



The APR Design® Guide for Plastics Recyclability is the most comprehensive resource outlining the plastics recycling industry’s recommendations in the marketplace today. The content is regularly updated to ensure APR’s Recyclability Categories represent today’s North American plastics recycling infrastructure. Although it is designed as an online resource, with links to all relevant information, a PDF of the complete document can be downloaded as well.

The APR Design® Guide specifically addresses plastic packaging, but the principles can be applied to all potentially recycled plastic items.

APR encourages package designers to utilize The APR Critical Guidance and Responsible Innovation programs, as well as the APR Design® Guide to create the most recyclable packaging. Assistance is available through APR or one of the APR member, independent laboratories found in the member directory.

The intended audience for the APR Design® Guide for Plastics Recyclability is the package design engineer for use in designing packaging that complies with the capabilities of the recycling infrastructure. Before accessing the APR Design® Guide for Plastics Recyclability the user should thoroughly understand the fundamentals of its concept as described in the scope, definition of recyclability and recyclability categories outlined below.

SCOPE

This guide covers plastic items entering the postconsumer collection and recycling systems most widely used in industry today. Collection methods include single stream and dual stream MRF’s, deposit container systems, mixed waste facilities, and grocery store rigid plastic and film collection systems. The impact of package design on automated sortation process steps employed in a single stream MRF, as well as high volume recycling processes is of primary consideration. Items recovered in recovery systems where they are source-selected and sent to a recycler specializing in this particular item are specifically excluded from this guide.

APR’s DEFINITION OF RECYCLABLE

An item is “recyclable per APR definition” when the following three conditions are met:

- At least 60% of consumers or communities have access to a collection system that accepts the item.
- The item is most likely sorted correctly into a market-ready bale of a particular plastic meeting industry standard specifications, through commonly used material recovery systems, including single-stream and dual stream MRFs, PRF’s, systems that handle deposit system containers, grocery store rigid plastic and film collection systems.
- The item can be further processed through a typical recycling process cost effectively into a postconsumer plastic feedstock suitable for use in identifiable new products.

PET PACKAGING

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APR's RECYCLABILITY CATEGORIES

The APR Design® Guide is itemized by design features commonly used with packaging applications. The recycling impact of each design feature is discussed within the Guide. The APR's guidance on the design feature is developed considering this impact and broken down into four categories which should be thoroughly understood:

- **APR DESIGN GUIDE® PREFERRED:** Features readily accepted by MRFs 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. Packages with these features are likely to pass through the recycling process into the most appropriate material stream with the potential of producing high quality material.
- **DETRIMENTAL TO RECYCLING:** Features that present known technical challenges for the MRF or recycler's yield, productivity, or final product quality but are grudgingly tolerated and accepted by the majority of MRFs and recyclers.
- **RENDERS PACKAGE NON-RECYCLABLE PER APR DEFINITION:** Features with a significant adverse technical impact on the MRF or recycler's yield, productivity or final product quality. The majority of MRFs or recyclers cannot remove these features to the degree required to generate a marketable end product.
- **REQUIRES TESTING:** In order to determine compatibility with recycling, testing per an APR testing protocol is required.

DISCLAIMER

This document has been prepared by the Association of Plastic Recyclers as a service to the plastic industry to promote the most efficient use of the nation's plastic recycling infrastructure and to enhance the quality and quantity of recycled postconsumer plastic. The information in this document is offered without warranty of any kind, either expressed or implied, including WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, which are expressly disclaimed. APR and its members accept no responsibility for any harm or damages arising from the use of or reliance upon this information by any party. Participation in the Recognition Program is purely voluntary and does not guarantee compliance with any U.S. law or regulation or that a package or plastic article incorporating the innovation is recyclable or will be recycled.

APR Design® Guide for Plastics Recyclability for PET (Polyethylene Terephthalate, Resin Identification Code #1)

Due to its clarity and natural CO₂ barrier properties, PET is one of the most widely used packaging resins. It is easily blown into a bottle or formed into a sheet, thereby becoming the resin of choice for many applications. PET does not normally have the desired properties for closures, handles, attachments or labels so other polymers are commonly used for these items and affixed to the PET package. PET properties can be enhanced with colorants, UV blockers, oxygen barriers/scavengers and other additives. Each modification and addition to the base, clear PET in a package must be considered for its effect on the recycling stream. Items should either be economically removed from the PET in the typical recycling process or be compatible with RPET in future uses. The density of PET is 1.38 and so it sinks in water. Closures, labels and attachments should be made from materials with a density less than 1.0 that will float in water and therefore be readily separated from the PET.

The APR's Recognition Program encourages consumer product, plastic package and bottle component manufacturers to work with the APR protocols to determine whether new modifications to a regularly recycled plastic package will negatively impact the recycling process prior to introducing the modification.

FEATURE	RECYCLABILITY CATEGORIES				TEST	
	APR DESIGN® GUIDE PREFERRED	REQUIRES TESTING	DETRIMENTAL TO RECYCLING	RENTERS PACKAGE NON-RECYCLABLE PER APR DEFINITION	SCREENING/BENCHMARK TEST (indicative only - see definition of Screening and Benchmark tests)	DEFINITIVE TEST
BASE POLYMER:						
PET with a crystalline melting point between 225-245°C	X					
Post consumer RPET content	X					
Blends of PET and other resins		X				Critical Guidance Protocol for Clear PET Resins and Molded Articles
BARRIER LAYERS, COATINGS & ADDITIVES						
Non-PET layers and coatings		X			PET Heat History and Discoloration Evaluation	Critical Guidance Protocol for Clear PET Resins and Molded Articles
Degradable additives		X			PET Degradable Additives Test	
Additives		X			PET Heat History and Discoloration Evaluation	Critical Guidance Protocol for Clear PET Resins and Molded Articles
Optical brighteners			X			
COLOR						
Clear unpigmented	X					
Transparent light blue	X					
Transparent green	X					
Transparent colors other than green and light blue			X			
Translucent and opaque colors including white			X			
Nucleating agents, hazing agents, fluoescers, and other additives for visual and technical effects			X			
Dark color with an L value < 40 or NIR reflectance <=10%		X			Evaluation of the Near Infrared (NIR) Sorting Potential of a Whole Plastic Article	
DIMENSIONS						
More 2 dimensional than 3 dimensional (one dimension <2")				X		
2 dimensions less than 2"		X			Evaluation of Size Sorting Potential for Articles with at Least 2 Dimensions Less Than 2"	
Greater than 2 gallons in volume			X			
CLOSURES AND DISPENSERS						
Polypropylene or Polyethylene	X					
Closure systems without liners	X					
EVA and TPE liners in plastic closures	X					
Metal parts and foils		X			Evaluation of Sorting Potential for Plastic Articles Utilizing Metal, Metalized or Metallic Printed Components	Critical Guidance Protocol for Clear PET Articles with Labels and Closures
Polystyrene or thermoset plastics			X			
Silicone polymer parts			X			
PVC				X		

FEATURE	RECYCLABILITY CATEGORIES				TEST	
	APR DESIGN® GUIDE PREFERRED	REQUIRES TESTING	DETRIMENTAL TO RECYCLING	RENDERS PACKAGE NON-RECYCLABLE PER APR DEFINITION	SCREENING/BENCHMARK TEST (indicative only - see definition of Screening and Benchmark tests)	DEFINITIVE TEST
LABELS INKS AND ADHESIVES						
PP or PE with specific gravity less than 1.0	X					
Full bottle sleeve labels		X				Critical Guidance Protocol for Clear PET Articles with Labels and Closures
Pressure sensitive labels		X			Benchmark Test for Clear PET Articles with Labels and Closures	Critical Guidance Protocol for Clear PET Articles with Labels and Closures
Polystyrene labels		X			PET Packaging Component Sink or Float Evaluation	
Label systems that sink in water because of substrate, inks, decoration, coatings, and top layer		X				Critical Guidance Protocol for Clear PET Articles with Labels and Closures
Paper labels (for pressure sensitive use pressure sensitive category)			X			
Metal foil, metalized or metallic printed labels		X			Evaluation of Sorting Potential for Plastic Articles Utilizing Metal, Metalized or Metallic Printed Components	
PVC and PLA labels				X		
ADHESIVES						
Non-water soluble/dispersible adhesives			X			
Inks		X			Benchmark Test for Clear PET Articles with Labels and Closures	See appropriate test for label type
Direct printing other than date coding		X			Benchmark Test for Clear PET Articles with Labels and Closures	Critical Guidance Protocol for Clear PET Articles with Labels and Closures
ATTACHMENTS						
Clear PET	X					
Tamper evident sleeves and safety seals		X			PET Packaging Component Sink or Float Evaluation	Critical Guidance Protocol for Clear PET Articles with Labels and Closures
Non-PET attachments		X			PET Packaging Component Sink or Float Evaluation	Critical Guidance Protocol for Clear PET Articles with Labels and Closures
Metal and metal containing		X			Evaluation of Sorting Potential for Plastic Articles Utilizing Metal, Metalized or Metallic Printed Components	
Paper			X			
Welded attachments			X			
RFID's			X			
PVC and PLA				X		

BASE POLYMER

PET and PET variants resins which have a crystalline melting point between 225 and 255C are preferred. Materials of a lower melt point or non-crystalline materials often become sticky in the reclaimers' pre-extrusion dryer when the dryer is operated at PET temperatures and prevent the material from flowing through the process. Materials of a higher melt point remain solid in the reclaimers' extruder and cause blockages in melt screens. Both conditions greatly hinder the ability of the reclaimer to operate.

Blends of PET and other resins require testing to determine the appropriate APR recyclability category. Other resins may be blended into the PET to enhance certain properties during the package's intended first use. The

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materials' effect on the RPET in future uses must be evaluated since it will not be removed in the recycling system.

Definitive Test: [*Critical Guidance Protocol for Clear PET Resins and Molded Articles \(PET-CG-01\)*](#)

BARRIER LAYERS, COATINGS & ADDITIVES

Non-PET layers and coatings require testing to determine the appropriate APR recyclability category.

The use of non-PET layers and coatings can be detrimental to recycling of PET if not implemented according to APR test protocols. Layers and coatings must either separate and be removed from the PET in the recycling process or have no adverse effects on the RPET in future uses. When used, their content should be minimized to the greatest extent possible to maximize PET yield, limit potential contamination, and reduce separation costs. Some layers and coatings have been found compatible with PET or are easily separated in conventional recycling systems.

Screening Test: [*PET Heat History and Discoloration Evaluation \(PET-S-03\)*](#)

Definitive Test: [*Critical Guidance Protocol for Clear PET Resins and Molded Articles \(PET-CG-01\)*](#)

Degradable additives (photo, oxo, or bio) require testing to determine the appropriate APR recyclability category. Recycled PET is intended to be used in new products. The new products are engineered to meet particular quality and durability standards given properties of typical recycled PET. Additives designed to degrade the polymer diminish the life of the material in the primary use. If not removed in the recycling process, these additives shorten the useful life of the product made from the RPET as well, possibly compromising quality and durability.

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 RPET that includes the additive. These additives must either separate and be removed from the PET in the recycling process or have no adverse effects on the RPET in future uses. When used, their content should be minimized to the greatest extent possible to maximize PET yield, limit potential contamination, and reduce separation costs.

Screening Test: [*PET Degradable Additives Test \(PET-S-06\)*](#)

Additives require testing to determine the appropriate APR recyclability category.

The APR recognizes that other types of additives may be required for the performance of a particular package but are not addressed in this document. Additives such as de-nesting, anti-static, anti-blocking, anti-fogging, anti-slip, UV barrier, stabilizer and heat receptor agents and lubricants should be tested to determine their compatibility with recycling. Of particular concern are additives which cause the RPET to discolor or haze after remelting or solid stating since RPET with poor haze or discoloration is greatly devalued and has limited markets. This is particularly troublesome since it is difficult to identify material with this effect until extremely late in the recycling process where a great deal of added cost has been imparted into the material.

Screening Test: [*PET Heat History and Discoloration Evaluation \(PET-S-03\)*](#)

Definitive Test: [*Critical Guidance Protocol for Clear PET Resins and Molded Articles \(PET-CG-01\)*](#)

Optical brighteners are detrimental to recycling.

Like many other additives, optical brighteners are not removed in the recycling process and can create an unacceptable fluorescence for next uses of RPET containing the brighteners. It is difficult to identify material with this negative effect until extremely late in the recycling process where a great deal of added cost has been imparted into a material of low value due to the additive.

COLOR

Clear unpigmented PET is preferred

Clear material has the highest value as a recycled stream since it has the widest variety of end-use applications. It is the most cost effective to process through the recycling system.

Transparent light blue packaging is preferred

Light blue material is most often included with the clear material stream to act as a bluing agent and offset some yellowing. This not only adds volume to the high value clear stream, it improves its quality when used in limited amounts. Normally it can also be added to the green stream with little negative effect.

Transparent green packaging is preferred

Green material has significant volume in the marketplace. At the MRF, it is baled along with the clear PET and may comprise up to 30% of the PET bale. The green material is separated from the clear by the original reclaimer, who may process it into a value added product, or send it to a reclaimer dedicated to green material. Its value is second only to clear material. However, green is not without its issues. Because a consistent, clear color is critical to future products using clear RPET, the recycling process includes a great deal of machinery and manpower dedicated to separating colored material. This adds significant cost to the operation. Even so, small but significant amounts of colored material, including transparent green, pass into the clear stream, thereby affecting the quality of clear RPET. Markets such as clothing, carpet, soft drink bottles and thermoformed sheet depend on very precise colors, using clear material as a basis.

Colors with an L value less than 40 or an NIR reflectance less than or equal to 10 percent require testing to determine the appropriate APR recyclability category.

NIR (near-infrared) sorting technology used in MRFs and reclaimers is not capable of identifying many dark polymers because the colorant absorbs light. Some dark shades may be detected by NIR but these must be tested to determine their sortability. Manual sorting generally cannot distinguish one dark polymer from another either. Other separation techniques such as float-sink cannot be employed since many black polymers sink with PET. Therefore, black and dark packaging is considered a contaminant for nearly all PET reclaimers.

Benchmark Test:

[Evaluation of the Near Infrared \(NIR\) Sorting Potential of a Whole Plastic Article \(SORT-B-01\)](#)

All other colors and additives creating visual effects in PET are detrimental to recycling

These colored bottles are categorized as detrimental because of their impact on bale yield loss and productivity when reclaiming clear PET containers. Most communities with curbside collection allow for collection of colored PET bottles and these are often included in bales of clear PET bottles. PET reclaimers can use color auto-sorters to remove the colored bottles from the clear stream. However, reclaimers regularly report that there is low market demand and low value for mixed color PET containers.

Reclaimers report that transparent colors can be used in applications such as bulk fiber and black sheet and are more likely to find a market application than opaque colors. Today, most reclaimers report that opaque bottles do not often find an economically viable market and so can become a waste stream.

DIMENSIONS

Size and shape are critical parameters in MRF sorting, and this must be considered in designing packages for recycling. The MRF process separates items by size and shape first, then by material. Screens direct paper, and

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similar two-dimensional lightweight items, into one stream; containers and similar three-dimensional heavier items into another stream; while broken glass and smaller but heavy items are allowed to drop by gravity to yet another stream, which may or may not be further sorted. Large, bulky items are typically manually sorted on the front of the MRF process.

Items more two-dimensional than three-dimensional render the package non-recyclable per APR definition.

Aside from not being captured in the plastic stream, they cause contamination in the paper stream. Items should have a minimum depth of two inches in order to create a three-dimensional shape for proper sorting. This issue is unrelated to the polymer type. The APR encourages and anticipates developments in MRF design and technology to improve capture and recovery of thin plastics; however, at the current time this technology either does not exist or is uninstalled in the majority of MRFs.

Items smaller than 2 inches in 2 dimensions require testing to determine the appropriate APR recyclability category.

The industry standard screen size loses materials less than two inches to a non-plastics stream, causing contamination in that stream, or directly to waste. These small packages are lost to the plastic recycling stream. It is possible that some small containers travel with larger ones when either the screens wrap with film or they are operated above their design capacity. Film wrapping reduces the effective size of the screen and over-running provides a cushion of large items on which the smaller items travel. The design guidelines use clean screens operating at their design capacity for the determination of the recyclability category. The APR anticipates and encourages technology development to improve the process of small package recovery but currently these items are not recovered.

Benchmark Test:

[Evaluation of Size Sorting Potential for Articles with at least 2 Dimensions Less than 2 Inches \(SORT-B-02\)](#)

Items greater than two gallons in volume are detrimental to recycling.

Recycling machinery, particularly automatic sorting equipment, is not large enough to accept items larger than two gallons. Because larger containers jam the systems, most MRFs employ manual sortation before the automatic line to remove the large items. These items are recovered in a stream of bulky rigid containers that are sold and processed as polyethylene since the vast majority of bulky rigid items are comprised of this polymer. Other polymers either negatively affect or are lost by the polyethylene processing.

CLOSURES & DISPENSERS

Polypropylene and polyethylene closures and components that float in water are preferred.

Since these polymers float in water, they are most easily separated from PET flake in conventional separation systems. Additionally, the PET recycling process captures floatable polyethylene and polypropylene to create an ancillary stream of marketable material. Care must be taken when modifying the polyethylene or polypropylene, with mineral fillers for example, to ensure the modifier does not increase the overall density to the point it sinks.

Silicone, polystyrene, thermoset plastics, nylon and acetal are examples of plastics that are expected to sink in the float-sink tank with PET and be detrimental to PET recycling. Sinking plastics are difficult to remove from PET, thereby causing contamination in the final product. Reclaimers may remove packages known to employ these sinking plastics manually to reduce contamination levels if they are commonly found in the recycle stream.

Benchmark Test: **[Benchmark Evaluation for Clear PET Articles with Labels and Closures \(PET-B-02\)](#)**

Definitive Test: **[Critical Guidance Protocol for Clear PET Articles with Labels and Closures \(PET-CG-02\)](#)**

PE, EVA and TPE liners in plastic closures are preferred.

PE, EVA and TPE float in water and will be separated in the recycling process with the floatable polyethylene and polypropylene closures. Since PET reclaimers can recover PE, EVA and TPE in the float stream, they are preferred liner materials.

Dispensers, closures or lidding with metal components require testing to determine the appropriate recyclability category

Metal contamination is highly undesirable in recycled PET so the use of metal components with PET packaging is discouraged; metals create wear in process machinery, increase operation costs and yield loss, and are a primary source of defects in products made with recycled PET.

MRFs and PET reclaimers use magnets, eddy current separators and metal detectors to keep packages with metal components out of the process stream. Any metal components that trigger these devices will cause the entire plastic product to be removed from the stream and render the package non-recyclable.

When metal components are not detected and removed by process equipment, the package generally passes into the granulator and the metal components are considered detrimental to PET recycling. In cases where a package with a metal component passes through metal detection, some PET reclaimers remove these manually from the stream to reduce the impact of metals contamination; packages removed manually become waste. Aluminum components are particularly difficult to remove effectively due to the limitations of eddy current separators and flake sorters in detecting smaller non-ferrous components or granulated pieces.

Benchmark Test: [Evaluation of Sorting Potential for Plastic Articles Utilizing Metal; Metalized or Metallic Printed Components \(SORT-B-03\)](#)

The use of PVC closures or closure liners renders the package non-recyclable per APR.

(See “Attachments” tab for information about tamper-evident and safety seals.)

PVC sinks and is extremely hard for the recycler to remove, particularly in small pieces. The recycled PET stream is very intolerant of even minute amounts of PVC.

LABELS, INKS AND ADHESIVES

Label selection should be considered carefully to find the solution most compatible with the recycling process that also provides the necessary performance characteristics. There are many label designs available and each of these designs performs differently in the various recycling processes. As a minimum, labels should use adhesives that release from the bottle and be designed so NIR sorting machinery can identify the bottle polymer with the label attached. Label systems, adhesives and inks designed to perform in specific portions of the recycling process are all beneficial. Removing adhesives is a significant component to the cost of recycling so the packages using the lowest quantity of appropriate adhesive are the most compatible.

APR provides an overview of labels and their compatibility with specific portions of the recycling process in our [Label Summary Table](#).

Additional guidance for choosing labels can be found in the following Resource Documents:

[Film Pressure Sensitive Labels on PET Containers](#)

[Shrink Sleeve Labels on PET Containers](#)

Polypropylene or polyethylene labels with a specific gravity less than 1.0 are preferred.

These materials float in water so they are separated from the PET in the float-sink tank with the closures. Since they are the same general polymer as most of the closures they do not contaminate or devalue this stream. Care should be taken to ensure that any modifiers to the label material do not increase its density above 1.0.

Laminated labels require testing to determine the appropriate APR recyclability category.

Labels that break into small, very thin pieces of material are more difficult to manage in the recycling process because they behave erratically in a float-sink tank. Therefore, labels that stay intact are preferred. Carry-over of delaminated labels into the RPET can result in contamination.

Definitive Test: New Delamination Test *Coming Soon

Full bottle sleeve labels require testing to determine the appropriate APR recyclability category.

Full bottle sleeve labels cover a large amount of the bottle surface with a polymer that is not the same as the bottle body. Because of this, a sleeve label designed without considering recycling may cause a false reading on an automatic sorter and direct a PET bottle to another material stream where it is lost to the process. Furthermore, some sleeve label materials cannot be removed in the recycling process and contaminate the RPET produced. Sleeve labels that have been found compliant with the APR test protocols should be selected.

Definitive Test: [Critical Guidance Protocol for Clear PET Articles with Labels and Closures \(PET-CG-02\)](#)

Pressure sensitive labels require testing to determine the appropriate APR recyclability category.

Pressure sensitive labels generally require complete adhesive coverage which is greater than other typical label methods. This raises the importance of the compatibility of the type of adhesive with the recycling process. Adhesives resistant to washing in the recycling process allow labels to remain on the PET and become contaminants in the final product. Adhesives that have been found compliant with the APR test protocols should be selected.

Screening Test: [Benchmark Test for Clear PET Articles with Labels and Closures \(PET-B-02\)](#)

Definitive Test: [Critical Guidance Protocol for Clear PET Articles with Labels and Closures \(PET-CG-02\)](#)

Polystyrene labels require testing to determine the appropriate APR recyclability category. While PS labels are tolerated by some PET reclaimers, PS has been identified as causing serious processing and end-use problems by others and should only be used if it can be easily and completely removed from the PET in conventional

separation systems. PS inherently sinks in water due to its density so it travels with the PET in the recyclers' float-sink systems. However, expanded PS may float and in this case, it may be less of a problem to the recycler.

Screening Test: [PET Packaging Component Sink or Float Evaluation \(PET-S-05\)](#)

Label structures that sink in water because of the choice of substrate, ink, decoration, coatings, and top layer require testing to determine the appropriate APR recyclability category.

The reclaimers rely on float-sink systems to separate non-PET materials. Label components that sink with the PET end up in the RPET stream as contaminants.

Definitive Test: [Critical Guidance Protocol for Clear PET Articles with Labels and Closures \(PET-CG-02\)](#)

Paper labels are detrimental to recycling (for pressure sensitive paper labels reference the pressure sensitive label category). The PET reclamation process involves a hot caustic wash that removes glue and other label components to the levels required to render the RPET usable. Paper, when subjected to these conditions, becomes pulp which is very difficult to filter from the liquid, thereby adding significant load to the filtering and water treatment systems. Individual paper fibers making up pulp are very small and difficult to remove so some travel with the PET. Paper fibers remaining in the RPET carbonize when the material is heated and remelted, causing unacceptable quality degradation. Non-pulping paper labels that resist the caustic wash process sink in the float-sink tank, thereby causing RPET contamination.

Metal foil, metalized and metallic printed labels require testing to determine the appropriate APR recyclability category. Sorting equipment in the recycling process is designed to detect and eliminate metal from PET. Even very thin metalized labels may be identified as metal by the sorting equipment and cause the entire bottle to be rejected as waste, thereby creating yield loss. If not detected, they pass through the process with the PET and cause contamination issues in the RPET.

Benchmark Test: [*Evaluation of Sorting Potential for Plastic Articles Utilizing Metal, Metalized or Metallic Printed Components \(SORT-B-03\)*](#)

PVC and PLA labels render the package unrecyclable per APR.

Both materials are extremely difficult to remove in the recycling process due to their similarity in density to PET. Both cause severe quality degradation in the final recycled PET stream even in very small amounts.

Adhesives require testing to determine the appropriate APR recyclability category.

Adhesives that wash off cleanly from PET and remain adhered to the label are preferred. Label adhesive that is not removed from PET, or which re-deposits on the PET during the wash step is a source of contamination and discoloration when PET is recycled.

The recycling process is designed to remove reasonably expected contamination from the surface of the PET to a degree necessary to render the RPET economically reusable in further applications. In practice, some adhesives are resistant to this process so are detrimental to recycling. In extreme cases, an adhesive and label cannot be separated from the PET and may render a package not recyclable.

Screening Tests: [*Benchmark Test for Clear PET Articles with Labels and Closures \(PET-B-02\)*](#)

Definitive Test: [*Critical Guidance Protocol for Clear PET Articles with Labels and Closures \(PET-CG-02\)*](#)

Label inks require testing to determine the appropriate APR recyclability category.

Some label inks bleed color in the reclamation process, discoloring the PET in contact with them and significantly diminishing its value for recycling. The APR and NAPCOR have developed a testing protocol to assist label manufacturers in evaluating whether a label ink will bleed in conventional PET reclaiming systems. Label inks must be chosen that do not bleed color when tested under this protocol.

Screening Tests: [*Benchmark Test for Clear PET Articles with Labels and Closures \(PET-B-02\)*](#)

*See the definitive test for the appropriate label type

Direct printing other than date coding requires testing to determine its compatibility with the recycling system. Historically, inks used in direct printing tend to bleed or otherwise discolor the PET during the recycling process or introduce incompatible contaminants. In either case, the value of the RPET is diminished. Some inks used in direct printing do not cause these problems. The specific ink must be tested to determine its effect.

Screening Tests: [*Benchmark Test for Clear PET Articles with Labels and Closures \(PET-B-02\)*](#)

Definitive Test: [*Critical Guidance Protocol for Clear PET Articles with Labels and Closures \(PET-CG-02\)*](#)

ATTACHMENTS

Clear PET attachments are preferred.

Attachments made of the base polymer are recovered and recycled with the base polymer without causing contamination or yield loss, thereby generating the highest value.

Tamper evident sleeves and safety seals require testing to determine the appropriate APR recyclability category. If tamper resistance is required in specific product applications, it should be an integral design feature of the bottle. The use of tamper-resistant or tamper-evident sleeves or seals is discouraged as they can act as

contaminants if they do not completely detach from the bottle or are not easily removed in conventional separation systems. If sleeves or safety seals are used, they should be designed to completely detach from the bottle, leaving no remains on the bottle. The material used should float and separate from the PET in the float-sink system.

Screening Test: [*PET Packaging Component Sink or Float Evaluation \(PET-S-05\)*](#)

Definitive Test: [*Critical Guidance Protocol for Clear PET Articles with Labels and Closures \(PET-CG-02\)*](#)

Non-PET attachments such as handles require testing to determine the appropriate APR recyclability category. These should not be adhesively bonded to the package and should readily separate from the package when ground. They should be made from materials that float in water such as PP or HDPE. If adhesives are used to affix attachments, their selection should consider the adhesive criteria within this document.

Screening Test: [*PET Packaging Component Sink or Float Evaluation \(PET-S-05\)*](#)

Definitive Test: [*Critical Guidance Protocol for Clear PET Articles with Labels and Closures \(PET-CG-02\)*](#)

Metal, metalized and metal containing attachments require testing to determine the appropriate APR recyclability category.

Examples include metal foils and metalized substrates that sink in water as well as metal sprayer balls and springs. In the recycling process these items are either identified and removed along with their PET component in the early stages, thereby causing yield loss, or they pass into the recycling process causing a contamination issue. Since they are heavier than water they sink with the PET in the float-sink tank. Many of these items are too small to be removed with machinery designed to remove metal such as eddy current and optical separators. Springs in particular unravel and become entangled in filtering screens throughout the recycling process.

Benchmark Test: [*Evaluation of Sorting Potential for Plastic Articles Utilizing Metal, Metalized or Metallic Printed Components \(SORT-B-03\)*](#)

Paper attachments are detrimental to recycling.

The PET reclamation process uses a hot caustic wash to remove glue and other contaminants to the levels required to render the RPET usable. Paper, when subjected to these conditions, becomes pulp which is very difficult to filter from the liquid, thereby adding significant load to the filtering and water treatment systems. Individual paper fibers making up pulp are very small and difficult to remove so some travel with the PET. Paper fibers remaining in the RPET carbonize when the material is reused causing unacceptable quality degradation.

Welded attachments are detrimental to recycling.

A certain amount of a welded attachment cannot be separated from the PET in the recycling process. These attachments, even when ground and made of floatable materials, cause RPET contamination and yield loss issues in both cases: when the PET they are attached to causes the ground section containing both polymers to sink, or when the ground section floats.

RFID's (radio frequency identification devices) on packages, labels or closures are detrimental to recycling.

Unless they are compatible with PET recycling and are demonstrated not to create any disposal issues based on their material content, the use of RFID's is discouraged as it limits PET yield, introduces potential contamination, and increases separation costs.

PVC and PLA attachments of any kind render the package non-recyclable per APR definition. The use of PVC or PLA attachments of any kind on PET packaging is undesirable and should be scrupulously avoided. This includes thermoforms of PVC and/or PLA that may be visually confused with PET thermoforms. Very small amounts of PVC or PLA can severely contaminate and render large amounts of PET useless for most recycling applications. In addition, PVC and PLA are very difficult to separate from PET in conventional water-based density separation systems due to similar densities (densities greater than 1.0) that cause both to sink in these systems.

BIO-BASED PET RESIN

The use of bio-based PET resin, in which the MEG component is sourced from biological materials such as sugar cane residue or similar materials, are fully compatible with petroleum-based PET in the recycling process. Bio-based PET should not be confused with PET containing bio- or oxo-degradable additives.

POSTCONSUMER CONTENT

The use of postconsumer PET in all packages is encouraged to the maximum amount technically and economically feasible.

RESIN IDENTIFICATION CODE, RIC

Use the correct Resin Identification Code symbol of the proper size as detailed in ASTM D7611 is encouraged.