

Leak Reduction Initiative

A proactive approach to reducing leaks over the lifetime of commercial refrigeration systems.



NORTH AMERICAN
**Sustainable
Refrigeration
Council**



Introduction

Supermarket refrigeration is one of the leading sources of super-polluting hydrofluorocarbon refrigerant (HFC) emissions. Together with NASRC, U.S. supermarkets are taking steps to characterize and proactively reduce refrigerant leaks over the lifespan of refrigeration systems.

This document outlines the information gathered from NASRC retailer members on the major sources of refrigerant leaks in existing systems. It proposes equipment specification measures for new systems to minimize these leaks and reduce overall greenhouse gas (emissions).



Background

HFC emissions from supermarket refrigerant leaks are a leading climate issue

HFC refrigerants commonly used in supermarkets are extremely potent greenhouse gases with thousands of times more heat-trapping power than carbon dioxide (CO₂). The average U.S. supermarket refrigeration system contains thousands of pounds of refrigerant. Due to the size and complexity of the system, they leak on average 25% of the refrigerant charge each year. **The climate impact from supermarket and grocery store refrigerant leaks alone is estimated to be 55 million metric tons of carbon dioxide equivalent (MTCO₂e) annually or more than half a billion MTCO₂e over ten years.**

The climate impact

from supermarket and grocery store refrigerant leaks

1 Year

**55 MILLION
MTCO₂e**

10 Year

**HALF BILLION
MTCO₂e**

Refrigerant leaks negatively impact U.S. supermarkets

Refrigerant leaks are not only problematic for the climate—they present logistical challenges and additional expenses for supermarkets. Leaks prevent refrigeration systems from working optimally, leading to costly repairs and food spoilage. Furthermore, as new federal regulations under the American Innovation & Manufacturing (AIM) Act phase down HFCs, refrigerant prices are expected to increase significantly, making leaks costlier. One study projected future quarterly **costs to replace leaked refrigerant could increase by more than 200% by 2025.**

Systems with climate-friendly natural refrigerants, such as CO₂, experience leak issues at the same or even higher rate as HFC systems. While these leaks don't have the same environmental concerns as HFC systems, they still incur additional costs due to operational and maintenance issues.

Costs to replace
leaked refrigerant

200%
Increase
by **2025**

The Problem

Top Leak Issues

In 2020, NASRC's supermarket members prepared a data-driven list of the top issues causing refrigerant leaks to form solutions that reduce refrigerant leaks over the lifespan of a system. Participants included representatives from 14 retailers representing national and regional chains with nearly 17,000

U.S. locations. Data indicated that leak issues were not occurring when the system was newly installed but over the system's lifetime primarily due to expansion and contraction from thermal cycling, vibration, and chemical corrosion.

Retailers identified leak issues across four categories: cases and fixtures, machine rooms and racks, condensers, and connecting piping. Based on the retailer data compiled, leak in Category A and B accounted for over 80% of leak incidents.

CATEGORY

A



Leaks Occurring in Cases and Fixtures

1. Evaporator leaks due to tubing failures
2. Access valves used for servicing
3. Lines rubbing together either through contact and vibration or through thermal expansion
4. Electrical wiring failure causing leaks

B



Leaks Occurring in the Machine Room and Rack

5. Compressor vibration relative to the rack structure, causing tubing failure (stress)
6. Leaks from high side control lines
7. Mechanical fitting connections
8. Access valves used for servicing, such as rotolock valves and stem packing leaks
9. Tubing vibrating against dissimilar metals

C



Leaks Occurring at the Condenser

10. Tube sheet leaks at condensers
11. Fan breakage/motors falling into the coil and causing leaks

D



Leaks Occurring on Connecting Pipes

12. Corrosion and abrasion

Leak Reduction Measures

To address the leak issues identified, NASRC retailers formed a committee to develop best practices and standard equipment specification measures to proactively reduce leaks over the refrigeration system's life. The committee intended to adopt these specifications across the participating retailer companies

to drive a new standard for the industry and reduce the cost burden through economies of scale. The committee identified the following six measures and shared them with major original equipment manufacturers (OEM).



MEASURE ①

Require 45 bar working pressure (Type K copper) in display case and walk-in coils, all piping, and on racks

Problem: Corrosion, stress, abrasion

Solution: Thicker wall tubing takes longer to corrode, leak due to fatigue, and wear out, adding years of leak-free service.

Addresses categories: A, B and D



MEASURE ②

Any tubing or part that carries refrigerant cannot come into contact with any other metal

Problem: When copper piping carrying refrigerant comes into contact with other metals and wiring, thermal cycling can cause friction that wears away the piping over time, resulting in leaks.

Solution: Properly isolate and clamp tubing to protect from wear and contact with any metals or hardened materials and reduce vibration related fatigue/stress.

Addresses categories: A



MEASURE 3

Eliminate any flare fittings on copper tubing

Problem: Flare nuts loosen from vibration or thermal cycling

Solution: Use double ferrule compression fittings or solder all joints and fitting.

Addresses categories: A, B



MEASURE 4

Eliminate rotolock fittings

Problem: Over time rotolock mount nut loosens from thermal cycling and compressor vibration

Solution: Eliminate rotolock valves and use a flange mount valve

Addresses categories: B



MEASURE 5

Add a temporary pressure gauge or indicator to visually confirm that the system is pressurized after arriving on site

Problem: Some leaks occur during shipping

Solution: Add gauges to pressurized components to ensure leaks are noticed before installation

Addresses categories: B



MEASURE 6

Specify better CO2 relief valves

Problem: Once CO2 release valves engage, fine particles get into the valves, preventing them from reseating properly

Solution: Unknown

Addresses categories: B (for CO2 systems)

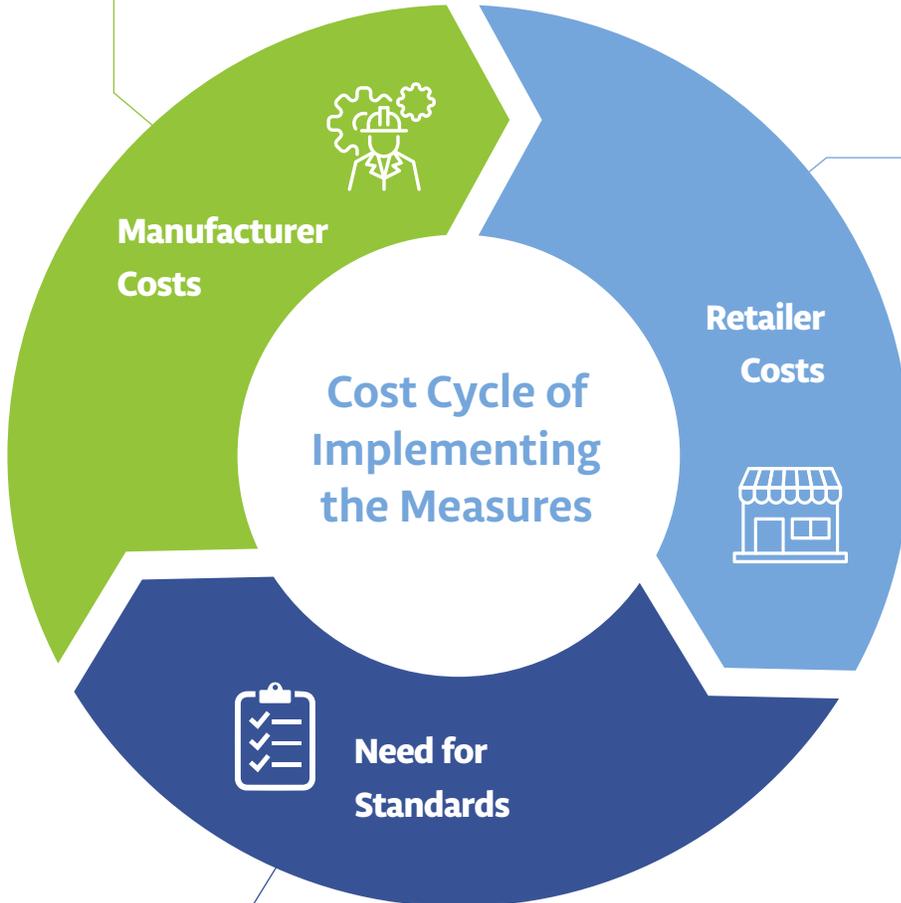
The Next Step

IMPLEMENTING THE MEASURES

The main barrier to incorporating the leak reduction measures into industry standard practice is increased upfront capital costs. While it is possible to design leakproof refrigeration

systems, it is not cost-effective. OEMs and retailers must address the following factors to implement the leak reduction measures:

OEMs and manufacturers will incur costs from implementing the leak reduction measures that will **increase equipment costs**. To control costs and stay competitive, OEMs and manufacturers **need commitments from the retailers** to justify the internal investment required to make the changes.



Retailers must be able to **justify the incremental cost** of the measures internally to incorporate as part of their equipment specifications. **Data is needed** to demonstrate that the cost of leak reduction measures is less than the annual cost of refrigerant leaks.

Currently, the leak reduction measures are not required by any equipment or engineering standard. **Standardizing the measures can drive the economies of scale** needed to reduce costs and accelerate implementation to reduce leak rates quickly and cost-effectively.

GreenChill Best Practices Guideline:

Commercial Refrigeration Leak Prevention & Repairs

<https://www.epa.gov/greenchill/greenchill-best-practices-guideline-commercial-refrigeration-leak-prevention-repairs>

California Air Resources Board Compliance Assistance Series:

Performing a Refrigerant Leak Inspection

<https://ww2.arb.ca.gov/resources/documents/stopping-leaks>

NASRC Refrigerant Transition Hub:

<https://nasrc.org/hub>



NASRC is a 501(c)(3) environmental nonprofit working to advance climate-friendly natural refrigerants and reduce greenhouse gas emissions caused by traditional hydrofluorocarbon (HFC) refrigerants. We collaborate with stakeholders from across the industry, including over 38,000 food retail locations, to eliminate the barriers to natural refrigerants in supermarkets.

To learn more visit nasrc.org or contact us at info@nasrc.org.



NORTH AMERICAN
**Sustainable
Refrigeration
Council**

To learn more visit nasrc.org or contact us at info@nasrc.org.