



ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 82

[EPA-HQ-OAR-2003-0118; FRL-11349-01-OAR]

RIN 2060-AG12

Protection of Stratospheric Ozone: Determination 38 for Significant New Alternatives Policy Program

AGENCY: Environmental Protection Agency (EPA).

ACTION: Determination of acceptability.

SUMMARY: This determination of acceptability expands the list of acceptable substitutes pursuant to the U.S. Environmental Protection Agency's Significant New Alternatives Policy program. This action lists as acceptable additional substitutes for use in the refrigeration and air conditioning and fire suppression sectors.

DATES: This determination is applicable on [Insert date of publication in the Federal Register].

ADDRESSES: EPA established a docket for this action under Docket ID No. EPA-HQ-OAR-2003-0118 (continuation of Air Docket A-91-42). All electronic documents in the docket are listed in the index at www.regulations.gov. Although listed in the index, some information is not publicly available, e.g., Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Publicly available docket materials are available either electronically at www.regulations.gov or in hard copy at the EPA Air Docket (Nos. A-91-42 and EPA-HQ-OAR-2003-0118), EPA Docket Center (EPA/DC), William J. Clinton West, Room 3334, 1301 Constitution Avenue, NW, Washington, DC 20460. The telephone number for the Public Reading Room is (202) 566-1744, and the telephone number for the Air Docket is (202) 566-1742. For further information on EPA Docket Center services and the current status, please visit us online at www.epa.gov/dockets.

FOR FURTHER INFORMATION CONTACT: Margaret Sheppard by telephone at (202) 343-9163, by e-mail at Sheppard.Margaret@epa.gov, or by mail at U.S. Environmental Protection Agency, Mail Code 6205A, 1200 Pennsylvania Avenue, NW, Washington, DC 20460.

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Appendix A: Summary of Decisions for New Acceptable Substitutes

I. Listing of New Acceptable Substitutes

This action is listing as acceptable additional substitutes for use in the refrigeration and air conditioning and fire suppression sectors. This action presents EPA's most recent decisions under the Significant New Alternatives Policy (SNAP) program to list as acceptable several substitutes in different end-uses. New substitutes are:

- R-471A in retail food refrigeration, industrial process refrigeration, and cold storage warehouses (new equipment only);
- R-515B in retail food refrigeration (refrigerated food processing and dispensing equipment, remote condensing units, and supermarket systems), commercial ice machines, and cold storage warehouses (new equipment only);
- Powdered Aerosol I in total flooding fire suppression (both occupied and normally unoccupied areas).

EPA's review of certain substitutes listed in this document is pending for other end-uses. Listing decisions in the end-uses in this document do not prejudice EPA's listings of these substitutes for other end-uses. While certain substitutes being added through this action to the acceptable lists for specific end-uses may have a higher risk in one or more SNAP criteria than

certain other substitutes already listed as acceptable or acceptable subject to restrictions, they have a similar or lower overall risk than other acceptable substitutes in those end-uses.

For additional information on SNAP, visit the SNAP portion of EPA's Ozone Layer Protection website at: www.epa.gov/snap. Copies of the full lists of acceptable substitutes for ozone-depleting substances (ODS) in the industrial sectors covered by the SNAP program are available at www.epa.gov/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 published March 18, 1994 (59 FR 13044), and the regulations codified at 40 CFR part 82, subpart G. SNAP decisions and the appropriate Federal Register citations are found at: www.epa.gov/snap/snap-regulations. Under the SNAP program, EPA may list a substitute as acceptable for specified end-uses where the Agency has reviewed the substitute and found no reason to restrict or prohibit its use. Substitutes listed as unacceptable; acceptable, subject to narrowed use limits; or acceptable, subject to use conditions are also listed in the appendices to 40 CFR part 82, subpart G.

The sections below discuss each substitute listing in detail and summarize the results of EPA's assessment of the human health and environmental risks posed by each substitute. EPA's evaluation considers the criteria at 40 CFR 82.180(a)(7), including: atmospheric effects and related health and environmental effects, ecosystem risks, consumer risks, flammability, and cost and availability of the substitute. When evaluating potential substitutes, EPA evaluates these criteria in risk screens, which are technical documents that evaluate risks to human health and the environment from substitutes in specific end-uses, including comparisons to other available substitutes and evaluations against relevant thresholds of risk starting with protective assumptions. The risk screens cited in this document include evaluation of atmospheric effects, exposure assessments, toxicity data, flammability, and other environmental impacts such as ecotoxicity and local air quality impacts. Each of these analyses is described in more detail at www.epa.gov/snap/overview-snap. In this document, the global warming potentials (GWPs) for

the substitutes are determined using the 100-year GWP values from the International Panel on Climate Change's (IPCC) Fourth Assessment Report (AR4)¹ for all substances or components of blends.² For substances for which no GWP is provided in AR4, the 100-year GWP listed in World Meteorological Organization (WMO) 2022³ is used. Where a GWP value in the source document is preceded with a less than (<), very less than (<<), greater than (>), approximately (~), or similar symbol, the numerical value from the source document is cited in this document. For blends of chemicals, such as the listed refrigerant blends, this document weights the GWPs of each component of the blend by their mass percentage in the blend.

Appendix A contains tables summarizing each listing decision in this action. The statements in the "Further Information" column in the tables provide additional information but these are not legally binding under section 612 of the Clean Air Act (CAA). Although you are not required to follow recommendations in the "Further Information" column of the table under section 612 of the CAA, some of these statements may refer to obligations that are enforceable or binding under Federal or State programs other than the SNAP program. The identification of other enforceable or binding requirements should not be construed as a comprehensive list of such obligations. In many instances, the information simply refers to standard operating practices in existing industry standards and/or building codes. When using these substitutes in the identified end-use, EPA strongly encourages you to apply the information in the "Further Information" column. Many of these recommendations, if adopted, would not require significant changes to existing operating practices.

¹ IPCC, 2007: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., Tignor M., and Miller, H. L. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. This document is accessible at www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html.

² The AR4 100-year GWP values are consistent with the exchange values for the regulated hydrofluorocarbons (HFCs) listed in subsection (c) of the American Innovation and Manufacturing (AIM) Act and with Annexes A, C, and F of the *Montreal Protocol on Substances that Deplete the Ozone Layer* (Montreal Protocol).

³ WMO (World Meteorological Organization), *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). In this action, the 100-year GWP values are used.

Under separate authority of subsection (i) of the American Innovation and Manufacturing (AIM) Act of 2020, EPA has proposed restrictions on higher-GWP hydrofluorocarbons (HFCs) in specific sectors and subsectors (December 15, 2022; 87 FR 76738). The Agency notes that once that rule is finalized, it may restrict certain substitutes that are listed as acceptable under the SNAP program for some uses. Thus, an acceptable listing of a substitute under the SNAP program should not be considered full permission to use that substitute in all circumstances. Any restrictions under subsection (i) of the AIM Act, as well as other relevant authorities, must also be considered.⁴

You can find submissions to EPA for the substitutes listed in this document, as well as other materials supporting the decisions in this action, in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov.

A. Refrigeration and Air Conditioning

1. R-471A

EPA's decision: EPA finds R-471A acceptable as a substitute for use in:

- Retail food refrigeration – stand-alone equipment (new equipment only)
- Retail food refrigeration – refrigerated food processing and dispensing equipment (new equipment only)
- Retail food refrigeration – remote condensing units (new equipment only)
- Retail food refrigeration – supermarket systems (new equipment only)
- Industrial process refrigeration (new equipment only)
- Cold storage warehouses (new equipment only)

R-471A, marketed under the trade name Solstice[®] 471A, is a weighted blend of 78.7 percent hydrofluoroolefin (HFO)-1234ze(E), which is also known as *trans*-1,3,3,3-tetrafluoroprop-1-ene; (Chemical Abstracts Service Registry Number [CAS Reg. No.] 29118-24-

⁴ For example, there may be restrictions or prohibitions in regulations issued under section 610 of the CAA at 40 CFR part 82 subpart C for nonessential products containing ODS, under the Toxic Substances Control Act, under the Occupation Safety and Health Act, and under State or local laws and regulations that warrant consideration.

9); 17.0 percent HFO-1336mzz(E), also known as *trans*-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2); and 4.3 percent HFC-227ea, which is also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0) .

You may find a copy of the applicant’s submission, with CBI redacted, providing the required health and environmental information for this substitute in this end-use in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, “Supporting Materials for Notice 38 Listing of R-471A in Refrigeration and Air Conditioning. SNAP Submission Received December 8, 2021.” EPA performed assessments to examine the health and environmental risks of this substitute and the results are summarized below. These assessments are available in Docket EPA-HQ-OAR-2003-0118:

- “Risk Screen on Substitutes in Retail Food Refrigeration (New Equipment). Substitute: R-471A (Solstice[®] N71).”
- “Risk Screen on Substitutes in Industrial Process Refrigeration and Cold Storage Warehouses (New Equipment). Substitute: R-471A (Solstice[®] N71).”

Environmental information: R-471A has an ozone depletion potential (ODP) of zero. Its components, HFO-1234ze(E), HFO-1336mzz(E), and HFC-227ea, have GWPs of one,⁵ 26,⁶ and 3,220, respectively.⁷ If these values are weighted by mass percentage, then R-471A has a GWP of about 144. The components of R-471A are excluded from the EPA’s regulatory definition of volatile organic compounds (VOC) under CAA regulations (see 40 CFR 51.100(s)) addressing the development of State implementation plans (SIPs) to attain and maintain the National Ambient Air Quality Standards (NAAQS). Knowingly venting or releasing this refrigerant blend is limited by the venting prohibition under section 608(c)(2) of the CAA, codified in EPA’s regulations at 40 CFR 82.154(a).

⁵ WMO, 2022.

⁶ Ibid.

⁷ Unless otherwise stated, all GWPs in this document for individual chemicals are 100-year values from IPCC’s Fourth Assessment Report (AR4), based upon the 100-year GWPs in IPCC, 2007, if available, in that document.

Flammability information: R-471A is not flammable. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has assigned R-471A a flammability class of “1,” meaning it does not propagate a flame under standard test conditions.⁸

Toxicity and exposure data: Potential health effects of exposure to this substitute include drowsiness or dizziness. The substitute may also irritate the skin or eyes or cause frostbite. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many refrigerants.

ASHRAE has established an occupational exposure limit (OEL) for the blend of 710 ppm on an eight-hour time-weighted average (8-hr TWA).⁹ For the components of R-471A, the Workplace Environmental Exposure Limit (WEEL) Committee of the Occupational Alliance for Risk Science (OARS) has established a WEEL of 400 ppm on an 8-hr TWA for HFO-1336mzz(E) and ASHRAE has established OELs of 800 ppm and 1,000 ppm on an 8-hr TWA for HFO-1234ze(E) and HFC-227ea, respectively. EPA anticipates that users will be able to meet these workplace guidance limits and address potential health risks by following recommendations in the manufacturer’s safety data sheet (SDS), ASHRAE Standard 15, and other safety precautions common to the refrigeration and air conditioning industry.

Comparison to other substitutes in these end-uses: R-471A has an ODP of zero, comparable to or less than other listed substitutes in these end-uses with ODPs ranging from zero to less than 0.0004.

For new remote condensing units and supermarket systems, R-471A’s GWP of about 144 is lower than that of other acceptable substitutes for new equipment such as R-450A (GWP of 601), R-513A (GWP of 630), R-407A (GWP of 2,110), and R-421A (GWP of 2,630). R-471A’s GWP of about 144 is higher than that of other acceptable substitutes for new equipment such as ammonia vapor compression in a secondary loop (GWP of zero) and carbon dioxide (CO₂)

⁸ ASHRAE Standard 34-2022, Designation and Safety Classification of Refrigerants.

⁹ Ibid.

(GWP of one). There may be situations in which ammonia or CO₂ may not be feasible for new remote condensing units and supermarket systems or are restricted by local laws and building codes and standards, particularly for smaller equipment used in a public area.

For stand-alone equipment, R-471A's GWP of about 144 is lower than that of other acceptable substitutes for new equipment such as R-450A (GWP of 601) and R-513A (GWP of 630). R-471A's GWP of about 144 is higher than that of other acceptable substitutes for new equipment such as ammonia vapor compression in a secondary loop (GWP of zero), CO₂ (GWP of one), and propane (GWP of three). There may be situations in which ammonia in a secondary loop, CO₂, or larger charges of propane may not be feasible or are restricted by local laws and building codes and standards because of flammability or toxicity.

For refrigerated food processing and dispensing equipment, R-471A's GWP of about 144 is comparable to or lower than that of other acceptable substitutes for new equipment such as R-450A (GWP of 601), R-513A (GWP of 630), HFC-134a (GWP of 1,430), and R-426A (GWP of 1,510). R-471A's GWP of about 144 is higher than that of other acceptable substitutes for new equipment such as ammonia vapor compression in a secondary loop (GWP of zero) and CO₂ (GWP of one). There may be situations in which ammonia in a secondary loop or CO₂ may not be feasible for new refrigerated food processing and dispensing equipment or are restricted by local laws and building codes and standards, due to flammability and toxicity.

For industrial process refrigeration, R-471A's GWP of about 144 is comparable to or lower than that of other acceptable substitutes for new equipment such as R-450A (GWP of 601), R-513A (GWP of 630), R-404A (GWP of 3,920) and R-508B (GWP of 13,400). R-471A's GWP of about 144 is higher than that of other acceptable substitutes for new equipment such as ammonia absorption (GWP of zero), CO₂ (GWP of one), and propane (GWP of three). There may be situations in which ammonia, CO₂, or propane may not be feasible for new industrial process refrigeration equipment, *e.g.*, because of temperature range, or are restricted by local laws and building codes and standards, due to flammability and toxicity.

For cold storage warehouses, R-471A's GWP of about 144 is comparable to or lower than that of other acceptable substitutes for new equipment such as R-450A (GWP of 601), R-513A (GWP of 630), and R-407F (GWP of 1,820). R-471A's GWP of about 144 is higher than that of other acceptable substitutes for new equipment such as ammonia absorption (GWP of zero) and CO₂ (GWP of one). There may be situations in which ammonia or CO₂ may not be feasible for new cold storage warehouses or are restricted by local laws and building codes and standards, particularly for smaller equipment.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-uses. Toxicity risks can be minimized by use consistent with the OARS WEEL and ASHRAE OELs, ASHRAE 15, and other industry standards, recommendations in the manufacturer's SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds R-471A acceptable in the retail food refrigeration (new equipment only)—refrigerated food processing and dispensing equipment, remote condensing units, stand-alone units, and supermarket systems; industrial process refrigeration (new equipment only); and cold storage warehouses (new equipment only) end-uses because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-uses.

2. R-515B

EPA's decision: EPA finds R-515B acceptable as a substitute for use in:

- Retail food refrigeration – refrigerated food processing and dispensing equipment (new equipment only)
- Retail food refrigeration – remote condensing units (new equipment only)
- Retail food refrigeration – supermarket systems (new equipment only)
- Commercial ice machines (new equipment only)
- Cold storage warehouses (new equipment only)

R-515B is a weighted blend of 91.1 percent HFO-1234ze(E), which is also known as *trans*-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9), and 8.9 percent HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0).

You may find a copy of the applicant’s submissions, with CBI redacted, providing the required health and environmental information for this substitute in these end-uses in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the names, “Supporting Materials for Notice 38 Listing of R-515B in Refrigeration and Air Conditioning. SNAP Submission Received May 28, 2020” and “Supporting Materials for Notice 38 Listing of R-515B in Refrigeration and Air Conditioning. SNAP Submission Received December 10, 2021.” EPA performed assessments to examine the health and environmental risks of this substitute and the results are summarized below. These assessments are available in Docket EPA-HQ-OAR-2003-0118:

- “Risk Screen on Substitutes in Retail Food Refrigeration—Refrigerated Food Processing and Dispensing Equipment (New Equipment). Substitute: R-515B (Solstice® N15).”
- “Risk Screen on Substitutes in Retail Food Refrigeration—Supermarket Systems and Remote Condensing Units (New Equipment). Substitute: R-515B (Solstice® N15).”
- “Risk Screen on Substitutes in Commercial Ice Machines (New Equipment). Substitute: R-515B (Solstice® N15).”
- “Risk Screen on Substitutes in Cold Storage Warehouses (New Equipment). Substitute: R-515B (Solstice® N15).”

Environmental information: R-515B has an ODP of zero. Its components, HFO-1234ze(E) and HFC-227ea, have a GWP of one¹⁰ and 3,220, respectively. If these values are weighted by mass percentage, then R-515B has a GWP of about 287. The components of R-515B are excluded from the EPA’s regulatory definition of VOC under CAA regulations (see 40

¹⁰ WMO, 2022.

CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS.

Knowingly venting or releasing this refrigerant blend is limited by the venting prohibition under section 608(c)(2) of the CAA, codified at 40 CFR 82.154(a)(1).

Flammability information: R-515B is not flammable. ASHRAE has assigned R-515B a flammability class of “1.”¹¹

Toxicity and exposure data: Potential health effects of exposure to this substitute include drowsiness or dizziness. The substitute may also irritate the skin or eyes or cause frostbite. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many refrigerants.

ASHRAE has established OELs of 800 ppm and 1000 ppm as an 8-hr TWA for HFO-1234ze(E) and HFC-227ea, respectively. For the R-515B blend itself, ASHRAE recommends an OEL of 810 ppm.¹² EPA anticipates that users will be able to meet each of the OELs and address potential health risks by following recommendations in the manufacturer’s SDS, in ASHRAE Standard 15, and other safety precautions common to the refrigeration and air conditioning industry.

Comparison to other substitutes in these end-uses: R-515B has an ODP of zero, comparable to or less than other listed substitutes in these end-uses, with ODPs ranging from zero to less than 0.0004.

For refrigerated food processing and dispensing equipment, R-515B’s GWP of about 287 is comparable to or lower than that of other acceptable substitutes for new equipment such as R-450A (GWP of 601), R-513A (GWP of 630), HFC-134a (GWP of 1,430), and R-426A (GWP of 1,510). R-515B’s GWP of about 287 is higher than that of other acceptable substitutes for new equipment such as ammonia vapor compression in a secondary loop (GWP of zero) and CO₂ (GWP of one). There may be situations in which ammonia in a secondary loop or CO₂ may not

¹¹ ASHRAE Standard 34-2022, Designation and Safety Classification of Refrigerants.

¹² Ibid.

be feasible for new refrigerated food processing and dispensing equipment or are restricted by local laws and building codes and standards, due to flammability and toxicity.

For remote condensing units and supermarket systems, R-515B's GWP of about 287 is comparable to or lower than that of other acceptable substitutes for new equipment such as R-450A (GWP of 601), R-513A (GWP of 630), R-407A (GWP of 2,110), and R-421A (GWP of 2,630). R-515B's GWP of about 287 is higher than that of other acceptable substitutes for new equipment such as ammonia vapor compression in a secondary loop (GWP of zero) and CO₂ (GWP of one). There may be situations in which ammonia or CO₂ may not be feasible for new remote condensing units and supermarket systems or are restricted by local laws and building codes and standards, particularly for smaller equipment used in a public area.

For commercial ice machines, R-515B's GWP of about 287 is comparable to or lower than that of other acceptable substitutes for new equipment, such as R-513A (GWP of 630), R-449B (GWP of 1,410), R-410A (GWP of 2,090), R-404A (GWP of 3,920), and R-507A (GWP of 3,990). R-515B's GWP of about 287 is higher than that of other acceptable substitutes for new equipment such as ammonia vapor compression in a secondary loop (GWP of zero), CO₂ (GWP of one), and propane (GWP of three). There may be situations in which ammonia in a secondary loop, CO₂, or larger charges of propane may not be feasible or are restricted by local laws and building codes and standards because of flammability or toxicity.

For cold storage warehouses, R-515B's GWP of about 287 is comparable to or lower than that of other acceptable substitutes for new equipment such as R-450A (GWP of 601), R-513A (GWP of 630), and R-407F (GWP of 1,820). R-515B's GWP of about 287 is higher than that of other acceptable substitutes for new equipment such as ammonia absorption (GWP of zero) and CO₂ (GWP of one). There may be situations in which ammonia or CO₂ may not be feasible for new cold storage warehouses or are restricted by local laws and building codes and standards, particularly for smaller equipment.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-uses. Toxicity risks can be minimized by use consistent with the ASHRAE OELs, ASHRAE 15, and other industry standards, recommendations in the manufacturer's SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds R-515B acceptable in the end-uses listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-uses.

B. Fire Suppression and Explosion Protection

1. Powdered Aerosol I (GreenSol)

EPA's decision: EPA finds Powdered Aerosol I acceptable as a substitute for:

- Total flooding uses, both occupied and normally unoccupied spaces

Powdered Aerosol I is prepared as a solid material that generates, by a combustion process, a powdered aerosol that acts chemically and physically to extinguish fires. Based on review of information from the submitter that supports the safe use of the powdered aerosol in normally occupied spaces, EPA determines that Powdered Aerosol I is acceptable for use in total flooding systems for both occupied and normally unoccupied spaces. In the "Further Information" column of the tables summarizing today's listing decisions and found at the end of this document, we state that use of this agent should be used in accordance with the safety guidelines in the latest edition of the National Fire Protection Association (NFPA) 2010 Standard for Aerosol Extinguishing Systems. Although EPA is not requiring use conditions on the use of Powdered Aerosol I, we believe that the fire suppression industry will use this agent safely because the NFPA 2010 Standard establishes health and safety requirements for its use¹³ and

¹³ EPA is a member of NFPA's standard-setting committee in developing NFPA 2010 and provides relevant health information for that document.

because of the acceptable level of toxicity of this substitute (see below under “Toxicity and exposure data).”

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, “Supporting Documentation for Notice 38 Listing of Powdered Aerosol I (GreenSol) in Fire Suppression. SNAP Submission Received December 1, 2020.” EPA performed an assessment to examine the health and environmental risks of this substitute and the results are summarized below. This assessment is available in Docket EPA-HQ-OAR-2003-0118:

- “Risk Screen on Substitutes in Total Flooding Systems in Normally Occupied Spaces. Substitute: Powdered Aerosol I (GreenSol)”

Environmental information: The active ingredients of Powdered Aerosol I are solids both before and after use; thus, their ODP and GWP are both zero. The gaseous post-activation products for Powdered Aerosol I also have zero ODP and those released with GWPs are carbon monoxide (CO) and CO₂ with GWPs of three or less. The remaining gaseous post-activation products either have no GWP or are present only in trace amounts. Further, the remaining gaseous post-activation products are not organic, and thus are excluded from the EPA’s regulatory definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS. The solid active ingredients and particulate post-activation products have no ODP or GWP, do not participate in atmospheric photochemical reactions, and are inorganic compounds that are not VOC.

Flammability information: Powdered Aerosol I’s post-activation products are nonflammable.

Toxicity and exposure data: Because the fire suppressant precursors are prepared as solids that are not reactive and do not crumble or flake, inhalation or ingestion of the pre-activation compounds is not likely. Exposure to Powdered Aerosol I after activation may cause temporary, mild irritation of the mucous membrane. If eye or skin contact occurs, end users

should flush eyes with water or wash skin with soap and water. If inhaled, end users should be removed and exposed to fresh air. Exposure to the post-discharge products is expected to be below the relevant workplace exposure limits for those compounds. Because it is housed in a hermetically sealed container, exposure should not occur unless the system is activated.

The post-activation components of the proposed substitute are common compounds that are not expected to exceed immediately dangerous to life or health (IDLH) levels from the National Institute for Occupational Safety and Health (NIOSH) that apply to occupational and end-use exposure.

Information on additional safety recommendations: The discharge of the aerosol results in a reduction of visibility in the protected space due to the uniform distribution of the particulate generated. EPA recommends use in accordance with the NFPA 2010 standard to reduce any safety risks due to reduced visibility. In addition, EPA recommends that cross-zone detection systems and abort switches located near an exit from the protected space be employed; improved detection systems within the protected space and manual abort switches outside of the space could help avoid inadvertent discharge. The use of appropriate safety and protective equipment (e.g., protective gloves, tightly sealed goggles, protective work clothing, and particulate-removing respirators using NIOSH type N95 or better filters) consistent with U.S. Occupational Safety and Health Administration (OSHA) guidelines minimizes personnel exposure from inhalation of the substitute.

EPA provides additional information on safe use of this substitute for establishments manufacturing, installing and maintaining equipment using this agent in the “Further Information” column of the tables summarizing the listing decisions in this document. EPA encourages users of substitutes to apply all statements in the “Further Information” column in their use of this substitute as best practices for safer use. In many instances, the information simply refers to standard operating practices in existing industry standards and/or building codes, which if adopted, would not require significant changes to existing operating practices.

EPA expects that procedures identified in the SDS for Powdered Aerosol I and good manufacturing practices will be adhered to, and that the appropriate safety and personal protective equipment (PPE) consistent with OSHA guidelines will be used during installation, servicing, post-discharge clean-up and disposal of total flooding systems using Powdered Aerosol I. The manufacturer should provide guidance upon installation of the system regarding the appropriate time after which workers may re-enter the area for disposal to allow the maximum settling of all particulates.

Comparison to other substitutes in this end-use: Powdered Aerosol I has an ODP of zero, comparable to other listed substitutes in this end-use, with ODPs ranging from zero to 0.048.

For total flooding agents, Powdered Aerosol I's GWP of zero (and one to three for certain post-activation products) is lower than that of other acceptable substitutes, such as HFC-227ea (GWP of 2,220) and other substitutes with GWPs up to 22,800.¹⁴ Other acceptable substitutes in this end-use have comparable GWPs ranging from zero to one, such as water, inert gases, and a number of other powdered aerosol fire suppressants.

Toxicity risks can be minimized by use consistent with the NFPA 2010 standard, recommendations in the SDS, and other safety precautions common in the fire suppression industry. The potential toxicity risks due to inhalation exposure are common to many total flooding agents, including those already listed as acceptable under SNAP for this same end-use. Powdered Aerosol I's post-activation products are nonflammable, as are all other available total flooding agents.

EPA finds Powdered Aerosol I acceptable in the end-use listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

¹⁴ For SF₆, the substitute with the highest GWP, the SNAP listing finds SF₆ as "acceptable subject to narrowed use limits."

List of Subjects in 40 CFR Part 82

Environmental protection, Administrative practice and procedure, Air pollution control,
Reporting and recordkeeping requirements.

Paul M. Gunning,
Director, Office of Atmospheric Protection,
Office of Air and Radiation.

APPENDIX A: SUMMARY OF DECISIONS FOR NEW ACCEPTABLE SUBSTITUTES

Refrigeration and Air Conditioning

End-Use	Substitute	Decision	Further Information ¹
Retail food refrigeration – stand-alone equipment (<i>new equipment only</i>).	R-471A	Acceptable	<p>This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i>-1,3,3,3-tetrafluoroprop-1-ene (Chemical Abstracts Service Registry Number [CAS Reg. No.] 29118-24-9); HFO-1336mzz(E), also known as <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2); and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0).</p> <p>R-471A has a 100-year global warming potential (GWP) of 144.</p> <p>The blend is not flammable.</p> <p>The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has established an occupational exposure limit (OEL) of 710 ppm on an 8-hr TWA for R-471A, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm for HFC-227ea on an eight-hour time-weighted average (8-hr TWA).</p> <p>The Occupational Alliance for Risk Science (OARS) has established a Workplace Environmental Exposure Limit (WEEL) of 400 ppm on an 8-hr TWA for HFO-1336mzz(E).</p>
Retail food refrigeration – refrigerated food processing and dispensing equipment (<i>new equipment only</i>).	R-471A	Acceptable	<p>This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i>-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9); HFO-1336mzz(E), also known as <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2); and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0).</p> <p>R-471A has a GWP of 144.</p> <p>The blend is not flammable.</p> <p>ASHRAE has established an OEL of 710 ppm on an 8-hr TWA for R-471A, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm for HFC-227ea on an 8-hr TWA.</p> <p>OARS has established a WEEL of 400 ppm on an 8-hr-TWA for HFO-1336mzz(E).</p>

End-Use	Substitute	Decision	Further Information ¹
Retail food refrigeration – refrigerated food processing and dispensing equipment (<i>new equipment only</i>).	R-515B	Acceptable	<p>This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i>-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9) and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0).</p> <p>R-515B has a GWP of 287.</p> <p>The blend is not flammable.</p> <p>ASHRAE has established an OEL of 810 ppm on an 8-hr TWA for R-515B, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm HFC-227ea on an 8-hr TWA.</p>
Retail food refrigeration – remote condensing units (<i>new equipment only</i>).	R-471A	Acceptable	<p>This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i>-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9); HFO-1336mzz(E), also known as <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2); and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0).</p> <p>R-471A has a GWP of 144.</p> <p>The blend is not flammable.</p> <p>ASHRAE has established an OEL of 710 ppm on an 8-hr TWA for R-471A, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm for HFC-227ea on an 8-hr TWA.</p> <p>OARS has established a WEEL of 400 ppm on an 8-hr-TWA for HFO-1336mzz(E).</p>
Retail food refrigeration – remote condensing units (<i>new equipment only</i>).	R-515B	Acceptable	<p>This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i>-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9) and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0).</p> <p>R-515B has a GWP of 287.</p> <p>The blend is not flammable.</p> <p>ASHRAE has established an OEL of 810 ppm on an 8-hr TWA for R-515B, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm HFC-227ea on an 8-hr TWA.</p>

End-Use	Substitute	Decision	Further Information ¹
Retail food refrigeration – supermarket systems (<i>new equipment only</i>).	R-471A	Acceptable	<p>This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i>-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9); HFO-1336mzz(E), also known as <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2); and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0). R-471A has a GWP of 144.</p> <p>The blend is not flammable.</p> <p>ASHRAE has established an OEL of 710 ppm on an 8-hr TWA for R-471A, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm for HFC-227ea on an 8-hr TWA.</p> <p>OARS has established a WEEL of 400 ppm on an 8-hr-TWA for HFO-1336mzz(E).</p>
Retail food refrigeration – supermarket systems (<i>new equipment only</i>).	R-515B	Acceptable	<p>This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i>-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9) and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0). R-515B has a GWP of 287.</p> <p>The blend is not flammable.</p> <p>ASHRAE has established an OEL of 810 ppm on an 8-hr TWA for R-515B, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm HFC-227ea on an 8-hr TWA.</p>
Industrial process refrigeration (<i>new equipment only</i>).	R-471A	Acceptable	<p>This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i>-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9); HFO-1336mzz(E), also known as <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2); and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0). R-471A has a GWP of 144.</p> <p>The blend is not flammable.</p> <p>ASHRAE has established an OEL of 710 ppm on an 8-hr TWA for R-471A, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm for HFC-227ea on an 8-hr TWA.</p> <p>OARS has established a WEEL of 400 ppm on an 8-hr-TWA for HFO-1336mzz(E).</p>

End-Use	Substitute	Decision	Further Information ¹
Commercial ice machines (<i>new equipment only</i>).	R-515B	Acceptable	This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i> -1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9) and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0). R-515B has a GWP of 287. The blend is not flammable. ASHRAE has established an OEL of 810 ppm on an 8-hr TWA for R-515B, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm HFC-227ea on an 8-hr TWA.
Cold storage warehouses (<i>new equipment only</i>).	R-471A	Acceptable	This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i> -1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9); HFO-1336mzz(E), also known as <i>trans</i> -1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2); and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0). R-471A has a GWP of 144. The blend is not flammable. ASHRAE has established an OEL of 710 ppm on an 8-hr TWA for R-471A, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm for HFC-227ea on an 8-hr TWA. OARS has established a WEEL of 400 ppm on an 8-hr-TWA for HFO-1336mzz(E).
Cold storage warehouses (<i>new equipment only</i>).	R-515B	Acceptable	This substitute is a blend of HFO-1234ze(E), which is also known as <i>trans</i> -1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9) and HFC-227ea, also known as 1,1,1,2,3,3,3-heptafluoropropane (CAS Reg. No. 431-89-0). R-515B has a GWP of 287. The blend is not flammable. ASHRAE has established an OEL of 810 ppm on an 8-hr TWA for R-515B, as well as OELs of 800 ppm for HFO-1234ze(E) and 1,000 ppm HFC-227ea on an 8-hr TWA.

¹ See recommendations in the manufacturer's safety data sheet (SDS) and guidance for all listed refrigerants.

Fire Suppression

End-Use	Substitute	Decision	Further Information
Total flooding	Powdered Aerosol I	Acceptable	<p>EPA recommends the use of this agent in accordance with the safety guidelines in the latest edition of the National Fire Protection Association (NFPA) 2010 standard for Aerosol Extinguishing Systems.</p> <p>For establishments manufacturing the agent or filling, installing, or servicing containers or systems to be used in total flooding applications, EPA recommends the following:</p> <ul style="list-style-type: none"> —the appropriate safety and personal protective equipment (PPE) (<i>e.g.</i>, protective gloves, tightly sealed goggles, protective work clothing, and particulate-removing respirators with National Institute for Occupational Safety and Health (NIOSH) type N95 or better filters) consistent with Occupational Safety and Health Administration (OSHA) guidelines and requirements must be used during manufacture, installation, servicing, and disposal of total flooding systems using the agent; —adequate ventilation should be in place to reduce airborne exposure to constituents of agent; —an eye wash fountain and quick drench facility should be close to the production area; —training for safe handling procedures should be provided to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent; —workers responsible for clean-up should allow for maximum settling of all particulates before reentering area and wear appropriate personal protective equipment; and —all spills should be cleaned up immediately in accordance with good industrial hygiene practices. <p>As required by the manufacturer, units installed in normally occupied spaces will be equipped with features such as a system-isolate switch and cross-zone detection system to reduce risk of accidental activation of an agent generator while persons are present in the protected space. Also, the manufacturer requires warning of pending discharge and delay in release to ensure egress prior to activation of the agent to reduce risk of exposure.</p> <p>See additional notes 1, 2, 3, 4, 5.</p>

1. EPA recommends that users consult Section VIII of the OSHA Technical Manual for information on selecting the appropriate types of personal protective equipment for all listed fire suppression agents. EPA has no intention of duplicating or displacing OSHA coverage related to the use of personal protective equipment (*e.g.*, respiratory protection), fire suppression, hazard communication, worker training or any other occupational safety and health standard with respect to halon substitutes.
 2. Use of all listed fire suppression agents should conform to relevant OSHA requirements, including 29 CFR part 1910, subpart L, §§1910.160 and 1910.162.
 3. Per OSHA requirements, protective gear (SCBA) should be available in the event personnel should reenter the area.
 4. Discharge testing should be strictly limited to that which is essential to meet safety or performance requirements.
 5. The agent should be recovered from the fire suppression system in conjunction with testing or servicing and recycled for later use or destroyed.
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