



The APR Design® Guide for Plastics Recycling Guidance Addendum for PET Packaging

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New Guidance impacting PET packaging has been recently approved for inclusion in the APR Design® Guide for Plastics Recycling. This new guidance is shown below and is available for immediate use. There are four sections presented below:

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Design Guide section title:

PET base resin

Additional information - Clear PET is valued for its high transparency and colorless appearance; clear PET has the most value for recycling. The APR does not have quantitative guidance on color values for PET base resin today. But we do encourage those that specify PET resins to work with their suppliers to identify the best resins available that will result in low color in an initial application, and then have good color stability when the PET is recycled.

Preferred guidance

Base resin used to make injection stretch blow molded containers

- Melting point between 225 °C and 255 °C

Additional information - Determined by DSC and ASTM D3418-15 with heating rate of 10 °C / minute on second melt after 1st melt rapid quench to create amorphous material.

- Intrinsic viscosity (IV) between 0.72 and 0.90 dL/g, with higher values being more desirable for PET recycling.

Additional information - Acceptable test method: ASTM D 4603 solution IV with phenol/tetra-chlor-ethane at 30 °C with values to be converted into intrinsic viscosity according to section 11.2 using the Billmeyer equation

- The terephthalic acid or dimethyl terephthalate and monoethylene glycol reacted constitutes at least 90 percent of the mass of the monomer reacted to form the polymer.

Additional information - Bis(2-hydroxyethyl) terephthalate, or BHET, is a solid crystalline compound that can be used as a starting material to produce PET, but it is not in wide commercial use. When terephthalic acid reacts with ethylene glycol, BHET is an intermediate that forms early in PET manufacture. Further, BHET is a reaction product that is recovered from glycolysis of chemically recycled PET.

PET co-polymers made with BHET can meet this composition requirement. To evaluate, simply convert the BHET employed to the equivalent starting mass of terephthalic acid and ethylene glycol.

- Any use of recycled resins will meet the above criteria.



- Purified monomers used to produce PET can be derived from petroleum, renewable sources or from chemically recycled waste PET.

Preferred resins for extrusion blow molding applications

- Preferred resins will meet the testing criteria given in PET-CG-01

Preferred resin for thermoforms

- PET resins employed for thermoforms should meet the melting point and monomer composition requirements outlined for injection stretch blow molding applications. To benefit PET recycling, thermoform resins should be as high in IV as possible.

Requires testing or prior test data for categorization

- Blends of PET with other polymers intended to improve package performance, or PET co-polymer compositions that are not described above.

Additional information - Blends might be employed with making the initial package. Blends might also result when multi-layer structures are recycled, and a layer or coating used to make a package becomes blended into the recycled PET. APR recommends use of PET-CG-01 to evaluate impact of blends or new co-polymers on PET recycling. Applications Guidance is recommended to assess potential for impact on end uses of recycled PET. Should a composition impact the NIR spectrum of the package, Sort-B-01 is necessary.



Design Guide section title:

Closures, fitments, liners, and safety seals

Preferred guidance

Primary material employed to make a closure shell and liner

- Preferred closures will be entirely plastic and can be made with: PP, HDPE, LDPE, PE copolymers including TPO's and EVA, TPE elastomers.

Additional information - Here is additional detail on preferred materials that may be used for closure shells and liners.

- Polypropylene – including copolymers with ethylene, impact modified grades, nucleated or clarified grades.
 - Ethylene polymers and copolymers including EVA copolymers and ionomers.
 - Thermoplastic elastomers based on olefinic constituents. The more common elastomers are ethylene and/or propylene based plastomers/elastomers as well as olefin block copolymers including SEBS.
 - Foamed olefin-based materials.
- Closures will also entirely float in water after granulation.

Additional information - PET-S-05 can be employed to evaluate floating performance of closures and liners.

Dispensing closures and fitments

- Preferred criteria for closures shells and liners given immediately above also apply to dispensing closures and fitments used for PET containers.

Additional information - Examples of dispensing closures are those on condiment bottles that may employ a valve, or multi-component closures on sport drink bottles.

Safety seals for closures

- Closures with tamper proof features are Preferred when materials described for closure shells and liners are employed.



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Additional information - Tamper proof features include features such as bands, tapes, induction or heat seals, pull-tabs, or shrink film where at least some, or all, of the tamper evidence material might remain on the PET container after consumer use.

Safety/tamper evident features that are designed to be completely removed and discarded by a consumer prior to opening the package and are shown to perform as intended in actual use, may be made with any material.

Detrimental

Closure liners and safety seals that are composites of aluminum foil and paper

Additional information - These materials will contaminate wash water, will contribute to waste disposal costs, or will stick to the saleable closure material or valuable PET and reduce quality and value of the final products.

Closures, seals, and shrink film safety sleeves made of polymers with density > 1.0 g/cm³

Additional information - Polystyrene, silicone, nylon, acetal, and thermoset plastics are plastics that are expected to sink in the float-sink tank with PET and be detrimental to PET recycling. Sinking plastics are not removed from PET, thereby causing contamination in the final product.

Requires testing for categorization

Closures with metal components

Additional information - Some metal components may be of sufficient size to either cause rejection at a metal detector, or steel closures may cause a package to be removed by a magnet. In these cases, the package is sent to a waste stream and not recycled.

If a metal closure does not impact metal detectors or magnets, it is categorized as detrimental because metals sink with the PET and are difficult to remove from the washed PET flake.

Any closure or dispenser design not within the scope of information provided above.



Design Guide section title:

Labels, inks, and adhesives

Additional information - This section speaks to design of labels, inks and adhesives employed with PET packaging. To be categorized as Preferred, a finished label must meet both these criteria:

1. The printed label will not interfere with automated sorting steps.
2. The printed label (Inks and adhesives) will not interfere with the quality and quantity of the recycled PET.

Preferred guidance

Automated sorting performance criteria

- For containers with a brimful volume of 550 ml or less, the surface area coverage of the label is no more than 55%, and no metal decoration is employed on the label.

Additional information - Surface area is defined as the area of the label divided by the area of the side wall and shoulder of the container. The area of the neck ring, threaded finish and base are not included in the area calculation. Metal decoration includes vapor deposited metal films, metal foils, or inks with metallic pigments.

Containers with no more than 55% surface area coverage by a label are expected to sort accurately in both NIR and color optical sorters. Labels with metal decoration can be tested for any impact on sorting performance using SORT-B-03.

Since labels for PET packaging most often become a waste stream, APR encourages labels that are as small in surface area and weight as possible.

- For containers with a brimful volume of over 550 ml, the surface area coverage is no more than 75%, and no metal decoration is employed on the label.

Additional information - Surface area is defined as the area of the label divided by the area of the side wall and shoulder of the container. The area of the neck ring, threaded finish and base are not included in the area calculation. Metal decoration includes vapor deposited metal films, metal foils, or inks with metallic pigments.

Containers with no more than 75% surface area coverage by a label are expected to sort accurately in both NIR and color optical sorters. Labels with metal decoration can be tested for any impact on sorting performance using SORT-B-03.

Since labels for PET packaging most often become a waste stream, APR encourages labels that are as small in surface area and weight as possible.

- When higher surface area coverage than detailed above is employed, a label can be categorized as Preferred when meeting guidance criteria of SORT-B-04 for color, as well as SORT-B-01 for NIR detection of the PET container.

Additional information - Labels with high surface area coverage may interfere with detection of the PET container. The label substrate (film or paper), inks, and metal decoration can interfere with NIR detection when the label covers a high surface area of the container. Also, high label surface area coverage may cause a clear PET bottle to be sorted as a colored bottle in a color sorter.

- When metal decoration is employed, a label can be categorized as Preferred with respect to sorting performance only when the metal detection criteria presented in SORT-B-03 are met.

Additional information - A label can be categorized as Preferred with respect to sorting performance when the metal detection criteria presented in APR-SORT-PR-02 are met. A summary of the starting points for spherical equivalent and maximum surface area coverage by decoration technology are shown in the tables below. Any label coverage below the Preferred surface coverages listed would be considered to be Preferred (for metal sortation). Any packages that have surface areas above these starting points would need to be tested using SORT-B-03 to verify they are below the spherical equivalent thresholds. Without further testing, metal foils with surface areas above the starting points in the table are categorized as detrimental due to a higher probability of being removed by the metal detector during sortation. Solid foils will continue to render the package non-recyclable per APR's definition.

SPHERICAL EQUIVALENT (B)					
PET Rigid Article					Applicable APR Recyclability Category for "NIR Sorting Potential" (see category definitions In APR Design Guide for Plastics Recyclability Home Page)
Rigid metal or Attachment	Solid Foils	Metallized Transfer Product	Filmic Metalized Label	Metallic Ink	
0 - 2 mm		0 - 8 mm	0 - 8 mm	0 - 8 mm	APR Design Guide Preferred
> 2 - < 16 mm		8.1 - 15.9 mm	8.1 - 15.9 mm	8.1 - 15.9 mm	Detrimental to Recycling
≥ 16 mm	All	≥ 16 mm	≥ 16 mm	≥ 16 mm	Renders Package non-Recyclable per APR Definition



PET Rigid Article				
	Solid Foils	Metallized Transfer Product	Filmic Metalized Label	Metallic Ink
Preferred Surface Area	N/A	310 cm ² (48 in ²)	194 cm ² (30 in ²)	310 cm ² (48 in ²)

Printed label films that are intended to float in water

- Labels will employ hot caustic resistant inks designed to be compatible with PET recycling, and float in water.

Additional information - Hot caustic resistant ink is defined by the Design Guide to be an ink specifically developed for labels employed for PET packaging and meet the guidance criteria in either PET-B-02 or PET-CG-02. APR recommends that the information in our Product Stewardship Statement be taken into consideration when developing/approving inks for PET packaging.

Adhesives employed with the label film are those specifically developed to wash cleanly from the package, not impact the color of recycled PET, and meet the testing criteria of PET-CG-02.

Today, the only test available for confirming that an adhesive can be categorized as Preferred in PET-CG-02. QT-504 is a screening test published by EPBP, and PET-B-02 is a less complex test that can be used to pick “better” adhesives before conducting PET-CG-02. APR recommends that the information in our Product Stewardship Statement be taken into consideration when developing/approving adhesives for PET packaging.

In the specific case of pressure sensitive film adhesives, the adhesive will adhere to the label and the label film with ink and adhesive floats in water.

Shrink sleeve and other label films that sink in water

- Un-printed label films that meet the guidance criteria of PET-CG-02 for shrink sleeve labels.

Additional information - Printed label films that employ wash-off inks designed for use on crystallizing co-polyester label films and meet the criteria of either PET-B-02 or PET-CG-02.

The APR Design Guide defines wash-off inks to be those specifically designed for higher density “sinking” label films where the ink washes off in particles and is shown to meet guidance criteria of PET-B-02 or PET-CG-02. Wash off inks are expected to be used on co-polyester films that show crystallizing behavior and so do not cause the “clumping”



caused by amorphous PETG films. APR recommends that the information in our Product Stewardship Statement be taken into consideration when developing/approving inks for PET packaging.

- Olefin films with ink that sink in water can be Preferred providing the ink is a wash-off ink that allows the label film to float after exposure to hot caustic wash solution and when the ink meets the criteria of either PET-B-02 or PET-CG-02.

Labels and decoration printed directly onto a PET package

- Printing employs wash-off inks designed for use for printing directly on the surface of polyester packaging.

Additional information - Inks will meet criteria of PET-B-02 or PET-CG-02.

Design Guide section title:

Additives

Brief description of the section: This section speaks to the use of degradable additives in PET containers.

Please refer to APR's Position on Degradable Additives Used in Plastic Bottles, Thermoforms, and Films.

DOCUMENT VERSION HISTORY

Version	Publication Date	Revision notes
1	10-20-2022	Creation of document.
2	03-24-2023	Updated metallization, additives, and units.
3	05-22-2023	Added spherical guidance table and corrected capitalization.