Reusable packaging system design standard–

Part 2:
Containers

Version 1.3
2023

RESOLVE

RESOLVE

Draft Standard

2024
Reusable Packaging System Design Standard:
Containers

NOTE: This draft is under development and subject to change; it should not be used for reference purposes.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the Specification set forth in this document, and to provide supporting documentation.

This specification is being offered without any warranty whatsoever, and in particular, any warranty of non-infringement is expressly disclaimed. Any use of this specification shall be made entirely at the implementer's own risk, and neither resolve, nor any of its members or submitters, shall have any liability whatsoever to any implementer or third party for any damages of any nature whatsoever, directly or indirectly, arising from the use of this specification.

Please submit comments to:

Mason Hines, Project Manager
mhines@resolve.ngo

RESOLVE
2445 M Street NW
Suite 550
Washington, DC 20037

Version: Date 2024 – Working draft (Version 1.0)

Contents

Foreword

PR3 is a partnership between corporate, government and NGO stakeholders to create standards for reusable packaging systems. PR3's goal is to transform disconnected, proprietary, and small-scale reuse models into interoperable systems with common infrastructure. PR3 standards are meant to integrate, de-risk, and support reuse initiatives globally.

This document was prepared by PR3 with input from stakeholders across the value chain, including businesses, communities, workers, consumers, governments and public-interest groups.

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

This edition (Version 1.3) 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.pr3standards.org/the-pr3-standards.

Any feedback or questions on this document should be directed to PR3 Technical Director at: https://www.pr3standards.org/contact

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 mostly operate within their own systems for collection and reverse logistics.

PR3 has developed the Reusable Packaging System Design standard with the goal of transforming these hundreds of disconnected reuse systems into an interoperable system that is more efficient, 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 instructions for aligning container design across brands and companies in a way that enables sharing of container collection points, washing facilities, and logistics.

The intended users of this document are packaging designers, brand owners, and others that intend to operate containers in a reuse system.

This standard does not establish or require exact container shapes or sizes and does not require containers be harmonized or shared between brands and companies. 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.pr3standards.org.

Reusable packaging system design – Specifications and recommendations

Part 2:
Containers

1 Scope

This document specifies design requirements and recommendations for reusable containers.

It is applicable to containers that are intended to be part of an interoperable reuse ecosystem that utilizes common 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.

- DRAFT RES-003 – PR3's Reusable Packaging System Design Standard – Part 05: Labeling
- DRAFT RES-004 – PR3's Reusable Packaging System Design Standard – Part 03: Digital
- DRAFT PR3's Reusable Packaging System Design Standard – Part 01: Collection points
- DRAFT PR3's Reusable Packaging System Design Standard – Part 04: Return incentives
- DRAFT PR3's 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 owner
owner of a reuse asset or container, e.g. this could be a consumer goods company, a retail or food service company, an industry group that owns/services a pool of containers, or a reuse service provider.

3.2
container
piece of primary packaging, such as a bottle, cup, bag, or jar, that is used to safely and hygienically deliver goods from a business to a consumer and is designed to be used in a reusable packaging system

3.3
pool
containers with the same shape, size, and function and owned and/or operated by a single organization

3.4
use cycle
one trip for one container that includes filling, usage, collection, washing and redistribution for refilling.

4 Minimum use cycles

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

Container owner/operator SHALL calculate the average number of use cycles for containers in a pool.

Note: Example methodology for calculating average use cycles is available in Part 6: Reverse logistics.

Containers SHALL be designed to withstand at least 20 use cycles.

If a container achieves more than 10 use cycles in practice then it SHALL be designed to withstand one of the following:

- the number of use cycles it achieves in practice times two (2). E.g. if a pool of containers achieves 20 uses cycles on average in practice, then the container should be designed to achieve 40 use cycles.

- the number of use cycles it achieves in practice plus 2 times the standard deviation (SD) of the average number of use cycles. E.g. if a pool of containers achieves an average of 20 use cycles and has a standard deviation of 6 cycles, then the containers should be designed to achieve 32 cycles.

  Example:
  Average use cycles = 20
  Standard of deviation = 6
  Design to achieve => Average use cycles + (SD x 2)
  Design to achieve => 20 + (6 x 2) = 32 use cycles

Note: Use cycles are directly related to return rates. A return rate of 90% corresponds to an average of 10 use cycles per container. A return rate of 95% corresponds to an average of 20 use cycles per container.

Note: Part 6: Reverse logistics requires containers in a pool to achieve an average return rate of 90% within the first 3 years of operation and 95% within 5 years .

Note: A container that is used 10 times in practice but designed to achieve dozens or hundreds of use cycles has potential to use more material than needed and be unnecessarily heavy.

Container designers and owners MAY consider peer reviewed environmental life cycle assessments (LCAs) and reports, such as those offered by UNEP's Life Cycle Initiative, for general guidance on the environmental tradeoffs and breakeven points for different packaging formats and materials.

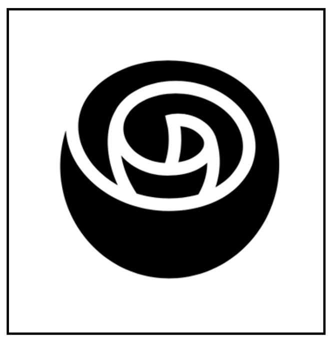
Note: LCAs are constrained to a limited number of environmental impacts, leaving out important factors like impacts of litter on marine and terrestrial ecosystems, impacts of microplastics, and a full range of social impacts associated with material production, use, and waste. Nevertheless, they are one of the only tools available to compare some environmental factors between different packaging formats. After a comprehensive review of numerous LCAs, the United Nations Environment Programme found reusable packaging most often has lower environmental impacts than single-use alternatives, though the exact impacts and break even points vary greatly across different packaging formats and systems.

5 Labeling requirements

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, as described in Part 5: Labeling.

Reuse symbol:



6 Digital requirements

Containers SHOULD 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.

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 use cycles (E.g., when microwaved, placed in a residential dishwasher, etc.)

7 Materials

Containers SHOULD be plastic-free.

Note: A large and growing body of peer reviewed studies and emerging science 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.

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 U.S. states, including Minnesota HF 4132. PR3 is seeking guidance on existing tools this standard can point to for assessing chemicals and materials. Some existing tools include: GreenScreen's chemical 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.

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 use cycles described in Section 4.

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 lead to more complex logistics and potentially longer supply routes.

Visual tainting MAY be mediated by using darker materials (e.g. beige or 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 exposure to chemical washing agents without tainting, cracking or other physical damages that impact quality and safety.

Containers SHALL not leach materials, chemicals, 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, lids, and safety seals multiple times to the same container.

Containers SHOULD maintain existing standard 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.

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 SHOULD be square or rectangular where possible to increase nesting potential.

Note: For more information see Netherlands Institute for Sustainable Packaging: Standardization in Reusable Food Packaging, located here: https://kidv.nl/media/cop/herbruikbaar/shared_packaging_def_standardisation_in_reusable_food_packaging__cop__jan-21_.pdf?1.2.2

Containers MAY be designed to collapse, where possible, such as where boxes or bags are used.

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 and drying

Containers SHOULD have 90° 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 have rounded corners to facilitate more effective emptying and cleaning.

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

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

Containers SHOULD be plastic-free where possible because plastics absorb less heat and is more difficult to dry.

Note: For more information see Netherlands Institute for Sustainable Packaging: Standardization in Reusable Food Packaging, located here: https://kidv.nl/media/cop/herbruikbaar/shared_packaging_def_standardisation_in_reusable_food_packaging__cop__jan-21_.pdf?1.2.2

For bottles and other containers that have closures at the top, containers SHOULD have an interior angle greater than 90° 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.

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

