

REFRIGERANT



Many of the refrigerants used for heat transfer in refrigeration and air conditioning systems (A/C) are harmful to human health and/or the environment. As a result, refrigerants are regulated under [Title VI of the Clean Air Act](#) and regulations promulgated by the U.S. Environmental Protection Agency (EPA) under [40 CFR Part 82](#). Many retail facilities have refrigeration or A/C equipment that are covered by EPA's regulations, which establish requirements for refrigerant handling, equipment maintenance, technician certification, and associated recordkeeping.

WHY ARE REFRIGERANTS REGULATED?

STRATOSPHERIC OZONE DEPLETION

Refrigerants were originally made of substances that can deplete the stratospheric ozone layer, which protects the earth from the sun's ultraviolet radiation. These refrigerants, known as ozone-depleting substances (ODSs), are classified into two groups based on their ozone depleting potential:

1. **Class I substances.** This class includes the most potent ODSs and include all chlorofluorocarbons (CFC) as well as other ODSs that cause or contribute significantly to degradation of the stratospheric ozone layer.
2. **Class II substances.** This class is known or reasonably anticipated to cause or contribute to harmful effects on the stratospheric ozone layer. This class includes hydrochlorofluorocarbons (HCFC).

Due to their ozone depleting potential, these refrigerants either have been or are in the process of being phased out, meaning that production and importation is banned or is being incrementally reduced and will be banned in the future.

CLIMATE CHANGE

In addition to their stratospheric ozone-depleting potential, many refrigerants, including ODSs and their substitutes, are highly potent greenhouse gases (GHG) with high global-warming potentials (GWP). The EPA revised the refrigerant regulations in November 2016 to limit the impact of these potential GHGs. Under these revised rules, the EPA amended the definition of "refrigerant" to include both ODSs and substitute refrigerants, and expanded requirements related to ODSs to most substitutes.

REFRIGERATION AND A/C EQUIPMENT IN THE RETAIL ENVIRONMENT

EQUIPMENT

Five main categories of refrigerant-containing equipment are typically found at retail facilities:

- **Domestic refrigeration equipment.** This includes household refrigerators and freezers, and water coolers.
- **Commercial refrigeration equipment.** This equipment covers three end-uses:
 - Cold storage warehouses, for bulk storage of meat, produce, dairy products, and other perishable goods. The size of these warehouses and refrigeration systems varies greatly.
 - Retail food systems, used to refrigerate food and beverages in commercial retail establishments, such as grocery stores and also includes walk-in or reach-in refrigerator/freezers, under the counter refrigerator/freezers, ice cream machines, vending machines, and display cases at delis; and
 - Ice makers, to produce ice for consumer use in commercial establishments.
- **Refrigerated transport equipment.** Refrigerated semi-trailers called reefer trailers are the most common form of refrigerated transport.
- **Comfort cooling equipment.** This stationary A/C equipment includes such appliances as chillers, commercial split systems, and packaged roof-top units

that provide cooling to control heat and/or humidity in facilities.

- **Motor vehicle A/C equipment (MVAC).** This equipment is used to cool driver and passenger compartment in motor vehicles.

REFRIGERANTS

Refrigerant-containing equipment may contain different types of refrigerants. Under EPA regulation, these refrigerants may be defined as a:

1. **Class I ODS;**
2. **Class II ODS; or**
3. **Substitute.** A substitute is any chemical or product, whether existing or new, that is used as a refrigerant to replace a class I or II ODSs. Substitute refrigerants may be either:
 - **Exempt substitutes.** Certain substitutes when used in certain end-uses as specified in [40 CFR 82.154\(a\)\(1\)](#) are exempt from the venting prohibition and other requirements under 40 CFR Part 82, Subpart F. Under 40 CFR 82.154(a)(1), the following are exempt substitutes:
 - Carbon dioxide, nitrogen, or water in any application;
 - Ammonia in commercial refrigeration;
 - Isobutane (R-600a), propane (R-290), and R-441A in household refrigerators, freezers, and combination refrigerators and freezers;
 - Isobutane (R-600a), propane (R-290), and R-441A in retail food refrigerators and freezers (stand-alone units only);
 - Propane (R-290) and R-441A in self-contained room A/C units for residential and light commercial A/C, and heat pumps;
 - Isobutane (R-600a), propane (R-290), and R-441A in vending machines;
 - Propane (R-290) in self-contained commercial ice machines and water coolers; and
 - Propane (R-290) and ethane (R-170) in very low-temperature refrigeration equipment.
 - **Non-exempt substitutes.** All substitutes and end-uses not specified as exempt in 40 CFR 82.154(a)(1).

AMMONIA

When facilities with commercial and retail refrigeration systems use ammonia, the facilities must comply with the requirements or operating procedures to reduce the risks associated with ammonia. EPA's Chemical Accident Prevention provisions, commonly known as the Risk Management Program (RMP), applies to large refrigeration processes using at least 10,000 pounds of anhydrous ammonia or 20,000 pounds of ammonia with a concentration of 20% or greater.

Facilities not large enough to be covered by the RMP must still minimize risks associated with ammonia. All facilities where extremely hazardous substances are present have a general duty under the Clean Air Act to identify hazards and take actions to prevent and minimize the impacts of accidental releases. This is known as the [general duty clause](#), and it is consistently enforced by EPA. Since ammonia is both flammable and toxic, it can be considered an extremely hazardous substance in this context. As result, ammonia refrigeration systems must comply with the general duty clause, regardless of the quantity of ammonia.

There are no regulations detailing how to comply with the general duty clause, but the objective is to prevent an accidental release and minimize the consequences of a release. To accomplish this, facilities with ammonia refrigeration systems must:

- Identify hazards that may result from accidental releases using appropriate hazard assessment techniques;
- Design and maintain a safe facility by taking steps to prevent releases; and
- Minimize the consequences of accidental releases

Each facility is unique and requires site-specific actions to meet the obligations of the general duty clause. At a minimum, facilities must follow recognized industry standards and practices for ammonia refrigeration. An example of recognized industry standards and practices are those published by the International Institute for Ammonia Refrigeration.

PHASE-OUT OF ODSS AND PRODUCT BANS

The United States is a party to the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol), which is a landmark international agreement for the protection of the stratospheric ozone layer. The agreement outlines specific measures and timetables for phasing-out the production and import of CFCs and other ODSSs, many of which are, or were, used as refrigerants. The Montreal Protocol does not prohibit the use of ozone-depleting chemicals, only their production or import.

To limit ODS refrigerants entering commerce in the U.S., the EPA is implementing incremental bans on the production and import of Class I and II ODSSs. The ban on the production and import of all Class I ODSSs was fully implemented in 1996, subject to several exemptions. The phasing-out of Class II ODSSs is ongoing according to the incremental schedule established by the EPA.

Since 2001, the sale or distribution of all refrigeration and A/C equipment containing CFCs has been banned. In addition, the sale or distribution of any refrigeration or A/C appliance manufactured after January 1, 2010 and pre-charged with R-22, R-142b, or a blend containing one or both of these refrigerants is banned.

PURCHASING REFRIGERANTS AND REFRIGERATION EQUIPMENT

ODSSs and non-exempt substitutes may only be purchased by certified technicians. This purchasing restriction does not apply to refrigeration or A/C equipment containing ODS refrigerants, nor does it apply to the retail sale of such equipment.

BLACK MARKET ODSS

Anyone purchasing or possessing an ODS is responsible for making sure the substance was produced and obtained legally. Therefore, hiring reputable firms to install and service refrigeration and A/C equipment is paramount. Such firms should be able to document the legality and purity of the refrigerants being used.

In addition to the confiscation of the ODSs, those in possession of illegally obtained ODSs may become the target of an investigation by the U.S. Customs Service, the EPA, and/or the Internal Revenue Service (IRS) that may result in fines or imprisonment.

RETROFITTING EXISTING EQUIPMENT

One solution for equipment using ODS or high GWP refrigerants is to retrofit the equipment to use a more environmentally friendly refrigerant. A retrofit can extend the useful life of refrigeration and A/C equipment, but there are potential pitfalls. Refrigeration equipment designed for one refrigerant may not function at all or as efficiently using a different refrigerant and using a different refrigerant could also create safety problems.

ENVIRONMENTALLY PREFERABLE REFRIGERANTS

The EPA established the Significant New Alternatives Policy (SNAP) to review ODS alternatives. Under the policy, the EPA evaluates the risk to human health and the environment, including GWP, of ODS substitutes, and publishes lists of acceptable and unacceptable substitutes by [end-use](#). EPA has identified alternatives for end-uses including chillers, cold storage warehouses, commercial ice machines, household refrigerators and freezers, MVAC, residential and light commercial A/C and heat pumps, retail food refrigeration, and vending machines.

[GreenChill](#) is a voluntary partnership program between the EPA and food retailers to help reduce the impact of refrigerants on the environment. GreenChill provides resources and a certification program and helps food retailers in:

- Transitioning to environmentally friendlier refrigerants;
- Reducing the size of refrigerant charges and leaks; and
- Adopting green refrigeration technologies and best environmental practices



TECHNICIANS

STATIONARY EQUIPMENT

Only properly trained and certified technicians can maintain, service, repair, or dispose of stationary equipment that could release a Class I ODS, Class II ODS, or non-exempt substitute refrigerant. Proper certification must be obtained by passing an exam under section 608 of the Clean Air Act by an [EPA-approved testing organization](#). There are four types of certifications available under section 608 of the Clean Air Act:

1. **Type I** – for servicing appliances with a full charge of 5 pounds or less of refrigerant ("small appliances");
2. **Type II** – for servicing or disposing of high- or very high-pressure appliances, except small appliances and MVAC systems;
3. **Type III** – for servicing or disposing of low-pressure appliances; and
4. **Universal** – for servicing all types of equipment.

Businesses employing certified technicians must maintain a copy of each technicians' certification onsite, and keep it until three years after that person is no longer working as a certified technician. If no in-house employees are certified, a maintenance and repair company that employs certified technicians can be hired.

MVAC

Only properly trained and certified technicians can maintain, service, repair, or dispose of MVAC systems. Proper certification must be obtained by passing an exam under section 609 of the Clean Air Act by an EPA-approved testing organization. Service shops are responsible for verifying and maintaining records that the technicians are properly certified.

VENTING PROHIBITION

No person is allowed to knowingly vent an ODS or non-exempt substitute refrigerant into the atmosphere, except for:

- De minimis releases associated with good-faith attempts to recover and recycle or safely dispose of refrigerants and substitutes; and
- Refrigerants emitted during the normal operation of A/C and refrigeration equipment, as long as units normally containing more than 50 pounds comply with leak and repair requirements.

LEAKS AND REPAIRING EQUIPMENT

Leaks from refrigeration and A/C equipment is one of the main ways that refrigerant enters the atmosphere. Facilities with equipment with a full charge of 50 or more pounds of any Class I ODSs, Class II ODSs, or non-exempt substitute refrigerant ("large appliances") are required to calculate the leak rate every time refrigerant is added, unless the addition is made immediately following a retrofit, installation of a new appliance, or qualifies as a seasonal variance.

The leak rate is the rate at which the equipment is losing refrigerant, measured between refrigerant charges. The leak rate is expressed as a percentage of the appliance's full charge that would be lost over a 12-month period if the current rate of loss were to continue over that period. The

leak rate can be determined using either an annualized method or a rolling average method, but the same method must be used for all refrigeration or A/C equipment at the facility.

When the calculated leak rate exceeds the applicable threshold listed below, the owner or operator must repair, retrofit, or retire the appliance. The leak rate threshold is:

1. 20% for commercial refrigeration equipment; and
2. 10% for comfort cooling appliances or other appliances.

In addition, when a large appliance leaks 125% or more of the full charge in a calendar year, facilities must submit a report to EPA that describes the efforts taken to identify the leaks and repair the leaking appliance. EPA's [Updated Refrigerant Management Requirements](#) has information on how to report.

REPAIR

When the leak rate exceeds the applicable leak rate, the facility must identify and repair the leak with 30 days of adding the refrigerant. To conduct the repair, a certified technician must conduct a leak inspection of the whole appliance to identify the location of the leak(s). All identified leaks must be repaired with an initial and a follow-up verification test conducted to confirm that each leak was successfully repaired. Additional time is permitted for leak repairs where the repair parts are unavailable, or the equipment is mothballed, so long as an extension is submitted to EPA and EPA does not reject the request.

Following repair and successful verification tests, inspections must be conducted:

- For commercial refrigeration appliances with a full charge of 500 or more pounds, once every three months until the leak rate calculation is below the applicable leak rate for four quarters in a row.
- For commercial refrigeration appliances with a full charge of 50 or more pounds but less than 500 pounds, once per calendar year until the leak rate calculation is below the applicable leak rate for one year.
- For comfort cooling appliances and other appliances, once per calendar year until the leak rate calculation is below the applicable leak rate for one year.

Annualized Method

$$\text{Leak rate \%} = 100 \times \frac{\left(\frac{\text{lbs refrigerant added}}{\text{lbs refrigerant in full charge}} \right)}{\left(\frac{\text{days since refrigerant last added or 365 days, whichever is shorter}}{365 \text{ days}} \right)}$$

Rolling Average Method

$$\text{Leak rate \%} = 100 \times \frac{\text{lbs refrigerant added over past 365 days or since leaks were last repaired if that period is less than 1 year}}{\text{lbs refrigerant in full charge}}$$

These inspections are not required on appliances, or portions of appliances, that are continuously monitored by an automatic leak detection system that is audited or calibrated annually. The installation and the annual audit/calibration must be documented for three years.

RETROFIT OR RETIREMENT

In lieu of conducting repairs, facilities may retrofit or retire refrigeration or A/C equipment. In this event, facilities must create a retrofit or retirement plan within 30 days after determining that the leak rate trigger has been exceeded or after a failed follow-up verification test, or if good-faith efforts to repair a leak are unsuccessful. A retrofit or retirement plan must:

- Identify the appliance and its location;
- Identify the refrigerant type and the full charge of the appliance;
- Identify the refrigerant type and the full charge to which the appliance will be converted (if retrofitted);
- Itemize the procedure for converting the appliance to a different refrigerant (if retrofitted);
- Plan for the disposition of recovered refrigerant;
- Plan for the disposition of the appliance (if retired);
- Include a schedule for completion of the appliance retrofit or retirement; and
- The date and signature of an authorized company official.

These plans must be maintained for at least three years.

All retrofit or retirement work must be completed within one year, unless an extension is submitted to EPA and EPA rejects the request.

RECORDKEEPING

INVENTORY

Facilities must maintain certain information for all large appliances containing Class I ODSs, Class II ODSs, or non-exempt substitute refrigerants. This information includes:

1. The name of the owner or operator of the appliance;
2. The address where the appliance is located;

3. The full charge of the appliance and the method used to determine the full charge. The full charge may be determined using one or a combination of the following methods:

- Manufacturer's determination;
- Appropriate calculations based on component sizes, density of refrigerant, volume of piping, and other relevant considerations;
- Actual measurements of the amount of refrigerant added to or evacuated from the appliance, including for seasonal variances; and/or
- Use of an established range based on the best available data regarding the normal operating characteristics for the appliance, where the midpoint of the range will serve as the full charge. When this method is used, the record must include the range of the full charge of the appliance, its midpoint, and how the range was determined.

4. This information must be maintained for each appliance until three years after the appliance is retired.

REPAIR, SERVICE, MAINTENANCE, AND DISPOSAL RECORDS

Facilities must maintain certain information when refrigerant is evacuated from an appliance with a full charge of more than 5 pounds and less than 50 pounds of any Class I ODSs, Class II ODSs, or non-exempt substitute refrigerant ("mid-sized appliances"), for purposes of disposing of that appliance. This information includes:

1. The company name, location of the appliance, date of recovery, and type of refrigerant recovered for each appliance;
2. The total quantity of refrigerant, by type, recovered from all disposed appliances in each calendar month; and
3. The quantity of refrigerant, by type, transferred for reclamation and/or destruction, the person to whom it was transferred, and the date of transfer.

Facilities must maintain records of maintenance, service, repair, and disposal for all large appliances containing Class I ODSs, Class II ODSs, or non-exempt substitute refrigerants.

The record must include:

1. The identity and location of the appliance;
2. The date of the maintenance, service, repair, or disposal performed;
3. The part(s) of the appliance being maintained, serviced, repaired, or disposed;
4. The type of maintenance, service, repair, or disposal performed for each part;
5. The name of the person performing the maintenance, service, repair, or disposal; and
6. The amount and type of refrigerant added to or removed from the appliance.

When your own technician performs this work on large appliances, the record must also include:

1. The full charge of the appliance; and
2. The leak rate and the method used to determine the leak rate.

These repair, service, maintenance, and disposal records must be maintained for at least three years.

VERIFICATION TEST RECORDS

Facilities must maintain records of repair verification tests for all large appliances containing any Class I ODSs, Class II ODSs, or non-exempt substitute refrigerant. This record must include:

1. The date of the verification tests;
2. The location of the appliance and location(s) of all repaired leaks that were tested;
3. The type(s) of verification tests used; and
4. The results of those tests.

Verification test records must be maintained for at least three years.

LEAK INSPECTION RECORDS

Facilities must maintain records of leak inspection for all large appliances containing any Class I ODSs, Class II ODSs, or non-exempt substitute refrigerant. This record must include:

1. Date of inspection;
2. The method(s) used to conduct the leak inspection;

3. A list of the location of each leak that was identified; and
4. A certification that all visible and accessible parts of the appliance were inspected.

Leak inspection records must be maintained for at least three years.

END-OF-LIFE OPTIONS FOR REFRIGERANTS AND REFRIGERATION EQUIPMENT

RECOVER

In general, before disposal of refrigeration or A/C equipment, the refrigerant must be recovered from the equipment, meaning the refrigerant is removed and properly stored. A certified technician must recover refrigerant before disposal for refrigeration equipment that is dismantled onsite. Technicians use different methods and equipment depending on the size and age of the equipment and often the recovery equipment must be certified by an EPA-approved organization.

For small appliances that enter the waste stream with the refrigerant charge intact, the final person in the disposal chain (i.e., scrap metal recycler or landfill) is responsible for refrigerant recovery. However, the recycler or landfill operator may require the refrigerant to be properly removed by a certified technician. In such circumstances, the recycler or landfill will require a signed certification statement to verify the proper removal of all remaining refrigerant. If the refrigerant leaked out of the appliance before reaching the recycler or landfill, a signed statement confirming such will need to be provided to the recycler or landfill.

A small appliance is considered to be any of the following products that are fully manufactured, charged, and hermetically sealed in a factory with five pounds or less of refrigerant: refrigerators and freezers designed for home use, room A/C units, dehumidifiers, under-the-counter ice makers, vending machines, and drinking water coolers.

Once recovered, the refrigerant can be reclaimed or recycled. For the purposes of reselling or reusing previously-used refrigerants.

RECLAIM

A recovered refrigerant cannot be resold unless it is reclaimed to the purity of virgin refrigerant by an [EPA-certified reclaimer](#).

RECYCLING

Recycling involves recovering the refrigerants for reuse within the same system or another system operated by the same owner. Recycling may involve using EPA-approved equipment to clean refrigerants for reuse, but not to the same standards as reclamation.

DESTRUCTION

A recovered ODS refrigerant can be sent for destruction to a facility that can achieve the destruction efficiencies required by regulations under the Clean Air Act or the Resource Conservation and Recovery Act (RCRA).

HAZARDOUS WASTE

CFC refrigerants that will be reclaimed for further use are eligible for an exemption from federal hazardous waste regulation in 40 CFR 261.4(b)(12). CFC refrigerants that cannot be reclaimed must be evaluated to determine if they exhibit any of the characteristics of a hazardous waste (i.e., ignitability, corrosivity, reactivity, and toxicity). Those exhibiting such characteristics must be handled according to regulations established under RCRA. Non-CFC refrigerants destined for reclamation or recycling that involves filtering, cleaning or purifying the refrigerants prior to reuse may be considered wastes and must also be evaluated to determine if they are hazardous wastes and managed accordingly. For example, ammonia or any ignitable compressed gas such as propane will need to be evaluated to determine if they exhibit any of the characteristics of a hazardous waste. Many states are authorized to implement their own hazardous waste regulations, and they may be more stringent than federal regulations.

IMPORTS/EXPORTS

Importers or exporters of appliances designed for household or commercial use that are precharged with fluorinated GHG refrigerants, such as HFCs, are subject to EPA's Mandatory GHG Reporting Rule under [40 CFR 98](#), Subpart QQ, if either the total imports or total exports of fluorinated GHGs is greater than or equal to 25,000 metric tons of CO₂ equivalents per year. Such appliances may include A/C units, MVACs, refrigerators, chillers, and freezers.

STATE REQUIREMENTS

California is currently the only state aggressively regulating refrigerants. However, the state regulations are focused on the climate change potential of refrigerant emissions, rather than the ozone-depletion potential. As part of the California's Global Warming Solutions Act of 2006 (AB 32), the California Air Resources Board (CARB) has taken numerous actions to regulate high GWP substances. These regulations impact:

1. Businesses with refrigeration systems;
2. Any person who installs, services or disposes of any appliance using a high-GWP refrigerant; and
3. Retailers selling small containers of automotive refrigerant.

The state also has plans to regulate refrigerated shipping containers (RSCs), which commonly use R-134a. The CARB regulations will include requirements to reduce GHG emissions from RSCs during the entire cold chain process, meaning anyone who might use or decommission an RSC. This includes product producers, shipping companies, the ports, cold storage and product preparers, and product sellers.

Within California, the South Coast Air Quality Management District ([SCAQMD](#)), the air quality regulatory agency for Orange County, and portions of Los Angeles, San Bernardino, and Riverside counties, has established regulations governing refrigerants in stationary A/C systems.

ENFORCEMENT

The EPA enforces regulations governing ODS emissions. Enforcement actions can range from civil fines to criminal prosecution. The EPA can impose civil fines up to \$37,500 per day per violation. The most common violation is failure to comply with the requirements for leaking equipment.

For California facilities, the CARB is responsible for implementing and enforcing the requirements of the state's refrigerant management program, and the SCAQMD implements and enforces its refrigerant regulation within its jurisdiction.