, such as:

- white office paper
- magazines, including glossy magazines
- brochures
- newspapers
- corrugated cardboard
- cardboard boxes such as cereal boxes
- liquid packaging board– milk and juice cartons; hot and cold paper cups
- shredded paper (not always recommended as it is difficult to bale and it shortens the paper fibres)

Paper only becomes non-recyclable when:

- heavy foils and embellishments are added (i.e. gift wrap; cards, luxury packaging)
- glues are added e.g. 'stick-it' notes
- wax coating, foil linings or laminates are added to boxes
- plastic protective layers are added e.g. cement bags, dog food bags, disposable nappies

Contaminants – or more importantly "non-recyclable materials" – such as those indicated above can affect the reprocessing of the paper. It is for this reason that paper should ideally be kept free from such materials. Considerable research is being done in SA to try to deal with some of these materials. Ideally all players within the paper chain including packaging converters and printers should be mindful of the current constraints.

6.3 Uses for recovered paper

Table 8: Different types of uses for paper

RECOVERED	RECYCLED
Corrugated boxes	New corrugated boxes
Newspapers and magazines	Newspaper
Office paper, newspaper, magazines, printer off-cuts	Bath tissue products. Kitchen and industrial paper towelling
Office paper, corrugated boxes, newspaper, carton board trims, printer off-cuts	Carton board – cereal boxes, soap carton
Newspaper, carton board trims	Moulded paper products i.e. egg boxes
Liquid board packaging Milk and juice cartons – 75% virgin paper board + 25% polyethylene and aluminium (poly/al) Paper cups – 95% virgin paper board + 5% polyethylene (PE) coating	Paper board used in new paper packaging Poly/al and PE – various plastic injection moulded products

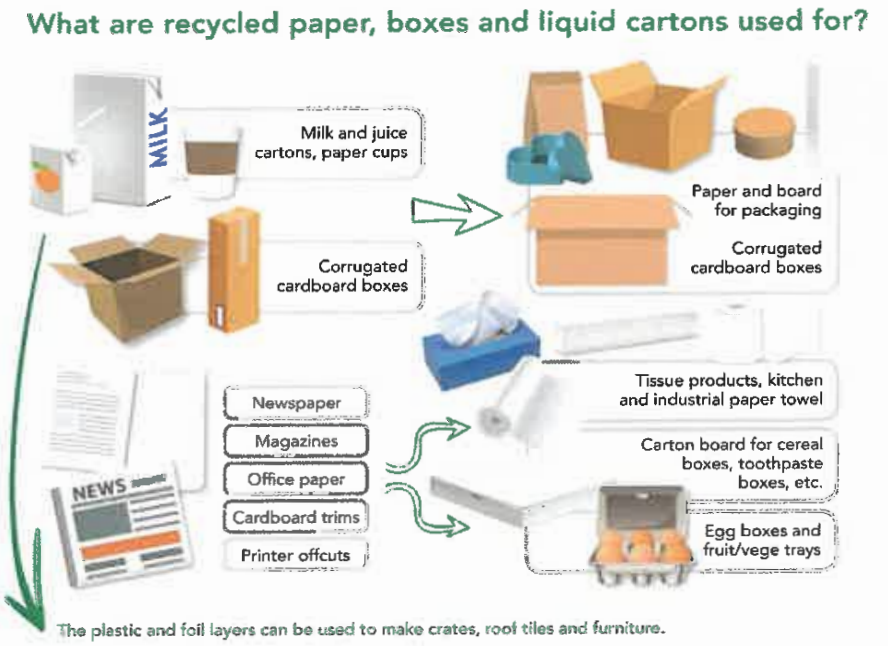


Figure 2: Uses of recycled paper, boxes and liquid cartons

6.4 Ink coverage

For white paper which is largely used for tissue products or blended into fine paper production, the mills have de-inking plants which can deal with a normal amount of ink coverage. As with other contaminants, excessive ink coverage can cause bottlenecks or interruptions in production. Heavily inked papers will be recycled but as a lower grade paper.

6.5 Adhesives

The system deals with water-based adhesives without difficulty, but latex or hotmelt adhesives can stick to the cylinders on the paper machines, causing holes in the paper produced. Such contaminants are known as 'stickies'. This is more serious for lightweight papers and tissue. Some of the paper mills have upgraded their equipment to deal with the adhesives (hotmelt glues) found in spines of magazines but these could be a problem for smaller paper producers.

6.6 Wet-strength additives

Certain papers (e.g. potato sacks) contain additives to prevent the paper breaking up in moist conditions. These are recyclable in a liquid packaging recycling plant however they are not commonly recycled. An inhibiting factor for recycling is identification and sorting. Ideally packaging should clearly state that it contains wet strength additives.

6.7 Liquid board packaging– beverage cartons

Milk, juice and certain food cartons are made up of a combination of paper board, polyethylene and aluminium (PolyAlu) or paper board and a polyethylene (PE) plastic lining.

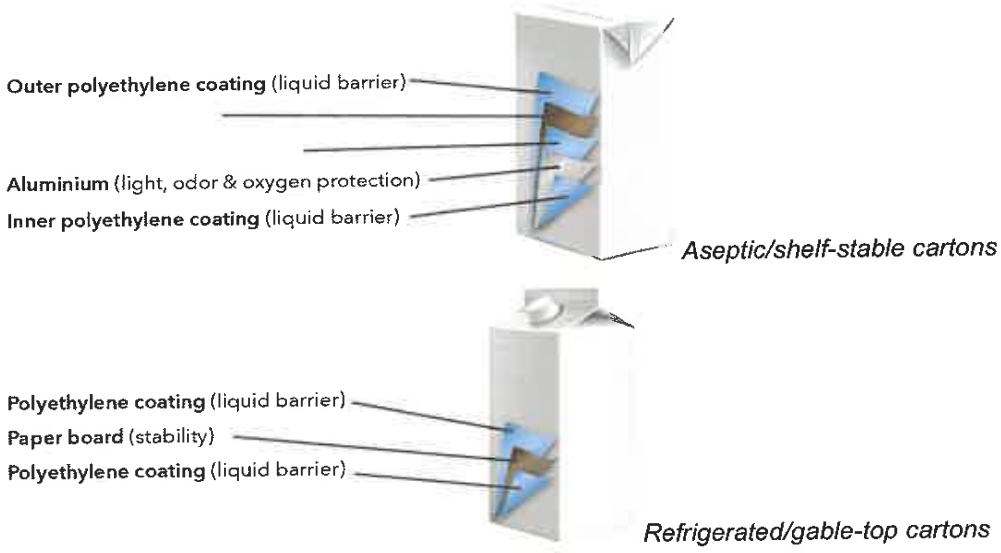


Figure 3: Composition of a beverage carton

Paper board is the dominant component and is made from imported virgin board making it attractive recoverable paper fibre.

Bales of recovered liquid board packaging are fed into a specially designed hydropulper that rubs the paper fibre away from the PolyAlu or PE layers. The fibre is then used to manufacture recycled paper board for various end uses. The PolyAlu and plastic, including the closures and straws, is processed further into various plastic injection moulded products. Lids of milk cartons, for instance, can be used to make wheelie bins.

6.8 Liquid board packaging – paper cups

Paper cups are also a form of liquid packaging. Cups are made mostly from paperboard. A thin layer of polyethylene (PE) lines the inside, making them liquid proof and providing function.

Hot cups

- Usually two layers of paperboard for insulation.
  - One layer of PE lining on the inside.
  - Some hot cups are single walled but usually come with a sleeve.

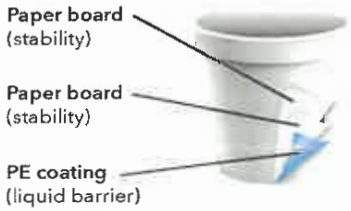


Figure 4: Hot paper cup composition

Cold cups

- One layer of paperboard.
- Outer layer of PE to handle condensation while an inner PE layer prevents leaking.

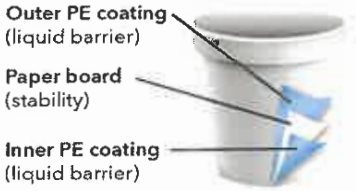


Figure 5: Cold paper cup composition

6.8.1 Paper cups and biodegradability

Some paper cups may be labelled as biodegradable or compostable. This means that the paperboard is coated with a starch-based lining called polylactic acid (PLA) instead of a plastic lining.

Compostability or biodegradability refers to environments with specific conditions such as those found in industrial composting facilities (airflow, temperature and moisture) and it is unlikely that these conditions will occur naturally. While this lining will biodegrade over time, unless in these specific environments, this might be a much longer period than anticipated. Generally, EU standard EN13432 is used as reference.

As this product is designed to decompose and break down, generally speaking, biodegradable or compostable plastic is not suitable for recycling as it "contaminates" the plastic recycling stream – if an end product is made with non-biodegradable plastic and biodegradable plastic, this could reduce the integrity of the product, with parts of it breaking down.

6.9 Laminates and wax layers

Liners are applied separately from the board production. Recycling companies don't particularly want a wax material as this would melt back into solution during the pulping process and would be very difficult to remove. The wax would form into stickies and cause runnability problems on the paper and board machines.

Extensive research is carried out by the various centres to improve both the environmental sustainability and the performance of the packaging.

Table 9: Guideline table for newspapers, magazines, envelopes etc.

	Green guidelines	Orange guidelines	Red guidelines
Tinted Paper		Pastel Colour	Heavily dyed
Inserts in Magazines	Same Paper	Different paper types	
Inks		Excessive coverage	Heavy Metal Metallic
Adhesives	Water Based		Latex/Hotmelt Self-Adhesive
Laminates on Envelopes		Window carbonless papers Non-cellulose envelopes	Wax Label backing papers (release liner)
Corrugated Boxes			
Adhesives	Water Based Latex/Hotmelt Self-Adhesive labels		
Inks		Containing heavy metallic	
Laminations			Polycoat Wax
Other Packaging			
Adhesives	Water based	Latex/Hotmelt Self-adhesive labels	
Laminates/additives	Liquid Packaging Board Cartons	Wet strength paper Polycoat* Wax* Foil lined papers coated	Sacks containing free film
Features		Windows	
Ream Wrap			Polycoat*

6.10 Paper grade definitions for recycling

This list of South African Standard Grades of Recovered Paper and Board gives a general description of the standard grades by defining what they do and do not contain.

It is recognised that specific deals between buyer and supplier for standard grades with special specifications will still be necessary to meet individual requirements.

It is recommended that the standard is used at all industry levels. It secures the quality of the recovered paper supply to the paper mills. Where paper recycling mills can receive a known

and consistent product from collectors and on-sellers, this creates value for the recovered product.

Out-throws

The term "out-throws" is defined as all papers that are so manufactured or treated or are in such a form as to be unsuitable for consumption as the grade specified.

Prohibitive materials

Anything which is not paper or paperboard and if included in the recovered paper may during processing cause damage to machines or interruptions to production.

Specific examples include: Metal, plastic, glass, textiles, wood, sand and building materials, synthetic materials and synthetic paper.

Moisture content in recovered paper and board

Recovered paper and board will in principal be supplied with moisture of not more than the naturally occurring level – where the moisture content is higher than 10% on paper and 12% on kraft/board (of air dried weight), the additional weight in excess of the allowed percentage may be claimed back.

Method of testing and sampling

The equipment to be used for testing is either:

- Emco AP 500 hand gauge (or equipment with similar specifications)
- Oven dry method
- Aquabouy

In both cases a random representative sample will be taken and subject to testing by one or other of the above methods as agreed between buyer and seller. When new or advanced technology becomes available these procedures may change and will be communicated by way of revised schedule.

Table 10: Product schedule

Grade definition	Abbr.	Description	Prohibitive materials allowed	Total out-throws may not exceed
Mixed paper	**[CMW]**	A mixture of various grades of paper and board without restriction on fibre content.	1%	10%
Carton board cuttings	**[IMW]**	Consists of new cuttings of paperboard as are used in the manufacture of folding paper cartons and similar boxboard products.	1%	2%
Mechanical grades				
Special news	**[SN]**	Consists of newspaper, magazines and sorted graphic paper from kerbside and other post-consumer collections. All kraft paper must be removed.	1%	3%
Over issue news	**[FN]**	Consists of overrun unsold newspapers containing not more than the normal percentage of inserts No flexographic printed material allowed.	None permitted	1%
Magazine	**[SBM]**	Consists of unsold magazines and trims from magazine printers including catalogues,	None permitted	2%

		brochures with or without latex bindings. May contain up to 10% of uncoated news type paper.		
Special magazine	**[SSBM]**	Unsold magazines and trims from magazine printers, including catalogues, brochures without latex bindings. May contain a small percentage of news type paper.	None permitted	2%
High grades				
White one	**[W1]**	Consists of unprinted white wood free paper or board, off cuts or shavings free from water insoluble matter.	None permitted	None permitted
Heavy letter one	**[HL1]**	Consists of white printed or unprinted sheets, shavings originating from printers or office records. This grade must be free of heavily printed or coloured stock and non-water soluble adhesives.	None permitted	2%
Heavy letter two	**[HL2]**	Consists of pastel coloured printed or unprinted sheets, shavings and cuttings originating from printers or office records. This grade must be free of heavily printed or coloured stock and non-water soluble adhesives.	1%	2%
Super mix	**[SMW]**	Consists of mix of HL1 / HL2 in ratio 50% HL1, 50% HL2. This grade must be free of non-water soluble adhesives.	1%	2%
Sorted office paper	**[SOP]**	Consists of paper as typically generated by offices, containing primarily white and coloured ground wood free paper, free of unbleached fibre. May include a small percentage of carbonless paper.	1%	5%
Kraft grades				
Corrugated containers	**[K4]**	Consists of corrugated containers having liners of kraft or test liner.	1%	5%
New corrugated kraft waste	**[K3]**	Consists of new corrugated cuttings, sheets and unused boxes as generated by corrugating convertors having liners of kraft or test liner.	None permitted	2%
Unused kraft bags	**[K1]**	Consists of new kraft multi wall bag cuttings, sheets and misprint bags, free of stitched papers, poly liners and wet strength paper.	None permitted	2%
Special grades				
Liquid board packaging	**[LBP]**	Used or unused liquid packaging boards including used PE – coated liquid packaging board (with or without aluminium content). Containing a minimum of 50% by weight of fibres and the balance being aluminium or coatings.	None permitted	3%
Telephone directories	**[TD]**	Consists of clean telephone directories printed for or by telephone directory publishers.	None permitted	2%

7 PLASTICS

7.1 General principles for plastics recycling

Sorting, processing and recycling systems make a significant difference to the efficacy of plastics recycling and these differ around the world.

For example, in the case of sorting, techniques which facilitate material identification according to the kind of plastic with the aid of the near infrared process (NIR spectroscopy) are being used with increasing frequency in other parts of the world. In South Africa, sorting is mainly done by hand and this section reflects South African conditions.

Shredding and granulating equipment is used to reduce the size of the product. The flakes are separated in the water-based washing process.

The objective is to clean and separate the different material fractions or types of plastics. These processes rely on the differences in the density of the materials for separation in water. Magnetic and inductive metal separators are also used.

Materials which cannot be separated or which can only be separated partially, impair the quality of the recyclate, leading to lower proceeds.

7.1.1 Special requirements

Sorting, processing and recycling requirements are based, amongst others, on the following criteria:

a. Material combination and selection;

b. Separability of composite materials;

c. Ease of emptying; and

d. Labels, printing inks and adhesives used.

7.1.2 Material combination and selection

The use of one sort of plastic for a pack is the optimum solution. The recycling industry understands "sorting" as separating a PE-HD from a PE-LD product, for example. Such packs can be separated homogeneously during sorting and prepared in the subsequent processing steps.

If a combination of different kinds of plastics is necessary, plastics with different densities (a plastic with a density of less than one and a plastic with a density of more than one) are acceptable for recycling since they can easily be separated in water during the standard recycling process.

If a plastics pack consists of different types of plastics which cannot be separated with water, the plastics types should at least be compatible. A matrix for evaluating compatibility is attached and explained in section 7.11.

Where different components can be separately manually, such information should be printed on the pack to invite the consumer's participation, e.g. remove shrink label before discarding and in most cases the shrink sleeve must be perforated for easy removal. The combination of different types of plastics within the same density range, e.g. PE and PP or PET and PVC, is not favouring recycling.

7.1.3 Separability of composite materials

If a piece of packaging consists of several parts, these should be manufactured all from the same plastic material wherever possible. If this is not feasible, it is preferable to select designs which disintegrate into components of different density during mechanical shredding or granulating which can subsequently be separated in the washing stage.

Designs with different materials that cannot be separated mechanically should be avoided wherever possible. If a composite material is necessary on account of the function to be fulfilled by the packaging (e.g. to achieve certain barrier properties), thin layers should be given preference, for instance, vapour-deposition. Vapour-deposition does not impair recyclability. This includes vapour metallising of films. However, thicker layers lead to coating residue which impairs the quality of recyclate.

7.1.4 Ease of emptying

It should be possible to empty a pack so that only very little product residue is left. This simplifies processing and recycling of the plastic packaging.

Suitable design measures can help to promote ease of emptying. These include smooth surfaces, flexible packs that can be squeezed until they are completely empty, such as those already in use as refill packs, or packs that are suitable for upside down storage.

Chemical containers should be triple rinsed and cut in half before being transported to recyclers to ensure that the recycler doesn't have to deal with any substantial amounts of hazardous chemicals on site.

7.1.5 Labelling, printing and adhesives

In general, labels should be manufactured from the same sort of plastic as the main component of the pack, except in the case of PET. If the materials or the plastics used for the labels and sleeves differ from those of the body of the container, combinations of plastics are acceptable if their densities differ sufficiently for technical separation. Sleeves and wraparound or collar labels which are only stuck to the container at a few points and not over a large area, are optimum solutions for bottles. They can be separated without any residue if water-soluble adhesives are used.

If the products frequently come into contact with water (sanitary sector), in mould processes are optimal as long as the same type of plastic is used. Paper labels are acceptable if they are attached with water-soluble adhesives. Paper labels should not delaminate or pulp in the washing process. Some paper label fibres can be carried over into the recycled plastic causing problems such as surface defects and pinholes during the subsequent product manufacturing process.

Use of decorative or protective finishes like foil, lacquers and coatings, should be minimised.

Hazardous substances should be avoided in printing inks in the interest of good manufacturing practice. These include inks containing heavy metals.

7.1.6 Material identification

Identify the polymer(s) in use clearly. To facilitate the visual identification of plastics during manual separation, the plastic components should carry a material identification code. The symbol should be clear and ideally moulded into the container.

For consistency, material identification codes should be embossed on the base of the container. Exceptionally, the code can be located close to the base or printed on the label. In the case of printed films, the symbol should be lightly and repeatedly printed.

The triangle with chasing arrows and a number within is used merely as an identifier for the predominant plastic type and does not necessarily imply that the material is recyclable, see section 7.9. This is a very important issue and is the joint responsibility of the brand owner and packaging converter.

7.1.7 Colour

Un-pigmented polymer has the highest recycling value. The widest variety of polymer uses un-pigmented film and containers which is preferred over pigmented packaging. Strongly coloured plastics have a much lower value for recycling than non-pigmented plastics and at all cost fluorescents neon pigments must be avoided.

Solidly printed plastic films and films with high ink coverage cost more to recycle and the recyclate have a lower value. The amount of colour should be minimised as much as possible within the constraints set by technical considerations, branding and consumer acceptance.

Where use of colour is necessary, designers should consider alternative approaches such as perforated sleeves or wrap around labels that can be removed prior to recycling. Avoid direct printing onto un-coloured plastics.

7.1.8 Additives

The use of additives should be avoided as pure polymers are recyclable, but compounds and modified materials not necessarily.

Lately, the use of cost-saving fillers like $CaCO_3$, has turned perfectly recyclable plastics products into the unrecyclable category. High levels of fillers increased the product density to levels bigger than one where the products will no longer separates with its kind during mechanical recycling.

7.1.9 Sleeves

Use of a material of a different type for the sleeve offers the opportunity to colour and decorate the surface of the container to a very high percentage whilst avoiding colour contamination of the main material and preferably perforated.

7.1.10 Laminated films or multi-layer packaging

In some cases, lightweight laminates were engineered for specific properties and/or light weighting of the pack. Laminates are very difficult to recycle. Only very specialised recycled products can make use of laminates. Energy recovery would be an option but is not yet available in South Africa. Non- recyclable plastics can be used as additives on tarmac asphalt

as another option to divert them from landfills. Laminated and multi-layer packaging should only be considered if all other options were exhausted.

Multi-layer packaging should be marked with a number 7 material identification code with the relevant acronyms underneath. For example, a multi-layer film consisting of PP and PE-LD should be marked as:

Multi-material packaging is sometimes required for extensive shelf life or very high barrier properties and consists of various combinations of paper, plastics and aluminium. These multi-material combinations cannot always be recycled in South Africa. Composite packs should only be used if no other simpler option is available.

7.2 Poly Ethylene Terephthalate (PET)

7.2.1 General

PET is extensively used for bottles but is also used in other packaging formats, e.g. thermoformed sheet for trays and punnets, strapping tapes, flexible packaging and transit packaging.

PET bottles make up approximately 70% of the total PET market in South Africa, with thermoformed trays, edible-oil bottles, jars, strapping and films accounting for the balance. PET trays and blister packs (alongside PVC plastic trays) are not currently collected and recycled in South Africa. This will be addressed soon.

However, although not currently being recycled, packaging designers should still incorporate all the aspects to render the tray recyclable. For PET trays, moulds with specific polymer logos should not be used for other materials; for example, a mould with a No 1 PET insert cannot be used for No 5 PP etc.

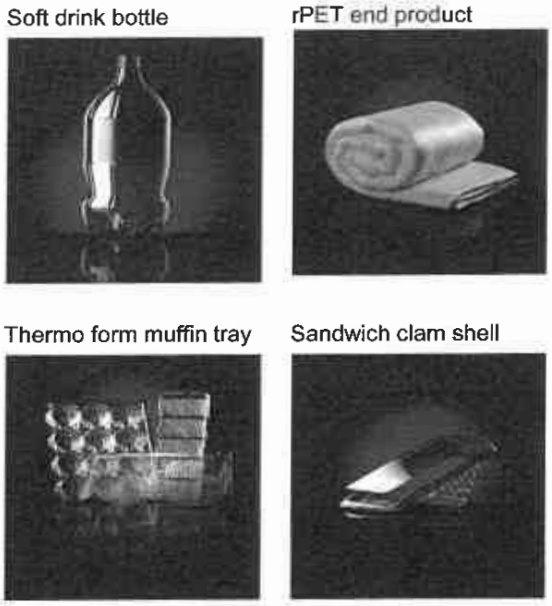


Figure 6: Examples of packaging products made out of PET

7.2.2 Designing for PET packaging

Packaging form

Good packaging design can encourage reduced content waste. It should be possible to empty a pack so that only very little of the residual contents is left in the pack. This simplifies processing and recycling of the plastic packaging. For PET bottles, wide necks allow the bottle to be placed upside down to drain all of the contents without any residue being left behind. This applies more to the "sauce" and similar segments of the market.

Material type

Not all packaging materials can be recycled in South Africa. Understanding which different polymers can be recycled in South Africa can drastically improve the design for recyclability. The aim is to minimise the number of different plastics used and to specify plastics that can be recycled together or easily separated in the recycling process.

- Combinations of different types of plastics with the same density ranges should be avoided; PET is heavier than water and will sink during one stage of the recycling process.
- During the PET washing process, caps or labels manufactured from polypropylene or high-density polyethylene (HDPE) will float and can be easily removed.
- Avoid PVC as its similar appearance and overlapping range of densities with PET make the two polymers difficult to separate, often resulting in PVC contamination. This contamination (even at levels as low as ca50-200ppm) can render large amounts of PET useless for most recycling applications. For this reason, the use of PVC components of any kind with PET containers should be scrupulously avoided. These

components generally include, but are not limited to closure liners, labels, sleeves and tamper-evident seals.

- Avoid PETG (PET with glycol added) for similar challenges to PVC and especially given its lower melting temperature to PET, which renders it a contaminant.
- Other types of PET that share the same material identifier may cause problems in separation and conventional recycling.
- Other types of polymers that are sometimes substituted for PET include PLA, polycarbonate (PC) and rigid polystyrene (PS). Even the lowest levels of PLA in PET leads to haze and a deterioration of physical properties within recycled PET.

Material identification

To facilitate the ease of visual identification of plastic types during manual separation, major plastic components should carry a material identifier, otherwise known as a polymer identification code (PIC).

- The PIC symbol should be clear, legible and moulded into the container so as to be easily identifiable.
- In the case of films, the PIC symbol should be lightly and repeatedly printed onto the material.
- Multilayer polymer composites should be marked with PIC '7'.
- Do not use the PIC 1 for PETG, PET/PE laminate, or PET with biodegradable laminates (refer to bullet point directly above).
- In exceptions, the PIC symbol can be located close to the base or printed on the label.

Composite materials / barrier layers

Other external coatings (e.g. O_2 or CO_2 barriers) can cause recycling issues. External coatings such as those that are applied to extend the shelf-life of products may sometimes cause recycling problems. If absolutely necessary to use a barrier, it needs to flake off the PET and be efficiently removed during granulation. Designers and converters need to select the correct combinations.

Where performance-enhancing barrier layers are used that could interfere with current recycling (e.g. PET wine bottles), it is important to ensure that the container is easily distinguishable and sorted from conventional PET bottles and marked with a PIC '7'.

Additives

The inclusion of nucleating and hazing agents, colours and fluorescent pigments, oxygen scavengers and other additives for visual and technical effects should be examined on a case-by-case basis for their impact on the overall plastic recycling stream. Such additives, which often (but not always) cause PET to discolour and/or haze, should be avoided unless means are readily and economically available to minimise their effect.

Colour of plastic

Clear bottles have the highest commercial value for recycling. Very light blue bottles are also acceptable as they can be blended in small amounts with clear bottles. Green and brown bottles are also recycled but have a much lower value than clear bottles. Designers are encouraged to consider alternatives (e.g. perforated sleeves) if colour is absolutely necessary.

Tubs and trays should be clear without the addition of any colorants. Do not print directly onto the bottle as it contaminates the PET and therefore deems the bottle unrecyclable. Note that minimal printing, for e.g. batch numbers, is acceptable but should be avoided if possible.

Closures / closure liners / cap sleeves / seals

All closures, closure liners, puffers, inserts, caps, sleeves, and tamper-evident seals should be recyclable themselves.

- Use PP/PE-HD/PE-LD or PE-LLD for closures on PET bottles.
- For trays and blisters packs, the plastic lid must be an integral part of the tray or at least the same plastic as the main body.
- Coated paper lids make separation very difficult.
- Avoid metal caps on bottles as they are difficult and costly to remove, which results in good bottles being rejected in sorting systems.
- Additionally, any residual metal not removed can damage machinery. Consider tethering your cap to the bottle.

Labels and adhesives

- For bottles, sleeves and tamper-evident seals should be designed to completely detach from the container during the re-processing / washing phase of recycling.
- For trays, labels have a negative effect on recycling especially if they cannot be removed easily in water. Even if the labels can be separated, adhesive residue on the tray that is difficult to remove significantly impairs the quality of the recyclate. Combinations of different plastics with a similar specific density, such as the combinations of PET and PVC, and combinations of plastics with other substrates render the packaging unrecyclable.
- The use of PET sleeves and labels with PET bottles is to be avoided.
- The use of PVC sleeves and labels with PET bottles is to be avoided.
- Paper labels are not ideal, especially on plastic film; they cause significant problems in conventional recycling.
- Polyethylene and polypropylene labels are preferred.
- Where adhesives are absolutely necessary, use those that are water-soluble or alkali-soluble at 60-80˚C.
- For self-adhesive labels, use glue that is designed to stay on the label.
- Avoid foil tamper-evident seals that leave remnants of foil and adhesive.
- Metallised/foil labels on film are costly to remove, increase contamination and have the potential to devalue the collected material. They also increase the rejection rate in the sorting line and reduce the yield.

Inks

Do not print directly onto the bottle as it contaminates the PET and therefore deems the bottle unrecyclable. For printing of batch or date information on the bottle, use lasers, in preference to ink jet or other printing which uses no ink.

Other components

The use of other components of a different material (e.g. pour spouts, handles, etc.) is discouraged as they often increase the separation costs and reduce resin yield.

- Avoid metal springs / components, as found in trigger mechanisms.

- Avoid silicon seals.
- The use of RFIDs on bottles, labels, or closures is discouraged.
- Do not consider thermoformed In-Mould Labelled (t-IML) as the inclusion of these labels renders the PET unrecyclable.

Closing the loop

Designers, manufacturers of packaging, and brand owners should always consider the possibility of including increasing percentages of recycled PET plastic in their packaging. The specification of recycled materials in the design of new products supports the recovery of plastics by providing a market for reprocessed materials and reduces reliance on virgin materials. Advantages include a potential cost-saving, marketing benefits, and reduced environmental impact.

Table 11: Guideline for PET Bottles

		Green guidelines	Orange guidelines	Red guidelines
PACKAGING	**PET**			PLA / PVC / PS / PETG
Body	**Colour**	Transparent clear	Transparent light-blue	Other transparent colours / opaque / metallic / fluorescent colours / carbon black
Closure	**Barrier / coatings**	SiOx plasma-coating	Outer or inner layer coating	EVOH or PA monolayer blends Dual layer combination of different polymers Multilayer
	Additives			O_2 scavengers; UV stabilisers Acetaldehyde blockers Nano composites
	Caps	Materials with densities less than 1g/cm3 like PP/PE-HD/ PE-LD		Materials with densities more than 1g/cm^3 e.g. PVC and PET Metals
	Seals	Materials with densities less than 1g/cm3 like PE, PP, BOPP		Materials with densities more than 1g/cm^3 like PVC, Al, Silicone, PS
Decoration	**Direct printing**	Do not print on bottles or jars unless production or expiry date, in which case use		Direct printing on bottle or jar

		laser printing (minimally)		
	Labels	Materials with densities less than 1g/cm3 like PE, PP, BOPP	Self-adhesive labels where glues are designed to stay on the label when detached from the bottle	Materials with densities more than 1g/cm^3 like PVC, PS, PET Self-adhesive with improper glue i.e. glue does not stay on the label Metalised labels Paper labels
	Sleeves (including tamper resistance)	Materials with densities less than 1g/cm3 like PE, PP, BOPP	Shrink sleeve with perforation, with density less than 1g/cm^3	Materials with densities more than 1g/cm^3 like PVC, PS, PET, PETG Heavily inked shrink sleeve without perforation; full body sleeves without perforation Metalised materials
	Adhesive	Water or alkali soluble in 60-80˚C, designed to remain on the label	Hot melt alkali adhesives	Not removable or soluble in water
	Ink	Good manufacturing practice – excluding heavy metal containing inks Laser printing		Direct printing on bottle, jar or tray
Other	**Trigger sprays**	PE-HD/PE-LD PE / PP - HD / PE - LD / PP / uncoloured PET		Glass components Metal springs / ball bearings Coloured PET

Table 12: Guideline for PET Trays and Blister Packs

		Green guidelines	Orange guidelines	Red guidelines
PACKAGING	**PET**		Delaminating PET / PE / PET-GAG structure	PLA / PVC / PS / PETG / C-PET Any PET based multi-layer material apart from delaminating PET / PE and PET-GAG Expanded PET
Body	**Colour**	Transparent clear	Delaminating PET / PE / PET-GAG structure	the transparent colours / opaque / metallic/ fluorescent colours / carbon black

	Barrier / coatings	None	Transparent light-blue	EVOH or PA / any other barrier / any other oxygen scavenger
	Additives	Silicone surface coating (on coating area); Antiblocking masterbatch (max 3%)	Inner or outer layer coating	O^2 scavengers; UV stabilisers Acetaldehyde blockers Nano composites Oxo-biodegradable additives
Closure	**Lid**	Integral with container PET; floating combination of plastics with density less than 1 g/ cm3 (floating to be proven with sink/float test); in any case with no glue residuals (to be proven with glue removal test and oven test)	Peel-off lids if adhesive layer remains with lid Made of materials with densities less than 1g/cm3 including PP / PE-HD / PE-LD	Peel-off lids where adhesive remains on container Made of PVC, PLA or any material with density greater than 1g/cm^3
Decoration	**Direct printing**	Do not print on tray unless production or expiry date, in which case use laser printing (minimally		Direct printing on tray
	Labels	Adhesives with 100% removing ratio and no adhesive residuals on flakes at 70°C testing temperature Materials with densities less than 1g/cm^3 like PE, PP, BOPP	Self-adhesive labels where glues are designed to stay on the label when detached from the tub or the tray BPA-Free Paper labels not losing fibres (pulping)	Materials with densities more than 1g/cm^3 like PVC, PS, PET Self-adhesive with improper glue i.e. glue does not stay on the label Metalised labels Paper labels losing fibres (pulping) or paper containing BPA
	Adhesive	No adhesives on body	Water soluble adhesives Hot melt alkali adhesives	Any other adhesive
	Ink	Good manufacturing practice – excluding heavy metal-containing inks Laser printing		Direct printing on tray
Other	**Inserts**		PE / PE-HD / PE-LD/ PP/ uncoloured PET Paper - all inserts should be completely removable and leave no traces	PVC; PLA

7.3 High Density Polyethylene (PE-HD)

7.3.1 General

HDPE properties are commonly enhanced with colorants, additives and fillers, or it is placed alongside other polymers in a multi-layer package. Each modification and addition to the natural HDPE in a package must be considered for its effect on the recycling stream. Non-HDPE packaging features should either be economically removed from the HDPE in the typical recycling process or be compatible with HDPE in future uses. Of particular concern are mineral fillers or additives that cause the overall blend to sink in water. The density of HDPE is .94- .96 so it floats in water. Density is an important property as reclaimers typically rely on float-sink tanks to separate polymers and to remove contaminants.

For efficient separation and removal in conventional recycling with water-based separation processes, parts of the packaging system that are not compatible with PE-HD should have a density of more than 1 g/cm^3.

Base Polymer

Applications using colourless polyethylene have the highest recycling value; therefore, use of unpigmented containers is preferred. Coloured containers, tubes and films are acceptable. Postconsumer polyolefin content is preferred. The use of postconsumer HDPE in all packages is encouraged to the maximum amount where technically and economically feasible.

PE-HD packaging must be marked with a number 2 material identification code.

Barrier Layers

Some applications require the use of additional barrier layers for specific applications. The use of non-polyethylene layers should be minimised (to maximise polyethylene yield and reduce potential contamination and separation costs), but when required they should be compatible with or easily separable from polyethylene in conventional recycling systems. Current PE-HD recycling systems can tolerate the use of low levels of EVOH (ethylene vinyl alcohol) layer. PVDC and nylon-based barrier layers should be avoided.

EVOH is a common layer material used to increase the barrier properties of HDPE. It is not separable in the recycling process and therefore will become part of the recycled HDPE. Although EVOH blended with HDPE is not without issue it is generally accepted.

7.3.2 Additives

The use of additives and fillers such as calcium carbonate, talc etc. in concentrations that alter the density such that they cause the PE-HD to sink in water or alter the properties of the regrind, are undesirable and should be avoided. For this reason, the PE-HD density should be kept below 1 g/cm^3.

Degradable additives should not be used without testing to demonstrate that their inclusion will not materially impair the full-service life and properties of any product made from the recycled HDPE that includes the additive. Testing must show that these additives will either separate and be removed from the HDPE in the recycling process or have no adverse effects on the recycled HDPE in future uses. Degradable additives should be avoided.

7.3.3 Other Components

Components should be made of PE-HD or PE-LD or should be designed in such a way that they separate from the PE-HD during granulation and can be removed during the washing process, i.e. the density should be more than 1 g/cm3. When components are made from polyethylene, they need to be unpigmented or at least the same colour as the main pack to be optimum recycling friendly.

7.3.4 PE-HD bottles and jars

Material and Material Combinations

PE-HD bottles should be unpigmented, single polymer without any multi-layer construction.

The principal polymer contaminant of recycled PEHD is PP from bottle caps and bottles. Both PE-HD and PP are opaque and less dense than water and consequently difficult for recyclers to separate.

PP has a higher melting point (160 - 170°C) than PE-HD at 130°C and does not disperse readily in the PE-HD recyclate mix. PP contamination can limit the recycled PE-HD to lower value applications. In general, a level of PP contamination up to 5% can be tolerated in the total mix. Higher levels can only be tolerated for some lower specification applications and then it should be limited to below 10%. When designing packaging, it is recommended that PP components are restricted to a maximum of 5% of the overall pack weight to avoid potential end use issues. PE-HD is very susceptible to contamination from the contents, e.g. pesticides, motor oil, etc. which can result in colour and odour problems. Whilst recyclate derived from milk bottles can result in malodour issues, this should be avoidable using hot wash recycling. PE-HD containers used for mineral oil based products (e.g. motor oil) will smell but more importantly, the oil migrates into the plastic and is not removed during normal recycling. Therefore, recycled oil containers have limited applications in the agricultural market only.

Colour

Unpigmented bottles are preferred. In multi-layer PE-HD bottles, the use of inner layers of the same colour as the outer layer is preferred to maximise recyclability but inner and outer layers of different colours can be tolerated.

Closures

The use of closures that are the same colour as the bottle is desirable (although not essential). Foil safety seals that leave foil or remnants of adhesive on the PE-HD bottle should be avoided.

Polyethylene closures are preferred. Since polyethylene is the same polymer as the package body, closures and dispensers made of it will be captured and processed with HDPE. This increases the reclaimers yield and reduces possible waste.

Polypropylene closures are detrimental to recycling. Since polypropylene floats in water like polyethylene it is not separated in the reclaimers float-sink tank. When blended with HDPE it negatively affects the impact properties and can render the material brittle. Although very small amounts of PP, such as that contributed by labels, are regularly accepted by HDPE reclaimers, closures and dispensers comprise a larger weight percentage of the package and therefore a greater negative affect.

Closure systems without liners are preferred. Due to size and thickness, most liners are lost in the recycling process thereby slightly decreasing yield.

Closures containing floating silicone polymer are detrimental to recycling. This material passes through the float-sink tank along with the HDPE and is difficult to remove with other methods, thereby causing contamination in the final product.

The use of PVC closures is detrimental to recycling. PVC is relatively easy to remove in the float-sink tank since it sinks while the HDPE floats. However, the float- sink tank is imperfect and even a very small amount of PVC with the recycled HDPE renders large amounts of it unusable as the PVC degrades at lower temperatures than those at which HDPE is processed.

Labelling

In applications using unpigmented PE-HD, all direct printing other than date coding, used either for product labelling or decoration, presently contaminates the recycled unpigmented PE-HD in conventional recycling systems. Adhesives that are water soluble (or dispersible) at 60 - 80 degrees Celsius and hot melt alkali soluble adhesives are the most readily removed during the recycling process. Adhesive that is not removed from HDPE during the wash step is a source of contamination and discoloration when HDPE is recycled. For these reasons, minimal adhesive usage is encouraged.

Paper labels are detrimental to recycling. The HDPE reclamation process involves water and agitation. Paper remaining adhered to the HDPE travels with the HDPE to the extruder where the material carbonizes and causes colour defects. Even after melt filtering, the burned smell and discoloration remain with the recycled HDPE thereby negatively affecting its potential reuse. Polyethylene and polypropylene labels are preferred.

In-mould labels of a compatible polymer are preferred. In-mould labels are not removed in the recycling process since they are bonded with the wall of the package. They will flow though the recycling process with the HDPE and be blended with the recycled HDPE. The lack of adhesive is beneficial to recycling since it cannot affect colour or other mechanical properties. Full bottle sleeve labels designed for sorting are preferred with the exception of PVC sleeves. Metal foil labels are detrimental to recycling when used with an adhesive that does not release in the wash. PVC labels are detrimental to recycling and should be avoided.

Other attachments

The use of any other attachments is discouraged, as they reduce base material yield and increase separation costs. If attachments are added to a bottle, they should be made from either materials that are easily separable from PE-HD in conventional recycling or are compatible e.g. PP, PELD or preferably, unpigmented PE-HD. Use of PP or PE-LD attachments, if necessary, should be limited to less than 5% of the total bottle weight wherever possible as higher percentages can contaminate the PE-HD for many recycling applications.

Where an attachment is essential, like a neck ring on a tamper evident closure, the neck ring must be the same colour as the bottle or must be designed in such a way that it is removed with the closure.

If pour spouts are added to a bottle they should allow for complete removal of product contents and be designed to leave virtually no product residue when the bottle is empty.

If adhesives are used to affix attachments, their selection should consider the adhesive criteria within this guideline.

The use of attachments that contain metallic and other non-plastic components is discouraged and should be avoided.

Polypropylene or polyethylene tamper evident safety sleeves are preferred. PVC tamper evident safety seals are detrimental to recycling.

Table 13: Guideline for product labelling

	Green guidelines	Orange guidelines	Red guidelines
Colour	Colourless; White	Transparent colours; Coloured; Black inner layer;Paper3 labels; Metallised labels4	
Labels	PE-HD; PE-MD: PE-LD; PE-LLD; PP or BOPP1; sleeves and wraparound or collar labels manufactured from PE-HD	Paper3; PET; PETG; PS; PVC2	Al; Metallised labels
Sleeves, including tamper evident sleeves	PE-HD; PE-MD: PE-LD	PP[1]; PVC[2] ; Paper[3]; BOPP	PS; PS-E
Barriers and Coatings		E/VAL; PA	PVDC
Additives	PE-HD; PE-LD, No additives that can amend the product density	Limited amounts of additives as long as the overall density remains below 0.995 g/cm^3	Talc, CaCO3 and other fillers that increase the density of PE-HD above 0.995 g/cm3; Oxo-biodegradables
Caps & Closures	Materials with densities less than 1 g/cm^3 like PE-HD, PE-LD;	PE-HD multi-piece caps with sealing rings ; PP[1]; PVC[2]	Steel; Al; PS; Thermosets
Cap Liners	PE-HD; PE-LD; PE+E/VAC; PP	PVC2	PS; E/VAC; Al
Seals	PE-HD; PE-LD; PP; BOPP	Al; PVC[2]	Silicone
Direct Printing	No direct printing on bottle unless it is production or expiry date		Other direct printing
Adhesives	Water-soluble adhesive or alkali soluble adhesives up to80°C; No adhesive residue on body	PP[1]	Non-soluble adhesive in water or alkali at 80°C; Hot melt glues;
Inks	Good manufacturing practices, i.e. no heavy metals containing inks		Inks that bleed and dye wash-solution
Residual content	Residual content of less than 1 vol.-% (up to 1 litre); Residual content of less than 0.5 vol.-% (larger than 1 litre)	Residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than0.5 vol.-% (larger than 1 litre)	Inks that bleed and dye wash solution. Any silicone containing packaging is not recyclable
Other components, e.g. handles, dispensers, etc.	PE-HD of the same colour	PE-HD of different colour; PE-LD; PP1; PVC[3]	RFID tags; Non-plastic components

7.3.5 PE-HD tubs, trays and cups

NOTE*: Trays: Because of great difficulties in identifying and separating the different substrates, there is very little recycling of this form of post-consumer packaging in South Africa. From a recycling perspective, moulds that have a specific polymer logo should not be used to make products with other substrates.

PE-HD trays are fully recyclable and are currently recycled once separated properly.

Material and Material Combinations

Tubs and dishes are often made of injection grade PE-HD, exhibiting higher melt flow rates than blow moulding grade of PE-HD. Mixing the two types of PE-HD together decreases the

value of the mixture. Do not mix PE-HD bottles with PE-HD tubs or dishes. The recycler needs to keep injection- and blow moulding grades separate for optimum results.

Closures

In principle aluminium lids are acceptable on PE-HD, especially peel-off ones. Adhesives should stay with the aluminium lid. PE-HD tubs, trays and cups that have a clear or colourless body and where the printed information is presented on the lid are particularly suitable for recycling.

Labelling

Direct printing is acceptable provided attention is paid to ink types to avoid interference with the quality of recyclate. Excessive paper content can cause issues during recycling and thus use of paper labels is less desirable. If used, they should be lightweight and cover only a minor area of the container. Paper labels should not pulp in the washing processes. Water soluble adhesives to be used. PE-LD, PP and BOPP labels are preferable. Best still is a shrink or stretch sleeve in PE-LD, PP or BOPP.

Table 14: Guideline for lids, labels, adhesives and inks

	Green guidelines	Orange guidelines	Red guidelines
Colour Additives	Colourless; White No additives that can amend the product density.	Coloured; Black Limited amounts of additives as long as the overall density remains below 0.995 g/cm^3	Talc, CaCO3 and other fillers that increase the density of PE-HD above 0.995 g/cm3; Oxo-biodegradables
Lids	PE-HD integral lids; PE-LD	Al - as long as the adhesive remains on the lid when removed and the lid peels off cleanly from the container.	Al lids where the adhesive and pieces of Al lid remain on the tub.
Direct Planning	No direct printing unless production or expiry date		Other direct printing
Labels	PE-HD; PE-MD: PE-LD; PE-LLD; PP or BOPP1; sleeves and wraparound labels	Paper3; PET; PETG; PS; PVC2	Non-water soluble label adhesives
Adhesives	Water-soluble adhesive or alkali soluble adhesives up to 80°C; No adhesive residue on body		Non-soluble adhesive in water or alkali at 80°C; Hot melt glues;
Inks	Good manufacturing practices, i.e. no heavy metals containing inks		Inks that bleed and dye wash-solution
Residual Content	Residual content of less than 1 vol.-% (up to 1 litre); Residual content of less than 0.5 vol.-% (larger than 1 litre)	Residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than 0.5 vol.-% (larger than 1 litre)	Any silicon container

7.3.6 PE-HD tubes

Material and Material Combinations

Only a small percentage of PE-HD flexible packaging tubes are used in South Africa. Caps and tubes should be manufactured from the same type of plastic and ideally from the same polymer (in this case PE-HD). An elevated percentage of PP lowers the quality of the recycled plastic.

Labelling

Paper labels also can be used, provided they are easily removed in water and leave no adhesive residue. Due to consumer preference, most flexible tubes contain high levels of printing inks which are difficult to remove during recycling. Together with high levels of residual content, flexible tubes are only recycled in rare occasions.

7.3.7 PE-HD caps and closures

Closures

It is unlikely to have unpigmented closures which would be most suitable for recycling. The principal polymer contaminant of recycled PEHD is PP closures. PE-HD closures from soft drink bottles are about 1 mm shorter than equivalent PP closures and sorting is done by hand. The closure should at least be marked with the material identification code to assist in sorting when there is doubt.

7.3.8 PE-HD crates

Due to brand owner requirements, it is highly unlikely to get unpigmented, colourless crates. A number of closed loop, large volume returnable crates (e.g. Brewery crates) have their own recycling system and colour is not a problem in these instances.

Material and Material Combinations

The principle polymer contaminant of recycled PE-HD is PP crates. Both materials have density of less than 1 g/ cm3 and cannot be separated in conventional recycling processes with water-based separation. The material identification code will make the PE-HD crates slightly more desirable for recycling.

Agricultural crates are often used and stored out of doors where they are exposed to Ultraviolet rays. Crates need to be suitably UV stabilised to prevent UV degradation during 1 to 2 seasons. Damaged, but unweathered crates are suitable for recycling.

Crates remain the property of the original intended owner and can only be recycled with the written permission of the owner.

Table 15: Guideline table for PE-HD crates, tubes, caps and closures

	Green guidelines	Orange guidelines	Red guidelines
Colour	Colourless; Caps and neck rings the same colour as the container;	Coloured;	
Labels	PE-HD in-mould labels; No additives to be used that will amend the product density.	PE-HD; PE-MD: PE-LD; PE-LLD; PP or BOPP1; Paper3;	PET; PETG; PS; PVC2; Al
Additives	UV stabilisers in crates and pallets	CaCO3 (limited quantities as to still render product density below 1 g/cm3)	Talc, CaCO3 and other fillers that increase the density of PE-HD above 0.995 g/cm3; Oxo-biodegradables;
Cap Liners	PE-HD; PE-LD; PE+E/VAC	PP1; PVC2	PS; E/VAC;
Direct Printing	No direct printing unless production or expiry date	Direct printing, other than date markings.	
Inks	PE-HD of the same colour	Good manufacturing practices, i.e. no heavy metals containing inks	Inks that bleed and dye wash-solution

7.3.9 PE-HD film and bags

Material and Material Combinations

The majority of vest type bags are made from PE-HD. Unpigmented bags and coloured, unprinted bags have the highest recycling value. The biggest challenge in recycling PE-HD bags remains the residual contents from its secondary use. Consumers use shopping bags as refuse- and waste bags. The remains of the "waste" is often more than the 7 g of the average PE-HD shopping bag and renders the bag unsuitable for recycling. Where shopping bags are included in the recyclables from Separation-at-Source processes and generally less contaminated, they are recycled.

Black refuse bags normally contain recycled content already, up to 100% in some cases. The film producer also manufactures refuse bags "fit for purpose" and blend in PE-LD, E/VAC and PE-MD to achieve optimum mechanical properties. These films can only be used for lower specification applications. Virgin refuse bags can be recycled if the residual content does not make the bag undesirable to collect and recycle. It is therefore challenging to design PE-HD film for recycling as such.

Additives

The use of additives and fillers such as calcium carbonate, talc etc. in concentrations that alter the density such that they cause the PE-HD to sink in water or alter the properties of the regrind, are undesirable and should be avoided. For this reason, the PE-HD density should be kept below 1 g/cm^3.

Table 16: Guideline for additives, labels, adhesives and inks

	Green guidelines	Orange guidelines	Red guidelines
Colour	Colourless; White	Coloured; Black	
Additives	No additive that will amend the product density	Limited amounts of additives as long as the overall density remains below 0.995 g/cm3	Talc, CaCO3 and other fillers that increase the density of PE-HD above 0.995 g/cm3; Oxo-biodegradables
Direct Printing	Little or no printing	Solid printing: limit printing to less than 50% of the pack weight	Solid printing exceeding 50% of the pack weight
Labels		PE-HD; PE-MD: PE-LD; PE-LLD; PP or BOPP1; Paper;	PET; PETG; PS; PVC; Al
Adhesives		Water-soluble adhesive or alkali soluble adhesives up to 80°C; No adhesive residue on body	Non-soluble adhesive in water or alkali at 80°C; Hot melt glues;
Inks		Good manufacturing practices, i.e. no heavy metals containing inks	Inks that bleed and dye wash-solution
Residual Content	Only relatively clean bags obtained from Separation-at-Source collection systems	Residual content of less than 1 vol.-% (up to 1 litre); Residual content of less than 0.5 vol.-% (larger than 1 litre)	Residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than 0.5 vol.-% (larger than 1 litre)

7.4 Polyvinyl chloride (PVC)

7.4.1 General

For efficient separation and removal in conventional recycling with water-based separation processes, parts of the packaging system that are not compatible with PVC should have a density of less than 1 g/cm^3.

The use of PET components of any kind on PVC bottles is undesirable and should be scrupulously avoided. Very small amounts of PET (in the parts per million range) can severely contaminate the recyclate and make it useless for most applications. In addition, PET and PVC both sink (densities are similar and larger than 1 g/cm3) and thus are very difficult to separate in conventional water-based density separation systems. PVC packaging must be marked with a number 3 material identification code:

7.4.2 PVC Bottles and Jars

Closures

Plastic closures made from PE-HD, PE-LD or PP is preferred.

Labels

Shrink sleeve labels that require no adhesive and can be removed prior, or during recycling, are preferred. The use of PET should be scrupulously avoided. Sleeves and safety seals should be designed to completely detach from the container. Adhesives that are water soluble (or dispersible) at 60 - 80 degrees Celsius and hot melt alkali soluble adhesives are the most readily removed during the recycling process. Paper labels should not delaminate in the washing process. Polyethylene and polypropylene labels are preferred.

Other Components

The use of any attachments on the bottle is discouraged but when required; PE-HD and clear PVC should be used.

Table 17: Guideline for closures

	Green guidelines	Orange guidelines	Red guidelines
Colour	Clear, unpigmented	Transparent colours; coloured	
Caps & Closures	PE-HD; PE-LD; PP; E/VAC	PVC	PET; PS; Thermosets; Al; Steel
Cap Liners	PE-LD	PS-E	PET; E/VAC; Paper2;
Seals	Unpigmented PVC; BOPP; E/VAC		PS
Direct Printing	No direct printing except production or expiry date	Other direct printing1	
Labels	PE-HD; PE-MD: PE-LD; PE-LLD; PP or BOPP; PVC;	PS-E	Paper2; PET; PS; Metallised labels
Sleeves (including tamper evidence)	Clear PVC; BOPP; PP	Printed PVC	PS; PET
Adhesives	Water-soluble adhesives; No residual adhesives on body		Non-water soluble adhesives; Hot melt glues;
Inks		Good manufacturing practices, i.e. no heavy metals in inks	Inks that bleed and dye was solution
Residual content	Design in such a manner that less than 1% of residual contents remain in container of up to 1 litre capacity and 0.5% in the case of larger containers.	Residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than 0.5 vol.-% (larger than 1 litre)	
Other components, e.g. handles, dispensers, etc.	PE-HD; PE-LD; PP; Unpigmented PVC	E/VAC	PA; PC; PMMA; PS; PS-E; TPU; Thermosets; Metal; Al; Glass

7.4.3 PVC tubs and trays

NOTE*: Trays: Because of great difficulties in identifying and separating the different substrates, there is very little recycling of this form of post-consumer packaging in South

Africa. From a recycling perspective, moulds that have a specific polymer logo should not be used to make products with other substrates.

PVC trays, blister packs and die-cut packaging represent a significant fraction by weight of the domestic plastics waste stream. PVC is popular for recycling if it can be distinguished amongst other trays and successfully separated.

Colour

Ideally, tubs and trays should be clear or colourless. Barriers and coatings can be introduced via thin vapour-deposition coatings. E/VAL and PA barriers are undesirable for recycling.

Closures

The plastic lid must be an integral part of the tray or at least the same plastic as the main body. In principle, aluminium lids are acceptable on PVC tubs and trays as long as they peel off the container with the adhesive sticking to the lid or tray. Coated paper lids make separation very difficult.

Labels

Labels have a negative effect on recycling especially if they cannot be removed easily in water. Even if the labels can be separated, adhesive residue that is difficult to remove significantly impairs the quality of the recyclate. Adhesives that are water soluble (or dispersible) at 60 - 80 degrees Celsius and hot melt alkali soluble adhesives are the most readily removed during the recycling process. Polyethylene and polypropylene labels are preferred.

Material and Material Combinations

As with other PVC packaging formats, it is vitally important that contamination by PET is avoided. PET trays and blister packs contaminate the PVC tray and blister stream and every effort needs to be made to try and ensure that such contamination is avoided either at design stage and/or at the recycling stage.

Table 18: Guideline for material and material combinations

	Green guidelines	Orange guidelines	Red guidelines
Colour	Clear, unpigmented	Transparent colours; coloured	
Lids	Integral with container	Peel-off lids if adhesive layer remains with lid	Peel-off lids where adhesive remains on container PET; E/VAC; Paper2;
Press-on lids	PVC	Materials with densities less than 1 g/ cm3 including PP; PE-HD; PE-LD	PET; PS; PLA; Paper2; Al
Direct Printing	No direct printing except production or expiry date	Other direct printing1	
Labels	PE-HD; PE-MD: PE-LD; PE-LLD; PP or BOPP; PVC;	PS-E	Paper2; PET; PS; Metallised labels

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Sleeves (including tamper evidence)	Clear PVC; BOPP;PP;PE-LD	Printed PVC	PS; PET
Adhesives			Non-water soluble adhesives; Hot melt glues;
Inks		Good manufacturing practices, i.e. no heavy metals in inks	Inks that bleed and dye was solution
Residual content	Design in such a manner that less than 1% of residual contents remain in container of up to 1 litre capacity and 0.5% in the case of larger containers	Residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than 0.5 vol.-% (larger than 1litre)	
Other components, e.g. handles, dispensers, etc.	PE-HD; PE-LD; PP; Unpigmented PVC	E/VAC	PA; PC; PMMA; PS; PS-E; TPU; Thermosets; Metal; Al; Glass

7.4.4 PVC Film

The use of PVC film is widespread but small and primarily in butcheries and delicatessens. The low gauge and lightweight material makes it almost impossible to recover and recycle. Often, the residual food content and meat juices also renders the product unrecyclable.

7.4.5 PVC Sheeting

Thicker PVC Sheeting is used in up-market, and often, re-usable packaging. Rigid PVC in folded die-cut containers are commonly used for merchandising clothing items, cosmetics and personal care products.

Flexible PVC is used in sachets and fabricated containers for linen, towels and some clothing items. The combination with sewn-in or welded-on zips, fasteners, handles and trimming often create challenges when not separated prior to recycling.

Table 19: Guideline for PVC sheeting

	Green guidelines	Orange guidelines	Red guidelines
Colour	Clear, unpigmented	Transparent colours; coloured	
Handles	Welded on PVC handles	Stitched on PVC handles; PP handles	PA handles; PA webbing; PET
Inserts, Trimming and reinforcement	PVC	PP or PE; Paper if loose inserts	PA; PET; Paper[2]
Direct Printing	No direct printing except production or expiry date	Other direct printing[1]	
Labels	PE-HD; PE-MD: PE-LD; PE-LLD; PP or BOPP; PVC;	PS-E	Paper[2]; PET; PS; Metallised labels
Zips and other fasteners	PVC (Welded on)	PVC (Stitched on); PP	PA; Metal
Adhesives			Non-water soluble adhesives; Hot melt glues;

Inks	Good manufacturing practices, i.e. no heavy metals in inks	Inks that bleed and dye wash solution

7.5 Low Density Polyethylene (PE-LD)

7.5.1 General

PE-LD films and bags form the single biggest component of all packaging recycled in South Africa.

Use of mono-materials or mixed materials of the same type are the materials of choice from a recycler's point of view and combinations with a different type of plastic of similar density should be avoided wherever possible.

However, plastics films often require the use of a variety of plastic materials to provide both the technical properties required and to satisfy user needs. Recognising this need, and in the absence of any other specific guidance, designers should strive to keep the film clear, unprinted and single polymer use as much as possible.

Thicker PE-LD film and bags are more cost effective to recycle and therefore preferable to thin films. Use of aluminium foil in bags for frozen food should be avoided. PE-LD packaging must be marked with a number 4 material identification code.

7.5.2 PE-LD film, wrap and bags

Labels

Labels manufactured from materials that sink in water while the film floats (e.g. PET) or vice versa and attached with water-soluble adhesive are acceptable. Paper labels also can be used, provided they too are easily removed in water and leave no adhesive residue that is difficult to remove and do not reduce to pulp in the washing process.

Printing should be kept to the bare minimum and where the printing surface exceeds 50% of the film, the final recyclate will have a lower value. Packaging designer requirements in shrink film applications demand 100% printing in some cases which reduces the value of the end-of-life films.

Additives

Tackifiers are added to stretch- and pallet wrap and addition levels should be kept at the bare minimum. The recycled film sticks together and it is costing more to recycle and will be less popular as a result.

Barriers and Coatings

PE-LD film is often co-extruded or laminated with other materials to provide both the technical properties required and to satisfy user needs like extended shelf life, for example. It is then no

longer a single polymer construction. The same sort of polymers can be recycled but different kinds of materials create a problem for recycling.

Attachments

Metal staples can be removed with metal detectors, but it needs to be separated first from the film. Avoid any attachments.

Table 20: Guideline for attachments

	Green guidelines	Orange guidelines	Red guidelines
Colour	Clear	Coloured	
Barriers and coatings	Single material films	E/VAL; Co-extruded films of plastics of the same sort, i.e. PE-LD, PE-LLD, PE-MD and PE-HD.	Co-extruded and laminated with different sorts of materials
Additives	No additive that will amend the product density	Slip additives and anti-block additives; Tackifiers;	CaCO3 and other fillers that increase the density to more than 1 g/cm3; Oxo-biodegradables
Direct Printing	Little or no printing	Limit printing to less than 50% of the pack weight	Solid printing
Labels	No labels	PE-HD; PE-MD: PE-LD; PE-LLD; PP or BOPP; Paper2;	PET; PETG; PS; PVC; Al
Adhesives		Water-soluble adhesive or alkali soluble adhesives up to 80°C; No adhesive residue on body	Non-soluble adhesive in water or alkali at 80°C; Hot melt glues;
Inks	No printing	Good manufacturing practices, i.e. no heavy metals containing inks	Inks that bleed and dye wash-solution
Residual Content		Residual content of less than 1 vol.-% (up to 1 litre); Residual content of less than 0.5 vol.-% (larger than 1 litre)	Residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than 0.5 vol.-% (larger than 1 litre)

7.6 Polypropylene (PP)

7.6.1 General

For efficient separation and removal in conventional washing processes, parts of the packaging system that are not compatible with PP should have a density of more than 1g/cm3.

PP packaging must be marked with a number 5 material identification code.

7.6.2 PP bottles and jars

Material and Material Combinations

The use of unpigmented PP bottles is preferred to pigmented bottles as the recyclate from

unpigmented bottles will have a greater value due to the larger number of potential applications. The principal polymer contaminant of recovered PP is PE-HD from bottles, closures and attachments. PP and PE-HD are both opaque and less dense than water and consequently difficult for recyclers to separate.

Since PE-HD has a lower melting point (ca 130°C) than PP (160 - 170°C) the overall PP mix will be more tolerant to PE-HD contamination than the converse. Nonetheless, when designing packaging it is recommended that PE-HD components are restricted to a maximum of 5% by weight of the total pack to avoid potential end use issues.

Barriers

Current PP recycling systems can tolerate the use of E/VAL layers. Similarly nylon-based barrier layers are tolerated, particularly if the layers are readily separated from the PP in conventional recycling systems. In all such cases their content should be minimised to the greatest extent possible to maximise PP yield and reduce potential contamination and separation costs. PVDC barriers should be avoided.

Closures, caps and cap liners

The use of closures that are unpigmented or the same colour as the bottle is desirable (although not essential). Foil safety seals that leave foil or remnants of the attaching adhesive on the PP bottle should be avoided.

Labelling

In applications using unpigmented PP, all direct printing other than date coding, either for product labelling or decoration, presently contaminates the recycled unpigmented PP in conventional recycling systems.

Adhesives that are water soluble (or dispersible) at 60 or 80 degrees Celsius and hot melt alkali soluble adhesives are the most readily removed during the recycling process. Paper labels should not delaminate in the washing process. Polyethylene and polypropylene labels are preferred.

Other components

The use of any other attachments is discouraged, as they reduce base material yield and increase separation costs. If attachments are added to a bottle, they should be made from either materials that are easily separable from PP in conventional recycling or are compatible e.g. PE-HD, PE-LD or preferably, unpigmented PP.

Use of PE-HD or PE-LD attachments, if necessary, should be limited to less than 5% of the total bottle weight wherever possible as higher percentages can contaminate the PP for many recyclate applications. Where an attachment is essential, like a neck ring or a tamper evident closure, the attachment must be the same colour as the bottle or must be designed in such a way that it is being removed with the closure. If pour spouts are added to a bottle they should

allow for complete removal of product contents and be designed to leave virtually no product residue when the bottle is empty.

If adhesives are used to affix attachments, they should be water-soluble or dispersible at temperatures between 60°C and 80°C in order to be removed in conventional washing and separation systems. The use of attachments that contain metallic and other non-plastic components is discouraged and should be avoided.

Table 21: Guideline table for PP bottles and jars

	Green guidelines	Orange guidelines	Red guidelines
Colour	Unpigmented; White	Coloured	
Barriers and Coatings		E/VAL; PA	PVDC
Additives	No additive that could amend the product density.	Clarifier1; Limited amounts of additives as long as the overall density remains below 0.995 g/cm3	Fillers like CaCO3 that will increase the product density to more than 1g/cm3; Oxo-biodegradables;
Caps & Closures	PE-LD; PP	PE-HD	PS; Thermosets; Al; Steel
Cap Liners	PE-HD; PE-LD; PE+E/VAC; PP	PVC2	PS; E/VAC; Al
Seals	PE-HD4; PE-LD; PP; BOPP	Al; PVC2	Silicone with density less than 1g/cm3
Direct Printing	No direct printing on bottle unless it is production or expiry date	Limited direct printing	
Labels	PE-HD4; PE-MD: PE-LD; PE-LLD; PP or BOPP1; sleeves and wraparound or collar labels manufactured from PE-HD4; PP in-mould labels	Paper3; PET; PETG; PS; PVC2	Al; Metallised labels
Sleeves (including tamper evidence)	PP; BOPP; PE-MD: PE-LD	PE-HD4; PVC2 ; Paper3;	PS; PS-E
Adhesives		Water-soluble adhesive or alkali soluble adhesives up to 80°C; No adhesive residue on body	Non-soluble adhesive in water or alkali at 80°C; Hot melt glues
Inks	No printing	Good manufacturing practices, i.e. no heavy metals containing inks	Inks that bleed and dye wash-solution
Other components, e.g. spouts, dispensers, etc.	PE-LD; Uncoloured PP	PE-HD4; PVC; E/VAC; Coloured PP;	PS; PS-E; TPU; PA; PC; PMMA; Thermosets; Metallic

7.6.3 PP tubs, trays and cups

PP tubs, trays and cups are the most widely recycled plastics in the tray family.

NOTE*: Trays: Because of great difficulties in identifying and separating the different substrates, there is very little recycling of this form of post-consumer packaging in South

Africa. From a recycling perspective, moulds that have a specific polymer logo should not be used to make products with other substrates.

Closures, caps and cap liners

In principle aluminium lids are acceptable on PP, especially peel-off ones. Adhesives should stay with the aluminium lid.

Colour

Tubs that have a clear or colourless body and where the information is restricted to the removable lid are particularly suitable for recycling.

Labelling

Excessive paper content can cause issues during recycling and thus use of paper labels is less desirable. If used, they should be lightweight and cover only a minor area of the container. Paper labels should not pulp in the washing processes. Water soluble adhesives to be used. PE-LD, PP and BOPP labels and sleeves are preferable.

Residual Content

Residual content in tubs, e.g. yogurt, margarine, etc, is problematic to the recyclers. Where relatively clean tubs are part of the recyclables collected in Separation at Source projects, they are recycled.

Table 22: Guideline for PP bottles

	Green guidelines	Orange guidelines	Red guidelines
Colour	Colourless; White	Transparent colours; coloured	
Additives	No additives to be used that can amend the product density	Limited amounts of additives as long as the overall density remains below 0.995 g/cm3	Talc, CaCO3 and other fillers that increase the density of PP above 0.995g/cm3; Oxo-biodegradables
Lids Press-on lids	PP integral lids; PP; PE-LD PP; PE-HD1; PE-LD	PE-HD1; PVC2; Paper3; Al Materials with densities more than 1 g/cm3 including PVC, PS, PET, Paper2, Al;	PS;
Direct Printing	No direct printing unless production or expiry date	Other direct printing	
Labels	PE-HD1; PE-MD: PE-LD; PE-LLD; PP or BOPP sleeves and wraparound labels;	In-mould PP labels; Paper3; PET; PETG; PS; PVC2	Al
Adhesives		Water-soluble adhesive or alkali soluble adhesives up to 80°C; No adhesive residue on body	Non-soluble adhesive in water or alkali at 80°C; Hot melt glues;
Inks	No printing	Good manufacturing practices, i.e. no heavy metals in inks	Inks that bleed and dye was solution
Residual content	Residual content of less than 1 vol.-% (up to 1 litre); Residual content of less than 0.5 vol.-% (larger than 1 litre)	Residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than 0.5 vol.-% (larger than 1litre)	

7.6.4 PP tubes

Residual content in PP tubes often make the tubes undesirable for recycling.

Closures, caps and cap liners

Caps and tubes should be manufactured from the same type of material and ideally from the same polymer (in this case both from PP). Co-extruded tubes are used to improve the barrier properties for more demanding materials to be packaged in flexible tubes. E/VAL as a barrier material is acceptable but will render the recyclate less valuable.

Labelling

Paper labels also can be used, provided they are easily removed in water and leave no adhesive residue that is difficult to remove. Direct printing is acceptable for marking tubes. Due to consumer preferences, most flexible tubes contain high levels of printing inks which are difficult to remove during recycling. Together with high levels of residual content, flexible tubes are only recycled in rare occasions.

7.6.5 PP film, bags and wraps

Orientated and bi-axially orientated PP (BOPP) films are widely used in the packaging industry. They are chosen for the excellent barrier properties and gloss. Their mechanical properties include high tensile strength and puncture resistance. Metallised BOPP films are very popular for the confectionary and sweets industry. The metallised films are often laminated to clear, reversed printed PP films. Metallised films can be recycled but are less popular than clear, as well as clear and printed films. It is very difficult to remove the printing inks as they are captured between two layers of film.

In applications using unpigmented PP, all direct printing other than date coding, either for product labelling or decoration, presently contaminates the recycled unpigmented PP in conventional recycling systems. BOPP films for sweets and confectionary are printed more than 100% in some cases which is not recycling friendly. The consumer preferences and the brand owners marketing utilises PP films as marketing tools and printing and metalizing are part of the value adding appearance of the merchandised product.

Table 23: Guideline for PP film, bags and wraps

	Green guidelines	Orange guidelines	Red guidelines
Colour	Clear; Pearlescent; White	Coloured; Metallised;	
Additives	No additive that can amend the product density	Limited amounts of additives as long as the overall density remains below 0.995 g/cm3	Talc, CaCO3 and other fillers that increase the density of PE-HD above 0.995 g/cm3; Oxo-biodegradables
Direct Printing	No printing	Solid printing: limit printing to less than 50% of film weight	Solid printing exceeding 50% of the

			pack weight
Labels	No labels	PE-HD; PE-MD: PE-LD; PE-LLD; PP or BOPP1; Paper;	PET; PETG; PS; PVC; Al
Adhesives		Water-soluble adhesive or alkali soluble adhesives up to 80°C; No adhesive residue on body	Non-soluble adhesive in water or alkali at 80°C; Hot melt glues;
Inks	No printing	Good manufacturing practices, i.e. no heavy metals containing inks	Inks that bleed and dye wash-solution
Residual Content	Residual content of less than 1 vol.-% (up to 1 litre); Residual content of less than 0.5 vol.-% (larger than 1 litre)	Residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than 0.5 vol.-% (larger than 1 litre)	

7.6.6 PP woven tapes, bags and sacks

Colour

Unpigmented tapes would be optimum. The woven or knitted bag is colour coded for various marketing strategies and product identification and unpigmented PP tapes are unheard of.

Residual Content

PP tapes used in bulk packaging are normally contaminated with the powdery contents of the bags, especially in the agricultural industry. Residual contents lower the value of the PP tapes recyclate considerably.

Other Components

Coating should be limited to PE-LD or PP coatings to be compatible with the PP main pack. In making up the bags, yarn and webbing for stitching should also be selected to be compatible with the main material.

Table 24: Guideline for PP woven tapes, bags and snacks

	Green guidelines	Orange guidelines	Red guidelines
Colour	Clear; White	Coloured;	
Additives	No additive to be used that can amend the product density	Limited amounts of additives as long as the overall density remains below 0.995 g/cm3	Talc, CaCO3 and other fillers that increase the density of PE-HD above 0.995 g/cm3; Oxo-biodegradables
Direct Printing	Little or no printing	Solid printing: limit printing to less than 50% of film weight	
Labels		PP or BOPP; PE-HD; PE-MD: PE-LD; PELLD; Paper;	PET; PETG; PS; PVC; Al
Adhesives		Water-soluble adhesive or alkali soluble adhesives up to 80°C; No adhesive residue on body	Non-soluble adhesive in water or alkali at 80°C; Hot melt glues;

Inks		Good manufacturing practices, i.e. no heavy metals containing inks	Inks that bleed and dye wash-solution
Residual Content	Residual content of less than 1 vol.-% (up to 1 litre); Residual content of less than 0.5 vol.-% (larger than 1 litre)	Residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than 0.5 vol.-% (larger than 1 litre)	
Other components, e.g. webbing, handles, stitching			

7.7 Polystyrene (PS)

7.7.1 General

Recent advancements in polystyrene recycling in South Africa means that all colour (including black) polystyrene are readily accepted for recycling. Perforated PS-E trays are designed to absorb the juices from the product packaged. The impregnated trays are also suitable for recycling and accepted in some of the metropolitan areas.

Tubs and caps no longer need to be clear or colourless to be recycled, nor does printed packs pose problems. Direct printing is acceptable provided attention is paid to ink types to avoid interference with quality of granulate or recyclate.

Excessive paper content can cause issues during recycling and thus use of paper labels is less desirable. If used, they should be lightweight and cover only a minor area of the container.

Consumer instructions to separate lids, lidding seals, labels and sleeves or instruct the consumer to wash or wipe clean the container will create a recyclable container that is in bigger demand.

Packaging designed for proper emptying will always be preferred for recycling, i.e. smooth internal surfaces, no undercuts where product gets stuck. PS packaging must be marked with a number 6 material identification code.

7.7.2 General Purpose Polystyrene (PS), High Impact Polystyrene (PS-HI) and Expanded Polystyrene (PS-E)

Foaming agents are added to PS to improve its impact strength, insulation properties and reduce its weight. PS-E and PS can be recycled together. PS-E containers which enter the recycling stream and are separated at source, are desirable for recycling in large quantities.

Table 25: Guideline for General Purpose Polystyrene (PS), High Impact Polystyrene (PS-HI) and Expanded Polystyrene (PS-E)

	Green guidelines	Orange guidelines	Red guidelines
Colour	Colourless; White	Black; Pigmented;	
Lids	PS integral lids; PS; PS-E; PP; PE-LD; PE-HD;	Paper[1];	PET; Al;
Press-on lids	PS; PS-E; PP; PE-HD; PE-LD	Paper1;	Materials with densities more than 1g/cm3 including PVC, PET, Al;
Direct Printing	No direct printing except production or expiry date	Direct printing	
Labels	PE-HD[1]; PE-MD: PE-LD; PE-LLD; PP or BOPP sleeves and wraparound labels;	Paper[1];	PET; PETG; PVC; Al
Adhesives	No adhesives	Water-soluble adhesive or alkali soluble adhesives up to 80°C; No adhesive residue on body	Non-soluble adhesive in water or alkali at 80°C; Hot melt glues;
Inks		Good manufacturing practices, i.e. no heavy metals in inks	Inks that bleed and dye wash solution
Residual content	Scraped clean	Perforated meat trays; Oil, fat and sugar residue; Design in such a manner that less than 1% of residual contents remain in container of up to 1 litre capacity and 0.5% in the case of larger containers.	Residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than 0.5 vol.-% (larger than 1litre)
Seals and lidding films		Peel-off lidding seals if adhesive layer remains with lid/seal	Peel-off lidding seals where residual adhesives stick to container

7.8 Bio-degradable and Compostable Plastics

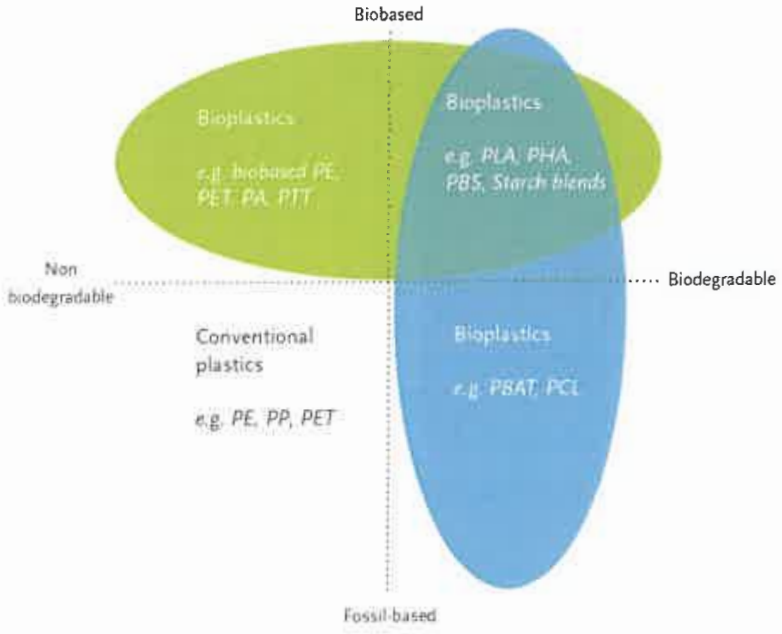

Figure 7: Bio-degradable and Compostable Plastics

The South African Initiative to End Plastic Waste concluded a comprehensive review of the South African landscape with regard to biodegradable and compostable packaging. The objective of the review is two-fold. Firstly, to provide a balanced perspective and consolidated position for South Africa with regards to biodegradable and compostable packaging, based on sound research and stakeholder inputs. Secondly, to be used to inform players across the value chain, as well as other interested stakeholders around the responsible manufacture, use, management and disposal of biodegradable and compostable packaging.

What follows is based on the contextual analysis and should be referred to by packaging converters, brand owners and retails when considering the use of biodegradable and compostable packaging.

7.8.1 Things to consider before introducing biodegradable products

Products with the compostable standard specifications ASTM D6400, ASTM D6868, EN 13432 and ISO 170088 are certified for industrial composting only. Such materials have been tested and certified to degrade under specific conditions at a temperature of 58 – 60 °C. These certifications do not cover home composting or environmental degradation at ambient temperature. Furthermore, the degradation rate of these materials has been shown to be significantly slower in an aquatic environment than in soil.

South Africa currently has very few large-scale industrial composting facilities that are managed to maintain the conditions required by the certifications mentioned above.

There are currently no large-scale post-consumer waste management programmes for the separation and processing of biodegradable and compostable packaging. As a consequence, these materials have no intrinsic value to formal or informal waste collectors, so the products are likely to remain in the environment or at best, end up at landfill.

There is currently uncertainty about the impact that these materials will have on the efficient operation of existing recycling operations and the integrity of recycled products should biodegradable/compostable products be incorporated into recyclate.

7.8.2 Existing South African legislation and standards relating to biodegradable products

Two existing pieces of legislation currently govern product claims and standards:

Consumer Protection Act Sections 29 and 41 prohibit false, misleading or deceptive claims regarding product ingredients or performance characteristics.

Standards Act 2008 Sections 27(1) & (2) prohibit businesses from falsely claiming or operating in a manner that is likely to create the impression that products comply with a South African National Standard or other publications of the SABS.

The voluntary South African National Standard: SANS 1728 was published in 2019 and regulates the marking and identification of degradable products (including biodegradable, compostable, oxo-biodegradable and water-soluble plastics).

Key requirements include:

- The product must carry the polymer code, material type acronym (e.g. PET, PLA etc.) along with the appropriate wording (i.e. biodegradable, compostable or oxo-biodegradable).
- If the product is made of multiple components and these are intended for different waste streams, the information must be clearly displayed on the package (e.g. closure – recyclable, PLA bottle – compostable).
- If separation of components is required, clear instructions on how to do this must be included.
- If products claim to be biodegradable, compostable or oxo-biodegradable, they must conform to the appropriate international standards. Claims must be verified by accredited laboratories and supported by raw material technical data sheets, as per the appropriate standard.
- No vague or non-specific claims that imply the product has environmental benefits, such as "green", "environment friendly", "earth safe" etc. are permitted.
- No claims of achieving sustainability should be made as there are no currently definitive methods for measuring sustainability or confirming its accomplishment.
- An explanatory statement must accompany self-declared environmental claims.

A proposed standard for compostability (SANS 17088) is currently open for comment until 14 April 2020, as per Government Gazette number 43050 (28 February 2020). It is based on ISO 17088 which addresses the following:
Specifications for compostable plastics that refer to:

- Biodegradation
- Disintegration during composting
- Negative effects on the composting process and facility
- Negative effects on the quality of the resulting compost

7.8.3 Biodegradable certifications and labelling

Should your organisation choose to introduce any biodegradable / compostable products, we urge you to ensure that they are labelled with the appropriate certification logos (e.g. DIN, TUV or BPI) and that the suppliers provide you with the relevant certificates to support the use of the logos, as per SANS 1728:2019.

This will ensure that the packaging can be differentiated from conventional packaging and will also assist with authentication and risk management.

7.8.4 Bio-based biodegradable plastics: Material types and applications

These plastics are derived from renewable biomass that may either be classified as first generation or second generation. First generation feed stocks are agricultural crops such as corn, wheat or potatoes, while second generation refers to non-food crops (switch grass, algae

etc.) or the non-edible residues from feed crops (bagasse, rice bran etc.). Biodegradable materials can be broken down to their constituents as a result of microbial activity. Compostable materials biodegrade beyond a threshold level under specified conditions within a defined time period.

Summary of bio-based, additive containing and biodegradable plastics

Name	Feedstock	Properties	Applications	Biodegradable	Industrial composting	Home composting	Mechanical recycling
Bio-PET/PE/PP/PVC	Ethanol	Identical to fossil fuel-based analogues	Wide range of rigid and flexible packaging applications	X	X	X	✓
Plastics with oxo-additives	Fossil fuels or ethanol	Similar to base polymer with accelerated fragmentation when exposed to UV and heat	Similar applications to base polymer	Contested	X	X	Uncertain
Plastics with bio-additives	Fossil fuels or ethanol	Similar to base polymer, less hydrophobic, accelerated degradation due to microbial attack (aerobic and anaerobic)	Similar applications to base polymer	Uncertain	X	X	Uncertain
PEF	Glucose from vegetables and potentially from lignocellulosic biomass	Similar to PET, with improved thermal and barrier properties for oxygen, CO_2 and water vapour	Similar to those for PET	X	X	X	✓
TPS	Food crops	Typically blended with other materials to improve properties. Can be glassy or rubbery	Rigid and flexible packaging, service ware and agricultural products	✓	✓	✓	X
PGA	Fermentation of starch or petrochemical	High melting point, high crystallinity, relatively high glass transition temperature	Biomedical applications and potential as an interlayer in films to improve barrier properties	✓	✓	X	X
PLA	Food crops, potentially agricultural waste or fossil fuels	Isomer blends allow variety of properties, ranging from PS to PET	Rigid and flexible packaging, service ware and textiles	✓	✓	X	X
PHAs	Fermentation of renewable feedstocks	Mechanical properties similar to PP. Good UV stability and barrier properties	Flexible packaging, films, carrier bags, food trays and disposable cutlery	✓	✓	✓	X
PBS/PBSA	Renewable feedstocks or fossil fuel	Similar properties to PP	Flexible packaging and agricultural/horticultural applications	✓	✓	X	X
PBAT	Fossil fuels	Low crystallinity, tough, flexible, similar to LDPE	Flexible packaging (films and bags), waterproof coatings, additives	✓	✓	✓	X
PCL	Fossil fuels	Semi-crystalline, resistant to water, oil, solvents and chlorine	Biomedical applications or blended with starch to improve properties	✓	✓	✓	X

Modified from The Green House - Decision Tree for Biodegradable Plastic

Figure 8: Summary of bio-based, additive containing and biodegradable plastics

7.9 Plastics Material Identification

In South Africa material identification currently is voluntary, however, all responsible brand owners should make it mandatory for their packaging. If it is to be used then Commission Decision 97/129/ EC should be followed although the widely adopted and substantially similar SPI system, developed in the USA for plastics, seems also to be acceptable.

Article 8.2 of Directive 94/62/EC requires that "to facilitate collection, reuse and recovery including recycling, packaging shall indicate for purposes of its identification and classification by the industry concerned the nature of the packaging material(s) used" and that "the European Commission determine the numbering and abbreviations on which the identification system is based and shall specify which materials shall be subject to the identification system".

The European Commission published its Decision on Material Identification in January 1997 (97/129/EC). The system proposed is a detailed one, based on numbers and abbreviations, and covers an extensive range of material types including paper, plastics, steel, aluminium and individual composite materials. The use of the Commission system remains voluntary.

The Commission's material identification system for plastics is very similar to the existing and well established SPI material identification code already developed by the plastics material sector. The SPI system uses a triangle made of chasing arrows with the number of the polymer placed inside and the polymer abbreviation placed outside the base. The numbers and abbreviations used for the major plastics are indicated above.

All other plastics are allocated the number '7' with the appropriate abbreviation underneath the triangle. Where more than one material is used in the construction of the packaging, both materials are listed, e.g. a polyethylene and nylon co-extrusion film would be identified with PE+PA. Further examples of number 7 materials include PETG; E/VAL and laminates like PP+metallised. PP, etc.

7.10 Density Range of Plastics

Table 27: Density ranges of plastics commonly used in plastics packaging

Polymer	Polymer abbreviation	Density (g/cm^3)	Behaviour in clean, soapy water
Ethylene vinyl acetate	E/VAC	0.925 – 0.950	float
Polypropylene	PP	0.90 – 0.91	float
Low density polyethylene	PE-LD	0.91 – 0.925	float
Linear low density polyethylene	PE-LLD	0.926 - 0.940	float
High density polyethylene	PE-HD	0.941 – 0.965	float
Polystyrene	PS	1.04 – 1.11	Variable
Nylon	PA	1.13 – 1.14	sink
Polyethylene terephthalate	PET	1.34 – 1.38	sink
Poly(vinyl chloride)	PVC	1.30 – 1.58	sink

The above table shows the density ranges of plastics commonly used in plastics packaging. Densities are approximate and relate to virgin, unpigmented and unfilled polymer. Colouring with 4% pigment can raise density by 0.03 g/cm^3 which may cause further overlaps of polymer densities.

A density difference between the polymer and water of at least 0.05 g/cm^3 is required to ensure that the material will either sink or float in a sink/float tank.

7.11 Plastics Compatibility Matrix

In general, different plastics cannot be mixed at "molecular-homogenous" level. This thermodynamically justifiable fact leads to a relatively poor property profile for materials recycled from mixed plastics. The following table shows to what extent a recyclable mixture of different plastics can be achieved.

Table 28: Recyclable mixture of different plastics

	Compatibility matrix (Nickel*, 1996)							
	Base material	PE	PP	PS	PVC	PET	PC	PA
	PE	1	3-4	4	4	4	4	2-4
	PP	2-4	1	4	4	4	4	2-4
	PS	4	4	1	4	3	2-4	3-4
	PVC	4	4	2-4	1	4	3-4	4
	PET	4	4	4	4	1	1	3-4
	PC	4	4	2-4	4	1	1	3-4
	PA	4	4	3-4	4	3	4	1
	PBT	4	4	2-4	4	3-4	1	3-4

7.12 Plastic Systematics

The use of one sort of plastic for a pack is the optimum solution. Such packs can be separated during sorting and prepared in the subsequent recycling processing steps. If a combination of plastic kinds is necessary, plastics with different density ranges are acceptable for recycling since they can be easily separated in water with normal processing techniques.

The combination of different plastic kinds with the same density ranges, e.g. PE and PP or PET and PVC are unfavourable. More information is available under each type of packaging.

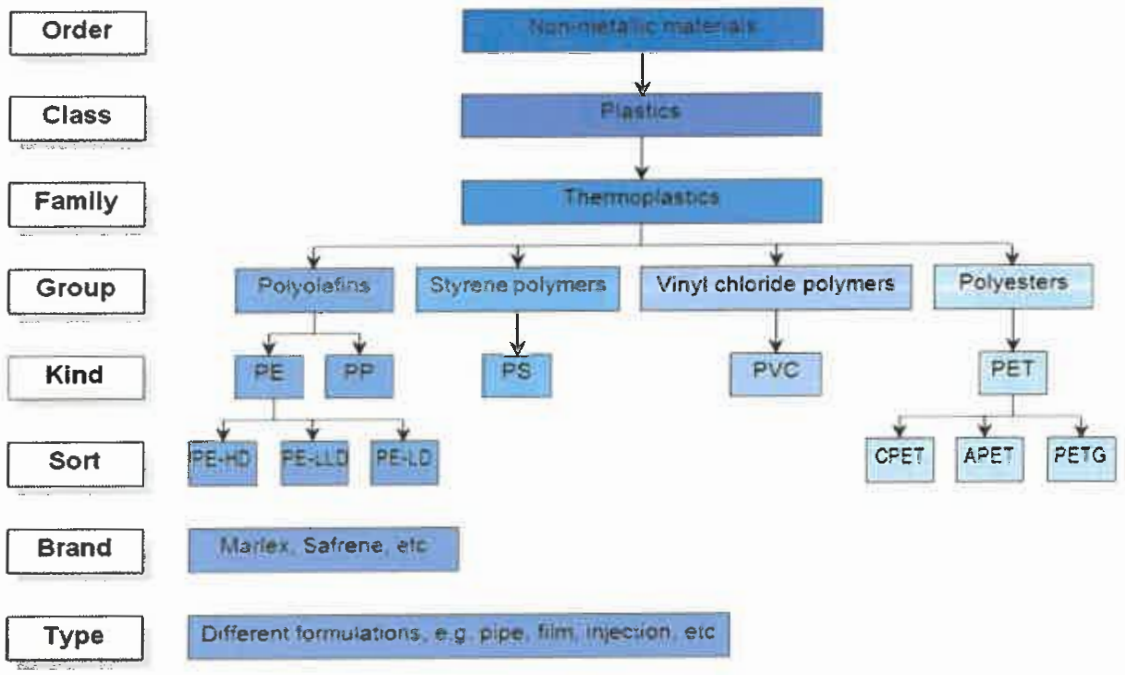

Figure 9: Summary of plastic systematics

8. Conclusion

This guideline was developed with the intention of assisting packaging designers, policy developers, sustainability managers, line convertors, printers and students in all forms of packaging and paper in understanding the environmental implications of the decisions they make. As climate change and sustainability are society's biggest challenges today, it is paramount for companies to reduce the environmental impact of products and services through their whole life cycle. This guideline acts as an aid for the paper and packaging industry in interpreting all the elements of design for recycling with regards to their products. With the growing environmental consciousness across the world, this guideline will assist companies with competing in the global market while protecting the environment.

9. Glossary

A: **ABS** Acrylonitrile/butadiene/styrene
AMA Aerosol Manufacturers' Association

B: **Blister Pack** Flat plastic containing shallow single serving reservoirs backed by a thin layer of aluminium foil, board or plastic
BOPP Bi-axially orientated Polypropylene
Biodegradable materials degrade via an aerobic or anaerobic process that involves the alteration of the chemical structure due to biological action, resulting in the loss of a specific property of the substance. The end products are gas (carbon dioxide or methane), water, biomass and mineral components. The degradation of biodegradable materials does not necessarily imply that the material can be converted

into good quality compost or that degradation will take place within a specified timeframe.
Bio-based polymers Bio-based polymers are identical to petro-based polymers (e.g. PET, HDPE) where the monomeric units (e.g. ethylene) are derived from plant-based materials (e.g. sugar cane, corn) rather than fossil fuels. These materials can be recycled with conventional petro-based plastics.

C: **Coating** the application of dispersion paint, aqueous solutions, varnish and molten or sintered masses to packaging material in order to produce adhering layers with a higher density. The layers normally have a thickness of between 1 and 100 µm.
Composite Materials biodegrade in an aerobic composting process through the action of naturally occurring micro-organisms and do so to a high extent within a specified timeframe. The biological processes yield dioxide, water, inorganic compounds and biomass, leaving no visible contaminants or toxic residues.

D: **Detinning** Extracting the tin content from steel cans
DFFE Department of Forestry, Fisheries and the Environment

E: **E/VAC** Ethylene/Vinyl Acetate (also referred to as EVA)
E/VAL Ethylene/Vinyl Alcohol (also referred to as EVOH)

F: **FTIR** Fourier Transform Infrared Spectroscopy

H: **HCl** Hydrochloric Acid

I: **Incpen** Industrial Council for Packaging and Environment (UK)
IR Infrared (radiation)
ISO International Standards Organisation

M: **MRF** Materials Recovery Facility

O: **OPET** Oriented PET
OPP Oriented Polypropylene
OPS Oriented Polystyrene

P: **PA** Polyamide (also referred to as nylon)
PAMSA Paper Manufacturing Association of SA
PBT Poly (butylene terephthalate)
PC Polycarbonate
PE-HD High Density Polyethylene
PE-LD Low Density Polyethylene
PE-LLD Linear Low Density Polyethylene
PE-MD Medium Density Polyethylene
PEN Poly (ethylene 2,6 naphthalate)
PET Poly (ethylene terephthalate)
PETG Poly (ethylene terephthalate) Glycol Modified
PF Phenol-Formaldehyde

PLA Polylactic Acid
PMMA Poly (methyl methacrylate)
PP Polypropylene
PRASA Paper Recycling Association of SA
PRO Producer Responsibility Organisation
PSPC Polystyrene Association of South Africa
PS Polystyrene
PS-E Expanded Polystyrene
PS-HI High-Impact Polystyrene
PVC Polyvinyl Chloride
PVDC Polyvinylidene Chloride

R: **Recycling** Reprocessing waste to produce another product
RPMASA Responsible Packaging Management Association of Southern Africa
RFID Radio Frequency Identification Devices which are affixed to packaging to identify the product

S: **SAPRO** South African Plastics Recycling Organisation
Stickies Hotmelt adhesives that are problematic in papermaking

T: **TGRC** The Glass Recycling Company
TPU Thermoplastic Polyurethane

V: **Vapour-deposition** Process for producing layers of metals, oxides or salts on metals, plastics and similar materials by means of thermal vaporisation in a vacuum. The layers normally have a thickness of between 0.1 and 1 µm.

W: **Wet strength** Chemical additive mixed with paper fibres to improve strength and bonding moist conditions.

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