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**ENVIRONMENTAL PROTECTION AGENCY**

6560-50-P

**40 CFR Part 82**

**[EPA-HQ-OAR-2003-0118; FRL-10016-19-OAR]**

**RIN 2060-AG12**

**Protection of Stratospheric Ozone: Determination 36 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 (EPA) Significant New Alternatives Policy (SNAP) program. This action lists as acceptable additional substitutes for use in the refrigeration and air conditioning, foam blowing, and fire suppression sectors.

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

**ADDRESSES:** The 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](http://www.regulations.gov). Although listed in the index, some information is not publicly available, i.e., Confidential Business Information (CBI) or other information whose

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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. Out of an abundance of caution for members of the public and our staff, the EPA Docket Center and Reading Room are closed to public visitors, with limited exceptions, to reduce the risk of transmitting COVID-19. Our Docket Center staff will continue to provide remote customer service via email, phone, and webform.

**FOR FURTHER INFORMATION, CONTACT:** Chenise Farquharson by telephone at (202) 564-7768, by e-mail at [Farquharson.chenise@epa.gov](mailto:Farquharson.chenise@epa.gov), or by mail at U.S. Environmental Protection Agency, Mail Code 6205T, 1200 Pennsylvania Avenue, NW, Washington, DC 20460. Overnight or courier deliveries should be sent to the office location at 1201 Constitution Avenue, NW, Washington, DC 20004.

**SUPPLEMENTARY INFORMATION:**

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Appendix A: Summary of Decisions for New Acceptable Substitutes

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## **I. Listing of New Acceptable Substitutes**

This action is listing as acceptable additional substitutes for use in the refrigeration and air conditioning, foam blowing, and fire suppression sectors. This action presents EPA's most recent decision to list as acceptable several substitutes in different SNAP end-uses. New substitutes are:

- Hydrochlorofluoroolefin (HCFO)-1233zd(E) in industrial process refrigeration (new and retrofit equipment);
- R-515B in centrifugal and positive displacement chillers and industrial process air conditioning (new equipment);
- Blends of 10 to 99 percent by weight hydrofluoroolefin (HFO)-1336mzz(Z) and the remainder hydrofluorocarbon (HFC)-152a in polystyrene: extruded boardstock and billet;
- HFO-1336mzz(E) in a number of foam blowing end-uses;
- Methylal in rigid polyurethane (PU) spray foam (high-pressure two-component, low-pressure two-component, and one-component foam sealants); and
- HCFO-1233zd(E)/C6-perfluoroketone blend in total flooding fire suppression (normally occupied and unoccupied spaces).

EPA's review of certain substitutes listed in this document is pending for other uses.

Listing decisions in the end-uses and applications in this document do not prejudge EPA's listings of these substitutes for other end-uses. The substitutes being added through this action to the acceptable lists for specific end-uses have a similar or lower risk than other substitutes already listed as acceptable in those end-uses. However, certain substitutes may have a higher

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overall risk than certain other substitutes already listed as acceptable or acceptable subject to restrictions. In such cases, those already-listed alternatives have not yet proved feasible in those specific end-uses to date.

For additional information on SNAP, visit the SNAP portion of EPA's Ozone Layer Protection website at: [www.epa.gov/snap](http://www.epa.gov/snap). Copies of the full lists of acceptable substitutes for ozone-depleting substances (ODS) in all industrial sectors are available at [www.epa.gov/snap/substitutes-sector](http://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](http://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 to 40 CFR part 82, subpart G.

The sections below discuss each substitute listing in detail. 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 to use a substitute consistent with 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

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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.

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](http://www.regulations.gov).

#### *A. Refrigeration and Air Conditioning*

##### 1. HCFO-1233zd(E)

*EPA’s decision: EPA finds HCFO-1233zd(E) acceptable as a substitute for use in:*

- Industrial Process Refrigeration (new and retrofit equipment)

HCFO-1233zd(E), marketed under the trade name Solstice™ N12 Refrigerant, is also known as *trans*-1-chloro-3,3,3-trifluoroprop-1-ene (Chemical Abstracts Service Registry Number [CAS Reg. No.] 102687-65-0).

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](http://www.regulations.gov) under the name, “Supporting Materials for Notice 36 Listing of HCFO-1233zd(E) in Refrigeration and Air Conditioning. SNAP Submission Received June 6, 2019.” EPA performed an assessment to examine the health and environmental

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risks of this substitute. This assessment is available in Docket EPA-HQ-OAR-2003-0118: “Risk Screen on Substitutes in Industrial Process Refrigeration. Substitute: HCFO-1233zd(E).”

EPA previously listed HCFO-1233zd(E) as acceptable for use in several refrigeration and air conditioning and foam blowing end-uses (August 10, 2012, 77 FR 47768; October 21, 2014, 79 FR 62863).

*Environmental information:* HCFO-1233zd(E) has an ozone depletion potential (ODP) of less than 0.0004 and a global warming potential (GWP) of 3.7.<sup>1</sup> HCFO-1233zd(E) is excluded from the 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 at 40 CFR 82.154(a)(1).

*Flammability information:* HCFO-1233zd(E) is not flammable.

*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.

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<sup>1</sup> WMO (World Meteorological Organization), *Scientific Assessment of Ozone Depletion: 2018*, Global Ozone Research and Monitoring Project – Report No. 58, 588 pp., Geneva, Switzerland, 2018. Available at: <https://ozone.unep.org/sites/default/files/2019-05/SAP-2018-Assessment-report.pdf>. In this action, the 100-year GWP values are used.

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The American Industrial Hygiene Association (AIHA) has established a Workplace Environmental Exposure Limit (WEEL) of 800 ppm on an eight-hour time-weighted average (8-hr TWA) for HCFO-1233zd(E). EPA anticipates that users will be able to meet the WEEL and address potential health risks by following requirements and recommendations in the manufacturer's safety data sheet (SDS), American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 15, and other safety precautions common to the refrigeration and air conditioning industry.

*Comparison to other substitutes in these end-uses:* HCFO-1233zd(E) has an ODP of less than 0.0004, comparable to or less than other listed substitutes in this end-use with ODPs ranging from zero to 0.098.

For industrial process refrigeration, HCFO-1233zd(E)'s GWP of about 3.7 is comparable to or lower than that of other acceptable substitutes such as ammonia absorption for new equipment and carbon dioxide (CO<sub>2</sub>), R-450A, R-513A and hydrofluorocarbon (HFC)-23 for new and retrofit equipment, with GWPs<sup>2</sup> ranging from zero to 14,800.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the AIHA WEEL, ASHRAE 15, and other industry standards, recommendations

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<sup>2</sup> Unless otherwise stated, all GWPs in this document are 100-year values from: 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](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html).

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in the manufacturer's SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds HCFO-1233zd(E) acceptable in the industrial process refrigeration (new and retrofit equipment) end-use because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

## 2. R-515B

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

- Centrifugal chillers (new equipment)
- Positive displacement chillers (new equipment)
- Industrial process air conditioning (new equipment)

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 submission, 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](http://www.regulations.gov) under the name, "Supporting Materials for Notice 36 Listing of R-515B in Refrigeration and Air Conditioning. SNAP Submission Received September 6, 2019." EPA performed an assessment to examine the health and environmental risks of this substitute. This assessment is available in Docket EPA-HQ-OAR-2003-0118: "Risk Screen on Substitutes in Centrifugal and Positive Displacement Chillers and Industrial Process Air Conditioning. Substitute: R-515B."



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*Environmental information:* R-515B has an ODP of zero. Its components, HFO-1234ze(E) and HFC-227ea, have a GWP of less than one<sup>3</sup> 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 definition of VOC under CAA regulations (see 40 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.

*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.

For the components of R-515B, the AIHA has established WEELs of 800 ppm and 1000 ppm as an 8-hr TWA for HFO-1234ze(E) and HFC-227ea, respectively. The manufacturer of R-515B recommends an acceptable exposure limit (AEL) for the blend of 810 ppm as an 8-hr TWA. EPA anticipates that users will be able to meet each of the WEELs, the manufacturer's AEL, and address potential health risks by following requirements and recommendations in the

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<sup>3</sup> WMO (World Meteorological Organization), *Scientific Assessment of Ozone Depletion: 2018*, Global Ozone Research and Monitoring Project – Report No. 58, 588 pp., Geneva, Switzerland, 2018. Available at: <https://ozone.unep.org/sites/default/files/2019-05/SAP-2018-Assessment-report.pdf>.

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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 0.055.

For centrifugal and positive displacement chillers, R-515B's GWP of about 287 is comparable to or lower than that of other acceptable substitutes for new equipment, such as ammonia absorption, CO<sub>2</sub>, HFO-1336mzz(Z), and R-513A, with GWPs ranging from zero to 630.

For industrial process air conditioning, R-515B's GWP of about 287 is comparable to or lower than that of other acceptable substitutes for new equipment, such as ammonia absorption, CO<sub>2</sub>, HFO-1336mzz(Z), R-134a, and R-507A, with GWPs ranging from zero to 3,985.

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 AIHA WEEL, manufacturer's AEL, 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 centrifugal chillers, positive displacement chillers, and industrial process air conditioning end-uses because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-uses.

#### *B. Foam Blowing*

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1. Blends of 10 to 99 percent by weight HFO-1336mzz(Z) and the remainder HFC-152a

*EPA's decision: EPA finds blends of 10 to 99 percent by weight HFO-1336mzz(Z) and the remainder HFC-152a ("HFO-1336mzz(Z)/HFC-152a blends") acceptable as a substitute for use as a blowing agent in:*

- Polystyrene: extruded boardstock and billet

These blends range in composition from 10 percent HFO-1336mzz(Z) and 90 percent HFC-152a to 99 percent HFO-1336mzz(Z) and 1 percent HFC-152a. Accordingly, these blends are also referred to as blends of 10 to 99 percent by weight HFO-1336mzz(Z) and the remainder HFC-152a in this action. HFO-1336mzz(Z) is an HFO and is also called (Z)-1,1,1,4,4,4-hexafluorobut-2-ene or *cis*-1,1,1,4,4,4-hexafluorobut-2-ene (CAS Reg. No. 692-49-9); it also goes by the trade names of FEA-1100 or Formacel® 1100. HFC-152a is an HFC and is also called ethane, 1,1-difluoro (CAS Reg. No. 75-37-6).

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](http://www.regulations.gov) under the name, "SNAP Information Notice for Blends of 10 to 99 percent by Weight HFO-1336mzz(Z) and the Remainder HFC-152a as a Foam Blowing Agent. SNAP Submission Received October 10, 2019." EPA has performed an assessment to examine the health and environmental risks of this substitute. This assessment is available in docket EPA-HQ-OAR-2003-0118 under the name "Risk Screen on Substitutes for Use in Extruded Polystyrene Boardstock and Billet Foam Substitute: HFO-1336mzz(Z) and HFC-152a Blends."

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*Environmental information:* These HFO-1336mzz(Z)/HFC-152a blends have an ODP of zero. Their components, HFO-1336mzz(Z) and HFC-152a, have GWPs of about two<sup>4</sup> and 124, respectively. If these values are weighted by mass percentage, then the blends range in GWP from about three to about 110. Both components of the blends are excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS.

*Flammability information:* The component HFC-152a is moderately flammable. HFO-1336mzz(Z) is not flammable at standard temperature and pressure using the standard test method ASTM E681. Certain of these HFO-1336mzz(Z)/HFC-152a blends are flammable, depending on the specific composition. For example, blends containing less than 91.5 percent HFO-1336mzz(Z) and more than 8.5 percent HFC-152a by weight are flammable.

*Toxicity and exposure data:* Potential health effects of this substitute include skin or eye irritation or frostbite. At sufficiently high concentrations, the substitute may cause irregular heartbeat. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many foam blowing agents. The EPA anticipates that these HFO-1336mzz(Z)/HFC-152a blends will be used consistent with the recommendations specified in the SDS.

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<sup>4</sup> WMO (World Meteorological Organization), *Scientific Assessment of Ozone Depletion: 2018*, Global Ozone Research and Monitoring Project – Report No. 58, 588 pp., Geneva, Switzerland, 2018. Available at: <https://ozone.unep.org/sites/default/files/2019-05/SAP-2018-Assessment-report.pdf>.

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The AIHA has established a WEEL of 1,000 ppm as an 8-hr TWA for HFC-152a, and the WEEL committee of the Occupational Alliance for Risk Science (OARS) has established a WEEL of 500 ppm for HFO-1336mzz(Z). EPA anticipates that users will be able to meet the AIHA and OARS WEELs and will address potential health risks by following requirements and recommendations in the manufacturer's SDSs and other safety precautions common to the foam blowing industry.

*Comparison to other foam blowing agents:* These HFO-1336mzz(Z)/HFC-152a blends have an ODP of zero, comparable to all other acceptable substitutes in this end-use, such as HFC-152a, HFO-1234ze(E), methyl formate, and CO<sub>2</sub>. These HFO-1336mzz(Z)/HFC-152a blends' GWPs from about three to 110 is lower than or comparable to those of other acceptable substitutes in the same end-use for which we are finding it acceptable, such as HFC-152a, HFO-1234ze(E), light saturated hydrocarbons C3-C6 and methyl formate, with respective GWPs of 124, one,<sup>5</sup> less than one,<sup>6</sup> and 11.<sup>7</sup> Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the AIHA's and OARS's WEELs, recommendations in the SDS, and other safety precautions common in the foam blowing industry.

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<sup>5</sup> WMO (World Meteorological Organization), *Scientific Assessment of Ozone Depletion: 2018*, Global Ozone Research and Monitoring Project – Report No. 58, 588 pp., Geneva, Switzerland, 2018. Available at: <https://ozone.unep.org/sites/default/files/2019-05/SAP-2018-Assessment-report.pdf>.

<sup>6</sup> Ibid.

<sup>7</sup> Ibid.

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EPA finds blends of 10 to 99 percent by weight HFO-1336mzz(Z) and the remainder HFC-152a acceptable in the polystyrene: extruded boardstock and billet end-use because they do not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

## 2. HFO-1336mzz(E)

*EPA's decision: EPA finds HFO-1336mzz(E) acceptable as a substitute for use in:*

- Flexible Polyurethane (PU)
- Integral skin PU
- Rigid PU: appliance
- Rigid PU: commercial refrigeration
- Rigid PU and polyisocyanurate laminated boardstock
- Rigid PU: sandwich panels
- Rigid PU: slabstock and other
- Rigid PU: spray--high-pressure two-component
- Rigid PU: spray--low-pressure two-component
- Rigid PU: spray--one-component foam sealants

HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and *trans*-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). It is marketed under the trade names Opteon™ 1150 and Formacel™ 1150.

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You may find a copy of the applicant's submission, 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](http://www.regulations.gov) under the name, "Supporting Documentation for Notice 36 Listing of HFO-1336mzz(E) in Foam Blowing. SNAP Submission Received December 5, 2018." EPA performed assessments to examine the health and environmental risks of this substitute. These assessments are available in Docket EPA-HQ-OAR-2003-0118 under the following names:

- "Foam Blowing Sector--Risk Screen on Substitutes in Rigid Polyurethane Appliance; Rigid Polyurethane Commercial Refrigeration; Rigid Polyurethane Sandwich Panels; Rigid Polyurethane & Polyisocyanurate Laminate Boardstock; Rigid Polyurethane Slabstock and Other; Flexible Polyurethane; Integral Skin Polyurethane--Substitute: HFO-1336mzz(E)"
- "Foam Blowing Sector--Risk Screen on Substitutes in Rigid Polyurethane Spray Foam--Substitute: HFO-1336mzz(E)"

*Environmental information:* HFO-1336mzz(E) has an ODP of zero. It has a GWP of about 16.<sup>8</sup> Under CAA regulations (see 40 CFR 51.100(s)) defining VOC for the purpose of addressing the development of SIPs to attain and maintain the NAAQS, HFO-1336mzz(E) would be considered a VOC. That definition provides that "any compound of carbon" which

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<sup>8</sup> WMO (World Meteorological Organization), *Scientific Assessment of Ozone Depletion: 2018*, Global Ozone Research and Monitoring Project – Report No. 58, 588 pp., Geneva, Switzerland, 2018. Available at: <https://www.esrl.noaa.gov/csl/assessments/ozone/2018/>.

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“participates in atmospheric photochemical reactions” is considered a VOC unless expressly excluded in that provision based on a determination of “negligible photochemical reactivity.”

The manufacturer has petitioned the EPA to exclude HFO-1336mzz(E) from the definition of VOC under those regulations based on its claim that the chemical exhibits low photochemical reactivity. EPA has not yet taken action on that petition. EPA notes for informational purposes that this substitute is subject to a Toxic Substances Control Act (TSCA) section 5(e) Consent Order and a TSCA section 5(a)(2) Significant New Use Rule (SNUR).

EPA anticipates that HFO-1336mzz(E) will be used consistent with the recommendations specified in the SDS. The OARS WEEL committee recommends a WEEL for the workplace of 400 ppm on an 8-hour TWA. EPA anticipates that users will be able to meet the WEEL and address potential health risks by following requirements and recommendations in the SDS and other safety precautions common to the foam blowing industry.

*Comparison to other substitutes in these end-uses:* HFO-1336mzz(E) has an ODP of zero, comparable to or lower than that for other listed substitutes in these end-uses, with ODPs ranging from zero to 0.02.

HFO-1336mzz(E)'s GWP of about 16 is lower than that of other acceptable substitutes in the listed end-uses, such as HFC-152a with a GWP of 124. HFO-1336mzz(E)'s GWP is higher than or comparable to the GWPs of other acceptable substitutes for these end-uses, such as HFO-



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1336mzz(Z), methyl formate, saturated light hydrocarbons C3-C6,<sup>9</sup> and *trans*-1-chloro-3,3,3-trifluoroprop-1-ene with GWPs ranging from less than one to approximately 11.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the OARS WEEL, recommendations in the manufacturer's SDS, and other safety precautions common in the foam blowing industry; moreover, those risks are common to many foam blowing agents, including many of those already listed as acceptable under SNAP for these end-uses.

EPA finds HFO-1336mzz(E) acceptable in the end-uses listed above in section 1.B.2 because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-uses.

### 3. Methylal

*EPA's decision: EPA finds methylal acceptable as a substitute for use in:*

- Rigid PU: spray--high-pressure two-component
- Rigid PU: spray--low-pressure two-component
- Rigid PU: spray--one-component foam sealants

Methylal is also called dimethoxymethane (CAS Reg. No. 109-87-5) and belongs to a class of chemicals referred to as acetals; it also goes by the trade name Novicell™.

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<sup>9</sup> That is, hydrocarbons with single bonds with three to six carbons, such as propane, isobutane, pentane, isopentane, cyclopentane, and hexane.

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You may find a copy of the applicant's submission, 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](http://www.regulations.gov) under the name, "Supporting Materials for Notice 36 Listing of Methylal in Foam Blowing. SNAP Submission Received April 18, 2014." EPA performed an assessment to examine the health and environmental risks of this substitute. This assessment is available in Docket EPA-HQ-OAR-2003-0118 under the following name: "Risk Screen on Substitutes for Use in Rigid Polyurethane Spray Foam Substitute: Methylal."

EPA previously listed methylal as acceptable for use as a foam-blowing agent in a variety of foam blowing end-uses (October 21, 2014; 79 FR 62863).

*Environmental information:* Methylal has an ODP of zero and a GWP less than one.<sup>10</sup> Under CAA regulations (see 40 CFR 51.100(s)) defining VOC for the purpose of addressing the development of SIPs to attain and maintain the NAAQS, methylal would be considered a VOC. That definition provides 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."

*Flammability information:* Methylal is flammable. Under the Globally Harmonized System of Classification and Labelling of Chemicals, it is classified as a Class II flammable liquid and under the Occupational Safety and Health Administration's (OSHA's) regulations at

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<sup>10</sup> WMO (World Meteorological Organization), *Scientific Assessment of Ozone Depletion: 2018*, Global Ozone Research and Monitoring Project – Report No. 58, 588 pp., Geneva, Switzerland, 2018. Available at: <https://ozone.unep.org/sites/default/files/2019-05/SAP-2018-Assessment-report.pdf>.

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29 CFR 1910.106, it is classified as a Class IB flammable liquid. Some specific blends of methylal with other blowing agents are flammable as formulated and should be handled with proper precautions, as specified by the manufacturer. EPA recommends that users follow all requirements and recommendations specified in the SDS and other safety precautions for use of flammable blowing agents used in the foam blowing industry. Use of methylal will require safe handling and shipping as prescribed by OSHA and the Department of Transportation (for example, using personal protective equipment (PPE) and following requirements for shipping hazardous materials at 49 CFR parts 170 through 173).

*Toxicity and exposure data:* Potential health effects of exposure to this substitute include drowsiness or dizziness. Higher concentrations may cause central nervous system depression and loss of consciousness. The substitute may also irritate the skin or eyes. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many foam-blowing agents.

For methylal, the American Conference of Governmental Industrial Hygienists (ACGIH) has established a threshold limit value (TLV) of 1,000 ppm on an 8-hr TWA. The National Institute of Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 1,000 ppm for methylal on a 10-hour TWA. EPA anticipates that users will be able to meet workplace exposure limits (TLV and REL) and address potential health risks by following requirements and recommendations in the manufacturer's SDS and other safety precautions common to the foam-blowing industry.

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*Comparison to other substitutes in these end-uses:* Methylal has an ODP of zero, comparable to other listed substitutes in these end-uses, with ODPs ranging from zero to 0.012.

Methylal's GWP of less than one is less than or comparable to the GWPs of other acceptable substitutes in the listed end-uses, including CO<sub>2</sub>, Exxsol™ blowing agents, HFC-152a, HFO-1336mzz(Z), methyl formate,<sup>11</sup> and *trans*-1-chloro-3,3,3-trifluoroprop-1-ene, with GWPs ranging from less than 1 to approximately 124.<sup>12</sup>

Methylal's flammability risks are comparable to or lower than flammability risks of other available substitutes in the same end-uses, including Exxsol™ blowing agents and methyl formate. Other acceptable substitutes in these end-uses are nonflammable (e.g., CO<sub>2</sub>, HFO-1336mzz(Z), and *trans*-1-chloro-3,3,3-trifluoroprop-1-ene).

Toxicity risks are comparable to or lower than toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the ACGIH TLV, recommendations in the manufacturer's SDS, and other safety precautions common in the foam-blowing industry.

EPA finds methylal acceptable in the end-uses listed above in section I.B.3 because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

### *C. Fire Suppression and Explosion Protection*

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<sup>11</sup> Originally listed under the trade name "ecomate™" in these end-uses. 69 FR 5803, October 4, 2004.

<sup>12</sup> Except for HFC-152a, all the GWPs in this sentence are from WMO (World Meteorological Organization), *Scientific Assessment of Ozone Depletion: 2018*, Global Ozone Research and Monitoring Project – Report No. 58, 588 pp., Geneva, Switzerland, 2018. Available at: <https://ozone.unep.org/sites/default/files/2019-05/SAP-2018-Assessment-report.pdf>.

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HCFO-1233zd(E)/C6-perfluoroketone blend

*EPA's decision: EPA finds HCFO-1233zd(E)/C6-perfluoroketone blend acceptable as a substitute for:*

- Total flooding (normally occupied and unoccupied spaces)

HCFO-1233zd(E)/C6-perfluoroketone blend is a weighted blend of 50 percent (E)-1-chloro-3,3,3-trifluoroprop-1-ene or HCFO-1233zd(E) (CAS Reg. No. 102687-65-0) and 50 percent C6-perfluoroketone (CAS Reg. No. 756-13-8), also known as 1,1,1,2,2,4,5,5,5-nonafluoro-4-(trifluoromethyl)-3-pentanone or FK-5-1-12. Both components are currently listed as acceptable under SNAP for use in this end-use. The blend is sold under the trade name Solstice™ Quench 55.

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](http://www.regulations.gov) under the name, "Supporting Documentation for Notice 36 Listing of HCFO-1233zd(E)/C6-perfluoroketone blend in Fire Suppression. SNAP Submission Received August 1, 2018." EPA performed an assessment to examine the health and environmental risks of this substitute. This assessment is available in Docket EPA-HQ-OAR-2003-0118: "Risk Screen on Substitutes for Total Flooding Systems in Normally Occupied and Unoccupied Spaces. Substitute: HCFO-1233zd(E)/C6-perfluoroketone blend (Solstice™ Quench 55)."

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*Environmental information:* The HCFO-1233zd(E) component of the blend has an ODP less than 0.0004 and a GWP of 3.7.<sup>13</sup> The C6-perfluoroketone component has no ODP and a GWP of less than one.<sup>14</sup> The blend has an average ODP of less than 0.0002 and an average GWP of less than two. The HCFO-1233zd(E) component is excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS; the C6-perfluoroketone component falls within the definition of VOC in those regulations.

*Flammability information:* HCFO-1233zd(E)/C6-perfluoroketone blend is not flammable.

*Toxicity and exposure data:* Potential health effects of this substitute include serious eye and skin irritation. If eye or skin contact occurs, end users should flush the affected area with large amounts of water. If inhaled, end users should be removed and exposed to fresh air. The potential health effects of HCFO-1233zd(E)/C6-perfluoroketone blend are unlikely to occur when following good industrial hygiene practices and the PPE and engineering control (e.g., ventilation) recommendations outlined in the SDSs for HCFO-1233zd(E)/C6-perfluoroketone blend.

The OARS has established a WEEL as an 8-hr TWA of 800 ppm for HCFO-1233zd(E). The manufacturer of C6-perfluoroketone recommends an AEL of 150 ppm on an 8-hr TWA.

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<sup>13</sup> WMO (World Meteorological Organization), *Scientific Assessment of Ozone Depletion: 2018*, Global Ozone Research and Monitoring Project – Report No. 58, 588 pp., Geneva, Switzerland, 2018. Available at: <https://ozone.unep.org/sites/default/files/2019-05/SAP-2018-Assessment-report.pdf>.

<sup>14</sup> Ibid.

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During installation or servicing of HCFO-1233zd(E)/C6-perfluoroketone blend total flooding systems, exposure to the substitute is not likely if the instructions on system installation and servicing are adhered to; these instructions are included in manuals for the HCFO-1233zd(E)/C6-perfluoroketone blend systems and the relevant industry standards (i.e., latest edition of the National Fire Protection Association [NFPA] 2001 Standard for Clean Agent Fire Extinguishing Systems and Underwriters' Laboratories [UL] 2166 Standard for Halocarbon Clean Agent Extinguishing System Units). In the event of an accidental release of the substitute from the total flooding system, potential acute exposures may be of concern. The design concentration is less than the cardiotoxic No Observed Adverse Effect Level of 8.66 percent (86,600 ppm) for the blend. Appropriate protective measures should be taken, and proper training administered for the manufacture, clean-up and disposal of this product and for the installation and maintenance of the total flooding systems using this product.

NFPA 2001 provides that in the case of accidental release in normally occupied spaces, required engineering controls as specified in NFPA 2001 should be employed to limit personnel exposure to clean agent discharges. Specifically, audible and visual pre-discharge alarms and a 30–60 second time delay should be employed within the protected space to indicate the operation of the system and pending discharge to ensure egress for all personnel prior to activation. EPA's evaluation indicates that the use of HCFO-1233zd(E)/C6-perfluoroketone blend is not expected to pose a significant toxicity risk to personnel or the general population. In addition, the risks it may pose after exposure are common to many total flooding agents, including those already listed as acceptable under SNAP for this same end-use. EPA's review of the human health

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impacts of HCFO-1233zd(E)/C6-perfluoroketone blend, including the summary of available toxicity studies, is in the risk screen mentioned above in the docket for this action (EPA-HQ-OAR-2003-0118).

Protective gloves and tightly sealed goggles should be worn for installation and servicing activities to protect workers in any event of potential discharge of the substitute, accidental or otherwise. Filling or servicing operations should be performed in well-ventilated areas. Toxicity risks can be minimized by use consistent with NFPA 2001 standard, recommendations in the SDS, and other safety precautions common in the fire suppression industry. EPA provides additional information on safe use of this substitute in the “Further Information” column of the table summarizing this listing for total flooding agents (see Appendix A).

*Comparison to other substitutes in this end-use:* HCFO-1233zd(E)/C6-perfluoroketone blend has an average ODP of less than 0.0002, comparable to or less than that for other listed substitutes in this end-use, with ODPs ranging from zero to 0.048.

For total flooding agents, HCFO-1233zd(E)/C6-perfluoroketone blend’s average GWP of less than two is lower than that of other acceptable substitutes, such as HFC-227ea and other HFCs, with GWPs which range from about 1,430 to 14,800. Other acceptable substitutes in this end-use, such as water, inert gases, and a number of powdered aerosol fire suppressants, have lower or comparable GWPs ranging from zero to seven.

Toxicity risks can be minimized by use consistent with the NFPA 2001 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



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flooding agents, including those already listed as acceptable under SNAP for this same end-use.

HCFO-1233zd(E)/C6-perfluoroketone blend is nonflammable, as are all other available total flooding agents.

EPA finds HCFO-1233zd(E)/C6-perfluoroketone blend acceptable in the total flooding end-use because it does not pose greater overall environmental and human health risk than other available substitutes in this end-use.

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**List of Subjects in 40 CFR Part 82**

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

Dated: \_\_\_\_\_

Hans Christopher Grundler,  
Director,  
Office of Atmospheric Programs.

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APPENDIX A: SUMMARY OF DECISIONS FOR NEW ACCEPTABLE SUBSTITUTES

**Refrigeration and Air Conditioning**

End-Use	Substitute	Decision	Further Information <sup>1</sup>
Centrifugal chillers ( <i>new equipment</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 (Chemical Abstracts Service Registry Number [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 100-year global warming potential (GWP) of 287.</p> <p>The blend is not flammable.</p> <p>The American Industrial Hygiene Association (AIHA) has established Workplace Environmental Exposure Limits (WEELs) of 800 ppm and 1000 ppm on an eight-hour Time-Weighted Average (8-hr TWA), respectively, for HFO-1234ze(E) and for HFC-227ea.</p> <p>The manufacturer has established an Acceptable Exposure Limit (AEL) of 810 ppm, on an 8-hr TWA for R-515B.</p>
Industrial process air conditioning ( <i>new equipment</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>The AIHA has established WEELs of 800 ppm and 1000 ppm on an 8-hr TWA, respectively, for HFO-1234ze(E) and for HFC-227ea.</p> <p>The manufacturer has established an AEL of 810 ppm on an 8-hr TWA for R-515B.</p>

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End-Use	Substitute	Decision	Further Information <sup>1</sup>
Industrial process refrigeration ( <i>new and retrofit equipment</i> ).	HCFO-1233zd(E)	Acceptable	<p>HCFO-1233zd(E) is also known as <i>trans</i>-1-chloro-3,3,3-trifluoroprop-1-ene (CAS Reg. No 102687-65-0).</p> <p>HCFO-1233zd(E) has an ozone-depleting potential (ODP) of less than 0.0004 and a GWP of about 3.7.</p> <p>HCFO-1233zd(E) is nonflammable.</p> <p>The AIHA has established a WEEL of 800 ppm on an 8-hr TWA for HCFO-1233zd(E).</p>
Positive displacement chillers ( <i>new equipment</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>The AIHA has established WEELs of 800 ppm and 1000 ppm on an 8-hr TWA, respectively, for HFO-1234ze(E) and for HFC-227ea.</p> <p>The manufacturer has established an AEL of 810 ppm on an 8-hr TWA for R-515B.</p>

<sup>1</sup> Observe recommendations in the manufacturer’s SDS and guidance for all listed refrigerants.

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**Foam Blowing Agents**

End-Use	Substitute	Decision	Further Information <sup>1</sup>
Extruded Polystyrene: Boardstock and Billet	Blends of 10 to 99 percent by weight HFO-1336mzz(Z) and the remainder HFC-152a	Acceptable	<p>HFO-1336mzz(Z) is also known as (2Z)-1,1,1,4,4,4-hexafluoro-2-butene and <i>cis</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 692-49-9). HFC-152a is also known as ethane, 1,1-difluoro (CAS Reg. No. 75-37-6). The blends range in composition from 10 percent HFO-1336mzz(Z) and 90 percent HFC-152a to 99 percent HFO-1336mzz(Z) and 1 percent HFC-152a.</p> <p>These blends have 100-year global warming potentials (GWPs) from about three to about 110, depending on the specific composition. Certain blends of these compounds are flammable, depending on the specific composition. The American Industrial Hygiene Association (AIHA) has established a Workplace Environmental Exposure Limit (WEEL) of 1,000 ppm as an 8-hour Time-Weighted Average (8-hr TWA) for HFC-152a and Occupational Alliance for Risk Science (OARS) has established a WEEL of 500 ppm for HFO-1336mzz(Z).</p>
Flexible Polyurethane (PU).	HFO-1336mzz(E)	Acceptable	<p>HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). . HFO-1336mzz(E) has a GWP of approximately 16.</p> <p>HFO-1336mzz(E) is nonflammable.</p> <p>The OARS recommends a WEEL for the workplace of 400 ppm on an 8-hr TWA.</p> <p>This substitute is subject to a Toxic Substances Control Act (TSCA) section 5(e) Consent Order and a TSCA section 5(a)(2) Significant New Use Rule (SNUR).</p>

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Integral skin PU.	HFO-1336mzz(E)	Acceptable	<p>HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). HFO-1336mzz(E) has a GWP of approximately 16.</p> <p>HFO-1336mzz(E) is nonflammable.</p> <p>The OARS recommends a WEEL for the workplace of 400 ppm on an 8-hr TWA.</p> <p>This substitute is subject to a TSCA section 5(e) Consent Order and a TSCA section 5(a)(2) SNUR .</p>
Rigid PU: appliance.	HFO-1336mzz(E)	Acceptable	<p>HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). HFO-1336mzz(E) has a GWP of approximately 16.</p> <p>HFO-1336mzz(E) is nonflammable.</p> <p>The OARS recommends a WEEL for the workplace of 400 ppm on an 8-hr TWA.</p> <p>This substitute is subject to a TSCA section 5(e) Consent Order and a TSCA section 5(a)(2) SNUR .</p>
Rigid PU: commercial refrigeration.	HFO-1336mzz(E)	Acceptable	<p>HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). HFO-1336mzz(E) has a GWP of approximately 16.</p> <p>HFO-1336mzz(E) is nonflammable.</p> <p>The OARS recommends a WEEL for the workplace of 400 ppm on an 8-hr TWA.</p> <p>This substitute is subject to a TSCA section 5(e) Consent Order and a TSCA section 5(a)(2) SNUR .</p>

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Rigid PU and polyisocyanurate laminated boardstock.	HFO-1336mzz(E)	Acceptable	<p>HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). HFO-1336mzz(E) has a GWP of approximately 16.</p> <p>HFO-1336mzz(E) is nonflammable.</p> <p>The OARS recommends a WEEL for the workplace of 400 ppm on an 8-hr TWA.</p> <p>This substitute is subject to a TSCA section 5(e) Consent Order and a TSCA section 5(a)(2) SNUR .</p>
Rigid PU: sandwich panels.	HFO-1336mzz(E)	Acceptable	<p>HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). HFO-1336mzz(E) has a GWP of approximately 16.</p> <p>HFO-1336mzz(E) is nonflammable.</p> <p>The OARS recommends a WEEL for the workplace of 400 ppm on an 8-hr TWA.</p> <p>This substitute is subject to a TSCA section 5(e) Consent Order and a TSCA section 5(a)(2) SNUR.</p>
Rigid PU: slabstock and other.	HFO-1336mzz(E)	Acceptable	<p>HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). HFO-1336mzz(E) has a GWP of approximately 16.</p> <p>HFO-1336mzz(E) is nonflammable.</p> <p>The OARS recommends a WEEL for the workplace of 400 ppm on an 8-hr TWA.</p> <p>This substitute is subject to a TSCA section 5(e) Consent Order and a TSCA section 5(a)(2) SNUR.</p>

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Rigid PU: spray-high-pressure two-component.	HFO-1336mzz(E)	Acceptable	<p>HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). HFO-1336mzz(E) has a GWP of approximately 16.</p> <p>HFO-1336mzz(E) is nonflammable.</p> <p>The OARS recommends a WEEL for the workplace of 400 ppm on an 8-hr TWA.</p> <p>This substitute is subject to a TSCA section 5(e) Consent Order and a TSCA section 5(a)(2) SNUR.</p>
Rigid PU: spray-high-pressure two-component.	Methylal	Acceptable	<p>Methylal is also known as dimethoxymethane and belongs to a class of chemicals referred to as acetals (CAS Reg. No. 109-87-5).</p> <p>Methylal has a GWP of less than one.</p> <p>Methylal is flammable.</p> <p>The American Conference of Governmental Industrial Hygienists (ACGIH) has established a threshold limit value (TLV) of 1,000 ppm, on an 8-hr TWA for methylal. The National Institute of Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 1,000 ppm for methylal on a 10-hour TWA.</p>
Rigid PU: spray-low-pressure two-component.	HFO-1336mzz(E)	Acceptable	<p>HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and <i>trans</i>-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). HFO-1336mzz(E) has a GWP of approximately 16.</p> <p>HFO-1336mzz(E) is nonflammable.</p> <p>The OARS recommends a WEEL for the workplace of 400 ppm on an 8-hr TWA.</p> <p>This substitute is subject to a TSCA section 5(e) Consent Order and a TSCA section 5(a)(2) SNUR.</p>



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Rigid PU: spray-low-pressure two-component.	Methylal	Acceptable	Methylal is also known as dimethoxymethane and belongs to a class of chemicals referred to as acetals (CAS Reg. No. 109-87-5). Methylal has a GWP of approximately less than one. Methylal is flammable. ACGIH has established a TLV of 1,000 ppm on an 8-hr TWA for methylal. The NIOSH has established a REL of 1,000 ppm for methylal on a 10-hour TWA.
Rigid PU: spray-one-component foam sealants.	HFO-1336mzz(E)	Acceptable	HFO-1336mzz(E) is also known as (2E)-1,1,1,4,4,4-hexafluoro-2-butene and <i>trans</i> -1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 66711-86-2). HFO-1336mzz(E) has a GWP of approximately 16. HFO-1336mzz(E) is nonflammable. The OARS recommends a WEEL for the workplace of 400 ppm on an 8-hr TWA. This substitute is subject to a TSCA section 5(e) Consent Order and a TSCA section 5(a)(2) SNUR.
Rigid PU: spray-one-component foam sealants.	Methylal	Acceptable	Methylal is also known as dimethoxymethane and belongs to a class of chemicals referred to as acetals (CAS Reg. No. 109-87-5). Methylal has a GWP of less than one. Methylal is flammable. ACGIH has established a TLV of 1,000 ppm on an 8-hr TWA for methylal. NIOSH has established a REL of 1,000 ppm for methylal on a 10-hour TWA.

<sup>1</sup> Observe recommendations in the manufacturer's SDS and guidance for all listed foam blowing agents.

### Fire Suppression and Explosion Protection

End-use	Substitute	Decision	Further Information
<p>Total flooding (normally occupied and unoccupied spaces).</p>	<p>HCFO-1233zd(E)/C6-perfluoroketone blend</p>	<p>Acceptable</p>	<p>HCFO-1233zd(E)/C6-perfluoroketone blend is a blend of (E)-1-chloro-3,3,3-trifluoroprop-1-ene or HCFO-1233zd(E) (CAS Reg. No. 102687-65-0) and C6-perfluoroketone (CAS Reg. No. 756-13-8), also known as 1,1,1,2,2,4,5,5,5-nonafluoro-4-(trifluoromethyl)-3-pentanone or FK-5-1-12.</p> <p>This blend has an average ozone depletion potential (ODP) of &lt;0.0002 and an average 100-year global warming potential (GWP) of less than two.</p> <p>The blend is nonflammable.</p> <p>The Occupational Alliance for Risk Science (OARS) has established a Workplace Environmental Exposure Limit (WEEL) as an 8-hour Time-Weighted Average (8-hr TWA) of 800 ppm for HCFO-1233zd(E). The manufacturer of C6-perfluoroketone recommends an Acceptable Exposure Limit (AEL) of 150 ppm on an 8-hr TWA. The cardiotoxic No Observed Adverse Effect Level (NOAEL) is 8.66 percent for the blend.</p> <p>Use of this agent should be in accordance with the safety guidelines in the latest edition of the National Fire Protection Association (NFPA) 2001 Standard on Clean Agent Fire Extinguishing Systems. Safety features that are typical of total flooding systems such as pre-discharge alarms, time delays, and system abort switches should be provided, as directed by applicable Occupational Safety and Health Administration (OSHA) regulations and NFPA standards.</p> <p>For establishments manufacturing, installing and maintaining equipment using this agent, EPA recommends the following:</p> <ul style="list-style-type: none"> <li>• In the case that HCFO-1233zd(E)/C6-perfluoroketone blend is inhaled, person(s) should be immediately removed and exposed to fresh air; if breathing is difficult, person(s) should seek medical attention.</li> </ul>

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			<ul style="list-style-type: none"><li>• Eye wash and quick drench facilities should be available. In case of ocular exposure, person(s) should immediately flush the eyes, including under the eyelids, with water for 15 minutes.</li><li>• In the case of dermal exposure, the safety data sheet (SDS) recommends that person(s) should immediately wash the affected area with water and remove all contaminated clothing to avoid irritation.</li><li>• Although unlikely, in case of ingestion of HCFO-1233zd(E)/C6-perfluoroketone blend, the person(s) should drink a cup of water, if fully conscious, and consult a physician immediately.</li><li>• Manufacturing space should be equipped with engineering controls, specifically an adequate exhaust ventilation system, to effectively mitigate potential occupational exposure.</li><li>• Employees responsible for chemical processing should wear the appropriate personnel protective equipment (PPE), such as protective gloves, tightly sealed goggles, protective work clothing, and suitable respiratory protection in case of release or insufficient ventilation.</li><li>• All spills should be cleaned up immediately in accordance with good industrial hygiene practices.</li><li>• 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.</li></ul> <p>See additional comments 1, 2, 3, 4, 5.</p>
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1. The 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. The EPA has no intention of duplicating or displacing OSHA coverage related to the use of personal protective equipment (e.g., respiratory protection), fire protection, 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, sections 1910.160 and 1910.162.

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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 protection system in conjunction with testing or servicing, and recycled for later use or destroyed.