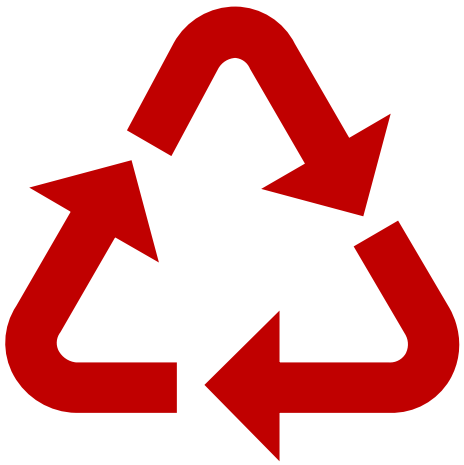
SAPRO

South African Plastics Recycling Organisation

DESIGN FOR RECYCLING GUIDELINES

for Plastic Packaging in South Africa

2026



Acknowledgement: This guideline document is based on a framework document generated by Plastics SA in a collaborative effort to harmonise national standards on D4R, however in lieu of the harmonised guidelines, SAPRO offers their adaptation of the framework.

1. Definitions

1.1 "Recyclable" ISO 14021:2017

1.1.1 "Usage of term

- A characteristic of a product, packaging or associated component that can be diverted from the waste stream through available processes and programmes and can be collected, processed and returned to use in the form of raw materials or products.

1.1.2 Qualifications

- If collection or drop-off facilities for the purpose of recycling the product or packaging are not conveniently available to a reasonable proportion[1] of purchasers, potential purchasers and users of the product in the area where the product is sold, then the following shall apply.
- a) A qualified claim of recyclability shall be used.
- b) The qualified claim shall adequately convey the limited availability of collection facilities.
- c) Generalized qualifications, such as "Recyclable where facilities exist", which do not convey the limited availability of collection facilities are not adequate."

1.1.3 Evaluation methodology

- Evaluation shall …. include evidence of the following.
  a) The collection, sorting and delivery systems to transfer the materials from the source to the recycling facility are conveniently available to a reasonable proportion of the purchasers, potential purchasers and users of the product.
  b) The recycling facilities are available to accommodate the collected materials.
  c) The product for which the claim is made is being collected and recycled."

1.2 Table Colours Defined

The design guidelines tables in the next section indicate the implication of a chosen packaging feature on the recyclability of the packaging overall. Using a feature which is listed under the Red Guidelines, would negate the recyclability of the entire packaging set.

1.2.1 Green Guidelines = Design Preferred

Packaging features in this column are readily accepted by sorters and recyclers since the majority of the industry has the capability to identify, sort, and process a package exhibiting this feature with minimal or no negative effect on the productivity of the operation or final product quality.

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[1] ***Note**: Since collection and drop-off facilities are not the only way that recyclables are collected in RSA, (in 2019) SAPRO took the decision to consider the actual recycling rate of products as a benchmark, using 30% as the initial threshold for "Recycled". As determined by the Plastics SA Annual Recycling Survey.*

Using only Green Guidelines features to make a packaging item, ensures the highest value of materials for recycling and therefore the highest likelihood of being recycled.

If the Green guidelines are followed, the recyclate from these products would be suitable for the same product again.

1.2.2 Orange Guidelines = Detrimental to Recycling

Packaging features in this column present known technical challenges for the collector or recycler's yield, productivity or final product quality, but are grudgingly tolerated and accepted by the majority of collectors and recyclers.

These features reduce the overall recycling value of the packaging item. The Orange guidelines will result in a lower standard recyclate but the Recyclate still be suitable for alternative (lower value) products.

Packaging designers are encouraged to move away from Orange towards Green Guidelines features; however Orange Guidelines' features are still adequate for recycling as these items are recycled in practice and at scale in South Africa.

1.2.3 Red Guidelines = Renders Packaging Non-Recyclable

The majority of collectors or recyclers cannot remove these features to the degree required to generate a marketable end product or the package cannot be captured by most collectors under current capabilities.

Features from the Red Guidelines are therefore Not Recycled in South Africa and adding these features to a packaging item negates the recyclability of the entire packaging item.

2. PLASTICS

2.1 General principles for plastics recycling

Before we consider plastics packaging to be "recyclable" in practice (ie both technically recyclable and feasibly recyclable) four essential steps have to be met:

Only if packaging material can follow all these steps, and collection services or drop-off sites are available to a reasonable number of residents, can it be considered recyclable (ISO 14021:2017), as referred to in Extended Producer Responsibility (EPR) legislation.

2.1.1 Collection of plastics in South Africa

In South Africa, certain plastic streams are often collected and recycled in recycling plants across a number of provinces, while others have a more limited collection and recycling rate, and some are poorly collected and recycled only in a small number of cities, due to a specific project creating a demand for the material (**Error! Not a valid bookmark self-reference.**).

Table 1 Collection rates for common categories of plastic packaging in SA

Collection rates	**PET**	**HDPE**	**PVC**	**LDPE**	**PP**	**PS**	**Other – multi-polymer packaging**
 Relatively well-collected	• Bottles – beverage: clear/ transparent light blue • Bottles/ jars – edible oil: clear (collection improving)	• Bottles/ jars – all except oily contents • Bottles/ jars – oily contents (collection improving)		• Wrap or bags - clear and coloured from A5 size upwards	• Rigids – food packaging • Rigid – personal care – vaseline jars • Rigids – paint buckets	EPS – white goods and electronics packaging	• Flexibles – HDPE:LDPE – multilayer
 Poor to no collection	• Thermoform – cups, trays, domes (collection in early phases) • Bottles/ jars: opaque/ transparent other colours (not light blue) • Strapping • Flexibles – eg oven bags and labels		All PVC rigid and flexible packaging	• Cling wrap – food-contact • Barrier bags (very thin bags, eg used to weight fruit and vegetables) • Food packaging – coloured, highly contaminated	• Rigid – personal care – multi components incompatible for recycling • Bread tags • Flexibles: oily snacks - coloured, and metalised • Flexibles – clear, metalised	• EPS - trays – other food and products (collection in early phases) • EPS Trays - meat (including chicken) • HIPS – bread tags • HIPS tubs • EPS takeaway packaging	All multi-polymer packaging (unless HDPE:LDPE)

2.1.2 Sorting and re-processing of plastic waste in South Africa

Sorting, re-processing and recycling systems differ around the world, and these differences influence the efficacy of plastics recycling.

For example, in the case of sorting, techniques that facilitate identification of plastic types by near infrared techniques (NIR spectroscopy) are being used with increasing frequency in other parts of the world. In South Africa, sorting is mainly done by hand. Carbon black (a black colouration) of plastics renders the plastic undetectable by NIR spectroscopy, and therefore packaging including carbon black in markets using NIR for sorting will be labelled as not recyclable. In South Africa, the use of carbon black is not a barrier to sorting, and packaging including carbon black may be recycled.

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 used to detect any metallic contamination.

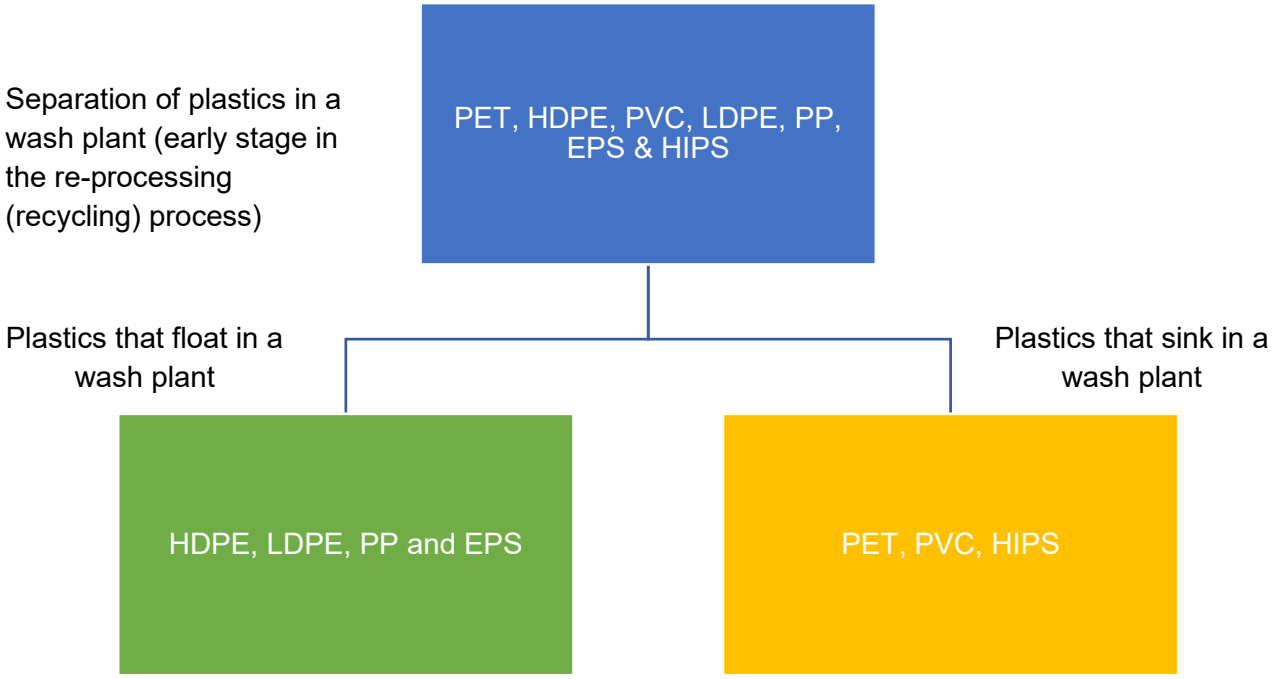

Figure 1 Density separation of plastics in a wash plant

2.1.3 Materials which cannot be separated or which can only be separated partially, impair the quality of the recyclate.

Therefore, in packaging design, material selection for different features of the packaging should take

- the density of the polymers into account.

- If the densities are similar of certain pack features, a further consideration is the compatibility of the common polymers for high-quality recycling[2].
    - Ie HDPE and LDPE may be recycled together
    - A small proportion of HDPE or LDPE may be including in PP (rigids) recycling
    - All other combinations will produce a low-quality recyclate

For example, a common disruption to the recycling of PET beverage bottles in South Africa, is PET or PVC shrink sleeves on PET beverage bottles. If this packaging type enters a recycling plant and is flaked along with the other bottles, it will form a highly disruptive contaminant in the recycling plant. In the wash plant, the shrink sleeve material will sink with the bottle flake, and not only contaminate due to the colour of the label material, but also due to incompatible properties with the bottle flake. A few such bottles in a bale of PET bottles will render all 500 kg unrecyclable.

2.1.4 End market applications for recycled plastics in South Africa

The potential market application of the recyclate determines the level of separation (or contamination permittable) of the incoming recyclables. Where the product is recycled into a similar product, the material needs to be in its purest form possible. In the case of very different applications, higher levels of material contaminants can be tolerated.

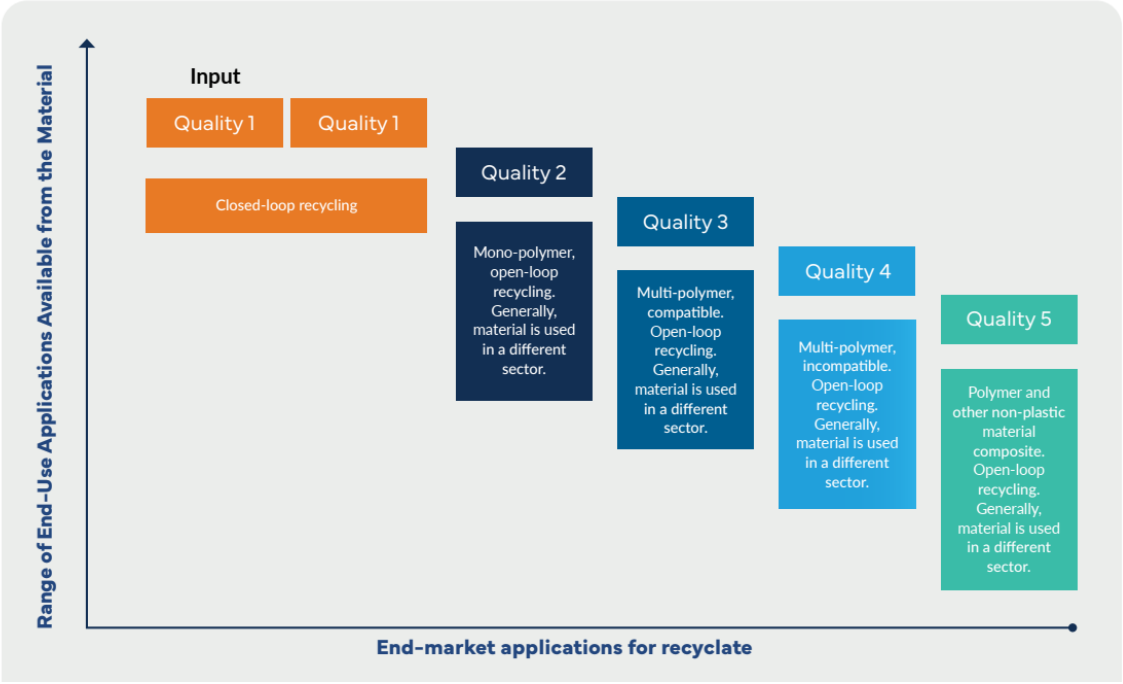

Figure 2 Generic representation of a material cascade that can be used to represent possible applications for packaging formats by polymer

Figure 2 presents a value cascade where from the packaging input material into recycling at the top left of the diagram is then recycled into other products. The nature of those products – such as the colour, size, and whether the product is mono-polymer or multimaterial/

[2] Note: aiming at a high quality recyclate means that the recyclate will have more value (it will be able to be included into more products). As a result, packaging producing high quality recyclate is more likely to be collected and recycled, than packaging resulting in a low quality recyclate.

multipolymer dictates the value of that product at the end of its use. Recycling the product back into a similar product retains the material at its highest possible value, while recycling the material into a different product will likely reduce the value of the material and the number of products it can in turn be recycled into.

The market determines in many cases the specific recycling process utilised as well as the requirements of the incoming recyclable waste. The recommendations in this guide follow two directions in terms of recyclability:

- Green guidelines: products recycled into the same product (milk bottles into milk bottles, represented by “Quality 1” in Figure 2) and
- Orange guidelines
    - products recycled into alternative plastic products (such as shampoo bottles into refuse bags but still a monopolymer plastic product recycled into a monopolymer plastic product (represented by “Quality 2” in Figure 2).
    - products recycled into alternative plastic products (such as milk bottles and LDPE shrink wrap recycled into carrier and rubbish bags (represented by “Quality 3” in Figure 2)

Note: the Red guidelines include where plastic products (whether mono- or multi-polymer) are recycled into

- multipolymer products, that are incompatible for mechanical recycling (plastics with very different properties so that products differ in properties) – such as some ‘plastic wood’ products (this is represented by “Quality 4” in Figure 2)
- Where plastic packaging is recycled into a multi-material product, such as plastics into concrete blocks (this is represented by “Quality 5” in Figure 2).

If the Green guidelines are followed, the recyclate would be suitable for the same product again and some alternate products (mono-material and compatible polymers for recycling). The Orange guidelines will result in a lower standard recyclate but still suitable for alternative products. The objective is to shift all recycling processes to a standard where the recyclate can be turned into the same product. However, the bulk of recycling operations in South Africa produce recyclate for alternative markets.

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

1) Material selection and combination, and its separability, in a pack, and
2) Labels (including printing inks and adhesives), markings and decoration techniques.

2.1.5 Format and Material combinations

As a packaging designer, the first step in your design journey will be to identify the format you are working with to contain your product. Once a format is chosen, the second step is to choose which primary material of the format construction would be best suited. After these two decisions are made, the designer can consider a wide variety of features to complete their packaging.

In order to help packaging designers navigate these Design For Recycling Guidelines, the below table separates format and material choices which either lead to recyclable options or not.

Table 2. Format to Material Navigation

Format		Material which leads to Recycled choices	Material which does not have any Recycled outcomes
Bag / Packet		LDPE – Table 9 HDPE – Table 5	PP - Table 11 PVC, Nylon
Blister Pack	PP – Table 10	PET & PETG PVC HIPS	
Bottle		PET – Table 3 HDPE – Table 5 PP – Table 10	PVC - Table 6
Bucket		HDPE – Table 5 PP – Table 10 PVC – Table 7	PET
Clamshell		PP – Table 10	PET
Cup		PP – Table 10 HDPE – Table 5	PET
Doypack		LDPE - Table 9	Multi-Material
Film		LDPE - Table 9 HDPE - Table 5	PP - Table 11 PVC - Table 8
Jar		PET - Table 3 HDPE - Table 5 EPS - Table 13	PVC - Table 6
Netting / Woven bag		PP - Table 12 LDPE - Table 9 HDPE - Table 5	
Punnet / Tub / Tray	EPS - Table 13 PP – Table 10 HDPE – Table 5	PVC - Table 7 PET - Table 4	
Sachet / Pouch		LDPE - Table 9 HDPE - Table 5	Nylon PVC - Table 8 PP - Table 11
Tube		LDPE - Table 9	PVC - Table 8

2.2 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 clearly visible material identification code.

For consistency, material identification codes should be embossed on, or close to the base or printed on the film or sheeting. Material identification codes could be printed on the label in addition to embossing on the pack itself.

The material identification code, see section 8.14, consists of a triangle with chasing arrows and a number. It does not imply that the material is recyclable or recycled. Material identification is the joint responsibility of the brand owner and the packaging converter.

2.2.1 Material selection and combination

The use of one type of plastic for a pack is the optimum solution. The recycling industry understands “sorting” as separating a PE-HD from a PP product, for example.

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. The combination of different types of plastics within the same density range, e.g. PE-HD and PP or PET and PVC, in one pack is not favouring recycling.

If a plastics pack consists of different types of plastics which cannot be separated with water, the plastic types should at least be compatible, for example a PE-LD cap is compatible with a PP tube. A matrix for evaluating compatibility is attached and explained in section 8.16.

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 such cases the shrink sleeve must be perforated for easy removal. This is unlikely to happen, and such designs are not encouraged. In this guide, these designs will be in the red guidelines column.

2.2.2 Separability of components

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 and vapour metallising do not impair recyclability. Co-extruded compatible layers are preferred whereas laminates of incompatible materials are not recycled.

2.3 Labels, Markings and Decoration

The design and application of labels, print and any form of decoration impact directly on the quality of the recyclate and the recycler, the technology used and the recyclate market application will ultimately determine the recyclability of the pack.

Use of decorative or protective finishes like foil, lacquers and coatings, should be minimised. Printing inks that contain hazardous substances and heavy metals should be avoided in the interest of good manufacturing practice.

2.3.1 Recyclate to be used in the same product

The label should be manufactured and adhered to the product in such a way that it will cleanly separate from the product and easily be removed from the flakes during normal recycling processes. 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. Plastic labels must have a density that differ sufficiently from the container density.

Examples include a PP wrap-around label on a PET bottle which will separated during mechanical granulation and the label (with a density of less than one) will separate from the PET flakes (with a density of more than one) during washing of the flakes. A second example would be a wet-strength paper label on a PE-HD bottle where label is removed during a wet-agitation wash cycle, the adhesive will remain with the label and the wet paper label fragments will sink and separate from the PE-HD flakes during the settling stage of the washing process. Paper labels that are pulped into short fibres should not be used as the pulp is likely to remain with the recyclate flakes and cause imperfections in the film or container produced from the recyclate.

If the above guidance is followed, the resultant flakes remain clear and clean to be recycled into the same product.

2.3.2 Recyclate to be used in darker coloured and mostly alternative products

Labels could be manufactured from the same sort of plastic as the main component of the pack in the case of PE-LD, PE-HD, PP, PVC and PS and can remain on the pack for recycling. The amount of dark coloured inks will influence the colour of the recyclate. For example, heavily printed in-mould labels used on white PP tubs will result in dark-coloured recyclate that cannot be used for white tubs again but is suitable for black chairs. If not the same or compatible material, plastic labels must have a density that differs sufficiently from the container density.

The adhesives used for different density material and paper labels must be water-soluble adhesives or at least adhesives that will release during a wet-agitation process and remain with the label. Paper labels that are pulped into short fibres should not be used as the pulp is likely to remain with the recyclate flakes and cause imperfections in the film or container produced from the recyclate.

2.4 Colour

Un-pigmented polymer has the highest recycling value. Strongly coloured plastics have a lower value for recycling than non-pigmented plastics. Fluorescent and neon pigments must be avoided.

The amount of colour should be minimised 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 during recycling.

Use of a material of a different type for the sleeve offers the opportunity to colour and decorate the container whilst avoiding colour contamination of the main material. The density of the sleeve and the container should differ sufficiently to enable separation during the recycling process.

Avoid direct printing onto un-coloured plastic containers. Solidly printed plastic films and films with high ink coverage cost more to recycle and the recyclate have a lower value, meaning that the waste packaging is unlikely to be collected for recycling. Printing inks with lighter colours than the base film will “disappear” during recycling and the films can be subsequently recycled into the same, or similar application. Printed films are preferred above labelled films, as labels are often made from a material or using an adhesive which is incompatible with the recycling of the item it is applied to. Labels on films are often paper, which is incompatible with any film recycling, as during pulping of the paper in a wash plant, some pulp may float and other pulp with shorter fibres may sink.

Pigmentation, dyes and inks that contain hazardous substances and heavy metals should be avoided in the interest of good manufacturing practice.

2.5 Additives

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

The use of cost-saving fillers like calcium carbonate ($CaCO_3$), has turned perfectly recyclable plastics products into the unrecyclable category. High levels of fillers increased the product density to levels where the products will no longer float with its kind during mechanical recycling.

Degradable additives might be classified as bio-degradable, or oxo-degradable. There might also be a descriptor added that gives the user insight into the conditions needed for the packaging to break down. Ie. oxo- and bio-degradable, with the descriptor aerobic (decomposes in the presence of oxygen) or anaerobic (decomposes in the absence of oxygen).

Each additive type may not be suitable for use with all plastics. Regardless of their mode of action and compatibility in the first use of a plastic product, degradable additives may present technical challenges for the mechanical recycling process and future uses of the product produced from that process. As plastics degrade, they typically lose molecular weight, the loss of which impacts the processing and physical property characteristics of postconsumer plastic. This loss can reduce certain required physical properties of parts manufactured from the degraded plastic. Recyclers strive for low variability in processing performance. Variable amounts of additives that promote degradation work against the goal of consistently maintaining the mechanical and rheological properties that allow recycled plastic to have commercial value. Degradable additives are not to be used in recyclable packaging.

Note: oxobiodegradable additives have been banned in some geographies, and are considered for banning in South Africa, due to the fact that these additives don’t break down the plastics to naturally occurring compounds, rather they just break down to microplastics quicker than plastics without the additive.

2.6 Laminated films or multi-layer, multi-material packaging

Laminates and multi-layer, multi-material packaging are engineered for specific properties, including extensive shelf life or specialised barrier properties and consists of various combinations of plastics, as well as combinations of paper, plastics and aluminium. These multi-material combinations are not favoured for recycling and only small quantities are used

in a few specialised and limited market applications for recycled laminates. Ie. There is insufficient demand for this recycled material to achieve adequate collection and recycling.

Examples of these limited market applications are composite pressed boards and polywood profiles are manufactured and fabricated into building components, furniture and playground structures. Energy recovery would be an option but is not yet available in South Africa. Laminates and multi-material products can be added to tarmac asphalt, thereby keeping the packaging out of landfill. Some of these applications have shown improved asphalt properties, and there is further work being done on such applications in South Africa.

Multi-layer packaging should be marked with a number 7 material identification code with the relevant acronym(s) underneath. For example, a multi-layer film consisting of PP and PET should be marked as follows:

Laminated and multi-material packaging should only be considered if all other options were exhausted as the packaging will likely not be recycled.

2.7 PET or Poly(ethylene terephthalate)

2.7.1 General comments for PET packaging

PET bottles make up approximately 70% of the total PET packaging market in South Africa. PET beverage bottles are widely recycled.

Beverage bottles and small quantities of thermoformed trays and punnets are recycled into beverage bottles and sheet for food contact. Other PET packaging formats, e.g. strapping tapes, flexible packaging laminates and the majority of trays and punnets, have limited collection and recycling rates currently in South Africa. If an item is not recycled in South Africa, it is not useful to design it for recycling, rather chose a material and format combination from Table 2 which offers recyclable options and build the package from there.

Combinations of different types of plastics with the same density ranges in the same pack should be avoided. The density of PET is more than that of water and PET flakes will sink during the washing and settling stage of the recycling process.

Avoid using any PVC components as its similar appearance and overlapping range of densities with PET make the two polymers difficult to separate. Small amounts of PVC contamination can render large quantities of PET recyclate useless. These components generally include, but are not limited to closure liners, labels, sleeves and tamper-evident seals.

Avoid using PETG components as the lower melting temperature renders it a contaminant to PET. Other polymers that are sometimes substituted for PET include PLA, polycarbonate (PC) and polystyrene (PS). Even the lowest levels of these materials lead to haze and a deterioration of physical properties of the recycled PET.

2.7.2 Format and shape

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 non-beverage PET bottles, e.g. sauces and marinades, wide necks allow the bottle to be placed upside down to drain all of the contents.

Although very small packs like hospitality bottles or portion packs for jams and spreads are not likely collected for recycling, packaging designers should still follow the guidelines. As collection improves, more of these products will be captured for recycling.

2.7.3 Base material

Virgin PET can be obtained from any reputable raw material producer. Recycled PET should be sourced only from accredited PET recyclers with certification for food-contact if so required.

The material identification code (MIC) facilitates the ease of visual identification of PET packaging during manual separation. The symbol should be clear, legible and moulded into the container. For bottles, the MIC is located on the base or close to the base.

Do not use the number 1 MIC for PETG, PET/PE laminate, or PET with biodegradable laminates. Biobased PET has the same chemical composition as fossil-based PET and is also identified with the number 1 MIC.

2.7.4 Barrier layers

External coatings (e.g. O_2 or CO_2 barriers) are applied to extend the shelf-life of products and can cause recycling issues. 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 MIC 7.

2.7.5 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.

2.7.6 Colour

Clear bottles have the highest commercial value for recycling. Light blue bottles are 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 required. Tubs and trays should be clear without the addition of any colorants. Solid colours render PET packaging unrecyclable.

Do not print directly onto the bottle. Minimal printing, for e.g. batch numbers, is acceptable but should be avoided if possible.

2.7.7 Closures, closure liners, cap sleeves and 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. Consider tethering the cap to the bottle. Avoid metal caps 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.

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.

For bottles, sleeves and tamper-evident seals should be designed to completely detach from the container during the re-processing / washing phase of recycling. Avoid foil seals that leave remnants of foil and adhesive.

2.7.8 Labels and adhesives

For trays, labels have a negative effect on recycling especially if they cannot be completely removed during the washing stage. Even if the labels can be separated, adhesive residue on the tray 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- and PVC sleeves and labels with PET bottles is to be avoided. Paper labels are not ideal. Polyethylene and polypropylene labels are preferred. Where adhesives are absolutely necessary, use those that are water-soluble or alkali-soluble at 60 to 80˚C. For self-adhesive labels, use glue that is designed to stay on the label.

Metallised/foil labels are costly to remove, increase contamination and have the potential to devalue the recycled material.

2.7.9 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 or any metal components in trigger mechanisms. Avoid silicon seals. The use of RFIDs on bottles, labels, or closures is discouraged.

Do not consider in-mould labelling (IML) as the inclusion of these labels renders the PET unrecyclable.

2.7.10 Closing the loop

Designers, manufacturers of packaging, and brand owners should always consider the possibility of including increasing percentages of recycled PET 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.

The use of post-consumer recyclate (PCR) in all packages is encouraged to the maximum amount technically and economically feasible.

Table 3: Guideline for PET bottles

	Green guidelines	Orange guidelines	Red guidelines
Colour	Transparent clear or light blue	Other transparent colours	Opaque, metallic, or fluorescent colours; Carbon black
Barriers / Coatings	Silicon oxide plasma-coating		E/VAL (EVOH) or PA monolayer blends; Dual layer combination of different polymers; Multi-layers Outer or inner layer coating
Additives			O_2 scavengers; UV stabilisers; Acetaldehyde blockers; Nano composites; Oxo-biodegradable additives
Caps and Closures	Materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD or PP		Materials with densities more than 1 g/cm^3 e.g. PVC and PET; Metal
Seals	Materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP		Materials with densities more than 1 g/cm^3 e.g. PVC, Al, Silicone, PS
Direct printing	Minimal laser printed production- or expiry dates only; Laser printing		Direct printing
Labels	Wrap around from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP	Self-adhesive labels from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP where glues are designed to stay on the label when detached from the bottle	Materials with densities more than 1 g/cm^3 e.g. PVC, PS, PET; Self-adhesive with glue that does not stay on the label; Metallised labels; Paper labels
Adhesive	Water or alkali soluble in 60 to 80˚C, designed to remain on the label		Not removable or soluble in water Hot melt alkali adhesives
Sleeves (including tamper evident)	Materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP		Materials with densities more than 1 g/cm^3 e.g. PVC, PS, PET, PETG or metallised materials
Trigger sprays, pumps and dispensers	All components to be made from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or uncoloured PET		Components made from glass, metal or materials with densities more than 1 g/cm^3; Coloured PET

	Green guidelines	Orange guidelines	Red guidelines
Contents	Non-oil-based sources:		Oils, paints, chemicals

Table 4: Guideline for PET trays and blister packs

	Green guidelines	Orange guidelines	Red guidelines
Material			PLA; PVC; PS; PETG; C-PET; Any PET based multi-layer material apart from delaminating PET/PE; PET-GAG; Expanded PET Delaminating PET/PE; PET-GAG structure
Colours			Opaque, metallic, or fluorescent colours; Carbon black Transparent clear or light blue Other transparent colours
Barriers / Coatings			E/VAL (EVOH), PA or any other barrier or oxygen scavenger
Additives			O_2 scavengers; UV stabilisers; Acetaldehyde blockers; Nano composites; Oxo-biodegradable additives Silicone surface coating; Anti-blocking master batch up to maximum 3% Inner or outer layer coating

	Green guidelines	Orange guidelines	Red guidelines
Lids and sealing lids			Peel-off lids where adhesive remains on container; Lids made from PVC, Al, PLA or any other material with density more than 1 g/cm^3 PET lid integral with PET container; Separate lids made from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD or PP Peel-off lids if adhesive layer remains with lid made from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP; Separate PET lids;
Direct printing	Minimal laser printed production- or expiry dates only; Laser printing	Water-wash-off inks only if approved by recyclers	Direct printing on tray with colourfast inks
Labels	Labels made from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP using adhesives with 100% removal ratio and no adhesive residuals on flakes at 70˚C testing temperature	Self-adhesive labels from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP where glues are designed to stay on the label when detached from the tub or tray; BPA-free wet-strength paper labels	Labels made from materials with densities more than 1 g/cm^3 e.g. PVC, PS, PET; Self-adhesive with glue that does not stay on the label; Metalised labels; Paper labels that pulp in friction wash; Paper containing BPA
Adhesive	No adhesives remaining on flakes at 70˚C testing temperature	Water soluble adhesives;	Any other adhesive Hot melt alkali adhesives
Inserts	No inserts	Inserts made from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP, Uncoloured PET, paper; all inserts should be completely removable and leave no trace	Inserts made from materials with densities more than 1 g/cm^3 e.g. PVC, PS, PET, PVC or PLA; Coloured or printed PET;

2.8 PE-HD or High density polyethylene

2.8.1 General comments for PE-HD packaging

Due to its toughness, natural UV barrier properties and chemical resistance, PE-HD is one of the most widely used packaging materials. It is easily injection moulded, blow moulded, or otherwise processed into a bottle, canister, bucket, tub, squeeze tube or closure. In its natural state, PE-HD appears a milky white colour. This is due to light reflection on the polymer structure rather than a colorant.

PE-HD properties can be enhanced with colorants, additives and fillers, or alongside other materials in a multi-layer pack. Each modification and addition to the natural PE-HD must be considered for its effect on the recycling stream. Non-PE-HD packaging features should either be fully and sustainably removable from the PE-HD in the typical recycling process or be compatible with PE-HD in future applications. Of particular concern are mineral fillers and additives that increase the overall density of PE-HD to more than 1 g/cm^3. The modified material will not float with pure PE-HD and will become processing waste during the recycling process.

Components that are part of the overall pack that are not compatible with PE-HD should have a density of more than 1 g/cm^3.

2.8.2 PE-HD packaging formats

2.8.2.1 Drums, bottles and jars

Blow moulded PE-HD bottles and drums are very popular for recycling. Unpigmented and white containers are more valuable, but all blow moulded containers are recycled.

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

Agricultural crates are used and often stored out of doors and exposed to ultraviolet. Crates need to be suitably UV stabilised to prevent UV degradation during 1 to 2 seasons. Damaged, but un-weathered crates are suitable for recycling.

Contamination from PP is the biggest challenge for crate recyclers.

2.8.2.3 Film and bags

The majority of vest type shopping 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 uneconomical 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. Refuse bags are widely recycled.

It has been demonstrated that ethylene copolymer ionomers do not affect recyclability when used up to 20% in PE-HD formulations for cereal, dry-food, etc. bags.

2.8.2.4 Trays

Because of great difficulties in identifying and separating the different substrates, there is very little recycling of post-consumer trays 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.

2.8.2.5 Tubs and Cups

Do not mix PE-HD bottles with PE-HD tubs or cups. Tubs and cups are injection moulded from PE-HD that have higher melt flow rates than blow moulding grades. Mixing the two types of PE-HD together decreases the value of the mixture. The recycler needs to keep injection- and blow moulding grades separate for optimum results.

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

2.8.2.6 Tubes

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).

2.8.3 Base material

Applications using unpigmented polyethylene have the highest recycling value. Coloured containers, tubes and films are acceptable. Virgin PE-HD can be obtained from any reputable raw material producer. Recycled PE-HD should be sourced only from accredited PE-HD recyclers with certification for food-contact if so required. There is currently no food-contact approved PE-HD recyclers in South Africa. The use of post-consumer PE-HD in all non-food contact packages is encouraged to the maximum amount where technically and economically feasible.

Blow moulded, extruded and injection moulded recyclate should be kept separate. Do not mix recyclate from different packaging formats.

The material identification code (MIC) facilitates the ease of visual identification of PE-HD packaging during manual separation. The symbol should be clear, legible and moulded into the container. For bottles, the MIC is located on the base or close to the base. PE-HD packaging must be marked with a number 2 material identification code.

The principal polymer contaminant of recycled PE-HD is polypropylene. PP has a higher melting point than PE-HD and does not disperse readily in the PE-HD recyclate mix. PP

components should be restricted to a maximum of 5% of the overall pack weight to avoid potential end-use issues.

PE-HD is also susceptible to content contamination, e.g. pesticides, motor oil, etc. which can result in colour and odour problems. Recyclers with hot wash processes can sufficiently remove residual content to avoid odour problems. Mineral oil migrates into the plastic and is not removed during normal recycling. Recycled oil- and pesticide containers have limited market applications and recyclate must be managed appropriately.

2.8.4 Colour

Unpigmented and white containers 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 recycled.

2.8.5 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). When required, they should be compatible with or easily separable from polyethylene in conventional recycling process. Current PE-HD recycling systems can tolerate fluorination and low levels of E/VAL (Ethylene vinyl alcohol), i.e. less than 5% of the overall pack weight. PVDC and nylon-based barrier layers should be avoided.

It has been demonstrated that ethylene copolymer ionomers do not affect recyclability when used up to 20% in PE-HD formulations.

2.8.6 Additives

The use of additives and fillers such as calcium carbonate, talc etc. in concentrations that raise the density of the material above 1 g/cm^3 are undesirable and should be avoided.

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 PE-HD that includes the additive. Generally, degradable additives should be avoided.

2.8.7 Other Components

Components should only be made of PE-HD, PE-LLD or PE-LD of the same colour or unpigmented. Components from any other material 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/cm^3.

The use of polyethylene 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 or jar should be avoided. PE closures and dispensers will remain with the main container and increase the recycling yield. PP closures are detrimental to recycling and can render the recyclate material more brittle. Although very small amounts of PP are regularly accepted, closures and dispensers comprise a larger weight percentage of the package and therefore a greater negative effect. Neck rings on tamper evident closures, must be the same colour as the bottle or must be designed in such a way that it is removed with the closure.

Closure systems without liners are preferred. Closures containing silicone (density less than 1 g/cm^3) are detrimental to recycling.

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.

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

2.8.8 Labels and Sleeves

In applications using unpigmented PE-HD, all direct printing other than date coding, contaminates the recycled PE-HD in conventional recycling systems.

Adhesives that are water soluble (or dispersible) at 60 to 80°C and hot melt alkali soluble adhesives are the most readily removed during specialised recycling processes.

Most recyclers use cold water and adhesives must at least be removed during a wet-agitation process in cold water to be acceptable. Minimal adhesive usage is encouraged. Paper labels with the correct adhesive should also have a minimum wet strength to prevent pulping during the wash agitation and settling processes. Pulped paper residue and pieces of labels that are not easily removed from the PE-HD, are detrimental to recycling. PE and PP labels are preferred.

In-mould labels will remain on the PE-HD flakes and be blended with the PE-HD recyclate. The amount of dark coloured inks will influence the colour of the recyclate. For example, heavily printed in-mould labels used on white PE-HD bottles will result in dark-coloured recyclate that cannot be used for white bottles again but is suitable for black or dark coloured bottles.

Metal foil labels are detrimental to recycling when used with an adhesive that does not release in the wash.

Tamper evident seals of PVC must be designed in such a manner that the sleeve is completely removed once the container is opened.

Table 5: Guideline for PE-HD packaging

	 **Green guidelines**	 **Orange guidelines**	 **Red guidelines**
Colour	Colourless; White	Transparent colours; Coloured; Black inner layer;	
Labels	Labels made from compatible materials e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP; PE-HD sleeves and wrap-around or collar labels	Labels made from materials with densities more than 1 g/cm^3 e.g. PET, PETG, PS and PVC as well as Paper labels using adhesives with 100% removal ratio	Al; Metallised labels; Hot melt adhesives

	Green guidelines	Orange guidelines	Red guidelines
Sleeves, including tamper evident sleeves	Unpigmented PE-HD; PE-MD; PE-LD; PE-LLD with minimum printing	Printed or coloured PE-HD; PE-MD; PE-LD; PE-LLD; PP; BOPP;	PS-E; PVC if remaining with pack once opened PS; PVC
Barriers and Coatings	Fluorination	E/VAL (EVOH) (less than 5%)	PVDC; PA
Additives	PE-HD; PE-LD, No additives that can raise the density of the material blend to more than 1 g/cm^3		Talc, $CaCO_3$ and other fillers that increase the density of PE-HD above 0.995 g/cm^3; Oxo-biodegradable additives
Caps and Closures	Unpigmented PE-HD, PE-LD or in the same colour as the container	Coloured PE-LD and PE-HD multi-piece caps with sealing rings; PP (no more than 5% of the overall pack weight);	Steel; Al; PS; Thermosets PVC
Cap Liners	PE-HD; PE-LD; PE+E/VAC; PP		PS-E; E/VAC; Al PVC; Paper with some wet strength, not prone to pulping
Lids, Closures and Sealing lids	PE-HD integral lids; PE-LD or PE-LLD		Al lids where the adhesive and pieces of Al lid remain on the tub Al films, as long as the adhesive remains on the lid when removed and the lid peels off cleanly from the container
Seals and gaskets	PE-HD; PE-LD; PP; BOPP		Silicone Al; PVC
Direct Printing	Minimal laser printed production- or expiry dates only; Laser printing	Any other direct printing; Good manufacturing practice to apply – excluding heavy metal containing inks	Foils and metallised decoration; Inks that bleed and dye wash-solution
Printing on film and bags	Where printing is required, use ink colours that are lighter than the base film	Limit printing to less than 50% of the pack area; Good manufacturing practice to apply – excluding heavy metal containing inks	Solid printing exceeding 50% of the pack weight; Inks that bleed and dye wash- solution
Residual content	Water soluble residual content of less than 1 vol.-% (up to 1 litre); Residual content of less than 0.5 vol.-% (larger than 1 litre)	Water soluble residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than0.5 vol.-% (larger than 1 litre)	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; PP;	RFID tags; Non-plastic components PVC

2.9 PVC or Poly(vinyl chloride)

2.9.1 General comments for PVC

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 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:

2.9.2 PVC Bottles and Jars

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

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 at least will separate during wet-agitation and settling during the washing stage are preferred. Paper labels should not delaminate or pulp in the washing process. Polyethylene and polypropylene labels are preferred.

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

Table 6: Guideline for PVC bottles and jars

	Green guidelines	Orange guidelines	Red guidelines
Colour	Clear; Unpigmented	Transparent colours; Coloured; Black	
Caps and Closures	Caps made from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PP or E/VAC	PVC	Steel; Al; PS; PET; Thermosets
Cap Liners	PE-HD; PE-LD; PE+E/VAC; PP	PS-E	PET; Paper
Seals and gaskets	Unpigmented PVC; PE-HD; PE-LD; PP; BOPP; E/VAC	Coloured or printed PVC	Silicone; PS

	Green guidelines	Orange guidelines	Red guidelines
Labels	Labels made from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP; Sleeves and wrap-around or collar labels	PVC labels; PS-E; Paper labels with some wet strength using adhesives with 100% removal ratio	Al; Metallised labels; PS; PET; Paper prone to pulping; Hot melt adhesives
Sleeves, including tamper evident sleeves	Clear PVC; PP or BOPP	Printed PVC on clear bottles	PS; PS-E; PET if remaining with bottle once opened
Direct Printing	Do not print on bottles or jars unless minimal laser printed production- or expiry dates; Laser printing	Any other direct printing; Good manufacturing practice to apply – excluding heavy metal containing inks	Foils and metalised decoration; 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)	Any silicone containing packaging is not recyclable
Other components, e.g. handles, dispensers, etc.	PE-HD, PE-LD, PP; PVC of the same colour or unpigmented	Coloured PVC; E/VAC	PA; PC; PMMA; PS; PS-E; TPU; Thermosets; RFID tags; Non-plastic components

2.9.3 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. However it is disruptive to other recycling streams if it gets mixed up with these materials, such as PET bottles for example. Therefore it is preferable to use only the more commonly used materials in such applications.

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.

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 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 at least can be

removed during wet-agitation and settling in cold water are preferred. Polyethylene and polypropylene labels are preferred.

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 7: Guideline for PVC tubs and trays

	Green guidelines	Orange guidelines	Red guidelines
Colour	Clear; Unpigmented	Transparent colours; Coloured; Black	
Lids	Integral with container	Peel-off lids if adhesive layer remains with lid	Peel-off lids where adhesive remains on container; PET; Paper prone to pulping
Press-on lids	PVC	Lids made from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD or PP	PET; PS; PLA; Al; Steel; Paper prone to pulping
Labels	Labels made from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP; Sleeves and wrap-around or collar labels	PVC labels; PS-E; Paper labels with some wet strength using adhesives with 100% removal ratio	Al; Metallised labels; PS; PET; Paper prone to pulping; Hot melt adhesives
Sleeves, including tamper evident sleeves	Clear PVC; PP or BOPP; PE-LD and PE-LLD	Printed PVC on clear tubs and trays	PS; PS-E; PET if remaining with tub or tray once opened
Direct Printing	Do not print on tubs and trays unless minimal laser printed production- or expiry dates; Laser printing	Any other direct printing; Good manufacturing practice to apply – excluding heavy metal containing inks;	Foils and metalised decoration; 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)	Any silicone containing packaging is not recyclable
Other components, e.g. handles, dispensers, etc.	PE-HD, PE-LD, PP; PVC of the same colour or unpigmented	Coloured PVC; E/VAC[RLR1][OB2]	PA; PC; PMMA; PS; PS-E; TPU; Thermosets; RFID tags; Non-plastic components

[RLR3]

2.9.4 PVC Film and Sheeting

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. When PVC is mixed into recycling streams for other materials such as LDPE film, it causes major losses and disruptions, therefore this material should be avoided if possible. The residual food content and meat juices also renders the product uneconomical to recycle.

Thicker, rigid PVC sheeting is used in up-market, and often, re-usable packaging. Rigid PVC in folded die-cut containers are 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 create challenges when not separated prior to recycling.

Table 8: Guideline for PVC film and sheeting[AP4]

	 Green guidelines	 Orange guidelines	 Red guidelines
Colour	Clear; Unpigmented	Transparent colours; Coloured; Black	
Handles	Welded on PVC handles; PP handles	Stitched on PVC handles;	PA handles; PA webbing; PET
Inserts, Trimming and reinforcement	PVC	PP or PE; Paper if loose inserts	PA; PET; Paper attached/glued to the film; Al; Steel
Direct Printing	Do not print on film and sheeting unless minimal laser printed production- or expiry dates; Laser printing	Any other direct printing; Good manufacturing practice to apply – excluding heavy metal containing inks;	Foils and metalised decoration; Inks that bleed and dye wash-solution
Labels	Labels made from materials with densities less than 1 g/cm^3 e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP	PVC labels; PS-E; Paper labels with some wet strength using adhesives with 100% removal ratio	Al; Metallised labels; PS; PET; Paper prone to pulping; Hot melt adhesives
Zips and other fasteners	PVC (Welded on)	PVC (Stitched on); PP	PA; Metal [OB5]

2.10 PE-LD or Low density polyethylene

2.10.1 General comments for PE-LD and PE-LLD

PE-LD/LLD films and bags form the single biggest component of all packaging recycled in South Africa. For this discussion, PE-LD and PE-LLD are treated similarly as they are recycled together. Only a couple of recyclers can recycle PE-LLD separately.

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 modification 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 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 should be avoided.

PE-LD packaging must be marked with a number 4 material identification code.

2.10.2 PE-LD film, wrap and bags

Unpigmented bags and coloured, unprinted bags have the highest recycling value. Printing should be kept to the minimum and where the printing surface exceeds 50% of the film, the final recyclate will have a lower value.

Labels manufactured from materials that sink in water while the film floats (e.g. PET) attached with water-soluble adhesive or adhesives coming off during the wet-agitation and settling stages, are acceptable. Paper labels 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.

PE-LD film is often co-extruded or laminated onto other materials to provide both the technical properties required and to satisfy user needs like extended shelf life, for example. These multi-material films have very limited market applications and are not recycled. Brand owners are developing mono-material films that addresses the abovementioned needs of improved barriers and tear strength. It is essential to follow this development through with education and awareness raising as the final pack appears to be similar than the multi-material unrecyclable pouches.

Based on the chemical similarity of ethylene copolymer ionomers, it has been demonstrated that they do not affect recyclability performance when used up to 20% in PE-LD formulations.

Metal staples can be detected by metal detectors, but can only be removed if separated from the film. Avoid any attachments if possible, especially metal ones. PP packing tape is not compatible with PE-LD film and is costly to remove prior to recycling.

Table 9: Guideline for PE-LD film, wrap and bags

	Green guidelines	Orange guidelines	Red guidelines
Colour	Clear	Coloured	
Barriers and coatings	Single material films; Ionomer layers up to 20%	E/VAL (limited to 5%); Co-extruded films of plastics of the	Co-extruded and laminated with

	Green guidelines	Orange guidelines	Red guidelines
		same sort, i.e. PE-LD, PE-LLD, PE-MD and PE-HD	different materials, i.e. not polyethylene
Additives	No additive that will amend the product density to be more than 1 g/cm^3		$CaCO_3$ and other fillers that increase the density to more than 1 g/cm^3; Oxo-biodegradable additives[AP6] Slip additives and anti-block additives; Tackifiers
Direct Printing	Do not print on film and sheeting unless minimal laser printed production- or expiry dates; Laser printing	Limit printing to less than 50% of the pack area; Good manufacturing practice to apply – excluding heavy metal containing inks	Foils and metallised decoration; Inks that bleed and dye wash-solution
Labels	No labels	Labels made from compatible materials e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP;	Al; Metallised labels; Paper prone to pulping; Hot melt adhesives Paper labels with some wet strength using adhesives with 100% removal ratio[AP7][OB8]
Residual content[OB9][OB10][OB11]		Water soluble 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)

2.11 Polypropylene (PP)

2.11.1 General comments for PP

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 1 g/cm3.

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

The use of unpigmented PP packaging is preferred to coloured ones as the recyclate 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. Since PE-HD has a lower melting point than PP, 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 recyclate market application challenges.

Current PP recycling systems can tolerate the use of E/VAL layers. PVDC barriers should be avoided.

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

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 easily removed during the wet-agitation and settling process in cold water are preferred. Paper labels should not delaminate or pulp in the washing process. Polyethylene and polypropylene labels are preferred.

The use of any 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.

2.11.2 PP tubs and cups

PP dairy tubs and cups are very popular for recycling. Tubs, trays and cups that have a clear or colourless body and where the information is restricted to the removable lid are particularly suitable for recycling. Only a handful of recyclers will separate the clear and white tubs from the multi-coloured waste stream. Packaging and non-packaging injection moulded products are mostly recycled in one stream with dark coloured (black) recyclate as a result.

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

Excessive paper content labels can cause issues during recycling and thus use of paper labels is less desirable, especially those that are prone to pulping. If used, they should be lightweight and cover only a small area of the container. Water soluble adhesives or adhesives that will come off during the wet-agitation and settling stages are to be used. PE-LD, PP and BOPP labels and sleeves are preferable.

Residual content in tubs, e.g. yogurt, margarine, etc, is problematic to the recyclers.

Because of great difficulties in identifying and separating the different substrates used for thermoformed trays, there is very little recycling data available for post-consumer trays. PP trays, however, are the most widely recycled plastic in the tray family. Marking tubs, trays and cups with large, eligible number 5 MIC facilitates collection and supports recycling.

Table 10: Guideline for PP tubs, trays and cups

	Green guidelines	Orange guidelines	Red guidelines
Colour	Colourless; White	Transparent colours; Coloured; Black;	
Additives	PE-LLD; PE-LD, No additives that can raise the density of the material blend to more than 1 g/cm^3		Fillers like $CaCO_3$ that will increase the product density to more than 1 g/cm^3; Oxo-biodegradable additives[AP12] Clarifier; Nucleating agents; Limited amounts of additives as long as the overall density remains below 0.995 g/cm^3
Barriers and Coatings		E/VAL (limited to 5%)	PVDC; PA
Lids, Closures and sealing layers	PP integral lids; PE-LD, PE-LLD or PP of the same colour	Coloured PE-LD, PE-HD and PP; PET; Al films, as long as the adhesive remains on the lid when removed and the lid peels off cleanly from the container	PS; PVC; Paper lids with some wet strength; Al lids where the adhesive and pieces of Al lid remain on the tub; Thermosets; PS
Cap Liners	PE-HD; PE-LD; PE+E/VAC; PP		PS; E/VAC; Al; Paper[AP13] PVC
Direct Printing	Do not print on pack unless minimal laser printed production- or expiry dates; Laser printing	Any other direct printing; Good manufacturing practice to apply – excluding heavy metal containing inks	Foils and metallised decoration; Inks that bleed and dye wash-solution
Labels	Sleeves and wrap-around labels made from materials with densities more than 1 g/cm^3 e.g. PET, PETG, PS and PVC	Labels made from compatible materials e.g. PE-LD, PE-LLD, PP or BOPP; In-mould PP labels; Labels as well as Paper labels using adhesives with 100% removal ratio	Al; Metallised labels; Paper prone to pulping; Hot melt adhesives
Sleeves, including tamper evident sleeves	Unpigmented and lightly printed PE-MD, PE-LD, PE-LLD, PP and BOPP	Coloured and printed PE-MD, PE-LD, PE-LLD, PP and BOPP sleeves; PE-HD; PS; PVC (only if designed to be fully removed on opening)	PS; PS-E if remaining with bottle once opened
Residual content	Water soluble residual content of less than 1 vol.-% (up to 1 litre); Residual content of less than 0.5 vol.-% (larger than 1 litre)	Water Soluble residual content of more than 1 vol.-% (up to 1 litre); Residual content of more than0.5 vol.-% (larger than 1 litre)	Any silicone containing packaging is not recyclable

	Green guidelines	Orange guidelines	Red guidelines
Other components, e.g. handles, dispensers, etc.	PE-LD and PP of the same colour or unpigmented	PE-HD; Coloured PE-LD and PP;	PS; PS-E; TPU; PA; PC; PMMA; Thermosets; RFID tags; Non-plastic components PVC; E/VAC

2.11.3 PP bottles and jars

The number of PP bottles and jars available in the waste stream does not justify economic separation of blow moulded containers from injection moulded products. Only one or two recyclers process PP bottles and jars in a separate material stream. It is typically recycled with PP tubs, cups and trays.

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

2.11.4 PP tubes

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

Caps and tubes should be manufactured from the same type of material. Co-extruded tubes are used to improve the barrier properties for more demanding contents. E/VAL as a barrier material is acceptable but will render the recyclate less valuable.

Paper labels can be used, provided they are easily removed in water and leave no adhesive residue that is difficult to remove. Direct printing is acceptable. Together with high levels of residual content, flexible tubes are only recycled in rare occasions.

2.11.5 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 popular for the confectionary and sweets industry. The metallised films are laminated to clear, reverse printed PP films. Metallised films can be recycled but are less popular than clear- or printed films as it is not possible 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. The consumer preferences and the brand owners marketing

utilises PP films as marketing tools and printing and metalising are part of the value adding appearance of the merchandised product.

Bi-axially orientated PET and metalised PET films look very similar to BOPP films and is the most challenging material contaminant for PP film, especially for clean, post-industrial films. Post-consumer films are washed and PET films will separate from the PP films in long, slow settling tanks.

Extruded PP films, BOPP- and cast PP films are all recycled in one waste stream.

Table 11: Guideline for PP film, wrap and bags

	 **Green guidelines**	 **Orange guidelines**	 **Red guidelines**
Colour	Clear; Pearlescent; White	Coloured;	Metallised
Additives	No additive that will amend the product density to be more than 1 g/cm^3		$CaCO_3$ and other fillers that increase the density to more than 1 g/cm^3; Oxo-biodegradable additives Slip additives and anti-block additives; Limited amounts of additives to ensure the overall density remains below 0,995 g/cm^3
Direct Printing	Do not print on film and sheeting unless minimal laser printed production- or expiry dates; Laser printing	Limit printing to less than 50% of the surface area; Good manufacturing practice to apply – excluding heavy metal containing inks	Foils and metallised decoration; Inks that bleed and dye wash-solution[AP14]
Labels	No labels	Labels made from compatible materials e.g. PE-HD, PE-LD, PE-LLD, PP or BOPP; Paper labels with some wet strength using adhesives with 100% removal ratio	PET; PETG; PS; PVC; Al; Metallised labels; Paper prone to pulping; Hot melt adhesives
Residual content		Water soluble 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)

2.11.6 PP woven tapes, bags and sacks

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.

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. Bags used for recyclable glass chips or cement are not recycled.

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 12: Guideline for PP woven and non-woven bags, tapes and sheeting[OB15]

	Green guidelines[RLR16][RLR17][OB18]	Orange guidelines	Red guidelines
Colour	Clear; White	Coloured	
Additives	No additive that will amend the product density to be more than 1 g/cm^3	Limited amounts of additives to ensure the overall density remains below 0,995 g/cm^3	$CaCO_3$ and other fillers that increase the density to more than 1 g/cm^3; Oxo-biodegradable additives
Coatings and barrier layers		PE-LD coatings or laminates; BOPP laminates	PET or PA layers;
Direct printing	Little or no printing	Solid printing: limit printing to less than 50% of film weight; Good manufacturing practice to apply – excluding heavy metal containing inks	Inks that bleed and dye wash- solution
Labels	Stitched on woven or non-woven PP labels; PE-HD non-woven labels	PP or BOPP; PE-HD; PE-MD: PE-LD; PELLD	PET; PETG; PS; PVC; Al; Paper; Hot melt adhesives
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); Residual sugar; Fine residual sand;	Residual glass flakes; Residual cement powder
Other components, e.g. webbing,	PP webbing, valves and stitching of the same colour	Coloured PP webbing and stitching; PET or	Metal fasteners

	Green guidelines[RLR16][RLR17][OB18]	Orange guidelines	Red guidelines
handles, stitching, draw strings		PA webbing and stitching; Raffia or jute draw strings	

2.12 PS or Polystyrene

2.12.1 General comments for PS

Recent advancements in polystyrene recycling in South Africa means that polystyrene are readily accepted for recycling. Tubs and cups 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 small 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 and no undercuts where product gets stuck.

PS packaging must be marked with a number 6 material identification code. This applies also to high impact PS, extrusion-gassed PS as well as expanded PS.

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 13: Guideline for PS, PS-HI and PS-E[OB19][OB20][OB21]

	Green guidelines	Orange guidelines	Red guidelines
Colour	Colourless; White	Coloured;	Black
Lids	PS integral lids; PS; PS-E;		PET; PVC; Al; PLA PP; PE-LD; PE-HD; Paper

	Green guidelines	Orange guidelines	Red guidelines
Direct Printing	Do not print on tubs, trays and cups unless minimal laser printed production- or expiry dates; Laser printing	Direct printing; Good manufacturing practice to apply – excluding heavy metal containing inks	
Labels		PE-HD; PE-MD: PE-LD; PE-LLD; PP or BOPP sleeves and wraparound labels;	Paper;
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.[RLR22][RLR23][OB24]	Residual content of more than 1 vol.-% (up to 1 litre) or 0.5 vol.-% for containers larger than 1litre Meat trays
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

2.13 Bio-degradable and Compostable Plastics[OB25][OB26][OB27]

Bioplastics are a large family of different materials. A plastic material is defined as a bioplastic if it is either bio-based, biodegradable, or features both properties[3] (*Figure 3*).

Bio-based means that the material is derived from biomass from corn, sugarcane, or cellulose[3].

Biodegradation is a process by which microorganisms in the environment break down materials into natural substances such as water, carbon dioxide or methane, and compost (natural organic material from the breakdown of plant and animal tissue). The environmental conditions in which materials break down, such as the presence or absence of oxygen and the temperature influence the rate of biodegradation and the products of biodegradation (ie methane is produced in the absence of oxygen, and carbon dioxide is produced in the presence of oxygen) .

Bio-based does not equal *biodegradable*. The property of biodegradation does not depend on the source of the material a product is made from, but is rather linked to its chemical structure. [K28]In other words, bio-based plastics may be non-biodegradable, and fossil based plastics can biodegrade (*Figure 3*).

Given the need to identify renewable sources for our current plastic products, and concerns around the negative effects of plastic pollution, there are a growing number of bioplastic products and applications. There are two major advantages of bio-based plastic products compared to their conventional versions:

[3] European Bioplastics factsheet, https://docs.european-bioplastics.org/publications/fs/EuBP_FS_What_are_bioplastics.pdf

- They are made from biomass (natural material from plants or animals), which means that fossil non-renewable resources (such as coal or gas). Biomass regenerates – ie more biomass can be grown and used to make more products, and if this process is well-planned can be renewable with limited to no negative impacts on resources. These sources can therefore be carbon neutral, especially if the biomass used is a waste material from another process (ie bagasse as the waste remaining from processing sugar cane).
- Furthermore, biodegradability is an is a property of certain types of bioplastics, which means they can be treated through composting or other treatment processes used to handle food waste. In addition, if these products leak into the environment (they are littered), they biodegrade to naturally occurring compounds, which means they have a much lower impact than conventional plastics when littered..[K29][K30][OB31]

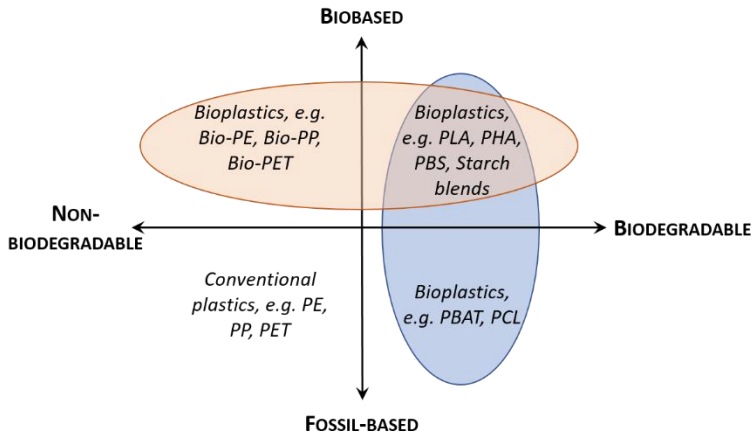

Figure 3:Matrix of the source material for plastics (bio-based or fossil-based) versus their biodegradability [K32]

Source: European Bioplastics [K33][K34][OB35][K36]

2.13.1 Considerations before introducing biodegradable products

2.13.1.1 Certifying biodegradability

Any product labelled biodegradable needs to be assessed according to standard test methods and be certified that the product truly breaks down to naturally-occurring components[4]. For such truly biodegradable products, there are 2 possible routes for certification

1. Industrially compostable materials – which means that the products break down under specific controlled environmental conditions, including a temperature of 58 – 60 °C.

[4] The Moss Group (2020), Biodegradable and Compostable Packaging: A review of the South African landscape. Prepared by The Moss Group (2020) on behalf of The South African Initiative to End Plastic Waste.

The commonly used standard specifications for industrially compostable materials are ASTM D6400[5], ASTM D6868[6], EN 13432[7] and ISO 170088[8].

2. Home-compostable materials – these are materials that can be certified to break down under a wider range of conditions that would likely occur in home composting, and/or break down at ambient temperatures (ie for material that is littered).

It must be noted that, biodegradation in water will be significantly slower than biodegradation in industrial or home composting settings, or for material littered on land.

To add: Technical assessment – CSIR Lab[K37]

2.13.2 Capacity to treat biodegradable materials in South Africa[9]

There are a limited number of industrial composting facilities in South Africa that maintain the conditions specified in the biodegradation standards mentioned above.

Furthermore, there are also limited collection and treatment systems or services available for post-consumer food and garden waste, which are the streams in which compostable packaging can be included for handling. Any services or collections are generally at commercial or industrial sites (such as hotels, restaurants or agro-processing plants) and therefore cover a very small percentage of the organic waste in the country, and therefore represent very limited opportunity to process biodegradable and compostable packaging. As a result, biodegradabale and compostable packaging waste has no value for collectors, whether in the formal or informal sectors, and such packaging is likely to be littered or landfilled, in the best case scenario.

Certain biodegradable and compostable packaging is a risk to current mechanical plastics recycling, through contamination of the recycling stream, for eg. PLA bottles cannot be visually differentiated from PET bottles, and are highly detrimental in PET recycling plants.

Other biodegradable and compostable packaging, such as those used for takeaways, have limited potential to contaminate an existing recycling stream, as takeaway packaging is often not collected for recycling.

When selecting biodegradable and compostable packaging, the end-of-life should be carefully considered:

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[5]ASTM D6400-21 "Standard Specification for Labeling of Plastics Designed to be Aerobically Composted in Municipal or Industrial Facilities", https://www.astm.org/d6400-21.html

[6]ASTM D6868-21 "Standard Specification for Labeling of End Items that Incorporate Plastics and Polymers as Coatings or Additives with Paper and Other Substrates Designed to be Aerobically Composted in Municipal or Industrial Facilities", https://www.astm.org/d6868-21.html

[7] BS EN 13432:2000 "Packaging. Requirements for packaging recoverable through composting and biodegradation. Test scheme and evaluation criteria for the final acceptance of packaging", https://www.en-standard.eu/bs-en-13432-2000-packaging.-requirements-for-packaging-recoverable-through-composting-and-biodegradation.-test-scheme-and-evaluation-criteria-for-the-final-acceptance-of-packaging/

[8]ISO 17088:2021 "Plastics — Organic recycling — Specifications for compostable plastics", https://www.iso.org/standard/74994.html

[9] The Moss Group (2020), Biodegradable and Compostable Packaging: A review of the South African landscape. Prepared by The Moss Group (2020) on behalf of The South African Initiative to End Plastic Waste.

- Could the material contaminate existing recycling streams? If so, a collection system be designed that diverts the material to appropriate treatment, such as composting?
- As a producer in terms of the National Extended Producer Responsibility (EPR) legislation, how can I meet my obligations to recover, and treat (such as composting) my packaging? (for more information, see section 2.13.3.1)

2.13.3 Existing South African legislation and standards relating to biodegradable products[K38]

2.13.3.1 Extended Producer Responsibility Legislation[K39]

National Extended Producer Responsibility legislation and associated notices[10] were published in November 2020, and amended in May 2021. The first year of implementation of mandatory EPR for the identified sectors[10] was the calendar year 2022. The applicable notice for the purposes of these design guidelines is the notice addressing paper, packaging, and some single-use products (GN 43882, 5 November 2020, and amended by GN 44539, 5 May 2021)[11].

Under the national EPR legislation producers (including importers, packaging manufacturers and brand owners) are required to take responsibility for their identified products through the end of life stage. This responsibility is expressed through the meeting of specified annual targets for collection, recycling, and in some cases reuse of their identified products.

The current legislated targets for biodegradable and packaging in the EPR notice range from a collection target of 15% in 2022 to 80% in 2026, and a recycling target (really composting or other organic material treatment) ranging from 5% in 2022 to 70% in 2026. Compostable packaging has the same collection target range as biodegradable packaging and the recycling (composting) rate for compostable packaging is the same as the collection targets.

Please consult the South African Waste Information Centre for any updates to legislated targets (https://sawic.environment.gov.za/).

2.13.3.2 Legislation concerning product claims and standards

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 South African Bureau of Standards (SABS).[K40]

[10] Addressing 1. Paper, packaging, and some single-use products 2. The electrical and electronic equipment sector 3. The lighting sector

[11] For any updates regarding national EPR legislation and notices, please consult the South African Waste Information Centre (SAWIC) https://sawic.environment.gov.za/

The voluntary South African National Standard: SANS 1728[12] 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 identification code, 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[13]) is currently open for comment until 14 April 2020, as per Government Gazette number 43050 (28 February 2020). [K41]It is based on ISO 17088 which addresses the 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

2.13.4 Biodegradable certifications and labelling

Biodegradable and compostable products must be labelled with the appropriate certification logos (e.g. DIN, TUV or BPI) and the relevant certificates to support the use of the logos must be available upon request, 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.

[12] SANS 1728:2019 “The requirements for the marking and identification of degradable plastics”, https://store.sabs.co.za/sans-1728-2019-ed-1-00-2142887.html
[13] SANS 17088:2020 “Specifications for compostable plastics.”, https://store.sabs.co.za/sans-17088-2020-ed-1-00-2143764.html

2.13.5 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 feedstock 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.[K42]

Table 14: 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 lignocellulose 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	✓

Name	Feedstock	Properties	Applications	Biodegradable	Industrial Composting	Home composting	Mechanical recycling
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 feedstock	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 feedstock or fossil fuels	Similar properties to PP	Flexible packaging and agricultural / horticultural applications	✓	✓	X	X
PBAT	Fossil fuels	Low crystallinity, tough, flexible, similar to PE-LD	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

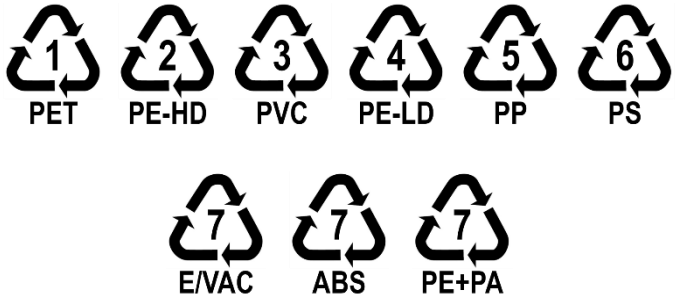
Modified from The Green House – Decision Tree for Biodegradable Plastic, Source: Biodegradable and Compostable Packaging: A review of the South African landscape. Prepared by The Moss Group (2020) on behalf of The South African Initiative to End Plastic Waste.

2.14 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 or [K43][K44][OB45]the widely adopted ASTM D7611 [K46][K47]should be followed.

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.

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 numbers and abbreviations used for the major plastics are indicated below.[K48][K49][OB50]



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+PET, etc.

2.1 Density Range of Plastics

The following 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.

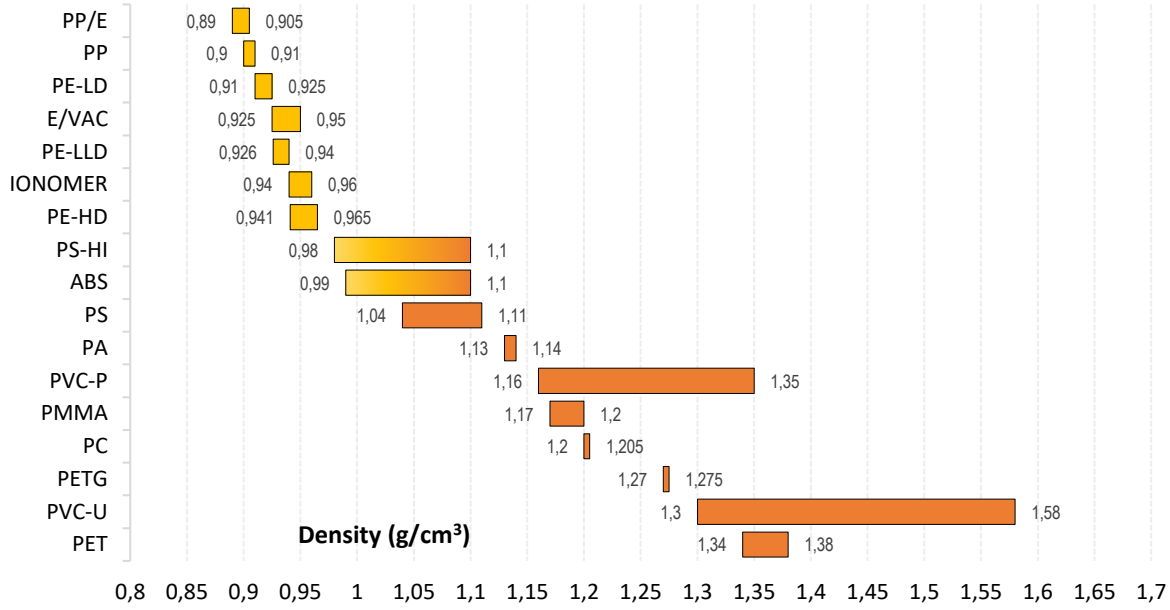


Figure 4: Density ranges of plastics commonly used in plastics packaging

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. The density of water is generally 1 g/cm3 but can range from 0,95 to 1,05 for water with a high salt content.

2.2 Plastics Compatibility Matrix[K51]

In general, different plastics cannot be mixed at "molecular-homogenous" [K52]level, meaning that melting different plastics together normally doesn't result in a homogeneous mixture, so that the properties of the mixture will vary through the material. This thermodynamically justifiable fact leads to a relatively poor property profile [K53]for materials recycled from mixed plastics. The following table shows to what extent a recyclable mixture of different plastics can be achieved.

Table 15: Recyclable mixture of different plastics[K54]

Compatibility matrix (Nickel, 1996)							
Base Material	**PE (HD-PE and (L)LD-PE)[K55]**	**PP**	**PS**	**PVC**	**PET**	**PC**	**PA[K56]**
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	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

Source: Designing Recycling-friendly Plastic Sales Packaging, Deutsche Gesellschaft für Kunststoff Recycling mbH [14]

Key:

1 = good compatibility *2 = mixable to approximately 20%*

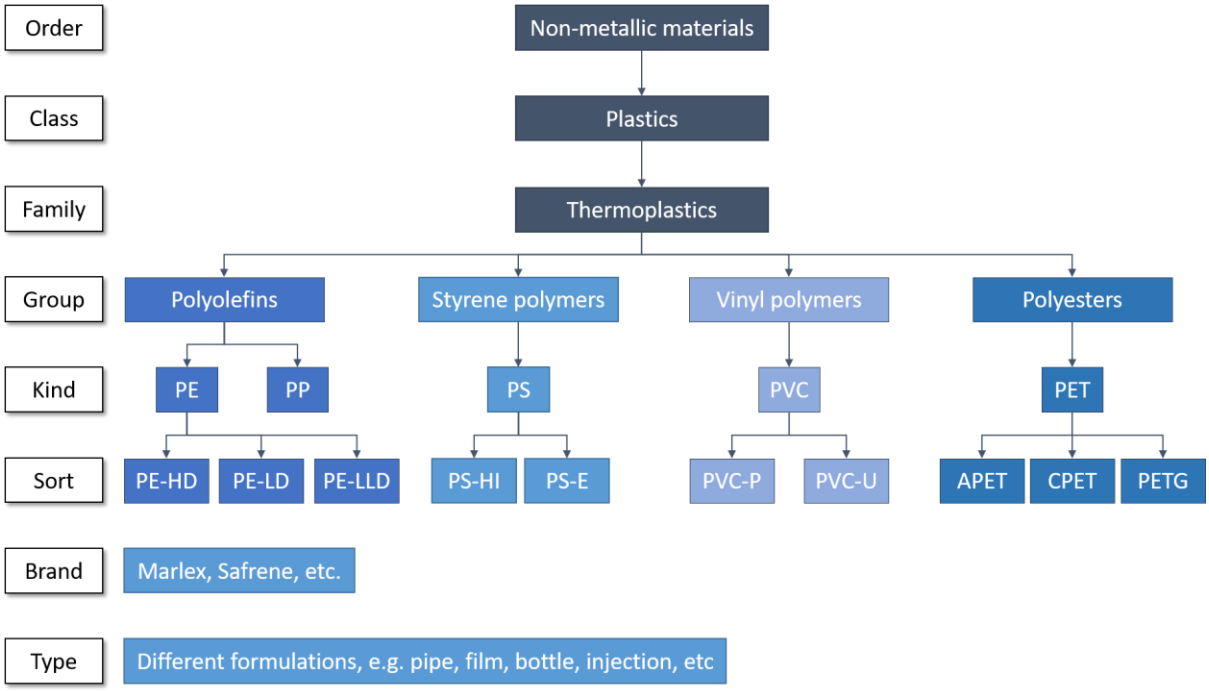
3 = mixable to approximately 5% *4 = non-compatible*

2.3 Plastic Systematics[K57][K58]

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.

[14] *Nickel, W and Fleischer, G; Recycling-Handbuch, Strategien Technologien Produkte, VDI-Verlag GmbH, Düsseldorf, 1996; https://doi.org/10.1007/978-3-642-95768-0*



Source: Designing Recycling-friendly Plastic Sales Packaging. A discussion paper for packaging designers based on the experience of the Deutsche Gesellschaft für Kunststoff Recycling mbH [1]

Figure 5: Summary of plastic systematics