Steel Container Design Guide for Recyclability

September 2022

Commissioned by

Can Manufacturers Institute

FORWARD

THIS STEEL CONTAINER DESIGN GUIDE FOR RECYCLABILITY covers cans, including food and nonfood cans such as paint cans, aerosol cans, and decorative tins. It is intended to ensure recyclability is considered in the design, manufacturing, and filling/sealing of steel containers for use in the U.S. and Canada. As such it is a resource prepared for designers of steel containers, can sheet manufacturers, container manufacturers, and decorators/fillers.

This steel container design guide for recyclability was commissioned by the Can Manufacturers Institute and prepared by Circular Matters LLC. Questions or comments regarding this guide should be directed to the Can Manufacturers Institute at info@cancentral.com or +1 202-232-4677.

Can Manufacturers Institute (CMI) is the national trade association of the metal can manufacturing industry and its suppliers in the United States. The can industry accounts for the annual domestic production of approximately 130.7 billion food, beverage, and general line cans; employs more than 28,000 people with plants in 33 states, Puerto Rico and American Samoa; and generates about $15.7 billion in direct economic activity. CMI members are committed to providing safe, nutritious, and refreshing canned food and beverages to consumers in the most sustainable packaging.

Circular Matters LLC is a consulting firm dedicated to bringing about the circular economy. We believe it's important to limit the depletion of natural resources and protect the environment for future generations, and we are inspired by organizations that share this viewpoint. We are honored to work with companies, government entities, and industry organizations to navigate the complex world of policies, strategies and tools to turn goals and targets into real progress. Our mission is to help our clients achieve their sustainable materials management and circular economy goals.

The information in this guide is offered in good faith by CMI based on interviews with materials recovery facilities, steel mills, a U.S. detinner, and the research and industry knowledge of Circular Matters LLC. It 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. CMI and its members accept no responsibility for any harm or damages arising from the use of or reliance upon this information by any party.

ABOUT STEEL CONTAINERS

Steel is iron alloyed with less than 1 percent carbon. Other alloying elements may be added to the iron depending on the product produced. The process of recycling used steel products into new steel removes most impurities and alloying elements, allowing steel products to be recycled again and again.

For economic and environmental reasons, the steel industry consumes as much recycled iron and steel products as is available, limited by what is collected for recycling. Steel containers are highly recycled in the United States with a recycling rate of 58 percent.[1]

Although some refer to steel cans as "tin" cans, they are nearly all steel, and those that do contain tin are made with only a very thin electroplated coating of tin and/or chrome[2] making up less than 2 percent[3] of the weight of the can. The electroplated coating prevents corrosion of the steel.

Most steel cans, particularly food cans, also have a liner[4] that is applied to the inside of the finished can. Can linings protect the integrity of the can, prevent corrosion, and provide a high-quality barrier to bacteria, while maintaining quality, flavor, and freshness.

1 American Iron and Steel Institute and Steel Manufacturers Association. ***Determination of Steel Container Recycling Rates in the United States. 2021***. P 6. https://www.steel.org/wp-content/uploads/2021/08/AISI-and-SMA-Steel-Container-Recycling-Rates-Report-Final-07-27-2021.pdf. The recycling rate includes 58 percent from post-consumer cans. An additional 4 percent scrap from the can manufacturing process is also recycled.

2 Can sheet made only with a chrome coating is commonly referred to as tin free steel.

3 Industry Today. "Tin Containers for Packaging." November 26, 2019. https://industrytoday.com/tin-containers-for-packaging accessed August 24, 2022.

4 The Can Manufacturers Institute provides information about can linings at https://www.cancentral.com/content/innovations-food-cans.

Six characteristics of linings performance are tested to inform a comprehensive assessment of the best liner for each specific product contained in a can:

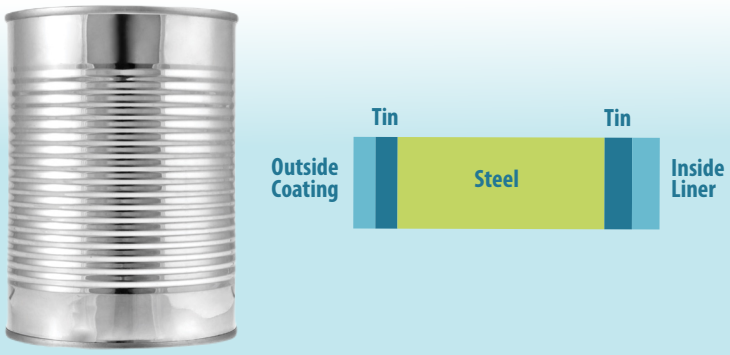
1. Compatibility with container — adheres to metal;
2. Application — can be applied consistently to metal;
3. Fabrication — durability during can-making process;
4. Corrosion Resistance — prevents interaction of acidic foods with metal;
5. Organoleptic Properties — does not impart taste or scent to food; and
6. Universality — effectiveness with multiple food types.

In summary, the choice of which specific composition of coatings and liners to use depends on (1) what type of container is being made and (2) the specific product inside of the container. Common categories of steel containers, each of which may have differing constructions of coatings and liners, are:

- Food cans;
- Nonfood cans (e.g., paint cans);
- Aerosol cans (e.g., cooking oil sprays, spray paints); and
- Decorative tins (e.g., holiday cookie tins).

The figure below is a simplified illustration of the construction of a typical tin-plated and lined steel food can.[5]

Construction of a typical tin-plated and lined steel food can



5 This is a simplified illustration of a generic example of typical layers of a steel food can. The layers are not to scale. Also, it does not include all components associated with finished steel cans.

How a steel container becomes a steel I-beam

Steel can placed into recycling bin

It is then taken to the nearest sorting facility (MRF)

Steel containers are sorted & baled by the MRF

Steel containers are melted with other steel items & cast into sheets

The steel sheets are converted into items such as a steel I-beam

THE STEEL CONTAINER RECYCLING PROCESS

Collection. Steel container collection begins with residential recycling programs — 87 percent of U.S. households have a recycling program that accepts steel food cans for recycling.[6] Acceptance of nonfood cans, aerosol cans, and decorative tins in recycling programs is often not well-communicated to program participants, and program participants recycle such containers at lower rates.

Sorting. Steel containers are sorted at a materials recovery facility (MRF) to separate them from paper, plastic, and aluminum. A magnet efficiently sorts them, and typically there is no need for people to hand sort steel containers from other recyclables.

Baling. Normally the MRF bales steel containers separately from other metals recycled at the facility as their own special grade known as steel can bundles (ISRI code 213).[7] These bales are approximately 3 feet by 4 feet by 5 feet in size and are shipped to scrap metal yards.

Recycling. The steel containers from residential MRFs are combined with other scrap metal collected by local scrap yards, melted by steel mills, and blended with new steel from iron ore to make new steel products. In North America, it is normal for steel mills to recycle various grades of scrap metal into the specific products that each mill produces — many, but not all, steel mills accept steel can bundles for recycling.

6 Sustainable Packaging Coalition. ***2020-2021 Centralized Study on Availability of Recycling***. 2022. P 18. https://sustainablepackaging.org/wp-content/uploads/2022/03/UPDATED-2020-21-Centralized-Study-on-Availability-of-Recycling-SPC-3-2022.pdf.

7 ISRI. ***ISRI Scrap Specifications Circular***. 2022. P 20. http://www.scrap2.org/specs/20/.

Each year, American steelmaking furnaces consume nearly 70 million tons of domestic steel scrap in the production of new steel[8] — steel containers make up 1.12 million tons of this scrap each year,[9] or 1.6 percent of the steel recycled by these steel mills each year.

DESIGN CHOICE IMPACTS ON STEEL CONTAINER RECYCLING

There are Few Design Choices that Hinder Steel Container Recycling

During spring 2022, Circular Matters conducted interviews with several steel mills and one specialty recycler that removes tin to understand if there are any steel can design choices that hinder their ability to recycle steel cans. **These interviews revealed that there are very few steel container design components that pose problems to recycling them.**

Recyclers of Steel Packaging Have Some Concerns

Aerosol cans. Aerosol cans are sometimes excluded from recycling collection programs because steel mills and MRFs are concerned about aerosol cans that are not empty. If non-empty aerosol cans are placed in the residential recycling stream, workers in recycling facilities are at risk of injury and exposure to the contents if the can bursts during processing. Flammable residual contents and/or propellants in cans that have not been emptied also have the potential to cause fires either when baled at the MRF or recycled at the steel mill, which can potentially damage recycling equipment.

8 American Iron and Steel Institute. "Recycling." https://www.steel.org/sustainability/recycling/ accessed August 24, 2022.

9 United States Environmental Protection Agency. ***Advancing Sustainable Materials Management: 2018 Tables and Figures***. 2020. P 8. https://www.epa.gov/sites/default/files/2021-01/documents/2018_tables_and_figures_dec_2020_fnl_508.pdf.

Aerosol Can Recycling Limitations Not Due to Steel Can Design

Sometimes other considerations limit the ability of a consumer to recycle some types of steel containers such as aerosol cans for reasons that are not related to a steel container design choice. These limitations may be instituted by MRFs or steel mills that then pass the limitations down to residential recycling programs. **The concerns mentioned in this Design Guide only relate to aerosol cans that are not empty.** Most aerosol cans that are not empty are regulated by the U.S. Environmental Protection Agency as a hazardous or universal waste and are prohibited from being placed by consumers in mixed recycling and solid waste disposal streams, although some individuals do improperly place them in these streams. **Empty aerosol cans are not hazardous and are not a hazardous or universal waste,** and there is no federal prohibition against collecting and including them in a steel container recycling stream.

In December 2019, the U.S. Environmental Protection Agency established a rule to clarify the regulatory status of aerosol cans and increase the amount of them that are recycled. Interested readers can delve deeper into this topic by downloading the rule and EPA's discussion at https://www.govinfo.gov/content/pkg/FR-2019-12-09/pdf/2019-25674.pdf. While state adoption of this rule is optional, significant strides have been made in its adoption.

A MRF interviewed for this project shared that in late 2021 their steel mill buyer began strictly enforcing a requirement that all aerosol cans be crushed or punctured in order to be accepted for recycling.[10] This MRF now manually removes aerosol cans from the steel packaging recycling stream and instead places them in other mixed scrap metal, which it sends to a shredder to ensure they are no longer sealed and pressurized.

Steel mill concerns over tin. Interviews with steel mill companies found that some electric arc furnace steel mills do not accept steel containers for recycling because the products they produce have high purity and performance specifications. Most of the tin is commonly not removed by electric arc furnace steel mills during the recycling process, and it becomes an impurity in the recycled steel products that are produced.

Because electric arc furnaces consume high percentages of scrap metal in their steel-making processes, an individual mill may limit the amount of tin-bearing scrap that it sources, depending on the specific products it produces and cost, and availability of other ferrous metal inputs.[10] As a result, many, but not all, U.S. steel mills accept steel containers for recycling.

Steel mills interviewed for this design guide for recyclability desire that more steel cans be collected for recycling and stated that U.S. steel mills are able to recycle all steel containers that are generated in the U.S. and Canada.

10 Circular Matters LLC estimates that U.S. electric arc furnaces recycle approximately nine times more old scrap than is recycled by U.S. basic oxygen furnaces, in part because most steel is produced in electric arc furnaces in the U.S., but also because electric arc furnaces typically consume a higher proportion of scrap than basic oxygen furnaces. Because the recycled content percentage in steel produced by basic oxygen process steel mills is typically less than in steel produced by electric arc furnaces, most are less restrictive of the amount of tin-bearing materials in the scrap that they source.

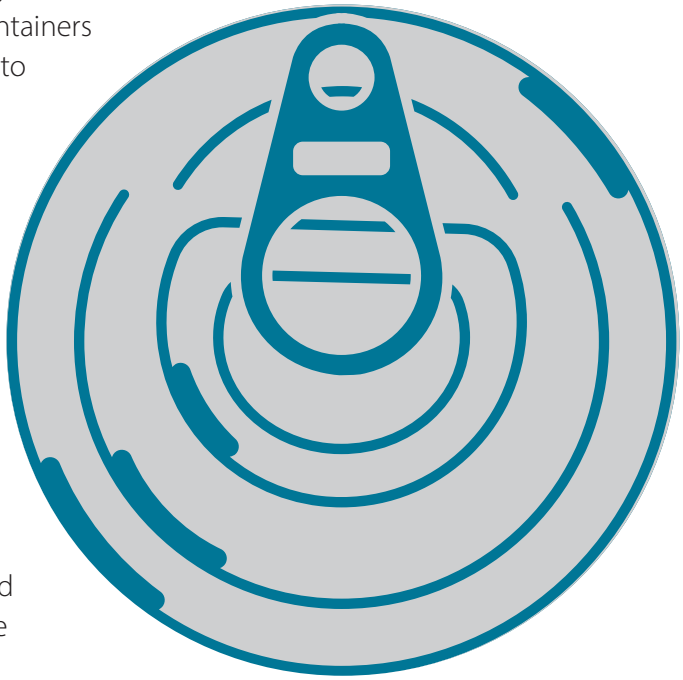
STEEL CONTAINER DESIGN FOR RECYCLABILITY GUIDANCE

This design guide for recyclability presents three guidelines that if more greatly followed would likely increase the number of steel mills that accept steel containers for recycling. Steel containers that do not follow these guidelines are still able to be recycled by the steel mills that currently accept steel cans for recycling. These guidelines and the steel container type that each applies to is summarized in the following table and are further described after the table.

Table 1: Applicability of Recyclability Design Guideline to Steel Container Type

	DESIGN GUIDELINES		
Applicable Container Type	**Minimize tin**	**No heavy metals in inks or paints**	**Use compressed gases when possible**
Food Cans	✓	✓	
Nonfood Cans	✓	✓	
Aerosol Cans	✓	✓	✓
Decorative Tins	✓	✓	

Minimize tin. Even though the tin coating on steel containers is not desired by some steel mills because it results in an impurity that is not easily removed, the low percentage of tin on those containers and the low percentage of steel containers in comparison to other ferrous scrap means the tin can be accommodated at many, but not all, steel mills. Having said that, if the performance of the steel container does not require a tin coating, tin-free alternatives such as tin free steel with chromium coatings are preferred from the perspective of having even more steel mills accept steel cans for recycling.



No heavy metals used in printing and decorating. Model Toxics in Packaging Legislation (formerly known as CONEG legislation) and related regulations seek to reduce the amount of four heavy metals (cadmium, mercury, lead, and hexavalent chromium) in packaging and packaging components sold or distributed throughout the

United States.[11] Reduction of toxics in packaging has been a focus in Europe as well to advance protection of human health and the environment. As a result, heavy metals used in pigments for packaging have largely been phased out in North America and Europe. If decorators of metal containers source paints or inks from other parts of the world, they should verify that there are no heavy metals in the paints or inks used on steel containers or their labels.

Use compressed gases in aerosols when possible. Aerosol cans that have not been emptied may contain residual propellants and/or remaining product that are combustible. Some are concerned that these cans may cause fires at MRFs and steel mills if consumers improperly place them in mixed recycling collection streams and the aerosol container is not punctured to depressurize the container. The aerosol industry conducted research in the 1990s that found that the likelihood of an accident with significant consequences, such as a fire, from such cans was very low.[12] Explore eliminating or minimizing the use of flammable chemicals, both for the propellant and for the product the can contains. For example, consider using compressed noncombustible gases, such as nitrogen and compressed air, as propellants. While not all aerosol products are able to function with the use of a compressed gas and require the use of a liquified propellant, there are several product categories in which it is technically feasible to use nitrogen or compressed air to expel the product. **Make sure to consider the flammability of the overall product (propellant and formulation together), not just the propellant.** Lowering the flammability of aerosol can contents could reduce the concerns that recycling facilities have about potential aerosol can fires and lead to greater acceptance of them in the household mixed recycling stream.

11 See the Toxics in Packaging Clearinghouse information on this topic at https://toxicsinpackaging.org/model-legislation/#:~:text=Model%20Toxics%20in%20Packaging%20Legislation%20(formerly%20known%20as%20CONEG%20legislation,distributed%20throughout%20the%20United%20States.

12 Kumar R. Bhimavarapu and Dimitrios M. Karydas. ***Recycling Aerosol Cans: A Risk Assessment***. Factory Mutual Research Corporation. 1996.

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