# Fluorocarbons

## Substances and main applications

## Major HFC - HFO – HCFC molecules

## Major HFC molecules

| Designation | Complete Name | Formula | CAS number | GWP (1) | | Atmospheric lifetime (3) | Main Applications |
|---|---|---|---|---|---|---|---|
| | | | | F-Gas Regulation AR4 (2) | AR5 (3) | | |
| HFC-23 | trifluoromethane | $CHF_3$ | 75-46-7 | 14800 | 12400 | 222 years | • Very low temperature specialist refrigerant<br>• By product in production of HCFC-22 and aluminium smelting |
| HFC-32 | difluoromethane | $CH_2F_2$ | 75-10-5 | 675 | 677 | 5.2 years | • Refrigerant for air-conditioning<br>• Component of refrigerants for air-conditioning, commercial refrigeration and heat pumps |
| HFC-125 | pentafluoroethane | $CHF_2CF_3$ | 354-33-6 | 3500 | 3170 | 28.2 years | • Blend component for stationary air-conditioning, commercial refrigeration and heat pumps<br>• Firefighting agent |

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|---|---|---|---|---|---|---|---|
| HFC-134a | 1,1,1,2-tetrafluoroethane | $CH_2FCF_3$ | 811-97-2 | 1430 | 1300 | 13.4 years | • Refrigerant for mobile air-conditioning applications (servicing only for cars)<br>• Blend component for stationary-air conditioning and commercial refrigeration<br>• Propellant for pharmaceutical aerosols (MDIs); and for technical aerosols, to meet national safety standards from 2018<br>• Blowing agent component for extruded polystyrene foams (XPS) |
| HFC-143a | 1,1,1-trifluoroethane | $CH_3CF_3$ | 420-46-2 | 4470 | 4800 | 47.1 years | • Blend component for commercial refrigeration |
| HFC-152a | 1,1-difluoroethane | $CH_3CHF_2$ | 75-37-6 | 124 | 138 | 1.5 years | • Propellant for specialized industrial aerosols<br>• Blowing agent component for extruded polystyrene foams (XPS) |
| HFC-227ea | 1,1,1,2,3,3,3-heptafluoropropane | $CF_3CHFCF_3$ | 431-89-0 | 3220 | 3350 | 38.9 years | • Propellant for Pharmaceutical Aerosols (MDIs)<br>• Firefighting Agent<br>• Refrigerant for high-temperature environments |
| HFC-236fa | 1,1,1,3,3,3-hexafluoropropane | $CF_3CH_2CF_3$ | 290-39-1 | 9810 | 8060 | 242 years | • Firefighting Agent<br>• Refrigerant for high-temperature environments |

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| HFC-245fa | 1,1,1,3,3-pentafluoropropane | $CHF_2CH_2CF_3$ | 460-73-1 | 1030 | 858 | 7.7 years | • Foam Blowing agent for Polyurethane (PUR) foams<br>• Working fluid for organic rankine cycles (ORC) |
| HFC-365mfc | 1,1,1,3,3-pentafluorobutane | $CF_3CH_2CF_2CH_3$ | 406-58-6 | 794 | 804 | 8.7 years | • Foam Blowing agent for Polyurethane (PUR) and phenolic foams<br>• Blend component for Solvents<br>• Working fluid for organic rankine cycle (ORC) |
| HFC-43-10mee | 1,1,1,2,2,3,4,5,5,5-decafluoropentane | $CF_3CHFCHFCF_2CF_3$ | 138495-42 | 1640 | 1650 | 16.1 years | • Solvent for specialized applications |

## Major HFO molecules

| Designation | Complete Name | Formula | CAS number | GWP (1) | | Atmospheric lifetime (3) unless stated | Ozone Depleting Substance (ODS) | Main Applications |
|---|---|---|---|---|---|---|---|---|
| | | | | F-Gas Regulation AR4 (2) unless stated | AR5 (3) unless stated | | | |
| HCFO-1224yd(Z) | 2,3,3,3 Tetrafluoro-1-chloroprop-1-ene | $CF_3$-CF=CHCl | 111512-60-8 | *na* | < 1 (4) | 21 days (4) | No, a VSLS (5) | • Refrigerant for centrifugal chillers, high temperature heat pumps<br>• working fluid for organic rankine cycle (ORC)<br>• Blowing agent for polyurethane foams |

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|---|---|---|---|---|---|---|---|---|
| HBFO-1233xfB | 2-bromo-3,3,3-trifluoropropene | $CF_3CBr=CH_2$ | 1514-82-5 | *na* | 0.26 (4) | 7 days (4) | No, a VSLS (5) | • Fire extinguishant streaming agent (also known as 2-BTP) |
| HCFO-1233zd(E) | Trans 1-Chloro-3,3,3-trifluoroprop-1-ene | Trans-CHCl=CHCF3 | 2730-43-0 | 4.5 | 1 | 26 days | No, a VSLS (5) | • Refrigerant for chiller applications, high temperature heat pumps<br>• Working fluid for organic rankine cycle (ORC)<br>• Blowing agent for Insulation foams<br>• Precision solvents |
| HFO-1234yf | 2,3,3,3-tetrafluoroprop-1-ene | $CF_3CF=CH_2$ | 754-12-1 | 4 (6) | <1 | 10.5 days | No | • Refrigerant for mobile air-conditioning, stationary air conditioning and refrigeration<br>• Blend component for HFC-HFO blends |
| HFO-1234ze(E) | Trans-1,3,3,3-tetrafluoroprop-1-ene | Trans-$CF_3CH=CFH$ | 29118-24-9 | 7 (6) | <1 | 16.4 days | No | • Refrigerant for chillers, refrigeration<br>• Blend component for HFC-HFO blends<br>• Aerosol propellant<br>• Blowing agent for insulation foams |
| HFO-1336mzz(Z) | Cis-1,1,1,4,4,4-hexafluorobut-2-ene | Cis-$CF_3CH=CHCF_3$ | 692-49-9 | 9 | 2 (7 &3) | 22 days (8 &3) | No | • Refrigerant for chillers, high temperature heat pumps<br>• Working fluid for organic rankine cycle (ORC)<br>• Fire extinguishant |

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|---|---|---|---|---|---|---|---|---|
| | | | | | | | | • Blowing agent for insulation foams<br>• Solvent<br>• Aerosol propellant |
| HFO-1336mzz(E) | Trans-1,1,1,4,4,4-hexafluorobut-2-ene | Trans-$CF_3CH=CHCF_3$ | 66711-86-2 | | 7 (7) | 67 days (7) | No | • Refrigerant for high temperature heat pumps<br>• Working fluid for organic Rankine cycle (ORC)<br>• Blowing agent for Insulation foams |

## Major HCFC molecules

| Designation | Complete Name | Formula | CAS number | GWP (1) | | Atmospheric lifetime (3) unless stated | Ozone Depleting Potential (ODP) | Main Applications |
|---|---|---|---|---|---|---|---|---|
| | | | | AR4 (2) | AR5 (3) | | | |
| HCFC-22 | chlorodifluoromethane | $CHClF_2$ | 75-45-6 | *1810* | 1760 | 11.9 years | 0.055 | • Used as feedstock for the production of PTFE and other fluorocarbons polymers |
| HCFC-123 | 2,2-dichloro-1,1,1,1-trifluoroethane | $CHCl_2CF_3$ | 306-83-2 | *77* | 79 | 1.3 years | 0.020 | • No longer used in the EU |
| HCFC-124 | 1-chloro-1,2,2,2-tetrafluoroethane | $CHClFCF_3$ | 20837-89-0 | 609 | 527 | 5.9 years | 0.022 | • No longer used in the EU |

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| HCFC-141b | 1,1-dichloro-1-fluoro-ethane | $CH_3CCl_2F$ | 1717-00-6 | 725 | 782 | 9.2 years | 0.11 | • No longer used in the EU |
| HCFC-142b | 1-chloro-1,1 - difluoro-ethane | $CH_3CClF_2$ | 75-68-3 | 2310 | 1980 | 17.2 years | 0.065 | • No longer used in the EU |

## NOTES

1) See Selecting and Using GWP Values
2) IPCC Fourth Assessment Report GWP values
3) IPCC Working Group I – The Physical Science Basis – Chap.8 Annex 8.A.1, 5th Assessment Report
4) Measured by the National Institute of Advanced Industrial Science and Technology (AIST), Japan, GWP calculated according to the IPCC AR5 method
5) Very short-lived substances (VSLS) have chemical lifetimes comparable with tropospheric transport time scales, with the result that the amount of the substance in the atmosphere depends on where and when (time of year) it is released. In practice, this happens for species with atmospheric lifetimes of a few months or less. From a regulatory point of view this means that VSLS cannot be included in the normal categories of the Montreal Protocol; not only is their contribution to ozone depletion very low but it is highly variable between countries and regions. For more detail see Learn About HCFO-1224yd(Z), HCFO-1233zdE, HBFO-1233xfB, Stratospheric Ozone and Climate Change
6) GWP according to the Report of the 2010 Assessment of the Scientific Assessment Panel (SAP) of the Montreal Protocol, Tables 1-11, citing two peer-reviewed scientific references.
7) Atmospheric chemistry of Z- and E-CF3CHQCHCF3, Freja F. Østerstrøm, Simone Thirstrup Andersen, Theis I. Sølling, Ole John Nielsena and Mads P. Sulbaek Andersen, Phys. Chem. Chem. Phys., 2017, 19, 735—750, https://pubs.rsc.org/en/content/articlehtml/2017/cp/c6cp07234h
8) M. Baasandorj, A. R. Ravishankara and J. B. Burkholder, J. Phys. Chem. A, 2011, 115, 10539–10549