

Naming and numbering HFCs, HFOs, HCFOs and HCFCs and refrigerant blends- the basics

To avoid refrigeration engineers having to remember chemical names and to make sure mistakes in identifying refrigerants can be avoided a simple naming and numbering system is used. Unfortunately, this has become slightly more complicated as new refrigerants have been introduced as they sometimes have more complicated chemical formulas and structures. The ASHRAE 34 and ISO 817 standards numbering system for refrigerant blends is also explained here.

Names - the easy part

Pre-fix (abbreviation)	Substance	Atoms and double bonds present in the molecule	Comments
HFC	hydrofluorocarbon	H, F, C	
HFO	hydrofluoro-olefin	H, F, C and C=C	Sometimes referred to as unsaturated-HFCs, or alkenes
HCFO	hydrochlorofluoro-olefin	H, Cl, F, C and C=C	Sometimes referred to as unsaturated-HCFCs or alkenes
FIC	fluoroiodocarbon	F, I, C	
HCFC	hydrochlorofluorocarbon	H, Cl, F, C	
CFC	chlorofluorocarbon	Cl, F, C	

Numbering System - here it starts getting complicated

The above prefixes are followed by a set of numbers indicating how many double bonds, C, H and F atoms are present in the molecule.

From this the number of Cl (chlorine atoms) can be deduced as it is not indicated. If I (iodine) is present in the molecule then I is added the number of I atoms indicated.

Examples

	Number of C atoms - 1	Number of H atoms +1	Number of F atoms	Number of I atoms	
HFC-125	C ₂	H	F ₅		C ₂ HF ₅
HFC-32	C	H ₂	F ₂		CH ₂ F ₂
FIC-1311	C	0	F ₃	I	CF ₃ I

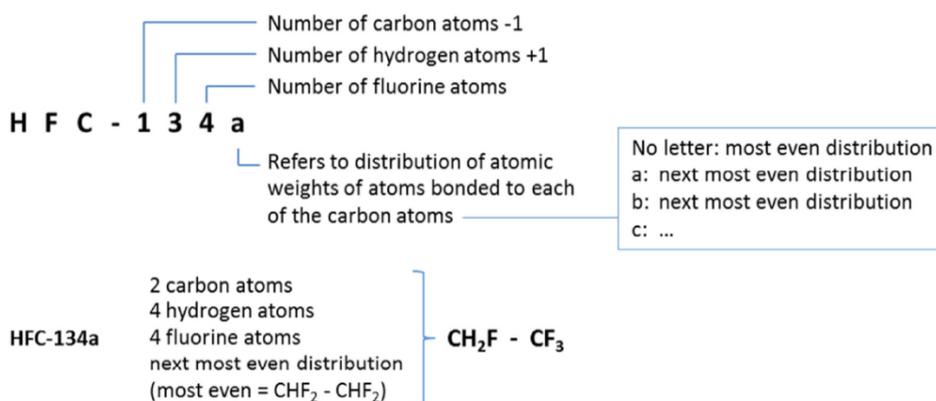
Note HFC-32 is understood to mean HFC-032, IFC-1311 is understood to mean IFC-01311

Suffixes that define the structure - the difficult part

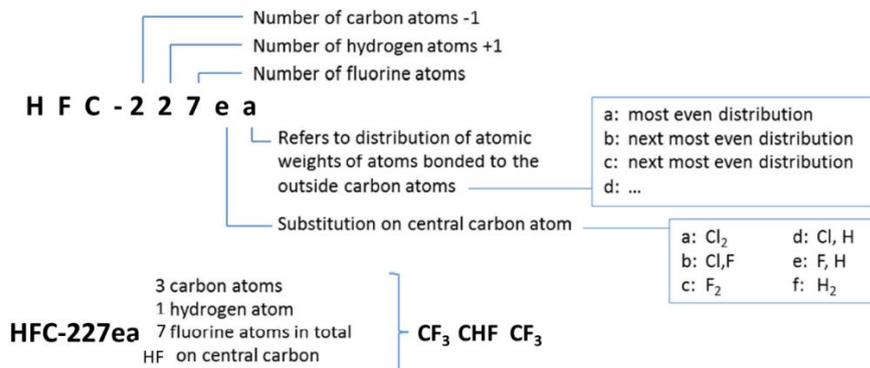
Some molecules can have more than one structure resulting in different properties. These are called isomers.

Examples

Ethane-derived chains (2 carbon atoms)

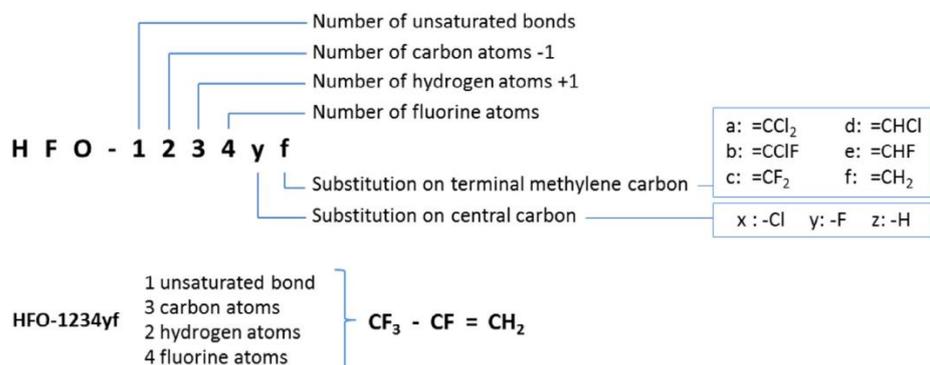


Propane-derived chains (3 carbon atoms)



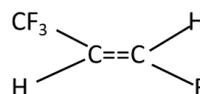
Hydrofluoro-olefins, isomers and stereo-isomers

Hydrofluoro-olefins (HFOs) have a double bond (C=C) and this introduces additional structure possibilities, resulting in designations such as HFO-1234ze(E) and HFO-1336mzz(Z). A straightforward example is HFO-1234yf.

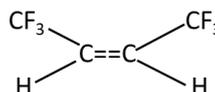


The effect of carbon carbon bonds (C=C): For double bonds, cis (substitutes on the same the same side of the double bond) and trans configurations (substitutes on opposite sides of the double bond) may need to be indicated depending on the atoms or groups attached to the double bond. In the case of trans or opposite ('Entgegen') the E suffix is added and for cis or same side ('Zusammen') the Z suffix is added.

HFO-1234ze(E) Trans-1,3,3,3-tetrafluoroprop-1-ene



HFO-1336mzz(Z) Cis-1,1,1,4,4,4-hexafluorobut-2-ene



For HFO-1336mzz(Z), the 'm' indicates CF₃ (letters from a to l indicate other groups) and the two 'z' s indicate H on the central carbon C=C

ASHRAE 34 and ISO 817 Refrigerant designations for blend refrigerants

For fluorocarbon refrigerants there are two important series -the 400 series and the 500 series.

The 400 series such as R-410A are blends of two or more substances. Once a blend is submitted for designation and classification, if it is new in terms of the blend components then it is assigned the next available number. Once the number is assigned to the blend components then letters are added to indicate different blend compositions, such as R-407A to R-407H.

The 500 series is for azeotropes, ie blends of two or more substances that where the equilibrium vapour and liquid phase compositions are the same at a given pressure. Azeotropic compositions are different at different pressures, therefore they can be more than one composition, for example R-513A and R-513B.