



Classification of refrigerants

This text is based on the American standard ANSI/ASHRAE 34 published in 2001 and entitled “Designation and Safety Classification of Refrigerants”.

This classification makes it possible to designate all refrigerants used in a clear and internationally recognized manner by classifying them according to their chemical composition.

1 Numbering of Refrigerants

An identifying number shall be assigned to each refrigerant. It consists of a prefix made up of letters and a suffix made up of digits.

1.1 Prefixes

The prefix is composed of the letter R (for refrigerant).

Examples: R22, R134a, R600a, R717

Sometimes, the letter C is used in the prefix to denote carbon, preceded by B, C or F (or a combination of these letters in the same order) to indicate the presence of bromine, chlorine or fluorine. Compounds containing hydrogen must be preceded by the letter H.

Examples: HCFC22, HFC134a

These prefixes must only be used in non-technical publications.

Note: the name of the brand or of the manufacturer is also used sometimes; these names must not be used in official documents (identification labels, etc.).

1.2 Suffixes

- **Hydrocarbons and derivatives**

The first digit on the right (units) is the number of fluorine (F) atoms.

The second digit on the right (tens) is one more than the number of hydrogen (H) atoms.

The third digit on the right (hundreds) is one less than the number of carbon (C) atoms (when the digit is zero, it is omitted from the number).

The third digit on the right (thousands) is equal to the number of unsaturated carbon-carbon bonds (when the digit is zero, it is omitted from the number).

For refrigerants that contain bromine (Br), the letter B is added after the identification number, followed by the number of atoms present. These refrigerants are no longer manufactured in developed countries since the application of the Montreal Protocol on substances that deplete the ozone layer.

The number of chlorine (Cl) atoms is found by subtracting the sum of fluorine, bromide, and hydrogen atoms from the total number of atoms that can be connected to the carbon atoms: 4 for methane derivatives (CH₄), 6 for ethane derivatives (C₂H₆), etc.

Example: R22 (chlorodifluoromethane – CHClF_2)

R022

0: Number of carbon atoms – 1

2: Number of hydrogen atoms + 1

2: Number of fluorine atoms

Number of chlorine atoms : 1

(i.e. 4 minus 1 hydrogen atom and minus 2 fluorine atoms)

For cyclic derivatives, the letter C is used before the refrigerant's identification number.

Example: RC318 (octafluorocyclobutane – C_4F_8)

In the case of isomers in the ethane series, each has the same number, with the most symmetrical one indicated by the number alone. As the isomers become more and more unsymmetrical, successive lowercase letters (i.e. a, b or c) are appended.

Example: R134 and R134a

- **Azeotropic and zeotropic mixtures**

Mixtures are designated by their respective refrigerant numbers and mass proportions. Refrigerants shall be named in order of increasing normal boiling points of the components.

Zeotropic mixtures shall be assigned an identifying number in the 400 series. This number designates which components are in the mixture but not the amount of each. To differentiate among zeotropes having the same components with different amounts (percent by mass), an uppercase letter shall be added as a suffix.

The numbers are in chronological order of the refrigerant's approval by ASHRAE.

Example: R407A (R32/R125/R134a (20/40/40)), R407B (R32/R125/R134a (10/70/20)), R407C (R32/R125/R134a (23/25/52)), R407D (R32/R125/R134a (15/15/70)), R407E (R32/R125/R134a (25/15/60))

Zeotropic mixtures shall be assigned an identifying number in the 500 series.

Example: R507 (R125/R143a (50/50))

- **Miscellaneous organic compounds**

Miscellaneous organic compounds shall be assigned a number in the 600 series; numbers are given in numerical order.

Example: R600a, isobutane

- **Inorganic compounds**

Inorganic compounds shall be assigned a number in the 700 series, identification numbers are formed by adding the relative molecular mass of components to 700.

Example: R717 corresponds to ammonia which has a molecular mass of 17.

2 Safety group classifications

This classification consist of two alphanumeric characters (e.g. A2); the capital letter corresponds to toxicity and the digit to flammability.

2.1 Toxicity classification

Refrigerants are divided into two groups according to toxicity:

- Class A signifies refrigerants for which toxicity has not been identified at concentrations less than or equal to 400 ppm;
- Class B signifies refrigerants for which there is evidence of toxicity at concentrations below 400 ppm.

2.2 Flammability classification

Refrigerants are divided into three groups according to flammability:

- Class 1 indicates refrigerants that do not show flame propagation when tested in air at 21°C and 101 kPa;
- Class 2 indicates refrigerants having a lower flammability limit of more than 0.10 kg/m³ at 21°C and 101 kPa and a heat of combustion of less than 19 kJ/kg;
- Class 3 indicates refrigerants that are highly flammable as defined by a lower flammability limit of less than or equal to 0.10 kg/m³ at 21°C and 101 kPa or a heat of combustion greater than or equal to 19 kJ/kg.

2.3 Mixtures

Mixtures, whether zeotropic or azeotropic, with flammability and/or toxicity characteristics which may change as the composition changes during fractionation, shall be assigned a safety group classification based on the worst case of fractionation.

Example: R404A is classified A1

ANNEX

Classification of a few refrigerants

Classification	Denomination	Composition or chemical formula (mass percentage)	Safety classification
INORGANIC COMPOUND			
R717	ammonia	NH ₃	B2
R718	water	H ₂ O	A1
R744	carbon dioxide	CO ₂	A1
ORGANIC COMPOUND			
Hydrocarbons			
R170	ethane	CH ₃ CH ₃	A3
R290	propane	CH ₃ CH ₂ CH ₃	A3
R600a	isobutane	CH(CH ₃) ₂ CH ₃	A3
Halocarbons			
Chlorofluorocarbons (CFCs) and Bromofluorocarbons (BFCs)			
R11	trichlorofluoromethane	CCl ₃ F	A1
R12	dichlorodifluoromethane	CCl ₂ F ₂	A1
Hydrochlorofluorocarbures (HCFC)			
R22	chlorodifluoromethane	CHClF ₂	A1
R141b	1,1-dichloro-1-fluoroethane	CH ₃ CCl ₂ F	A2
R142b	1-chloro-1,1-difluoroethane	CH ₃ CClF ₂	A2
Hydrofluorocarbons (HFCs)			
R32	difluoromethane	CH ₂ F ₂	A2
R125	pentafluoroethane	CHF ₂ CF ₃	A1
R134a	1,1,1,2-tetrafluoroethane	CH ₂ FCF ₃	A1
R143a	1,1,1-trifluoroethane	CH ₃ CF ₃	A2
R152a	1,1-difluoroethane	CH ₃ CHF ₂	A2
Azeotropic mixtures			
R502		R22/R115 (48.8/51.2)	A1
R507		R125/R143a (50/50)	A1
Zeotropic mixtures			
R404A		R125/R143a/R134a (44/52/4)	A1
R407C		R32/R125/R134a (23/25/52)	A1
R410A		R32/R125 (50/50)	A1