Small-Food Retail Refrigeration Guide

Prepared for CDFA

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Healthy Refrigeration Grant Program

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A Public Benefit Corporation

Contents

Glossary

Greenhouse gas: A gas in the atmosphere that absorbs and emits radiation, trapping heat and warming the Earth. Common greenhouse gasses include water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

Cooling demand: The amount of cooling needed to maintain a desired temperature in a space. It is influenced by factors such as outdoor temperature, humidity, building insulation, and internal heat gain from occupants and equipment.

Cooling capacity: The ability of a cooling system to remove heat from a space. It is typically measured in watts (W), BTU (British thermal units) per hour, or tons of refrigeration (TR). A higher cooling capacity indicates the system can remove more heat and cool a larger space or maintain a cooler temperature.

CARB: California Air Resources Board. A state agency responsible for setting refrigerant requirements under the Refrigerant Management Program (RMP).

CFC: Chlorofluorocarbons. Class I controlled substances. New production and import phased out in 1995.

GWP: Global warming potential. A value indicating the amount of global warming a substance may cause. GWP is the ratio of the warming caused by a substance to the warming caused by a similar mass of CO_2 (carbon dioxide), which has a GWP = 1.0.

HFC: Hydrofluorocarbons. A newer class of replacement refrigerants for CFCs. All HFCs have ODP = 0, but typically have high GWPs (>150).

EPA: Environmental Protection Agency, a federal agency responsible for setting refrigerant requirements under Section 608 of the Clean Air Act (CAA).

WAGWP: Weighted average global warming potential. The WAGWP calculation takes the average GWP of the mix, weighted by the amount of each gas present. This provides a single metric for the mix's total warming potential relative to carbon dioxide (CO_2).

GHGp: Greenhouse gas potential. A term used to describe the relative potency, molecule for molecule, of a greenhouse gas, taking account of how long it remains active in the atmosphere.

Charge: The amount of refrigerant present within a refrigeration system.

Introduction

Refrigeration is a critical component of any food business, ensuring perishable goods stay fresh and safe for consumption. It's important to understand how your refrigeration system works, so you can make informed decisions about maintenance, repairs, and upgrades. This guide will provide you with an overview of refrigeration systems, common issues, and some tips for keeping them running smoothly. The purpose of this guide is to provide store owners and managers who have limited technical experience with the knowledge and resources necessary for effective maintenance and management of their refrigeration systems.

The purpose of the California Department of Food and Agriculture's Healthy Refrigeration Grant Program is to improve access to healthy foods in underserved communities, while promoting California-grown agriculture. The program also aims to use the most environmentally friendly refrigeration options. The use of traditional refrigerants in refrigeration equipment has been identified as a significant contributor to greenhouse gas emissions and climate change. The program aims to promote the use of energy efficient equipment and refrigerants with a low global warming potential (GWP). Refrigerants with a high GWP, such as hydrofluorocarbons (HFCs), the most commonly used class of refrigerants, contribute significantly to global warming and climate change. Climate-friendly refrigeration technologies use alternative refrigerants with lower-GWP values, such as hydrocarbons, carbon dioxide, or ammonia.

With growing concerns about climate change, regulations are also evolving to curb the use of harmful refrigerants. This guide explores key regulations, in particular the American Innovation and Manufacturing (AIM) Act and Californian legislation, which are both mandating a shift towards more environmentally friendly refrigeration systems. These regulations focus on phasing out high-global warming potential (GWP) refrigerants, impacting both new equipment and existing systems. Understanding these regulations will be crucial for businesses and individuals who rely on refrigeration.

Refrigeration System Design

All refrigeration systems consist of several key components:

- The **compressor** is the heart of the refrigeration system. Its primary function is to compress the refrigerant to produce high pressure and temperature, and circulate it through the system. It acts like a pump, creating a pressure difference that drives the refrigerant around the circuit in a continuous cycle.
- The **condenser** is responsible for transferring heat from the compressed high-pressure vapor refrigerant to the surrounding air or a water supply which causes the refrigerant gas to convert into a liquid. In a remote system, the condenser is often located outside.

- The **receiver** stores excess liquid refrigerant, ensuring only liquid enters the expansion valve. It maintains a steady flow of refrigerant, optimizing system efficiency across the seasons as the refrigerant charge required of a system varies.
- The **expansion valve** located inside the display case reduces pressure and temperature, and controls the flow of the refrigerant before it enters the evaporator. This is important because it allows the refrigerant to evaporate and absorb heat, which is essential for the cooling process.
- The **evaporator** is responsible for absorbing heat from the enclosed space or system by evaporating the refrigerant. As the refrigerant evaporates, it absorbs the heat from the surrounding air or water, which causes the air or water to cool down.

Self-contained units house all the cooling components within the cabinet, making them simpler to install and ideal for smaller spaces. However, the condenser generates heat and noise which can be drawbacks in customer areas. Remote systems, on the other hand, have the condenser unit located outside the store, keeping the display case quieter and cooler. This is usually more suitable for large stores or open floor plans, but requires professional installation and additional piping, making them initially more expensive.

Common Issues

Refrigeration systems may experience a variety of problems that can impact their performance, efficiency, and lifespan. Some common problems include:

- **Leaks**: Refrigerant leaks can occur in the compressor, condenser, evaporator, or other components of the system. Leaks can result in reduced cooling performance, increased energy consumption, and increased greenhouse gas emissions.
- **Clogging**: Clogging can occur in the refrigerant lines or other components of the system due to the buildup of debris, such as dirt, dust, or ice. Clogging can result in reduced cooling performance, increased energy consumption, and increased wear and tear on the system.
- **Electrical issues**: Electrical problems can occur in the compressor, fan motors, or other electrical components of the system, which can result in reduced cooling performance, increased energy consumption, and potential safety hazards.
- **Improper installation**: Improper installation of the refrigeration system can result in reduced cooling performance, increased energy consumption, and potential safety hazards. It is important to have the system installed by a qualified technician who understands the proper installation procedures.
- **Inadequate maintenance**: Inadequate maintenance can result in reduced cooling performance, increased energy consumption, and increased wear and tear on the

system. It is important to have the system regularly serviced and maintained by a qualified technician to ensure optimal performance.

- **Incorrect sizing**: If the refrigeration system is incorrectly sized, which means there is a mismatch between the cooling demand and cooling capacity of a system, it may result in reduced cooling performance and increased energy consumption; or if the system is oversized, it may cycle on and off frequently, leading to increased wear and tear on the system.
- **Poor ventilation**: Poor ventilation can result in reduced cooling performance and increased energy consumption. It is important to ensure that the refrigeration system has adequate ventilation to dissipate the heat generated by the system.

Temperature Monitoring

Why Monitor Temperature?

- **Food Safety**: Certain temperature ranges are crucial for preventing the growth of harmful bacteria that can cause foodborne illness. Regular monitoring ensures your food stays within the safe zone.
- **Quality Control**: Maintaining consistent temperatures helps preserve the texture, flavor, and appearance of your food, keeping your customers satisfied.
- **Regulatory Compliance**: Most regions have regulations mandating temperature monitoring for food storage. Regular checks with documented logs will help you remain compliant.

Temperature Monitoring Methods

- **Digital Thermometers**: The classic and reliable option for spot checks. It’s prudent to invest in high-quality, NIST (National Institute of Standards and Technology)-certified thermometers for accurate readings.
- **Data Loggers**: These electronic devices continuously record temperatures, providing a complete picture of a cooler or freezer's performance. They often include alarm systems to provide notification when out-of-range temperatures occur.
- **Wireless Monitoring Systems**: These high-tech systems offer real-time temperature data accessible from your smartphone or computer. Perfect for multi-location operations or additional peace of mind.

Best Practices for Temperature Monitoring

- **Establish Target Ranges**: Research and document the ideal temperature ranges for all food items, keeping in mind that different food products require a different temperature range. As a general rule, refrigerators should be kept below 40 degrees Fahrenheit. Food held at temperatures above 40 °F for more than 2 hours should not be consumed.
- **Schedule Regular Checks**: Develop a routine for checking temperatures, ideally multiple times a day for high-risk foods.
- **Placement Matters**: Position thermometers and sensors in key locations within units, away from vents and doors.
- **Record Keeping**: Maintain detailed logs of temperature readings, including timestamps and corrective actions taken for any out-of-range temperatures.

A well-maintained refrigeration system is vital for accurate temperature control. Preventative maintenance should be scheduled regularly to ensure your equipment is functioning optimally.

Servicing and Maintenance

It's important to keep a log of maintenance activities, including dates and observations made. Consult the user manual for specific cleaning and maintenance instructions. Before cleaning any electrical components, unplug the unit and ensure it's completely off and never use harsh chemicals or abrasive cleaners on refrigeration equipment, opting instead for mild soap and water or a specialized appliance cleaner.

In any fast-paced environment, keeping equipment running smoothly is key. To achieve this, there are two approaches to maintenance: preventative and reactive. Preventative maintenance focuses on addressing small issues before they snowball into major problems. A proactive approach helps extend equipment life, minimize downtime, and reduce costs, whereas a reactive approach deals with problems as they arise. In some cases, this is necessary such as replacing filters when they no longer work. However, relying solely on reactive maintenance, while it may seem simpler and easier, can lead to costly repairs, productivity loss, and potential safety hazards.

Preventative Maintenance

It's important to note that the frequency of preventive maintenance tasks can vary depending on the specific equipment or system. While this guide provides a general framework, employing discretion and tailoring maintenance schedules to the unique needs of your assets is essential.

Regularly

- **Ensure Proper Airflow**: Ensure there is at least 2-3 inches of clearance around the entire refrigerator, allowing for proper airflow.
- **Inspect Door Seals**: Inspect door seals for any tears, cracks or signs of wear. A damaged seal allows cold air to escape, making the unit work harder and wasting energy. Wipe down the seals with a damp cloth to remove any debris that might prevent a proper seal.
- **Defrost**: A build up of frost can affect performance and efficiency as well as food quality as air flow is hindered. For refrigerators with manual defrost settings, defrost the unit according to the manufacturer's instructions. This typically involves removing all food and allowing the ice to melt completely.

Monthly

- **Clear Outdoor Condensing Units**: Clear away weeds and debris.
- **Clean Motor and Fan Blades**: Clean with a soft cloth.
- **Remove and Clean Shelves, Drawers, and Crisper Bins**: Regularly remove and clean according to the manufacturer's instructions.

Every Few Months

- **Clean Evaporator and Condenser Coils**: The condenser coils are located on the back or bottom of the refrigerator and are responsible for releasing heat. Dust and debris buildup on the coils can significantly reduce efficiency. Use a vacuum cleaner with a soft brush attachment to clean the coils to ensure proper heat transfer and prevent dust and dirt accumulation
- **Check Drain Line**: A clogged drain can lead to water buildup inside the unit, which can damage components and cause odors.

Biannually (by a qualified technician):

- **Deep Clean**: A professional technician can perform a more thorough cleaning of the unit, including the evaporator coils and internal drainage system.
- **Refrigerant Level Check**: Low refrigerant levels can reduce efficiency and strain the compressor. A technician can check and adjust refrigerant levels if needed. (note: refrigerant handling is regulated by the EPA, so only certified technicians should perform this task).
- **General Preventative Maintenance Check**

    - Check the amperage of motors and compressors.
    - Test controls and safety switches to ensure they are functioning properly.
    - Check refrigerant lines for insulation decay, especially from the condensing unit and the evaporator coils and replace as needed.
    - Inspect electrical connections.
    - Lubricate moving parts of the refrigeration system to reduce friction and wear.

Reactive Maintenance

- **Remove Corrosion and Repaint**
    - Corrosion on steel components should be removed and components recoated with a rust inhibiting paint to help prevent future corrosion.
- **Monitor Refrigerant Charge Level**
    - The amount of refrigerant required in the system (refrigerant charge) should be checked and adjusted as needed.
- **Replace Air Filters**
    - Air filters protect the condenser coils that expel heat to the ambient environment and other components from dust, dirt and debris buildup. Clogging can lead to increased energy consumption and potentially reduced cooling capacity.
    - A clogged condenser can also result in overheating which can put strain on the compressor and other parts of the refrigeration unit, leading to premature wear and tear and shortening the lifespan of the equipment.
    - It’s important to regularly check and replace air filters to ensure proper airflow, which will also reduce maintenance costs in the long run as the condenser coil will need to be cleaned less frequently.
- **Clean Spills**: Clean spills inside the unit immediately and thoroughly to prevent bacteria growth and odors.

Disposal/EOL Best Practices

Proper disposal of refrigeration equipment is essential to prevent environmental harm and to comply with all regulatory requirements. The best way to dispose of refrigeration equipment is to have it recycled by a licensed professional who can properly recover the refrigerant and dispose of the equipment in an environmentally responsible manner.

The removal and disposal of refrigerant assets should comply with all regulatory requirements including, but not limited to, the following:

- US EPA Evacuation Requirements (prior to disposal)
- US EPA Safe Disposal Requirements (for assets with intact refrigerant charges)
- CARB RMP (Refrigerant Management Program) Requirements
    - Service Technicians & Contractors
    - Distributors, Wholesalers & Reclaimers

Regulatory Considerations

The effective operation of refrigeration systems is vital for any food retail establishment. However, proper management also extends beyond ensuring food safety and freshness. Regulations have been implemented with a focus on environmental sustainability, specifically targeting the reduction of hydrofluorocarbons (HFCs) used in refrigeration equipment.

Why Regulate HFCs?

HFCs, while effective refrigerants, are potent greenhouse gasses. Intentional or unintentional releases of HCFs into the atmosphere contributes significantly to climate change. Regulations are designed to minimize HFC emissions through two key strategies:

- **Leak Detection and Repair:** Refrigeration systems are not perfect and leaks can occur. These regulations mandate regular inspections to identify and repair leaks promptly in order to minimize the release of HFCs into the environment.
- **Transition to Lower-GWP Refrigerants:** Global Warming Potential (GWP) is a measure of a gas's ability to trap heat. Regulations encourage the use of refrigerants with lower GWP values, significantly reducing their potential impact on the environment.

California Refrigerant Management Program

California's Refrigerant Management Program (RMP) targets and regulates facilities with stationary, non-residential refrigeration systems that use high global warming potential (GWP) refrigerants exceeding 50 pounds. The program mandates that these facilities adopt best practices to minimize leaks and emissions. Here is a summary of the key requirements:

- **Leak Detection and Monitoring:** Regular inspections for leaks are mandatory. The frequency depends on the refrigerant amount and type of system.

- **Leak Repair:** California's RMP mandates fixing refrigerant leaks within 14 days of detection, with some exceptions allowing up to 45 or 120 days under special circumstances. Facilities must use certified technicians and keep repair records.
- **Service Practices:** Certified technicians must perform service and maintenance procedures to minimize refrigerant release.
- **Recordkeeping and Reporting:** Facilities must maintain service records and submit reports through the Refrigerant Registration and Reporting System (R3) regarding refrigerant use, leaks, and service activities.

California HFC Prohibitions

Company-Wide Reduction Targets

Company-wide targets apply to systems with more than 50 pounds of refrigerant:

- **Large Retailers (20+ Stores)** must achieve a weighted average global warming potential (WAGWP) below 2,500 or a 25% reduction in greenhouse gas potential (GHGp) by December 31, 2026. In addition, large retailers must also achieve a weighted average global warming potential below 1,400 or a 55% reduction in GHGp by January 1, 2030.
- **Small & Medium Retailers (Less than 20 Stores)** must achieve a company-wide WAGWP below 1,400 or a 55% reduction in GHGp by January 1, 2030.

HFC Prohibitions

There are a range of refrigerant prohibitions for new applications and retrofits depending on the application, refrigerant charge size, and whether the equipment is for a new refrigeration facility:

- Refrigerants with a GWP of 150 or greater are prohibited in new refrigeration facilities.
- HFC-227ea, R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A, R-507A are prohibited in new supermarket systems and remote condensing units.
- R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A, R-507A are prohibited in retrofits of supermarket systems and remote condensing units.
- Similarly for self-contained units, there is an even wider range of prohibited refrigerants. Please refer to the regulation link in the appendix for further details.

Federal Regulation

The American Innovation and Manufacturing (AIM) Act is a federal law passed in December 2020 with the goal of reducing the use of high global warming potential (GWP) refrigerants in the United States. There are three main elements in the AIM Act:

1. **HFC Phasedown:** The AIM Act requires the Environmental Protection Agency (EPA) to phase down the production and consumption of HFC refrigerants over time. Specifically, the law sets targets to reduce the production and consumption of HFCs by 85% by 2036. This may result in price increases of HFC refrigerants, which will impact grocers unless refrigeration systems are changed to non-HFC refrigerants.
2. **Technology Transitions:** The EPA has finalized GWP limits on new products and systems in various end-use sectors.
3. **Management of Regulated Substances (Emissions Reduction & Reclamation Program):** The EPA has finalized requirements for the purpose of maximizing refrigerant reclaim, minimizing releases of HFCs and their substitutes from refrigeration and air conditioning equipment, and ensuring the safety of technicians and consumers. Regulated activities include installation, servicing, repair, and disposal.

It’s important to note that these regulations do not prevent existing equipment from being used but may make it more difficult to continue using HFCs or their substitutes. The phasedown will result in less HFCs being produced, making them less available. The technology transition rules place restrictions on replacement equipment, and the refrigerant management rules require the use of reclaimed HFCs and timely leak repairs.

Appendix

Useful Sources

Guides

- Refrigerant Management
- Refrigerant Leak Prevention
- Best Practices
- Refrigeration and Food Safety

Federal Regulation

Factsheets

- Phasedown of HFCs
- Technology Transitions
- AIM Act Subsection (h)

Full Regulation

- Phasedown of HFCs
- Technology Transitions
- AIM Act Subsection (h) (pre-publication)

California Regulation

- Refrigerant Management Program
- HFC Prohibitions