6560-50-P

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 82

[EPA-HQ-OAR-2024-0503; FRL-12207-01-OAR]

RIN 2060-AW45

Protection of Stratospheric Ozone: Listing of Substitutes Under the Significant New Alternatives Policy Program in Refrigeration and Air Conditioning and Fire Suppression

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: Pursuant to the U.S. Environmental Protection Agency's Significant New Alternatives Policy program, this action proposes to list several substitutes as acceptable, subject to use conditions, for residential and light commercial air conditioning and heat pumps, chillers, household refrigerators and freezers, motor vehicle air conditioning, and fire suppression and explosion protection. This action also proposes to update use conditions for substitutes previously listed for certain air conditioning end-uses and for water coolers.

DATES: Comments must be received on or before **[INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER**] unless a public hearing is held. If a public hearing is held, comments on this notice of proposed rulemaking must be received on or before **[INSERT DATE 30 DAYS AFTER DATE OF PUBLIC HEARING]**. *Public hearing*: Any party requesting a public hearing must notify the contact listed in the **FOR FURTHER INFORMATION CONTACT** section, which is Emily Maruyama at email address: maruyama.emily@epa.gov by 5 p.m. Eastern Daylight Time on or before **[INSERT DATE 5 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. If a public hearing is held, it will take place on or around **[INSERT DATE 15 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. Please refer to the **SUPPLEMENTARY INFORMATION** section for additional information on the public hearing.

ADDRESSES: You may send comments, identified by Docket ID No. EPA-HQ-OAR-2024-

0503 by any of the following methods:

- Federal Rulemaking Portal: https://www.regulations.gov (our preferred method). Follow the online instructions for submitting comments.
- Email: a-and-r-Docket@epa.gov. Include Docket ID No. EPA HQ-OAR-2024-0503 in the subject line of the message.
- Mail: U.S. Environmental Protection Agency, EPA Docket Center, Air and Radiation Docket, Mail Code 28221T, 1200 Pennsylvania Avenue, NW, Washington, DC 20460.
- Hand Delivery or Courier: EPA Docket Center, WJC West Building, Room 3334, 1301 Constitution Avenue, NW, Washington, DC 20004. The Docket Center's hours of operations are 8:30 a.m. to 4:30 p.m., Monday-Friday (except Federal Holidays).

Instructions: All submissions received must include the Docket ID No. for this rulemaking. Comments received may be posted without change to https://www.regulations.gov, including personal information provided. For detailed instructions on sending comments and additional information on the rulemaking process, see the "Public Participation" heading of the **SUPPLEMENTARY INFORMATION** section of this document. For information on EPA Docket Center services, please visit us online at https://www.epa.gov/dockets.

If a public hearing is requested on or before **[INSERT DATE 5 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, the EPA will post an update at https://www.epa.gov/snap. The EPA does not intend to publish a document in the *Federal Register* announcing updates. The public hearing will be held on or around **[INSERT DATE 15 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. Information on the hearing including the time and URL will be posted at EPA's Stratospheric Ozone website at https://www.epa.gov/snap. Refer to the section titled, Public Participation for additional information.

FOR FURTHER INFORMATION CONTACT: For information about this proposed rule, contact Emily Maruyama, Stratospheric Protection Division, Office of Atmospheric Protection

(Mail Code 6205A), Environmental Protection Agency, 1200 Pennsylvania Ave. NW, Washington, DC 20460; telephone number: (202) 564-2809; email address: maruyama.emily@epa.gov. Notices and rulemakings under the EPA's Significant New Alternatives Policy (SNAP) program are available on the EPA's SNAP website at https://www.epa.gov/snap/snap-regulations.

SUPPLEMENTARY INFORMATION:

Preamble acronyms and abbreviations. Throughout this preamble the use of "we," "us," or "our" is intended to refer to the EPA**.** We use multiple acronyms and terms in this preamble. While this list may not be exhaustive, to ease the reading of this preamble and for reference purposes, the EPA defines the following terms and acronyms here:

2-BTP—2-bromo-3,3,3-trifluoropropene
AC—Air Conditioning
AIHA—American Industrial Hygiene Association
AIM—American Innovation and Manufacturing
ANSI—American National Standards Institute
APU—Auxiliary Power Unit
ASHRAE—American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASTM—American Society for Testing and Materials
BTMS—Battery Thermal Management Systems
CAA—Clean Air Act
CAS Reg. No.—Chemical Abstracts Service Registry Identification Number
CBI—Confidential Business Information
CFC—Chlorofluorocarbon
CFR—Code of Federal Regulations
CMAQ—Community Multiscale Air Quality
CO_2—Carbon Dioxide
CRP—Cooperative Research Program
DIY—Do it yourself
DOT—United States Department of Transportation
EEAP—Environmental Effects Assessment Panel
EPA—United States Environmental Protection Agency
ER&R—Emissions Reduction and Reclamation
EV—Exchange Value
FMEA—Failure Mode and Effects Analysis
FR—*Federal Register*
GHG—Greenhouse Gas
GSHP—Ground-Source Heat Pump
HC—Hydrocarbon
HCFC—Hydrochlorofluorocarbon
HCFO—Hydrochlorofluoroolefin
HCR—Hydrocarbon Refrigerant
HD—Heavy-Duty

HDOH—Heavy-Duty On-Highway
HFC—Hydrofluorocarbon
HFO—Hydrofluoroolefin
ICF—ICF International, Inc.
IEC—International Electrotechnical Commission
IPCC—Intergovernmental Panel on Climate Change
IPR—Industrial Process Refrigeration
IRC—International Residential Code
LD—Light-Duty
LFL—Lower Flammability Limit
LMDV—Light- and Medium-Duty Vehicle
MIR—Maximum Incremental Reactivity
MVAC—Motor Vehicle Air Conditioning or Motor Vehicle Air Conditioner
MY—Model Year
NAAQS—National Ambient Air Quality Standard
NAICS—North American Industrial Classification System
NCEL—New Chemical Exposure Limit
NFPA—National Fire Protection Association
NRTL—Nationally Recognized Testing Laboratory
ODP—Ozone Depletion Potential
ODS—Ozone-Depleting Substances
OECD—Organisation for Economic Co-operation and Development
OEL—Occupational Exposure Limit
OEM—Original Equipment Manufacturer
OMB—United States Office of Management and Budget
OSHA—United States Occupational Safety and Health Administration
PBI—Proprietary Business Information
PEL—Permissible Exposure Limit
PFAS—Per- and Polyfluoroalkyl Substances
PFC—Perfluorocarbon
PMN—Pre-Manufacture Notice
PMS—Pantone® Matching System
PPE—Personal Protective Equipment
ppm—Parts Per Million
PRA—Paperwork Reduction Act
PTAC—Packaged Terminal Air Conditioner
PTHP—Packaged Terminal Heat Pump
RAL—“Reichs-Ausschuß für Lieferbedingungen und Gütesicherung,” Germany's National Commission for Delivery Terms and Quality Assurance
RCRA—Resource Conservation and Recovery Act
RFA—Regulatory Flexibility Act
RfC—Reference Concentration
SAE—SAE International, previously known as the Society of Automotive Engineers
SDS—Safety Data Sheet
SIP—State Implementation Plan
SNAP—Significant New Alternatives Policy
SNUR—Significant New Use Rule
TEAP—Technology and Economic Assessment Panel
TFA—Trifluoroacetic Acid
TLV—Threshold Limit Value
TWA—Time Weighted Average
UL—UL, formerly known as Underwriters Laboratories, Inc.

UMRA—Unfunded Mandates Reform Act
VOC—Volatile Organic Compounds
VRF—Variable Refrigerant Flow
WEEL—Workplace Environmental Exposure Limit
WMO—World Meteorological Organization
WSHP—Water-Source Heat Pump

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I. Executive Summary

A. Purpose of the regulatory action

The EPA is proposing new and revised listings after our evaluation of human health and environmental information for certain substitutes under Clean Air Act (CAA) section 612, Significant New Alternatives Policy (SNAP) program. The Agency is proposing action on these new listings in the refrigeration and air conditioning (AC), and fire suppression and explosion protection sectors based on the information that the EPA has included in the docket. This proposed action would provide new refrigerant and fire suppressant options in specific uses, thereby increasing flexibility for industry. It also would revise certain existing requirements under the SNAP program to allow for greater consistency and compatibility with current industry safety standards such as those for AC equipment and for water coolers.

B. Summary of the major provisions of the regulatory action

This action proposes to list new alternatives as well as to revise use conditions for existing alternatives for the refrigeration and AC sector and to list a new alternative for the fire suppression and explosion protection sector. Specifically, the EPA is proposing to:

- Update existing use conditions for hydrofluorocarbon (HFC)-32, R-452B, R-454A, R-454B, R-454C, R-457A, R-290, and R-441A in residential and light commercial AC and heat pumps;
- List the hydrocarbon refrigerant (HCR) blend HCR 4141, hydrofluoroolefin (HFO)-1234ze(E), and the HFO/HFC blend R-516A as acceptable, subject to use conditions, in residential and light commercial AC and heat pumps;
- List HCR 4141 as acceptable, subject to use conditions, in household refrigerators and freezers;
- Update existing use conditions for R-290 in water coolers;
- List R-516A as acceptable, subject to use conditions, in positive displacement chillers and centrifugal chillers;
- List HFO-1234yf as acceptable, subject to use conditions, in retrofit light- and medium-

duty vehicle (LMDV) motor vehicle air conditioning (MVAC), in new MVACs on buses, and in new MVACs in heavy-duty on-highway (HDOH) vehicles;

- List the blend R-444A as acceptable, subject to use conditions, in retrofit LMDV MVACs and retrofit heavy-duty (HD) pickup trucks and van MVACs (complete and incomplete);
- List the blend R-456A as acceptable, subject to use conditions, in retrofit LMDV MVACs, retrofit HD pickup trucks and van MVACs (complete and incomplete), retrofit HDOH MVACs, and retrofit MVACs on buses and trains;
- List the blend R-480A as acceptable, subject to use conditions, in retrofit LMDV MVACs, retrofit MVACs on HD pickup trucks and vans (complete and incomplete), retrofit HDOH MVACs, and retrofit MVACs on buses and trains;
- List the blend R-453A as acceptable, subject to use conditions, in retrofit MVACs on buses and trains; and
- List 2-bromo-3,3,3-trifluoropropene/carbon dioxide (2-BTP/CO_2) as acceptable, subject to use conditions, as a total flooding agent in fire suppression for use in normally unoccupied spaces onboard aircraft including engine nacelles, auxiliary power units (APUs), and cargo bays.

In summary, the common use conditions proposed for new household refrigerators and freezers, residential and light commercial AC and heat pumps, water coolers, and chillers are as follows:

(1) These refrigerants may be used only in new equipment, designed specifically and clearly identified for use with the refrigerant. None of these substitutes may be used as a conversion or “retrofit” refrigerant for existing equipment.

(2) These refrigerants must be used with warning labels on the equipment and packaging that are similar to or match verbatim those required by the relevant Underwriters Laboratories (UL) standard.

(3) Equipment must be marked with distinguishing red color-coded hoses and piping to indicate use of a flammable refrigerant and marked service ports, pipes, hoses, and other devices through which the refrigerant is serviced.

Additional use conditions specific to particular end-uses also apply and are discussed with each proposed listing. The regulatory text of the proposed listings, including the proposed use conditions and further information, appears in tables in the docket for this rulemaking under the title "Proposed Regulatory Text for SNAP Rule 27." All proposed new listings appear in proposed appendix Z of 40 Code of Federal Regulations (CFR) part 82, subpart G. The proposed updated listings for HFC-32, R-452B, R-454A, R-454B, R-454C, R-457A, R-290, and R-441A in residential and light commercial AC and heat pumps and for R-290 in new water coolers appear as proposed changes in appendix R, appendix W, and appendix V of 40 CFR part 82, subpart G.

II. Public Participation

A. Written comments

Submit your comments, identified by Docket ID No. EPA-HQ-OAR-2024-0503 at https://www.regulations.gov (our preferred method), or the other methods identified in the **ADDRESSES** section. Once submitted, comments cannot be edited or removed from the docket. The EPA may publish any comment received to its public docket. Do not submit to the EPA's docket at https://www.regulations.gov any information you consider to be Confidential Business Information (CBI), Proprietary Business Information (PBI), or other information whose disclosure is restricted by statute. Multimedia submissions (audio, video, etc.) must be accompanied by a written comment. The written comment is considered the official comment and should include discussion of all points you wish to make. The EPA will generally not consider comments or comment contents located outside of the primary submission (*i.e.*, on the web, cloud, or other file sharing system). Please visit https://www.epa.gov/dockets/commenting-epa-dockets for additional submission methods; the full EPA public comment policy;

information about CBI, PBI, or multimedia submissions; and general guidance on making effective comments.

B. Participation in virtual public hearing

The EPA may hold a virtual public hearing if the agency receives a request to hold one. Any party requesting a public hearing must notify the contact listed in the **FOR FURTHER INFORMATION CONTACT** section, which is Emily Maruyama at email address: maruyama.emily@epa.gov by 5 p.m. Eastern Daylight Time on or before **[INSERT DATE 5 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. If a virtual public hearing is held, it will take place on or around **[INSERT DATE 15 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]** and further information will be provided on the EPA's Stratospheric Ozone website at https://www.epa.gov/snap.

The EPA will make every effort to follow the schedule as closely as possible on the day of the hearing; however, please plan for the hearings to run either ahead of schedule or behind schedule. Each commenter will have 3-5 minutes to provide oral testimony. The EPA encourages commenters to provide a copy of their oral testimony electronically by emailing it to maruyama.emily@epa.gov. The EPA also recommends submitting the text of your oral comments as written comments to the rulemaking docket EPA-HQ-OAR-2024-0503. Written statements and supporting information submitted during the comment period will be considered with the same weight as oral comments and supporting information presented at the public hearing. The EPA may ask clarifying questions during the oral presentations but will not respond to the presentations at that time.

Please note that any updates made to any aspect of the hearing are posted online at https://www.epa.gov/snap. While the EPA expects the hearing to go forward as set forth above, please monitor our website or contact Emily Maruyama, 202-564-2809, maruyama.emily@epa.gov to determine if there are any updates. The EPA does not intend to publish a document in the *Federal Register* announcing updates.

C. Public access to voluntary consensus safety standards

The EPA is proposing to incorporate by reference the American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ANSI/ASHRAE) Standard 15-2024, "Safety Standard for Refrigeration Systems" (hereafter "ASHRAE 15-2024") in the use conditions for one refrigerant proposed to be listed for use in chillers. The standard concerns the safe design, construction, installation, and operation of refrigeration systems. This standard is available at https://www.ashrae.org/technical-resources/bookstore/ashrae-refrigeration-resources and may be purchased by mail at: 180 Technology Parkway NW, Peachtree Corners, Georgia 30092; by telephone: 1-800-527-4723 in the United States or Canada. ASHRAE 15-2024 and ASHRAE 34-2024 are available as a bundle costing $178.00 for an electronic copy or hard copy. The cost of obtaining this standard is not a significant financial burden for equipment manufacturers or for those selling, installing, and servicing the equipment. Therefore, the ASHRAE standard the EPA is proposing to incorporate by reference is reasonably available.

As one of two co-proposed options for use conditions for listings in the residential and light commercial AC and heat pumps, household refrigerators and freezers, and water coolers end-uses, the EPA proposes to incorporate by reference several industry safety standards from UL. The EPA is also proposing to incorporate by reference an industry safety standard from UL in the use conditions for one refrigerant proposed to be listed for use in chillers. The 2022 revision of the standard UL 60335-2-40, "Household And Similar Electrical Appliances - Safety - Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers" (hereafter "UL 60335-2-40"), 4th edition, December 15, 2022 is available at: https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=43802, and may be purchased by mail at: COMM 2000, 151 Eastern Avenue, Bensenville, IL 60106; Email: orders@shopulstandards.com; Telephone: 1-888-853-3503 in the United States or Canada (other countries dial 1-415-352-2178); Internet address: https://ulstandards.ul.com or

https://www.shopulstandards.com. The cost of the 2022 revision to UL 60335-2-40 is $521 for an electronic copy and $652 for a hard copy.

The 2024 revision of the standard UL 60335-2-24, "Household And Similar Electrical Appliances - Safety - Part 2-24: Particular Requirements for Refrigerating Appliances, Ice-Cream Appliances and Ice-Makers," (hereafter "UL 60335-2-24"), 3rd edition, July 29, 2022, and revisions through February 29, 2024, is available at: https://www.shopulstandards.com/ProductDetail.aspx?productId=UL60335-2-24_3_S_20220729. It may be purchased by mail, email, or telephone as described in the previous paragraph for UL 60335-2-40. The cost of the 2024 revision to the 3rd edition of UL 60335-2-24 is $555 for an electronic copy and $694 for a hard copy.

The February 2024 revision of the standard UL 399, "Drinking Water Coolers" (hereafter "UL 399"), 8th edition, March 30, 2017, and revisions through February 28, 2024, is available at: https://www.shopulstandards.com/ProductDetail.aspx?productId=UL399_8_S_20170330. It may be purchased by mail, email, or telephone as described in the previous paragraphs for UL 60335-2-40 and UL 60335-2-24. The cost of the February 2024 revision to the 8th edition of UL 399 is $798 for an electronic copy and $998 for a hard copy.

UL also offers a subscription service to the Standards Certification Customer Library that allows unlimited access to their standards and related documents. The cost of obtaining these standards is not a significant financial burden for equipment manufacturers and purchase is not necessary for those selling, installing, and servicing the equipment. Therefore, the UL standards the EPA is proposing to incorporate by reference are reasonably available.

III. General Information

A. Does this action apply to me?

The following list identifies regulated entities that may be affected by this rule and their respective North American Industrial Classification System (NAICS) codes:

- New Single-Family Housing Construction (except For-Sale Builders) (236115).

- Commercial and Institutional Building Construction (236220).
- Plumbing, Heating, and Air Conditioning Contractors (238220).
- All Other Basic Organic Chemical Manufacturing (325199).
- Air Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing (333415).
- Aircraft Manufacturing (336411).
- Motor Vehicle Manufacturing (3361).
- Motor Vehicle Parts Manufacturing (3363).
- Refrigeration Equipment and Supplies Merchant Wholesalers (423740).
- Recyclable Material Merchant Wholesalers (423930).
- Convenience Stores (445120).
- General Automotive Repair (811111).
- Appliance Repair and Maintenance (811412).
- Fire Protection (922160).

This list is not intended to be exhaustive, but rather to provide a guide for readers regarding entities likely to be affected by this action. To determine whether your facility, company, business, or organization could be affected by this action, you should carefully examine the regulations at 40 CFR part 82, subpart G, and the proposed revisions. If you have questions regarding the applicability of this action to a particular entity, consult the person listed in the **FOR FURTHER INFORMATION CONTACT** section.

B. What action is the Agency proposing to take?

The EPA is proposing to list new alternatives for the refrigeration and AC sector and for the fire suppression and explosion protection sector. The Agency also proposes to revise use conditions for existing alternatives for the refrigeration and AC sector and list a new alternative for the fire suppression and explosion protection sector.

C. What is the Agency's authority for taking this action?

This action is based upon the EPA's authority under CAA section 612. The SNAP program implements CAA section 612. The first SNAP rulemaking was promulgated in 1994, and set forth the framework for the program in addition to finalizing listings for a number of alternatives as acceptable. Since that time, EPA has issued 26 final rules and 39 Federal Register notices under the SNAP program. Several major provisions of CAA section 612 are as follows:

CAA section 612(c) requires the EPA to promulgate rules making it unlawful to "replace any class I [(chlorofluorocarbon (CFC), halon, carbon tetrachloride, methyl chloroform, methyl bromide, hydrobromofluorocarbon, and chlorobromomethane)] or class II [(hydrochlorofluorocarbon (HCFC))] substance with any substitute substance which the Administrator determines may present adverse effects to human health or the environment, where the Administrator has identified an alternative to such replacement that (1) reduces the overall risk to human health and the environment; and (2) is currently or potentially available." CAA section 612(c) requires the EPA to publish a list of the substitutes that it finds to be unacceptable for specific uses and to publish a corresponding list of acceptable substitutes for specific uses. Since its inception, the SNAP program has continually responded to petitions and submissions using either a rulemaking or notice to convey listing decisions.

CAA section 612(d) grants the right to any person to petition the Administrator to add a substance to, or delete a substance from, the lists published in accordance with section 612(c).

CAA section 612(e) directs the EPA to require "any person who produces a chemical substitute for a class I substance … to notify the [Agency] not less than 90 days before new or existing chemicals are introduced into interstate commerce for significant new use as substitutes for a class I substance." The producer must also provide the Agency with the producer's unpublished health and safety studies on such substitutes.

The regulations for the SNAP program are promulgated at 40 CFR part 82, subpart G, and the Agency's process for reviewing SNAP submissions is described in regulations at 40 CFR 82.180. Under these rules, the Agency identified five types of listing decisions: acceptable;

acceptable, subject to use conditions; acceptable, subject to narrowed use limits; unacceptable; and pending. Use conditions and narrowed use limits are both considered "use restrictions." Substitutes that are deemed acceptable with no use restrictions (no use conditions or narrowed use limits) can be used for all applications within the relevant end-uses in the sector. After reviewing a substitute, the Agency may determine that a substitute is acceptable if certain conditions in the way that the substitute is used are met to minimize risks to human health and the environment. The EPA describes such substitutes as "acceptable, subject to use conditions."[1] For some substitutes, the Agency may permit a narrowed range of use within an end-use or sector. For example, the Agency may limit the use of a substitute to certain end-uses or specific applications within an industry sector. The EPA describes these substitutes as "acceptable subject to narrowed use limits."[2] Under the narrowed use limit, users intending to adopt these substitutes "must ascertain that other alternatives are not technically feasible."[3] CAA section 612 and the EPA regulations do not allow the introduction of substitutes on the "unacceptable" list into interstate commerce unless and until the effective date of a final rule that changes an unacceptable listing to acceptable, acceptable subject to use conditions, or acceptable subject to narrowed use limits.

Many SNAP listings include "comments" or "further information" to provide additional information on substitutes. Since this additional information is not part of the regulatory decision under SNAP, these statements are not binding for use of the substitute under the SNAP program. The EPA encourages users of substitutes to apply all statements in the "Further Information" column in their use of these substitutes. Regulatory requirements so listed may be binding under other regulatory programs (*e.g.*, worker protection regulations promulgated by United States Occupational Safety and Health Administration (OSHA) or Department of Transportation (DOT) requirements for transport of flammable gases). In many instances, the information simply refers

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[1] 40 CFR 82.180(b)(2).
[2] 40 CFR 82.180(b)(3).
[3] *Id.*

to sound operating practices that have already been identified in existing industry and/or building codes or safety standards. Thus, many of the statements, if adopted, would not require the affected user to make significant changes in existing operating practices.

The "Further Information" column also does not necessarily include all other legal obligations pertaining to the manufacture, use, handling, and disposal of the listed substitute. Flammable refrigerants being recovered or otherwise disposed of from commercial or industrial air conditioning equipment are likely to be considered hazardous waste under the Resource Conservation and Recovery Act (RCRA).[4] Lower flammability ignitable spent refrigerants that are recycled for reuse can follow alternative safety standards under 40 CFR part 266, subpart Q, instead of the full RCRA Subtitle C hazardous waste requirements.

For additional information on the SNAP program, visit the EPA's SNAP website at https://www.epa.gov/snap. The lists of acceptable substitutes for Ozone-Depleting Substances (ODS) in all industrial sectors are available at https://www.epa.gov/snap/snap-substitutes-sector. For more information on the Agency's process for administering the SNAP program or criteria for evaluation of substitutes, refer to the initial SNAP rulemaking, codified at 40 CFR part 82, subpart G.[5] SNAP decisions and the appropriate *Federal Register* (FR) citations can be found at https://www.epa.gov/snap/snap-regulations. Substitutes listed as unacceptable; acceptable, subject to narrowed use limits; or acceptable, subject to use conditions, are also listed in the appendices of 40 CFR part 82, subpart G.

D. What are the guiding principles of the SNAP program and what are the SNAP criteria for evaluating substitutes?

The guiding principles of the SNAP program are described in the preamble to the first SNAP rule.[6] These principles, reiterated and described in many subsequent SNAP rulemakings, are:

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[4] 40 CFR parts 260-270.
[5] See 59 FR 13044; March 18, 1994.
[6] *Ibid.*

1. Evaluate substitutes within a comparative risk framework: The SNAP program evaluates the risk of substitutes compared to available or potentially available substitutes which the new substitutes are intended to replace.
2. Do not require that substitutes be risk free to be found acceptable: Substitutes found to be acceptable must not pose significantly greater risk than other substitutes, but they do not have to be risk free.
3. Restrict those substitutes that are significantly worse: The EPA does not intend to restrict a substitute if it has only marginally greater risk.
4. Evaluate risks by use: Central to SNAP's evaluations is the intersection between the characteristics of the substitute itself and its specific end-use application.
5. Provide the regulated community with information as soon as possible.
6. Do not endorse products manufactured by specific companies.
7. Defer to other environmental regulations when warranted: In some cases, the EPA and other federal agencies have developed extensive regulations under other sections of the CAA or other statutes that address potential environmental or human health effects that may result from the use of certain substitutes. The SNAP program takes existing regulations under other programs into account when reviewing substitutes.

In making decisions regarding whether a substitute is acceptable or unacceptable, and whether substitutes present risks that are lower than or comparable to risks from other substitutes that are currently or potentially available in the end-uses under consideration, the EPA examines the following criteria in 40 CFR 82.180(a)(7): "(i) atmospheric effects and related health and environmental impacts; (ii) general population risks from ambient exposure to compounds with direct toxicity and to increased ground-level ozone; (iii) ecosystem risks; (iv) occupational risks; (v) consumer risks; (vi) flammability; and (vii) cost and availability of the substitute." To enable the EPA to assess these criteria, we require submitters to include various information including but not limited to ozone depletion potential (ODP), flammability, and the potential for human

exposure. The EPA applies the same criteria to all evaluations; however, the Agency notes, for different sectors, the relevance of the factors may vary. For example, for the fire suppression sector, flammability would be considered differently than for the other sectors.

To assess atmospheric effects, the EPA uses both the ODP of class I and class II ODS in appendix A of 40 CFR part 82, subpart A and where appropriate the exchange values for HFCs listed in the American Innovation and Manufacturing (AIM) Act and codified at 40 CFR part 84, subpart A. For both ODP and exchange values, there are equivalent values listed in *Montreal Protocol on Substances that Deplete the Ozone Layer* (Montreal Protocol) annexes.[7] For substitute compounds without these values, the Agency uses information provided in the World Meteorological Organization (WMO) 2022 assessment,[8] and other relevant sources. For chemical blends, such as the fire suppressant blend proposed as acceptable in this document, the EPA calculates atmospheric effects values as a mass weighted average of each component of the blend.

In a future notice and comment rulemaking, the EPA plans to revisit the criteria used for these evaluations particularly regarding atmospheric effects. The EPA acknowledges that there is an important relationship between ODS and HFCs. Therefore, this future rulemaking may be combined with other relevant proposals in order to consider the provisions regarding substitutes under CAA Title VI and the AIM Act subsection (i) paragraph (5) holistically. The Agency is not proposing or seeking comment on these topics in this rulemaking.

The SNAP program uses exposure assessments to estimate concentration levels of substitutes to which workers, consumers, the general population, and environmental receptors may be exposed over a determined period of time. These assessments are based on personal

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[7] https://ozone.unep.org/treaties/montreal-protocol/montreal-protocol-substances-deplete-ozone-layer

[8] WMO, *Scientific Assessment of Ozone Depletion: 2022*, GAW Report No. 278, 509 pp.; WMO: Geneva, 2022. Available at: https://ozone.unep.org/system/files/documents/Scientific-Assessment-of-Ozone-Depletion-2022.pdf. (WMO, 2022).

monitoring data or area sampling data if available. Exposure assessments may be conducted for many types of releases including: (1) releases in the workplace and in homes; (2) releases to ambient air and surface water; (3) releases from the management of solid wastes.

The SNAP program uses toxicity data to assess the possible health and environmental effects of exposure to substitutes. We use broad health-based criteria such as: (1) Permissible Exposure Limits (PELs) for occupational exposure; (2) inhalation reference concentrations (RfCs) for noncarcinogenic effects on the general population; and (3) cancer slope factors for carcinogenic risk to members of the general population. When considering risks in the workplace, if OSHA has not issued a PEL for a compound, the EPA then considers Recommended Exposure Limits from the National Institute for Occupational Safety and Health, Workplace Environmental Exposure Limits (WEELs) set by the American Industrial Hygiene Association (AIHA), or Threshold Limit Values (TLVs) set by the American Conference of Governmental Industrial Hygienists. If limits for occupational exposure or exposure to the general population are not already established, then the EPA derives these values following the Agency's peer reviewed guidelines. Exposure information is combined with toxicity information to explore any basis for concern. Toxicity data are used with existing EPA guidelines to develop health-based limits for interim use in these risk characterizations.

The SNAP program examines flammability as a safety concern for workers and consumers. The EPA assesses flammability risk using data on: (1) flash point and flammability limits (*e.g.,* OSHA flammability/ combustibility classifications); (2) data on testing of blends with flammable components; (3) test data on flammability in consumer applications conducted by independent laboratories; and (4) information on flammability risk mitigation techniques.

The SNAP program also examines other potential environmental impacts such as ecotoxicity and local air quality impacts. A compound that is likely to be discharged to water may be evaluated for impacts on aquatic life. Some substitutes are volatile organic compounds (VOC). The EPA also notes whenever a potential substitute is considered a hazardous or toxic air

pollutant (under CAA sections 112 (b) and 202 (l)) or hazardous waste under the RCRA subtitle C regulations.

The EPA also notes that the U.S. government has not adopted a single definition of per- and polyfluoroalkyl substances (PFAS) and has not included HFCs, HFOs, 2-BTP, or trifluoroacetic acid (TFA) in any PFAS-related restrictions. There also is no consensus definition of PFAS as a class of chemicals, and different definitions can result in more or fewer chemicals being classified as PFAS. There are several HFCs and HFOs, among other chemicals such as 2-BTP and TFA, that are defined as PFAS by some states and other jurisdictions. The EPA is not proposing or seeking comment on any definitions of PFAS in this rulemaking.

As described above, the proposed listing decisions consider whether substitutes present risks that are lower than or comparable to risks from other substitutes that are currently or potentially available in the end-uses under consideration. The EPA does not assume any substitute is risk free.

IV. Residential and Light Commercial Air Conditioning and Heat Pumps

A. What is the EPA proposing in this action?

The EPA is proposing to list R-516A and HFO-1234ze(E) as acceptable, subject to use conditions, for use in all applications under the residential and light commercial AC and heat pumps end-use. The EPA is also proposing to list HCR 4141 as acceptable, subject to use conditions, for use in self-contained room AC, a limited subset of equipment covered by this end-use.

SNAP use conditions are designed to ensure that refrigerants are listed for specific end-uses and in a way that mitigates risks to human health and the environment. The use conditions proposed for these new listings are discussed in Section IV.F. They include a requirement that these refrigerants be used in new equipment only and specific requirements for warning labels and markings. The EPA is also co-proposing two options for an additional use condition related to equipment certification or industry safety standard requirements. These options are described

in detail in Section IV.F.4. One option would incorporate by reference a new edition of the safety standard for this end-use. The second option would require residential and light commercial AC and heat pump equipment to be certified to a U.S. industry consensus safety standard by an organization that is recognized as a Nationally Recognized Testing Laboratory (NRTL).

The proposed regulatory text for listings using the third-party certification option can be found in the docket for this rulemaking under the title "Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Third-Party Certification Option (co-proposed as an alternative to Section III)." The proposed regulatory text for listings using the incorporate by reference option can be found in the docket for this rulemaking under the title "Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Incorporate by Reference Option." If one of the use condition options is finalized, the EPA would publish corresponding finalized listings for R-516A, HCR 4141, and HFO-1234ze(E) in new residential and light commercial AC and heat pump equipment in appendix Z of 40 CFR part 82, subpart G.

The EPA is also proposing to update use conditions for the previously listed refrigerants HFC-32, R-452B, R-454A, R-454B, R-454C, R-457A, R-290, and R-441A for use in the residential and light commercial AC and heat pumps end-use. Information on the previous listing locations and the existing use conditions for these refrigerants can be found in Section IV.E.

The EPA proposes that the same use conditions described previously in this section for the new listings in this end-use would also apply to these updated listings. The EPA is also co-proposing the same two options for a use condition related to equipment certification or industry safety standard requirements. For these updated listings, the EPA intends to finalize one of these co-proposed options along with an appropriate transition period to provide manufacturers with opportunity for a smooth transition between the existing and updated use conditions. Throughout Sections IV. and VI. in this document, the term "updated use conditions" refers to the set of use conditions being proposed that would apply to new equipment manufactured after the effective

date of a final rule. The updated use conditions would neither apply to nor affect equipment manufactured before the effective date of the final rule. All the proposed use conditions are described in detail in Section IV.F. The EPA would update the existing listings for these substitutes in the following locations:

- HFC-32 in new residential and light commercial AC and heat pumps--self-contained room AC only in appendix R of 40 CFR part 82, subpart G;
- HFC-32 in new residential and light commercial AC and heat pumps excluding self-contained room AC in appendix W of 40 CFR part 82, subpart G;
- R-452B, R-454A, R-454B, R-454C, and R-457A in new residential and light commercial AC and heat pumps in appendix W of 40 CFR part 82, subpart G; and
- R-290 and R-441A in new residential and light commercial AC and heat pumps--self-contained room AC only in appendix R of 40 CFR part 82, subpart G.

This proposal would also add listing numbers to each row in the end-use column of appendix W in the table "Refrigerants - Substitutes Acceptable Subject to Use Conditions." Additionally, this proposal would fix a typographical error in appendix R and appendix V where the name of a standard was written as "UL 60355-2-89" instead of "UL 60335-2-89" in the "Further information" column. These formatting and typographical edits would not substantively change any listings in the tables and would improve clarity and readability.

B. Background on residential and light commercial AC and heat pumps

The residential and light commercial AC and heat pumps end-use includes equipment for cooling air in individual rooms, single-family homes, and small commercial buildings. Heat pumps are equipment types that offer both air heating and cooling options for such locations. This end-use differs from commercial comfort AC, which uses chillers to cool water that is then circulated to cool air throughout a large commercial building, such as an office building or hotel. This end-use includes both self-contained and split systems. Self-contained systems include some rooftop AC units (*e.g.*, those ducted to supply conditioned air to multiple spaces) and many

types of room ACs, including packaged terminal air conditioners (PTACs), packaged terminal heat pumps (PTHPs), window AC units, portable room AC units, and wall-mounted self-contained ACs, designed for use in a single room. The EPA refers to the variety of self-contained equipment for cooling a single room using the phrase "residential and light commercial AC and heat pumps—self-contained room AC," irrespective of whether they are air conditioners, providing space cooling, or heat pumps that can either heat or cool a space. Split systems include ducted and non-ducted mini-splits (which might also be designed for use in a single room), multi-splits and variable refrigerant flow (VRF) systems, and ducted unitary splits. Water-source and ground-source heat pumps (WSHPs/GSHPs) often are packaged systems similar to self-contained equipment but could be applied with the condenser separated from the other components similar to split systems. Examples of equipment for residential and light commercial AC and heat pumps include:

- Unitary AC or unitary split systems, also called central air conditioners: These systems include an outdoor unit with a condenser and a compressor, refrigerant lines, an indoor unit with an evaporator, and ducts to carry cooled air throughout a building. Central heat pumps are similar but offer the choice to either heat or cool the indoor space.
- Multi-split and mini-split air conditioners and heat pumps: Multi-split systems include one or more outdoor unit(s) with a condenser and compressor, and multiple indoor units, each of which is connected to the outdoor unit by refrigerant lines. Mini-split systems are similar to multi-split systems, but they have only a single outdoor unit and a single indoor unit, and they cool a single room. Non-ducted multi-splits and mini-splits provide cooled or heated air directly from the indoor unit rather than providing the air through ducts.
- Rooftop AC units: These are units that combine the compressor, condenser, and evaporator in a single package and may contain additional components for filtration and dehumidification. Most units also include dampers to control air intake. Rooftop AC units cool or heat outside air that is then delivered to the space directly through the ceiling or a

duct network. Rooftop AC units are common in small commercial buildings such as a single store in a mall with no indoor passageways between stores (*e.g.*, a "strip-mall"). They can also be set up in an array to provide cooling or heating throughout a larger commercial establishment such as a department store or supermarket.

- Window air conditioners: These are self-contained units that fit in a window with the condenser extending outside the window.
- PTACs and PTHPs: These are self-contained units that consist of a separate, un-encased combination of heating and cooling assemblies mounted through a wall. PTACs and PTHPs are intended for use in a single room and use no ducts to carry cooled air and no external refrigerant lines. Typical applications include motel or dormitory air conditioners.
- Portable room air conditioners: These are self-contained units that usually have wheels and are designed to be moved easily from room to room. They may contain an exhaust hose that can be placed through a window or door to eject heat to the outside.
- WSHPs and GSHPs: These are similar to unitary split systems except that, when in cooling mode, heat is ejected from the condenser through a second circuit rather than directly with outside air. The second circuit transfers the heat to the ground, ground water, or another body of water such as a lake. Water is used for this transfer, but brine can be used if temperatures would risk freezing. Some systems can perform heating in a similar matter with the refrigerant circuit running in reverse. Regardless, the term "heat pump" is most often used.

Unless specified, all these types of AC and heat pump equipment would be subject to the listing decisions under this rule for the identified substitutes. Of these types of equipment, window air conditioners, PTACs, PTHPs, rooftop AC units, portable room air conditioners, and often GSHPs and WSHPs are self-contained equipment with the condenser, compressor, evaporator, and tubing all within a single unit casing. In contrast, unitary split systems, multi-

split systems, and mini-split systems have an outdoor condenser that is separate from an indoor unit. Compared to these split systems, self-contained equipment typically has smaller charge sizes, fewer locations that are prone to leak, and is less likely to require servicing by a technician. These types of AC and heat pump equipment, both self-contained and split systems, typically fall under the scope of UL 60335-2-40.

C. What are the ASHRAE groups for refrigerant flammability and toxicity?

ASHRAE 34-2024 assigns a safety group for each refrigerant, which consists of two to three alphanumeric characters (*e.g.*, A2L or B1).[9] The initial character indicates the toxicity, and the numeral, with or without suffix letter, denotes the flammability. ASHRAE classifies Class A refrigerants as refrigerants for which toxicity has not been identified at concentrations less than or equal to 400 parts per million (ppm) by volume, based on data used to determine threshold limit value-time-weighted average (TLV-TWA) or consistent indices. Class B signifies refrigerants for which there is evidence of toxicity at concentrations below 400 ppm by volume, based on data used to determine TLV-TWA or consistent indices.

ASHRAE 34-2024 also assigns refrigerants a flammability class of 1, 2, 2L, or 3. Tests for flammability are conducted in accordance with American Society for Testing and Materials (ASTM) E681 using a spark ignition source at 140 °F (60 °C) and 14.7 psia (101.3 kPa). The flammability class "1" is given to refrigerants that, when tested, show no flame propagation. The flammability class "2" is given to refrigerants that, when tested, exhibit flame propagation, have a heat of combustion less than 19,000 kJ/kg (8,169 BTU/lb), and have a lower flammability limit (LFL) greater than 0.10 kg/m^3. The flammability class "2L" is given to refrigerants that meet the requirements of the "2" class and have a maximum burning velocity of 10 cm/s or lower when tested in dry air at 73.4 °F (23.0 °C) and 14.7 psia (101.3 kPa). Throughout this document, refrigerants in the flammability class of "2L" are referred to as lower flammability refrigerants.

[9] ASHRAE, 2024b. ANSI/ASHRAE Standard 34-2024: Designation and Safety Classification of Refrigerants.

The flammability class "3" is given to refrigerants that, when tested, exhibit flame propagation and either have a heat of combustion of 19,000 kJ/kg (8,169 BTU/lb) or greater or have an LFL of 0.10 kg/m^3 or lower. Throughout this document, refrigerants in the flammability class of "3" are referred to as higher flammability refrigerants.[10] Flammability for refrigerant blends are designated based on the worst case of formulation for flammability and the worst case of fractionation for flammability determined for the blend. Information about refrigerant safety groups is consistent with that in prior rules under the SNAP program. See Section II.A.2. of SNAP Rule 26[11] for more detail. Using these safety groups, HFO-1234ze(E), HFC-32 and the refrigerant blends R-452B, R-454A, R-454B, R-454C, R-457A, and R-516A are in the A2L Safety Group, while R-290, R-441A, and the components of HCR 4141 are in the A3 Safety Group.

D. What are the refrigerants the EPA is proposing to list as acceptable in the residential and light commercial AC and heat pumps end-use and how do they compare to other refrigerants in this end-use?

The EPA is proposing to list HCR 4141, HFO-1234ze(E), and R-516A as acceptable, subject to use conditions, for this end-use. HCR 4141 is a higher flammability refrigerant blend with each component in the A3 Safety Group. HFO-1234ze(E) and R-516A are lower flammability refrigerants, both in the A2L Safety Group. HCR 4141 is a blend of the saturated hydrocarbons (HCs) isobutane (R-600a), n-butane (R-600), and propane (R-290); the percentages of each component in the blend are claimed as CBI. The respective Chemical Abstracts Service Registry Identification Numbers (CAS Reg. Nos.) of R-600a, R-600, and R-290 are 75-28-5, 106-97-8, and 74-98-6. HFO-1234ze(E), also known by the trade names "Solstice® ze and Solstice® 1234ze," is also known as *trans*-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9). R-516A, also known by the trade name "Forane® 516A," is a blend

[10] To see a diagram depicting these classifications, see SNAP Rule 26, 89 FR 50417; June 13, 2024.
[11] See 89 FR 50410; June 13, 2024.

consisting of 77.5 percent HFO-1234yf (also known as 2,3,3,3-tetrafluoroprop-1-ene, CAS Reg. No. 754-12-1), 14 percent HFC-152a (also known as 1,1-difluoroethane, CAS Reg. No. 75-37-6), and 8.5 percent HFC-134a (also known as 1,1,1,2-tetrafluoroethane, CAS Reg. No. 811-97-2).

Redacted submissions and supporting documentation for HCR 4141, HFO-1234ze(E), and R-516A are provided in the docket. The EPA performed a risk screening assessment to examine the human health and environmental risks of each of these substitutes which are available in the docket.[12] [13] [14]

Environmental information: The specific atmospheric effects values can be found in the individual risk screens for HCR 4141, HFO-1234ze(E), and R-516A. These were determined consistent with the source information noted in Section III.C. above as well as using the methodology for determining values for blends of chemicals (*i.e.*, determined by the percentage of each component). HFO-1234ze(E) and the components of R-516A— HFC-134a, HFC-152a, and HFO-1234yf — are excluded from the EPA's regulatory definition of VOC[15] addressing the development of State Implementation Plans (SIPs) to attain and maintain the National Ambient Air Quality Standards (NAAQS).[16]

HCR 4141 is a blend of saturated HCs, all of which fall under the EPA's regulatory definition of VOC[17] for the purpose of developing SIPs to attain and maintain the NAAQS. The

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[12] ICF, 2025a. Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps (New Equipment); Substitute: HCR 4141.
[13] ICF, 2025b. Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps (New Equipment); Substitute: HFO-1234ze(E) (Solstice® ze, Solstice® 1234ze).
[14] ICF, 2025c. Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps (New Equipment); Substitute: R-516A (Forane® 516A).
[15] 40 CFR 51.100(s).
[16] 40 CFR 51.100(s) states that "any compound of carbon" which "participates in atmospheric photochemical reactions" is considered a VOC unless expressly excluded in that provision based on a determination of "negligible photochemical reactivity" when compared to ethane's photochemical reactivity.
[17] 40 CFR 51.100(s).

maximum incremental reactivities (MIRs)[18] of the components of this blend are as high or higher and more reactive than that of ethane (MIR of 0.26 g O_3/g ethane), which the EPA uses as a threshold to determine whether substances may have negligible photochemical reactivity in the lower atmosphere (troposphere). The MIR of the blend HCR 4141 is expected to be less than that of R-600a (MIR of 1.23 g O_3/g isobutane) and R-290 (MIR of 0.49 g O_3/g propane). The EPA has previously listed R-290 as acceptable, subject to use conditions, in residential and light commercial AC and heat pumps—self-contained room AC.

The EPA has previously performed air quality modeling on various scenarios to determine whether emissions of HC refrigerants could have a significant impact on local air quality, particularly in certain cities with challenges in achieving attainment of the NAAQS for ground-level ozone. The EPA prepared an analysis in 2014[19] and a follow-on analysis in 2016[20] to evaluate the potential impact of the use of HC refrigerants on ground-level ozone concentrations in the United States. These analyses estimated refrigerant emissions from refrigeration and AC equipment which were all assumed to contain propylene, R-600a, R-290, and/or the HC blends R-441A and R-443A under different scenarios. The EPA concluded that potential emissions of saturated HC refrigerants used in refrigeration and AC equipment, such as R-290 and R-600a, do not have a significant impact on local air quality and would not have a greater overall impact on human health and the environment than other acceptable refrigerants, even if their market share grew much greater than anticipated.[21]

The analysis evaluated HC refrigerant in the following end-uses: cold storage warehouses, chillers, residential and light commercial AC and heat pumps, and specific small,

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[18] MIR values are from "Development of the SAPRC-07 Chemical Mechanism and Updated Ozone Reactivity Scales," Report to the California Air Resources Board by William P.L. Carter. Revised January 27, 2010. (Carter, 2010).
[19] ICF, 2014. Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. February, 2014.
[20] ICF, 2016. Additional Follow-on Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. September, 2016.
[21] ICF, 2014.

self-contained refrigeration and air-conditioning units. The EPA considered it possible that HC refrigerants may be used in those end-uses because either SNAP had received applications for HCs in these end-uses or UL standards that specifically address higher flammability refrigerants existed for these end-uses, showing industry interest in using HC refrigerants. The scenarios for these end-uses were modeled to consider whether they were or were not exempted from the CAA section 608 venting prohibition.[22] The HC emissions used for these scenarios were estimated based on the EPA's Vintaging Model, and their potential contributions to ozone concentrations were assessed using the EPA's Community Multiscale Air Quality (CMAQ) model.

CMAQ modeling was performed for the Atlanta, Houston, and Los Angeles regions, due to their distinctive geographic settings and chronic high levels of ground-level ozone. Their ozone concentrations were used to estimate and scale for national emission estimates. Ozone concentrations due to HC refrigerant emissions were compared to 70 ppb for the purposes of illustrating that even under a worst-case scenario, the projected impacts on ground-level ozone would be small.[23] We found that even if all the HC refrigerants in appliances in end-uses listed as acceptable, subject to use conditions, and listed as acceptable in previous rules were to be emitted, as well as two unsaturated HC refrigerants that the EPA ultimately listed as unacceptable in certain end-uses, there would be a worst-case impact of less than 0.15 ppb for ground-level ozone in the Los Angeles area.[24]

In 2022, the EPA conducted a more recent air quality analysis, which considered additional end-uses and recently listed acceptable refrigerants (*e.g.*, R-1150 [ethylene] in very low temperature refrigeration). This analysis did not include the refrigerants propylene and R-443A due to the EPA's listing of these refrigerants as unacceptable in certain end-uses, citing

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[22] ICF, 2016.
[23] The current NAAQS for ozone and other photochemical oxidants is 0.070 ppm, as the fourth-highest daily maximum 8-hour concentration, averaged across three consecutive years. The level of the NAAQS, 0.070 ppm, is equivalent to 70 ppb.
[24] ICF, 2016. *Op cit*.

their potential for local air quality impacts.[25] The analysis utilized updated models and projected future impacts out to 2040.[26] The EPA found that the revised air quality models showed slightly greater impacts compared to our 2014 and 2016 analyses when using the same refrigerants in the same end-uses. For example, when looking at a worst-case scenario where the most reactive HC refrigerant analyzed, propylene, was used broadly in all refrigeration and AC end-uses, the largest incremental amount of O_3 generated was 7.80 ppb in the 2016 analysis, which increased to 8.62 ppb in the 2022 analysis. Changes to the CMAQ model, more updated refrigerant emissions estimates from the EPA's Vintaging Model, as well as the longer time-period considered, resulted in the changes in impacts. However, the 2022 analysis also included analyses that accounted for updates in the SNAP listings since the prior analysis. In the 2022 analysis scenarios that estimated emissions if HC refrigerants then listed as acceptable, subject to use conditions, reached 100 percent market penetration in the end-uses in SNAP Rule 25, the worst-case increase in ground-level ozone in Los Angeles was 0.012 ppb, in Houston was 0.009 ppb, and in Atlanta was 0.006 ppb. Unlike the 2016 analysis, the 2022 analysis only examined impacts of propylene in the worst-case scenario and did not otherwise model propylene or the propylene blend R-443A in the more reasonable scenarios, as those refrigerants were listed as unacceptable in SNAP Rule 21.[27] Because propylene and R-443A had a much higher potential impact on local air quality than the saturated HCs, removing propylene and R-443A from the modeling resulted in lower projected impacts on local air quality in the 2022 analysis compared to the 2016 analysis in the more reasonable scenarios. The EPA considers the 2022 modeling to further support the Agency's earlier conclusions in 2015 and 2016 that use of saturated HCs as refrigerants would not result in a significant increase in ground-level ozone.

HCR 4141 is a blend of saturated HCs. The potential of this refrigerant blend to form

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[25] See SNAP Rule 21, 81 FR 86778; December 1, 2016.
[26] ICF, 2022. Additional Assessment of the Potential Impact of Hydrocarbon Refrigerants on Ground Level Ozone Concentrations. May 2022.
[27] See 81 FR 86778; December 1, 2016.

ground-level ozone, as determined by the MIRs of its components, is expected to be less than that of R-600a or the blend R-441A, and greater than that of R-290, as mentioned earlier in this section. The EPA is proposing to list HCR 4141 as acceptable, subject to use conditions, for use in household refrigerators and freezers, where other HC refrigerants with comparable MIRs are listed as acceptable, subject to use conditions, and for use in residential and light commercial AC and heat pumps—self-contained room AC. Thus, the EPA considers the potential impacts of HCR 4141 on local air quality, as well as the overall risk to human health and the environment, to be no greater than that of other substitutes available and already listed as acceptable in the same end-uses.

Flammability information: HCR 4141 has higher flammability, with all its components having an ASHRAE flammability classification of 3. HFO-1234ze(E) and R-516A have lower flammability, with an ASHRAE flammability classification of 2L.

Toxicity and exposure data: HFO-1234ze(E) and R-516A have an ASHRAE toxicity classification of A (lower toxicity). HCR 4141 has not yet been reviewed by ASHRAE's committee that develops the ASHRAE 34 standard, "Refrigerant Designation and Safety Classification;" however, its components all have an ASHRAE toxicity classification of A.

Potential health effects of exposure to these substitutes include drowsiness or dizziness. The substitutes may also irritate the skin or eyes or cause frostbite. At sufficiently high concentrations, the substitutes may cause irregular heartbeat. The substitutes could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many refrigerants.

The AIHA has established WEELs of 1,000 ppm as an 8-hr TWA for HFC-134a and HFC-152a and 500 ppm as an 8-hr TWA for HFO-1234yf. ASHRAE has adopted an Occupational Exposure Limit (OEL) of 800 ppm as an 8-hr TWA for HFO-1234ze(E). ASHRAE also has adopted an OEL of 590 ppm as an 8-hr TWA for R-516A.[28] ASHRAE has adopted

[28] ANSI/ASHRAE Standard 34-2024. Designation and Safety Classification of Refrigerants.

OELs of 1,000 ppm for each of the components of HCR 4141. The EPA anticipates that users can meet the AIHA WEELs and ASHRAE OELs and address potential health risks by following requirements and recommendations in the manufacturers' safety data sheets (SDSs), the proposed use conditions, and other safety precautions common to the refrigeration and AC industry.

Comparison to other substitutes in this end-use: The atmospheric effects for HCR 4141, HFO-1234ze(E), and R-516A are overall better than or comparable to many of the substitutes currently listed as acceptable in this end-use such as R-290, R-457A, R-454C, R-454A, R-454B, or R-513A. More specifically, for new residential and light commercial AC and heat pump applications, R-516A, HFO-1234ze(E), and HCR 4141 have better than or comparable profiles to other acceptable substitutes already listed in this end-use such as R-457A, R-454C, R-454A, R-454B, R-513A, and HFC-32. The EPA acknowledges that the atmospheric effects of ammonia absorption, acceptable in this end-use, may be lower than R-516A, HFO-1234ze(E), and HCR 4141; however, the EPA is unaware of any ammonia absorption systems that are being used in the United States for this end-use. Other regulations also may limit the use of ammonia absorption; therefore, the SNAP program does not consider this substitute to be available or potentially available for new equipment in the affected applications. Furthermore, as noted above, the EPA does not intend to restrict a substitute if it has only marginally greater risk. The EPA does not consider the atmospheric effects of these three substitutes to be significantly greater and the Agency recognizes that they can provide an additional option for situations where other refrigerants are not viable, such as for use in split-systems and equipment requiring larger charge sizes, or where equipment using other generally available alternatives may be restricted in some jurisdictions. For new residential and light commercial AC and heat pumps—self-contained room AC, the atmospheric effects of HCR 4141 are comparable to or lower than that of other acceptable substitutes in this end-use category such as HFC-32, R-290, R-441A, and R-454B.

Toxicity risks of use, determined by the likelihood of exceeding the exposure limit of these refrigerants in this end-use, are evaluated in the previously referenced risk screens. The toxicity risks of using HCR 4141, HFO-1234ze(E), and R-516A are comparable to or lower than toxicity risks of other available substitutes in the same end-use.[29] Toxicity risks of the proposed refrigerants can be minimized by use consistent with the proposed use conditions and best industry practices.

The flammability risks associated with HCR 4141, HFO-1234ze(E), and R-516A in this end-use, determined by the likelihood of exceeding their respective LFLs, are evaluated in the risk screens referenced earlier in this section. While these refrigerants are more flammable than available, acceptable A1 refrigerants in the same end-use, this risk can be minimized by use consistent with the proposed use conditions, as well as recommendations in the manufacturers' SDS and other safety precautions common in the refrigeration and AC industry. The flammability risks of these refrigerants are comparable to or less than other available lower flammability (*e.g.*, HFC-32, R-454B) or higher flammability refrigerants (*e.g.*, R-290) that the EPA has previously listed as acceptable, subject to use conditions. The EPA is proposing use conditions that mitigate human health and environmental risks associated with the flammability of these alternatives so that they will not pose greater overall risk than other acceptable substitutes in this end-use category.

The EPA is proposing to list R-516A, HCR 4141, and HFO-1234ze(E) as acceptable, subject to use conditions. Given the wide range of applications for residential and light commercial AC and heat pumps, not all refrigerants listed as acceptable under SNAP will be suitable for the full range of equipment in this end-use. This proposal would provide additional refrigerant options for the full range of residential and light commercial AC and heat pump equipment.

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[29] See previous listing decisions for information regarding the toxicity of other available alternatives (see https://www.epa.gov/snap/substitutes-residential-and-light-commercial-air-conditioning-and-heat-pumps).

E. What are the refrigerants for which the EPA is proposing to update use conditions and how do they compare to other refrigerants in the residential and light commercial AC and heat pumps end-use?

The EPA is proposing to update the use conditions for eight previously listed refrigerants in the residential and light commercial AC and heat pumps end-use. The EPA previously listed HFC-32, R-452B, R-454A, R-454B, R-454C, and R-457A as acceptable, subject to use conditions, for use in all residential and light commercial AC and heat pump applications, and R-290 and R-441A as acceptable, subject to use conditions, for use in residential and light commercial AC and heat pumps—self-contained room AC.

R-290 is a HC refrigerant with three carbons and the formula C_3H_8. R-441A is a HC blend[30] consisting of 55 percent R-290, 36 percent R-600, six percent R-600a, and three percent R-170 (ethane) by weight. R-290 and R-441A are higher flammability refrigerants in the A3 Safety Group.

HFC-32 is also known as difluoromethane. R-452B, also known by the trade names "Opteon™ XL 55," and "Solstice® L41y," is a blend consisting of 67 percent by weight HFC-32; seven percent HFC-125, also known as 1,1,1,2,2-pentafluoroethane; and 26 percent HFO-1234yf. R-457A, also known by the trade name "Forane® 457A," is a blend consisting of 18 percent HFC-32, 12 percent HFC-152a, and 70 percent HFO-1234yf. R-454A, also known by the trade name "Opteon™ XL 40," is a blend consisting of 35 percent HFC-32 and 65 percent HFO-1234yf. R-454B, also known by the trade names "Opteon™ XL 41" and "Puron Advance™," is a blend consisting of 68.9 percent HFC-32 and 31.1 percent HFO-1234yf. R-454C, also known by the trade name "Opteon™ XL 20," is a blend consisting of 21.5 percent HFC-32 and 78.5

[30] The EPA notes that under the SNAP program, we review and list refrigerants with specific compositions (59 FR 13044; March 18, 1994). To the extent possible, we follow ASHRAE's designations for refrigerants. Blends of refrigerants must be reviewed separately. For example, we consider each blend of R-290 with R-600a to be a different and unique refrigerant, and each would require separate submission, review and listing. Thus, blends of the refrigerants that we are listing as acceptable, subject to use conditions, in this rule are not acceptable.

percent HFO-1234yf. R-457A, also known by the trade name "Forane® 457A," is a blend consisting of 70 percent HFO-1234yf, 18 percent HFC-32, and 12 percent HFC-152a.

HFC-32, R-452B, R-454A, R-454B, R-454C, and R-457A are lower flammability refrigerant blends in the A2L Safety Group. Additional information on the refrigerants and their components can be found in the docket for this rulemaking under the title "Section IV.E. Information on Refrigerants and Their Components - Residential and Light Commercial AC and Heat Pumps."

Redacted submissions and supporting documentation for HFC-32, R-452B, R-454A, R-454B, R-454C, R-457A, R-290, and R-441A are provided in the docket. The EPA performed updated risk screening for two proposed updated A2L listings, R-454C and R-457A, and one proposed updated A3 listing, R-441A, to examine the human health and environmental risks of these substitutes and to evaluate the impact of applying the 4th edition of UL 60335-2-40. The EPA chose these three representative substitutes which had the most conservative (lowest) LFLs and most conservative short- and long-term exposure limits among the group of refrigerants proposed for updated use conditions. These representative refrigerants were selected because it was presumed that substances with higher LFLs and exposure limits that were modeled for the same scenarios and end-uses would also pass the risk screens. The EPA proposes to conclude from these comparisons that while some calculated concentrations changed due to different assumptions and requirements, the refrigerants still could be used without exceeding the LFL and therefore did not increase flammability or exposure risks compared to the EPA's previous risk screens that assumed equipment followed UL 60335-2-40, 3rd edition. Thus, the risk screens demonstrated no greater overall risk to human health and the environment than other refrigerants being used when considering the impact of the co-proposed use conditions requiring use that meets the requirements of UL 60335-2-40, 4th edition. These risk screens are available in the

docket.[31] [32] [33]

Environmental information: The specific atmospheric effects values can be found in the individual risk screens for HFC-32, R-290, R-441A, R-452B, R-454A, R-454B, R-454C, and R-457A. These were determined consistent with the source information noted in Section III.C. above (*e.g.*, CAA, the AIM Act) as well as using the methodology used for determining values for blends of chemicals (*i.e.*, determined by the percentage of each component).

The refrigerant blends R-452B, R-454A, R-454B, R-454C, and R-457A are made up of the components HFC-125, HFC-32, HFC-152a, and HFO-1234yf. R-441A is made up of HC components and R-290 is a neat HC refrigerant.

The components of the refrigerant blends, HFC-125, HFO-1234yf, HFC-152a, and HFC-32, are excluded from the EPA's regulatory definition of VOC[34] for the purpose of addressing the development of SIPs to attain and maintain the NAAQS. See Section IV.D. for discussion of air quality analysis that was performed, which the EPA used to evaluate potential air quality impacts due to emissions of R-290, R-441A, and other HC refrigerants that are VOC under the EPA's regulatory definition of VOC.[35] The EPA has also established certain exemptions to the CAA section 608 venting prohibition, as listed in 40 CFR 82.154(a)(1), and none of those exemptions apply to HFC-32, R-452B, R-454A, R-454B, R-454C, or R-457A. The EPA previously exempted R-290 and R-441A in self-contained room air conditioners for residential and light commercial AC and heat pumps from the venting prohibition under CAA section 608(c)(2), finding that such venting, release, or disposal does not pose a threat to the

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[31] ICF, 2025e. Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps (New Equipment); Substitute: R-441A.
[32] ICF, 2025f. Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps (New Equipment); Substitute: R-454C (Opteon™ XL20).
[33] ICF, 2025g. Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps (New Equipment); Substitute: R-457A (Forane® 457A).
[34] 40 CFR 51.100(s).
[35] *Id.*

environment.[36] The EPA is not proposing to change either of these decisions and is not reopening them for comment.

Flammability information: HFC-32, R-452B, R-454A, R-454B, R-454C, and R-457A have lower flammability, with an ASHRAE flammability classification of 2L. R-290 and R-441A have higher flammability, with an ASHRAE flammability classification of 3.

Toxicity and exposure data: HFC-32, R-290, R-441A, R-452B, R-454A, R-454B, R-454C, and R-457A have an ASHRAE toxicity classification of A (lower toxicity). Potential health effects of exposure to these substitutes include drowsiness or dizziness. The substitutes may also irritate the skin or eyes or cause frostbite. At sufficiently high concentrations, the substitutes may cause irregular heartbeat. The substitutes could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many refrigerants.

The AIHA has established WEELs of 1,000 ppm as an 8-hr TWA for HFC-32, HFC-125, HFC-134a, and HFC-152a and 500 ppm as an 8-hr TWA for HFO-1234yf. ASHRAE also has adopted OELs of 1,000, 1,000, 870, 690, 850, 620, and 650 ppm as an 8-hr TWA for R-290, R-441A, R-452B, R-454A, R-454B, R-454C, and R-457A, respectively.[37] The EPA anticipates that users can meet the AIHA WEELs and ASHRAE OELs and address potential health risks by following requirements and recommendations in the manufacturers' SDS, the proposed use conditions, and other safety precautions common to the refrigeration and AC industry.

Comparison to other substitutes in this end-use: The atmospheric effects for HFC-32, R-290, R-441A, R-452B, R-454A, R-454B, R-454C, and R-457A are overall better than or comparable to many of the substitutes currently listed as acceptable. For new residential and light commercial AC and heat pump applications (the full category), HFC-32, R-452B, R-454A, R-454B, R-454C, and R-457A have comparable or higher individual values than some other

[36] See 80 FR 19454; April 10, 2015.
[37] OELs are those in ASHRAE 34-2024, "Designation and Safety Classification of Refrigerants."

substitutes listed as acceptable in part of this end-use such as R-290 and ammonia absorption and lower values than other acceptable substitutes listed in this end-use (*e.g.*, the exchange value of HFC-32 is lower than HFC-134a, R-407C, and R-410A). However, the EPA is unaware of any ammonia absorption systems being used in the United States for this end-use and due to its flammability, R-290 is listed as acceptable for use in self-contained room AC only and is not an available substitute for any of the other end-uses within the sector. As noted above, the EPA does not intend to restrict a substitute if it has only marginally greater risk. The EPA does not consider the atmospheric effects of these proposed substitutes to be significantly greater than other acceptable substitutes and the Agency recognizes that they can provide an additional option for situations where other refrigerants are not viable.

Toxicity risks of HFC-32, R-290, R-441A, R-452B, R-454A, R-452B, R-454C, and R-457A in this end-use, determined by the likelihood of exceeding their respective exposure limits, are evaluated in the previously referenced risk screens. The toxicity risks of using HFC-32, R-290, R-441A, R-452B, R-454A, R-454B, R-454C, and R-457A are comparable to or lower than toxicity risks of other available substitutes in the same end-use.[38] Toxicity risks of the proposed refrigerants can be minimized by use consistent with the proposed use conditions and best industry practices.

The flammability risks of HFC-32, R-290, R-441A, R-452B, R-454A, R-454B, R-454C, and R-457A in this end-use, determined by the likelihood of exceeding their respective LFLs, are evaluated in the previously referenced risk screens. While these refrigerants may pose greater flammability risk than other available substitutes in the same end-use, this risk can be minimized by use consistent with the proposed use conditions, as well as recommendations in the manufacturers' SDS and other safety precautions common in the refrigeration and AC industry. The EPA is proposing use conditions that maintain the low potential risk associated with the

[38] See previous listing decisions for information regarding the toxicity of other available alternatives (https://www.epa.gov/snap/substitutes-residential-and-light-commercial-air-conditioning-and-heat-pumps)

flammability of these alternatives so that they will not pose greater overall risk than other acceptable substitutes in this end-use category. A full discussion of the proposed use conditions may be found in Section IV.F.

While R-290 and R-441A have higher flammability than many substitutes listed as acceptable in this end-use, the proposed updated use conditions would reduce the potential risk associated with the flammability of these alternatives so that they would not pose greater overall risk than other acceptable substitutes in this end-use. The proposed substitutes HFC-32, R-452B, R-454A, R-454B, R-454C, and R-457A would provide additional options for situations where other refrigerants are not viable, such as for use in split-systems or equipment requiring larger charge sizes, or where equipment using other generally available alternatives may be restricted in some jurisdictions.

The EPA proposes to find that updating the use conditions for the existing listings for HFC-32, R-452B, R-454A, R-454B, R-454C, and R-457A as acceptable, subject to use conditions, for use in all types of residential and light commercial AC and heat pumps and for R-290 and R-441A in residential and light commercial AC and heat pumps—self-contained room AC, is appropriate to maintain a broad list of acceptable substitutes available for the full range of applications under this end-use and to continue safe use of these refrigerants. These updated listings would help establish and maintain an equal playing field for substitutes used in the market.

HFC-32, R-452B, R-454A, R-454B, R-454C, R-457A, R-290, and R-441A are currently listed as acceptable, subject to use conditions, for use in the residential and light commercial AC and heat pumps end-use. The EPA is not proposing to move any of these listings to any other listing category (*e.g.*, unacceptable). Rather, the EPA is proposing to update the use conditions because the industry consensus safety standards that were incorporated by reference at the time

of the listing have since been either updated[39] or superseded.[40]

This list provides a summary of the existing listings for each refrigerant in the residential and light commercial AC and heat pumps end-use that the EPA is proposing to update:

- HFC-32 is listed as acceptable, subject to use conditions, in all new residential and light commercial AC and heat pump applications. The current use conditions incorporate by reference UL 60335-2-40, 3rd edition. Previous listings for this refrigerant in this end-use and detailed information on the use conditions, listing decision, and rationale for these previous listings can be found in SNAP Rule 19,[41] SNAP Rule 23,[42] and SNAP Rule 25.[43]
- R-452B, R-454A, R-454B, R-454C, and R-457A are listed as acceptable, subject to use conditions, in all new residential and light commercial AC and heat pump applications. The current use conditions incorporate by reference UL 60335-2-40, 3rd edition. Previous listings for these refrigerants in this end-use and detailed information on the use conditions, listing decision, and rationale for these previous listings can be found in SNAP Rule 23.[44]
- R-290 and R-441A are listed as acceptable, subject to use conditions, in new residential and light commercial AC and heat pumps- self-contained room AC only. The current use conditions incorporate by reference Supplement SA and Appendices B through F of the 8th edition of UL 484. Previous listings for these refrigerants in this end-use and detailed information on the use conditions, listing decision, and rationale for these previous listings can be found in SNAP Rule 19.[45]

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[39] UL 60335-2-40.
[40] UL 484.
[41] See 80 FR 19454; April 10, 2015.
[42] See 86 FR 24444; May 6, 2021.
[43] See 88 FR 26382; April 28, 2023.
[44] See 86 FR 24444; May 6, 2021.
[45] See 80 FR 19454; April 10, 2015.

F. What use conditions is the EPA proposing in this action for new and updated listings in this residential and light commercial AC and heat pumps end-use?

The proposed use conditions described in this section would apply to newly listed refrigerants HCR 4141, HFO-1234ze(E), and R-516A in this end-use and to previously listed refrigerants HFC-32, R-452B, R-454A, R-454B, R-454C, R-457A, R-290, and R-441A in this end-use. For these eight previously listed refrigerants, the proposed use conditions would apply to new equipment manufactured after the effective date of the final rule. The proposed updated use conditions would neither apply to nor affect equipment manufactured before the effective date of the final rule.

Many of the proposed use conditions described in this section mirror the SNAP program's historical approach to requirements for lower flammability and higher flammability refrigerants. For example, the proposed use condition related to use only in new equipment is consistent with previously listed lower flammability and higher flammability refrigerants in this end-use. The proposed use conditions related to labels and markings are very similar to previous requirements for lower and higher flammability refrigerants in this end-use, with a few changes to better align the EPA's requirements with updated industry consensus safety standards. The co-proposed option that would incorporate by reference UL 60335-2-40 described in Section IV.F.4.a. would simply update the required safety standard to the latest edition in a manner consistent with the EPA's historical practice of incorporating portions of or entire industry consensus safety standards by reference. The other co-proposed option described in Section IV.F.4.b., while different than the EPA's historical practice, would address situations where agency regulations require adherence to editions of industry consensus safety standards that have been updated and replaced subsequent to the issuance of a final rule.

The EPA is proposing to remove the existing use conditions specific to refrigerant charge size limits for R-290, R-441A, R-452B, R-454A, R-454B, R-454C, and R-457A in residential

and light commercial AC and heat pump applications. SNAP Rule 19[46] included a specific use condition for R-290 and R-441A in self-contained room AC for refrigerant charge size limits based on cooling capacity and type of equipment. SNAP Rule 23[47] included a specific use condition for R-452B, R-454A, R-454B, R-454C, and R-457A in all residential and light commercial AC and heat pump applications for charge size based on UL 60335-2-40 and the room size where the equipment is used. The EPA is not proposing to eliminate charge size restrictions. Rather, the EPA is co-proposing two use condition options related to equipment certification or industry consensus safety standards, which both include requirements to ensure that equipment is designed using safe refrigerant charge sizes. The EPA is proposing to rely on the charge size restrictions inherent in that proposed requirement rather than duplicate charge size restrictions in a separate use condition. The EPA proposes the following use conditions:

1. New equipment only; not intended for use as a retrofit alternative

The EPA is proposing that all refrigerants covered by this action in the residential and light commercial AC and heat pumps end-use, including the applicable applications (*e.g.*, unitary split AC systems, mini-splits, and heat pumps), may be used only in new equipment designed to address concerns unique to lower and higher flammability refrigerants. In other words, none of these substitutes may be used as a conversion or "retrofit" refrigerant for existing equipment. These lower and higher flammability refrigerants were not submitted under the SNAP program to be used in retrofitted equipment, and no information was provided on how to address hazards if they were to be used in equipment that was designed for nonflammable refrigerants.

2. Labels

The EPA is proposing to require labels for residential and light commercial AC and heat pump equipment. These labels would need to be permanently attached at the locations provided. The following text would be required for residential and light commercial AC and heat pump

[46] See 80 FR 19454; April 10, 2015.
[47] See 86 FR 24444; May 6, 2021.

equipment containing an A2L refrigerant that is proposed to be listed in this rule:

a. On the outside of the equipment: “WARNING — Risk of Fire. Flammable Refrigerant Used. To Be Repaired Only by Trained Service Personnel. Do Not Puncture Refrigerant Tubing.”

b. On the outside of the equipment: “WARNING — Risk of Fire. Dispose of Properly in Accordance with Federal or Local Regulations. Flammable Refrigerant Used."

c. On the inside of the equipment near the compressor: “WARNING — Risk of Fire. Flammable Refrigerant Used. Consult Repair Manual/Owner’s Guide Before Attempting to Service This Product. All Safety Precautions Must be Followed.”

d. For any equipment pre-charged at the factory, on the equipment packaging: “WARNING — Risk of Fire due to Flammable Refrigerant Used. Follow Handling Instructions Carefully in Compliance with National Regulations”

e. On the indoor unit near the nameplate: A label stating the minimum installation height (if applicable), in m and ft, and the minimum room area (operating or storage), in m^2 and ft^2. These values shall be calculated according to a U.S. industry consensus safety standard for AC and heat pump equipment.

f. On the outside of non-fixed equipment, such as portable air conditioners and window air conditioners and heat pumps: “WARNING — Risk of Fire— Store in a well ventilated room without continuously operating flames or other potential ignition.”

g. For fixed equipment such as packed terminal air conditioners, packaged terminal heat pumps, rooftop units, and split air conditioners: “WARNING — Risk of Fire — Auxiliary devices which may be ignition sources shall not be installed in the ductwork, other than auxiliary devices listed for use with the specific appliance. See instructions.”

The EPA has previously stated that it would be difficult to see warning labels with the minimum lettering height requirement for A2L refrigerants of 1⁄8 inch as required by the UL

standard. Therefore, as in previous rules,[48] the EPA is proposing that the minimum height for lettering be 1⁄4 inch (6.4 mm) as opposed to 1⁄8 inch, which would make it easier for technicians, consumers, retail storeowners, first responders, and those disposing of the appliance to view the warning labels. Other than the proposed label under paragraph e, the text of the labels is similar or verbatim in language to those required by the 4th edition of UL 60335-2-40. They are also aligned with labeling requirements for A2L refrigerants in previous SNAP Rules 23[49] and 25.[50]

The proposed label under paragraph e describes the required content of a label rather than exact language that the label would need to contain. The same change is being proposed for one of the labels for equipment using A3 refrigerants, see paragraph l, later in this section. This proposed change would allow the EPA's use conditions to remain consistent with the requirements of the latest edition of UL 60335-2-40 while giving flexibility for the use condition to remain applicable even if the third-party certification option described in Section IV.F.4.b. is finalized, and the UL standard is not incorporated by reference. This proposed change is intended to avoid potential conflict between the regulatory requirements and the industry safety standards if the specific requirements in those standards are changed.

The EPA is also proposing labels for residential and light commercial AC and heat pump equipment using A3 refrigerants proposed in this rule. The following text would need to be permanently attached at the locations provided:

h. On the outside of the equipment: "DANGER — Risk of Fire or Explosion. Flammable Refrigerant Used. To Be Repaired Only by Trained Service Personnel. Do Not Puncture Refrigerant Tubing."

i. On the outside of the equipment: "WARNING — Risk of Fire or Explosion. Dispose Of Properly in Accordance with Federal or Local Regulations. Flammable Refrigerant Used."

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[48] See 86 FR 24444, May 6, 2021; 88 FR 26382, April 28, 2023.
[49] See 86 FR 24444, May 6, 2021.
[50] See 88 FR 26382, April 28, 2023.

j. On the inside of the equipment near the compressor: "DANGER — Risk of Fire or Explosion. Flammable Refrigerant Used. Consult Repair Manual/Owner's Guide Before Attempting to Service This Product. All Safety Precautions Must Be Followed."

k. For any equipment pre-charged at the factory, on the equipment packaging: "DANGER — Risk of Fire or Explosion due to Flammable Refrigerant Used. Follow Handling Instructions Carefully in Compliance with National Regulations."

l. On an indoor unit near the nameplate: A label stating the minimum installation height (if applicable), in m and ft, and the minimum room area (operating or storage), in m^2 and ft^2. These values shall be calculated according to a U.S. industry consensus safety standard for AC and heat pump equipment.

m. On the outside of non-fixed equipment, such as portable air conditioners and window air conditioners and heat pumps: "WARNING — Risk of Fire or Explosion — Store in a well ventilated room without continuously operating flames or other potential ignition."

The EPA is proposing that the minimum height for lettering be at least 1⁄4 inch (6.4 mm), consistent with the labeling requirements for A3 refrigerants under the 4th edition of UL 60335-2-40. This text size makes it easier for technicians, consumers, retail storeowners, first responders, and those disposing the appliance to view the warning labels. The text of the proposed labels is similar or verbatim in language to those that required by the 4th edition of UL 60335-2-40. This proposed text differs from that in SNAP Rule 19[51] for A3 refrigerants in this end-use. For example, the proposed labels under paragraphs k and m do not currently exist as use conditions for R-290 and R-441A but are consistent with the latest labeling requirements for A3 refrigerants under the 4th edition of UL 60335-2-40. Additionally, the proposed labels under paragraphs i and j use the words "WARNING" and "DANGER" in lieu of "CAUTION." The EPA proposes these updates to the labeling requirements to be consistent with the 4th edition of UL 60335-2-40 and with the SNAP labeling requirements for other higher flammability

[51] See 80 FR 19454; April 10, 2015.

refrigerants. The EPA proposes to find that using a common set of labels would aid in compliance, especially for a manufacturer that uses more than one of these refrigerants or produces both self-contained room ACs and heat pumps and other types of residential and light commercial AC and heat pumps. The labels for residential and light commercial AC and heat pump equipment using A3 refrigerants are listed in paragraphs a through f in appendices R and Z in the proposed regulatory text for the A3 listings in this end-use. The proposed regulatory text can be found in the docket for this rulemaking under the title "Proposed Regulatory Text for SNAP Rule 27" in the sections "Proposed revisions to Appendices R, V, W, and new Appendix Z—Incorporate by Reference Option" and "Proposed revisions to Appendices R, V, W, and new Appendix Z—Third-Party Certification Option (co-proposed as an alternative to Section III)." The proposed labeling requirements are identical in both sections.

3. Color-coded hoses and piping

The EPA is proposing to require that equipment have distinguishing red (Pantone® Matching System [PMS] #185 or "Reichs-Ausschuß für Lieferbedingungen und Gütesicherung," [RAL] 3020 from Germany's National Commission for Delivery Terms and Quality Assurance) color-coded hoses and piping to indicate use of a flammable refrigerant. The equipment would need to have red marked service ports, pipes, hoses, and other devices through which the refrigerant is serviced. This color would need to be present at all service ports and where service puncturing or otherwise creating an opening from the refrigerant circuit to the atmosphere might be expected. Markings would need to extend at least one inch (25 mm) from the servicing port and would need to be replaced if removed. The EPA has applied this proposed use condition in past actions for lower and higher flammability refrigerants.[52] The EPA is proposing that such markings apply to both A2L and A3 refrigerants to establish a common, familiar, and standard means of identifying the use of a lower or higher flammability refrigerant. Being able to immediately identify the use of a lower or higher flammability refrigerant would reduce the risk

[52] See 86 FR 24444, May 6, 2021; 88 FR 26382, April 28, 2023.

of a technician using sparking equipment or otherwise having an ignition source nearby. The AC and refrigeration industry currently uses red-colored hoses and piping as means for identifying the use of a lower or higher flammability refrigerant based on previous SNAP listings. Likewise, distinguishing coloring is used elsewhere to indicate an unusual and potentially dangerous situation, for example in the use of orange-insulated wires in hybrid electric vehicles.

The use of color-coded hoses and piping would be in addition to the proposed use of warning labels. Having two such warning methods is reasonable and consistent with other general industry practices. This approach is the same as in our previous rules on A2L and A3 refrigerants.[53]

4. Use condition options related to equipment certification or industry safety standard requirements

The EPA is co-proposing two options for a use condition related to equipment certification or industry safety standard requirements. Under the first option, the EPA would incorporate by reference a new edition of the industry consensus safety standard for this end-use. Under the second option, the EPA would require residential and light commercial AC and heat pump equipment to be certified by an organization that is recognized as an NRTL to a U.S. industry consensus safety standard that is designed to allow for safe use of flammable refrigerants and mitigates risks such that the listed refrigerants can be used in a manner that does not pose a greater overall risk to human health and the environment than other substitutes in this end-use.

a. Incorporate by reference UL 60335-2-40, 4th edition option

Since 2008, the EPA has listed numerous A2, A2L, and A3 refrigerants as acceptable, subject to use conditions, addressing use of lower and higher flammability refrigerants in end-uses where the EPA has determined it is necessary to mitigate risks. Most often, the EPA has

[53] See 76 FR 78832, December 20, 2011; 80 FR 19454, April 10, 2015; 88 FR 26382, April 28, 2023.

relied in part on incorporating by reference industry consensus safety standards to ensure these risks are mitigated. Industry consensus safety standards are developed in cooperation with parties with an interest in participating in the development or use of the standard. For example, UL uses a process where experts with various interests, including manufacturers, government agencies, and academia, come together to agree on the safety requirements for a product, resulting in a standard that reflects a collective consensus on best practices for safety. These standards are typically under continuous maintenance, meaning that they are updated and superseded by newer editions. This often means that regulations and safety standards are out of step; and thus, the EPA often updates its regulations to incorporate the newer version of the standard. The revision cycle for the 4th edition of UL 60335-2-40, including final recirculation, concluded with its publication on December 15, 2022.

Under this first option, the EPA is proposing to set a use condition consistent with the latest version of UL standards through incorporation by reference. Thus, the EPA proposes to list new refrigerants and update existing listings for refrigerants in the relevant end-use covered by this action with a use condition that these refrigerants may be used only in equipment that meets all requirements in UL 60335-2-40, 4th edition. This option continues the practice of updating regulations to align with newer editions of standards.

Specifically, the EPA is proposing to update the condition to meet all requirements listed in UL 60335-2-40, 3rd edition, "Household and Similar Electrical Appliances—Safety—Part 2-40: Particular Requirements for Electrical Heat Pumps, Air Conditioners and Dehumidifiers," dated November 1, 2019 (for A2L refrigerants), or Supplement SA and Appendices B through F of UL Standard 484 8th edition, "Room Air Conditioners," dated August 2, 2012 (for R-290 and R-441A), with the proposed condition to meet all requirements listed in the 4th edition of UL 60335-2-40, "Household and Similar Electrical Appliances—Safety—Part 2-40: Particular Requirements for Electrical Heat Pumps, Air Conditioners and Dehumidifiers," dated December 15, 2022. This proposed use condition incorporating the 4th edition would apply to new

equipment manufactured after the effective date of any final action. In cases where this rule includes requirements that are different than those of UL 60335-2-40 (*e.g.*, font size), the EPA is proposing that the requirements of this rule apply.

UL 60335-2-40 applies to the SNAP applications of window unit room air conditioners, PTACs and PTHPs, portable air conditioners, central air conditioners, non-ducted AC systems, packaged rooftop units, WSHPs, GSHPs, and other products. This UL standard indicates that refrigerant charges greater than a specific amount (called "m3" in the UL standard and based on the refrigerant's LFL) are beyond its scope and that national safety standards might apply, such as ANSI or ASHRAE 15.2. Because the EPA has not evaluated such situations, this proposal only covers residential and light commercial AC and heat pump equipment that fits within the scope of the UL standard.

UL 60335-2-40 was developed in an open and consensus-based approach, with the assistance of experts in the refrigeration and AC industry as well as experts involved in assessing the safety of products. Participants of the UL 60335-2-40 consensus standard process reviewed results of testing on equipment for flammability risk in residential applications and evaluated the relevant scientific studies. Further, UL has developed safety standards for construction and system design, markings, and performance tests concerning refrigerant leakage, ignition of switching components, surface temperature of parts, and component strength after being scratched. Aspects of system construction and design, including charge size, ventilation, and installation space, and greater detail on markings, are discussed later in this section. While similar safety standards exist from other bodies, such as the International Electrotechnical Commission (IEC), we are proposing in this option to use specific UL standards that are most applicable and used by U.S. manufacturers. The EPA used this approach in previous SNAP rules concerning lower and higher flammability refrigerants.[54]

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[54] See 76 FR 78832, December 20, 2011; 80 FR 19454, April 10, 2015; 86 FR 24444, May 6, 2021; 88 FR 26382, April 28, 2023.

The EPA has evaluated the revisions and proposes to find that construction and use of equipment in accordance with the 4th edition would not pose greater overall risk to human health and the environment than use in accordance with the 3rd edition. The 4th edition makes changes that address potential hazards of flammable refrigerants including refined requirements for leak detection systems to accommodate various methods, increase robustness and reliability, and account for deviation and drift over the system life cycle.

The requirements in UL 60335-2-40 would reduce the risk to workers and consumers. Incorporating the latest edition of the UL standard as a use condition would also reduce conflict between federal regulations, building codes, and other authorities that require compliance with the latest version of the UL standard. This section summarizes relevant aspects of UL 60335-2-40 for information only and is not meant to be a complete review of the standard or how it is applied.

UL 60335-2-40 limits the amount of refrigerant allowed in each type of appliance based on several factors explained in that standard. The EPA is proposing to require charge size limits for each of the proposed refrigerants by equipment type in accordance with UL 60335-2-40, 4th edition. Annex GG of the standard provides the charge limits, ventilation requirements, and requirements for secondary circuits. The standard specifies requirements for installation space of an appliance (*i.e.,* room floor area) and/or ventilation or other requirements which are determined according to the refrigerant charge used in the appliance, the installation location, and the type of ventilation of the location or of the appliance. Within Annex GG, table GG.1DV provides guidance on how to apply the requirements to address the potential flammability hazards of flammable refrigerants.

UL 60335-2-40, 4th edition also contains new specific requirements for determining releasable charge. As opposed to total refrigerant charge, which is the actual refrigerant charge of a single refrigerating system, releasable charge is the mass of refrigerant that can be released into the indoor space from a refrigerating system in the event of a leak. While accounting for

releasable charge results in larger total refrigerant charges allowed under the 4th edition when compared to the 3rd edition, the EPA proposes to find that the mitigation requirements in the 4th edition of the standard, such as leak detection systems and safety shutoff valves, effectively reduce risk and address the hazards of flammable refrigerants even at larger total charge sizes.

UL 60335-2-40, 4th edition contains provisions for safety mitigation that were developed to ensure the safe use of flammable refrigerants over a range of appliances. In general, as larger charge sizes are used, more stringent mitigation requirements apply. In certain applications, refrigerant detection systems (as described in Annex LL, Refrigerant detection systems for A2L refrigerants), refrigerant sensors (as described in Annex MM, Refrigerant sensor location confirmation test), and safety alarms are required. The 4th edition includes significantly improved requirements for refrigerant detection systems, including clarified sensor location requirements and better test methods for leak simulation tests.

Where mechanical ventilation (*i.e.*, fans) is required in accordance with Annex GG, it must be initiated by a separate refrigerant detection system either as part of the appliance or installed separately. In a room with no mechanical ventilation, Annex GG provides requirements for openings to rooms based on several factors including the charge size and the room area. The minimum opening is intended to be sufficient so that natural ventilation would reduce the risk of using a flammable refrigerant. The standard also includes specific requirements for split system appliances covering construction, instruction manuals, and allowable charge sizes, mechanical ventilation, safety alarms, and shut off valves for A2L refrigerants.

In addition to Annex GG and table GG.1DV, UL 60335-2-40 has a requirement for the maximum charge for an appliance using an A2L refrigerant, such as HFC-32, HFO-1234ze(E), R-452B, R-454A, R-454B, R-454C, R-457A, and R-516A. The 4th edition sets more comprehensive requirements on A2L refrigerants than the 3rd edition, and the EPA proposes to consider these additional safety mechanisms, including charge size limitations, to be more protective of human health and the environment. If the appliance is a portable appliance, a non-

fixed factory-sealed single package, or a cord-connected appliance, which may be periodically or seasonally relocated (excluding servicing) by the end user, there are no additional requirements for room area, ventilation, or other risk mitigation if the charge is sufficiently small—under three times the LFL. Additional requirements exist for charge sizes exceeding three times the LFL.

For A3 refrigerants, including R-290, R-441A, and HCR 4141, UL 60335-2-40 requires a maximum charge of three times the LFL for an appliance that is a portable appliance, a non-fixed factory-sealed single package, or a cord-connected appliance which may be periodically or seasonally relocated (excluding servicing) by the end user. For example, for R-290 this maximum charge for non-fixed appliances would be 114 g.

The EPA compared the effect that requirements from previous standards (UL 484 and UL 60335-2-40, 3rd edition) versus UL 60335-2-40, 4th edition, would have on the results of the EPA's comparative risk screens, which are included in the docket. The EPA conducted updated risk screening on two proposed A2L listings and one proposed A3 listing, which had the most conservative (lowest) LFLs and most conservative short- and long-term exposure limits among the proposed alternatives. As discussed in Section IV.E., these risk screens demonstrated that use of these refrigerants in the residential and light commercial AC and heat pumps end-use would not pose greater overall risk to human health and the environment than other refrigerants being used when considering the impact of the co-proposed use condition requiring use that meets the requirements of UL 60335-2-40, 4th edition.

As discussed earlier in this section, the EPA is proposing to remove the existing use conditions specific to refrigerant charge size limits for R-290, R-441A, R-452B, R-454A, R-454B, R-454C, and R-457A in residential and light commercial AC and heat pump applications. Rather than duplicate charge size restrictions in a separate use condition, the EPA is proposing to rely on the charge size restrictions inherent in the requirements of UL 60335-2-40, 4th edition. Consistent with previous listings for other lower and higher flammability refrigerants in this end-use, the EPA is not proposing to include a use condition related to adherence to ASHRAE 15 or

ASHRAE 15.2. As discussed in this section, the 4th edition of UL 60335-2-40 includes changes from the 3rd edition that specifically address the potential flammability hazards of lower and higher flammability refrigerants. The EPA proposes to find that these refrigerants can be used safely provided the use conditions in this proposed rule are followed, including compliance with the 4th edition of UL 60335-2-40. The EPA recognizes that in certain clauses, UL 60335-2-40 refers to ASHRAE 15 and ASHRAE 15.2 for compliance. We also note that other authorities might impose additional requirements, such as the adoption of ASHRAE 15 and 15.2 in building codes, that would provide an additional layer of safety above what the EPA is proposing to require under SNAP.

Under this incorporate by reference option, all three of the new refrigerant listings and the eight updated refrigerant listings proposed for this end-use would include the use conditions described in Sections IV.F.1., IV.F.2., and IV.F.3., as well as a use condition that the refrigerant may only be used in equipment that meets all the requirements of UL 60335-2-40, 4th edition.

The EPA performed assessments to examine the human health and environmental risks of each of these substitutes. These assessments are available in the docket.[55] The proposed regulatory text for new and updated listings under this option can be found in the docket under the title "Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Incorporate by Reference Option."

b. Third-party certification option

As noted elsewhere, in recent rulemakings for listings of lower and higher flammability refrigerants, the EPA has incorporated by reference portions of or entire industry consensus safety standards as use conditions for SNAP listings. The Agency recognizes that these standards are under continuous maintenance, meaning that they are updated and superseded by newer editions. This often means that regulations and safety standards are out of step; and thus, the

[55] See in section XII., "References": ICF, 2025a; ICF, 2025b; ICF, 2025c; ICF, 2025e; ICF, 2025f; and ICF, 2025g.

EPA often updates its regulations to incorporate the newer version of the standard and to avoid directing regulated entities to editions of standards that have been updated and replaced subsequent to the issuance of a final rule. This is time-consuming, increases administrative burden, and there is often time between the issuance of a new edition of a standard and a later revised regulation which could result in confusion for the regulated community as well as slowing down adoption of revised requirements based upon the most recent science and industry experience.

This approach also may result in the EPA's requirements including sections of standards that are not needed to address the flammability risks of refrigerants. For example, UL 60335-2-40 includes certain tests that apply to all parts of the equipment, not just to the refrigerating system, and specifications about leakage current and electrical strength, which are not needed specifically to address flammability of refrigerants. Therefore, the EPA is proposing another option to streamline use conditions and to maintain consistency with the latest version of the relevant standards. This option allows for the EPA to address flammability risks while recognizing that a specific edition of a relevant standard applicable for the residential and light commercial AC and heat pumps end-use may be replaced by a later edition. This option is described in this Section IV.F.4.b.

Under this potential option, the EPA proposes that all residential and light commercial AC and heat pump equipment using the refrigerants listed in this rulemaking would need to be certified by an OSHA-recognized NRTL to a U.S. industry consensus safety standard that is designed to allow for safe use of flammable refrigerants in residential and light commercial AC and heat pump equipment, and mitigates risks such that the listed refrigerants can be used in a manner that does not pose a greater overall risk to human health and the environment than other substitutes in this end-use. For listings in this end-use under this option, the EPA is proposing replacing the practice of incorporating by reference portions of or entire industry consensus safety standards with a use condition that relies on NRTLs certifying equipment to a U.S.

industry consensus safety standard that mitigates risks. The industry consensus safety standard would need to be designed for use in the United States and be consistent with best industry safety practices (*e.g.*, UL 60335-2-40). The EPA proposes that an industry consensus safety standard used to meet this use condition would need to contain requirements for:

- Refrigerant charge sizes and risk mitigation measures that are designed to allow for safe use of flammable refrigerants (*e.g.*, refrigerant detection systems, ventilation to maintain refrigerant concentrations below the LFL in the case of a leak); and
- Markings that communicate the risks.

Definitions and requirements for the OSHA NRTL Program can be found at 29 CFR 1910.7. The term "NRTL" means an organization recognized by OSHA in accordance with appendix A to 29 CFR 1910.7, and which tests for safety, lists or labels or accepts equipment or materials, and meets the criteria described in 29 CFR 1910.7. Any testing agency or organization considering itself to meet the definition of an NRTL as specified in § 1910.7 may apply for OSHA recognition.

While the EPA is proposing reliance on certification by these NRTLs, the EPA is not opening OSHA's regulations at 29 CFR 1910.7 for comment, including definitions or requirements, nor is the EPA seeking comment on the OSHA program itself. For listings in this end-use under this option, the EPA is proposing a use condition based on certification by NRTLs instead of incorporation by reference of portions of or entire industry consensus safety standards. In addition to meeting the requirements laid out above, the U.S. industry consensus safety standard used to meet this requirement would also need to be deemed an appropriate test standard and approved by OSHA. The NRTL Program regulation at 29 CFR 1910.7(c) sets forth the criteria for determining whether a test standard is appropriate. An appropriate test standard is a document which specifies the safety requirements for specific equipment or class of equipment and is (1) recognized in the United States as a safety standard providing an adequate level of safety; (2) compatible with and maintained current with periodic revisions of applicable national

codes and installation standards; and (3) developed by a standards developing organization under a method providing for input and consideration of views of industry groups, experts, users, consumers, governmental authorities, and others having broad experience in the safety field involved; or (4) in lieu of paragraphs (c) (1), (2), and (3), the standard is currently designated as an ANSI safety-designated product standard or an ASTM test standard used for evaluation of products or materials. The various procedures for approval of appropriate test standards are found in the OSHA NRTL Program Policies, Procedures, and Guidelines CPL-01-00-004 (Program Directive). NRTLs and a list of appropriate test standards that are recognized by OSHA are publicly available, and updated periodically, on OSHA's website.[56]

As discussed earlier in Section IV.F.4.a., industry consensus safety standards are developed in cooperation with parties with an interest in participating in the development or use of the standard. The EPA has confidence in this safety standards development process, as it relies on consensus built by the industry. For example, UL uses a process where experts with various interests, including manufacturers, government agencies, and academia, come together to agree on the safety requirements for a product, resulting in a standard that reflects a collective consensus on best practices for safety.

One example of an appropriate test standard for equipment in the residential and light commercial AC and heat pumps end-use is UL 60335-2-40. UL 60335-2-40 was developed in an open and consensus-based approach. The EPA proposes to view this standard as one example of a U.S. industry consensus safety standard that could be used to meet this requirement, as the requirements of the standard align with the levels of safety that the EPA expects in terms of mitigating risks to human health and the environment. As mentioned in Sections IV.D. and IV.E., the EPA performed risk screening assessments to examine the human health and environmental risks of the refrigerants being proposed in this action for this end-use. These risk

[56] https://www.osha.gov/nationally-recognized-testing-laboratory-program/current-list-of-nrtls and https://www.osha.gov/nationally-recognized-testing-laboratory-program/list-standards.

screens demonstrated that use of these refrigerants in the residential and light commercial AC and heat pumps end-use consistent with the latest edition of UL 60335-2-40 would not pose greater overall risk to human health and the environment than other acceptable substitutes for new equipment in this end-use.

One potential downside of this third-party certification option is that future revisions could be made to OSHA-recognized appropriate test standards that do not align with the SNAP program's criteria for mitigating risks to human health and the environment. However, the EPA already monitors the development and revision process for industry consensus safety standards that apply to equipment in the residential and light commercial AC and heat pumps end-use and other end-uses. If this option is finalized, the EPA would continue monitoring these standards, and if revisions are made to industry safety standards that impact their alignment with the SNAP program's risk mitigation criteria, the EPA would raise concerns and could revisit and propose changes to refrigerant listing categories and/or use conditions through rulemaking.

OSHA recognizes NRTLs at the organizational-level as opposed to the laboratory-level. Therefore, the laboratory that performs the equipment testing would need to be part of an NRTL that is recognized by OSHA and have the necessary equipment and training required to test to a specific standard that would be most applicable to the equipment applications in this section.

OSHA requires all electrical equipment used in the workplace to be tested and certified by an NRTL or otherwise determined to be "acceptable" as defined in 29 CFR 1910.399. The EPA is proposing that equipment in the residential and light commercial AC and heat pumps end-use using the refrigerants proposed in this action would need to be certified to a U.S. industry consensus safety standard by an OSHA-recognized NRTL. In accordance with Annex B of the OSHA NRTL Program Directive and section 4 of ISO/IEC 17065:2012, NRTLs shall maintain registration of a certification mark with the U.S. Patent and Trademark Office, and an NRTL's procedures shall require clients to apply the NRTL's registered certification mark to the certified equipment to signify that the equipment is certified by an NRTL and complies with the

requirements of an appropriate safety test standard. In addition, the test standard(s), certification category, or a symbol or code that identifies the test standard(s) to which the unit is certified shall be shown adjacent to the NRTL's mark. These markings provide users with evidence that the equipment complies with applicable safety test standard requirements and is safe for use.

The EPA is not proposing to establish specific requirements or protocols for laboratories because OSHA already has established such requirements and performs detailed reviews of equipment certification entities. OSHA's review of NRTLs includes a thorough evaluation of application materials, assessments of the organization's programs and facilities, publication of findings in the *Federal Register*, response to public comments, and announcement of a final decision on NRTLs. OSHA also performs ongoing evaluations of NRTLs and responds to safety concerns that occur in the field. Because NRTLs must be recognized to test to a specific safety standard, all of the requirements of that particular safety standard are adopted by the NRTL, which is similar to SNAP's current use condition approach for HFC-32, R-452B, R-454A, R-454B, R-454C, R-457A, R-290, and R-441A that incorporates by reference a particular safety standard.

By not incorporating by reference a specific edition of a relevant safety standard in this use condition option, the EPA intends to increase efficiencies by not having to propose a new rule each time a safety standard is updated and to leverage OSHA's NRTL Program. The EPA does not expect this option to pose significant additional burden on manufacturers or NRTLs because most manufacturers of residential and light commercial AC and heat pump equipment have their equipment certified by an NRTL already. Manufacturers that do not already certify their equipment through an OSHA-recognized NRTL would need to do so beginning two years after the effective date of the final rule.

The EPA is aware of three entities, UL, Intertek, and CSA Group, that are currently NRTLs and test and certify equipment to industry consensus safety standards for equipment in the residential and light commercial AC and heat pumps end-use. The EPA understands there

may be additional entities now or in the future.

As noted previously, the current SNAP regulations incorporate by reference UL 60335-2-40, 3rd edition, which is no longer the latest edition of a standard that is publicly available and applicable to this end-use. OSHA regulations do not specify specific editions of standards. Rather, an NRTL recognized for an ANSI-approved test standard may use either the latest proprietary version or the latest ANSI version of the standard, regardless of which version appears in its list of test standards on OSHA's web page for the NRTL. When an NRTL applies to be recognized to test to a particular standard, they must submit the specific standard to which they aim to test. If an NRTL is found to be testing and certifying equipment to a standard they are not recognized for, OSHA may act.

As discussed earlier in this section, the EPA is proposing to remove the existing use conditions specific to refrigerant charge size limits for R-290, R-441A, R-452B, R-454A, R-454B, R-454C, and R-457A in residential and light commercial AC and heat pump applications. Rather than duplicating charge size restrictions in a separate use condition, the EPA is proposing to rely on the charge size restrictions inherent in the process of getting residential and light commercial AC and heat pump equipment certified by an NRTL to an industry consensus safety standard that is designed to allow for safe use of flammable refrigerants.

Under this third-party certification option, all three of the new refrigerant listings and eight updated refrigerant listings proposed for this end-use would include the use conditions described in Sections IV.F.1., IV.F.2., and IV.F.3. There would also be a condition that equipment be certified by an OSHA-recognized NRTL to a U.S. industry consensus safety standard that is designed to allow for safe use of flammable refrigerants in residential and light commercial AC and heat pump equipment.

The EPA performed an assessment to examine the human health and environmental risks of each of the proposed new substitutes. These assessments are available in the docket.[57] As

[57] See in section XII., "References": ICF, 2025a; ICF, 2025b; and ICF, 2025c.

discussed in Section IV.E., the EPA also conducted updated analyses for three representative substitutes for the updated listings to evaluate the health and safety implications of designing and using AC equipment in accordance with the latest edition of UL 60335-2-40, which the EPA proposes to view as one example of a U.S. industry consensus safety standard that could be used to meet this third-party certification requirement. These analyses found that use of these proposed refrigerants in accordance with this standard would not pose greater overall risk to human health and the environment than other acceptable substitutes for new equipment in this end-use. These assessments are available in the docket.[58] Proposed regulatory text for these new and updated listings under this potential option can be found in the docket under the title "Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Third-Party Certification Option (co-proposed as an alternative to Section III)."

5. When would the use conditions take effect?

For the newly listed refrigerants in this end-use, the use conditions would take effect on the effective date of a final rule based upon this proposal. For the refrigerants for which the EPA is proposing to update use conditions in this end-use, the EPA is proposing to allow regulated entities to follow either the existing use conditions or the proposed updated use conditions from the effective date of a final rule until two years after the effective date of the final rule.

If the EPA finalizes the third-party certification option, equipment manufactured between the effective date of the final rule and two years after that effective date could follow either the existing use conditions that include use of either UL 60335-2-40, 3rd edition[59] or the updated use conditions that would include certification of equipment by an OSHA-recognized NRTL. The updated use conditions would neither apply to nor affect equipment manufactured before the effective date of the final rule.

G. What additional information is the EPA including in these proposed listings?

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[58] See in section XII., "References": ICF, 2025e; ICF, 2025f; and ICF, 2025g.
[59] Or UL 484, 8th edition for R-290 and R-441A.

For all proposed listings in this end-use, the EPA is including recommendations, found in the "Further Information" column of the proposed listings, to protect personnel from the risks of using flammable refrigerants. Similar to our previous listings of flammable refrigerants, the EPA is including information on the OSHA requirements at 29 CFR part 1910, proper ventilation, personal protective equipment (PPE), fire extinguishers, use of spark-proof tools and equipment designed for flammable refrigerants, and training.

If the third-party certification option described in Section IV.F.4.b. is finalized, the EPA would also include a sentence in the "Further Information" column stating that the EPA views UL 60335-2-40 to be an example of an appropriate U.S. industry consensus safety standard that mitigates risks.

Since this additional information is not part of the regulatory decision under SNAP, these statements are not binding for use of the substitute under the SNAP program. While the statements in the "Further Information" column are not legally binding under the SNAP program, the EPA encourages users of substitutes to apply all statements in the "Further Information" column in their use of these substitutes.

V. Household Refrigerators and Freezers

A. What is the EPA proposing in this action?

The EPA is proposing to list HCR 4141 as acceptable, subject to use conditions, for use in new household refrigerators and freezers. The EPA would list HCR 4141 in a table in the new appendix Z of 40 CFR part 82, subpart G.

The EPA is proposing several use conditions for the use of HCR 4141 in the household refrigerators and freezers end-use. SNAP use conditions are designed to ensure that refrigerants are listed for specific end-uses and in a way that mitigates risks to human health and the environment. In summary, the EPA is co-proposing two options for use conditions to address flammability risks of the refrigerant HCR 4141 in household refrigerators and freezers similar to the two options discussed in Section IV.F.4. for the residential and light commercial AC and heat

pumps end-use. The key difference between the two options in the household refrigerators and freezers end-use and the two options in the residential and light commercial AC and heat pumps end-use is the industry safety standard that the EPA would incorporate by reference or would describe as being a relevant industry consensus safety standard for third-party certification. In the household refrigerators and freezers end-use the relevant U.S. industry consensus safety standard that addresses safe use of flammable refrigerant is UL 60335-2-24, "Household and Similar Electrical Appliances - Safety - Part 2-24: Particular Requirements for Refrigerating Appliances, Ice-Cream Appliances and Ice-Makers," rather than UL 60335-2-40.

Under both options, the EPA proposes the same use conditions that would restrict the use of the refrigerant HCR 4141 to new equipment that is specifically designed for that refrigerant and that would require warning labels and markings on equipment to inform consumers, technicians, and first responders of potential flammability hazards. Those common use conditions are described in Section V.E.

The two co-proposed options take two different potential approaches to proposed use conditions addressing design safety requirements for household refrigerators and freezers and in particular, charge size. These options are described in detail in Sections V.E.4.a. and V.E.4.b. Section V.E.4.a. describes an option in which the EPA would incorporate by reference UL 60335-2-24, 3rd edition, including testing and charge sizes. Section V.E.4.b. describes an option in which the EPA would require household refrigerators and freezers to be certified to a U.S. industry consensus safety standard such as UL 60335-2-24 by an organization that OSHA recognizes as an NRTL. The EPA will consider comments and available information and could finalize either of these two co-proposals.

The common use conditions are described in Sections V.E.1., V.E.2., and V.E.3. The use condition option requiring household refrigerators and freezers using HCR 4141 to meet a specific edition of UL 60335-2-24 is described in Section V.E.4.a. The option for a use condition requiring third-party certification of household refrigerators and freezers using HCR 4141 is

described in Section V.E.4.b.

The proposed regulatory text for this listing using the third-party certification option appears in the docket for this rulemaking under the title "Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Third-Party Certification Option (co-proposed as an alternative to Section III)." The proposed regulatory text for this listing using the incorporate by reference option can be found in the docket for this rulemaking under the title "Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Incorporate by Reference Option." If one of the use condition options is finalized, the EPA would publish a corresponding finalized listing for HCR 4141 in new household refrigerators and freezers in appendix Z of 40 CFR part 82, subpart G.

B. Background on household refrigerators and freezers

Household refrigerators, freezers, and combination refrigerators and freezers are intended primarily for residential use, although they may be used outside the home (*e.g.*, workplace kitchen pantries). The designs and refrigeration capacities of equipment vary widely. This equipment is composed of three main categories: household freezers only offer storage space at freezing temperatures, household refrigerators only offer storage space at non-freezing temperatures, and products with both a refrigerator and freezer in a single unit which are most common and are referred to as combination refrigerators and freezers. Small refrigerated household appliances (*e.g.*, chilled kitchen drawers, wine coolers, mini-fridges, stand-alone ice makers, home ice cream makers) are also within this end-use. In addition, refrigerators or freezers that are designed for consumer, but not commercial or professional, use and that are merely situated on a moving vehicle (*e.g.*, personal vehicle, recreational vehicle, or boat for leisure purposes) are within the scope of the household refrigerators and freezers end-use for purposes of the SNAP program. These uses are within the scope of the relevant U.S. industry safety standard, UL 60335-2-24. Throughout this document, we refer to all these uses with the

phrase “household refrigerators and freezers.” Refrigerators or freezers in a commercial kitchen such as onboard a cruise ship or on aircraft are not household refrigerators or freezers for purposes of the SNAP program and such equipment is outside the scope of UL 60335-2-24. Household refrigerators and freezers have all refrigeration components integrated, and for the smallest types, the refrigeration circuit is entirely brazed or welded. These systems are charged with refrigerant at the factory and typically require only an electricity supply to begin operation.

ASHRAE’s Handbook of Refrigeration provides an overview of food preservation regarding household refrigerators and freezers. Generally, a storage temperature between 32 and 39 °F (0 to 3.9 °C) is desirable for preserving fresh food. Humidity and higher or lower temperatures are more suitable for certain foods and beverages. Wine chillers, for example, are frequently used for storing wine, and have slightly higher optimal temperatures from 45 to 65 °F (7.2 to 18.3 °C). Freezers and combination refrigerators and freezers that are designed to store food for long durations have temperatures below 8 °F (-13.3 °C) and are designed to hold temperatures near 0 to 5 °F (-17.7 to -15 °C). In single-door refrigerators, the optimum conditions for food preservation are typically warmer than this because food storage is not intended for long-term storage.

C. What are the ASHRAE groups for refrigerant flammability and toxicity?

See Section IV.C. for information on ASHRAE groups for refrigerant flammability and toxicity.

D. What is HCR 4141 and how does it compare to other refrigerants in the household refrigerators and freezers end-use?

HCR 4141 is a blend of the saturated HCs R-600a, R-600, and R-290, all of which are higher flammability refrigerants having an ASHRAE safety group of A3; the percentage of each component in the blend is claimed as CBI. See Section IV.D. for environmental information, flammability information, and toxicity and exposure information on HCR 4141. The redacted submission and supporting documentation for HCR 4141 in household refrigerators and freezers

are provided in the docket. The EPA performed a risk screening assessment to examine the human health and environmental risks of this substitute which also is available in the docket.[60]

Comparison to other substitutes in the household refrigerators and freezers end-use: The specific atmospheric effects values can be found in the individual risk screen for HCR 4141. The values were determined consistent with the source information noted in Section III.C. above (*e.g.,* CAA; the AIM Act; WMO, 2022) as well as using the methodology for determining values for blends of chemicals (*i.e.*, determined by the percentage of each component). The EPA compared HCR-4141 to other A3 refrigerants listed as acceptable subject to use conditions for the same end-use. The MIR of the blend HCR 4141 is expected to be less than that of R-600a (MIR of 1.23 g O_3/g isobutane) and greater than that of R-290 (MIR of 0.49 g O_3/g propane). The MIR of HCR 4141 is greater than that of compounds that have been excluded from the EPA's regulatory definition of VOC[61] addressing the development of SIPs to attain and maintain the NAAQS, such as HFC-152a.

The EPA's risk screen for HCR 4141 in new household refrigerators and freezers[62] found that HCR 4141 can be used without exceeding its recommended OEL of 1,000 ppm (8-hr TWA); thus, the toxicity risks of HCR 4141 are comparable to those of other acceptable substitutes in new household refrigerators and freezers, which also are used without exceeding their OELs.

Although we noted that the flammability of HCR 4141 may be greater than that of other available substitutes that have ASHRAE 1, 2 or 2L flammability classifications in the same end-use, we found its flammability risk to be not significant even under worst-case assumptions in this end-use when following the proposed use conditions.[63] Further, its flammability risk is comparable to that of other A3 refrigerants that the EPA has previously listed as acceptable in

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[60] ICF, 2025h. Risk Screen on Substitutes in Household Refrigerators and Freezers (New Equipment); Substitute: HCR 4141.
[61] 40 CFR 51.100(s).
[62] ICF, 2025h. *Op. cit.*
[63] ICF, 2025h. *Op. cit*.

this end-use. We note that flammability risk can be minimized by use consistent with industry safety standards such as UL 60335-2-24 – which would be required by the proposed use conditions – as well as recommendations in the manufacturers' SDS and other safety precautions common in the refrigeration and air conditioning industry. The proposed use conditions for household refrigerators and freezers would maintain low potential risk associated with the flammability of this alternative so that it would not pose greater overall risk than other acceptable substitutes in this end-use.

E. What use conditions is the EPA proposing in this action for the new listing for HCR 4141 in new household refrigerators and freezers?

The proposed use conditions described in this section would apply to new household refrigerators and freezers using HCR 4141. Many of the proposed use conditions mirror the SNAP program's historical approach to requirements for flammable refrigerants in this end-use. The proposed use condition related to use in new equipment only is consistent with previously listed higher flammability refrigerants in this end-use. The proposed use conditions related to labels and markings are very similar to what has previously been required by SNAP for higher flammability refrigerants in this end-use, with a few updates made specifically to better align the EPA requirements with updated industry safety standards. A use condition option that proposes to incorporate by reference the latest edition of UL 60335-2-24 is consistent with the EPA's historical practice for listing flammable refrigerants in this end-use. The other co-proposed option, while different from the EPA's historical practice of incorporating portions of or entire industry consensus safety standards by reference, would address situations where the EPA's regulations require adherence to editions of industry consensus safety standards that have been updated and replaced subsequent to the issuance of a final rule. The EPA proposes the following use conditions:

1. New equipment only; not intended for use as a retrofit alternative

The EPA is proposing that HCR 4141 may be used only in new equipment designed

specifically and clearly identified for the refrigerant. In other words, this substitute must not be used as a conversion or "retrofit"[64] refrigerant for existing equipment designed for another refrigerant. The EPA has established this same requirement for other A3 refrigerants in this end-use and in certain other refrigeration and AC end-uses, such as vending machines, retail food refrigeration—stand-alone units, and very low temperature refrigeration. This requirement is intended to ensure that equipment using a higher flammability refrigerant is specifically designed to address flammability risks.

2. Labels

The EPA is proposing to require labeling of household refrigerators and freezers using HCR 4141. The following markings, or the equivalent, would need to be provided and be permanent:

a. "DANGER—Risk of fire or explosion. Flammable refrigerant used. Do not use mechanical devices to defrost refrigerator. Do not puncture refrigerant tubing." This marking would need to be located on or near any evaporators that can be contacted by the consumer.

b. "DANGER—Risk of fire or explosion. Flammable refrigerant used. To be repaired only by trained service personnel. Use only manufacturer-authorized service parts. Any repair equipment used must be designed for flammable refrigerants. Follow all manufacturer repair instructions. Do not puncture refrigerant tubing." This marking would need to be located near the machine compartment.

c. "CAUTION[65]—Risk of fire or explosion. Dispose of refrigerator properly in accordance with the applicable federal or local regulations. Flammable refrigerant used." This marking would need to be located on the exterior of the refrigeration equipment.

d. "CAUTION[66]—Risk of fire or explosion due to puncture of refrigerant tubing; follow

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[64] Sometimes conversion refrigerant substitutes are inaccurately referred to as "drop in" replacements.

[65] The word "CAUTION" may be substituted with the word "WARNING."

[66] The word "CAUTION" may be substituted with the word "WARNING."

handling instructions carefully. Flammable refrigerant used." This marking would need to be located near all exposed refrigerant tubing.

Both the 3rd and 2nd editions of UL 60335-2-24 have required labels with the above text as a hazard warning on refrigerated equipment that uses a flammable refrigerant. The 3rd edition of UL 60335-2-24 has revised two requirements in the 2nd edition concerning warning labels. The first change was that one marking would no longer be required that stated, "CAUTION—Risk of fire or explosion. Flammable refrigerant used. Consult repair manual/owner's guide before attempting to service this product. All safety precautions must be followed." The EPA also would not require this marking in the proposed use conditions.

The second change to the labels in the 3rd edition of UL 60335-2-24 is that the height of the letters on the warning labels have changed from no less than 6.4 mm (1⁄4 inch) to no less than 3.2 mm (1/8 inch), with the signal words "DANGER," "WARNING," and "CAUTION" being no less than 5.0 mm (0.2 inch). This would be a smaller font size that would allow for smaller labels that would be more convenient for manufacturers to apply. The EPA is instead proposing that the label text size be no less than 6.4 mm (1⁄4 inch) to allow for greater visibility for technicians, consumers, recyclers, and first responders. The larger font size is also consistent with the font size that the EPA has previously required for these labels in other SNAP rules for refrigeration or AC equipment using flammable refrigerants.

3. Color-coded hoses and piping

The EPA is proposing to require that equipment have distinguishing red (PMS #185 or RAL 3020) color-coded hoses and piping to indicate use of a flammable refrigerant. This color would need to be present at all service ports and other parts of the system where service puncturing or other actions creating an opening from the refrigerant circuit to the atmosphere might be expected, would need to extend a minimum of one inch (25 mm) in both directions from such locations, and would need to be replaced if removed. The EPA has applied this

proposed use condition in past actions for flammable refrigerants.[67]

Red markings are a requirement of the 3rd edition of UL 60335-2-24. The standard allows for an exception if the labels are visible when a technician attempts to access a process tube. In addition, the 3rd edition of UL 60335-2-24 calls for red markings but does not specify any particular shade of red. The EPA's proposal would not allow for this exception and is specifying particular shades of red, as in previous rules.

4. Use condition options related to equipment certification or industry safety standard requirements

The EPA is co-proposing two options for a use condition related to equipment certification or industry safety standard requirements for equipment that uses HCR 4141 in household refrigerators and freezers. Under the first option, the EPA would incorporate by reference a new edition of the safety standard for this end-use. Under the second option, the EPA would require household refrigerators and freezers to be certified by an organization that is recognized as an NRTL to a U.S. industry consensus safety standard that is designed to allow for safe use of flammable refrigerants in household refrigerators and freezers. This is the same proposed approach discussed in Section IV.F.4.a.

For the most recent listings of flammable refrigerants used in household refrigerators and freezers, the EPA addressed design elements to reduce flammability risks by incorporating by reference the 2nd edition of UL 60335-2-24, "Household and Similar Electrical Appliances—Safety—Part 2-24: Particular Requirements for Refrigerating Appliances, Ice-Cream Appliances and Ice-Makers."[68] The EPA is co-proposing an option to incorporate by reference UL 60335-2-24, 3rd edition (dated July 29, 2022, with revisions through February 29, 2024). As discussed in Section IV.F.4.b., the Agency recognizes that certain standards, including UL 60335-2-24, are under continuous maintenance, meaning that they are updated and superseded by newer editions.

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[67] See 86 FR 24444, May 6, 2021, and 88 FR 26382, April 28, 2023.
[68] Dated April 28, 2017. See 83 FR 38969; August 8, 2018.

This often means that regulations and safety standards are out of step. Therefore, the EPA is proposing another option to streamline use conditions and to maintain consistency with the most current version of the relevant standards. This potential option is discussed in Section V.E.4.b.

Each co-proposal in Sections IV.F.4.a. and IV.F.4.b. would include certain use conditions in addition to the common use conditions in Sections V.E.1., V.E.2., and V.E.3. (*i.e.,* for use in new equipment only, labels, and color-coded hoses and piping). The use conditions for HCR 4141 would apply to household refrigerators and freezers manufactured on and after the effective date of the final rule. The use conditions would be in a new appendix Z of 40 CFR part 82, subpart G.

a. Incorporate by reference UL 60335-2-24, 3rd edition option

In this first co-proposal, the EPA proposes that the refrigerant HCR 4141 may be used only in equipment that meets all the requirements in UL 60335-2-24.[69] The EPA has set a similar requirement for the use of R-290, R-600a, and R-441A in household refrigerators and freezers,[70] where the Agency's regulations require that those refrigerants be used only in equipment meeting the requirements of the 2nd edition[71] of UL 60335-2-24, rather than the 3rd edition of that standard. In this proposed new listing for HCR 4141 in new household refrigerators and freezers, the EPA would incorporate by reference the standard UL 60335-2-24, "Safety Requirements for Household and Similar Electrical Appliances, Part 2: Particular Requirements for Refrigerating Appliances, Ice-Cream Appliances and Ice-Makers."[72] This safety standard establishes requirements for the evaluation of household and similar electrical appliances, and safe use of flammable refrigerants. The EPA previously incorporated by reference UL 60335-2-24, 2nd edition for R-290, R-441A, and R-600a in our most recent rule on flammable refrigerants in household refrigerators and freezers.[73] This proposal would incorporate by reference the latest

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[69] 3rd edition, July 29, 2022, with revisions through February 29, 2024.
[70] See 83 FR 38969; August 8, 2018, and appendix R of 40 CFR part 82, subpart G.
[71] 2nd edition of UL 60335-2-24 dated April 28, 2017.
[72] 3rd edition, July 29, 2022, with revisions through February 29, 2024.
[73] See 83 FR 38969; August 8, 2018.

edition and revisions to that safety standard. Where the rule includes requirements that are different than those of UL 60335-2-24 (*e.g.*, font size), the EPA is proposing that the appliance would need to meet the requirements of the rule. UL 60335-2-24 establishes requirements for the evaluation of household and similar electrical appliances and the safe use of A2, A2L, or A3 refrigerants. The charge size limit for each separate refrigerant circuit (*i.e.*, compressor, condenser, evaporator, and refrigerant piping) is 150 grams (5.3 ounces), remaining the same in the 3rd edition as in the 2nd edition.

Both the 2nd and 3rd editions require testing of refrigeration appliances containing flammable refrigerants, including leakage tests, temperature and scratch tests, and heat testing requirements to address the hazards due to ignition of leaked refrigerant by potential ignition sources associated with the appliance. These tests are intended, among other things, to ensure that any leaks will result in concentrations well below the LFL, and that potential ignition sources will not be able to create temperatures high enough to start a fire. Specifically, the leakage test ensures that refrigerant concentrations do not reach or exceed 75 percent of the LFL inside any internal or external electrical component compartments. Appliances that comply with UL 60335-2-24 have passed appropriate ignition or leakage tests as stipulated in the standard. In addition, UL 60335-2-24, 3rd edition, includes labels and markings, as discussed in Sections V.E.2. and V.E.3. UL standard 60335-2-24 was developed using a consensus-based approach developed in cooperation with parties with an interest in participating in the development or use of the standard. For example, UL uses a process where experts with various interests, including manufacturers, experts in assessing the safety of products, government agencies, and academia, come together to agree on the safety requirements for a product, resulting in a standard that reflects a collective consensus on best practices for safety. While similar standards exist from other bodies such as the IEC, we are proposing in this option to use specific UL standards that are most applicable and used by U.S. manufacturers. The EPA used this approach in previous

SNAP rules concerning lower and higher flammability refrigerants.[74] UL standard 60335-2-24 was developed using a consensus-based approach developed in cooperation with parties with an interest in participating in the development or use of the standard. For example, UL uses a process where experts with various interests, including manufacturers, experts in assessing the safety of products, government agencies, and academia, come together to agree on the safety requirements for a product, resulting in a standard that reflects a collective consensus on best practices for safety. While similar standards exist from other bodies such as the IEC, we are proposing in this option to rely on specific UL standards that are most applicable and used by U.S. manufacturers. The approach of incorporating a UL standard by reference is the same as that in our previous rules on flammable refrigerants.[75]

Under this incorporate by reference option, this listing would include the use conditions described in Sections V.E.1., V.E.2., and V.E.3. as well as a use condition that the refrigerant may only be used in equipment that meets all the requirements of UL 60335-2-24, 3rd edition.

The EPA performed an assessment to examine the human health and environmental risks of HCR 4141 in household refrigerators and freezers. This assessment is available in the docket.[76] The proposed regulatory text for this new listing under this option can be found in the docket under the title "Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Incorporate by Reference Option."

b. Third-party certification option

Under this second co-proposal, the EPA is proposing a use condition where all household refrigerators and freezers using HCR 4141 must be certified by an OSHA-recognized NRTL to a U.S. industry consensus safety standard that is designed to allow for safe use of flammable

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[74] See 76 FR 78832, December 20, 2011; 80 FR 19454, April 10, 2015; 86 FR 24444, May 6, 2021; 88 FR 26382, April 28, 2023.
[75] See 76 FR 78832, December 20, 2011; 80 FR 19454, April 10, 2015; 86 FR 24444, May 6, 2021; 88 FR 26382, April 28, 2023.
[76] ICF, 2025h. Risk Screen on Substitutes in Household Refrigerators and Freezers (New Equipment); Substitute: HCR 4141. 2025.

refrigerants in household refrigerators and freezers and mitigates risks such that the listed refrigerant can be used in a manner that does not pose a greater overall risk to human health and the environment than other substitutes in this end-use. The industry consensus safety standard must be designed for use in the United States and be consistent with best industry safety practices.[77] For further detail on requirements of applicable industry consensus safety standards that the EPA proposes to find necessary to sufficiently mitigate risks, see Section IV.F.4.b. While the EPA is proposing reliance on certification by these NRTLs, the EPA is not opening OSHA's regulations at 29 CFR 1910.7 for comment, including definitions or requirements, nor is the EPA seeking comment on the OSHA program itself. For further information on OSHA's NRTL Program, see Section IV.F.4.b.

By not incorporating by reference a specific edition of a relevant safety standard in this use condition option, the EPA intends to increase efficiencies by not having to propose a new rule each time a standard is updated and to leverage OSHA's NRTL Program. The EPA does not expect this option to pose significant additional burden on manufacturers or NRTLs because most manufacturers of household refrigerators and freezers have their equipment certified by an NRTL already. Manufacturers that do not already certify their equipment through an OSHA-recognized NRTL would need to do so beginning two years after the effective date of the final rule.

Under this third-party certification option, the listing would include the use conditions described in Sections V.E,1., V.E.2., and V.E.3. as well as a use condition that equipment be certified by an OSHA-recognized NRTL to a U.S. industry consensus safety standard that is designed to allow for safe use of flammable refrigerants in household refrigerators and freezers. The EPA proposes that the use conditions for HCR 4141 in new household refrigerators and freezers would apply on the effective date of the final rule.

The EPA performed an assessment to examine the human health and environmental risks

[77] *e.g.*, UL 60335-2-24.

of HCR 4141 in household refrigerators and freezers. This assessment is available in the docket.[78] Proposed regulatory text for the new listing for HCR 4141 in household refrigerators and freezers under this option can be found in the docket under the title "Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Third-Party Certification Option (co-proposed as an alternative to Section III)."

F. What additional information is the EPA including in this proposed listing?

The "Further Information" column of the proposed listing for HCR 4141 in household refrigerators and freezers includes applicable OSHA requirements at 29 CFR part 1910, suggestions on ventilation and PPE, appropriate type of fire extinguisher (Class B), and suggestions for technicians. Among the suggestions for technicians are the appropriate type of tools and equipment to use for servicing, conditions for release of refrigerant if it is not recovered, and a recommendation that only technicians specifically trained in handling of flammable refrigerants service equipment containing the refrigerant.

The "Further Information" column of the listing for HCR 4141 under the third-party certification option would be the same as under the incorporation by reference of UL 60335-2-24 option.[79] In addition, because the EPA would not require use of UL 60335-2-24 in a use condition under the third-party certification option, the Agency would include a recommendation to follow the latest edition of UL 60335-2-24 or similar industry safety standard. While the statements in the "Further Information" column are not legally binding under the SNAP program, the EPA encourages users of HCR 4141 to apply all statements in the "Further Information" column in their use of this substitute.

VI. Water Coolers

A. What is the EPA proposing in this action?

The EPA is proposing to update use conditions for the previously listed refrigerant R-290

[78] ICF, 2025h.
[79] See section V.E.4.

for use in water coolers. The EPA listed R-290 as acceptable, subject to use conditions, in new water coolers in SNAP Rule 21.[80] The industry consensus safety standard that was incorporated by reference at the time of the original listing has since been updated. The EPA is not proposing to move this listing from acceptable, subject to use conditions, to any other listing category (*e.g.*, unacceptable).

The proposed updated use conditions include a requirement that R-290 be used in new equipment only, specific requirements for warning labels, and specific requirements for markings. As with some other listings in this rule, the EPA is co-proposing two options for an additional use condition related to equipment certification or industry safety standard requirements for R-290 in water coolers. The EPA intends to finalize one of these co-proposed options along with an appropriate transition period to provide manufactures with opportunity for a smooth transition between the existing use conditions and the updated use conditions. Throughout this section, the term "updated use conditions" refers to the set of use conditions being proposed that would apply to new equipment manufactured after the effective date of the final rule. The updated use conditions would neither apply to nor affect equipment manufactured before the effective date of the final rule.

The proposed regulatory text for this listing can be found in the docket for this rulemaking under the title "Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Incorporate by Reference Option" and in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Third-Party Certification Option (co-proposed as an alternative to Section III)." If one of the use condition options is finalized, the EPA would publish a corresponding finalized listing for R-290 in water coolers in appendix V to 40 CFR part 82, subpart G.

B. Background on water coolers

[80] See 81 FR 86778; December 1, 2016.

Water coolers are self-contained refrigerated units providing chilled water for drinking. They may or may not feature detachable containers of water. These devices are extensively used in homes, workplaces, public facilities, and warehouses typically employing a compact refrigeration system to chill water. Many models are self-contained, incorporating either bottle-fed or point-of-use water sources.

C. What are the ASHRAE groups for refrigerant flammability and toxicity?

See Section IV.C. for information on ASHRAE groups for refrigerant flammability and toxicity.

D. What is R-290 and how does it compare to other refrigerants in the water coolers end-use?

See Section IV.E. for information about R-290 and its environmental, flammability, and toxicity and exposure impacts. Redacted supporting documentation for R-290 in water coolers is provided in the docket. The EPA performed a risk screening assessment to examine the human health and environmental risks of R-290 in water coolers which also is available in the docket.[81]

Environmental information: See Section IV.D. for discussion of the EPA's analysis of potential air quality impacts due to emissions of R-290 and other HC refrigerants that are VOCs under EPA's regulatory definition of VOC.[82] The analysis showed relatively minimal air quality impacts of R-290 released to the atmosphere from the end-uses where it is already listed as acceptable, subject to use conditions, including water coolers. The EPA therefore concluded that R-290 does not have a greater overall impact on human health and the environment based on its effects on local air quality than other refrigerants listed as acceptable in the same end-uses.

The EPA previously exempted R-290 in water coolers from the venting prohibition under CAA section 608(c)(2), finding that such venting, release, or disposal does not pose a threat to the environment.[83] The EPA is not proposing to change either of these decisions and is not

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[81] ICF, 2025i. Risk Screen on Substitutes in Water Coolers (New Equipment); Substitute: Propane (R-290). 2025.
[82] 40 CFR 51.100(s).
[83] See 81 FR 86778; December 1, 2016; 40 CFR 82.154(a)(1)(viii).

reopening them for comment.

Flammability information: R-290 exhibits higher flammability than other alternatives in this end-use and has an ASHRAE flammability classification of 3.

Toxicity and exposure data: R-290 has an ASHRAE toxicity classification of A (lower toxicity).

Comparison to other acceptable substitutes in the water coolers end-use: The atmospheric effects values can be found in the individual risk screen for R-290. These were determined consistent with the source information noted in Section III.C. above. Other acceptable substitutes for the water coolers end-use include R-480A, R-513A, HFC-134a, R-404A, and R-507A. The atmospheric effects for R-290 are better than or comparable to other listed substitutes. R-290 has an ODP of 0, which is lower than or identical to the ODPs of other alternatives in this end-use.

R-290 is a VOC, unlike the other substitutes listed in this end-use. However, because of the relatively minimal air quality impacts of R-290 if it is released to the atmosphere from the end-uses where it is listed as acceptable, subject to use conditions, even in a worst-case scenario, the EPA has previously concluded that R-290 does not have a greater overall impact on human health and the environment based on its effects on local air quality than other refrigerants listed as acceptable in the same end-use. When used in this end-use, workplace and consumer exposure to R-290 is not expected to exceed relevant exposure limits. Thus, R-290 does not pose significantly greater toxicity risks than other acceptable refrigerants in this end-use.

The flammability risks of R-290 in this end-use, determined by the likelihood of exceeding the LFL, are evaluated in the risk screen previously referenced. Other acceptable substitutes in this end-use category, including R-404A and HFC-134a, have an ASHRAE flammability class of 1. The proposed updated use conditions reduce the potential risk associated with the flammability of this alternative so it would not pose greater overall risk than other acceptable substitutes in this end-use. Updating the use conditions for this refrigerant would

enable it to continue to be available and used safely in the industry. This proposed revised listing under SNAP would provide greater flexibility to use R-290, while maintain safe use in this end-use.

The EPA previously found R-290 acceptable, subject to use conditions, in new water coolers in SNAP Rule 21.[84] Those requirements are codified in appendix V of 40 CFR part 82, subpart G. The EPA provided information on the environmental and health properties of R-290 and the various substitutes available at that time for use in this end-use. The EPA's risk screen for R-290 in water coolers is available in the docket for that previous rulemaking.[85]

The existing use conditions for R-290 in water coolers address safe use of this higher flammability refrigerant and include incorporation by reference of Supplement SB to UL 399, 7th edition, a requirement that the refrigerant only be used in new equipment that is designed specifically and clearly identified for the refrigerant, a requirement that the charge size not exceed 60 grams per refrigerant circuit in the water cooler, and requirements for markings and warning labels on equipment using the refrigerant to inform consumers and technicians of potential flammability hazards.

Without appropriate use conditions, the flammability risk posed by this refrigerant would be higher than nonflammable refrigerants because individuals may not be aware that their actions could potentially cause a fire, and because the refrigerant could be used in existing equipment that has not been designed specifically to minimize flammability risks. Our assessment and listing decisions in SNAP Rule 21[86] found that with the use conditions, the use of this substitute, including the risk due to flammability, does not present a greater overall risk in the end-use than other substitutes that are currently or potentially available for that same end-use. The EPA has not updated the use conditions for R-290 in water coolers since 2016.

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[84] See 81 FR 86778; December 1, 2016.
[85] EPA-HQ-OAR-2015-0663.
[86] See 81 FR 86778; December 1, 2016.

In the Notice of Proposed Rulemaking for SNAP Rule 21, the EPA proposed 150 g of R-290 as the charge size limit.[87] This proposed charge size was greater than the 60 g charge size limit in the 7th edition of UL 399. Based upon the EPA's initial risk screen prepared for that rulemaking, a worst-case release of an entire charge of 150 g of R-290 in a small room could result in exceeding the LFL. The release of a charge of 120 g, as well as the 60 g charge limit in the 7th edition of UL 399, would not result in exceeding the LFL. Based upon public comment, the EPA revised its risk screen and finalized a 60 g charge limit to be consistent with the 60 g limit in the 7th edition of UL 399.

Based on additional risk screening and in response to a request from a manufacturer of water coolers, the EPA now proposes to find that the larger charge size of 130 g in the 8th edition of UL 399 with revisions through February 28, 2024, can be used safely through proposed, updated use conditions to address flammability risks.

E. What use conditions is the EPA proposing in this action for the updated listing for R-290 in new water coolers?

The use conditions that currently apply to R-290 in the water coolers end-use incorporate by reference an industry consensus safety standard[88] that has been updated since the listing decision was finalized. Similar to Section IV.F. for updated use conditions in the residential and light commercial AC and heat pumps end-use, the EPA is proposing to update the listing for R-290 in the water coolers end-use so that the use conditions reflect updated industry safety standards.

Many of the proposed use conditions described in this section mirror existing use conditions. A use condition option described that proposes to incorporate by reference the latest edition of UL 399 is consistent with the EPA's historical practice for listing flammable refrigerants in this end-use. The other co-proposed option, while different from the EPA's

[87] See 81 FR 22810; April 18, 2016.
[88] UL 399, 7th edition.

historical practice of incorporating portions of or entire industry consensus safety standards by reference, would address situations where the EPA regulations require adherence to editions of industry consensus safety standards that have been updated and replaced subsequent to the issuance of a final rule. The EPA proposes the following use conditions:

1. New equipment only; not intended for use as a retrofit alternative

The EPA is proposing that R-290 may be used only in new equipment designed specifically and clearly identified for the refrigerant. In other words, this refrigerant must not be used as a conversion or "retrofit" refrigerant for existing equipment designed for another refrigerant. This is an existing use condition for R-290 in water coolers and the EPA is only addressing use of R-290 in new equipment which can be properly designed for higher flammability refrigerants.

2. Labels

The EPA is proposing to require labeling of water coolers using R-290. The following statements would need to be attached on labels at the locations provided and be permanent:

a. On or near any evaporators that the user can contact: "DANGER — Risk of Fire or Explosion. Flammable Refrigerant Used. Do Not Puncture Refrigerant Tubing."

b. On the inside of the water cooler near the compressor/condenser compartment: "DANGER — Risk of Fire or Explosion. Flammable Refrigerant Used. To Be Repaired Only by Trained Service Personnel. Do Not Puncture Refrigerant Tubing."

c. On the inside of the water cooler near the compressor/condenser compartment: "CAUTION — Risk of Fire or Explosion. Flammable Refrigerant Used. Consult Instruction Manual/Repair Manual/Owner's Guide Before Attempting to Install or Service This Product. All Safety Precautions Must be Followed."

d. On the outside of the water cooler: "CAUTION — Risk of Fire or Explosion. Dispose of Properly in Accordance With Federal Or Local Regulations. Flammable Refrigerant Used."

e. Near all exposed tubing: "CAUTION — Risk of Fire or Explosion Due To Puncture Of Refrigerant Tubing; Follow Handling Instructions Carefully. Flammable Refrigerant Used."

The proposed text of the labels is verbatim in language to those required by the section SB6.1.1 through SB6.1.5 of Supplement SB of both the 7th and 8th editions of UL 399. As required in section SB6.1.1 of both the 7th and 8th editions of UL 399, the minimum height for lettering must be 1⁄4 inch (6.4 mm) for all these labels, making it easy for technicians, consumers, retail storeowners, first responders, and those disposing the appliance to view the warning labels. These requirements are also aligned with previous labeling requirements for A3 refrigerants in SNAP Rule 21.[89] Under both the use condition options proposed and discussed in Sections VI.E.4.a. and VI.E.4.b., the proposed listing would maintain this use condition for labels.

3. Color-coded hoses and piping

An existing use condition for R-290 in water coolers is that they must have distinguishing red (PMS #185) color-coded pipes, hoses, or other devices through which the refrigerant passes, to indicate the use of a flammable refrigerant. This color must be applied at all service ports and other parts of the system where service puncturing or other actions creating an opening from the refrigerant circuit to the atmosphere might be expected and must extend a minimum of one inch (25 mm) in both directions from such locations. If removed, these markings also shall be replaced. These markings are the same as those required in section SB6.1.6 of Supplement SB to the 7th and 8th editions of UL 399, although the exact wording of those requirements is slightly different (*e.g.*, states "refrigerant tubing or other devices through which the refrigerant is intended to be serviced"). The EPA proposes that this same use condition continue to apply. This would be the case either for the incorporate by reference option described in Section VI.E.4.a. or for the third-party certification option described in Section VI.E.4.b.

4. Use condition options related to equipment certification or industry safety standard

[89] See 81 FR 86778; December 1, 2016.

requirements

In the initial listing of R-290 as acceptable, subject to use conditions, for use in water coolers, the EPA set two use conditions that relate to charge size and risk mitigation: (1) limiting the maximum charge of R-290 to 60 g in each refrigerant circuit and (2) requiring that water coolers using R-290 must meet all requirements of Supplement SB to the 7th edition of UL 399, dated August 22, 2008, with all revisions through October 18, 2013. Supplement SB to the 7th edition of UL 399 set a maximum refrigerant charge size of 2 ounces or 60 g for class 3 (higher flammability) refrigerants and other requirements such as construction requirements, performance testing, and marking requirements.

The latest revision to the 8th edition of UL 399 issued in February 2024 allows up to 130 g of A3 refrigerants, including R-290, in water coolers. The Agency's most recent risk screening finds that R-290 may be used safely in new water coolers in accordance with the 8th edition of UL 399 and a charge size of up to 130 g of R-290 to mitigate flammability risks.

These water coolers are factory charged with R-290 by the manufacturer. The risk of fire is minimal if water coolers meet the provisions of the 8th edition of UL 399 and have a charge size of R-290 no greater than 130 g. Water coolers containing R-290 should not be installed in enclosed areas and water coolers containing R-290 that are installed in lobbies or locations of egress (*e.g.*, hallways) and would need to have a charge size no greater than three times the LFL, or 114 g of R-290, as stated in standards such as ASHRAE 15 and UL 399. Water coolers installed in locations with adequate space and/or ventilation in accordance with the EPA recommendations and requirements, industry consensus safety standards, and the installation and maintenance manuals for equipment using R-290, are unlikely to pose flammability risk and human health risk to end-users, personnel, or the general population when the proposed use conditions are followed. Thus, the EPA proposes to find that updating the charge size and being consistent with the 8th edition of UL 399 to address flammability risks from use of R-290 in water coolers is appropriate to protect against such risks.

EPA is proposing to update the condition to follow Supplement SB of the 7th edition of UL 399 and remove the existing, separate use condition to use a charge size of R-290 of no greater than 60 g. Supplement SB contains specific safety criteria for water coolers using flammable refrigerants such as R-290. These requirements, including testing to meet safety standards, are designed to mitigate risks associated with flammable refrigerants. EPA proposes to find that the requirements in the 8th edition of UL 399, including the larger charge size of 130 g, allow R-290 to be used in a manner that sufficiently addresses flammability risks.

The EPA is co-proposing two options for a use condition related to equipment certification or industry safety standard requirements for the use of R-290 in water coolers. Section VI.E.4.a. describes an option in which the EPA would incorporate by reference a new edition of the industry consensus safety standard for this end-use. Section VI.E.4.b. describes an option in which the EPA would require water coolers to be certified by an organization that is recognized as an NRTL to a U.S. industry consensus safety standard that is designed to allow for safe use of flammable refrigerants and mitigates risks such that R-290 can be used in a manner that does not pose a greater overall risk to human health and the environment than other substitutes in this end-use.

a. Incorporate by reference UL 399, 8th edition option

For background on the SNAP program's recent approach to identifying use conditions for lower and higher flammability refrigerants, refer to Section IV.F.4.a. In this first co-proposed option, the EPA proposes that R-290 only be used in water coolers that meet all the requirements listed in Supplement SB of UL 399, 8th edition. The EPA is proposing to incorporate by reference Supplement SB of UL 399, "Standard for Safety: Drinking Water Coolers," 8th edition, March 30, 2017, with revisions through February 28, 2024, which establishes requirements for the evaluation of household and similar electrical appliances, and safe use of flammable refrigerants. Where the rule requirements are different than those of UL 399, the EPA is proposing that the appliance would need to meet the requirements of the rule.

UL 399 establishes requirements for the evaluation of water coolers and the safe use of refrigerants with a flammability classification of A2, A2L, or A3. This section summarizes relevant requirements of UL 399 for information only and is not meant to be a complete review of the standard or how it is applied.

The EPA has evaluated the revisions to the standard published in the 8th edition and finds that construction and use of water coolers in accordance with the 8th edition would not pose greater overall risk to human health and the environment when compared to use in accordance with the 7th edition. The charge size limit for each separate refrigerant circuit (*i.e.*, compressor, condenser, evaporator, and refrigerant piping) is 130 grams (4.6 ounces), which is more than the 60 g limit in the 7th edition.

Both the 7th and 8th editions of UL 399 require testing of water coolers containing flammable refrigerants, including leakage tests, temperature and scratch tests, and heat testing requirements to address the hazards due to ignition of leaked refrigerant by potential ignition sources associated with the appliance. These tests are intended, among other things, to ensure that any leaks will result in concentrations well below the LFL, and that potential ignition sources will not be able to create temperatures high enough to start a fire. Water coolers that comply with UL 399 have passed appropriate ignition or leakage tests as stipulated in the standard. Passing the leakage test ensures that refrigerant concentrations in the event of a leak do not reach or exceed 75 percent of the LFL inside any internal or external electrical component compartments. In addition, the 8th edition of UL 399 includes hazard warning labels and markings to make users, technicians, first responders, and others aware of flammability hazards. UL 399 was developed in an open and consensus-based approach, with the assistance of experts in the refrigeration and AC industry as well as experts involved in assessing the safety of products. More information about the way in which UL standards are developed can be found in Section IV.F.4.a. While similar standards exist from other bodies, we are proposing in this option to rely on specific UL standards that are most applicable and used by U.S. manufacturers. The

EPA expects that there would be greater consistency for industry to move from an edition of a UL standard to another edition of the same UL standard than to change to a different standard from a different standards setting organization. This approach has also been taken in recent SNAP rules concerning lower and higher flammability refrigerants.[90]

The EPA recognizes that in certain clauses, UL 399 refers to ASHRAE 15 for compliance. Consistent with previous listings for other flammable refrigerants in this end-use, the EPA is not proposing to include a use condition related to adherence to ASHRAE 15. The EPA proposes to find that these refrigerants can be used safely provided the use conditions in this proposed rule are followed, including compliance with the 8th edition of UL 399.

As stated in Section VI.A., the EPA is proposing to update the use conditions for the listing of R-290 for use in new water coolers. The updated use conditions would apply to equipment manufactured after the effective date of the final rule. The updated use conditions would neither apply to nor affect equipment manufactured before the effective date of the final rule.

Under this incorporate by reference option, the updated refrigerant listing would include the use conditions described in Sections VI.E.1., VI.E.2., and VI.E.3. as well as a use condition that the refrigerant may only be used in equipment that meets all the requirements of Supplement SB of UL 399, 8th edition.

The EPA has conducted updated analysis to evaluate the environmental, health, and safety implications of designing and using water coolers using R-290 in accordance with UL 399, 8th edition and found that design and use in accordance with the 8th edition allows for safe use of R-290. This assessment is available in the docket.[91] The proposed regulatory text for the updated listing under this option can be found in the docket under the title "Proposed Regulatory

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[90] See 76 FR 78832, December 20, 2011; 80 FR 19454, April 10, 2015; 81 FR 86778, December 1, 2016; 86 FR 24444, May 6, 2021; 88 FR 26382, April 28, 2023.

[91] ICF, 2025i. Risk Screen on Substitutes in Water Coolers (New Equipment); Substitute: Propane (R-290).

Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Incorporate by Reference Option."

b. Third-party certification option

As explained in Section IV.F.4.b., the EPA is co-proposing a second use condition option to address flammability risks while recognizing that a specific edition of a relevant industry consensus safety standard applicable for the water coolers end-use may be replaced by a later edition. For listings in this end-use under this option, the EPA is proposing a use condition that relies on NRTLs certifying equipment to a U.S. industry consensus safety standard that mitigates risks.

Under this option, the EPA proposes that all new water coolers using R-290 would need to be certified by an OSHA-recognized NRTL to a U.S. industry consensus safety standard that is designed to allow for safe use of flammable refrigerants in water coolers and mitigates risks such that the listed refrigerant can be used in a manner that does not pose a greater overall risk to human health and the environment than other substitutes in this end-use. Under this option, the EPA would remove the use condition that incorporates by reference Supplement SB of the 7th edition of UL 399 for new equipment manufactured after the effective date of a final rule and instead require certification of equipment to a U.S. industry consensus safety standard by an NRTL. By not incorporating by reference a specific edition of a relevant safety standard, the EPA intends to increase efficiencies by avoiding questions about whether it should propose a new rule each time a standard is updated and to leverage OSHA's NRTL Program.[92]

The industry consensus safety standard used to meet this proposed requirement would need to be designed for use in the United States and be consistent with best industry safety practices (*e.g.*, UL 399). The EPA proposes to view UL 399 as one example of a U.S. industry consensus safety standard that could be used to meet this requirement, as the requirements of the standard align with the levels of safety that the EPA expects in terms of mitigating risks to

[92] Definitions and requirements for the OSHA NRTL Program can be found at 29 CFR 1910.7.

human health and the environment. As discussed in Section VI.E.4.a., the EPA has evaluated the latest edition of UL 399 and finds that use of R-290 in water coolers consistent with this standard would not pose greater overall risk to human health and the environment than other acceptable substitutes in this end-use.

The certification process confirms that the design, manufacture, and operation of the water coolers meet industry safety standards such as UL 399 for higher flammability refrigerants including R-290. This includes ensuring refrigerant containment and mitigating risks associated with pressure and electrical safety, among other things.

The EPA is not proposing to establish specific requirements or protocols for laboratories because OSHA already has established such requirements and performs detailed reviews of equipment certification entities. More information about OSHA's review of NRTLs and the NRTL Program can be found in Section IV.F.4.b.

While the EPA is proposing reliance on certification by these NRTLs, the EPA is not opening OSHA's regulations at 29 CFR 1910.7 for comment, including definitions or requirements, nor is the EPA seeking comment on the OSHA program itself.

The EPA does not expect this option to pose significant additional burden on manufacturers or NRTLs because most manufacturers of water coolers have their equipment certified by an NRTL already. Manufacturers that do not already certify their equipment through an OSHA-recognized NRTL would need to do so beginning two years after the effective date of the final rule.

For further explanation about this co-proposed option, refer to the information provided in Section IV.F.4.b.

Under this third-party certification option, the updated listing for R-290 in water coolers would include the use conditions described in Sections VI.E.1., VI.E.2., and VI.E.3. as well as a use condition that equipment be certified by an OSHA-recognized NRTL to a U.S. industry consensus safety standard that is designed to allow for safe use of flammable refrigerants in

water coolers. The updated use conditions would apply to equipment manufactured after the effective date of the final rule. The updated use conditions would neither apply to nor affect equipment manufactured before the effective date of the final rule.

The EPA performed an assessment to examine the human health and environmental risks of R-290 in water coolers. This assessment is available in the docket.[93] Proposed regulatory text for the revised listing for R-290 in water coolers under this option can be found in the docket for this rulemaking under the title "Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Third-Party Certification Option (co-proposed as an alternative to Section III)."

5. When would the use conditions take effect?

The EPA is proposing to allow regulated entities to follow either the existing use conditions or the proposed updated use conditions from the effective date of the final rule until two years after that effective date.

If the EPA finalizes the third-party certification option, equipment manufactured between the effective date of a final rule and two years after the effective date of a final rule could follow either the existing use conditions (including the 7th edition of UL 399, the 60 g limit, and the existing labeling and marking requirements) or the updated use conditions that would include certification of equipment by an OSHA-recognized NRTL. The updated use conditions would neither apply to nor affect equipment manufactured before the effective date of the final rule.

F. What additional information is the EPA including in this proposed listing?

The EPA would retain the additional information provided in the existing listing for R-290 in water coolers in the "Further Information" column of the regulatory text, to protect personnel and users from the risks of using flammable refrigerants. Similar to our previous listings of flammable refrigerants, the EPA is including information on the OSHA requirements at 29 CFR part 1910, proper ventilation, PPE, fire extinguishers, use of spark-proof tools and

[93] ICF, 2025i.

equipment designed for flammable refrigerants, and training.

Under the third-party certification option, the EPA would also include a sentence in stating that the EPA views UL 399 to be an example of an appropriate U.S. industry consensus safety standard that mitigates risks.

Since this additional information is not part of the regulatory decision under SNAP, these statements are not binding for use of the substitute under the SNAP program. While the statements in the "Further Information" column are not legally binding under the SNAP program, the EPA encourages users of R-290 to apply all statements in the "Further Information" column in their use of these substitutes.

VII. Chillers

A. What is the EPA proposing in this action?

The EPA is proposing to list R-516A as acceptable, subject to use conditions, for use in the centrifugal chillers and positive displacement chillers end-uses. This proposed listing for R-516A applies to all compressor types of chillers, *i.e.*, centrifugal and positive displacement (including reciprocating, screw, scroll, and rotary) chillers. The proposed listing is for comfort cooling applications of such chillers under the EPA's proposed use conditions, including but not limited to use in commercial comfort AC.

The proposed use conditions for chillers are similar to those finalized for other lower flammability refrigerants in these end-uses.[94] The proposed use conditions include a requirement that R-516A be used in new equipment only, specific requirements for warning labels, specific requirements for markings, and requirements that the refrigerant be used only in chiller equipment that meets all the requirements of UL 60335-2-40 and ASHRAE 15-2024. See Section VII.E. for further discussion on the requirements of this standard that the EPA is incorporating by reference.

The regulatory text of the proposed decision appears in the docket under the title

[94] See 88 FR 26382; April 28, 2023, and appendix X to 40 CFR part 82, subpart G.

"Proposed Regulatory Text for SNAP Rule 27" in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Incorporate by Reference Option" and in the section "Proposed revisions to Appendices R, V, W, and new Appendix Z—Third-Party Certification Option (co-proposed as an alternative to Section III)." The text for this listing is identical in both sections. This text would be codified in appendix Z of 40 CFR part 82, subpart G. The proposed regulatory text contains listing decisions for the proposed end-uses. The EPA notes that there may be other legal obligations pertaining to the manufacture, use, handling, and disposal of the proposed refrigerants that are not included in the information listed in the tables (*e.g.*, CAA section 608(c)(2) venting prohibition or DOT requirements for transport of flammable gases). Flammable refrigerants being recovered or otherwise disposed of from chillers are likely to be hazardous waste under RCRA (40 CFR parts 260–270). Lower flammability ignitable spent refrigerants, including R-516A, that are recycled for reuse can follow alternative standards under 40 CFR part 266, subpart Q, instead of the full RCRA Subtitle C hazardous waste requirements.

B. Background on centrifugal chillers and positive displacement chillers

A chiller is a type of equipment using refrigerant that typically cools water or a brine solution, which is then pumped to fan coil units or other air handlers to cool the air that is supplied to the occupied spaces transferring the heat to the water. The heat absorbed by the water can then be used for heating purposes and/or can be transferred directly to the air (air-cooled), to a cooling tower or body of water (water-cooled), or through evaporative coolers (evaporative-cooled). A chiller or a group of chillers could similarly be used for district cooling where the chiller plant cools water or another fluid that is then pumped to multiple locations being served such as several different buildings within the same complex. Chillers may also be used to maintain operating temperatures in various types of buildings, for example, in data centers, server farms, and agricultural and food operations. This proposal applies to chillers that are covered by UL 60335-2-40 and ASHRAE 15-2024. EPA understands that the UL standard applies to chillers used for comfort cooling. The EPA is not proposing to list R-516A in chillers

used in other applications such as IPR (*e.g.*, chillers used to cool process streams in industrial applications) and industrial process air conditioning (*e.g.*, chillers used for comfort cooling of operators or climate control and for protecting process equipment in industrial buildings).

Centrifugal chillers utilize a centrifugal compressor in a vapor-compression refrigeration cycle. Centrifugal chillers are typically used for commercial comfort AC, although other uses, that we are not proposing here, do exist. Centrifugal chillers tend to be used in larger buildings such as office buildings, hotels, arenas, convention halls, and airport terminals.

Positive displacement chillers are those that utilize positive displacement compressors such as reciprocating, screw, scroll, or rotary types in a vapor-compression refrigeration cycle. Positive displacement chillers are applied in similar situations as centrifugal chillers, again primarily for commercial comfort AC, except they tend to be used for smaller capacity needs such as in mid- and low-rise buildings.

C. What are the ASHRAE classifications for refrigerant flammability and toxicity?

See Section IV.C. for information on ASHRAE classifications for refrigerant flammability and toxicity.

D. What is R-516A and how does it compare to other refrigerants in the centrifugal chillers and positive displacement chillers end-uses?

R-516A is a lower flammability refrigerant blend in the A2L Safety Group. See Section IV.D. for information on the chemical components of R-516A as well as environmental information, flammability information, and toxicity and exposure information on R-516A. The redacted submission and supporting documentation for R-516A is provided in the docket. The EPA performed a risk screening assessment to examine the human health and environmental risks of this substitute which also is available in the docket.[95]

Comparison to other substitutes in the centrifugal chillers and positive displacement

[95] ICF, 2025j. Risk screen on Substitutes in Chillers (New Equipment); Substitute: R-516A (Forane® 516A).

chillers end-uses: The specific atmospheric effects values can be found in the individual risk screen for R-516A. These were determined consistent with the source information noted in Section III.C. above (*e.g.*, CAA, the AIM Act) as well as using the methodology for determining values for blends of chemicals (*i.e.*, determined by the percentage of each component). The atmospheric effects for R-516A are overall better than or comparable to many of the substitutes currently listed as acceptable in this end-use such R-454C, R-454A, R-454B, HFC-32, R-452B, R-514A, R-1224yd(Z), HFO-1234yf, and HFO-1234ze. Furthermore, as noted above, the EPA does not intend to restrict a substitute if it has only marginally greater risk.

Toxicity risks of use, determined by the likelihood of exceeding the exposure limit of the refrigerant in these end-uses, are evaluated in the previously referenced risk screen. The toxicity risks of using R-516A are comparable to or lower than toxicity risks of other available substitutes in the same end-uses.[96] Toxicity risks of the proposed refrigerants can be minimized by use consistent with the proposed use conditions and best industry practices.

The flammability risks associated with R-516A in these end-uses, determined by the likelihood of exceeding their respective LFLs, are evaluated in the previously referenced risk screen. In conclusion, while this refrigerant may pose greater flammability risk than other available substitutes in the same end-uses, this risk can be minimized by use consistent with the proposed use conditions, as well as recommendations in the manufacturers' SDS and other safety precautions common in the refrigeration and AC industry. The EPA is proposing use conditions that mitigate human health and environmental risks associated with the flammability of these alternatives so that they would not pose greater overall risk than other acceptable substitutes in these end-uses.

Given the wide range of applications for centrifugal chillers and positive displacement chillers, not all refrigerants listed as acceptable under SNAP will be suitable for the range of

[96] See previous listing decisions for information regarding the toxicity of other available alternatives (https://www.epa.gov/snap/substitutes-chillers).

equipment in these end-uses. To provide additional options to ensure the availability of substitutes for the full range of comfort cooling chillers, the EPA is proposing the new listing for R-516A.

E. What use conditions is the EPA proposing in this action for the new listing for R-516A in new centrifugal chillers and positive displacement chillers?

The proposed use conditions described in this section would apply to new centrifugal chillers and new positive displacement chillers using R-516A. In summary, these use conditions are:

1. New equipment only; not intended for use as a retrofit alternative: The EPA is proposing that this refrigerant may be used only in new equipment designed to address concerns unique to flammable refrigerants. None of these substitutes may be used as a conversion or "retrofit" refrigerant for existing equipment.

2. UL Standard: This refrigerant may be used only in chiller equipment that meets all requirements listed in the 4th edition, dated December 15, 2022, of the standard UL 60335-2-40, "Household and Similar Electrical Appliances—Safety—Part 2-40: Particular Requirements for Electrical Heat Pumps, Air Conditioners and Dehumidifiers." In cases where this rule includes requirements different than those of the 4th edition of UL 60335-2-40, the EPA is proposing that the appliance would need to meet the requirements of the rule.

3. ASHRAE Standard: This refrigerant may be used only in chillers that meet all requirements listed in ASHRAE 15-2024. ASHRAE 15-2024 is the latest version of the ASHRAE 15 standard. In cases where the rule includes requirements different than those of ASHRAE 15-2024, the EPA is proposing that the appliance would need to meet the requirements of the rule. The EPA is also proposing that in cases where similar requirements of ASHRAE 15-2024 and UL 60335-2-40 differ, the more stringent or conservative condition would apply unless superseded by the final rule.

4. Labels: The EPA is proposing that this refrigerant may be used only in equipment with

appropriate warning labels. These warning labels are identical to those proposed as use conditions for A2L refrigerants as detailed in Section IV.F.2., other than the proposed label under paragraph for non-fixed equipment since chillers for comfort cooling are typically fixed equipment. These labels are similar or verbatim in language to those required by UL 60335-2-40. The warning labels would need to be provided in letters no less than 6.4 mm (1⁄4 inch) high and would need to be permanent.

5. Color-coded hoses and piping: The EPA is proposing to require that equipment have distinguishing red (PMS #185 or RAL 3020) color-coded hoses and piping to indicate use of a flammable refrigerant. The equipment would need to have marked service ports, pipes, hoses, and other devices through which the refrigerant is serviced. Markings would need to extend at least one inch (25 mm) from the servicing port and would need to be replaced if removed. This requirement is identical to the requirement proposed as a use condition for A2Ls as detailed in Section IV.F.3.

UL 60335-2-40 applies to chillers used for comfort cooling, among other things. A summary of the requirements of UL 60335-2-40 as they affect the refrigerants and end-uses in this proposal can be found in Section IV.F.4.a.

UL 60335-2-40, 4th edition indicates that refrigerant charges greater than a specific amount (called "m3" in the UL standard and based on the refrigerant's LFL) are beyond its scope and that national standards apply, such as ASHRAE 15-2024. Given that either UL 60335-2-40 or ASHRAE 15-2024 would apply, depending on the charge size of the equipment, the EPA is proposing adherence to both standards as use conditions for chillers. Where similar requirements of ASHRAE 15-2024 and UL 60335-2-40 differ, the EPA is proposing that the more stringent or conservative condition would apply unless superseded by this rule.

The EPA is proposing that new chillers using R-516A would need to adhere to ASHRAE 15-2024, "Safety Standard for Refrigeration Systems," including all addenda published by the date of this proposal. Where the requirements specified in this rule and ASHRAE 15-2024 are

different, the requirements of this rule would apply. The EPA understands that ASHRAE 15-2024 was published early to align the standard with the model code revision cycle. Incorporating by reference ASHRAE 15-2024 would align the SNAP requirements with the latest industry best practices and model code requirements.

The 2024 edition of ASHRAE 15 incorporates ASHRAE 15-2022 and Addenda a, b, c, e, f, g, h, i, l, m, o, p, q, r, t, v, w, and ab. Most addenda to the 2022 edition address some aspect of flammable refrigerant use. Key changes include updated best practices for handling, transport, and storage of flammable refrigerants, and the installing, servicing, and decommissioning of equipment containing flammable refrigerants. ASHRAE 15-2024 provides information regarding machinery rooms including revised ventilation requirements in machinery rooms, information on what types of equipment are generally expected to be in a machinery room, types of equipment and materials that should not be located in a machinery room, and authorized personnel requirements for accessing a machinery room.

This section summarizes relevant aspects of ASHRAE 15-2024 for information only and is not meant to be a complete review of the standard or how it is applied. ASHRAE 15-2024 specifies requirements for refrigeration systems based on the safety group of the refrigerant used, the type of occupancy in the location where the system is used, and whether refrigerant-containing parts of the system enter the space or ductwork such that leakage in the space is deemed "probable." "High-probability" installations are those where leaks or failures result in refrigerant entering occupied space. Occupancies are divided into six classifications: institutional, public assembly, residential, commercial, large mercantile, and industrial. Examples of these include jails, theaters, apartment buildings, office buildings, shopping malls, and chemical plants, respectively.

Sections 7.2 and 7.3 of ASHRAE 15-2024 determine the maximum amount of refrigerant allowed in the system. Section 7.4 provides an option to locate equipment outdoors or in a machinery room constructed and maintained under conditions specified in the standard. Section

7.6 addresses A2L refrigerants when used for human comfort in "high-probability" systems, including requirements for nameplates, labels, refrigerant detection systems (under certain conditions), airflow initiation, activation of safety shutoff valves, other actions if a rise in refrigerant concentration is detected, and other restrictions.

ASHRAE 15 undergoes regular revision cycles with publication of periodic addenda and is typically updated and republished every three years. While the EPA is proposing to incorporate ASHRAE 15-2024 and all addenda published by the date of this proposal, there may be additional changes to ASHRAE 15-2024 by the time the EPA issues a final rule. Because the EPA would not have reviewed those changes, the EPA is not proposing to incorporate by reference any addenda or other changes made to ASHRAE 15-2024 after the date of the publication of this proposed rule.

F. What additional information is the EPA including in this proposed listing?

The EPA is providing additional information related to this proposed listing, found in the "Further Information" column of the regulatory text, to protect personnel from the risks of using a lower flammability refrigerant such as R-516A. Similar to our previous listings of lower flammability refrigerants, the EPA is including information on the OSHA requirements at 29 CFR part 1910, proper ventilation, PPE, fire extinguishers, use of spark-proof tools and equipment designed for flammable refrigerants, and training. Since this additional information is not part of the regulatory decision under SNAP, these statements are not binding for use of the substitute under the SNAP program. While the statements in the "Further Information" column are not legally binding under the SNAP program, the EPA encourages users of substitutes to apply all statements in the "Further Information" column in their use of these substitutes.

VIII. Motor Vehicle Air Conditioning

A. What is the EPA proposing in this action?

The EPA is proposing to list HFO-1234yf as acceptable, subject to use conditions, for use in new MVACs in HDOH vehicles and buses.

The EPA is proposing for retrofit equipment the following listings:

- HFO-1234yf, R-444A, R-456A, and R-480A as acceptable, subject to use conditions, for retrofit of LMDV MVACs;
- R-444A, R-456A, and R-480A as acceptable, subject to use conditions, for retrofit of MVACs in HD pickup trucks and vans (both complete and incomplete);
- R-456A and R-480A as acceptable, subject to use conditions, for retrofit of HDOH MVACs; and
- R-453A, R-456A, and R-480A as acceptable, subject to use conditions, for retrofit of MVACs in buses and trains.

The proposed retrofit listings would allow for retrofits of CFC-12 or HCFC-22 MVACs as well as for retrofits of MVACs using any of the refrigerants the SNAP program lists as acceptable, including HFC-134a and HFO-1234yf. None of these substitutes have been listed for retrofit applications previously, and with the exception of HFO-1234yf, none have been listed for use in MVACs previously.

The EPA also is proposing to modify the unacceptable listing of flammable refrigerants in MVACs to exclude R-444A and HFO-1234yf when used in retrofit equipment. These two refrigerants are lower flammability and are being proposed as acceptable, subject to use conditions, as retrofits in MVAC in this action.

The EPA is proposing to consider certain stand-alone battery thermal management systems (BTMS) on electric HD and nonroad vehicles as part of the MVAC end-use under the SNAP program. Refrigerants listed for use in MVACs in a given vehicle type would also be acceptable for use in BTMS onboard those vehicle types.

Finally, the EPA is proposing non-substantive changes to existing listings to reduce redundancy and improve clarity. The EPA is proposing to consolidate several listings for HFO-1234yf in appendix B of 40 CFR part 82, subpart G that share the same use conditions. For example, the EPA proposes to consolidate the listings for HFO-1234yf in five types of nonroad

equipment that share the same use conditions into a single row. The EPA is also proposing to reformat and clarify the existing listings for refrigerants in the table titled "Refrigerants-Unacceptable Substitutes" in appendix B of 40 CFR part 82, subpart G, by publishing the end-use for each row. The EPA is also proposing to number each row in the tables titled "Refrigerants-Acceptable Subject to Use Conditions," "Refrigerants-Acceptable Subject to Narrowed Use Conditions," and "Refrigerants-Unacceptable Substitutes" in appendix B of 40 CFR part 82, subpart G.

B. Background on motor vehicle air conditioning

The SNAP program uses the term MVAC broadly to describe a wide variety of non-stationary air conditioning systems that provide passenger comfort cooling for LMDVs, HD vehicles, nonroad vehicles, buses, and trains. The SNAP MVAC end-use includes systems that may also be subject to other CAA regulatory programs, including for example, where those systems fit within the regulatory definition of "MVAC" under 40 CFR 82.32,[97] or the definition of an "MVAC-like appliance"[98] or "appliance" under 40 CFR 82.152, or both.

To appropriately evaluate human health and environmental risks, the SNAP program considers the type of vehicle in which the proposed alternative would be used. The EPA is proposing listings for refrigerants used in MVACs in LMDVs (*e.g.*, common passenger vehicles such as sedans, small pickup trucks, and sport utility vehicles), complete and incomplete HD pickup trucks and vans (*e.g.*, large passenger vehicles such as large pickup trucks or vans),

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[97] As defined in 40 CFR 82.32, Motor vehicle air conditioners means 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. See also 40 CFR 82.152 (defining MVAC to mean "any appliance that is a motor vehicle air conditioner as defined in subpart B of 40 CFR part 82").

[98] As defined in 40 CFR 82.152 MVAC-like appliance means a mechanical vapor compression, open-drive compressor appliance with a full charge of 20 pounds or less of refrigerant used to cool the driver's or passenger'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.

HDOH vehicles (*e.g.*, vocational or commercial vehicles such as tractor-trailers and box trucks), buses, and trains.

MVACs across all vehicle types are typically charged during vehicle manufacture apart from incomplete HD vehicles. Incomplete HD vehicles are modified by secondary manufacturers and may involve the installation of additional AC or refrigeration equipment – for example, AC for the rear compartment of an ambulance or van.

The class I ODS refrigerant, CFC-12 was the refrigerant historically used in MVACs for passenger vehicles and trucks. HFC-134a, amongst other substitutes, was listed as acceptable for use in new and retrofit MVACs, including light-duty (LD) vehicles, in the initial SNAP rulemaking.[99] Since then, the EPA has listed additional alternatives for MVACs as acceptable, subject to use conditions, for use in new LMDV, including HFO-1234yf, HFC-152a, and carbon dioxide (R-744).

HFO-1234yf is the predominant refrigerant used in new LMDVs that are manufactured and imported in the United States. Older vehicles continue to use HFC-134a and in some cases, CFC-12. HFC-134a is the predominant refrigerant used in new HDOH and bus MVACs. The Class II ODS refrigerant HCFC-22 was historically used in buses and trains while newer buses and passenger trains often use HFC-134a or R-407C.

As noted above, the EPA considers other relevant regulatory programs when developing listing decisions and use conditions. For example, CAA section 609 and implementing regulations in 40 CFR part 82, subpart B address the repair and servicing of MVACs as well as technician training and certification. CAA section 608 and implementing regulations in 40 CFR part 82, subpart F restrict the sale of refrigerant and address disposal and other activities involving MVACs that are not regulated under CAA section 609.

The EPA notes that by considering the regulatory requirements that already exist consistent with the SNAP program's guiding principles, the EPA has been able to limit the use

[99] See 59 FR 13044; March 18, 1994.

conditions the Agency would have otherwise considered particularly for retrofits. Under CAA section 609 and its implementing regulations, no person may perform any service on an MVAC that involves refrigerant for consideration (*i.e.*, payment or bartering) without properly using[100] refrigerant recovery, recycling, and recharging equipment approved by the EPA or an EPA-approved independent standards organization. Individuals not accepting payment (also known as do-it-yourselfers or DIYers) are exempt from the certification requirements. The regulations under CAA section 609 prohibit refrigerant recovered from an MVAC to be recharged into an MVAC, including the MVAC it was extracted from, unless it has been recycled.[101] Recycling may be done through the use of EPA-approved equipment that recovers and subsequently recycles refrigerant before returning it to an MVAC. Alternatively, when using EPA-approved recover-only equipment the refrigerant must be sent offsite for reclamation as described in the definition of "properly using." While there are circumstances in which refrigerant recovered from MVACs is sent offsite to be reclaimed,[102] onsite recovery, recycling, and recharging of single-component MVAC refrigerants is currently the most common practice.

The EPA's regulatory approach under CAA sections 609 and 612 for MVACs seeks to mitigate refrigerant mixing and refrigerant emissions while accommodating the practice of onsite

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[100] As defined in 40 CFR 82.32(e)(1) properly using means using equipment in conformity with the regulations set forth in subpart B of 40 CFR part 82, including but not limited to the prohibitions and required practices set forth in 40 CFR 82.34, and the recommended service procedures and practices for the containment of refrigerant set forth in 40 CFR 82.36(a) and appendices A, B, C, D, E, and F to that subpart, as applicable. In addition, this term includes operating the equipment in accordance with the manufacturer's guide to operation and maintenance and using the equipment only for the controlled substance for which the machine is designed. For equipment that extracts and recycles refrigerant, properly using also means to recycle refrigerant before it is returned to an MVAC or MVAC-like appliance, including to the MVAC or MVAC-like appliances from which the refrigerant was extracted. For equipment that only recovers refrigerant, properly using includes the requirement to recycle the refrigerant onsite or send the refrigerant off-site for reclamation.

[101] 40 CFR 82.34(d)(1).

[102] As defined in 40 CFR 82.152, reclaim means to reprocess recovered refrigerant to all of the specifications in appendix A to subpart F of 40 CFR part 82 (based on AHRI Standard 700–2016, Specifications for Refrigerants) that are applicable to that refrigerant and to verify that the refrigerant meets these specifications using the analytical methodology prescribed in section 5 of appendix A of this subpart.

recycling. SNAP program requirements in appendix D of 40 CFR part 82, subpart G include specifications for unique fittings,[103] labeling of retrofit MVACs, and a prohibition against "topping off" an MVAC that uses another refrigerant. Together with the CAA section 609 requirement to use certified servicing equipment, these provisions minimize refrigerant mixing and cross contamination while allowing for onsite recovery, recycling, and recharging.

This framework for onsite refrigerant recycling relies on industry safety standards for refrigerant purity and the use of EPA-approved recover, recycle, and recharge equipment. For example, SAE International, previously known as the Society of Automotive Engineers (SAE) establishes requirements (*e.g.*, SAE J2843) for equipment used to recycle HFO-1234yf. The EPA did not change this framework in the 2024 Emissions Reduction and Reclamation (ER&R) final rule.[104] Subsection (h)(2)(B) of the AIM Act states that a "regulated substance used as a refrigerant that is recovered shall be reclaimed before the regulated substance is sold or transferred to a new owner, except where the recovered regulated substance is sold or transferred to a new owner solely for the purposes of being reclaimed or destroyed." As discussed in that rule, the EPA did not propose or establish requirements implementing subsection (h)(2)(B) for MVAC servicing facilities that currently reclaim or recycle recovered MVAC refrigerant. The EPA recognized the longstanding practice of onsite recovery and recycling to relevant MVAC safety standards (*e.g.*, SAE J2099) and that industry plans to develop relevant safety standards for recover, recycle, and recharge equipment for MVAC refrigerant blends, including those proposed in this action. As discussed in the ER&R final rule, the Agency intends to propose regulations for this sector after it has clarity on the development of such a safety standard and its likely content. Additionally, the EPA may need to consider potential approaches for recycling

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[103] A unique set of fittings is required for each refrigerant approved for use in MVACs under the SNAP program. These fittings are attachment points on the service ports of the MVAC itself, on all recovery and recycling equipment, on large refrigerant containers, and taps on small cans of refrigerant. The unique set of fittings for each refrigerant prevents the accidental mixing of different refrigerants. This helps protect the purity of the refrigerant. An adapter may not be used to make a fitting compatible with a refrigerant for which it was not intended.

[104] 89 FR 82862; October 11, 2024.

and/or reclaiming MVAC refrigerant blends, which may include HFCs and/or substitutes for HFCs, particularly given that refrigerant blends are currently not used in MVACs.[105]

Lastly, the EPA has received inquiries regarding the use of BTMS in HD and nonroad vehicles. In some cases, BTMS in these vehicle types may be separate from the AC systems that cool the passenger cabins of these vehicles. The EPA is proposing to consider these BTMS on HD and nonroad vehicles to be MVAC under the SNAP program. Thus, refrigerants listed as acceptable in MVACs in a given vehicle type would also be acceptable for use in BTMS in that same vehicle type. This interpretation would also mean that use conditions applicable to refrigerants in MVACs would apply to these refrigerants when used in BTMS. Requirements may include, but are not limited to, use of unique service port fittings, labeling, and compliance with industry safety standards. Note that this proposed interpretation would only apply to the SNAP program and would not change the treatment of MVACs under other EPA regulatory programs.[106]

In written correspondence, the EPA has previously said that "stand-alone" BTMS falls under other SNAP end-uses depending on the equipment configuration, such as non-mechanical heat transfer. However, upon further consideration, the EPA is proposing the aforementioned interpretation to ensure consistency in how BTMS are classified and clarity about what substitutes are acceptable.

The EPA is basing this proposed interpretation on similarities in risk profiles between BTMS and traditional MVACs that primarily provide comfort cooling for passengers. Both may be subject to collisions at high speeds, vibrations, and vehicle occupants who spend prolonged periods of time in the enclosed passenger cabin. Substitutes listed as acceptable for use in MVAC have already been screened taking these risk factors into consideration. Substitutes listed in other SNAP end-uses that predominantly consider use cases in stationary equipment would

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[105] 89 FR 82827; October 11, 2024.
[106] *e.g.*, the 609 program or the Technology Transitions rules.

not have considered these factors and may not be appropriate for use in BTMS.

Further, the standard setting bodies are the same for both traditional MVACs and BTMS in HD and nonroad vehicles. HD and nonroad vehicles typically follow standards set by SAE, and the EPA understands that SAE is currently researching alternative refrigerants and technologies to improve and optimize electric vehicle thermal management systems. The EPA expects that SAE would apply existing standards or would develop new standards to BTMS systems.

Finally, this interpretation aligns the SNAP classification of stand-alone BTMS in HD and nonroad vehicles with the program's treatment of combined BTMS/passenger cooling systems that are common in LMDVs. SNAP has consistently treated combined systems as MVAC. Classifying stand-alone BTMS as any other end-use under SNAP would subject these systems to a different slate of acceptable refrigerants and different use conditions that have not been evaluated for use in vehicles, which would create inconsistency and lack of clarity. The EPA's proposed interpretation means that stand-alone BTMS systems will have an analogous slate of alternatives and use conditions as combined systems across different vehicle types. This proposed interpretation would clearly identify acceptable refrigerants for use in BTMS in HD and nonroad vehicles, providing clarity for industry about the refrigerants acceptable in this application.

C. What are the ASHRAE classifications for refrigerant flammability and toxicity used in MVACs?

ASHRAE 34-2024 categorizes HFO-1234yf and R-444A as being in the A2L Safety Group and R-453A, R-456A, and R-480A in the A1 Safety Group. Refer to Section IV.C. for a description of the ASHRAE classifications for refrigerant flammability and toxicity.

The SNAP program has listed flammable refrigerants as unacceptable in MVAC end-uses for both new and retrofit equipment, with the exception of HFO-1234yf and HFC-152a in new MVACs under the use conditions in appendix B of 40 CFR part 82, subpart G. Within the SNAP

program, unacceptable substitutes may not be used unless and until the listing has been revised to acceptable, which we expect would involve the substitute undergoing a risk assessment and the necessary reviews by the SNAP program, generally including a notice and comment rulemaking.

This action proposes to list HFO-1234yf, as acceptable, subject to use conditions, in new MVACs in HDOH vehicles and buses, and as a retrofit for LMDV MVACs. The EPA understands that the submitter intends to market HFO-1234yf as a retrofit for other listed substitutes for LMDVs, specifically HFC-134a. The EPA conducted risk screens for these end-uses and proposes to find HFO-1234yf acceptable, subject to use conditions, for these end-uses. Similarly, the EPA conducted risk screens of R-444A as a retrofit in LMDV and HD pickup trucks and vans, and proposes to find it acceptable, subject to use conditions, in these end-uses. The EPA proposes to amend the restrictions on flammable refrigerants in MVACs to include these listings.[107]

D. What are refrigerants HFO-1234yf, R-444A, R-453A, R-456A, and R-480A and how do they compare to other refrigerants in the same end-use?

1. How do HFO-1234yf, R-444A, R-456A, and R-480A compare to other refrigerants for retrofit in the LDMV MVAC end-use?

The EPA is proposing to list HFO-1234yf, R-444A, R-456A, and R-480A as acceptable, subject to use conditions, for retrofit of LMDV MVACs. HFO-1234yf is also known as R-1234yf or 2,3,3,3-tetrafluoropropene.[108] R-444A is a refrigerant blend consisting of 12 percent HFC-32 (also known as difluoromethane or methylene fluoride; CAS Reg. No. 75-10-5), 5 percent HFC-152a (also known as 1,1-difluoroethane; CAS Reg. No. 75-37-6), and 83 percent HFO-1234ze(E) (also known as *trans*-1,3,3,3-tetrafluoroprop-1-ene; CAS Reg. No. 29118-24-9). R-456A is a refrigerant blend consisting of 6 percent HFC-32, 45 percent HFC-134a (also known as 1,1,1,2-tetrafluoroethane; CAS Reg. No. 811-97-2), and 49 percent HFO-1234ze(E). R-480A

[107] See section VIII.F.
[108] CAS Reg. No. 754-12-1.

is a refrigerant blend consisting of 5 percent R-744 (CAS Reg. No. 124-38-9), 86 percent HFO-1234ze(E), and 9 percent HFC-227ea (also known as 1,1,1,2,3,3,3-heptafluoropropane; CAS Reg. No. 431-89-0).

Redacted submissions and supporting documentation for these four proposed refrigerants are provided in the docket. The EPA performed risk screening assessments to examine the human health and environmental risks of each of these substitutes which also are available in the docket.[109] [110] [111] [112]

Environmental information: The specific atmospheric effects values can be found in the individual risk screens for HFO-1234yf, R-444A, R456A, and R-480A. These were determined consistent with the source information noted in Section III.C. above (*e.g.*, CAA, the AIM Act) as well as using the methodology for determining values for blends of chemicals (*i.e.*, determined by the percentage of each component).

HFO-1234yf and the components of R-444A, R-456A, and R-480A are excluded from the EPA's regulatory definition of VOC[113] for the purpose of addressing the development of SIPs to attain and maintain the NAAQS.

HFO-1234yf and HFC-134a (a component of R-453A and R-456A) can break down into TFA in the atmosphere. HFO-1234yf is almost completely transformed into TFA, while the yield of TFA from HFC-134a is estimated to be 7 to 20 percent.[114] For more information on TFA, see

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[109] ICF. Risk Screen on Substitutes in Motor Vehicle Air Conditioning (Light-Duty and Medium-Duty Vehicles) (Retrofit Equipment); Substitute: HFO-1234yf (Solstice® yf or Solstice® 1234yf). 2025. (ICF, 2025k).
[110] ICF. Risk Screen on Substitutes in Motor Vehicle Air Conditioning (Light-Duty Vehicles, Medium-Duty Vehicles, and Heavy-Duty Vehicles) (Retrofit Equipment); Substitute: R-444A (Klea® 444A). 2025. (ICF, 2025l).
[111] ICF. Risk Screen on Substitutes in Motor Vehicle Air Conditioning (Light-Duty Vehicles, Medium-Duty Vehicles, and Heavy-Duty Vehicles) (Retrofit Equipment); Substitute: R-456A (Klea® 456A). 2025. (ICF, 2025m).
[112] ICF. Risk Screen on Substitutes in Motor Vehicle Air Conditioning (Light-Duty Vehicles, Medium-Duty Vehicles, and Heavy-Duty Vehicles) (Retrofit Equipment); Substitute: R-480A (RS-20). 2025. (ICF, 2025n).
[113] 40 CFR 51.100(s).
[114] EEAP, 2023. Environmental Effects of Stratospheric Ozone Depletion, UV Radiation, and

the response to comments section of SNAP Rule 26.[115]

Flammability information: R-456A and R-480A are nonflammable refrigerant blends (ASHRAE flammability classification 1). Of the components of R-456A, HFC-134a is nonflammable, while HFC-32 and HFO-1234ze(E) are classified as A2L refrigerants. Of the components of R-480A, R-744 and HFC-227ea are nonflammable, while HFO-1234ze(E) is classified as an A2L refrigerant. Based on their ASHRAE safety group as A1, these refrigerants will not propagate a flame, and use of these refrigerants is not expected to pose flammability risk in LMDV MVACs.

HFO-1234yf and R-444A are lower flammability refrigerants (ASHRAE flammability classification 2L). HFO-1234yf and R-444A may pose greater flammability risk than nonflammable substitutes in retrofit LMDV MVACs. The flammability risk, determined by the likelihood of exceeding their respective LFLs, are evaluated in the risk screens referenced in this section. The EPA is proposing to determine that these substitutes may be used safely since flammability risk can be mitigated by use consistent with the proposed labeling requirements in appendix D of 40 CFR part 82, subpart G, recommendations in the manufacturers' SDS, and other safety precautions common in the refrigeration and AC industry.

The flammability characteristics of HFO-1234yf make the risk of ignition low. HFO-1234yf requires an open flame to ignite, such as a match or a cigarette lighter, because of its relatively high minimum ignition energy of greater than 5,000 mJ.[116] HFO-1234yf has an LFL of

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Interactions with Climate Change. 2022 Assessment Report. UNEP, Environmental Effects Assessment Panel. March, 2023. Available at: https://ozone.unep.org/system/files/documents/EEAP-2022-Assessment-Report-May2023.pdf

[115] See 88 FR 50457-8.

[116] B. Minor, D. Herrmann, and B. Gravell. (111g) Flammability Characteristics of Low GWP Refrigerant HFO-1234yf. AIChE 2009 Spring Meeting & 5th Global Congress on Process Safety. Available online at: https://proceedings.aiche.org/conferences/aiche-spring-meeting-and-global-congress-on-process-safety/2009/proceeding/paper/111g-flammability-characteristics-low-gwp-refrigerant-hfo-1234yf. Minor et al., 2009.

62,000 ppm,[117] and has a low burning velocity[118] compared to refrigerants with flammability classification of 2 such as HFC-152a[119] or with flammability classification of 3 such as HC refrigerants.[120] As a result of these flammability characteristics, HFO-1234yf is difficult to ignite, and is generally unable to propagate a flame once ignited (*i.e.*, flames resulting from HFO-1234yf put themselves out).

Under this proposal, HFO-1234yf could be used to retrofit MVACs originally designed for an A1 refrigerant. The EPA considered if this could create additional flammability risk distinct from its use in a new MVAC that is specifically designed with mitigation measures to use a flammable refrigerant. The original submission for HFO-1234yf in new vehicles included analyses that evaluated the flammability and toxicity risks of HFO-1234yf in MVACs that were originally designed for HFC-134a. The vehicles in these analyses did not feature any design changes to address potential flammability. In this way, MVACs used in the original analysis were analogous to vehicles that would be retrofit under this proposal.[121]

These analyses consisted of reports published in 2008, 2009, and 2013 from the SAE Cooperative Research Program (CRP). The 2008 report found that the increased flammability risk of HFO-1234yf in a vehicle designed for use with HFC-134a is well below those commonly

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[117] *Manufacturer's Safety Data Sheet for HFO-1234yf*. Honeywell, 23 May 2019. Also see Minor et al., 2009.

[118] A2L refrigerants have a burning velocity of less than 0.1 meters/second, per International Standards Organization 817 and ASHRAE 34-2024. HFO-1234yf has a burning velocity of 0.015m/s, per Minor et al., 2009.

[119] The burning velocity of HFC-152a is measured at approximately 0.236 m/s. Kenji Takizawa, Akifumi Takahashi, Kazuaki Tokuhashi, Shigeo Kondo, and Akira Sekiya. Burning velocity measurement of fluorinated compounds by the spherical-vessel method, *Combustion and Flame*, Volume 141, Issue 3, Pages 298-307, 2005. Available online at https://doi.org/10.1016/j.combustflame.2005.01.009. Takizawa et al., 2005.

[120] The burning velocity of R-290 is at least 0.4 m/s, depending on temperature and pressure. M. Metghalchi and J.C. Keck. Laminar Burning Velocity of Propane-Air Mixtures at High Temperature and Pressure. *Combustion And Flame* 38: 143-154 (1980). Available online at: https://james-keck-memorial-collection.unibs.it/JCKeck-papers/MetghalchiKeck-CombustionFlame-38-143-1980.pdf. Metghalchi and Keck, 1980.

[121] Gradient Corporation, 2008. Risk Assessment For Alternative Refrigerant HFO-1234yf. (Phase I) Prepared for the Society of Automotive Engineers (SAE) Cooperative Research Project 150.

accepted by the general public.[122] A revised 2009 report found that the risks of HFO-1234yf were low overall, and somewhat less than the toxicity risks posed by R-744.[123] The submitter of HFO-1234yf provided these analyses to the EPA to support the EPA's original consideration of HFO-1234yf in new vehicles, and the EPA based its listing of acceptability in part on the findings of these analyses. The Agency concluded that the risks of HFO-1234yf are comparable to or less than the risks from other available or potentially available alternatives in this end-use that the EPA had already listed or proposed as acceptable (*e.g.*, HFC-152a, HFC-134a, and R-744).[124]

SAE revised its assessment of HFO-1234yf and released a supplemental report in 2013 that contained two new fault tree analyses that included additional "worst-case scenarios."[125] The report revised the probability of a vehicle fire due to ignition of HFO-1234yf in a system featuring no design changes compared to an HFC-134a system to about 3×10^{-12} events per hour of vehicle operation. This probability remains extremely remote and is several orders of magnitude below other commonly accepted risks, including the probability of dying during a plane trip (7×10^{-8}), the probability of being in a police-reported vehicle collision (4×10^{-5}), and the probability of a vehicle fire due to any cause (1×10^{-6}).

The submitter of HFO-1234yf in retrofit LMDV MVACs provided an updated fault tree analysis that evaluated the additional risk associated with use of HFO-1234yf specifically in retrofit applications and the EPA considered this new analysis in our review of HFO-1234yf.[126]

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[122] Gradient Corporation, 2008. Risk Assessment for Alternative Refrigerant HFO-1234yf. Confidential report prepared for SAE International Cooperative Research Program 1234. February 2008.
[123] Gradient Corporation, 2009. Risk Assessment for Alternative Refrigerants HFO-1234yf and R-744 (CO_2). Confidential report prepared for SAE International Cooperative Research Program 1234. December 17, 2009.
[124] See 76 FR 17491; March 29, 2011.
[125] Gradient Corporation, 2013a. Additional Risk Assessment of Alternative Refrigerant R-1234yf. Confidential report prepared for SAE International Cooperative Research Program 1234-4. July 24, 2013.
[126] Gradient Corporation, 2023a. Retrofit Analysis Letter. Prepared for Honeywell International. September 26, 2023.

The analysis only considered scenarios that increased the flammability risk in a retrofit (such as increased risk of mechanical fan failure and electrical fires and less consistent presence and deployment of airbags) and did not consider scenarios that reduced the flammability risk in a retrofit (such as the larger cabin size in older vehicles that would be retrofit). The overall estimated risk was about 8 x 10^{-12} events per operating hour, which is similar to the risk of vehicle fire due to HFO-1234yf ignition in new MVAC equipment (5 x 10^{-12} events per operating hour).[127] The actual increased risk is likely lower than this, as the evaluation only considered circumstances that would increase the probability of a vehicle fire and did not consider circumstances that would reduce the probability.

The EPA conducted a risk screen for HFO-1234yf use in retrofit LMDVs. The risk screen found that concentrations of HFO-1234yf did exceed the LFL in the passenger compartment under certain worst-case scenarios but remained well below the LFL in more realistic industry consortium field testing. For example, using a simple box model, combining the highest ratio of refrigerant charge to observed passenger compartment size with a catastrophic release of 60 percent of the charge in 60 seconds resulted in a maximum instantaneous charge of 172,000 ppm, compared to an LFL of 62,000 ppm. However, analysis using the more accurate technique of computational fluid dynamics modeling found the instantaneous concentration of HFO-1234yf to vary from 65,000 ppm to 34,000 ppm. The industry consortium field testing found a maximum instantaneous concentration of HFO-1234yf of 29,774 ppm when a vehicle's full charge was released.[128]

The EPA's original risk analysis of HFO-1234yf for use in new LMDVs also identified scenarios in which concentrations exceeded the LFL. The EPA listed HFO-1234yf as acceptable,

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[127] Gradient Corporation, 2009. Risk Assessment for Alternative Refrigerants HFO-1234yf and R-744 (CO_2). Confidential report prepared for SAE International Cooperative Research Program 1234. December 17, 2009.
[128] ICF, 2025k.

subject to use conditions, in new LMDVs leveraging this risk analysis.[129] In the EPA's original listing, the Agency stated that it found that the use of HFO-1234yf in new passenger vehicle and LD truck MVACs, subject to the use conditions adopted in that listing, does not present a greater overall risk to human health and the environment compared to the currently approved MVAC alternatives or as compared to R-744.[130] The EPA has also subsequently listed R-744 as acceptable, subject to use conditions, in new LMDV MVACs.

Finally, HFO-1234yf in new LMDV MVACs has been widely adopted since being listed in 2012. In MY2023, the share of new LMDVs sold in the United States with HFO-1234yf reached 97 percent.[131] Even with its broad use, the EPA is not aware of any real-world instances in which HFO-1234yf has ignited and caused a vehicle fire, which further augments the record for this refrigerant. R-444A is also an A2L refrigerant. The EPA understands that the submitter of this refrigerant intends to market it to be used as a retrofit in MVACs, including those charged with HFO-1234yf. Based on review of materials available in the docket, the EPA is proposing to determine that R-444A is acceptable, subject to use conditions, for use in retrofit LMDV MVACs because the flammability risk associated with such use is low and is comparable to the flammability risk associated with the same use of HFO-1234yf.[132]

Similar to HFO-1234yf, the EPA conducted a risk screen of R-444A which identified certain scenarios in which concentrations exceed the LFL of R-444A. Using a simple box model, combining the highest ratio of refrigerant charge to observed passenger compartment size with a catastrophic release of 60 percent of the charge in 60 seconds resulted in a maximum instantaneous charge of 140,200 ppm, compared to an LFL of 82,000 ppm. However, analysis

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[129] ICF 2009 Risk Screen on Substitutes for CFC-12 in Motor Vehicle Air Conditioning: Substitute: HFO-1234yf. (ICF, 2009).
[130] See SNAP Rule 16, 76 FR 17488; March 29, 2011.
[131] U.S. EPA, 2024. EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975. US EPA. November, 2024.
[132] Gradient Corporation, 2013b. Risk Assessment for Alternative Refrigerants R-445A and R-1234yf. Phase III. Prepared for SAE International MRB CRP. December 30, 2013. See Appendix B, Fault Trees for R-1234yf and Appendix C, Fault Trees for R-444A.

using computational fluid dynamics modeling found the instantaneous concentration of HFO-1234yf to vary from 40,000 ppm to 76,000 ppm, which are below the LFL of R-444A. Further, the EPA's evaluation of flammability risks of R-444A in retrofit LMDV MVACs included a fault-tree analysis that evaluated the risk of a vehicle occupant being exposed to a flame resulting from R-444A ignition. This analysis found that risk to be slightly lower than the risk of an occupant being exposed to a flame resulting from HFO-1234yf ignition.[133]

SAE J1661 currently provides guidance on how to retrofit a vehicle originally charged with CFC-12 to HFC-134a. The EPA anticipates that SAE would develop an analogous standard or revise this standard for retrofitting vehicles using newer refrigerants, including those proposed as acceptable, subject to use conditions, for retrofitting in this proposal. Following such standards may further reduce the flammability risk associated with retrofitting MVACs, which is already expected to be extremely small in magnitude.

Given the findings of the evaluation materials available in the docket and, in the case of HFO-1234yf, its widespread adoption without documented flammability issues, the EPA is proposing that HFO-1234yf and R-444A may be safely used for retrofit of LMDV MVACs.

The other refrigerants that the EPA is proposing to list for retrofit of LMDV MVACs, R-456A and R-480A, are both nonflammable (ASHRAE classification of A1) and thus are comparable to or lower in their flammability risks than other acceptable substitutes for the same uses.

Toxicity information: Toxicity risk, determined by the likelihood of exceeding the exposure limits in these end-uses, are evaluated in the previously referenced risk screens. HFO-1234yf, R-444A, R-456A, and R-480A are lower toxicity (ASHRAE toxicity group A) refrigerants or refrigerant blends. ASHRAE has adopted OELs for these refrigerants of 500 ppm, 850 ppm, 900 ppm, and 900 ppm, respectively. The toxicity risks of using the proposed refrigerants in retrofit LMDV MVACs are comparable to or lower than that of other available

[133] *Id.*

substitutes in the same end-use, including HFC-134a and HFO-1234yf.[134] Toxicity risks of the proposed refrigerants can be mitigated by use consistent with applicable industry safety standards, recommendations in the manufacturers' SDS, and other safety precautions common in the refrigeration and AC industry.

HFO-1234yf is subject to a significant new use rule (SNUR) under 40 CFR 721.10182(a). Significant new uses under this requirement include:

(A) Use other than as a refrigerant: in MVAC systems in new passenger cars and vehicles (as defined in 40 CFR 82.32(c) and (d)), in stationary and transport refrigeration, or in stationary AC.

(B) Commercial use other than: in passenger cars and vehicles in which the original charging of MVAC systems with the pre-manufacture notice (PMN) substance was done by the motor vehicle original equipment manufacturer (OEM), in stationary and transport refrigeration, or in stationary AC.

(C) Use in consumer products other than products used to recharge the MVAC systems in passenger cars and vehicles in which the original charging of MVAC systems with the PMN substance was done by the motor vehicle OEM.

Use in all MVAC end-uses, except for when originally charged with HFO-1234yf, would fall under (B) or (C) as commercial or consumer use to recharge an MVAC in which the original charging of the MVAC was with a substance other than HFO-1234yf. The EPA considers retrofitting a vehicle to use HFO-1234yf that was not originally charged by the OEM with HFO-1234yf to be a significant new use of HFO-1234yf under this SNUR. Significant new uses require the chemical producer to submit a significant new use notice to the EPA for review of a substance before introducing the substance into interstate commerce in the significant new use.

Comparison to other substitutes in these end-uses: The specific atmospheric effects

[134] See previous listing decisions for information regarding the toxicity of other available alternatives. (https://www.epa.gov/snap/substitutes-motor-vehicle-air-conditioning).

values can be found in the individual risk screens for R-444A, R-456A, and R-480A. These were determined consistent with the source information noted in Section III.C. above (*e.g.*, CAA, the AIM Act) as well as using the methodology for determining values for blends of chemicals (i.e., determined by the percentage of each component). The atmospheric effects for HFO-1234yf, R-444A, R456A, and R-480A are overall better than or comparable to many of the substitutes currently listed as acceptable in this end-use, such as HFC-134a and HFC-152a. The EPA acknowledges that the atmospheric effects of one substitute, HFO-1234yf, may be lower than the three blends; however, the EPA is proposing to list R-444A, R-456A, and R-480A for retrofit use only where HFC-134a is the only available substitute currently listed as acceptable for retrofit of LMDV MVACs. Furthermore, as noted above, the EPA does not intend to restrict a substitute if it has only marginally greater risk. The EPA's analysis found that the effects on human health and the environment associated with retrofitting LMDV MVACs with the proposed alternatives are comparable to one another, and much lower than that of HFC-134a.[135]

The EPA is aware that the submitter of R-444A may market this substitute to retrofit MVACs originally charged with HFO-1234yf. The submitter provided information and analysis on R-444A which posits that the overall environmental impact of this substance used in retrofits for LMDV MVAC is comparable to that of HFO-1234yf. According to the submitter, this is because R-444A is expected to leak less and slower than HFO-1234yf due to its higher viscosity, and because R-444 has a slightly higher coefficient of performance, which allows R-444A MVACs to cool a given amount with less fuel. These improvements in leakage rate and efficiency may offset atmospheric effects of R-444A so that when it is used to retrofit MVACs originally charged with HFO-1234yf, its overall environmental effect is comparable to that of HFO-1234yf. The analysis supports the submitter's conclusion, that when evaluated using a

[135] The EPA is aware that the submitters of HFO-1234yf, R-456A, and R-480A are likely to market these substitutes to retrofit MVACs originally charged with HFC-134a.

more wholistic approach, the use of R-444A is unlikely to have a greater overall environmental impact.

The EPA's risk screens for HFO-1234yf, R-444A, R-456A, and R-480A in LMDV MVACs found that these substitutes can be used without exceeding their recommended OELs of 500 ppm (8-hr OEL), 900 ppm (8-hr OEL), 850 ppm (8-hr OEL), and 900 ppm (8-hr OEL) respectively; thus, the toxicity risks of these refrigerants are comparable to those of other acceptable substitutes in MVACs, which also are used without exceeding their OELs.[136] [137] [138] [139]

R-480A and R-456A are nonflammable refrigerants. The flammability of HFO-1234yf and R-444A may be greater than that of other available substitutes in the same end-use that have an ASHRAE flammability classification of 1. The EPA's analysis of the flammability risks of HFO-1234yf and R-444A found that when used in accordance with the proposed use conditions, these A2L refrigerants may be safely used in this end-use without presenting additional adverse effects to human health and the environment than other alternatives. HFO-1234yf has been used for over a decade in new LMDV MVACs without any reported harm or incidences of fire. R-444A is also an A2L refrigerant with a similar flammability profile. We note that flammability risk can be minimized by use consistent with applicable industry safety standards as well as recommendations in the manufacturers' SDS and other safety precautions common in the MVAC industry and any difference in flammability can be addressed by the existing labeling requirements in appendix D of 40 CFR part 82, subpart G.[140]

These proposed refrigerants provide additional retrofit options and would not pose additional adverse effects to human health or the environment when used in accordance with existing and proposed requirements and as intended by the submitter. To provide additional options for the full range of MVACs, the EPA is proposing the listings for HFO-1234yf, R-

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[136] ICF, 2025k.
[137] ICF, 2025l.
[138] ICF, 2025m.
[139] ICF, 2025n.
[140] Described in section VIII.E.1.

444A, R-456A, and R-480A as acceptable, subject to use conditions, for retrofit of LMDV MVACs.

2. How do R-444A, R-456A, and R-480A compare to other refrigerants for retrofit in the HD pickup trucks and HD vans MVAC end-uses?

The EPA is proposing to list R-444A, R-456A, and R-480A as acceptable, subject to use conditions, for retrofit of HD pickup trucks and HD van MVACs (complete and incomplete). Information about R-444A, R-456A, and R-480A and their components is described in Section VIII.D.1. Environmental, flammability, and toxicity information about these proposed substitutes are also described in Section VIII.D.1. and does not differ between end-uses.

Redacted submissions and supporting documentation for R-456A and R-480A are provided in the docket. The EPA performed a risk screening assessment to examine the human health and environmental risks of each of these substitutes in these end-uses which also are available in the docket.[141] [142] [143]

Comparison to other substitutes in these end-uses: The Agency understands that these substitutes will be marketed as retrofit options for different refrigerants, including HFC-134a and HFO-1234yf. HFC-134a is the only available refrigerant listed as acceptable for retrofit of MVACs in HD pickup trucks and vans, and HFO-1234yf is the primary refrigerant used in new HD pickup truck and van MVACs. For a comparison of the flammability, health, and environmental characteristics of these refrigerants to one another and to HFO-1234yf and HFC-134a, refer to Section VIII.D.1.

These proposed refrigerants provide additional retrofit options and would not pose additional adverse effects to human health or the environment when used in accordance with existing and proposed requirements and as intended by the submitter. To provide additional

[141] ICF, 2025l.
[142] ICF, 2025m.
[143] ICF, 2025n.

options for the full range of MVACs, the EPA is proposing the listings for R-444A, R-456A, and R-480A as acceptable, subject to use conditions, for retrofit of HD pickup truck and van MVACs.

3. How do HFO-1234yf, R-456A, and R-480A compare to other refrigerants in the HDOH MVAC end-use?

The EPA is proposing to list HFO-1234yf as acceptable, subject to use conditions, in new HDOH MVACs. The EPA is also proposing to list R-456A and R-480A for use in retrofit of HDOH MVACs. Environmental and toxicity information and information about the components of these proposed substitutes is described in Section VIII.D.1. and does not differ between end-uses.

Redacted submissions and supporting documentation for HFO-1234yf, R-456A, and R-480A are provided in the docket. The EPA performed a risk screening assessment to examine the human health and environmental risks of each of these substitutes which also are available in the docket.[144] [145] [146]

Flammability information: Flammability information about R-456A and R-480A is described in Section VIII.D.1. and does not differ between end-uses. HFO-1234yf is a lower flammability refrigerant with an ASHRAE classification of 2L. The EPA's risk screen found that concentrations of HFO-1234yf in this end-use could exceed the LFL in feasible worst-case scenarios. As discussed in Section VIII.D.1., HFO-1234yf is difficult to ignite and, in the event of ignition, flames are unlikely to propagate.

The EPA reviewed risk assessments for HFO-1234yf from the submitter in addition to developing its own risk screen. Fault tree analysis for use of HFO-1234yf in HDOH MVACs, which is included in the docket, demonstrates that even in worst-case scenarios, risk probabilities

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[144] ICF, 2025o. Risk Screen on Substitutes in Motor Vehicle Air Conditioning (Heavy-Duty On-Highway (HDOH) Vehicles) (New Equipment); Substitute: HFO-1234yf (Solstice® yf or Solstice® 1234yf). 2025.
[145] ICF, 2025m.
[146] ICF, 2025n.

are relatively small. The fault tree analysis determined that the risk of exposure to a vehicle fire due to HFO-1234yf ignition was 2.8 x 10^{-9} per vehicle engine hour (non-collision) and 2 x 10^{-14} per vehicle engine hour (collision).[147] This risk is equal to or below other risks in HDOH MVAC applications including: risk of an HD truck or bus experiencing a serious collision (1 x 10^{-5} per vehicle engine hour),[148] risk of a highway fire in a freight road transport vehicle (2 x 10^{-6} per vehicle engine hour), and the acceptable risk for road vehicles in the ISO 26262 standard "Road vehicles – Functional safety" (1 x 10^{-9} per vehicle engine hour).[149] The risk of a fire occurring in a new HDOH MVAC that uses HFO-1234yf is sufficiently small in magnitude so as to not be substantive; therefore, the EPA is proposing to list HFO-1234yf as acceptable, subject to use conditions, in new HDOH MVACs.

The worst-case flammability scenario that the EPA modelled for HDOH MVACs was for class 7 or 8 tractors. The probability of occupant exposure to a refrigerant leak from a class 7 or 8 HDOH tractor during use may be higher than in other MVACs due to the nature of how these vehicle types are used. For example, occupants of class 7 and 8 tractors may spend protracted lengths of time in the passenger cabin and may be sleeping or living in the vehicle. The EPA's review of a fault tree analysis of HFO-1234yf for use in new HDOH vehicles found that the flammability risks were not substantively different from that of HFO-1234yf in other MVAC end-uses or from that of other substitutes that the EPA has listed as acceptable (*e.g.*, R-744). Additionally, when HFO-1234yf is ignited in real-world tests it is unable to propagate a flame due to its high minimum ignition energy, its relatively high LFL, and its lower burning velocity.[150] These risks may be mitigated by use in accordance with the proposed use conditions and recommendations in the manufacturers' SDS, and other safety precautions common in the

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[147] *Id.*
[148] "Engine hour" is the terminology used in this fault tree analysis. Engine hour is synonymous with "operating hour."
[149] Gradient Corporation. 2023b. Gradient Risk Analysis for Heavy-Duty On-Highway Vehicles. 2023. (Gradient HDOH risk analysis, 2023b).
[150] *Id.*

refrigeration and AC industry.

Comparison to other substitutes in these end-uses: The EPA is proposing to list HFO-1234yf as acceptable, subject to use conditions, in new HDOH vehicles and to list R-456A and R-480A as acceptable, subject to use conditions, for retrofit of HDOH MVACs. HFC-134a is the principal refrigerant currently acceptable for use in new HDOH vehicles, and the only refrigerant acceptable for retrofit of HDOH MVACs. For a comparison of the flammability, health, and environmental characteristics of these refrigerants to one another and to HFC-134a, refer to Section VIII.D.1.

HFO-1234yf has a higher flammability risk than other substitutes available in HDOH MVACs. Flammability risk in HDOH vehicles may be higher than in other vehicle types due to the charge size to cabin volume ratio and the fact that drivers may spend prolonged periods in the vehicle with the engine running. However, as noted earlier, the risk of HFO-1234yf ignition in HDOH MVACs is sufficiently remote to not be substantively different from the risk of HFO-1234yf ignition in other MVAC applications.

We note that while the flammability of HFO-1234yf may be greater than that of other available substitutes in the same end-use, this risk can be minimized by use consistent with recommendations in the manufacturers' SDS and other guidance, the proposed use conditions, and other safety precautions common in the MVAC industry. Any difference in flammability can be addressed by the proposed use conditions described in Section VIII.E.1. Further, HFO-1234yf has lower environmental risks than other substitutes acceptable in this end-use.

These proposed refrigerants would not pose additional adverse effects to human health or the environment when used in accordance with the proposed use conditions and existing requirements and as intended by the submitter. These proposed listings would provide additional options to promote the availability of refrigerants for the full range of MVACs, thereby lowering overall risk to human health and the environment.

4. How do HFO-1234yf, R-453A, R-456A, and R-480A compare to other refrigerants in

the bus and train MVAC end-uses?

The EPA is proposing to list HFO-1234yf as acceptable, subject to use conditions, in new bus MVACs. The EPA is also proposing to list R-453A, R-456A, and R-480A as acceptable, subject to use conditions, for retrofit of bus and train MVACs. Information about the components of R-456A and R-480A is described in Section VIII.D.1. and does not differ between end-uses.

R-453A is a refrigerant blend consisting of 20 percent HFC-32, 20 percent HFC-125 (also known as pentafluoroethane; CAS Reg. No. 354-33-6), 53.8 percent HFC-134a, 5 percent HFC-227ea, 0.6 percent R-600 (CAS Reg. No. 75-28-5), and 0.6 percent R-601a (also known as isopentane; CAS Reg. No. 78-78-4).

Redacted submissions and supporting documentation for HFO-1234yf, R-453A, R-456A, and R-480A are provided in the docket. The EPA performed a risk screening assessment to examine the human health and environmental risks of each of these substitutes which also are available in the docket.[151] [152] [153] [154] [155]

Environmental information: Environmental information about HFO-1234yf, R-456A, and R-480A is described in Section VIII.D.1. and does not differ between end-uses.

The specific atmospheric effects values of R-453A can be found in the individual risk screen for R-453A. These were determined consistent with the source information noted in Section III.C. above (*e.g.*, CAA, the AIM Act) as well as using the methodology for determining values for blends of chemicals (*i.e.*, determined by the percentage of each component). The atmospheric effects of R-453A are comparable to or lower than other acceptable refrigerants

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[151] ICF, 2025s.
[152] ICF. Risk Screen on Substitutes in Motor Vehicle Air Conditioning (Buses) (New and Retrofit Equipment); Substitute: HFO-1234yf (Solstice® yf or Solstice® 1234yf). 2025. (ICF, 2025p).
[153] ICF. Risk Screen on Substitutes in Motor Vehicle Air Conditioning—Buses and Passenger Rail (Retrofit Equipment); Substitute: R-453A (RS-70). 2025. (ICF, 2025q).
[154] ICF. Risk Screen on Substitutes in Motor Vehicle Air Conditioning (Buses and Passenger Rail) (Retrofit Equipment); Substitute: R-456A (Klea® 456A). 2025. (ICF, 2025r)
[155] ICF. Risk Screen on Substitutes in Motor Vehicle Air Conditioning (Retrofit Equipment); Substitute: R-480A (RS-20). 2025. (ICF, 2025s).

used in retrofits of MVACs for buses and trains, such as HFC-134a. Components of R-453A making up 98.6 percent of the composition are excluded from the EPA's regulatory definition of VOC[156] for the purpose of addressing the development of SIPs to attain and maintain the NAAQS. The remaining two components, R-600 and R-601a, are VOCs under that definition. The reactivity of these two compounds in the lower atmosphere is not significantly different than that of other saturated HCs that the EPA has evaluated and the total amount of these two compounds used as refrigerants is significantly lower than that of other saturated HCs that the EPA has evaluated for potential impacts on local air quality.[157]

Flammability information: R-453A is a nonflammable blend. Based on this blend's ASHRAE classification as an A1 refrigerant, use of this refrigerant is not expected to pose flammability risk. Flammability information about R-456A and R-480A is described in Section VIII.D.1. and does not differ between end-uses.

HFO-1234yf is a lower flammability (ASHRAE classification of 2L) refrigerant. Although HFO-1234yf is more flammable than other refrigerants currently available in the new buses MVAC end-use, the EPA's risk screen of HFO-1234yf in this end-use found that concentrations of HFO-1234yf in the passenger cabin of buses did not exceed the LFL even in the feasible worst-case scenarios. To further mitigate flammability risk, the EPA is proposing use conditions as discussed in Section VIII.E.

Toxicity information: Toxicity information about HFO-1234yf, R-456A, and R-480A is found in Section VIII.D.1.

R-453A is a lower-toxicity (ASHRAE classification A) refrigerant blend. The toxicity risks of using R-453A for retrofit of bus and train MVACs are comparable to or lower than toxicity risks of other available substitutes in the same end-use, including HFC-134a. Toxicity risks of the proposed refrigerants can be mitigated by use consistent with applicable industry

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[156] 40 CFR 51.100(s).

[157] See section IV.D. for a discussion of the EPA's analyses of air quality impacts of HC refrigerants.

safety standards; recommendations in the manufacturers' SDS; and other safety precautions common in the refrigeration and AC industry.

HFO-1234yf is subject to a SNUR under 40 CFR 721.10182(a). Significant new uses under this requirement include:

(A) Use other than as a refrigerant: in MVACs in new passenger cars and vehicles (as defined in 40 CFR 82.32(c) and (d)), in stationary and transport refrigeration, or in stationary AC.

(B) Commercial use other than: in passenger cars and vehicles in which the original charging MVACs with the PMN substance was done by the motor vehicle OEM, in stationary and transport refrigeration, or in stationary AC.

(C) Use in consumer products other than products used to recharge MVACs in passenger cars and vehicles in which the original charging of MVACs with the PMN substance was done by the motor vehicle OEM.

This use of HFO-1234yf in new bus MVACs would fall under (A) and thus would not be a significant new use.

Comparison to other substitutes in these end-uses: The EPA is proposing to list HFO-1234yf as acceptable, subject to use conditions, in new bus MVACs, and R-453A, R-456A, and R-480A as acceptable, subject to use conditions, for retrofits of bus and train MVACs.

Buses historically used HCFC-22, a class II ODS, in MVACs. HFC-134a, HCFC-22, and R-407C historically have been the most used refrigerants in new bus and train MVACs, and HFC-134a and R-407C are the acceptable refrigerants most often used for retrofit of bus and train MVACs.[158] For a comparison of the environmental, health, and safety characteristics of HFO-1234yf, R-456A, and R-480A to HFC-134a and to one another, refer to Section VIII.D.1.

As stated above, the specific atmospheric effects values can be found in the individual

[158] Newly produced class I and II ODS including HCFC-22 cannot be used in manufacturing new MVACs per the statutory prohibition in CAA section 605.

risk screen for R-453A. The atmospheric effects for R-453A are overall better than or comparable to other refrigerants currently available in this end-use including HCFC-22, HFC-134a, R-407A, and R-407C. R-453A may be used without exceeding its OEL of 1,000 ppm; therefore, its toxicity risks are comparable to other substitutes available in this end-use.[159] R-453A is nonflammable with an ASHRAE flammability classification of 1; therefore, its flammability risks are comparable to other acceptable refrigerants in this end-use.

The EPA is aware that the submitter of R-453A may market this substitute to retrofit bus and train MVACs charged with HCFC-22, a class II ODS. Some refrigerants already listed as acceptable for retrofits in MVACs for buses and trains (*e.g.*, HFC-134a) operate at a lower pressure range than HCFC-22. These refrigerants may not be practical to use when retrofitting equipment originally charged with HCFC-22. Listing R-453A as acceptable, subject to use conditions, would provide a high-pressure alternative that is practical for retrofitting bus and train MVACs originally designed for HCFC-22. The EPA's analysis found that when used as intended by the submitter to retrofit bus and train MVACs originally charged with HCFC-22, and in accordance with the proposed use conditions described in Section VIII.E.4., this refrigerant does not pose increased risk to human health or the environment.

This proposed listing of R-453A, R-456A, and R-480A would allow for buses and trains currently using ozone-depleting HCFC-22, which has been phased out under the CAA, to be retrofitted to non-ozone depleting alternatives.

The EPA is proposing to list HFO-1234yf as acceptable, subject to use conditions, in new bus MVACs. HFO-1234yf, an A2L refrigerant, is more flammable than other refrigerants currently available in this end-use; however, the EPA's risk screen of HFO-1234yf in this end-use found that concentrations of HFO-1234yf that leaked in the passenger cabin did not exceed its LFL in worst-case scenarios. Thus, use of HFO-1234yf in this end-use does not result in greater flammability risk than other acceptable substitutes for new bus MVACs. Additionally,

[159] ICF, 2025q.

buses are maintained by technicians in workplace settings as part of fleets. These technicians are trained and have experience working with flammable substances, using safe practices in locations such as repair garages that have sufficient ventilation and other safeguards that can mitigate flammability risk. The risk associated with flammability in this application may be mitigated by use consistent with recommendations in the manufacturers' SDS and other guidance, the proposed use conditions in Section VIII.E.3., and other safety precautions common in the MVAC industry.

The proposed refrigerants can provide additional options and would not pose additional adverse effects to human health or the environment when used in accordance with the proposed use conditions and existing requirements and as intended by the submitter. All the refrigerants proposed in this rule in this end-use have better or comparable atmospheric effect values and toxicity. Any difference in flammability can be addressed by the proposed use conditions described in Section VIII.E.3. Furthermore, as noted above, the EPA does not intend to restrict a substitute if it has only marginally greater risk. The EPA does not consider any of these substitutes to pose significantly greater risks than other acceptable substitutes.

To provide additional options to promote the availability of refrigerants for the full range of MVACs, thereby lowering overall risk to human health and the environment, the EPA is proposing the listings for HFO-1234yf as acceptable, subject to use conditions, in new bus MVACs and for R-453A, R-456A, and R-480A as acceptable, subject to use conditions, for use for retrofit of bus and train MVACs.

E. What use conditions is the EPA proposing in this action that apply to proposed listings in this end-use?

1. What use conditions is the EPA proposing for HFO-1234yf, R-444A, R-456A, and R-480A for retrofit of MVACs in LMDVs, for R-444A, R-456A, and R-480A for retrofit of MVACs in HD pickup trucks and vans, and for R-456A and R-480A for retrofit of MVACs in HDOH MVACs; and what existing requirements apply to these refrigerants?

Appendix D of 40 CFR part 82, subpart G specifies requirements for unique fittings for new and retrofit MVAC listings, specifies information that must appear on a new label when a retrofit is performed, and outlines requirements for how the retrofit is completed including specifications for how unique fittings must be applied when performing a retrofit. The requirements for labeling, unique fittings, and the performance of the retrofit would apply to all proposed acceptability listings for MVAC retrofits in this action. The EPA is proposing minor adjustments to these retrofit specifications and labeling requirements. These existing requirements and proposed amendments are described fully in Section VIII.G.

The requirements for labeling and for service port conversion assemblies would minimize the risk of mixing refrigerant by serving as a mechanical barrier to inadvertent refrigerant mixing and ensuring that technicians are aware of the contents of the MVAC. Refrigerant that differs from its initial composition may compromise the purity of the refrigerant supply and the practice of onsite recovery, recycling, and recharging common in the MVAC sector. For additional discussion of onsite recovery, recycling, and recharging in MVACs, refer to Section VIII.B. For discussion of the environmental risks of refrigerant mixing, refer to Section VIII.D.1. Existing use conditions under appendix D of 40 CFR part 82, subpart G would mitigate the environmental risks associated with mixing refrigerants.

In the case of HFO-1234yf and R-444A, the requirement to include a label would mitigate flammability risk by ensuring that technicians are aware that the MVAC contents is flammable.

The EPA is proposing specifications for unique fittings for R-444A, R-456A, and R-480A when used to retrofit MVACs in LMDVs, HD pickup trucks and vans, and HDOH vehicles. The specifications of these fittings, along with the unique fittings proposed for the high and low side service ports and 30-lb cylinders, would be added to appendix B of 40 CFR part 82, subpart G. These proposed specifications can be found in the docket for this rulemaking under the title “Proposed Regulatory Text for SNAP Rule 27.”

The EPA's SNAP program has a longstanding approach of requiring unique fittings for use with each refrigerant in MVACs. Appendix D of 40 CFR part 82, subpart G requires that each refrigerant be used with a set of fittings that is unique to that refrigerant. This is intended to prevent cross contamination of different refrigerants, preserve the purity of recycled refrigerants, and ultimately to avoid venting of refrigerant consistent with requirements under CAA section 608(c), codified at 40 CFR 82.154(a). In the 1996 SNAP Rule requiring the use of unique fittings on all refrigerants submitted for use in MVACs, the EPA urged industry to develop mechanisms to ensure that the venting prohibition under CAA section 608(c) and the implementing regulations at 40 CFR 82.154 are observed.[160] The EPA has issued multiple SNAP rules requiring the use of fittings unique to a refrigerant for use on "containers of the refrigerant, on can taps, on recover, recycle, and recharge equipment, and on all [motor vehicle] air conditioning system service ports."[161]

The manufacturer of R-444A and R-456A has stated that they intend to use fittings for small cans of refrigerant that are the same as the fittings previously assigned to R-416A and Freeze 12. The EPA is proposing use of these fittings, even though they previously were assigned to R-416A and Freeze 12, because the EPA listed those refrigerants as unacceptable in SNAP Rule 20.[162] Thus, the EPA presumes that the fittings corresponding to R-416A and Freeze 12 are no longer in use and may be available to be used with other refrigerants. Permitting the use of smaller fittings previously assigned to refrigerants that are no longer in use would be less burdensome than requiring development of other, likely large fittings.

Currently, there are no approved recover, recycle, and recharge equipment or industry safety standards for the refrigerant blends in this end-use.[163] The EPA is aware that the submitters of these blends are working with SAE and equipment manufacturers. In the future, the

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[160] See 61 FR 54032; October 16, 1996.
[161] See appendix D of 40 CFR part 82, subpart G.
[162] See 80 FR 42870; July 20, 2015.
[163] *i.e.*, R-444A, R-456A, and R-480A.

EPA could pursue a notice and comment rulemaking under CAA 609 to potentially incorporate new or revised industry standards, amongst other things. In the absence of certified equipment and industry safety standards, these refrigerants may be inappropriately mixed or released. Mixing refrigerant may also lead directly to release due to certain mixtures having higher pressures than either component alone. Thus, pressure-sensitive components, such as air purge devices on recycling machines and relief devices on MVACs, may be activated by these mixtures, venting the refrigerant to the atmosphere. Inappropriately mixed refrigerants are also less attractive for the aftermarket because they are difficult to separate and return to the AHRI-700 purity standard.

Until certified equipment and relevant safety standards are developed, only recovery-only machines may be used to recover the refrigerant blends proposed for use in MVACs, consistent with requirements under CAA section 609. Recovery-only machines would allow for the refrigerants to be recovered (but not recycled or recharged) onsite and subsequently sent for reclamation. Development of industry safety standards and machines would allow for technicians to recover, recycle, and recharge these newer refrigerants onsite within the same framework as the currently listed refrigerants and would prevent inappropriate mixing of these refrigerants. Further, the EPA expects that the companies selling refrigerants intended to be used as retrofits would make appropriate unique fittings and refrigerant labels available to certified technicians and DIYers to allow them to conduct a retrofit in a manner that meets requirements under the CAA.

The EPA acknowledges that DIYers would not have the appropriate equipment to recover the original refrigerant from the MVAC prior to performing a retrofit. Instead, DIYers would likely need to bring their vehicles to a service shop or other facility to have the existing refrigerant recovered before the retrofit. Further, DIYers may not know how to prevent or fix leaks in an MVAC and may add additional refrigerant to the existing charge (*i.e.*, topping-off). DIYers also are less likely to be trained to safely handle flammable refrigerant compared to

technicians working in professional settings.

The EPA considered, but is not proposing, restricting retrofits of MVACs using these refrigerants in LMDVs, HD pickup trucks and vans, and HDOH vehicles to professional settings. The EPA considered this alternative as it may mitigate adverse effects to human health and the environment resulting from the release of these refrigerants, and because technicians in professional settings likely would be better able to handle flammable refrigerants for the reasons stated above. However, the EPA views existing regulatory requirements, such as those under CAA section 609, and the proposed use conditions as sufficient in addressing these concerns. As proposed, compliance with the use conditions should prevent knowingly venting or otherwise releasing refrigerants and allow for DIYers to retrofit their MVACs.

2. What use conditions is the EPA proposing for HFO-1234yf for use in new HDOH and bus MVACs; and what existing requirements apply to this refrigerant?

These proposed use conditions are designed to ensure that HDOH and bus MVACs using HFO-1234yf operate safely under normal and foreseeable conditions while mitigating risks associated with refrigerant leakage and flammability.

The EPA is proposing that the MVAC connections (*e.g.*, any points where components of an MVAC join together) either be located outside of the airflow path of the passenger cabin or be designed to prevent leaks into the passenger cabin. This requirement currently applies to use of HFO-1234yf in new passenger vehicles.[164] This use condition would further mitigate flammability risks associated with leaks of HFO-1234yf into the passenger cabin.

The EPA is also proposing that the manufacturer of MVACs and vehicles (*i.e.*, the OEM) to conduct and keep records of a Failure Mode and Effects Analysis (FMEA), a type of risk assessment, for at least three years from the date of creation. SAE J1739[165] provides applicable

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[164] New passenger vehicles charged with HFO-1234yf are subject to a use condition that they follow all requirements of SAE standard J639, which includes this requirement.

[165] SAE J1739, "Potential Failure Mode and Effects Analysis (FMEA) Including Design FMEA, Supplemental FMEA-MSR, and Process FMEA". Dated January 2021.

guidance. The EPA understands it is standard industry practice to perform the FMEA and to keep it on file while the vehicle is in production and for several years afterwards. Note that the EPA is not proposing to establish specific requirements or protocols for conducting and recording an FMEA, nor is the EPA requiring that manufacturers follow SAE J1739. This use condition currently applies to use of HFO-1234yf in new passenger vehicles, and as previously noted, HDOH vehicles have large charge sizes and drivers may frequently spend prolonged periods in the passenger cabin. The requirement to conduct FMEAs and retain them for three years would serve to identify and address flammability risks associated with system failures.

The EPA currently requires that new MVACs charged with HFO-1234yf on other vehicle types (including LMDVs and nonroad vehicles) comply with all requirements of SAE J639, and the EPA understands that most HDOH vehicles typically follow this standard. The EPA considered, but is not proposing, a requirement that new MVACs in bus and HDOH vehicles comply with all requirements of SAE J639. Instead, the EPA is proposing the aforementioned use conditions which mirror the safety requirements associated with HFO-1234yf in SAE J639. The use conditions as currently proposed would apply similar safety requirements to HFO-1234yf when used in bus and HDOH vehicles without incorporating a standard by reference. Several other refrigerants proposed in this rule do not have associated standards that may be incorporated by reference. Further, the EPA understands that buses may not typically follow SAE J639, and this standard may not be appropriate for equipment in this end-use. This approach as currently proposed establishes similar safety requirements while maintaining parity between the refrigerants proposed in this rule.

Existing requirements in appendix D of 40 CFR part 82, subpart G require that this substitute be used with unique service port fittings. Service port fittings for HFO-1234yf were previously established and are identified in appendix B of 40 CFR part 82, subpart G. For additional discussion of this requirement, refer to Section VIII.E.1.

EPA is proposing to require a label on the MVAC of new bus and HDOH vehicles that

use HFO-1234yf. The label would have the following characteristics:

- The label must include the statement "This refrigerant is FLAMMABLE. Take appropriate precautions."
- The label must be large enough to be easily read and must be permanent.
- The label must be affixed to the system over information related to the previous refrigerant, in a location not normally replaced during vehicle repair.
- Testing of labels must meet ANSI/UL 969-1991.

This proposed use condition would mitigate flammability risk associated with HFO-1234yf by ensuring that technicians are aware that the contents of the MVAC is flammable. For discussion of the flammability risk associated with HFO-1234yf, refer to Section VIII.D.3. These requirements mirror existing requirements for flammable refrigerants when used in retrofit MVACs.

3. What use conditions is the EPA proposing for R-453A, R-456A, and R-480A for retrofit of MVAC in buses and trains; and what existing requirements apply to this refrigerant?

These proposed use conditions for R-453A, R-456A, and R-480A for retrofit of MVAC in buses and trains are designed to ensure that buses and trains operate safely under normal and foreseeable conditions.

The EPA is proposing that the labeling requirements in paragraph 2 of appendix D of 40 CFR part 82, subpart G apply to these listings in buses and trains. Labeling requirements ensure that technicians are aware of the MVAC contents, thereby promoting proper refrigerant handling, preventing the inadvertent mixing of refrigerant, and preventing waste and refrigerant emissions during servicing. The EPA is proposing minor adjustments to these provisions. For a full discussion see Section VIII.G.

Existing technician certification requirements under CAA sections 608 and 609 apply to the retrofit of AC appliances on buses. Buses that use high-pressure AC appliances such as those

charged with HCFC-22 or R-407C can only be serviced by a CAA section 608 certified technician. Buses that do not use high-pressure AC systems (such as those originally charged with CFC-12 or HFC-134a) are considered MVACs under CAA section 609. For additional discussion of the EPA's requirements under CAA sections 608 and 609, refer to Section VIII.B.

The requirements at 40 CFR 82.156 includes requirements for the proper evacuation of appliances, MVACs, and MVAC-like appliances prior to being opened.[166] Refrigerants must be evacuated from the appliance to the specified level using certified equipment prior to the installation of a new service port conversion fitting and charging with the retrofit refrigerant. These existing requirements mitigate adverse effects to human health and the environment that would otherwise be associated with venting or intentional releases of refrigerant.

Buses and trains are typically serviced in professional settings as part of fleets. The EPA does not expect that significant numbers of DIYers would retrofit bus and train MVACs. For this reason, the EPA considered but is not proposing to require retrofits to these refrigerants on buses and trains be performed in professional settings.

F. Modification of "unacceptability" listing applicable to flammable refrigerants in motor vehicle air conditioning

Per appendix B of 40 CFR part 82, subpart G, flammable refrigerants in MVACs, both new and retrofit, are currently listed as unacceptable. Unacceptability does not apply to HFO-1234yf and HFC-152a when used in new MVAC equipment. The EPA is proposing to amend this provision so that unacceptability also would not apply to R-444A and HFO-1234yf used in retrofit MVACs.

The EPA had initially restricted the use of flammable refrigerants in MVACs because of the higher risks associated with that end-use, such as the risk of leaks due to collisions and punctures right behind the grille, and because the risks of these refrigerants had not been

[166] See 40 CFR 82.156(a), (c), and (d).

addressed by a risk assessment.[167] As described in Section VIII.D.1., the EPA is proposing to determine that HFO-1234yf and R-444A may be used safely in retrofit MVACs since flammability risk can be mitigated by use consistent with the proposed use conditions, recommendations in the manufacturers' SDS, and other safety precautions common in the refrigeration and AC industry.

G. Modifications to MVAC SNAP Requirements

The EPA is proposing a change to paragraph 2 in appendix D of 40 CFR part 82, subpart G related to labeling requirements for MVAC retrofits. These labeling requirements are applicable to all listing of MVAC retrofits and help to handle refrigerants safely and to avoid unintentional mixing of refrigerants. The EPA is proposing to remove the requirement in 2.c that the background color of the label be unique to the refrigerant. Removing this requirement would better align the label with industry safety standards and because the other required labeling provisions are sufficient to alert technicians of the refrigerant being used in the MVAC and whether that refrigerant is flammable.

The EPA is also proposing to replace references to "CFC-12 service ports" to "original service ports" in paragraphs 1.a. and 1.d. of appendix D of 40 CFR part 82, subpart G. The revised language would be as follows:

1.a. When original service ports are retrofitted, conversion assemblies shall attach to the original fitting with a thread lock adhesive and/or a separate mechanical latching mechanism in a manner that permanently prevents the assembly from being removed.

1.d. All original service ports not retrofitted with conversion assemblies shall be rendered permanently incompatible for use with service equipment related to the original refrigerant by fitting with a device attached with a thread lock adhesive and/or a separate mechanical latching mechanism in a manner that prevents the device from being removed.

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[167] See June 13, 1995, 60 FR 31092.

The EPA is proposing this change because new refrigerants have become available since these requirements were originally established, and retrofits may be performed on vehicles that were not originally charged with CFC-12. This update would ensure that the requirements are applied consistently across the MVAC end-use.

The EPA is also proposing several non-substantive changes to existing listings to reduce redundancy and improve clarity. These edits would not change the effect of the regulatory requirements. First, the EPA is proposing to collapse existing listings for HFO-1234yf in appendix B of 40 CFR part 82, subpart G in new LD passenger vehicles, new medium-duty passenger vehicles, new HD pickup trucks, new complete vans, and new HD nonroad vehicles into a single row since the use conditions are the same for all these end-uses. This change would simplify and shorten the existing regulatory text. The EPA is also proposing to reformat the existing listings for refrigerants listed in the table titled "Refrigerants-Unacceptable Substitutes" in appendix B of 40 CFR part 82, subpart G by publishing a single end-use in each row. The EPA is lastly proposing to number each row in the tables titled "Refrigerants-Acceptable Subject to Use Conditions", "Refrigerants, Acceptable Subject to Narrowed Use Conditions", and "Refrigerants, Unacceptable Substitutes", in appendix B of 40 CFR part 82, subpart G to facilitate cross references within a table.

IX. Fire Suppression and Explosion Protection

A. What is the EPA proposing in this action?

The EPA is proposing to list the 50/50 blend of 2-BTP/CO_2 as acceptable, subject to use conditions, as a total flooding agent in normally unoccupied spaces for use in aircraft engine nacelles, APUs, and cargo bays. While the EPA's SNAP program has not previously listed a blend containing both 2-BTP and CO_2, SNAP has listed 2-BTP and CO_2 separately. The EPA previously listed 2-BTP as acceptable, subject to use conditions, for use in:

- Engine nacelles and APUs on aircraft in total flooding fire suppression systems;[168]

[168] See 81 FR 86778; December 1, 2016.

- Aircraft as a streaming agent;[169]
- Normally unoccupied spaces under 500 cubic feet in total flooding fire suppression systems;[170] and
- Non-residential applications, other than for commercial home office and personal watercraft, as a streaming agent.[171]

The EPA previously listed CO_2 as acceptable for use as a total flooding agent and streaming agent.[172]

B. Background on total flooding fire suppression

In the United States, approximately 90 percent of installed total flooding systems protect anticipated hazards from ordinary combustibles (*i.e.*, Class A fires), while the remaining ten percent protect against applications involving flammable liquids and gases (*i.e.*, Class B fires). Approximately 75 percent of total flooding systems protect electronics (*e.g.*, computers, telecommunications, process control areas), while the remaining 25 percent protect civil aviation (*e.g.*, engine nacelles/APUs, cargo compartments, lavatory trash receptacles), military weapons systems (*e.g.*, combat vehicles, machinery spaces on ships, aircraft engines and tanks), oil/gas and manufacturing industries (*e.g.*, oil/gas pumping, compressor stations), and maritime uses (*e.g.*, machinery spaces, cargo pump rooms).

Total flooding systems, which historically have employed halon 1301 as a fire suppression agent, are used in both normally occupied and normally unoccupied areas. The EPA bases the terms "occupied areas" and "normally unoccupied areas" on definitions in the National Fire Protection Association (NFPA) 2001 "Standard on Clean Agent Fire Extinguishing Systems." NFPA 2001 defines "normally unoccupied enclosure or space" as "an enclosure or space not normally occupied but one that could be entered occasionally by one or more persons

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[169] *Id.*
[170] See 88 FR 26382; April 28, 2023.
[171] *Id.*
[172] See 59 FR 13044; March 18, 1994.

for brief periods." The standard defines an "unoccupiable enclosure or space" as an "enclosure or space that has dimensional or other physical characteristics such that it could not be entered by a person." Engine nacelles and APUs are considered unoccupiable spaces, and cargo bays are considered normally unoccupied spaces.

C. What is 2-BTP/CO_2 and how does it compare to other fire suppressants in the same end-use?

2-BTP/CO_2 is the 50/50 blend of 2-BTP and CO_2 which contains 50 percent 2-BTP (2-bromo-3,3,3-trifluoropropene)[173] and 50 percent CO_2.[174]

The redacted submission and supporting documentation for 2-BTP/CO_2 is provided in the docket. The EPA performed assessments to examine the human health and environmental risks of this substitute during production operations and the filling of fire extinguishers as well as in the case of an inadvertent discharge of the system during maintenance activities on the fire extinguishing system. These assessments are available in the docket.[175]

Environmental information: The specific atmospheric effects values can be found in the risk screen for 2-BTP/CO_2. Of note this blend has an ODP of 0.0014.[176] As reported in the 2025 Technology and Economic Assessment Panel (TEAP) Progress Report,[177] and as noted in Section III of this proposed rule, under some broad definitions of PFAS (*e.g.*, European Chemicals Agency (ECHA) 2023 proposal), 2-BTP could be considered a PFAS. The EPA notes that the U.S. government has not adopted a single definition of PFAS and has not included 2-BTP in any PFAS-related restrictions. Moreover, listing decisions consider whether substitutes present risks that are lower than or comparable to risks from other substitutes that are currently or potentially available in the end-uses under consideration. The EPA does not assume any

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[173] CAS Reg. No. 1514-82-5.
[174] CAS Reg. No. 124-38-9.
[175] ICF. Risk Screen on Substitutes in Total Flooding Systems in Normally Unoccupied Spaces; Substitute: VERDAGENT®. 2025. (ICF, 2025t).
[176] The ODP for 2-BTP/CO_2 is based on the ODP of 2-BTP that was used in previous SNAP listings (see 81 FR 86778 and 88 FR 26382).
[177] Report of the Technology and Economic Assessment Panel, May 2025, Volume 1: Progress report. Available online at: ozone.unep.org/system/files/documents/TEAP-May2025-Progress-Report-vol1.pdf (TEAP, 2025).

substitute is risk free. The EPA is not proposing or seeking comment on PFAS definitions in this rulemaking.

2-BTP is considered a VOC and is not excluded from the EPA's regulatory definition of VOC[178] for the purpose of addressing the development of SIPs to attain and maintain the NAAQS. To assess the potential impact of this compound on local air quality, the EPA assumed that 2.5 percent of the intended U.S. annual market for 2-BTP in total flooding fire suppression applications would be released annually.[179] This would result in release of about one metric ton of 2-BTP into the atmosphere annually from this proposed end-use[180] which translates to an extremely small proportion relative to total annual anthropogenic VOC emissions in the United States.[181] The Agency assumes that emissions would not occur in one location at one time, but instead much less than one metric ton would be emitted at different locations. Further, this analysis does not account for the fact that some releases could occur on aircraft flying at cruising altitude (*e.g.*, 35,000 ft), where releases would not have a significant impact on tropospheric ozone.[182] Given that annual 2-BTP emissions would be many orders of magnitude lower than annual emissions of other anthropogenic VOC emissions, and that some portion of these emissions are likely to occur at aircraft cruising altitude, the EPA does not consider the environmental impacts of this VOC to be a significant concern. This aligns with the EPA's review of pure 2-BTP for use as a total flooding agent.[183]

CO_2 is excluded from the EPA's regulatory definition of VOC[184] for the purpose of addressing the development of SIPs to attain and maintain the NAAQS.

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[178] 40 CFR 51.100(s).
[179] The EPA's Vintaging Model assumes an average annual leak rate of 2.5 percent for total flooding systems (EPA, 2022).
[180] Based on the 2022 annual total VOC emissions for the United States as reported in the National Emissions Inventory (ICF, 2025t).
[181] Emissions of one metric ton of 2-BTP is approximately 7.5×10^{-8} percent of total U.S. VOC emissions.
[182] Emission estimates calculated using CBI data.
[183] See 88 FR at 26408-26409; April 28, 2023.
[184] 40 CFR 51.100(s).

Flammability information: 2-BTP/CO_2 is nonflammable. The individual components, 2-BTP and CO_2, are also nonflammable.

Toxicity and exposure data: The EPA assessed potential health risks from exposure to the proposed substitute as a total flooding agent in normally unoccupied spaces. To assess potential health risks from exposure to the proposed substitute for personnel during manufacturing, EPA developed a New Chemical Exposure Limit (NCEL) of 1 ppm for 2-BTP based on review of available toxicity studies.[185] CO_2 has an OSHA PEL of 5,000 ppm.[186] These exposure limits represent the maximum eight-hour TWA exposure at which personnel in an occupational environment can be exposed regularly without adverse effects.

2-BTP is subject to a SNUR under 40 CFR 721.10966. Significant new uses under this requirement include any use other than as either a total flooding agent in unoccupied spaces, specifically engine nacelles and APUs in aircraft; or as a streaming fire extinguishing agent for use only in handheld extinguishers in aircraft. This SNUR also contains requirements for workplace protections and for hazard communication.

According to the SDS, exposure to this blend following a discharge may be hazardous if inhalation, skin contact, or eye contact with the proposed substitute occurs at sufficiently high levels. The most likely pathway of exposure is through inhalation. Overexposure via inhalation to the proposed substitute may cause central nervous system effects, such as dizziness, confusion, physical incoordination, drowsiness, anesthesia, or unconsciousness. At concentrations of 1.0 percent, or 10,000 ppm, or higher, the proposed substitute may cause increased sensitivity of the heart to adrenaline which might cause irregular heartbeats and possibly ventricular fibrillation or death. In the case that the proposed substitute is inhaled, person(s) should be immediately removed and exposed to fresh air. The SDS recommends that if breathing is difficult, person(s) should seek medical attention.

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[185] See 40 CFR 721.10966.
[186] Available at: http://www.cdc.gov/Niosh/npg/npgd0103.html.

Short ocular, dermal, or ingestion exposures are not expected to pose a hazard. However, in case of ocular exposure, the SDS for the proposed substitute recommends that person(s) immediately flush the eyes, including under the eyelids, with water and move to a non-contaminated area. Medical attention should be sought if irritation develops or persists. In the case of dermal exposure, the SDS recommends that person(s) immediately wash the affected area with large amounts of water and remove all contaminated clothing and footwear to avoid irritation. If water is not available, cover the affected area with a clean, soft cloth. Medical attention should be sought if irritation develops or persists. The proposed substitute is not likely to be hazardous by ingestion; however, in case of ingestion, the SDS recommends the person(s) consult a physician immediately. Do not induce vomiting without medical advice.

Vapors from 2-BTP/CO_2 can cause suffocation by reducing oxygen available for breathing, causing asphyxiation in high concentrations. Such vapors pose a potential hazard if large volumes are trapped in enclosed or low places. If person(s) are exposed to high concentrations, the person(s) will likely not realize that he/she is suffocating, but may experience central nervous system effects, such as drowsiness and dizziness.

The risks and procedures after exposure to the proposed substitute are similar for other common fire suppressants. The potential health effects of exposure to this substitute can be minimized by following the exposure guidelines, ventilation, and PPE recommendations in the installation and use manual for this proposed substitute. In addition, industry safety standards such as the NFPA 2001 standard for clean agent fire extinguishing systems and the NFPA 12 standard for CO_2 extinguishing systems provide guidelines for safe use of the components of this fire suppressant blend.

The EPA also evaluated the risks associated with potential exposures to the blend during manufacture (*e.g.*, filling total flooding systems), in the case of an inadvertent discharge of the system during installation and maintenance activities, and during clean up after system discharge.

The risks to workers are expected to be sufficiently mitigated when the engineering controls and PPE recommendations referenced in the SDS for this proposed substitute are followed. For operations requiring handling of the substitute, engineering controls should include adequate ventilation systems and enclosed or confined operations to ensure exposure levels are below the NCEL. Appropriate protective measures should be taken, and proper training administered for the manufacture, clean up, and disposal of this product.

In general, use of appropriate PPE is recommended, specifically respirators, during activities in which exposure to 2-BTP/CO_2 cannot be controlled through other means. If handled in enclosed spaces where exposure limits might be exceeded, a self-contained breathing apparatus (SCBA) should be used. When handling a leak in a storage container, protective clothing is recommended as well as vapor-in air detection systems. If detected in the workplace atmosphere, there may be a need to purge the gas from the confined space (*e.g.*, with air, or an inert gas followed by air), followed by additional testing of the space to ensure it has been removed completely from the atmosphere. Furthermore, gloves (*e.g.*, neoprene, polyvinyl chloride, or polyvinyl alcohol) should be worn when handling equipment containing the proposed substitute for prolonged periods. The combination of appropriate engineering controls and the use of PPE would ensure exposure levels are below the NCEL.

When used as intended by the submitter and in accordance with the proper safety and disposal precautions as listed in the risk screen and in the NFPA 2001 and NFPA 12 standards,[187] releases of this proposed substitute are not expected to cause a significant risk to the environment and human health in the general population when manufactured or used in normally unoccupied and unoccupiable spaces.

Comparison to other fire suppressants: The atmospheric effects of 2-BTP/CO_2 are comparable to or lower than other listed substitutes in this end-use including substitutes with

[187] ICF, 2025t. Risk Screen on Substitutes in Total Flooding Systems in Normally Unoccupied Spaces; Substitute: VERDAGENT®.

ODPs such as phosphorus tribromide and trifluoromethyl iodide (CF_3I). Other alternatives with comparable or better overall atmospheric effect profiles have not proven viable for certain aviation applications such as cargo bays. 2-BTP is considered a VOC and is not excluded from the EPA's regulatory definition of VOC[188] for the purpose of addressing the development of SIPs to attain and maintain the NAAQS. Other acceptable fire suppression agents currently in use in this end-use are also VOC (*e.g.*, pure 2-BTP, C6-perfluoroketone). 2-BTP/CO_2 is anticipated to pose no greater risk as a VOC than other alternatives listed as acceptable in this end-use (*e.g.*, C6-perfluoroketone) and would present half the risk from VOC impacts of pure 2-BTP. 2-BTP/CO_2 is nonflammable, as are all other available total flooding agents. The extinguishing cylinders for 2-BTP/CO_2 can weigh less and/or take up less space than cylinders such as those that contain CO_2 alone, since CO_2 typically requires a larger amount of substance to extinguish fires. This is particularly important for fire suppression aboard aircraft where transition from the class I ODS fire suppression agents (*e.g.*, halon 1301 and halon 1211) has been particularly challenging. The EPA is aware that other listed alternatives may not be viable especially for aircraft cargo bays. The EPA is proposing to find 2-BTP/CO_2 as acceptable, subject to use conditions, as a total flooding agent for use in normally unoccupied spaces in aircraft engine nacelles, APUs, and cargo bays because the overall human health and environmental risk posed by the substitute is lower than or comparable to the overall risk posed by other alternatives listed as acceptable in the same end-use.

D. What use conditions is the EPA proposing?

The EPA is proposing to list 2-BTP/CO_2 as acceptable, subject to use conditions, as a total flooding agent. The use condition is that this substitute be used only in normally unoccupied spaces, specifically only in aircraft engine nacelles, APUs, or cargo bays. The Agency notes that engine nacelles and APUs are unoccupiable spaces. Cargo bays are normally unoccupied, but people could enter cargo bays (*e.g.*, when loading or unloading cargo) and live animals may be

[188] 40 CFR 51.100(s).

transported in cargo bays.

This proposal includes the EPA's recommendation that this substitute be used as intended by the submitter and in accordance with the proper safety and disposal precautions as listed in the risk screen.[189] While this recommendation would not be legally binding under the SNAP program, the EPA would encourage users of this substitute to apply these recommendations, and others listed in the risk screen, in their use of this substitute as best practices for safer use.

E. Why is the EPA proposing these specific use conditions?

The EPA is proposing to list 2-BTP/CO_2 as acceptable as a total flooding agent with the use condition that it is only acceptable for use onboard aircraft in engine nacelles, APUs, and cargo bays which are considered normally unoccupied spaces. These applications are consistent with the information submitted to the EPA supporting use in normally unoccupied spaces and as requested by the submitter.

F. What additional information is the EPA including in this proposed listing?

Emissions of 2-BTP/CO_2 should be controlled by adhering to standard industry practices. Toxicity risks can be minimized by use consistent with the NFPA 2001 and 12 standards,[190] recommendations in the SDS, and other safety precautions common in the fire suppression industry.

X. On which topics is the EPA specifically requesting comment?

A. Residential and Light Commercial AC and Heat Pumps, Household Refrigerators and Freezers, and Water Coolers

1. The EPA is requesting comment on requiring labeling, the height of the lettering, and the likelihood of labels remaining on a product throughout the lifecycle of the product, including its disposal. This request is applicable to all proposed listings in Sections IV. through VI.

2. The EPA is requesting comment on whether specifying a particular shade of red for the color-

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[189] ICF, 2025t. Risk Screen on Substitutes in Total Flooding Systems in Normally Unoccupied Spaces; Substitute: VERDAGENT®.

[190] NFPA 2001, "Standard on Clean Agent Fire Extinguishing Systems."

coded hoses and piping is necessary to mitigate risks associated with using flammable refrigerants, or if a requirement for red markings, without specifying a particular shade, would be sufficiently protective. This request is applicable to all proposed listings in Sections IV. through VI.

3. The EPA is requesting comment on the two co-proposed options for use conditions related to equipment certification or industry safety standard requirements, described in Sections IV.F.4., V.E.4., and VI.E.4. This request is applicable to all proposed listings in Sections IV. through VI.

4. With respect to the proposed listing for household refrigerators and freezers under the incorporate by reference option described in Section V.E.4.a., the EPA is requesting comment on the risk mitigation offered by compliance with the current version of the standard proposed as use conditions, *i.e.*, 3rd edition of UL 60335-2-24, the nature of any updates proposed for this standard, and the expected timeline for those updates.

5. With respect to the proposed listing for water coolers under the incorporate by reference option described in Section VI.E.4.a., the EPA is requesting comment on whether the proposed listing of R-290 in water coolers should be updated to use conditions consistent with UL 399, 8th edition or should remain as currently listed, consistent with the requirements of UL 399, 7th edition.

6. Regarding the third-party certification option discussed in Sections IV.F.4.b., V.E.4.b., and VI.E.4.b., the EPA is requesting comment on the proposed use condition that would require equipment in these three end-uses to be certified by an OSHA-recognized NRTL. The EPA is requesting comment on the applicability of OSHA's NRTL Program to all applications within these three end-uses. Specifically, the EPA requests comments about whether there are situations under these end-uses where certification by an NRTL would not occur. The EPA is requesting comment on any safety or environmental concerns that would not be addressed through this proposed use condition option when compared to the use conditions that the EPA previously listed for these end-uses or when compared to the incorporation by reference option.

7. Regarding the proposed timing for when the updated use conditions would take effect for proposed updates to refrigerant listings in the residential and light commercial AC and heat pumps and water coolers end-uses, the EPA is requesting comment on the proposal that users (*e.g.*, manufacturers) be able to follow either the existing use conditions or the proposed updated use conditions from the effective date of the final rule until two years after that effective date to allow adequate time to transition from the existing to the new use conditions. The Agency also requests comment on the proposed timing for when the use conditions would be required for use of HCR 4141 in household refrigerators and freezers, *i.e.*, on and after the effective date of the final rule.

B. Chillers

1. The EPA is requesting comment on the proposed use conditions for use of R-516A, including the proposed requirements to comply with both the 4th edition of UL 60335-2-40 and ASHRAE 15-2024 including published addenda. The EPA is requesting comment on the risk mitigation offered by compliance with the current version of these standards proposed as use conditions, the nature of any updates to these standards that are expected to be adopted, and the expected timeline for those updates.

2. The EPA is requesting comment on the applicability of UL 60335-2-40, 4th edition to chillers, including which chillers and under which applications the standard applies, as well as on the applicability of ASHRAE 15-2024 with the addenda published to date.

C. Motor Vehicle Air Conditioning

1. The EPA is requesting comment on the proposal to consider BTMS in nonroad and HD vehicles as MVACs under SNAP. The EPA is requesting comment on whether existing use conditions for MVACs in these vehicle types would be suitable for BTMS. The Agency also requests comment on whether stand-alone BTMS exist in other vehicle types (such as LMDVs) and whether the EPA should expand this interpretation to include stand-alone BTMS in other vehicle types.

2. The EPA is requesting comment on the proposed use conditions intended to mitigate potential flammability risk from the refrigerants with an ASHRAE flammability rating of 2L, namely HFO-1234yf for use in new HDOH MVACs and the flammability risk of retrofits using HFO-1234yf and R-444A in LMDV. Specifically, retrofitting MVACs designed for a nonflammable refrigerant such as HFC-134a to use a flammable refrigerant may present new risks. The EPA seeks comment on whether additional strategies to mitigate the flammability risk of A2L refrigerants are necessary and suggestions of what those strategies may be.

3. The EPA is requesting comment on the unique service fittings proposed for use with R-444A and R-456A. The unique fittings proposed to be used were originally assigned to other refrigerants that are now listed as unacceptable and should no longer be in use. The EPA requests data on whether Freeze-12 and R-416A may still be in use in MVACs and whether that could raise concerns the proposal to reassign these unique fittings to other refrigerants.

4. The EPA is requesting comment on the environmental impacts of the use of R-444A in retrofit LMDVs. The EPA seeks comment on our evaluation that the overall environmental impact is comparable between R-444A and HFO-1234yf.

5. The EPA is requesting comment on whether to require as a use condition that new HDOH vehicles and new buses charged with HFO-1234yf follow the requirements of SAE J639. As discussed in Sections VIII.E.2. and VIII.E.3., the EPA is not proposing a use condition that new MVACs in buses comply with all requirements of SAE J639. The EPA is proposing that use conditions mirror the safety requirements associated with HFO-1234yf in SAE J639.

D. Fire Suppression and Explosion Protection

People are not normally present in cargo bays of civilian aircraft, although workers could be exposed in an accidental discharge of the fire suppression system *(e.g.*, during servicing of the system). In addition, there is the occasional presence of living animals in cargo bays for the duration of a flight who could be exposed to the fire suppression agent in the event of a system discharge (*e.g.*, cargo fire) until the aircraft can safely land. The EPA is requesting comments on

exposure of personnel and animals to 2-BTP/CO_2 in aircraft cargo bays.

XI. Statutory and Executive Order Reviews

Additional information about these statutes and Executive Orders can be found at https://www.epa.gov/laws-regulations/laws-and-executive-orders.

A. Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review

This action is not a significant regulatory action and was therefore not submitted to the Office of Management and Budget (OMB) for review.

B. Executive Order 14192: Unleashing Prosperity Through Deregulation

This action is expected to be an Executive Order 14192 deregulatory action. This proposed rule is expected to provide burden reduction by proposing to list more alternatives that would be available for use by industry, and in certain end-uses, better align EPA requirements with updated industry standards.

C. Paperwork Reduction Act (PRA)

This action does not impose any new information collection burden under the PRA. OMB has previously approved the information collection activities contained in the existing regulations and has assigned OMB control number 2060-0226. This rule contains no new requirements for reporting or recordkeeping.

D. Regulatory Flexibility Act (RFA)

I certify that this action will not have a significant economic impact on a substantial number of small entities under the RFA. In making this determination, the EPA concludes that the impact of concern for this rule is any significant adverse economic impact on small entities and that the agency is certifying that this rule will not have a significant economic impact on a substantial number of small entities because the rule has no net burden on the small entities subject to the rule. This action proposes to add the additional options under SNAP of using 2-BTP/CO_2, HCR 4141, HFO-1234yf, HFO-1234ze(E), R-444A, R-453A, R-456A, R-480A and

R-516A in the specified end-uses but does not mandate such use. Because equipment for HCR 4141 using residential and light commercial AC and heat pumps—self-contained room air conditioners and HFO-1234ze(E) using residential and light commercial AC and heat pumps, and R-516A using residential and light commercial AC and heat pumps is not manufactured yet in the United States, no change in business practice is required to meet the use conditions, resulting in no adverse impact compared with the absence of this rule. The revised use conditions for R-290 in water coolers and for HFC-32, R-290, R-441A, R-454A, R-454B, R-454C, and R-457A in residential and light commercial AC and heat pumps were requested by industry and allow for consistency with the latest, updated standards; these would allow for greater consistency in business practices for different types of equipment using the same refrigerants, as well as provide greater flexibility in designing and manufacturing equipment. Equipment using the proposed refrigerants already manufactured prior to the effective date of the final rule would not be required to be changed. Water coolers using R-290 and residential and light commercial AC and heat pumps using HFC-32, R-290, R-441A, R-454A, R-454B, R-454C, or R-457A have been subject to similar use conditions and would allow for use consistent with industry safety standards, and thus the updated requirements would result in no adverse impact compared with the absence of this rule. Thus, if the rule were finalized as proposed, it would not impose new costs on small entities. We have therefore concluded that this action will have no net regulatory burden for all directly regulated small entities.

E. Unfunded Mandates Reform Act (UMRA)

This action does not contain an unfunded mandate as described in UMRA, 2 U.S.C. 1531-1538, and does not significantly or uniquely affect small governments. The action imposes no enforceable duty on any state, local or Tribal governments or the private sector.

F. Executive Order 13132: Federalism

This action does not have federalism implications. It will not have substantial direct effects on the states, on the relationship between the national government and the states, or on

the distribution of power and responsibilities among the various levels of government.

G. Executive Order 13175: Consultation and Coordination with Indian Tribal Governments

This action does not have Tribal implications as specified in Executive Order 13175. It will not have substantial direct effects on Tribal governments, on the relationship between the Federal government and Indian Tribes, or on the distribution of power and responsibilities between the Federal government and Indian Tribes, as specified in Executive Order 13175. Thus, Executive Order 13175 does not apply to this action.

H. Executive Order 13045: Protection of Children from Environmental Health and Safety Risks

Executive Order 13045 directs federal agencies to include an evaluation of the health and safety effects of the planned regulation on children in federal health and safety standards and explain why the regulation is preferable to potentially effective and reasonably feasible alternatives. This action is not subject to Executive Order 13045 because it is not a significant regulatory action under section 3(f)(1) of Executive Order 12866, and because the EPA does not believe the environmental health or safety risks addressed by this action present a disproportionate risk to children. While the EPA has not conducted a separate analysis of risks to infants and children associated with this rule, the rule does contain use conditions that would reduce exposure risks to the general population, with the reduction of exposure being most important to the most sensitive individuals. This action's health and risk assessments are contained in the comparisons of toxicity for the various substitutes, as well as in the risk screens for the substitutes that are listed in this proposed rule. The risk screens are in the docket. However, the EPA's *Policy on Children's Health* applies to this action.

I. Executive Order 13211: Actions that Significantly Affect Energy Supply, Distribution, or Use

This action is not subject to Executive Order 13211, because it is not a significant regulatory action under Executive Order 12866.

J. National Technology Transfer and Advancement Act

This action involves technical standards. The EPA proposes to incorporate by reference

the 4th edition (2022) of UL 60335-2-40, which establishes requirements for the evaluation of AC and heat pump equipment and safe use of flammable refrigerants, among other things. This standard is discussed in greater detail in Section IV.F.4. The EPA also proposes to incorporate by reference the 3rd edition (2023) of UL 60335-2-24, which establishes requirements for the evaluation of household refrigerators and freezers and related small, household refrigerated appliances and safe use of flammable refrigerants, among other things. This standard is discussed in greater detail in Section V.E.4. The EPA also proposes to incorporate by reference Supplement SB of the 8th edition of UL 399, which establishes requirements for the evaluation of water coolers and safe use of flammable refrigerants, among other things. This standard is discussed in greater detail in Section VI.E.4.

The 4th edition of UL 60335-2-40, "Household and Similar Electrical Appliances - Safety - Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers", dated December 15, 2022, is available at: https://www.shopulstandards.com/ProductDetail.aspx?productId=UL60335-2-40. The 3rd edition of UL 60335-2-24, "Household and Similar Electrical Appliances - Safety - Part 2-24: Particular Requirements for Refrigerating Appliances, Ice-Cream Appliances and Ice-Makers," dated July 29, 2022, and revisions through February 20, 2024, is available at: https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=43189. The 8th edition of UL 399, "Drinking Water Coolers," dated March 30, 2017, and revisions through February 28, 2024, is available at https://www.shopulstandards.com/ProductDetail.aspx?productId=UL399_8_S_20170330. All three UL standards may be purchased by mail at: COMM 2000, 151 Eastern Avenue, Bensenville, IL 60106; Email: orders@shopulstandards.com; Telephone: 1-888-853-3503 in the United States or Canada (other countries dial 1-415-352-2178); Internet address: https://ulstandards.ul.com or https://www.shopulstandards.com. The cost of the 4th edition (2022) of UL 60335-2-40 is $521 for an electronic copy and $652 for a hard copy. The cost of the 3rd

edition (2022) of UL 60335-2-24, is $555 for an electronic copy and $694 for a hard copy. The cost of the February 2024 revision to the 8th edition of UL 399 is $798 for an electronic copy and $998 for a hard copy. UL also offers a subscription service to the Standards Certification Customer Library that allows unlimited access to their standards and related documents. The cost of obtaining this standard is not a significant financial burden for equipment manufacturers and purchase is not necessary for those selling, installing, and servicing the equipment. Therefore, the EPA concludes that the UL standards the EPA is proposing to incorporate by reference are reasonably available.

The EPA is also proposing to incorporate by reference ASHRAE 15-2024, which specifies requirements for the safe design, construction, installation, and operation of refrigeration systems, among other things. This standard is discussed in greater detail in Section VII.E. ANSI/ASHRAE Standard 15-2024, "Safety Standard for Refrigeration Systems," is available at https://www.ashrae.org/technical-resources/bookstore/ashrae-refrigeration-resources, and may be purchased by mail at: 180 Technology Parkway NW, Peachtree Corners, Georgia 30092; by email at store@techstreet.com; by telephone: 1-800-527-4723 in the United States or Canada; or at Internet address: https://store.accuristech.com/ashrae/standards/ashrae-15-2024-packaged-w-standard-34-2024?product_id=2922394. ASHRAE 15-2024 and ASHRAE 34-2024 are available as a bundle costing $178.00 for an electronic copy or hard copy. The cost of obtaining these standards is not a significant financial burden for equipment manufacturers or for those selling, installing and servicing the equipment. Therefore, the EPA concludes that the ASHRAE standard the EPA is proposing to incorporate by reference is reasonably available.

The EPA is proposing to incorporate by reference several industry safety standards from SAE in the use conditions for use of HFO-1234yf in MVACs in several types of equipment: SAE J639 (revised November 2020), "Safety and Design Standards for Motor Vehicle Refrigerant Vapor Compression Systems;" SAE J1739 (revised January 2021), "Potential Failure Mode and Effects Analysis (FMEA) Including Design FMEA, Supplemental FMEA-MSR, and Process

FMEA;" and SAE J2844 (revised January 2013), "R-1234yf (HFO-1234yf) New Refrigerant Purity and Container Requirements for Use in Mobile Air-Conditioning Systems." These standards may be purchased by mail at: SAE Customer Service, 400 Commonwealth Drive, Warrendale, PA 15096-0001; by telephone: 1-877-606-7323 in the United States or 724-776-4970 outside the United States or in Canada. The cost of SAE J639, SAE J1739, and SAE J2844 is $85 each for an electronic or hardcopy. The cost of obtaining these standards is not a significant financial burden for manufacturers of MVACs and purchase is not required for those selling, installing, and servicing the systems. Therefore, the EPA proposes to conclude that the use of SAE J639, SAE J1739, and SAE J2844 are reasonably available.

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Unless specified otherwise, all documents are available electronically at *https://regulations.gov*, docket number EPA-HQ-OAR-2024-0503.

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ICF, 2025g. Risk Screen on Substitutes in Residential and Light Commercial Air Conditioning and Heat Pumps Commercial Ice Machines (New Equipment); Substitute: R-457A (Forane® 457A).

ICF, 2025h. Risk Screen on Substitutes in Household Refrigerators and Freezers (New Equipment); Substitute: HCR 4141.

ICF, 2025i. Risk Screen on Substitutes in Water Coolers (New Equipment); Substitute: Propane (R-290).

ICF, 2025j. Risk Screen on Substitutes in Chillers (New Equipment); Substitute: R-516A (Forane® 516A).

ICF, 2025k. Risk Screen on Substitutes in Motor Vehicle Air Conditioning (Light-Duty and Medium-Duty Vehicles) (Retrofit Equipment); Substitute: HFO-1234yf (Solstice® yf or Solstice® 1234yf).

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List of Subjects in 40 CFR Part 82

Environmental protection, Administrative practice and procedure, Air pollution control, Chemicals.

Lee Zeldin,
Administrator.

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