DRAFT FOR REVIEW

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Reusable packaging system design – Specifications and recommendations

Part 2:
Containers

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RESOLVE

PR3 Partnership to Reuse, Refill, Replace Single-Use Packaging

Contents

Foreword

PR3 is a public-private partnership between corporate, government and NGO stakeholders that has created a standard for the design of reusable packaging systems and is testing it in collaborative demonstration projects. PR3's goal is to transform disconnected, proprietary, and small-scale reuse models into shared interoperable public-private systems. The standard is meant to integrate, de-risk, and support reuse initiatives globally.

PR3 founding partners, funders and advisors include Break Free from Plastic, Cisco, City of Seattle, Nestle, Plastic Solutions Fund, SAP, and The Ellen MacArthur Foundation.

This document was prepared by PR3 with input from its partners. It represents the views of PR3 only and does not indicate the views of any of PR3's partners.

This is a working draft document and is subject to change.

This edition (Version 1.0) cancels and replaces any previous editions.

A list and links to all parts in the PR3 Reusable Packaging System Design standard can be found on the PR3 website, see https://www.resolve.ngo/pr3.htm.

Any feedback or questions on this document should be directed to PR3 Technical Director Claudette Juska at cjuska@resolv-advisor.org.

Introduction

Single-use packaging is a critical threat to human health and the environment. Research shows that reuse has the greatest potential to dramatically reduce plastic production and greenhouse gas emissions compared to other packaging waste interventions.

As reusable packaging systems have emerged in recent years, they have been designed independently and are mostly small-scale, disconnected, and proprietary. They each operate within their own systems for collection and reverse logistics. As more enter the market, they will sow confusion, inconvenience, and inefficiencies for companies, workers, and consumers, and bump up against each other in their quest for scale.

PR3 has now developed the Reusable Packaging System Design standard with the goal of transforming these hundreds of disconnected reuse systems into a shared and interoperable public-private system that is more convenient and affordable and has the ability to truly scale.

This document represents the component of the standard that focuses on *reusable container design*. It provides detailed instructions for aligning container design across brands and companies in a way that enables sharing of container collection points, washing facilities and logistics. Sharing of this infrastructure is a lynchpin to propel new reuse systems to become scalable, affordable, and convenient.

The intended users of this document are packaging designers, brand owners, and others that intend to manufacture containers for a shared reuse ecosystem.

This standard does not establish or require exact container shapes or sizes and does not require containers be completely harmonized between brands or companies. It also does not require that containers be shared between brands and companies. This document does, however, *recommend* harmonized and shared containers as these can lead to optimized logistics and environmental performance.

This document does not preempt any existing standards or regulations for product packaging.

This document is one of multiple parts that together make up the Reusable Packaging System Design Standard. Other parts include collection points, containers, incentives, labeling, reverse logistics and washing. A list and links to all parts in the standard can be found on the PR3 website, see https://www.resolve.ngo/pr3.htm.

Reusable packaging system design – Specifications and recommendations

Part 2:
Container design

1 Scope

This document specifies design requirements and recommendations for reusable containers.

It is applicable to containers that are intended to be part of a shared, interoperable reuse ecosystem that utilizes shared collection points and reverse logistics as described in PR3 Standard Part 1: Collection points and Part 6: Reverse logistics.

This document is only applicable to *primary* packaging that comes into direct contact with a product and consumer.

This document is not applicable to secondary or tertiary packaging, such as e-commerce boxes or sleeves or business-to-business packaging.

This document does not preempt any industry standards or local, regional or national regulations related to food or product safety, quality, packaging, labeling or other topics that are often included in product packaging and labeling.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

PR3-P02 – Reusable Packaging System Design Standard – Part 01: Collection points

PR3-P03 – Reusable Packaging System Design Standard – Part 03: Digital

PR3-P04 – Reusable Packaging System Design Standard – Part 04: Return incentives

PR3-P05 – Reusable Packaging System Design Standard – Part 05: Labeling

PR3-P06 – Reusable Packaging System Design Standard – Part 06: Reverse Logistics

3 Terms and definitions

For the purposes of this document, the terms and definitions given in PR3's Glossary of Terms and the following apply.

In all clauses, the following verbal forms are used:

- Requirements are indicated by "SHALL" or "SHALL NOT"
- Recommendations indicated by "SHOULD" or "SHOULD NOT"
- Permission is indicated by "MAY" or "MAY NOT"

3.1
Container
asset
piece of primary packaging, such as a bottle, cup, or jar, that is used to safely and hygienically deliver goods from a business to a consumer and is designed to be reused in an industrial reusable packaging system

4 Minimum use cycles

Note: To be part of the new reuse systems, reusable containers must be intentionally designed to withstand multiple wash, transport and filling cycles, as well as wear and tear during use by consumers. Reusable containers indeed have a drastically different lifecycle than single-use containers, and are to be designed with this lifecycle in mind.

Containers SHALL be reused multiple times *in practice;* it is not enough to simply claim that a container is reusable.

Note: This is a crucial requirement to ensure the shift to reusable packaging delivers actual reductions in pollution and climate emissions.

Containers SHALL, at a minimum, be designed to withstand at least 20 use cycles, on average, before the container is decommissioned and transferred to end-of-life processing.

Note: For numerous packaging and delivery models, 20 use cycles can deliver environmental, social, and economic benefits. For example, if a plastic container in a reuse system is manufactured with twice the amount of plastic as its single-use alternative and achieves 20 use cycles, then it delivers a 90% reduction in the plastic production that would have occurred had there instead been 20 single-use containers. It also prevents the associated carbon and toxic pollutants. This is an enormous level of prevention, but still only a starting point. For certain packaging materials and formats, containers can and should be used dozens or hundreds of times before being recycled into new products.

Note: PR3 is collecting input and guidance from a wide range of stakeholders, including policy makers, environmental organizations, and consumer goods manufacturers on use cycles and will revise this requirement as more research and analysis is conducted.

Average use cycles per container SHALL be determined per Part 6: Reverse logistics.

Container designers SHOULD turn to peer reviewed LCAs and synthesized reports, such as those offered by UNEP's Life Cycle Initiative and Zero Waste Europe, for general guidance on the environmental tradeoffs and breakeven points for different packaging formats and materials.

Note: LCAs, currently used across industry and regulators, are imperfect at best and misleading at worst. They are often constrained to a limited number of environmental impacts, leaving out some important factors like human health, social equity, and litter. Nevertheless, they are one of the only tools currently available to assess environmental tradeoffs between different packaging formats. After a comprehensive review of numerous LCA methodologies, the United Nations Environment Programme found reusable packaging most often has lower environmental impacts than single-use alternatives. Peer reviewed LCAs and synthesized reports, such as those offered by UNEP's Life Cycle Initiative and Zero Waste Europe, offer data on the potential number of use cycles for different packaging models and the environmental tradeoffs that different design and logistics aspects offer.

5 Labeling requirements

Reuse symbol:

Containers SHALL include reuse labeling as described in Part 5: Labeling.

Reuse labeling SHALL include application of the reuse symbol as well as the type and value of any return incentive (e.g. deposit), and instructions for returning the container.

6 Digital requirements

Containers SHALL include a data carrier, such as a barcode or QR code, as described in Part 3: Digital.

If more than one data carrier is included on the product packaging, then the reuse data carrier SHALL be located adjacent to the reuse symbol as described in Part 5: Labeling so that all stakeholders, including filling companies, consumers, logistics companies, and washing companies, can easily identify it as the scan point for reuse.

The data carrier and reuse symbol MAY be located on the side or bottom of the packaging (at minimum), depending on the type of packaging used.

The data carrier SHALL be permanently attached to the container in a way that is not easily removed during the washing process or during intended use cycles.

The data carrier SHALL be designed in such a way that it is not easily damaged during the washing process or intended use cycles (E.g., when microwaved, placed in a dishwasher, etc.)

The data carrier SHALL be designed in such a way that it does not pose a danger during the washing process or un-intended use cycles (E.g., when microwaved, placed in a residential dishwasher, etc.)

7 Materials

Note: PR3 supports a shift away from all plastic packaging, including polypropylene, polyethylene, polycarbonate, and other types of plastics. A large and growing body of peer reviewed studies and new emerging science all demonstrate a wide range of intentional and unintentional additives and contaminants in plastic packaging have impacts on human health and ecosystems. These include but are not limited to chemicals that disrupt hormones, harm reproduction, cause obesity, cancer, and other diseases, affect DNA, and chemicals that do not break down, but build up in bodies, food chains and the environment.

Note: Regulations are emerging globally, including in the EU and in many global countries and cities, that restrict the use of plastics in packaging applications, like cups, takeaway food containers and tableware.

Containers SHOULD be plastic-free.

Note: Because the transition away from plastic will not happen overnight, this document allows plastic containers. Future versions of this document might include a timeline for phase-down of plastic materials.

Containers SHALL not contain the problematic substances listed in Table 1.

Table 1: Problematic substances in packaging

benzophenone and its derivatives
bisphenols
cadmium and cadmium compounds
formaldehyde
halogenated flame retardants
hexavalent chromium and compounds
lead and lead compounds
mercury and mercury compounds
ortho-phthalates
perchlorate
perfluoroalkyl and polyfluoroalkyl substances (PFAS)
polycarbonate

polystyrene
polyvinyl chloride
toluene

Note: Table 1 is taken from legislation introduced in several US states, including Minnesota HF 4132. PR3 is seeking the most up-to-date and frequently updated lists of problematic substances and important materials and chemicals to immediately phase out of packaging. Other examples include Nestle's Negative List, Amazon's Food Contact Materials Restricted Substance List, and Blue Angel's Ecolabeling standards for cups and bottles.

Containers SHALL NOT incorporate multiple materials or layers that limit or impede recycling at end-of-life.

Containers SHALL be designed to incorporate the maximum amount of recycled content that is available and meets food and product safety standards.

Note: This will help maximize the overall environmental performance of the system.

8 Container design

8.1 Design for durability

Containers SHALL be designed to *optimize* durability, as opposed to *maximize* durability.

Note: Higher quality materials and containers with thicker walls can significantly increase durability and use cycles, but potentially at the expense of other impacts, E.g., thicker, heavier containers will have higher transport emissions. *Optimizing* durability means increasing durability to the point where maximum environmental and social benefits are achieved.

Containers SHALL withstand scratching and denting enough to achieve a minimum average number of use cycles.

Containers SHALL withstand tainting by flavors, fragrances and colors that leach from products.

Note: Tainting results in fewer use cycles and can reduce consumer confidence and acceptance.

Potential for tainting MAY be reduced with glass and metal containers.

Tainting with fragrances and flavors MAY be mediated by refilling each container repeatedly with the same product, but this would reduce the benefits of a standardized reuse system by leading to more complex logistics and longer supply routes.

Visual tainting MAY be mediated by using darker materials (e.g. green instead of white), as long as the darker material is not associated with problematic additives or contaminants and as long the darker material does not pose added challenges to recycling at end-of-life.

Containers SHALL withstand repeated hot and cold cycles that could crack, taint, or apply other physical damages that impact quality or safety.

Note: One typical use cycle could include heat during packing, cold during transport or storage, heat during washing, etc. Unlike in forward supply routes, the reverse supply route for containers will not be climate controlled. Consumers may also expose containers to disadvantageous high heat or cold cycles.

Containers SHALL withstand multiple wash processes and parameters and exposure to chemical washing agents without tainting, cracking or other physical damages that impact quality and safety.

Containers SHALL not leach their own material additives or degradation products into the product, even after multiple use cycles.

Containers SHALL meet all local regulations and industry standards for food-safety, heat resistance, filling operations and other processes.

This document SHALL not preempt any other container design standards and regulation.

8.2 Design for refilling

Contains SHALL be designed to withstand multiple filling processes. I.e., it must be possible to add closures and safety seals multiple times to the same container.

Containers MAY maintain existing aperture and closure sizes, where possible, and where the existing apertures and closures do not hinder compliance with washing and sanitizing regulations and standards.

New equipment for filling reusable containers (e.g. automatic filling lines) SHOULD be designed to accommodate plastic-free materials, such as stainless or glass.

Note: New reusable packaging filling lines that are designed for plastic containers would lock in plastic use for years or decades to come. The intention is to work toward a phase-out of plastic packaging, especially in food and beverage applications.

8.3 Design for safety

For containers that are filled away from point-of-sale (E.g., soda bottles or condiment jars that are filled at manufacturing facilities), closures MAY be single-use.

For containers that are filled away from point-of-sale (E.g., soda bottles or condiment jars that are filled at manufacturing facilities), closures SHALL maintain the same or increased level of safety and security as existing systems and maintain the same or increased level of consumer confidence. For example, single-use twist caps with tamper-evident bands and seals can be used.

For containers that are filled at point-of-sale (E.g., coffee cups), safety is assured by point-of-sale employees or consumers (as currently the case for single-use) and closures SHOULD be reusable.

Placeholder for considerations regarding allergens.

8.4 Design for inventory management

Containers SHOULD fit into existing shelf spaces and secondary packaging containers, wherever possible, and these often vary by region.

Containers SHOULD be designed for nesting and collapsing to save storage space where possible.

Containers SHOULD have narrower tops to help facilitate insertion into secondary packaging (or narrow bottoms if the containers are to be inserted upside down). This is particularly important for glass containers, as narrow tops help minimize breakage during insertion.

8.5 Design for collection and logistics

Containers SHOULD have narrower tops to help facilitate insertion into collection points, secondary packaging, and washing systems (or narrow bottoms if the containers are to be inserted upside down). This is particularly important for glass containers, as narrow tops help minimize breakage during insertion.

Note: PR3 is still studying size parameters to determine whether/what restrictions should be placed to ensure that containers fit inside shared collection points.

8.5.1 Nesting and collapsing

Note: In a reuse system, transport emissions account for a relatively larger portion of the environmental impact per use cycle compared to single-use containers. Optimizing transport logistics is one of the best ways to improve climate and other emissions performance of a reuse system. Nesting and collapsing are important methods for optimizing collection and transport as they increase the length of time between collection cycles and reduce transport volumes.

Containers SHOULD be designed to nest, wherever possible. Cups are one type of container that is easily designed to nest. Take-away food containers can also be designed to nest.

Containers MAY be designed to collapse, where possible, such as where boxes are used, as long as clear directions for collapsing are provided.

Note: Collapsibility often comes at the expense of durability.

Where nesting and collapsing are not feasible, such as with bottles, containers SHOULD be designed to minimize transport volumes in other ways. For example, straight-sided bottles can reduce the volume of empty space between bottles in a crate or box.

8.5.2 Weight

Container weight SHOULD be optimized to the lowest weight (E.g., wall thickness) for the chosen material that meets durability requirements.

Note: Weight impacts a container in a number of ways - higher weights can increase durability to a certain point, but higher weights also increase transport emissions.

8.6 Design for washing

Containers SHOULD have 90º or greater interior angles at the base to facilitate wiping, washing, and sanitizing.

Containers SHOULD have smooth internal surfaces to facilitate more effective emptying and cleaning.

Containers SHOULD avoid any small gaps that can trap liquid and encourage microbial growth.

Containers SHOULD have "feet" that can assist in airflow during drying.

For bottles and other containers that have closures at the top, containers SHOULD have an interior angle greater than 90º between the sides and aperture, especially for products with high viscosities.

While larger aperture sizes might help facilitate washing, closures/lids SHOULD remain smaller than the diameter of the container body. This helps to prevent collision between closures/lids that might affect the seal.

8.7 Decommissioning

Existing standards for quality testing SHALL be followed to determine when the container must be decommissioned, E.g., detecting chips, checking/sniffing for contaminants, testing for durability and degradation, etc.

Containers SHALL be designed following best practices for recyclability at end-of-life.

Note: PR3 is seeking references for recyclability design standards.

Reuse labels and data carriers that are made from a different material than the body of the container SHALL be removable and/or designed to be separated during the material recovery and recycling process.

Label and data carrier removal and separation MAY occur manually, e.g. a worker manually removes the label or RFID chip.

Label and carrier removal and separation MAY be automated. E.g., PET bottles and their PP caps go into the same recycling stream and are first shredded together, after which they are separated through a float/sink process and moved into individual recycling processes.

Annex A
(informative)

Recommendations for harmonizing container designs

PR3 recommends sharing container designs as much as possible between brands and companies in order to optimize collection, transport, washing, other logistics, and inventory management. It is currently beyond the scope of PR3's work to design standardized containers. However, PR3 is considering the potential to recommend and refer to standard designs that are being developed by other organizations. PR3 would consider recommending standard shapes and sizes for the below containers, the designs for which might vary by geographic region:

- Hot cups
- Cold cups
- Variety of takeaway food containers
- Variety of beverage bottles (E.g., beer, water, soda, juice, etc.)
- Personal and home care products (E.g., shampoo, detergent, etc.)

For more information on the benefits of standardization, please see Zero Waste Europe's report, Reusable vs. Single-Use Packaging: A Review of Environmental Impacts. The report states,

> *Standardization of packaging can be a decisive tool to facilitate return logistics. Standardization means less variety in the packaging formats used when it comes to characteristics such as shape, volume, weight, and lid size, amongst others. Standardized packaging formats help to facilitate transport, logistics, cleaning processes and machinery, and can also result in overall cost reduction, as producers with the same packaging formats can share the operational costs of the system. Standardization can also lead to an increase in reuse [37] and extend the product's life when parts need to be replaced [38], [39]. Moreover, standardization can help reduce the complexity of packaging materials, which can further enhance its recyclability and consequently, its overall environmental impact. It's worth noting that standardized packaging is simpler to introduce in a pooling system, in which different producers make use of the same packaging materials while reducing inventory costs.*
>
> *"Beer bottles are a classic example of standardized packaging. With the introduction of the industry standard bottle (ISB), producers no longer need to sort and exchange bottles, which reduces costs by simplifying the collection and reuse process. Another successful example of packaging standardization can be seen in crates and pallets, which once standardized to specific sizes and models, reduce transport time and costs by optimizing logistics. Some authors even state that standardization in logistics is directly related to price competitiveness.*

Annex B
(informative)

Recommendations for sharing & pooling containers

PR3 recommends creating pools of containers to be shared between brands and companies, as they have shown to increase transport and logistics efficiency and reduce overall system costs. PR3 is considering and seeking input on whether to provide guidance on pooling systems in this or other parts of its standard.

For more information on the benefits of pooling, please see Zero Waste Europe's report, Reusable vs. Single-Use Packaging: A Review of Environmental Impacts. The report states,

> *In a pooling system different companies share the same resource in order to optimize operations and costs. Beer bottles have been pooled by companies in different countries, like Germany or the Netherlands. Another example are crates and pallets. Usually, a third-party company provides the crates and pallets, distributes, collects and cleans the packaging before sending them to the next company.*
>
> *The implementation of a pooling system can further decrease the need for extra transport and travel distances, increasing overall efficiency and reducing costs. For these reasons, standardised packaging and pooling systems can go hand-in-hand to ensure a successful reusable packaging system.*
>
> *Scaling up and utilizing pooling systems can help a company reduce its transportation impacts by making use of local distribution centres and cleaning facilities in order to reduce travel distances. Collaborating with other companies in the area can facilitate an easy transition. The adoption of subsidies for reusable packaging is also a good measure that could be implemented at local, national or European level to help scale it up.*

Bibliography