# Industry Sets Sights on Reducing Refrigerant Leaks

## Effective Leak Detection Good for Retailers and the Environment

**By John Wallace**
Director of Innovation, Retail Solutions
Emerson Climate Technologies


**The True Costs of Refrigerant Leaks**

For decades, refrigerant leaks have been considered an inevitable yet unfortunate consequence of operating typical supermarket refrigeration systems. Often thought of as a cost of doing business, refrigerant leaks and their far-reaching impacts are largely underestimated.

According to the EPA's GreenChill research,[1] the average supermarket has two to four refrigeration racks charged with approximately 3,500 pounds of refrigerant, of which approximately 25 percent — or the equivalent of 875 pounds — is lost each year to leaks.

With increased consumer, business and regulatory focus on minimizing the environmental impacts of hydrofluorocarbon (HFC) refrigerants, food retailers are recognizing the importance of reducing refrigerant leaks through effective leak detection practices. But aside from the obvious environmental concerns, these leaks are also cutting into retailers' profits.

Even in a more moderate scenario with a lower leak rate of 20 percent, the economic costs cannot be ignored. For an individual store, the loss of 700 pounds of R-404A (arguably the most common refrigerant in use today) at $7 per pound equates to an annual expense of nearly $5,000. Note that refrigeration racks and cases are where refrigerant leaks are most likely to occur.

Across a chain of 100 supermarkets, this impact becomes much more significant, costing the same retailer nearly $500,000 annually on lost refrigerant. This doesn't include the associated labor costs or the potential loss of business due to service disruptions in response to fixing a refrigerant leak.

This 100-store scenario also reveals the true environmental impacts: the nearly 70,000 pounds of leaked refrigerant is equivalent to 124,500 metric tons of $CO_2$, the emissions of 24,000 cars or 10,600 homes. Refrigerant leaks also affect equipment performance, causing systems to run harder to compensate.

While this example may not be representative of your exact scenario, we encourage everyone to calculate the impacts of refrigerant leaks in their systems. The EPA has provided financial calculators to help with these estimations.[2]

Before implementing strategies to reduce refrigerant leaks, it's important we fully understand the regulatory landscape to better align our efforts with existing and proposed regulations.

**Increased Regulatory Focus on Leak Detection**

*Existing Section 608*

The EPA introduced Section 608 as part of the Clean Air Act (CAA) in the 1990s to address emissions of ozone-depleting substances (ODS) such as chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC) refrigerants used in stationary refrigeration and air conditioning. The main tenets of the ruling are designed to ensure proper use, handling and disposal of these refrigerants, including:

- Prohibiting venting
- Requiring technician certification
- Providing for safe disposal
- Mandating accurate record keeping
- Requiring corrective actions for leak rates greater than 35 percent

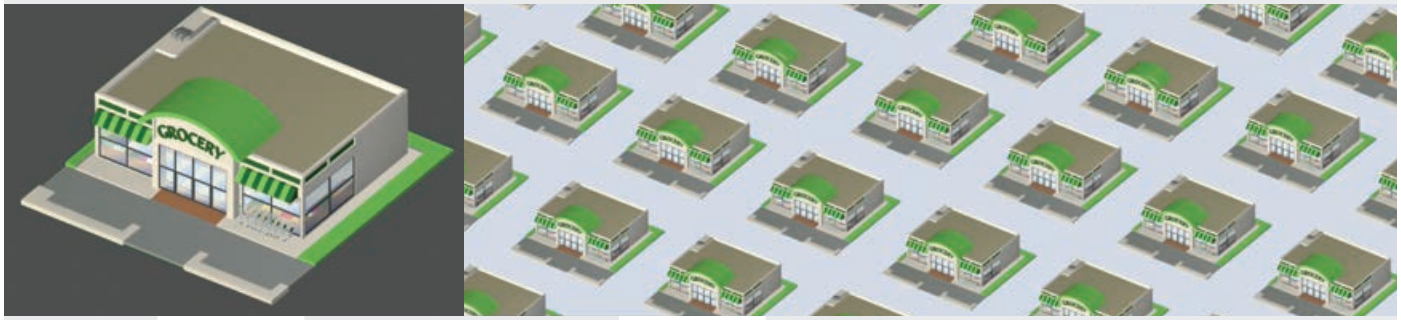
According to the EPA's Section 608 fact sheet,[3] the agency is authorized to assess up to $37,500 in fines per day for any violation of these regulations.

*California Air Resources Board (CARB)*

The California Environmental Protection Agency is historically a forerunner in environmental initiatives, and their CARB refrigerant management program[4] designed to reduce leaks and emissions of high-GWP refrigerants is no exception. The ruling builds upon the EPA's Section 608 regulation and introduces new measures to promote effective management of refrigerants and minimize leaks, including:

- Requiring periodic leak inspections and follow-up actions
  - Registration, record keeping and reporting
- Categorizing refrigeration systems by refrigerant charge
  - Small: 50 to 200 pounds
  - Medium: 200 to 2,000 pounds
  - Large: > 2,000 pounds

# Understanding the Impacts of Refrigerant Leaks




**Store Profile**

R-404A refrigerant
3,500 pounds of charge per site

20% leak rate (vs. 0%)

LEAK 700 POUNDS

Leak 700 pounds/year per site

**Economic Impact**

Average $7 per pound for R-404A

**100-Store Chain**

LEAK 70,000 POUNDS

Leak 70,000 pounds/year total per chain

$490,000
annual cost in refrigerant lost

- Potential for customer disruptions
- Damage to brand

**Environmental Impact**

124,500 METRIC TONS OF $CO_2eq$

Equivalent carbon dioxide

Equivalent to emissions of
24,000+ cars

or
10,600 homes

- Mandating Automated Leak Detection (ALD) equipment for large systems
  - Direct or indirect methods acceptable

According to the ruling, "if the large refrigeration system is indoors and operates, or is intended to operate year round, an ALD device is required."[5] I will explain the emergence and application of ALD technologies later in this article.

### SNAP Proposal to Section 608

In October 2015, the EPA announced a significant new alternatives policy (SNAP) proposal to amend Section 608 of its CAA.[6] It incorporates some of the key elements of the CARB initiative and lowers the leak rate threshold for penalties. Among the highlights of the proposal include:

- Reducing the leak detection threshold from 35 percent to 20 percent in industrial process and commercial refrigeration systems containing more than 50 pounds of refrigerant[6]
- Requiring regular leak inspections or continuous monitoring devices, including quarterly inspections for systems containing at least 500 pounds of refrigerant
- Prohibiting the operation of systems normally containing 50+ pounds of refrigerant that have leaked 75 percent or more of their full charge for two consecutive years
- Mandating that technicians keep a record of refrigerant recovered during system disposal in smaller systems with 5–50 pounds of charge
- Extending the requirements of the refrigerant management program to cover substitute refrigerants, such as hydrofluorocarbons[7]

As with all SNAP proposals, the EPA encouraged the industry to submit public comments to the federal register. We don't yet know when the final rule will be announced, but given its alignment with the CARB regulations, the proposal will likely lower the leak threshold and recommend automated monitoring or more frequent leak inspections.

### Key Elements of Effective Leak Detection Programs

Accurate detection methods, reliable notifications and continuous monitoring are the key elements in an effective leak detection program. When developing your program, your aim should be to not only establish proper leak detection response protocols, but also institute proactive measures to minimize or eliminate leaks altogether.

***Detection*** — an effective program starts with detection. There are differing technologies available depending on your requirements, and I will address these in the last section of this article. But installing devices in the locations most likely to produce refrigerant leaks — particularly racks and cases — is as equally as important.

***Notifications*** — ensure that the correct individuals in the organization are alerted when a leak has occurred. Alarms are typically remote, local or a combination of the two. Most remote notifications are tied into the store's energy management system that will alert a technician or monitoring center to ensure that the leak is handled correctly.

***Continuous monitoring*** — is one aspect that is often overlooked. By recording and analyzing the data around leak events, retailers can correlate the leaks with different types of equipment or maintenance events. In doing so, they can identify problem areas, develop more effective leak detection programs and improve their overall operations.

Finally, it's important for retailers to remember that there are many operational benefits of early leak detection. While most refrigeration systems are designed with enough capacity to offset the short-term impacts of a small refrigerant leak, even a small leak will significantly degrade performance and capacity over time. Left undetected, this leak could impair the refrigeration system's capacity to maintain proper cooling. At that point, not only have you lost refrigerant and compromised system performance, you're also faced with the cost of potential food loss.

## Leak detection program best practices

To maximize the effectiveness of leak detection programs, retailers should clearly communicate the importance of detecting and minimizing leaks across their organizations. Here are a few best practices to achieve that goal:

- Establish a zero-tolerance policy for refrigerant leaks
- Focus on the potential for cost savings
- Utilize automated leak detection devices
- Correlate leaks to equipment
- Analyze data to detect trends and decide on corrective actions
- Institute proper maintenance procedures
- Inform and educate with available resources

When developing your program, your aim should be to not only establish proper leak detection response protocols, but also institute proactive measures to minimize or eliminate leaks altogether.

**Leak Detection Technologies**

There are several continuous monitoring equipment technologies available to help retailers automate the leak detection process, meet CARB's ALD requirements and ensure future Section 608 regulatory compliance. The technology falls into two primary categories, direct and indirect, and there are pros and cons of each leak detection method.

***Direct leak detection*** — directly monitors the concentration of refrigerants in the air. Direct technologies can be fixed or portable, with fixed systems having a dedicated piece of hardware installed on-site to detect refrigerant leaks. Because fixed leak detection systems can be connected to a facility's energy management system to enable remote monitoring and notifications, they are good candidates for meeting the CARB ALD requirement. Fixed systems include both active and passive technologies:

- Active — centralized system with sniffing technology that utilizes tubing connected to multiple zones. The central unit takes air samples from zones to determine if there is refrigerant present in the air.
- Passive — zone-specific hardware with infrared technology placed in the specific areas where sensing is desired. There are no moving parts and generally require less maintenance than an active (tubing) system. If you need to sample a lot of different areas in a single location, this may become cost prohibitive.

***Indirect leak detection*** — monitors and interprets the status and operation of the entire refrigeration system to determine if leaks are occurring. This method typically uses existing sensors and hardware and does not require dedicated leak detection hardware to be installed on-site. Indirect technologies analyze refrigeration system data — such as temperatures, pressures, liquid levels and ambient conditions — against performance algorithms and historical data to evaluate system status. While this method has the advantage of not requiring location-specific sensors, it may not be capable of pinpointing the exact location of a leak. It is, however, also considered a suitable method for complying with CARB's ALD requirement.

Each method has specific advantages and offers retailers viable options to help meet their leak detection objectives. Some have even combined direct and indirect leak detection systems to benefit from the best of both technologies.

**Conclusion: Leak Detection Makes Good Business Sense**

With the renewed regulatory focus on reducing refrigerant leaks, retailers are taking a closer look at developing effective leak detection strategies. Through the help of ALD devices, retailers can achieve continuous monitoring, satisfy reporting requirements and reduce the need to perform manual inspections.

But achieving compliance with current or future regulations is only one benefit. When you examine the cost of lost refrigerant, the degradation of refrigerated system performance and the potential for eventual food loss, the business case for implementing effective leak detection programs is as clear as refrigerant-free air.

Resources


1. http://www2.epa.gov/sites/production/files/documents/gc_averagestoreprofile_final_june_2011_revised_1.pdf
2. http://www2.epa.gov/sites/production/files/greenchill/downloads/FinancialImpactCalculator.xls
3. http://www3.epa.gov/ozone/title6/downloads/Section_608_FactSheet2010.pdf
4. http://www.arb.ca.gov/cc/rmp/rmp.htm
5. http://www.arb.ca.gov/cc/rmp/RMP_QA_Guidance_Document.pdf
6. http://www2.epa.gov/snap/608-proposal
7. http://www3.epa.gov/ozone/title6/downloads/Section_608_FactSheet2010.pdf