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Film Pressure Sensitive Labels on PET Containers
APR Resource Document

Introduction

This Resource Document presents APR Guidance for characteristics of a film pressure sensitive label for PET packaging that is compatible with today's PET container recycling and that will have the most positive environmental impact in support of the plastics circular economy. The document specifically addresses label films made with HDPE or PP that are expected to float in water and can be cleanly separated in the recycle process from PET bottle flake that sinks in water. (Floating labels films reflect what is in commercial use today.)

Pressure sensitive labels compatible with PET recycling have been developed that allow the label film, inks and adhesive to have negligible, if any, impact on the quality or productivity of PET recycling. Such pressure sensitive labels are in regular commercial use today in the PET beverage segment. The quality of recycled PET can be improved—to the benefit of all recycling and sustainability stakeholders—when recycling compatible labels become the standard for the entire PET packaging industry.

The resources described herein can be helpful to each segment of the package supply chain:

- Consumer brands can learn what comprises a recycling compatible pressure sensitive label, and inform their label suppliers that they expect such technologies be offered to them;
- Label suppliers can assure brands that their products meet recyclability guidance by performing APR Test Methods to demonstrate this;
- Converters and manufacturers who want to lead the industry in sustainability can use APR pressure sensitive label design guidance to develop and commercialize innovations that will benefit the entire packaging industry.

This document is written to complement the APR Design® Guide for Plastics Recyclability by consolidating key pressure sensitive label guidance: https://plasticsrecycling.org/apr-design-guide/apr-design-guide-home

The APR offers programs, such as Critical Guidance Recognition, that distinguish innovations that are demonstrated to be compatible with recycling: https://plasticsrecycling.org/recognition/programs

This document contains four sections:

1. A brief review of pressure sensitive label selection criteria and potential impacts on PET recycling.
2. A listing of companies and trade associations with experience in labels and PET recycling that can help source pressure sensitive labels that are compatible with PET recycling.

3. A model specification that may be used as a starting point for buyers and sellers to specify a pressure sensitive label that is compatible with PET recycling.
4. Frequently asked questions concerning pressure sensitive labels and PET recycling

Brief Review of Pressure Sensitive Label Criteria and Potential Impacts on PET Container Recycling

To be compatible with PET recycling, pressure sensitive labels should be designed to allow the following performance characteristics.

1. ***PET containers must be sorted correctly to be recycled***
   In a first step when PET containers are recycled, automated sorting equipment is used that employs optical methods, as well as metals detection. Pressure sensitive labels are usually not expected to impact these sorting steps, but it is possible that labels with large surface area coverage of a bottle sidewall may prevent accurate optical sortation. Labels with foils or metalized layers can be ejected by metals detectors. Packages not sorted accurately are lost from the recycling stream, generally to waste streams.

2. ***Labels and adhesives must separate cleanly from ground PET bottle flake in the recycling wash process and not leave residue***
   After sortation, PET containers are granulated and the resulting granulate, also referred to as flake, is washed in hot water with caustic and detergent. The adhesive and label film must be designed to separate from the PET in this wash step. Although not currently specified in Critical Guidance, it is desirable for the adhesive to stick to the label and not become free in the wash solution. If the adhesive and label do not separate from the PET flake, they will become a source of contamination in the recycled PET, creating color and haze.

3. ***It is desirable that the printed label along with adhesive residue float together in water***
   Critical guidance requires that floating label materials separate from the PET flake that sinks in water in a float-sink tank. Although not currently specified in Critical Guidance, it is desirable that inks remain adhered to the label and do not contaminate the wash water. If freed from the label substrate, inks may redeposit onto the PET flakes and cause discoloration. When wash water is contaminated with ink, there is the need for more make-up water, heat energy, and waste disposal cost.

The APR offers a range of tests that can be used to confirm that labels are designed to sort accurately, separate from PET in the wash step, and are otherwise compatible with PET recycling. Those that supply labels and are familiar with PET recycling will already have test data and experience to demonstrate the recycle compatibility of label products. Those that have received APR Critical Guidance Recognition have employed a rigorous laboratory procedure to demonstrate that their label product is compatible with recycling.

Following are resources that can be contacted to help supply pressure sensitive labels with good recycling compatibility for all PET packaging applications.

APR Design® Guide Label Supply Resources

The companies listed below are APR member companies and/or companies that have engaged in the APR Critical Guidance Recognition Program to demonstrate a product that is compatible with PET recycling. The contact information given below is current as of the publication date of this document: October 2019. Additional information for those APR member companies may be found in the APR Member Directory: https://plasticsrecycling.org/membership/members-profiles. The APR encourages the use of any label supplier that offers test data to support the recycling compatibility of its labels.

Pressure sensitive film label converters — These are companies that supply finished printed labels that have employed APR's *Critical Guidance Protocol for Clear PET Articles with Labels and Closures* to demonstrate that their printed labels are compatible with PET recycling, or can supply labels using APR Recognized unprinted labels:

- Brook & Whittle – Andy Sharp; asharp@bwhittle.com; (716) 830-9402
- CCL – Alexandra Joesten; ajoesten@cclind.com; (609) 443 3700
- Kennedy Group – Chris Rini; crini@kennedygrp.com; (216) 906-6633
- Multi-Color Corp – Matthew Thomas; Matthew.Thomas@mcclabel.com; (402) 973-8018

Suppliers of un-printed pressure sensitive substrate films that offer APR Recognized labels – These un-printed labels have employed APR's *Critical Guidance Protocol for Clear PET Articles with Labels and Closures* to demonstrate that the unprinted labels are compatible with PET recycling:

- Avery Dennison – Tim Bohlke; timothy.bohlke@averydennison.com; (440) 520-8527
- UPM Raflatac – Kyle Strenski; kyle.strenski@upmraflatac.com; (513) 313-4782

Independent consulting companies that can conduct testing

These are independent consultants and laboratories that are experts in PET recycling and testing. These companies can help evaluate new label offerings:

- Plastic Forming Enterprises – Kristi Hansen; khansen@plasticsforming.com; (603) 668-7551
- Plastic Technologies Inc – Wei Zhang; w.zhang@pti-usa.com; (419) 867-5402

Trade association contacts

- The Association of Plastic Recyclers – Please refer first to the APR Design® Guide for Plastics Recycling: https://plasticsrecycling.org/apr-design-guide/apr-design-guide-home
- TLMI – Many label converters in North America belong to this organization; TLMI can help communicate steps its members can take to supply recycle compatible labels for PET packaging. Primary contact: Rosalyn Bandy, Rosalyn.Bandy@tlmi.com; (513) 401-9578

Model Specification
Film Pressure Sensitive Labels on PET Containers

Introduction

The APR has prepared this Model Specification to promote awareness and discussion of the characteristics of pressure sensitive labels that are expected to be compatible with PET recycling. This Model is not intended to replace detailed specifications agreed to between individual buyers and sellers of labels, and that may include requirements that extend beyond the guidance provided in this Model.

The Model Specification presents:

1. A guidance table describing the most important characteristics that must be demonstrated for the labeled container to provide a preferred level of performance with negligible impact on the quality and productivity of PET recycling. Those committed to a plastics circular economy will want to consider this level of performance.
2. Minimum guidance for a labeled container. (If a labeled PET container meets minimum guidance, it is likely to pass into the PET recycling stream, however the label, adhesive or inks may contribute detrimental impacts on the recycled PET.)
3. Alternate next best steps that can be taken should the preferred level not yet be possible.

APR Guidance for a Pressure Sensitive Label to be "APR Preferred"

With today's emphasis on developing the circular economy for plastics, packages that are compatible with widely used recycling processes and have negligible impact, if any, on the quality and productivity of PET recycling are considered APR Preferred. The following table presents the characteristics of a preferred pressure sensitive label:

Performance element	Test	APR Guidance	Impact
NIR optical sortation	Evaluation of the Near Infrared (NIR) Sorting Potential of a Whole Plastic Article, Sort-B-01	Meets preferred criteria	Provides support that labeled bottles can be positively identified as PET at a Materials Recovery Facility.
Metals detection (only if a label employs a metalized film or foil)	Evaluation of Sorting Potential for Plastic Articles Utilizing Metal, Metalized, or Metallic Printed Components, Sort B-03	Meets preferred criteria	Provides support that labels with metalized films or foils will not be ejected from the recycle stream by a metal detector.
Impact of the label film and adhesive on recycling	Critical Guidance Protocol for Clear PET Articles with Labels and Closures, PET-CG-02	Meets guidance criteria, or is an APR Recognized Product	Label and adhesive can be separated from PET in a float/sink step.
Table continues on next page			

Performance element	Test	APR Guidance	Impact
Impact of printed ink and label film on recycling	Critical Guidance Protocol for Clear PET Articles with Labels and Closures, PET-CG-02 or Benchmark Test for Clear PET Articles with Labels and Closures, PET-B-02	Meets guidance criteria, and/or is an APR recognized innovation Ink meets guidance criteria	Testing confirms that label film and adhesive materials separate cleanly from the PET flake, and that ink & adhesive from printed labels does not impact PET color. It is desirable that the ink and the adhesive remain adhered to the label so that ink does not contaminate wash water and adhesive does not cause flake discoloration or haze.
Color sortation at a PET reclaimer	None available today; see additional information immediately below	Surface area coverage with closure on container allows detection of clear PET containers	Label coverage expected to regularly allow a container to be identified as clear PET and included in the PET stream.

Additional information on color sortation

When clear PET bottles that have pressure sensitive labels that employ APR Recognized film substrates and tested inks pass through a color sorter, it is desirable that the color sorter be able to detect the clear PET bottle beneath the film. For this to happen, there generally must be some level of clear PET exposed that is not covered by a printed label, or an attached closure and tamper band. This is usually the case for pressure sensitive labels and PET reclaimers have not reported regular problems with pressure sensitive labels and color sorting. However, this may be a concern in rare cases where a label has high surface coverage with high ink coverage on the label.

It is not possible for the APR to give quantitative guidance, nor a standard test method, on this color sort topic today. The reasons include:

- There are several different suppliers of color sortation equipment that each have different designs and capabilities. The performance characteristics of color sortation equipment can be adjusted by individual PET reclaimers depending upon their objective and preferences.
- Sortation equipment performance can be influenced by the ink colors used on the label.
- The evaluation can be influenced by factors such as the size of the bottle, its orientation on a conveyor belt, and whether the bottle is flattened or folded over.

That said, listed below are resources that can be utilized to confirm a label has the potential to allow detection of a clear PET bottle in the color sort step:

- Label converters that are engaged in providing recycling solutions either have prior experience, or the network that can be used to obtain evaluations.
- Companies that manufacture color sortation equipment have demonstration laboratories where containers with labels can be tested.
- Work previously completed by an APR Working Group, on demonstration equipment with a single serve container size, resulted in data indicating that color sorters can be effective when about 20% of the PET bottle side wall and shoulder surface area is not covered with label. The area of the base and finish above the neck ring is not included in the area evaluation.
- PET reclaimers that are APR members are often able to help do evaluations of new container designs using their production equipment and provide feedback to package and label developers.
- If there is prior experience indicating good color sorting performance, that prior experience can be used to inform label coverage in a new application.

An APR Working Group is currently conducting new work in this area, the results of which will be reported when available.

Interim actions if APR Preferred label performance is not yet achievable in a specific application

APR acknowledges that companies may need time to change their specifications or develop innovations to allow the use of APR Preferred label technology. In the meantime, APR provides alternate, next best, actions that will reduce the risk of a pressure sensitive label impacting recycling.

A labeled PET container must first move correctly through the PET sortation and metal detection steps at the front of the process so as not be diverted to a waste stream and not recovered.

1. The labeled container must pass the Evaluation of the Near Infrared (NIR) Sorting Potential of a Whole Plastic Article, Sort-B-01, to confirm that containers with labels have the potential to be positively sorted at a Materials Recovery Facility (MRF) into PET bales for recycling.
2. A labeled container that employs a metalized film or foil must pass the Evaluation of Sorting Potential for Plastic Articles Utilizing Metal, Metalized, or Metallic Printed Components Test, Sort-B-03, to confirm that the foils or metalized film do not prevent containers from being positively sorted into PET bales for recycling. (Metal films are typically vapor-deposited and dissolve in the caustic wash during the PET reclamation process. Metal foils on labels that are ground with PET containers are detrimental to PET recycling.)

After ensuring correct sortation, additional interim steps that can be taken include:

1. Employ an unprinted label substrate that has received APR Critical Guidance Recognition.
2. Employ the PET Packaging Component Sink or Float Evaluation, PET-S-05 to confirm that the intended commercially printed label floats and that the presence of inks used in the commercial graphics do not cause the label to sink.
3. Employ the Critical Guidance Protocol for Clear PET Articles with Labels and Closures, PET-CG-02, or the Benchmark Test for Clear PET Articles with Labels and Closures, PET-B-02, to show that the ink does not discolor flake in cases where the ink is removed from the label in the wash step.

Frequently Asked Questions addressing testing and selection of pressure sensitive labels for PET containers

1. ***Why does this model specification emphasize "floating" labels in the text and description?***
   PET recyclers value labels that float in water which can be cleanly separated from PET that sinks in water in a float/sink process step. Pressure sensitive labels intended to float in water are most commonly employed. Some label developers have proposed using label films that sink in water; a sinking label may be offered in the market one day, but will require a different specification than that of floating labels.

2. ***What factors impact the ability of a PET container with a pressure sensitive label to be sorted as PET by near infrared optical sorters?***
   The vast majority of pressure sensitive labels that only cover a portion of the surface area of a container will not create any problem at all for NIR sortation. Cases where a label might interfere with NIR sortation include:
   - Complete coverage of the bottle side wall where the PP or HDPE label film attenuates the NIR spectrum for the PET container. Thicker label films or ink coverage may contribute to attenuation of the PET spectrum.
   - Complete coverage of the side wall when very opaque or dark colored inks are used that attenuate the NIR spectrum and prevent detection of the PET container.
   - Use of metalized films which are highly reflective of NIR light and may prevent detection of the PET container.

3. ***How can thin metal films or foils impact metals detection?***
   Metal detectors used for plastics recycling are like those used in airport security that detect, for example, when you have a foil gum wrapper in your pocket. The mass of the metal object influences the detector, but so too does the surface area of any metal component. When metal films on labels have a high surface area, they can look like a heavy metal object in a metal detector and trigger a rejection.

4. ***Can the tests recommended in this document rely on labels printed with "generic ink" test data, or should the actual intended printed commercial label be tested?***
   Least risk of a label causing a problem in commercial use will result when actual commercial labels are tested. Some specific concerns known from industry experience that need to be managed:
   a. Substantially black or dark colored labels interfere with NIR sortation. APR recommends the Evaluation of the Near Infrared (NIR) Sorting Potential of a Whole Plastic Article, SORT-B-01, to confirm label performance.
   b. Labels printed with layers of white ink may cause a label, intended to float in water, to sink instead. APR recommends use of the PET Packaging Component Sink or Float Evaluation, PET-S-05.
   c. The Benchmark Test for Clear PET Articles with Labels and Closures, PET-B-02 can be used to confirm overall label performance.

That said, prior successful experience with defined inks can eliminate the need for testing of all label designs.

5. ***What happens to printing ink on labels when PET is recycled?***
   Pressure sensitive labels with excellent ink adhesion in recycling wash water are in wide commercial use and thus are the most desirable option for today's floating pressure sensitive labels. The tests listed above are intended to encourage the use of pressure sensitive label inks that remain adhered to the label and that do not wash off into wash water. Those specifying pressure sensitive labels should be aware that inks in wash water are not desirable and can create the need for more make-up water, wash water heat energy, filtration maintenance, detergent, and wastewater treatment costs.

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