

Safe Servicing of Household Appliances with Flammable Refrigerants: Recommended Practices

By

AHAM

The Association of Home Appliance Manufacturers

The guidance and recommendations in this brochure were developed by representatives of appliance manufacturers, in conjunction with some of their refrigerant suppliers. These *Recommended Practices* were developed by the members of AHAM. January 2019

Version 2.0



Table of Contents

Introduction	3
Common Flammable Refrigerants	4
Recommended Procedures for Safe Handling and Servicing	5
Service Procedures	5
<i>Pre-service Safety Check</i>	5
<i>Leak Detection and Coolant-line Repair</i>	6
<i>Recharging or Replacing Refrigerant</i>	7
<i>Refrigerant Removal</i>	8
After Servicing	9
Disposal of Appliances Containing Flammable Refrigerants	10
Storage of Flammable Refrigerant Cylinders	10
Transport of Flammable Refrigerant Cylinders.....	11
Final Note	12

Introduction

The manufacturers of cold appliances (e.g. household refrigerators, freezers, ice makers, beverage coolers, room and portable air conditioners, and dehumidifiers), represented by the Association of Home Appliance Manufacturers (AHAM), provide the following recommended safety procedures and information for technicians servicing appliances with flammable refrigerants classified as A2, A2L, or A3 in customers' homes. This refrigerant nomenclature is found in American Society of Heating, Refrigeration, Air Conditioning Engineers (ASHRAE) Standard 34, *Designation and Safety Classification of Refrigerants*.

As part of its continuing effort to manufacture the most energy efficient, environmentally friendly products, the home appliance industry has begun to sell "cold products" that use alternative refrigerants. These refrigerants are being used, in part, due to regulatory changes that will phase out legacy refrigerants. These new alternatives include A3 refrigerants, such as R-600a and R-290, and A2L refrigerants, such as R-32 and R-452B, which have been safely and widely used for many years in home appliances sold in Europe and Asia.^{1 2} Another alternative is isobutane (R-600a), which has been safely used as a propellant in cosmetics and personal care products. Of the 100 million household refrigerators and freezers manufactured globally every year, roughly one-third or more use flammable refrigerants. These alternative substances have lower global warming potential. However, they are flammable. Thus, precautions are necessary to mitigate the associated risk of fire and explosion hazards related to the higher flammability of these new refrigerants. Unlike heating or cooking LP gas (propane) or natural gas, alternative refrigerants generally do not contain a special odorant.

To reduce the risk of fire or explosion, the home appliance industry recommends safety procedures when a service provider is working with or around appliances that utilize these refrigerants.

¹ Refrigerants used in the United States are subject to approval by the U.S. Environmental Protection Agency under the Significant New Alternatives Policy (SNAP). See Rules 17, 19, and 21 and any other applicable rules at <https://www.epa.gov/snap/snap-regulations> Canadian laws and regulations do not specifically permit certain refrigerants, but rather prohibit or restrict the use of certain substances. For example, the Ozone-depleting Substances Regulation controls the import, export, manufacture, use and sale of ozone depleting substances. <https://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=224>

² Note: This document does not provide guidance on the use of Ammonia as a refrigerant compound. Ammonia is a SNAP approved material, but is not commonly found in household appliances produced in the last 25 years.

This guidance does not attempt to be comprehensive and is not a substitute for manufacturer-specific instructions, applicable safety standards, or federal, provincial, state, or local regulations. This guidance also is not a substitute for additional training by manufacturers on the use of these refrigerants in specific models and appliances. Further, this guidance is in addition to the special product labeling and use conditions required by federal law and developed by industry stakeholders to help ensure such refrigerants can be safely used in the home.

Notice: Appliances that use one of these special refrigerants, such as R-600a, R-290 (propane), R-32, or R-452B, will be marked with a specific symbol that notifies the servicer of the presence of these refrigerants. A service provider should review this marking and follow all instructions from the original equipment manufacturer. Appliances that use A2L or A3 refrigerants will be marked with this label.



This chart lists the more common flammable refrigerants found in household appliances as of 2019.

Refrigerant	Flammable Refrigerant	ASHRAE 34 Classification	Status of Flammability	Required to be re-captured or may be released
R-32	Difluoromethane	A2L	Flammable	Must be recaptured
R-452B	Hydrofluoroolefin-based blend (HFO/HFC)	A2L	Flammable	
R-600a	Hydrocarbon (HC)	A3	Flammable	May be released ^{3, 4}
R-290	Hydrocarbon (HC)	A3	Flammable	

³ Refer to <https://www.epa.gov/snap/refrigeration-and-air-conditioning> for other acceptable refrigerants (the lists on the SNAP website include the ASHRAE 34 safety classification where available). Within the United States, these refrigerants are exempt from the venting prohibition under the Clean Air Act and are exempt from EPA's hazardous waste regulations (RCRA) when contained in a consumer-owned (rather than commercially owned) appliance.

⁴ Within Canada, all three levels of government (federal, provincial, and municipal) contribute to environmental protection and have a role with respect to hazardous waste and hazardous recyclable material. Refrigerants may be subject to regulation under the Canadian Environmental Protection Act or various other provincial and municipal requirements.

Recommended Procedures for Safe Handling and Servicing of Appliances with Flammable Refrigerants (A2, A2L, or A3) According to ASHRAE Standard 34)

Service Procedures

Pre-service Safety Check

The home appliance industry strongly recommends all service technicians receive training on the specific equipment, procedures, and handling of flammable refrigerants before conducting product service.

1. **Use a combustible gas leak detector to perform a background check and monitoring around the appliance. *CAUTION: To avoid a risk of injury, do NOT use leak detectors with an arc or spark module to check for leaks in and around appliances that use A2L or A3 refrigerants.*** The leak detector must be certified for use with the specific refrigerant class being serviced. If flammable refrigerant is detected, immediately ventilate the room, evacuate the area, and notify the owner or customer. Recheck with a combustible gas leak detector before proceeding.
2. **Review the safety data sheet (SDS)** for the refrigerant listed on the appliance's compressor. Because some refrigerants and compressor oils may cause frostbite and others may cause chemical burns, use personal protective equipment (PPE) such as protective gloves, eyewear, etc.
3. **Ensure a dry-powder fire extinguisher** rated for Class B fires is accessible on site. Technicians should be trained in the use of these fire extinguishers.
4. **Utilize a tubing cutter, not a torch** or other heated surface tool due to flammable refrigerants.
5. **Conduct all servicing in a well-ventilated area.** Whenever possible, open a window, door or other means to ventilate the area. Take extra care if the repair work is done in a confined space, including providing enhanced ventilation to prevent formation of flammable atmospheres.

Before repair work is performed, take these steps to ensure that no ignition sources are present:

- Check the area for obvious sources of sparking or open flames.
- Ensure the area is free of open flame or burning materials, including cigarettes, candles, or similar materials.

- Do not operate appliances that utilize open flames, igniters, or have hot surfaces (for example: electric or gas ranges, electric or gas dryers, toasters, and other small appliances) while servicing the appliance.
- Inform the homeowner/consumer that no open ignition sources should be present in or near the area, including cigarette-smoking materials.
- Check the area and the appliance for abnormal signs of ignition or melting of components that might have occurred prior to the service call. If there are signs of these situations, stop and contact the manufacturer before conducting service.
- Maintain a safe zone around the appliance during service work to prevent introduction of ignition sources or entry by the customers.
- If the appliance is being moved to a service center, take care to prevent damage to the appliance, especially the refrigerant lines.
- Utilize vacuum pumps, recovery equipment, and other tools that are rated for and certified for use with A2L or A3 flammable refrigerants. Vacuum pumps must be certified for the refrigerant being used.⁵ Service companies/technicians should consider, where appropriate, the use of spark-proof tools as an additional measure of safety.

Leak Detection and Coolant-line Repair

- Never use potential sources of ignition, open flame, charging with flammable refrigerants, or hot surface tools to detect the presence of a leak. Use soap-bubble testing when charging with oxygen-free dry nitrogen (OFN/OFDN), and a certified and calibrated combustible gas leak detector to test for leaks if the system is charged with an A2L or A3 refrigerant.
- After repair, use a combustible gas leak detector to check for any vented refrigerants. If a leak is detected or the coolant lines must be repaired, replaced or filled, strictly follow all instructions provided by the manufacturer.
- If the combustible gas leak detector signals a release of vented refrigerant, the technician should immediately ventilate the room, evacuate the area, notify the homeowner or customer, and wait until the detection device reads a safe level before conducting the following steps.

1. To reduce the risk of fire or explosion, never use compressed air or oxygen for flushing or pressure testing, if a repair is made to the coolant lines.

⁵ Note: EPA requires that recovery equipment for non-exempt substitutes (e.g., R-32) that is manufactured or imported after 1/1/2017 be certified. See 40 CFR § 82.158 and Appendix B3 and B4.

2. Purge refrigerant lines with OFDN, both before and after the repair. Technicians should be trained in the use of OFDN purging.

3. Purged gas should be discharged from the system according to the manufacturer's instructions, away from ignition sources or air intakes.

4. Use the combustible gas leak detector to determine the environment has no flammable refrigerant present.

5. Do not use external heat from open flame or heating tools with glowing elements to accelerate the defrosting process. If necessary, a hand-held steam cleaner can be used to defrost the evaporator coils.

6. For low refrigerant levels or possible leaks, follow the manufacturer's guidelines.

Recharging or Replacing Refrigerant

1. Recharge the appliance with the exact refrigerant specified by the manufacturer. Any time the sealed refrigerant system must be opened, including when the compressor must be replaced, the original exact refrigerant must be used. The entire system (e.g. fittings, valves, dryers, seals, tubes, etc.) was designed only for the refrigerant listed on the original compressor.

2. **Do not** use heat sources to open the coolant lines, especially those with open flames. Use mechanical means to cut, pierce or change valves.⁶ If brazing of the lines is necessary, strictly follow the instructions provided by the appliance manufacturer.

3. Strictly follow manufacturers' specifications for the recharging or replacement of refrigerant.

Important additional safeguards

If an electrical fault exists that could compromise the refrigerant, repair the electrical fault first.

Before performing service, discharge all capacitors in the machine compartment and disconnect electricity to the appliance, preferably at the circuit breaker. No live electrical components or wiring should be exposed during servicing of the coolant lines. If electricity is necessary to conduct the service work on systems other than the coolant, thoroughly test the coolant lines with the combustible gas leak detector before electricity is connected.

If the appliance has more than one coolant loop, ensure all leaks are repaired and checked.

⁶ See information on recovery requirements for refrigerants in 40 U.S. Code of Federal Regulations, § 82.156(b) and 82.158(e).

Do not expose coolant lines to materials that might cause corrosion to the line or the seals, such as chlorine bleach or ammonia.

Repair or replace all electrical components with the exact specified model and type required by the appliance manufacturer. Many electrical components are specifically engineered for use in appliances with flammable refrigerants and **must** be replaced accordingly.

Perform all service work in a manner to prevent damage to electrical components and insulation. In addition, return all wiring in such a way that the operation of the appliance will not be damaged by mechanical action.

Repair or replace all seals and sealing material to ensure that the areas of the appliance are returned to original condition.

When replacing refrigerant:

Ensure the refrigeration system is properly grounded if the appliance is being operated during charging.

Replace with the exact refrigerant and quantity found on the unit's nameplate/rating plate. The refrigerant should be refrigerant-grade gas and should not be contaminated with other gas materials.

Recharge with the correct amount specified by the manufacturer. *Recharge accuracy is critical for flammable refrigerants.* Consult the service instructions for the manufacturer and product in question. Incorrect charge sizes could result in poor performance.

Refrigerant Removal

1. In all cases, the removal of the refrigerant should be performed in a well-ventilated area.
2. To minimize the generation of static electricity, ensure that proper grounding/bonding of the appliance is maintained during the removal process.
3. Flammable HFC refrigerants required to be recaptured, such as R-32, HFO/HFC refrigerant blends, such as R-452B, and HFO refrigerants, such as R-1234yf (all classified A2L), **must be recaptured** using EPA-certified equipment and upon removal **must not be vented** into the external environment. Follow the manufacturer's recommendations to safely collect the refrigerant in the

appropriate container for transport to an appropriate destruction facility or to an EPA-certified refrigerant reclaimer that accepts A2L refrigerants.⁷

4. Flammable refrigerants containing hydrocarbons such as R-600a and R-290 (both classified as A3), **may be vented into the external environment.**^{8,9} Follow manufacturer recommendations for this type of venting.
5. If the manufacturer recommends removing the refrigerant to a temporary vessel to then release outside, follow all recommendations, including: *Carefully evacuate the gas to the outside, where it will be mixed with the external air, away from ignition sources or air intakes.*
6. If a hose or tube is used to transfer the refrigerant outside the dwelling, use one of sufficient length to prevent the gas from re-entering the dwelling.

- The hose should be of material compatible with the refrigerant.
- Maintain hose discharge end above the ground surface for adequate gas mixing.
- Ensure that no source of ignition is nearby the discharge end.

After Servicing

1. Return or replace all labels, especially safety labels, to their original condition to ensure the next consumer or next servicer is aware of the presence of a flammable refrigerant.
2. Ensure that the red marking for flammable refrigerant identification on the refrigerant tube or cap is visible following servicing.
3. Ensure all ventilation features are returned to their original construction. Ventilation openings are critical to the function of the appliance during and after repair.
4. Compressors may still contain residual refrigerant in the oil after refrigerant is removed. Take these precautions:

7 See <https://www.epa.gov/section608/epa-certified-refrigerant-reclaimers> for information on EPA certified reclaimers.

⁸ Within Canada, all three levels of government (federal, provincial, and municipal) contribute to environmental protection and have a role with respect to hazardous waste and hazardous recyclable material. Refrigerants may be subject to regulation under the Canadian Environmental Protection Act or various other provincial and municipal requirements.

⁹ Within the United States, these refrigerants are exempt from the venting prohibition under the Clean Air Act and are exempt from EPA's hazardous waste regulations (RCRA) when contained in a consumer-owned (rather than commercially owned) appliance.

- **Do not** use external heat sources to remove the compressor from the appliance or to seal off the tubes to/from the compressor.
- Compressors should be plugged, capped, or pinched to allow all refrigerant gases to remain inside until the compressor is recycled or repaired.
- **Never** heat compressors to extract the oil. The compressor oil should be safely disposed of in accordance with local requirements. See U.S. Code of Federal Regulations Chapter 40, Section 82.155 for instructions on the safe disposal of appliances, and section 4.16 of the Canadian Environmental Code of Practice for instructions on the disposal of refrigerants.

Disposal of Appliances Containing Flammable Refrigerants

1. The service organization should develop, maintain, and monitor a written plan for disposal of scrap appliances that contain alternative refrigerants.
2. The service technician must comply with all federal, provincial, state, and local requirements with regard to the recovery or venting of the refrigerants prior to disposal of the appliance. **The refrigerant must be recovered or removed prior to scrapping of the appliance.**
3. Flammable HFC refrigerants required to be recaptured, such as R-32, HFO/HFC refrigerant blends such as R-452B, and HFO refrigerants, such as R-1234yf (all classified A2L), must be recaptured using EPA-certified equipment, and upon removal must not be mixed with other refrigerants or vented into the external environment. Follow the manufacturer's recommendations to safely collect the refrigerant in the appropriate container, the refrigerant for transport to a licensed refrigerant reclamation or destruction facility.
4. Flammable hydrocarbon refrigerants (which may be vented to the external environment) such as R-600a or R-290 (both A3), should be removed safely from the appliance in a well-ventilated area and may be vented to the outside environment, away from ignition sources or air intakes. In removing the refrigerant from the appliance, maintain proper grounding/bonding of the appliance.
5. Appliances prepared for scrapping shall be marked with information required by local jurisdictions.¹⁰

Storage of Flammable Refrigerant Cylinders

1. Ensure that the storage facility has a fire suppression system approved for use with flammable refrigerants. At a minimum, a dry-powder fire extinguisher rated

¹⁰ Some scrap processing companies may require certification that the refrigerant was removed under 40 CFR § 82.155 processes.

for Class B fires must be located near the storage area and the facility should have emergency action and fire prevention plans. Note that flammable gas fires should not be extinguished until the source of the burning gas has been shut off.

2. Ensure the storage area is well ventilated.
3. Ensure the storage area is free of combustible or waste materials.
4. Ensure all areas used for storage of flammable gas containers comply with all federal, provincial, state, and local requirements.
5. **Never** store refrigerant cylinders near sources of ignition.
6. **Never** re-use or re-fill aftermarket service cylinders.
7. Protect gas cylinders from impact, falling, or being knocked over. Ensure that any accompanying protective caps/covers are in place.
8. Keep refrigerant cylinders out of the sun and away from sources of heat. Cylinders should be stored in cool, dry areas where the temperature does not exceed 125 deg. F or 52 deg. C.
9. Secure refrigerant cylinders to prevent theft or tampering.
10. Never fill refrigerant recovery cylinders beyond the maximum capacity.
11. Use appropriate markings and labeling on refrigerant recovery cylinders. This includes flammable material symbols and possible additional color markings.
12. Storage facilities should consider installing combustible gas detection systems in accordance with federal, provincial, state, and local requirements.

Transport of Flammable Refrigerant Cylinders

1. Ensure that a dry-powder fire extinguisher rated for Class B fires is available on the vehicle.
2. Transport of flammable refrigerant cylinders must be in accordance with federal, provincial, state and local requirements.
3. **Do not** store flammable refrigerant cylinders near heat or a source of ignition.
4. Store the cylinders for transport in accordance with US Department of Transportation and Transport Canada requirements.¹¹ Mark flammable

¹¹ For Transport Canada requirements, see the Transportation of Dangerous Goods Regulations, SOR/2017-137.

refrigerant cylinders with a red “FLAMMABLE GAS” graphic as prescribed by U.S. 49 CFR part 172.417.

5. Prior to loading and transport, close the main cylinder valve and remove any regulator valve. Ensure that any accompanying protective caps/covers are also in place.
6. Place cylinders with flammable refrigerant in a well-ventilated area. For enclosed vehicles, transport cylinders or canisters in accordance with US DOT and Transport Canada requirements. Service companies/technicians should consider, where appropriate, that storage cabinets be externally vented as an additional measure of safety.¹²
7. Secure flammable refrigerant cylinders to prevent theft, tampering, or movement during transport.

Final Note

Follow all safety, service, and installation requirements from the manufacturer very carefully. If there are questions, contact the service organization of the manufacturer before proceeding. EPA regulations (40 CFR Part 82, Subpart F) under Section 608 of the Clean Air Act require that technicians who maintain, service, repair, or dispose of equipment that could release ozone-depleting refrigerants into the atmosphere must be certified. This requirement applies to appliances containing most substitute refrigerants, such as HFCs.¹³ Within Canada, provincial regulations require certification for the removal, discharge, handling and disposal of refrigerants containing ozone depleting substances and other hydrocarbons.¹⁴ In addition, Canada has established an Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems and requires certification for technicians servicing halocarbon refrigerant-containing systems that are owned by the federal government.¹⁵ Provincial regulations may require that servicing procedures be carried out in accordance with the Code of Practice.¹⁶

Copyright © 2019 by the Association of Home Appliance Manufacturers (AHAM). All rights reserved.

¹² Consult regulatory requirements such as U.S. OSHA, U.S. DOT, or Transport Canada for transportation requirements of small, single-use cartridges.

¹³ <https://www.epa.gov/section608/section-608-technician-certification>

¹⁴ For example, under the Ontario Environmental Protection Act, in order to purchase and handle refrigerants, you need an Ozone Depletion Prevention certificate card.

¹⁵ This requirement is set out in the Federal Halocarbon Regulations

¹⁶ For example, this is a requirement of Alberta’s Ozone-Depleting Substances and Halocarbons Regulation (Alberta Regulation 181/2000, s. 5).