

RECYCLABILITY EVALUATION PROTOCOL FOR PET TRAYS

1.- INTRODUCTION.-

Petcore Europe is the association representing the complete PET value chain in Europe since 1993.

Its mission is to ensure that the entire PET industry is well aligned to enhance its value and sustainable growth, to represent the PET industry before the European institutions and other stakeholders, to ensure that PET is positioned as an outstanding packaging material and recognised as environmentally sound, to support and validate innovative packaging solutions from a recycling perspective, and to work with all interested parties to ensure a continuous increase of PET post-consumer collection and recycling.

To support its mission, Petcore Europe has recently published the latest [PET tray design guidelines](#) to ensure that all PET trays placed in the market are fully recyclable and effectively recycled.

The guidelines for PET tray design must be used by Sheet Manufacturers, thermoform producers, Packers and Retailers to ensure that the container/tray/package is compatible with the collection, sorting and recycling capabilities installed.

The protocol has to be applied to any existing packaging, new design or innovation to be implemented that can affect the recyclability of the packaging after use. It is designed to evaluate the PET solution to be implemented and its recyclability at the end of its life when it reaches the PET collection stream, and its influence on the quality of the recycled product.

Petcore Europe developed this document for testing PET trays based on the knowledge and common practices of recycling processes, and its experience on the impact of the different packaging elements for the recycling efficiency. Petcore Europe used its own experts' experiences combined with EPBP, PRE, and APR protocols.

In many cases, PET trays include non-PET components for packaging performance efficiency. These non-PET components may affect the properties of the rPET during all the process, from collection to sorting, recycling and reprocessing. To prevent the negative impact of these components, the protocol concludes that packaging indications should state that consumer action (remove certain packaging components to avoid their entry in the recycling stream) after use is necessary.

This protocol has the intention to evaluate the impact of the packaging in the recycling stream when considering the option of tray to tray recycling. This does not eliminate the use of rPET from trays into other applications such as film, sheet or fibres.

In many cases, the trays are collected in the same stream as the PET bottles. The intention of the protocol in this case is to prevent negative impact of PET trays in the PET bottle

recycling stream. For this reason, there will be a clear link between the PET tray and PET bottle recycling protocols and processes.

Thermoformed PET containers are made from PET sheet. Even if the use of certain packaging can be relatively local, films/sheet or recycling stream can cross borders and have cross countries implication. For that reason, the guidelines must apply to all the EU countries.

This protocol intends to analyse any existing or new thermoformed PET packaging and to verify its impact on the different steps of recycling: sorting, treatment/washing, extrusion and conversion into a new product. This will be applied at a lab scale, with the intention to be verified latter at an industrial level.

2.- SCOPE.-

The scope of the protocol will cover the evaluation of the impact of current design or innovative packaging, consisting of any PET tray or thermoformed packaging to be introduced in the market.

Prior to initiating any test, the applicant has to review and confront his packaging with the Design for Recycling guidelines for PET trays and Thermoformed PET packaging to verify compatibility with the recycling stream.

These guidelines make specific references to the formulation of the material used in the manufacturing of the sheet as well as the rest of the component of a thermoformed packaging:

- *PET resins*
- *Sealing layers*
- *Colours*
- *Barrier materials*
- *Additives*
- *Lidding films*
- *Printing*
- *Labels*
- *Glues*
- *Other components and inserts on/in the thermoformed packaging.*

The “easy to access” and “easy to empty” indexes have to be considered as important factors for the recyclability of the packaging. This is of high importance as most of the trays and thermoformed products are in contact with food, and leftover materials will lead to impurities in the recycling process.

Due to the complexity of the PET trays and Thermoformed packaging, the feasibility for consumers to separate components such as labels, lidding films or inserts (like soaking pads...) has to be confirmed.

3.- PRODUCT EVALUATION

The producer or the organisation bringing the packaging on the market (Packer, Brand Owner, Retailer.....), should make an evaluation of the product's recyclability by using as a main reference the Petcore Europe PET tray Design for Recycling Guidelines.

*For this evaluation, table 1 here under should be used. It is based on the **EPBP protocol**, adapted to the evaluation of trays. As an outcome of the evaluation, individual test programmes should be required:*

- **Step 1.** *It's very important to get good and complete information about the design of the packaging, and the innovation introduced if any, from both technical and market perspective. This allows the Producer/User to design the most appropriate test programme, and select only the relevant tests.*
- **Step 2.-** *If sorting technologies or any other separation techniques have the effect of reducing the impact of the packaging on the rPET stream, an assessment of any specific additional steps (for example, sorting) can be included in the test programme.*
- **Step 3.-** *Based on the available information, the producer of the packaging should contact Petcore Europe to determine if one of the properties reflected in table 2 is considered as "**critical**". If this is the case, this property should be tested.*
- **Step 4.-** *In parallel with Step 3, the packaging producer supported by a Petcore Europe assessment will decide on the full test programme, once the packaging passes Step 3. The evaluation of the required tests should help the producer to estimate total costs.*

The design of the test based on this protocol, has as objective to highlight all possible effects of the PET packaging on the collection, sorting and recycling processes, the conversion of the rPET into a new product, and the properties of the final product.

In table 2, there is a series of analytical guidelines for the evaluation of the impact of any given product on the quality of the recycling stream.

TABLE 1

Steps	Comments
Step 1.- Input from Application <i>Design of the packaging</i> <i>Composition</i> <i>Volume of addressable market</i>	For example, Colour, Size, Additives, Weight, Decoration, Labels, Lidding film, Soaking pad, Material on the Base, Lidding film, Sealing Layer, Barrier layer Size of the market, including geographical concentration to evaluate the impact on the collection.
Step 2.-Assessment on Sortability Technology (efficiency reference) <i>Colour Sorting (95%)</i> <i>IR Sorting (80%)</i> <i>Metal Detection (90%)</i> <i>Sink Float (99%)</i> <i>Air Elutriation (50%)</i>	Expected Efficiency <i>To be measured</i> <i>To be measured</i> <i>To be measured</i> <i>To be measured</i> <i>To be measured</i>
Step 3.-Testing critical properties Expeced critical properties <i>Expected concentration of clear/blue</i> <i>Expected concentration of dark/color</i> <i>Glue concentration</i> <i>Other polymers concentration</i> <i>Paper concentration</i> <i>Ads on</i> <i>lidding films</i> <i>labels</i> <i>Other materials</i> <i>Final product hold up after empty</i>	<i>Color measurement</i> <i>Color measurement</i> <i>Glue residues tet</i> <i>Other polymer oven test</i> <i>Paper residues oven test</i> <i>Feasibility to remove ads on componets as soaking pads</i> <i>Feadibility for easy removal of lidding films</i> <i>Fesibilty for easy removal of labels</i> <i>To be defined</i> <i>Weight masurement</i>
Step 4.-Final test program <i>Produce new specimen with different new design product concentration</i>	<i>Propeties to be selected from table number 2</i>

Specific test must be executed using modern test equipment, preferently by an independent test laboratory with no affiliation to the Producer. In house test should be used exceptionally

TABLE 2

RPET Properties	Critical test
Optical	
1.- Colour and Haze	L*, a*, b* and haze measured :a) in plaques or b) in similar product; in both cases, compared with sample made with virgin polymer (REFERENCE) Visual/Camera check, fibre spinnin and tensile testing depending on the case Visual UV test
2.- Black Speks and Gels	
3.- Fluorescence	
Processing	
4.- Air elutriation	Air separation of flakes (dust and fines) Agglomeration (presence of other plymers) Flowability of the flakes IV on Solid State or Liquid State, when IV increase is required Performance on Spinning or injection Filter test extrusion to detect impurities Performance on film extrusion or fiber spinnin(Bottle Bust test optional) Visual check after extrusion or injection on calender or mould
5.- Stikking during drying	
6.- Feeding properties	
7.- IV Build-up in Solid State or Liquid State	
8.- Reology (Viscosity, Melt Strength)	
9.- Filter Conamination	
10.- Strain Hardening	
11.- Mould Deposit (Plate Out)	
Mechanical	
12.- Impact resistance	Punch and tear test CO2 and Oxigen permeability Creep resistance at different temperatures Tensile test on film or fibers Tensile Modulus in film or fibers Film or fiber shrinkage
13.- Gas barrier	
14.- Thermal Stability (Creep)	
15.- Strenght/elongation	
16.- Modulus	
17.- Shrinkage	
Product stability and Thermal Properties	
18.- Melting and Crystalization Temperatue	DSC second run on flakes or pellets AA on final product Observation during Extrusion or injection IV Measurement before and after exrusion Screening test for VOC or NIAS
19.- AA generation	
20.- Stabiliy during Extrusion (fumes, bubbles)	
21.- IV stability/Break down	
22.- Product Stability (decomposition)	
Other Properties	
23.- Label Bleeding	EPBP QT 507
24.- Label separation after hot water	EPBP QT 502
25.- Glue Removal	EPBP QT 504
26.- Inertness	Filter Test High shear estrusion
27.- Residual lipophilic contain	To be defined

Remark. - None of this test reflect any food contact safety elements

4.- LABORATORY TEST METHOD. -

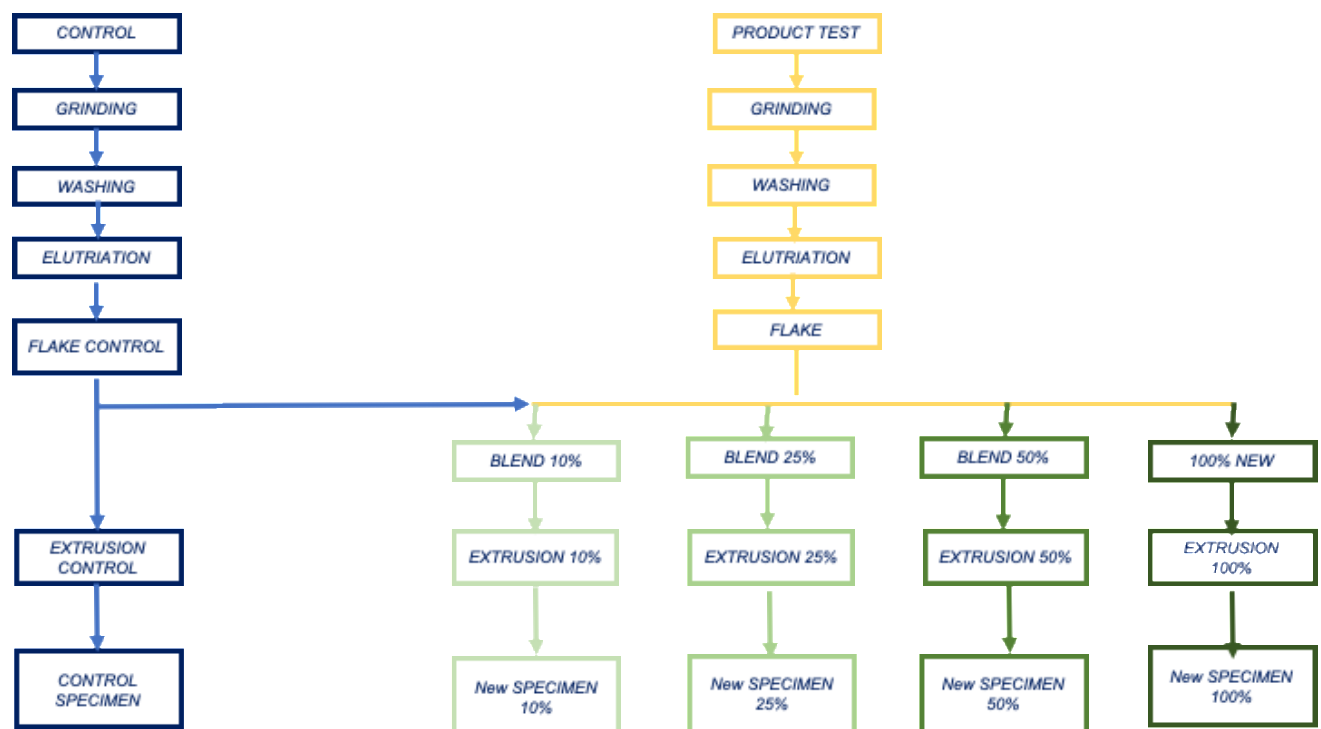
A laboratory analysis of the packaging aims to reproduce how the existing or new packaging should behave during the regular recycling process. The method described here under, should be followed in a precise way, and every problem or modification during the process, has to be clearly recorded.

In the lab, a sheet of similar thickness as the evaluated product should be prepared, ideally, a sheet between 500 and 900 microns. If not, a plaque of 1mm can be injected for reference.

An evaluation report with detailed results has to be submitted to the Petcore Europe Technical Committee (or other association) for final assessment.

The test process will be replicated to make a comparison with a control specimen. The control specimen should be a tray made with virgin PET. Different blends with the new product and the control material will be made to verify the impact of the packaging on the recycling stream. The blend should at least contain 10%, 25%, 50% and 100% of the product.

To determine the potential impact of the evaluated packaging on the recycling system, a percentage indication of the market share compared with the total PET stream in the region is necessary.



An analytical test as collected within table 2 above will be applied to every blend result to understand the impact of the packaging on the recycling stream, and particularly on the ability to produce new specimens using a certain amount of recycled product from the tested packaging.

5.- INDUSTRIAL TEST.-

If the lab test is considered as positive, an industrial test has to be performed using the same guidelines reflected above.

The final impact on the recycled product can determine the recyclability of the tested packaging.

The same protocol has to be implemented, recorded and audited by an independent body. The result of the audit report will determine the final recyclability of the product and its ability to be incorporated in the regular recycling stream.

6.- MASS BALANCE.

Loss of product during the recycling process is of extreme importance. During both, the lab test and the industrial test, mass balances must be applied to have an indication of the real % of recyclability of the product.

Across the recycling process, several steps (sorting, shredding, washing, elutriation, drying, screening, extrusion.....) can lead to a loss. These losses have to be evaluated as they are an essential part of the effectiveness of the recycling process.

The weight of the product has to be measured across every recycling step and must be recorded in a flow chart/table, as well as summarized in a mass balance report to determine the recycling compatibility of the product and its recycling efficiency.

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DESIGN FOR RECYCLING GUIDELINES FOR PET THERMOFORMED TRAYS CLEAR TRANSPARENT TO BE RECYCLED EVEN IN FOOD APPLICATIONS				
	YES	CONDITIONAL	NO	ASSESSING PROTOCOLS
	Full compatibility – materials that passed the testing protocols with no negative impact OR materials that have not been tested (yet), but are known to be acceptable in PET recycling	Limited compatibility – materials that passed the testing protocols if certain conditions are met OR materials that have not been tested (yet), but pose a low risk of interfering with PET recycling	Low compatibility – materials that failed the testing protocols OR materials that have not been tested (yet), but pose a high risk of interfering with PET recycling	All packaging should be tested according to the Petcore Europe Guidelines and PET trays Recycling protocol, evaluated by RECYCLASS.
Packaging	PET		PLA; PVC; PS; PETG; Other opaque and color material; any PET based multi-layer material (PET/PE, PET/PETG); Expanded PET	
Size				
Colors	transparent clear; transparent light blue		Other transparent colours; Opaque; Metallic	
Barrier	None ; PET based oxygen Barriers or Scavenger with no yellowness effects after EPBP oven test.	PET based oxygen Barriers or Scavenger with limited yellowness effects after EPBP oven test	EVOH; PA; any other barrier; any other oxygen scavenger	EPBP oven test
Additives	Silicone surface coating (on coating area); Antiblocking masterbatch; None of them should affect clarity	Any other additive (UV stabilisers; AA blockers; optical brighteners; antiblocking; anti-stat agents; anti-fogging (on coating area)) With Limited effect on clarity to be measured	Bio/Oxo/Photodegradable additives; Nanocomposites	
UNPRINTED Lidding films - Closure systems (with glue not harming the recycling process)	PET; OR Floating combination of plastics with density < 0,95 g/cm ³ ; NO glue residuals; If no PET, no lidding film residual on the tray. SiOx, AluOx plasma for barrier.		any other sinking film with density > 1 g/cm ³ (to be proven with sink/float test)	EPBP sink/float test. EPBP glue removal test. EPBP oven test
PRINTED Lidding films - Closure systems (with glue not harming the recycling process)	NO PRINTING PREFERRED. OR plastics/combination of floating plastics with density < 0,95 g/cm ³ ; NO glue residuals; foamed PET based films where foamed structure is not getting destroyed @ 90°C; If no PET, no lidding film residual on the tray. SiOx and AluOx plasma for barrier		any other film	EPBP sink/float test EPBP glue removal test EPBP oven test
Labels (with adhesive not harming the recycling process - see labels adhesive section)	NO LABEL PREFERRED. Plastic labels where label has a density < 1 g/cm ³ in the more heavily printed and adhesive area	BPA-Free Paper labels not loosing fibers (pulp) and floating	Plastic labels where label has a density > 1 g/cm ³ in the more heavily printed and adhesive area - Paper labels loosing fibers (pulp) - Paper containing BPA - non floating paper labels	EPBP sink/float test
Labels Adhesive	adhesives with 100% removing ratio and no adhesive residuals on flakes @ 70°C testing temperature	adhesives with 100% removing ratio and no adhesive residuals on flakes @ 85°C testing temperature	all other adhesives	Petcore Europe - PET thermoforms WG - adhesive removal on trays protocol
Adhesives on parts different than lidding films and labels	Water or alkali soluble in 60-80°C.		any other adhesive	EPBP glue removal test
Inks	Non toxic, follow EUPIA Guidelines		Inks that bleed; toxic or hazardous inks	
Direct Printing	Laser marked for trazability (production or expiry date)		Any other direct printing	
Other Components	NO other components Preferred	Inserts in HDPE / LDPE / PP, Soaker pads, bubble pads and paper & carboard - all inserts should be completely removable and leave no traces	PVC / PS / EPS / PU / PA (Nylon); PC / PMMA Thermoset plastics / metals; non compliant soaker pads	

This work is published by PETCORE Europe with experts in the plastics packaging and recycling industry. The information contained in this document is **for general guidance only**. Any details given are intended as a general recommendation based on the best of our knowledge at the time of publication. It does not necessarily guarantee compliance with the different recycling schemes. This is by no means an exhaustive list. Users are therefore advised to make their own enquiries with Petcore Europe - Thermoforms Working Group, local recyclers or recycling organisations to check for specific and up-to-date information.

It is important to note that this is a **living or dynamic document** which will be continually edited, updated and expanded by our panel of experts as more information becomes available. This means that a certain product and/or material classification may change in future. Users are therefore advised to check the website for the latest information.

We value your **feedback** because it will help us to develop this publication even more and to make it a useful tool for you and other actors in the PET value chain. We appreciate you taking the time to let us know what you think about Design for Recycling Guidelines for PET Thermoforming Trays, so please send your comments and/or additional information to Petcore Europe (www.petcore-europe.org).