**Penn State Refrigerant Management Program**

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# PURPOSE AND REQUIREMENTS

Chlorofluorocarbons (CFCs), also known as Freon, were developed in 1928 as a replacement for more flammable and toxic substances that had been in use as refrigerants. While CFCs are non-flammable and non-toxic, unfortunately, when released into the atmosphere, they do not begin to break down until they are in the stratosphere. At that level, ultraviolet (UV) light releases the chlorine, which then acts as a catalyst in the conversion of ozone (O3) into molecular oxygen (O2). Ozone depletion in the stratosphere allows harmful UV waves from the sun to reach the earth’s surface, which increases the risk of skin cancer and cataracts. Although CFCs are still used in some applications, they are no longer manufactured. However, they do have a lifespan of 20 to 100 years in the atmosphere, so the damage continues.

Hydrochlorofluorocarbons (HCFCs) are a large group of compounds, which are chemically similar to CFCs, though they are much less stable and persistent. They have replaced CFCs in some refrigerant applications. While not as persistent in the atmosphere as CFCs, they can still end up in the stratosphere and affect the ozone layer.

In an effort to protect the ozone layer, the Montreal Protocol was adopted in 1987 as a framework for international cooperation regarding CFC control on the basis of the Vienna Convention for the Protection of the Ozone Layer. As a result of this international agreement, CFCs were phased out. The ozone hole in Antarctica is slowly recovering, and CFCs in the stratosphere are decreasing from the 1997 peak concentrations. The protocol also addresses hydrochlorofluorocarbons (HCFCs), which began to be phased out in 1996.

Hydrofluorocarbons (HFCs) have begun to replace both CFCs and HCFCs. While HFCs do not affect the ozone layer, they, like HCFCs, are greenhouse gases. In October 2016, an amendment to the Montreal Protocol, known as the Kigali Agreement, was passed that aims to reduce HFCs. The agreement includes specific timetables to phase out these refrigerants and replace them with those that will not add to climate change. In response to this, the EPA revised the regulations governing the use of refrigerants (refer to [Section V, Laws and Regulations](#_LAWS_AND_REGULATIONS), for detail). Refrigerants are used throughout the University in many types of equipment including chillers, motor vehicles, refrigerators, and air conditioners. Refrigerant recovery must be done with the use of EPA-certified recovery equipment, by certified technicians, and must be handled and recycled properly. **No person maintaining, servicing, repairing, or disposing of an appliance or industrial process refrigeration may knowingly vent or otherwise release into the environment any refrigerant from such appliances.**  De minimis releases (such as those that occur from recovery/recycling machines disconnect) associated with good faith efforts to recycle or recover refrigerants are not subject to this prohibition. All used filters and oils from these appliances are treated as a hazardous waste. There is also a requirement to keep records of certain operations.

This Penn State Refrigerant Management Program addresses these requirements.

**This Penn State Refrigeration Management Program is maintained as Environmental Health and Safety document number EHS-0****013.**

# SCOPE

This program applies to all personnel maintaining, servicing, or repairing appliances containing class I, class II, or non-exempt substitute refrigerants, as well as refrigeration equipment installed, decommissioned, or serviced. The following are exempt substitute refrigerants:

* Carbon dioxide in any application;
* Nitrogen in any application;
* Water in any application;
* Ammonia (R-717) in commercial or industrial process refrigeration or in absorption units (which is covered by the Penn State Process Safety Management program);
* Chlorine in industrial process refrigeration (processing of chlorine and chlorine compounds);
* Hydrocarbons in industrial process refrigeration (processing of hydrocarbons);
* Ethane (R-170) in very low temperature refrigeration equipment and equipment for non-mechanical heat transfer;
* Propane (R-290) in retail food refrigerators and freezers (stand-alone units only); household refrigerators, freezers and combination refrigerators and freezers; self-contained room air conditioners for residential and light commercial air-conditioning; heat pumps; and vending machines;
* Isobutane (R-600a) in retail food refrigerators and freezers (stand-alone units only); household refrigerators, freezers, and combination refrigerators and freezers; and vending machines; and
* R-441A in retail food refrigerators and freezers (stand-alone units only); household refrigerators, freezers and combination refrigerators and freezers; self-contained room air conditioners for residential and light commercial air-conditioning; heat pumps; and vending machines.

At Penn State, it is the policy that all refrigerants (Class I, Class II, and their non-exempt substitutes) will be recovered to the maximum extent possible from all equipment, regardless of the charge of the equipment. All refrigerant must be recovered from any equipment where servicing could cause a release. Releases of refrigerant from all equipment will be minimized through prompt repair or removal from service.

# DEFINITIONS

For the purposes of Penn State’s Refrigerant Management Program, the following definitions apply:

Appliance - any device which contains and uses a Class I or Class II substance or non-exempt substitute as a refrigerant and which is used for household or commercial purposes, including any air conditioner, refrigerator, chiller, or freezer. For a system with multiple circuits, each independent circuit is an independent appliance.

* Low-pressure appliance - an appliance that uses a refrigerant with a liquid phase saturation pressure below 45 psia at 104 °F. This definition includes, but is not limited to, appliances using R-11, R-123, R-113, and R-245fa.
* Medium-pressure appliance - an appliance that uses a refrigerant with a liquid phase saturation pressure between 45 psia and 170 psia at 104 °F. This definition includes, but is not limited to, appliances using R-114, R-124, R-12, R-134a, and R-500.
* High-pressure appliance - an appliance that uses a refrigerant with a liquid phase saturation pressure between 170 psia and 355 psia at 104 °F. This definition includes, but is not limited to, appliances using R-22, R-407A, R-407C, R-410A, and R-502.
* Very high-pressure appliance - an appliance that uses a refrigerant with a critical temperature below 104 °F or with a liquid phase saturation pressure above 355 psia at 104 °F. This definition includes, but is not limited to, appliances using R-13, R-23, R-503, R-508A, and R-508B.
* Motor vehicle air conditioner (MVAC) - any appliance that is a motor vehicle air conditioner, i.e., mechanical vapor compression refrigeration equipment used to cool the driver’s or passenger’s compartment of any motor vehicle. This definition is not intended to encompass the hermetically sealed refrigeration systems used on motor vehicles for refrigerated cargo and the air conditioning systems on passenger buses using HCFC‑22 refrigerant.
* Motor Vehicle Air Conditioner-like (MVAC-like) appliance – a mechanical vapor compression, open-drive compressor appliances with a full charge of 20 pounds or less of refrigerant used to cool the occupant’s compartment of off-road vehicles or equipment. This includes, but is not limited to, the air-conditioning equipment found on agricultural or construction vehicles. This definition is not intended to cover appliances using R-22 refrigerant.
* Small appliance - any appliance that is fully manufactured, charged, and hermetically sealed in a factory with five (5) pounds or less of refrigerant including, but not limited to, refrigerators and freezers (designed for home, commercial or consumer use), medical or industrial research refrigeration equipment, room air conditioners (including window air conditioners, portable air conditioners, and packaged terminal heat pumps), dehumidifiers, under-the- counter ice makers, vending machines, and drinking water coolers.

Appliance Owner - the work group that is financially responsible for routine (functional) maintenance of the appliance.

Certified refrigerant recovery and/or recycling equipment - equipment manufactured before November 15, 1993, that meets the standards in [Section IX.B, Refrigerant Use and Recovery](#_Refrigerant_Use_and), or equipment manufactured after this date that has been certified by an approved equipment testing organization.

Certified Technician - any person who performs maintenance, service, or repair that could reasonably be expected to release refrigerant charge from appliances into the atmosphere. Certified technician also means any person performing disposal of appliances that could be reasonably expected to release refrigerants from appliances into the atmosphere. Activities reasonably expected to violate the integrity of the refrigerant circuit include, but are not limited to: attaching or detaching hoses and gauges from the appliance; adding or removing refrigerant; adding or removing components; and cutting the refrigerant line. Activities such as painting the appliance, rewiring an external electrical circuit, replacing insulation on a length of pipe, or tightening nuts and bolts are not reasonably expected to violate the integrity of the refrigerant circuit. Activities on appliances that have been properly evacuated are not reasonably expected to release refrigerants unless the activity includes adding refrigerant to the appliance.

De Minimis Release - small refrigerant releases made in the course of servicing.

Disposal - the process leading to and including:

* + The discharge, deposit, dumping or placing of any discarded appliance into or on any land or water;
	+ The disassembly of any appliance for discharge, deposit, dumping or placing of its discarded component parts into or on any land or water; or
	+ The vandalism of any appliance such that the refrigerant is released into the environment or would be released into the environment if it had not been recovered prior to the destructive activity;
	+ The disassembly of any appliance for reuse of its component parts; or
	+ The recycling of any appliance for scrap.

Evacuate - to remove gas from a refrigeration circuit or a portion of a refrigeration circuit to a pressure below atmospheric pressure. This is typically done utilizing recovery equipment or a vacuum pump.

Follow-up verification test - those tests that involve checking the repairs to an appliance after a successful initial verification test and after the appliance has returned to normal operating characteristics and conditions to verify that the repairs were successful. Potential methods for follow-up verification tests include, but are not limited to, the use of soap bubbles as appropriate, electronic or ultrasonic leak detectors, pressure or vacuum tests, fluorescent dyes and black light, infrared or near infrared tests, and handheld gas detection devices.

Full charge - the amount of refrigerant required for normal operating characteristics and conditions of the appliance as determined by using one or a combination of the following four methods:

1. Use of the equipment manufacturer’s determination of the full charge;
2. Use of appropriate calculations based on component sizes, density of refrigerant, volume of piping, and other relevant considerations;
3. Use of actual measurements of the amount of refrigerant added to or evacuated from the appliance, including for seasonal variances; and/or
4. Use of an established range based on the best available data regarding the normal operating characteristics and conditions for the appliance, where the midpoint of the range will serve as the full charge.

Initial verification test - those leak tests that are conducted after the repair is finished to verify that a leak or leaks have been repaired before refrigerant is added back to the appliance.

Leak inspection - the examination of an appliance to determine the location of refrigerant leaks. Potential methods include, but are not limited to, ultrasonic tests, gas-imaging cameras, bubble tests as appropriate, or the use of a leak detection device operated and maintained according to manufacturer guidelines. Methods that determine whether the appliance is leaking refrigerant, but not the location of the leak, such as standing pressure/vacuum decay tests, sight glass checks, viewing receiver levels, pressure checks, and charging charts, must be used in conjunction with methods that can determine the location of the leak.

Leak Rate - the rate at which an appliance is losing refrigerant measured between refrigerant charges. The leak rate is expressed in terms of the percentage of the total charge that would be lost over a 12-month period if the current rate of loss were to continue over that period. There are two methods that can be used to calculate this rate, however the same method must be used for all appliances subject to leak repair requirements located at a facility. See [Section IX.C, Extra Requirements for Equipment containing 50 pounds or more in a Circuit](#_Extra_Requirements_for), for how to calculate the leak rate.

Major maintenance, service, or repair - any maintenance, service, or repair involving the removal of any or all of the following appliance components: compressor, condenser, evaporator, or auxiliary heat exchanger coil; or any maintenance, service, or repair that involves uncovering an opening of more than four (4) square inches of “flow area” for more than 15 minutes.

Motor vehicle - any vehicle which is self-propelled and designed for transporting persons or property on a street or highway, including, but not limited to, passenger cars, light duty vehicles, and heavy duty vehicles.

Motor vehicle disposal facility - any commercial facility that engages in the disposal (which includes dismantling, crushing, or recycling) of MVACs or MVAC-like appliances, including, but not limited to, automotive recycling facilities, scrap yards, landfills, and salvage yards engaged in such operations. Motor vehicle repair and/or servicing facilities, including collision repair facilities, are not considered motor vehicle disposal facilities.

Opening an appliance - any service, maintenance, repair, or disposal of an appliance that would release refrigerant from the appliance to the atmosphere. Connecting and disconnecting hoses and gauges to and from the appliance to measure pressures, add refrigerant, or recover refrigerant from the appliance are not considered to be ‘‘opening an appliance.’’

Reclaim - to reprocess recovered refrigerant to all of the specifications based on Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 700-2016 that are applicable to the refrigerant and to verify that the refrigerant meets these specifications.

Recover - to remove refrigerant in any condition from an appliance and store it in an external container without necessarily testing or processing it in any way.

Recycle - to extract refrigerant from an appliance (except MVACs) and clean it for reuse in equipment of the same owner without meeting all of the requirements for reclamation. In general, recycled refrigerant is refrigerant that is cleaned using oil separation and single or multiple passes through devices, such as replaceable core filter-driers, which reduce moisture, acidity, and particulate matter.

Refrigerant - any substance, including blends and mixtures, consisting in part or whole of a class I (chlorofluorocarbons (CFCs)) or class II (hydrochlorofluorocarbons (HCFCs)) ozone-depleting substance or their non-exempt substitute that is used for heat transfer purposes and provides a cooling effect.

Refrigerant circuit – the parts of an appliance that are normally connected to each other (or are separated by internal valves) and are designed to contain refrigerant.

Refrigeration Duty Types

* Comfort Cooling - the air conditioning appliances used to provide cooling in order to control heat and/or humidity in occupied facilities including but not limited to residential, office, and commercial buildings. Comfort cooling appliances include, but are not limited to, chillers, commercial split systems, and packaged roof-top units.
* Commercial Refrigeration - the refrigeration appliances used in the retail food and cold storage warehouse sectors. Retail food appliances include the refrigeration equipment found in supermarkets, conveniences stores, restaurants, and other food service establishments. Cold storage includes the refrigeration equipment used to store meat, produce, dairy, products, and other perishable goods.
	+ Industrial Process - complex, customized systems used in the chemical, pharmaceutical, petrochemical, and manufacturing industries. These systems are directly linked to the industrial process. This sector also includes industrial ice machines, appliances used directly in the generation of electricity, and ice rinks. Where one appliance is used for both industrial process refrigeration and other applications, it will be considered an industrial process refrigeration system if 50 percent or more of its operating capacity is used for industrial process refrigeration.

Seasonal variance - the removal of refrigerant from an appliance due to a change in ambient conditions caused by a change in season, followed by the subsequent addition of an amount that is less than or equal to the amount of refrigerant removed in the prior change in season, where both the removal and addition of refrigerant occurs within one consecutive 12-month period.

Service Provider - a work group or contracted vendor who performs maintenance, service, or repair on refrigerant-containing appliances. In some cases, the Service Provider will also be the Appliance Owner.

Substitute - any chemical or product, whether existing or new, that is used as a refrigerant to replace a Class I or Class II ozone-depleting substance. Examples include, but are not limited to, hydrofluorocarbons, perfluorocarbons, hydrofluoroolefins, hydrofluoroethers, hydrocarbons, ammonia, carbon dioxide, and blends thereof. The term “exempt substitutes” refers to certain substitutes when used in end-uses that are specified in [Section II, Scope](#_SCOPE), are exempt from the venting prohibition and the requirements of this program. The term “non-exempt substitutes” refers to all other substitutes and end-uses.

# RESPONSIBILITIES

All persons working with refrigerant containing equipment at Penn State, with the exception of the Hershey Medical Center and College of Medicine, are responsible to comply with this program.

**Budget Executives and Budget Administrators must:**

* Ensure that responsibilities assigned with this program are carried out within their administrative work unit;
* Designate the person who will serve as the appliance owner;
* Monitor implementation of this program within their work unit; and
* Ensure adequate funding is available to support this program.

**Environmental Health and Safety (EHS) Department must:**

* Provide program oversight and assist work units in implementing the provisions of this program;
* Maintain records in accordance with this program;
* Provide training to work units on the requirements of the program; and
* Periodically audit and update this program as needed.

**College/Campus/Work Unit Safety Officers must:**

* Be thoroughly informed of the contents of this program and how it relates to their areas of responsibility and authority;
* Coordinate implementation of the Refrigerant Management Program within their work unit;
* Assist with the development of Standard Operating Procedures (SOPs) for refrigeration work within their work unit;
* Ensure that mechanisms exist for the tracking of refrigerant both by equipment and by purchase;
* Report all catastrophic releases of refrigerant to EHS;
* Periodically audit supervisors to ensure that the program requirements are adhered to; and
* Ensure that records are maintained for their work unit in accordance with this document.

**Facility Coordinators and Project Leaders must:**

* Work with project leaders to ensure that work done by contractors is in conformance with the *Penn State Design and Construction Standards*;
* Coordinate with the work group that will be responsible for the maintenance of the refrigeration equipment; and
* Ensure contractors performing work under their direction provide documentation of the work completed.

**Service Provider Supervisors must:**

* Be thoroughly informed of the contents of this program and how it relates to their areas of responsibility and authority;
* Ensure that all technicians who maintain, service, or repair equipment that contains refrigerant are appropriately trained, that certified refrigerant technicians are used when/where required, and that a copy of the certifications is maintained;
* Ensure that all certified technicians are provided with appropriate personal protective equipment and follow safe working practices;
* Ensure that there are written SOPs for refrigeration work within their work unit;
* Ensure that the work group has the proper recovery/recycling equipment for the types of refrigerants and appliances used;
* Maintain the required service records for their work group, submit them to the appliance owner, and ensure these are accessible in the event of an inspection;
* Ensure that all refrigerant purchased, used, removed, recycled, and reclaimed by their work group is tracked; and
* Complete a self-audit on an annual basis and provide this to EHS.

**Appliance Owners must:**

* Provide an initial listing to EHS of all appliances containing 50 pounds or more of refrigerant in a circuit under their purview in accordance with this program and provide annual updates of equipment added or removed;
* Ensure that service providers and contractors provide service records for all appliances under the “ownership” of the work group;
* Ensure that all maintenance of refrigerant in units containing 50 pounds or more in a circuit is tracked, leak rates calculated, and repaired within required time frames; and
* Complete a self-audit on an annual basis and provide this to EHS.

**Certified Technicians must:**

* Comply with all provisions of this program;
* Maintain certification and only perform work that is allowable to the certification that they hold;
* Know and follow SOPs;
* Track all refrigerant under their purview in accordance with work group procedures;
* Fill out and submit service records for every appliance with 50 pounds or more of refrigerant in a circuit; and
* Report problems to their supervisor.

**Contractors must:**

* Comply with the program requirements given in [Section XI, Contractor Requirements](#_CONTRACTOR_REQUIREMENTS);
* Must follow safe work practices;
* Must adhere to the *Penn State Design and Construction Standards*; and
* Provide refrigeration equipment installation and removal documentation, service records, and document any refrigerant addition or removal.

# LAWS AND REGULATIONS

## Clean Air Act

The Clean Air Act is the comprehensive federal law that regulates air emissions from stationary and mobile sources. Starting in 1990, Title VI of the Act mandated regulations regarding the use and production of chemicals that harm the Earth’s stratospheric ozone layer. This ozone layer protects against harmful ultraviolet B sunlight linked to several medical conditions including cataracts and skin cancer.

Title VI of the Act, Stratospheric Ozone Protection, provides the requirements for refrigeration management under Section 608, National Recycling and Emission Reduction Program, and Section 609, Servicing of Motor Vehicle Air Conditioners.

Section 602 provides a listing of the two groups of ozone-destroying chemicals that are currently regulated under the Act: Class I and Class II. Class I consists of substances, including CFCs, that have an ozone depletion potential of 0.2 or higher. Class II lists consists of HCFCs that are known to or may be detrimental to the stratosphere. Both groups have a timeline for phase-out:

* For Class I substances, no more than seven years after being added to the list, and
* For Class II substances no more than ten years.

The Environmental Protection Agency (EPA) promulgated regulations (40 CFR Part 82, Subparts B and F) under Sections 608 and 609 of the Clean Air Act that prohibit individuals from intentionally venting ozone-depleting substances or their non-exempt substitutes while maintaining, servicing, repairing, or disposing of air-conditioning or refrigeration equipment. This includes motor vehicle air conditioners or motor vehicle air conditioner-like equipment. As stated by EPA, only these types of releases are permitted:

* "De minimis" quantities of refrigerant released while making good faith attempts to recapture and recycle or safely dispose of refrigerant, including releases that occur when connecting or disconnecting hoses to charge or service appliances.
* Refrigerant emitted during the normal operation of air-conditioning and refrigeration equipment (as opposed to during the maintenance, servicing, repair, or disposal of this equipment), such as from mechanical purging and leaks. EPA, however, requires that leaks above a certain size be repaired in equipment that contains 50 pounds or more of refrigerant.
* Those materials specifically exempted from the definition of refrigerant.
* Releases of substitute refrigerants that EPA has determined do not pose a threat to the environment. Specifically, these are isobutane (R-600a) and R-441A in household refrigerators, freezers, and combination refrigerators and freezers; and propane (R-290) in retail food refrigerators and freezers (stand-alone units only).

## Occupational Safety and Health Act

The Occupational Health and Safety Act requires that facilities establish Emergency Action Plans to help prevent fatalities, injuries, and property damage in the event of an emergency. The regulations require that the plan cover the actions the employer and employees are to take to ensure employee safety in the case of fire or other emergencies. Penn State has Building Emergency Evacuation Plans. In addition, [Section VII.C, Emergency Action Plan](#_Emergency_Action_Plan), defines incidental and emergency responses and provides actions that employees should and should not be take in the event of a release.

## Emergency Planning Community Right to Know Act

In addition to the Clean Air Act and the regulations related to it and the Occupational Safety and Health Act, the EPA’s Emergency Planning Community Right to Know Act (EPCRA) requires Penn State to report any refrigerants (except those in consumer use products such as break room refrigerators) which exceed the threshold planning quantity at each location on an annual basis to the Pennsylvania Department of Labor and Industry’s Bureau of PennSafe, the county Local Emergency Planning Committee (LEPC), and the local fire company. For most refrigerants, the threshold planning quantity is 10,000 pounds.

Releases of two refrigerants to the atmosphere, CFC-11 and CFC-12, are covered under the Comprehensive Environmental Response, Compensations, and Liability Act (CERCLA) and need to be reported under EPCRA if the release is 5,000 pounds or more. Employees should contact EHS at 814-865-6391 immediately if a catastrophic release, such as this, occurs.

# TECHNICIAN CERTIFICATION/TRAINING

Any technician or outside contractor that performs repair, maintenance, service, or disposal to any appliance that could reasonably be expected to have the potential to release refrigerants to the ambient air, must be an EPA approved certified technician prior to conducting such work.

For the purpose of Penn State’s Refrigerant Management Program, a certified technician is someone who:

* Attaches and detaches hoses and/or gauges to an appliance for the purpose of measuring internal pressure of the appliance;
* Adds or removes refrigerant from an appliance; or
* Conducts any other activity that may compromise the integrity of a [small appliance](#SmallAppliance), motor vehicle air conditioning appliance, and motor vehicle air conditioning-like appliance.

Apprentice technicians are exempt from these certification requirements provided the apprentice is supervised at all times by a certified technician whenever maintaining, servicing, repairing, or disposing an appliance.

The table below lists the certifications needed by technicians to work on refrigerant-containing equipment. Certified technicians may only perform work for which they have the proper certification.

|  |  |
| --- | --- |
| **Certification Type** | **Type of Service** |
| Section 608 - Type I | Maintain, service, or repair small appliances |
| Section 608 - Type II | Maintain, service, repair or dispose of medium-, high-, or very high-pressure appliances, except small appliances and motor vehicle air conditioners or motor vehicle air conditioner-like equipment |
| Section 608 -Type III | Maintain, service, repair or dispose of low-pressure appliances  |
| Section 608 - Universal | Type I, Type II, and Type III  |
| Section 609 (motor vehicle) | Maintain, service, or repair of motor vehicle air conditioning or motor vehicle air conditioning-like equipment |

Documentation of each technician’s certification shall be maintained by any work group that is a service provider. The documentation shall be a copy of the certification and shall be kept for three years following the technician’s employment as a technician.

EPA is authorized to require a certified technician to demonstrate his/her ability to perform proper procedures for recovering/recycling refrigerant. Failure to demonstrate this may result in a revoked certification. If a technician’s certification is revoked, the technician would need to become recertified prior to maintaining, servicing, repairing, or disposing of any appliances containing refrigerant.

# SAFE HANDLING PRACTICES

The risks associated with the use of refrigerants vary by the type of refrigerant. Among these are flammability, asphyxiation, toxicity, and physical hazards. Mechanical rooms that contain refrigerant are required to be compliant with ANSI/ASHRAE Standard 15. This standard addresses proper ventilation and alarms for the refrigerants. Appliance owners should ensure that an annual inspection of refrigerant-containing mechanical rooms is conducted to ascertain if there have been changes that could affect the integrity of the room such as wall penetrations or doors that are no longer tight fitting. Any issues discovered during this inspection must be corrected. In addition, the location of refrigerant sensors should be reviewed as part of any project where equipment is either added to or removed from the mechanical room.

Supervisors must ensure that all certified technicians who handle refrigerants are properly trained in their safe use and handling, and have reviewed the Safety Data Sheet (SDS) for the refrigerant used. They must develop written Standard Operating Procedures (SOPs) for working on equipment containing refrigerant. These SOPs should be communicated to all technicians.

## General Guidelines for the Safe Handling of Refrigerants

* Be aware that the refrigerant/oil being removed from a system may contain contaminants that may be harmful to breathe or contact with the skin. Liquid refrigerant can cause frostbite if skin contact occurs. Technicians must wear safety glasses with side shields and gloves (cold resistant for pressurized refrigerant) at all times when handling refrigerants or servicing a refrigeration system. Refrigerant oil in a hermetic compressor is often very acidic and can cause severe burns. Avoid contact with this oil on skin or clothing.
* Liquid refrigerant on the skin may freeze the skin surface causing frostbite. If contact with the skin occurs, wash immediately with water, treat any damaged skin area for frostbite, and seek medical treatment.
* R-764 (sulfur dioxide) is very irritating to the eyes and lungs. Avoid exposure to this refrigerant.
* Each refrigerant machine room shall contain a leak detector in accordance with ANSI/ASHRAE Standard 15. The leak detector shall annunciate visual and audible alarms inside the mechanical room and outside the entrance to the room. The high level alarm set point shall be set no greater than the concentration that triggers an emergency response, as given in [Section VII.C, Emergency Action Plan](#_Emergency_Action_Plan), below. It is highly recommended that there be a digital readout of the refrigerant concentration outside the mechanical room in addition to the alarm panel.
* Always ventilate and test the atmosphere of an enclosed area before beginning work. Many refrigerants may be undetectable by human senses are heavier than air and will replace the oxygen in an enclosed area which could result in the loss of consciousness.
* Refrigeration technicians need to have a handheld refrigerant monitor for the types of refrigerants that they are working with; even if a mechanical room has leak sensors, there is a possibility for malfunction and the handheld meter provides backup. It is also necessary to help find leaks.
* In the event of a refrigerant leak alarm, no one shall enter the room without proper metering – both a handheld refrigerant monitor and an oxygen meter. Oxygen levels of less than 19.5% require evacuation.
* Proper ventilation is required for any work on equipment in an enclosed area where a leak is suspected. Certified technicians must ensure that the concentration of the refrigerant is below the emergency response level before they can safely enter and any work can be initiated (Refer to [Section VII.C, Emergency Action Plan](#_Emergency_Action_Plan), below).
* Inhaling refrigerants can cause sudden death. Intentional inhalation of refrigerants to produce intoxication can cause the heart to cease functioning properly and may be fatal.
* Do not smoke, braze, or weld when refrigerant vapors are present. Some refrigerant vapors decompose to phosgene acid vapors and other products when exposed to an open flame or hot surface.
* Be sure you are using the correct cylinder for the type of refrigerant to avoid mixing refrigerants. Only use D.O.T. cylinders approved for fluorocarbon refrigerants. Always inspect the container for pressure rating and ensure that it has a current hydrostatic test date. A standard cylinder will not work for high pressure refrigerants such as R-410A or very high pressure refrigerants such as R-503, R-13, R-23, or SUVA®-95. Do not use the cylinder if it is out of date, rusted, damaged, bulging, or has or any other imperfections that may render it unsafe to hold refrigerant for storage or transportation.
* Refrigerant cylinders should never be filled over 80% of their capacity (liquid expansion may cause the cylinder to burst). Always use a scale when filling the cylinder. Do not overfill. Make sure all closures are made tight on the container immediately after filling.
* Always check for the correct operating pressure of the refrigerant used. Use gauges to monitor the system pressure. Make sure all connections are made tight before transferring refrigerants into containers.
* When soldering, brazing, or welding on refrigeration lines, the lines must be continuously purged with low pressure carbon dioxide or nitrogen. Following this work, the lines must be pressure tested with carbon dioxide or nitrogen.
* For high pressure refrigerants use a manifold set with the low-side gauge that reads pressures up to at least 500 psig and a high side gauge that reads pressures up to 800 psig. Hoses must be UL rated for high-pressure use.
* Oil filters and oil may contain refrigerant. These materials are considered to be a hazardous waste when disposed.

## Labelling

Each unit system and each condensing unit, compressor, or compressor unit intended for field assembly shall carry a nameplate with:

* The manufacturer’s name;
* Nationally registered trademark or tradename;
* Identification number;
* Design pressures; and
* Refrigerant for which it was designed (R number).

Each refrigeration system erected on the premises shall be provided with a legible permanent sign indicating:

* The name and address of the installer;
* The refrigerant number and amount of refrigerant;
* The lubricant identity and amount; and
* The field test pressure applied.

The door of the refrigerant containing machine room shall be posted stating “Authorized Personnel Only. Stay out when Refrigerant Alarm sounds and call University Police Immediately.”

## Emergency Action Plan

Penn State has developed Building Emergency Evacuation Plans (BEEPs) for all locations. In addition, many locations have environmental emergency plans which address the storage and use of fuels, oils, and hazardous materials. The purpose of these plans is to describe measures to prevent spills and releases from occurring and to prepare for an effective, safe, and timely response to mitigate the impacts of a spill/release and to ensure that personnel are protected from the hazards of the spill/release.

The Occupational Health and Safety Administration (OSHA) defines emergency response as a response effort by employees from outside the immediate release area or by other designated responders (e.g., local fire companies or hazardous materials response teams) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance. Releases where the material can be controlled at the time of the release by technicians are not considered to be emergency responses. Responses to releases where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency response.

For the purposes of the Penn State Refrigeration Management Program, an emergency response is defined to be any release of refrigerant that cannot be safely managed by site certified technicians including:

* Events which produce a concentration that triggers an emergency response as defined in the table below (i.e., exceeding one-half of the Occupational Exposure Limit, 8-hour time weighted average [TWA] for the particular refrigerant), or
* Events which create an oxygen deficient environment (<19.5% oxygen).

In these situations, employees will evacuate the mechanical room and call 911 for an emergency response. Based on the nature if the release, the emergency responders may decide to evacuate the building. In the event of another type of emergency such as a fire or explosion, employees will follow the BEEP guidelines, evacuating the building and contacting 911.

Emergency response personnel must be supplied with self-contained breathing apparatus (SCBA) for safe entry (and possible rescue) into the refrigerant leak area. Refrigeration technicians will provide technical support to the emergency responders from a safe location outside the release area. If the refrigeration appliance cannot be shut down remotely, it will be allowed to leak and the refrigerant will be removed from the space by the ventilation system. There will be no entry into the area by Penn State technicians until it has been determined that the atmosphere is safe.

The table below provides the concentrations of various refrigerants that would require an emergency response if detected outside the of the refrigeration appliance (note: for mixtures, the lowest level is shown):

| **Refrigerant** | **Concentration that Triggers Emergency Response****(ppm)** | **Occupational Exposure Limit 8-hour time weighted average [TWA]****(ppm)** | **NIOSH Threshold Limit Value 8-hour time weighted average [TWA]****(ppm)** | **OSHA Permissible Exposure Limit [PEL]****(ppm)** | **AIHA Workplace Environmental Exposure Limit 8-hour time weighted average [TWA]****(ppm)** |
| --- | --- | --- | --- | --- | --- |
| R11 | 500 | 1,000 | 1,000 | 1,000 |  |
| R12 | 500 | 1,000 | 1,000 | 1,000 |  |
| R13 | 500 | 1,000 | None | None | None |
| R13B1 | 500 | 1,000 | 1,000 | 1,000 |  |
| R21 | 5 | None | 10 | 1,000 |  |
| R22 | 500 | 1,000 | 1,000 | None |  |
| R23 | 500 | 1,000 | None | None | 1,000 |
| R112 | 250 | None | 500 | 500 |  |
| R112A | 250 | None | 500 | 500 |  |
| R113 | 500 | 1,000 | 1,000 | 1,000 |  |
| R114 | 500 | 1,000 | 1,000 | 1,000 |  |
| R123 | 25 | 50 | None | None | 50 |
| R124 | 500 | 1,000 | None | None | 1,000 |
| R134A | 500 | 1,000 | None | None | 1,000 |
| R143A | 500 | 1,000 | None | None | 1,000 |
| R401A | 500 | 1,000 | 1,000 | 1,000 | 1,000 |
| R401B | 500 | 1,000 | 1,000 | 1,000 | 1,000 |
| R402A | 500 | 1,000 | 1,000 | 1,000 | 1,000 |
| R402B | 500 | 1,000 | 1,000 | 1,000 | 1,000 |
| R406A | 500 | 1,000 | 1,000 |  |  |
| R408A | 500 | 1,000 | 1,000 | 1,000 | 1,000 |
| R409A | 500 | 1,000 | 1,000 | 1,000 | 1,000 |
| R410A | 500 | 1,000 | None | None | 1,000 |
| R500 | 500 | 1,000 | 1,000 | 1,000 | 1,000 |
| R502 | 500 | 1,000 | 1,000 | 1,000 |  |
| R503 | 500 | 1,000 | None | None | None |

# RECYCLING AND RECOVERY EQUIPMENT

All certified technicians and contractors working on their behalf are required to use refrigerant recovery and recycling equipment that complies with EPA’s certification program. For all equipment *except motor vehicle air conditioner and motor vehicle air conditioner-like equipment*, EPA requires that refrigerant recovery and recycling equipment manufactured on or after November 15, 1993, be tested by an EPA-approved testing organization to ensure that it meets EPA requirements. Penn State personnel can only purchase equipment that meets this requirement. Certified recycling and recovery equipment will bear a label from either Underwrites Laboratories (UL) or the Air Conditioning, Heating, and Refrigeration Institute (ARHI, formerly ARI) that states it is certified. The label is required to state the following: *This equipment has been certified by [approved equipment testing organization] to meet EPA’s minimum requirements for recycling or recovery equipment intended for use with [appropriate category of appliance].*

If the recovery and recycling equipment was manufactured before November 15, 1993, it must be capable of achieving the recovery detailed in [Section IX.B, Refrigerant Use and Recovery](#_Refrigerant_Use_and).

For all *motor vehicle air conditioner and motor vehicle air conditioner-like equipment*, the EPA provides a list of approved recovery, recycling, and recharge equipment that has been tested and approved by either Underwrites Laboratory (UL) or Intertek at the flowing website:

<https://www.epa.gov/mvac/section-609-certified-equipment>

All service provider work groups that maintain, service, repair, or dispose of appliances must have at least one piece of the appropriate recovery/recycling equipment unless all the equipment containing refrigerants contain pump-out units. System-dependent equipment may not be used with appliances with a full charge of more than 15 pounds of refrigerant, unless the system-dependent equipment is permanently attached to the appliance as a pump-out unit. All recovery and/or recycling equipment must be used in accordance with the manufacturer’s directions.

# REFRIGERANT TRACKING, USE, RECOVERY, AND LEAK RATE CALCULATION

## Refrigerant Tracking

In order to ensure that refrigerant is not improperly vented to the atmosphere, certified technicians must track their refrigerant use. Units may decide to do this either by technician or by work group.

Ozone depleting (Class I or Class II) and non-exempt substitute refrigerant may be purchased only by certified technicians. Only Type I, II, III, or Universal certified technicians can purchase Class I, Class II and non-exempt substitute refrigerants intended for use with stationary refrigeration and air-conditioning equipment. Technicians certified under the motor vehicle air conditioner and motor vehicle air conditioner-like equipment certifications cannot purchase refrigerants that are intended for use with stationary equipment, regardless of container size. Purchases of refrigerants intended for motor vehicle air conditioner and motor vehicle air conditioner-like equipment must be made by MVAC certified technicians.

Refrigerant that has been recovered or recycled can be returned to the same system or other systems owned by Penn State without being reclaimed *except for motor vehicle air conditioner and motor vehicle air conditioner-like equipment*. For that equipment, all refrigerant added to the system must first be either recycled or reclaimed.

EPA regulations restrict the resale of used refrigerant to a new owner unless it has been reclaimed by an EPA-certified refrigerant reclaimer. To be properly reclaimed, used refrigerant must be reprocessed to at least the purity level specified by the Air Conditioning, Heating, and Refrigeration Institute (AHRI) standards. This purity level must be verified using the laboratory protocol set forth in this same standard.

Refrigerant reclaimers must be certified by EPA. Work groups can return recovered refrigerant to a consolidator (such as a refrigerant manufacturer, supplier, wholesale distributor, or refrigerant recovery company) for packaging and preparation prior to reclamation, or in some cases directly to an EPA reclaimer.

Work groups need to keep records of refrigerant use including purchases, quantities used or recovered, amount recycled, and amounts sent out for reclamation. It is recommended that each cylinder has a log sheet that is used to keep track of all refrigerant removed or added to the cylinder. Work groups that send refrigerant out for reclamation must ensure that they keep records including the name and address of the facility that the recycled refrigerant was sent to for reclamation and/or destruction, the person to whom it was transferred, as well as the date and amount of refrigerant that was sent.

## Refrigerant Use and Recovery

Certified technicians that open appliances for repair or servicing will evacuate the entire unit or the part of the unit to be serviced to a certified recovery and/or recycling machine. A certified technician must verify that the level of evacuation has been reached. *All appliances, except small appliances, motor vehicle air conditioners, and motor vehicle air conditioner-like appliances*, must be evacuated to the levels given in the table below prior to opening the device or prior to disposal of the appliance. There are two exceptions to this requirement:

1. If evacuation of the appliance to the atmosphere is not to be performed after completion of the maintenance, service, or repair, and if the maintenance, service, or repair is not major as defined in [Section III, Definitions](#_DEFINITIONS), the appliance must:
	1. Be evacuated to a pressure no higher than 0 psig before it is opened if it is a medium-, high-, or very high-pressure appliance;
	2. Be pressurized to a pressure no higher than 0 psig before it is opened if it is a low-pressure appliance. Certified technicians must cover openings when isolation is not possible. If pressurizing low-pressure appliances that use refrigerants with boiling points at or below 85 degrees Fahrenheit at 29.9 inches of mercury (standard atmospheric pressure), you may not use methods such as nitrogen that requires subsequent purging. If the boiling point is above 85 degrees Fahrenheit at 29.9 inches of mercury, you must use heat to raise the internal pressure of the appliance as much as possible, but you may use nitrogen to raise the internal pressure of the appliance from the level attainable through the use of heat to atmospheric pressure; or
	3. For the purposes of the oil changes, be evacuated or pressurized to a pressure no higher than 5 psig, before it is opened; or drain the oil into a system receiver to be evacuated or pressurized to a pressure no higher than 5 psig.
2. If leaks in the appliance make evacuation to the levels in the table below unattainable or would substantially contaminate the refrigerant being recovered, the certified technician opening or disposing of the device may:
	1. Isolate leaking from non-leaking components wherever possible;
	2. Evacuate non-leaking components to be opened or disposed of to the levels specified in the table below; and
	3. Evacuate leaking components to be opened or disposed of to the lowest level that can be attained without substantially contaminating the refrigerant. This level may not exceed 0 psig.

| Type of appliance | Values listed are Inches of Hg vacuum (relative to standard atmospheric pressure of 29.9 inches of Hg), except where noted |
| --- | --- |
| Using recovery and/or recycling equipment manufactured or imported before Nov. 15, 1993 | Using recovery and/or recycling equipment manufactured or imported on or after Nov. 15, 1993 |
| Very high pressure appliance | 0 | 0 |
| High pressure appliance, or isolated component of such appliance, normally containing less than 200 pounds or more of refrigerant. | 0 | 0 |
| High pressure appliance, or isolated component of such appliance, normally containing 200 pounds or more of refrigerant. | 4 | 10 |
| Medium pressure appliance, or isolated component of such appliance, normally containing less than 200 pounds of refrigerant | 4 | 10 |
| Medium pressure appliance, or isolated component of such appliance, normally containing 200 pounds or more of refrigerant  | 4 | 15 |
| Low-pressure appliance | 25 mm Hg absolute | 25 mm Hg absolute |

Prior to opening *small appliances* or when disposing of a small appliance, certified technicians will:

* Recover at least 80% of the refrigerant in the appliance when using recycling and recovery equipment manufactured before November 15, 1993; or
* Recover at least 90% of the refrigerant in the appliance when the compressor is operating or 80% of the refrigerant in the appliance when the compressor is not operating using recycling and recovery equipment manufactured on or after November 15, 1993; or
* Evacuate the small appliance to four inches of mercury vacuum.

All *motor vehicle air conditioner and motor vehicle air conditioner-like equipment* that is to be opened for maintenance, service, or repair must be done while properly using the certified recycling or recovery equipment manufactured after November 15, 1993. For recovery and recycling equipment manufactured before this date, the equipment must be able to reduce the system pressure to 102 mm mercury vacuum.

## Extra Requirements for Equipment Containing 50 Pounds or More in a Circuit

Each Penn State appliance owner work group subject to this program must keep a list of appliances under their purview with 50 pounds or more refrigerant in a single circuit. The listing needs to be maintained for at least three years after the appliance is retired. The listing needs to include:

* The appliance owner
* Location, building, building number, room;
* Type of equipment, duty type (comfort cooling, commercial refrigeration, industrial process);
* Make, model, serial number, and date installed;
* Type of refrigerant and full charge per circuit; and
* Method of determining full charge. If using an established range for determining full charge, records must include the range for the full charge of the appliance, its midpoint, and how the range was determined. If there have been any revisions to the full charge, there must be documentation on how they and when they were determined.

Further, these work units must perform leak rate calculations for these appliances and ensure that any repairs are made within required time frames. Certified technicians and contractors must provide service records to the designated person for the appliance owner work group who ensures that leak calculations are performed and maintains the repair records as soon as the work is complete. Since some repairs need to be performed within required time frames, it is important to ensure that the leak rate is calculated in a timely fashion.

The leak rate can be calculated using the formulae in the [refrigerant management spreadsheet series on the EHS website](https://ehs.psu.edu/sites/ehs/files/refrigerant_management_program_forms_rev_2019_triggers.xlsx), or by using either of the following formulae (note that only one of these formulae may be selected for all equipment under the purview of the appliance owner):

Annualizing Method:

$$Leak Rate \left(\%\right)=\left(\frac{pounds refrigerant added}{pounds full charge}\right)x \left(\frac{365 days}{shorter of days since last refrigerant addition or 365 days}\right) ×100\%$$

Rolling Average Method:

$$Leak Rate \left(\%\right)= \frac{pounds of refrigerant added over past 365 days\*}{pounds of refrigerant in full charge} x 100\%$$

*\* Or over the period that has passed since the last successful follow-up verification test showing all identified leaks in the appliance were repaired if that period is less than one year*

Corrective action must occur when an appliance that normally contains a refrigerant charge of 50 pounds or more is discovered to be leaking refrigerant at a rate that exceeds the applicable trigger rate during a 12-month period.

The following trigger leak rates apply for a 12-month period:

|  |  |
| --- | --- |
| **Appliance Type** | **Trigger Leak Rate** |
| Commercial refrigeration | 20% |
| Industrial process refrigeration | 30% |
| Comfort cooling | 10% |
| All other appliances | 10% |

In general, owners or operators of an appliance that is leaking refrigerant above the applicable trigger rate must either:

* Repair leaks within 30 days from the date the leak was discovered; or
* Develop, within 30 days, a plan to retrofit or retire the appliance and complete the actions under that plan within 1 year.

If the applicable leak rate is exceeded, a certified technician must conduct a leak inspection. For *commercial refrigeration* and *industrial process refrigeration* appliances with a full charge of 500 or more pounds, leak inspections must be conducted once every three months until the appliance owner can demonstrate through the leak rate calculations that the appliance has not leaked in excess of the applicable trigger rate for four quarters in a row.

For *commercial refrigeration* and *industrial process refrigeration* appliances with a full charge of 50 or more pounds but less than 500 pounds, leak inspections must be conducted once per calendar year until the appliance owner can demonstrate through the leak rate calculations that the appliance has not leaked in excess of the applicable trigger rate for one year.

For *comfort cooling* appliances and *other appliances*, leak inspections must be conducted once per calendar year until the owner or operator can demonstrate through the leak rate calculations that the appliance has not leaked in excess of the applicable trigger rate for one year.

Leak inspections must be conducted by a certified technician using appropriate methods for the appliance. All visible and accessible components of the appliance must be inspected with the following exceptions:

1. Where components are insulated, under ice that forms on the outside of equipment, underground, behind walls, or are otherwise inaccessible;
2. Where personnel must be elevated more than two (2) meters above a support surface; or
3. Where components are unsafe to inspect as determined by site personnel.

Quarterly or annual leak inspections are not required on appliances, or portions of appliances continuously monitored by an automatic leak detection system that is audited or calibrated annually. An automatic leak detection system may directly detect refrigerant in air, monitor its surrounding in a manner other than detecting refrigerant concentrations in air, or monitor conditions of the appliance.

For systems that directly detect the presence of a refrigerant in air, the system must:

1. Only be used to monitor components located inside an enclosed building or structure;
2. Have sensors or intakes located so that they will continuously monitor the refrigerant concentrations in air in proximity to the compressor, evaporator, condenser, and other areas with a high potential for refrigerant leak;
3. Accurately detect a concentration of 10 ppm of the specific refrigerant or refrigerants used on the appliance; and
4. Alert certified technicians or the owner when a refrigerant concentration of 100 ppm is reached.

For a system that monitors its surrounding in a manner other than detecting refrigerant concentrations in air or monitor conditions of the appliance, the system must automatically alert the certified technicians or owner when measurements indicate a loss of 50 pounds of refrigerant or 10% of the full charge, whichever is less.

Initial and follow-up verification tests must be conducted at the conclusion of any repair efforts in the event that the applicable leak rate is exceeded. These tests are essential to ensure that the repairs have been successful. The primary purpose of the initial verification test is to verify that the leak or leaks have been repaired before refrigerant is added back to the system. If the system fails this leak test, refrigerant should not be added and further efforts must be made to repair the leak. The initial verification test must be made within 30 days of exceeding the trigger leak rate. In cases where an industrial process shutdown is required, a repair period of 120 days is substituted for the normal 30-day repair period. If the initial verification test indicates that the repairs have not been successful, the appliance owner may have certified technicians conduct as many additional repairs and initial verification tests as needed within the allowable time frame. The follow-up verification test is performed within 10 days of the initial test or 10 days of the appliance reaching normal operating characteristics and conditions to re-verify that the repairs continue to hold after the system is returned to its normal operating characteristics or conditions. If the follow-up verification test indicates that the repairs have not been successful, the appliance owner may have certified technicians conduct as many additional repairs and verification tests as needed to bring the appliance below the applicable trigger leak rate within the allowable time period to verify the repairs.

Any appliance that requires additional time must meet the requirements below or the appliance must be mothballed. The request will be considered to be approved unless EPA notifies the appliance owner otherwise. One or more of the following conditions must apply:

1. The appliance is located in an area of radiological contamination or shutting down the appliance will directly lead to radiological contamination. Additional time is permitted to the extent needed to conduct and finish repairs in a safe working environment.
2. Requirements of other regulations make a repair within 30 days (or 120 days if an industrial process shutdown is required) impossible. Additional time is permitted to the extent needed to comply with pertinent regulations.
3. Components that must be replaced as part of the repair are not available within 30 days (or 120 days if an industrial process shutdown is required). Additional time is permitted up to 30 days after receiving delivery of the necessary components, not to exceed 180 days (or 270 days if an industrial process shutdown is required) from the date the appliance exceeded the applicable trigger leak rate.

Repairs to leaks that the certified technician has identified as significantly contributing to the exceedance and that do not require additional time must be completed within the initial 30 day repair period (or 120 days if an industrial process shutdown is required). The owner must document all repair efforts and any reason for the inability to not make the repair within the required time frame. The request to exceed the time frame must be submitted to the EPA within that time frame. The request must include:

* The identification and address of the facility;
* The name of the owner;
* The leak rate;
* The method used to determine the leak rate and full charge;
* The date the appliance exceeded the trigger leak rate;
* The location of the leak(s) to the extent determined to date;
* Any repair work that has been performed thus far, including the date that work was completed;
* The reasons why more than 30 days (or 120 days if an industrial process shutdown is required) are needed to complete the repair;
* And an estimate of when the work will be completed.

If the estimated date is to be extended, a new estimated date of completion and documentation of the reason for that change must also be submitted to EPA within 30 days of identifying that he completion date must be extended. The appliance owner must keep a dated copy of this submission. All reports must be submitted electronically to 608reports@epa.gov.

Chronically leaking appliances are those that contain 50 pounds or more of refrigerant and that leak 125% or more of the full charge in a calendar year. If these are present a report must be submitted to EPA by March 1st of the subsequent year describing the efforts to identify leaks and repair the appliance. Reports must be submitted to 608reports@epa.gov.

If the appliance is to be retrofitted or retired, the appliance owner must develop a plan within 30 days of:

1. The appliance is discovered to be leaking above the trigger rate and the appliance owner intends to retrofit or retire the appliance rather than fix the leak; or
2. The appliance continues to leak above the applicable trigger leak rate after having made the required repairs and verification tests.

If a retrofit or retirement plan is to be made, see [Section IX.D, Retrofit and Retirement Plans for Equipment containing 50 pounds or more of Refrigerant](#_Retrofit_and_Retirement).

For *all appliances* subject to the leak repair requirements, the timelines may be suspended if the appliance has undergone system mothballing. System mothballing means the intentional shutting down of an appliance for an extended period of time where the refrigerant has been evacuated to at least atmospheric pressure. However, the timelines pick up again as soon as the system is brought back on-line.

Service records must be maintained for appliances that contain 50 pounds or more of refrigerant. Each time service has occurred on an appliance, the certified technician must provide the appliance owner with the following information:

* The identity and location of the appliance;
* The date of the maintenance, service, repair, or disposal performed;
* The part of the appliance being maintained, serviced, repaired, or disposed;
* The type of maintenance, service, repair, or disposal performed for each part;
* The name of the certified technician performing the maintenance, service, repair, or disposal; and
* The amount and type of refrigerant added to, or in the case of disposal, removed from the appliance.

In addition to this information, the appliance owner must know the full charge of the appliance and must calculate the leak rate. The method used to calculate the leak rate (annualized or rolling average) must be identified.

## Retrofit and Retirement Plans for Equipment Containing 50 Pounds or More of Refrigerant

A retrofit and retirement plan must be developed if appliance owners decide not to repair appliances that are leaking above the applicable trigger leak rate. The appliance owner must create this plan within 30 days of:

* An appliance leaking above the applicable leak rate if the owner intends to retrofit or retire rather than repair the leak;
* An appliance leaking above the applicable trigger leak rate if the owner fails to take any action to identify or repair the leak; or
* An appliance continues to leak above the applicable trigger leak rate after having conducted the required repairs and verification tests.

The retrofit or retirement plan must contain the following information:

1. The identification and location of the appliance;
2. The type and full charge of refrigerant used in the appliance;
3. The type and full charge of the refrigerant to which the appliance will be converted, if retrofitted;
4. An itemized procedure for converting the appliance to a different refrigerant including changes required for compatibility with the new substitute if retrofitted;
5. A plan for the disposition of the appliance, if retired; and
6. A schedule, not to exceed one year, for completion of the appliance retrofit or retirement.

The retrofit or retirement plan must be signed by an authorized official, dated, accessible at the site of the appliance in paper copy or electronic format, and available for EPA inspection upon request. All identified leaks must be repaired as part of any retrofit plan. Unless granted additional time by EPA, all work performed in accordance with the plan must be finished within one year of the plan’s date (not to exceed 13 months from when the plan was required).

The appliance owner may request that EPA relieve it of the obligation to retrofit or retire that appliance if the appliance owner can establish with 180 days of the plan’s date that the appliance no longer exceeds the applicable trigger leak rate and if the appliance owner agrees in writing to repair all identified leaks within one year of the plan’s date. In this case, the appliance owner must submit to EPA the retrofit or retirement plan with the following information:

1. The date that the requirement to develop a plan was triggered;
2. The leak rate;
3. The method used to determine the leak rate and full charge;
4. The location of the leak(s) identified in the leak inspection;
5. A description of the repair work that has been completed;
6. A description of why the repair was not conducted within the time frames required by the regulations; and
7. A statement signed by an authorized official that all identified leaks will be repaired and an estimate of when those repairs will be completed (not to exceed on year from the data of the plan).

The request must be submitted to EPA at 608reports@epa.gov. The request will be considered approved unless EPA notifies the appliance owner within 60 days of receipt that the request is not approved.

Appliance owners may request extensions to the one year retrofit or retirement schedule. The request will be considered approved unless EPA notifies the appliance owner within 60 days of receipt that the request is not approved. The request must be submitted to EPA with seven months of discovering that the applicable trigger leak rate had been exceeded. The request must include:

1. The identification of the appliance;
2. The name of the appliance owner;
3. The leak rate;
4. The method used to determine the leak rate and full charge;
5. The date the appliance exceeded the applicable trigger leak rate;
6. The location of the leak(s) to the extent determined to date;
7. Any repair work that has been finished thus far, including the date the work was finished;
8. A plan to finish the retrofit or retire the appliance;
9. The date of notification to the EPA; and
10. An estimate of when the retrofit or retirement work will be finished.

A dated copy of the request must be available on-site in either electronic or paper copy. If the estimated completion date is to be revised, a new estimated date of completion and documentation for the reason for the change must be submitted to EPA at 608reports@epa.gov within 30 days.

Additionally, the time frames in this section are suspended when an appliance is mothballed. The time will resume running on the day additional refrigerant is added to the appliance (or component of an appliance if the leaking component was isolated).

Appliance owners of commercial refrigeration, industrial process refrigeration, comfort cooling, or other equipment are automatically allowed 18 months to retire an appliance if the replacement appliance uses a substitute exempted refrigerant.

Appliance owners of *industrial process refrigeration* may request additional time beyond the one year period to finish the retrofit or retirement under that following circumstances:

1. Requirements of other applicable regulations make a retrofit or retirement within one year impossible. Additional time is permitted to the extent needed to comply with the pertinent regulations;
2. The new or retrofitted equipment is custom built and the supplier of the appliance or one of its components has quotes a delivery time of more than 30 weeks from when the order is placed. The appliance or appliance components must be installed within 120 days after receiving delivery of the necessary parts; or
3. After receiving an extension, the appliance owner may request additional time if necessary to finish the retrofit or retirement of the equipment. The request must be submitted to EPA before the end of the ninth month of the initial extension and must include the same information submitted for the extension, with any necessary revisions. A dated copy of the request must be available on-site in either electronic or paper copy. The request will be considered approved unless EPA notifies the appliance owner within 60 days of receipt to the request that it is not approved.

## Extra Requirement for Motor Vehicle Air Conditioner and Motor Vehicle Air Conditioner-Like Equipment

Motor vehicle air conditioner and motor vehicle air conditioner-like equipment has an additional requirement. Any removed refrigerant must be recycled or reclaimed before it can be reused, even in same equipment. It can be recycled on-site which removes oils and impurities or reclaimed off-site by an EPA-certified reclaimer, who returns the refrigerant to virgin specifications.

## Changing Refrigerant Oil and Filters

The oil in a refrigeration appliance can contain large amounts of dissolved refrigerant. EPA requires a reduction in the pressure prior to an oil change to ensure that the bulk of the refrigerant contained in the oil is recovered. It is a violation to change oil at higher than 5 psig.

There are two acceptable procedures for recovering refrigerant contained in oil:

* Evacuate (or pressurize) the refrigeration appliance, or isolated portion, to a pressure no greater than 5 psig and then remove the oil; or
* Drain the oil into a system receiver to be evacuated (or pressurized) to a pressure no greater than 5 psig.

The oils and the oil filters need to be treated as hazardous waste and follow the requirements of the Penn State Chemical Waste Program.

# EQUIPMENT TO BE DISPOSED OF

Any Penn State equipment that contains refrigerants, such as refrigerators, freezers, etc., that is no longer needed is disposed of through Lion Surplus. If the equipment is functional and able to be resold, Lion Surplus will accept it with the refrigerant remaining in the equipment. If, however, the equipment is no longer functional and needs to be disposed, Lion Surplus requires that the refrigerant be removed prior to sending it to them. This must be done by a certified technician. At University Park, the Office of Physical Plant has certified technicians that can do this; at other locations, owners should contact the Maintenance Supervisor to determine who can do this. The exception to this requirement is for *motor vehicle air conditioner and motor vehicle air conditioner-like equipment* to be disposed of; the refrigerant is removed by the final disposition location.

For *small appliances*, All Class I, Class II, and non-exempt substitute refrigerants must be removed from any appliance prior to disposal.

For equipment that is to be disposed of, a certified technician must verify that the applicable level of evacuation has been reached in the appliance prior to it being opened. These levels are specified in [Section IX.B, Refrigerant Use and Recovery](#_Refrigerant_Use_and).

A “Certificate of Removal” label, as shown below, must be affixed to the appliance that certifies the refrigerant is removed.



Certified technicians that evacuate refrigerant from appliances with a full charge of more than five (5) pounds and less than 50 pounds of refrigerant for purposes of disposal of that appliance must keep records documenting the following for three years:

1. The company name, location of the appliance, date of recovery, and type of refrigerant recovered for each appliance; and
2. The total quantity of refrigerant, by type, recovered from all disposed appliances in each calendar month.

In addition, all oil and oil filters are to be removed prior to disposal.

# CONTRACTOR REQUIREMENTS

All contractors that work on Penn State equipment must be compliant with EPA’s refrigerant regulations. Only appropriately certified technicians can perform maintenance, service, or repair of appliances containing Class I, Class II, or non-exempt substitute refrigerant. The contractor must provide service records that include information on refrigerant removals and additions, and leak testing to the work group that is responsible for the equipment. The work group must ensure that the refrigerant in the appliance is tracked in accordance with this Refrigerant Management Program. No one may intentionally release refrigerant to the atmosphere.

Some work groups may act as “service provider” to other work groups. In these cases the work group who is the “appliance owner” is responsible to determine with the “service provider” who will be the record keeper. Each work group is responsible to ensure that all their requirements under the Penn State Refrigeration Management Program are met (Refer to [Section IV, Responsibilities](#_RESPONSIBILITIES)).

# RECORDKEEPING

Service Providers - three years of these records must be available within each work group:

1. Service Records - for every service to an appliance containing 50 pounds or more of refrigerant in a circuit:
* The identity and location of the appliance;
* The date of the maintenance, service, repair, or disposal performed;
* The part of the appliance being maintained, serviced, repaired, or disposed;
* The type of maintenance, service, repair, or disposal performed for each part;
* The name of the certified technician performing the maintenance, service, repair, or disposal; and
* The amount and type of refrigerant added to, or in the case of disposal, removed from the appliance.
1. Leak Inspections for each appliance with 50 pounds or more refrigerant – each service provider must record leak inspections and provide to the appliance owner the following:
* the date of the inspection,
* the method used to conduct the inspection,
* a list of the location of each leak that was identified, and
* a certification that all visible and accessible parts of the appliance were inspected.
1. Initial and Follow-up Verification Tests –
* Date of test
* Location of appliance
* Location(s) of all repaired leaks that were tested;
* Type of verification test performed;
* Results of the test.
1. Refrigerant Purchase Records - including type, amount, date, and supplier information. The supplier must have the name of at least one certified person in order to allow purchases of refrigerant. The work group must notify them if this person leaves employment and provide the name of another certified employee.
2. Refrigerant Use Records - maintain a log that shows refrigerant use either by work group or by technician for each type of refrigerant.
3. Refrigerant Reclamation Records - work groups who do this must ensure that they keep records including the name and address of the facility that the recycled refrigerant was sent to, the person to whom it was transferred, as well as the date and amount of refrigerant that was sent.
4. Technician Certification - maintain copies of each technician’s certification for three years following employments as a certified technician, and ensure that the work group has employees certified for all types of the required work.
5. Written Standard Operation Procedures (SOPs) for all refrigeration work.
6. Self-Audit - completed by January 31st each year by the work group leader with a copy sent to EHS.

Appliance Owners - three years of these records must be available:

1. Refrigerant Equipment Asset Listing - all appliances that contain 50 pounds or more of refrigerant in a circuit refrigerant under the purview of the Appliance Owner. The listing is to be submitted annually to EHS and includes the following:
* Location, building, building number, room;
* Type of equipment, duty type (comfort cooling, commercial refrigeration, industrial process);
* Make, model, serial number, and date installed;
* Type of refrigerant and full charge per circuit; and
* Method of determining full charge.
1. Service Records - for every service to an appliance containing 50 pounds or more of refrigerant in a circuit the invoice or service record from either a Penn State Service Provider or a contracted vendor must include:
* The identity and location of the appliance;
* The date of the maintenance, service, repair, or disposal performed;
* The part of the appliance being maintained, serviced, repaired, or disposed;
* The type of maintenance, service, repair, or disposal performed for each part;
* The name of the certified technician performing the maintenance, service, repair, or disposal; and
* The amount and type of refrigerant added to, or in the case of disposal, removed from the appliance.
1. Leak Inspections for each appliance with 50 pounds or more refrigerant when an applicable trigger leak rate is exceeded – each service provider must record leak inspections and provide to the appliance owner the following:
* the date of the inspection,
* the method used to conduct the inspection,
* a list of the location of each leak that was identified, and
* a certification that all visible and accessible parts of the appliance were inspected.
1. All leak rate calculations on appliances containing 50 pounds or more of refrigerant in a circuit and the type of calculation used (annualized or rolling average). If refrigerant has been excluded from the leak rate due to removal/addition from seasonal variation, records must be maintained stating that the appliance owner is using the seasonal variance flexibility and documenting the amount added and removed.
2. Initial and Follow-up Verification Tests following repairs where the applicable trigger leak rate was exceeded –
* Date of test
* Location of appliance
* Location(s) of all repaired leaks that were tested;
* Type of verification test performed;
* Results of the test.
1. Record of annual inspection of integrity of mechanical rooms with refrigerant-containing appliances.
2. Retrofit or retirement plans, if applicable and any extension requests.
3. Records of any mothballing of appliances including date of mothballing and when appliance was returned to service.
4. Any reports submitted to EPA and any responses received.
5. Self-Audit – completed by January 31st each year by the Appliance Owner with a copy sent to EHS.

# RECORD OF REVISIONS

|  |  |
| --- | --- |
| Date  | Revision |
| February 27, 2017 | Initial program document |
| August 5, 2022 | Added document numbers to forms; deleted pre-2019 leak rates |
|  |  |

# FORMS

* Refrigerant Management Program Self-Audit for Service Providers
* Refrigerant Management Program Self-Audit for Appliance Owners

Samples of forms that can be used for:

* Refrigerant Containing Equipment Asset Form
* Technician Service Log
* Refrigerant Leak Tracking Log – Annualizing Method
* Refrigerant Leak Tracking Log – Rolling Average Method
* Refrigerant Use Cylinder Tracking Log

Note: These forms are also available in an [Excel Workbook on the EHS webpage](https://ehs.psu.edu/sites/ehs/files/refrigerant_management_program_forms_rev_2019_triggers.xlsx) that include formulas for the leak rate calculations. Work groups must track all the items required under Recordkeeping but are not required to use any specific form, with the exception of the appropriate self-audit(s). The information must, however, be readily available in the event of an inspection.

**Refrigerant Management Program Self Audit for Service Providers**

Location: Work Group:

Work Group Leader: Date:

| **Item** | **Y/N/NA** | **Comments** |
| --- | --- | --- |
| * 1. Do you have service records for the last three years for all equipment containing 50 pounds or more of refrigerant that you have worked on?
 |  |  |
| * 1. If yes to Question 1, have you provided these records to the appliance owner?
 |  |  |
| 1. Do you have recycling and/or recovery equipment for every type of refrigerant that you work with?
 |  |  |
| 1. Do you have records of all refrigerant purchases within the last three years?
 |  |  |
| 1. Do you have records of all refrigerant that was sent for reclamation during the past three years?
 |  |  |
| 1. Are you tracking all refrigerant use?
 |  |  |
| 1. For equipment to be disposed of, have you ensured that all refrigerant is evacuated to required levels and documented this on the appliance?
 |  |  |
| 1. Do you have copies of all technicians’ certificates and are you maintaining those copies for 3 years following the end of employment as a certified technician?
 |  |  |
| 1. Do you have an appropriately certified technician for each type of equipment that your work group services?
 |  |  |
| 1. Have you provided your refrigerant dealer with a copy of a current and appropriate technician’s certification for refrigerant purchases?
 |  |  |
| 1. Is all refrigerant being properly stored in cylinders that are in good condition?
 |  |  |
| 1. Does your work group have the proper PPE/meters for the refrigerants that you work with?
 |  |  |
| 1. Does your work group have written SOPs?
 |  |  |

**Additional Comments/Clarifications:**

**Submit this completed audit annually to EHS on January 31st.**

**Refrigerant Management Program Self Audit for Appliance Owners**

Location: Work Group:

Work Group Leader: Date:

| **Item** | **Y/N/NA** | **Comments** |
| --- | --- | --- |
| * 1. Do you have refrigeration equipment that contains 50 pounds or more in a circuit? If yes, please attach a copy of the list containing the required information and submit to EHS.
 |  |  |
| * 1. Do you have service records (PSU and/or contractor) for the last three years for all equipment containing 50 pounds or more of refrigerant? If yes, indicate contractor, PSU, or both.
 |  |  |
| 1. Have you calculated leak rates for all appliances with 50 pounds or more refrigerant that have had refrigerant addition and/or leaks this year?
 |  |  |
| 1. Did any of the appliances under your purview exceed the appropriate trigger leak rate?
 |  |  |
| 1. If yes to question 4, was the leak repaired within the required time frame (including initial and follow-up verification tests and required leak inspections)? If no, provide detail.
 |  |  |
| 1. Do any of your appliances meet the definition of “chronically leaking” (loss of 125% of full charge over one year)?
 |  |  |
| 1. Have you been required to submit any reports to EPA? If yes, do you have copies of those reports?
 |  |  |
| 1. Have you mothballed any appliances?
 |  |  |
| 1. Have you had a service provider perform an annual inspection of the integrity of mechanical rooms with refrigerant-containing appliances?
 |  |  |
| 1. Provide the type and amount of refrigerant that was lost over the calendar year in all appliances with 50 pounds or more of refrigerant in a circuit.
 |  |  |

**Additional Comments/Clarifications:**

**Submit this completed audit annually to EHS on January 31st.**

**Penn State University - Refrigerant Containing Equipment Asset Form**

|  |  |
| --- | --- |
| **Campus/Location:** |   |
| **Building:** |   |
| **Building No.:** |   |
| **Room or Location Description:** |   |
| **Type of Equipment:** |   |
| **Type of Refrigerant:** |   |
| **Date Installed:** |   |
| **Manufacturer:** |   |
| **Model:** |   |
| **Serial Number:** |   |
| **Appliance Type:** |   |
| **Duty Type (see note):** |   |
| **Number of Circuits:** |   |
| **Work group responsible for records:** |   |
| **Notes:** |   |   |
|  |   |   |
|   |   |   |
|   | **Refrigerant Charge per Circuit (lbs.):** | **Method used to determine charge (see note)** |
| **Circuit 1:** |   |   |
| **Circuit 2:** |   |   |
| **Circuit 3:** |   |   |
| **Circuit 4:** |   |   |
|  |  |  |
| Notes: |  |  |
| 1. Duty type can be comfort cooling, industrial process, or commercial (food storage) |
| 2. Method used to determine charge can be unit name plate, scale (weighed charge), engineering specifications, estimate/calculation, other (describe) |

**Penn State University - Technician Refrigerant Service Log**

|  |  |
| --- | --- |
| **Building:** |   |
| **Unit:** |   |
| **Building Number:** |   |
| **Room Number:** |  |
| **Manufacturer:** |   |
| **Model No:** |   |
| **Serial No:** |   |
| **Circuit:** |   |
| **Type of Refrigerant:** |   |
| **Date of Service:** |   |
| **Actions Performed:** | **Description (include part and type of service, repair, maintenance or disposal):** |
|  \_\_ Maintenance |
|  \_\_ Upgrade |
|  \_\_ Start Up  |
|  \_\_ Leak Inspection |
|  \_\_ Decommission unit |
|  \_\_ Mothball unit |
|  \_\_ Return Unit to Service |
|  \_\_ Retirement/Retrofit Plan |
|  \_\_ Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Leak Repaired?** |   |
| **Initial Leak Test?** |   |
|  Method: |   |
|  \_\_ Pressurizing |   |
|  \_\_ Electronic |   |
|  \_\_ Deep Vacuum |   |
|  \_\_ Soap Bubble |   |
|  \_\_ Other (describe):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |   |
| **Follow-up Leak Test?** |   |
|  Method: |   |
|  \_\_ Pressurizing |   |
|  \_\_ Electronic |   |
|  \_\_ Deep Vacuum |   |
|  \_\_ Soap Bubble |   |
|  \_\_ Other (describe):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |   |
| **Refrigerant Removed (lbs.):** |   |
| **Refrigerant Added (lbs.):** |   |
| **Loss (lbs.):** |   |
| **Technician Name (printed):** |   |
| **Technician Signature:** |   |
| **Notes:** |   |
|   |   |
|   |   |
| **When service is complete, return this log to:** |

**Penn State University – Refrigerant Leak Tracking – Annualizing Method**

|  |  |
| --- | --- |
| **Building:** |   |
| **Unit:** |   |
| **Building Number:** |   |
| **Manufacturer:** |   |
| **Model No:** |   |
| **Serial No:** |   |
| **Circuit:** |   |
| **Full Charge (lbs.):** |   |
| **Type of Refrigerant:** |   |
|  |  |
| **Type of Equipment (insert an x in column next to the correct type)** |
|  | **Comfort Cooling** |
|  | **Industrial Process Refrigeration** |
|  | **Commercial Refrigeration** |
|  | **All Other Refrigeration** |
|  |  |
| **Trigger Rate:** |  |
| **Date last filled:** |  |
|  |  |
| **Date of service:** |  |
| **Refrigerant added:** |  |
| **Leak rate:** |  |
| **Leakage Rate Exceeds Trigger?** |  |
|  |  |
| **Date of service:** |  |
| **Refrigerant added:** |  |
| **Leak rate:** |  |
| **Leakage Rate Exceeds Trigger?** |  |
|  |  |
| **Date of service:** |  |
| **Refrigerant added:** |  |
| **Leak rate:** |  |
| **Leakage Rate Exceeds Trigger?** |  |

|  |  |
| --- | --- |
| **Date of service:** |  |
| **Refrigerant added:** |  |
| **Leak rate:** |  |
| **Leakage Rate Exceeds Trigger?** |  |

**Penn State University – Refrigerant Leak Tracking – Rolling Average Method**

|  |  |
| --- | --- |
| **Building:** |  |
| **Unit:** |  |
| **Building Number:** |  |
| **Manufacturer:** |  |
| **Model No:** |  |
| **Serial No:** |  |
| **Circuit:** |  |
| **Full Charge (lbs.):** |  |
| **Type of Refrigerant:** |  |
|  |  |
| **Type of Equipment (insert an x next to the correct type)** |
|  | **Comfort Cooling** |  |  |
|  | **Industrial Process Refrigeration** |  |  |
|  | **Commercial Refrigeration** |  |  |
|  | **All Other Refrigeration** |  |  |
|  |  |  |  |
| **Trigger Rate:** |  |  |  |
|  |  |  |  |
| **Date of Service** | **Refrigerant Added** | **Calculated 12 Month Rolling Sum** | **Leak Rate** |
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**Penn State University – Refrigerant Log**

|  |  |  |  |
| --- | --- | --- | --- |
| **Technician:** |  |  |  |
| **Type of Refrigerant:** |  |  |  |
| **Cylinder Size (lbs.):** |  |  |  |
| **Date Put Into Use:** |  |  |  |
| **Date Returned:** |   |  |  |
|  |  |  |  |  |
| **Date** | **Cylinder Gas Addition (lbs.)** | **Cylinder Gas Use (lbs.)** | **Location and Equipment Refrigerant Added/Removed** | **Cylinder Current Weight (lbs.)** |
|  |  |  |  |  |
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