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NUMBER DESIGNATION OF ORGANIC REFRIGERANTS

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BRIEF HISTORY

The ISO Recommendation R 817, *Number designation of organic refrigerants,* was drawn up by Technical Committee ISO/TC 86, *Refrigeration,* the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee began in 1960 and led, in 1966, to the adoption of a Draft ISO Recommendation.

In March 1967, this Draft ISO Recommendation (No. 1152) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Argentina	Greece	Switzerland
Australia	Hungary	Thailand
Belgium	Ireland	U.A.R.
Canada	Israel	United Kingdom
Chile	Italy	U.S.A.
Czechoslovakia	Japan	U.S.S.R.
Denmark	New Zealand	Yugoslavia
France	Poland	
Germany	Sweden	

No Member Body opposed the approval of the Draft.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in September 1968, to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 817 September 1968

NUMBER DESIGNATION OF ORGANIC REFRIGERANTS

1. SCOPE

This ISO Recommendation is intended to establish a simple system of referring to common organic refrigerants instead of using the chemical name, formula or trade name. Although the use of a number for each refrigerant covered is a concise and accurate way of designating the refrigerant, there is no intention of precluding the use of a chemical name or formula.

2. DEFINITIONS

2.1 *Refrigerant.* As covered in this ISO Recommendation, is the medium of heat transfer in a refrigerating system which absorbs heat by evaporating at a low temperature and a low pressure, and gives up heat on condensing at a higher temperature and pressure.

2.2 *Compound.* A substance formed by a union of two or more elements in definite proportions by mass.

2.3 *Hydrocarbon.* A compound containing only the elements hydrogen and carbon.

2.4 *Halocarbon.* Used to define a halogenated hydrocarbon containing one or more of the following four halogens : fluorine, chlorine, bromine, and iodine.

2.5 *Isomer.* One of a group of compounds having the same combination of elements, but arranged spatially in different ways.

2.6 *Mixture.* A complex of two or more compounds which do not bear a fixed proportion to one another, and which, however thoroughly mixed together, retain a separate existence.

2.7 *Azeotrope.* A mixture of refrigerants whose vapour and liquid phases have identical compositions at a given temperature.

3. CLASSIFICATION

Refrigerants are classified as indicated in the nomenclature given in the Table, pages 6, 7 and 8. Other refrigerants will be added through subsequent revisions.

4. NUMBERING SYSTEM

4.1 An identifying number should be assigned to each organic refrigerant within the scope of this ISO Recommendation.

The identifying numbers assigned to the hydrocarbons and halocarbons of the methane, ethane, propane, and cyclobutane series are such that the structure of the compounds may be deduced from the refrigerant numbers, and vice versa, without ambiguity. The rules of the fixed number systems are as follows :

4.1.1 The first digit on the right is the number of fluorine (F) atoms in the compound.

4.1.2 The second digit from the right is one more than the number of hydrogen (H) atoms in the compound.

4.1.3 The third digit from the right is one less than the number of carbon (C) atoms in the compound. When this digit is zero, it is omitted from the number.

4.1.4 The number of chlorine (C1) atoms in the compound is found by subtracting the sum of the fluorine (F) and hydrogen (H) atoms from the total number of atoms which can be connected to the carbon (C) atoms.

When only 1 carbon atom is present, the total number of attached atoms is 4. When 2 carbon atoms are present, the total number of attached atoms is 6, unless the compound is unsaturated; in this case, the total number of attached atoms is 4.

For saturated hydrocarbons, the total number of attached atoms is the following :

For 1 C, the total number of atoms is 4
For 2 C, the total number of atoms is 6
For 3 C, the total number of atoms is 8
For 4 C, the total number of atoms is 10, etc.
For n C, the total number of atoms is $2n + 2$.

For mono-unsaturated and cyclic saturated hydrocarbons, the total number of attached atoms is the following :

For 2 C, the total number of atoms is 4
For 3 C, the total number of atoms is 6
For 4 C, the total number of atoms is 8
For 5 C, the total number of atoms is 10, etc.
For n C, the total number of atoms is $2n$.

4.1.5 For cyclic derivatives the letter *C* is used before the identifying refrigerant number.

4.1.6 In those instances where bromine is present in place of part or all of the chlorine, the same rules apply except that the letter *B* after the designation for the parent chloro-fluoro compound shows the presence of bromine (Br). The number following the letter *B* shows the number of bromine atoms present.

4.1.7 In the case of isomers of the ethane series, each has the same number and the most symmetrical one is indicated by the number without any letter following it. As the isomers become more and more unsymmetrical, the letters a, b, c, etc., are appended. Symmetry is determined by adding the atomic masses of the groups of elements attached to each carbon atom and subtracting one sum from the other. The smaller the difference, the more symmetrical the product.

4.1.8 In the case of the ethylene series, the above rules apply, except that the number 1 is used as the fourth digit from the right.

4.2 Mixtures will be designated by their respective refrigerant numbers and mass proportions. Refrigerants should be named in order of increasing boiling points. For example, a 90 % and 10 % mixture of refrigerants 22 and 12 will be indicated as R 22/12 (90/10), or R 22/R 12 (90/10), or Refrigerant 22/Refrigerant 12 (90/10).

4.3 Arbitrary identifying numbers of the 500 series are assigned to azeotropes. Refrigerants should be named in order of increasing boiling points.

5. DESIGNATION

5.1 Form

5.1.1 The identifying number should be preceded by the letter symbol "R" or used in combination with the word "Refrigerant" (or its equivalent translation), and should be equally comprehensible in all cases.

The identifying number may also be preceded by the manufacturer's trademark or trade name.

Example : R 12, Refrigerant 12, or 12 Refrigerant,
(Trade name) R 12,
(Trade name) Refrigerant 12, or
(Trade name) 12 Refrigerant.

5.2 Use on nameplates and in textual matter

5.2.1 Designation of a refrigerant on a nameplate or in specifications should be transcribed as R 12 or Refrigerant 12, R 22 or Refrigerant 22.

5.2.2 In text or manual writing, the following manner of expression is acceptable :

The compressor can be used with R 12 or R 22,

The compressor can be used with Refrigerants 12 or 22,

The compressor can be used with Refrigerant 12 or Refrigerant 22.

TABLE – Organic refrigerant nomenclature

Refrigerant numbering designation	Chemical name*	Chemical formula*	Molecular mass
Halocarbon compounds			
10	Carbontetrachloride	CCl_4	153.8
11	Trichloro(mono)fluoromethane***	CCl_3F	137.4
12	Dichlorodifluoromethane	CCl_2F_2	120.9
13	(Mono)chlorotrifluoromethane***	$CClF_3$	104.5
13B1	(Mono)bromotrifluoromethane***	$CBrF_3$	148.9
14	Carbontetrafluoride	CF_4	88.0
20	Chloroform	$CHCl_3$	119.4
21	Dichloromonofluoromethane	$CHCl_2F$	102.9
22	Monochlorodifluoromethane	$CHClF_2$	86.5
23	Trifluoromethane	CHF_3	70.0
30	Methylene chloride	CH_2Cl_2	84.9
31	Monochloromonofluoromethane	CH_2ClF	68.5
32	Methylene fluoride	CH_2F_2	52.0
40	Methyl chloride	CH_3Cl	50.5
41	Methyl fluoride	CH_3F	34.0
50	Methane**	CH_4	16.0
110	Hexachloroethane	CCl_3CCl_3	236.8
111	Pentachloro(mono)fluoroethane***	CCl_3CCl_2F	220.3
112	1, 1, 2, 2-Tetrachlorodifluoroethane	CCl_2FCCl_2F	203.8
112a	1, 1, 1, 2-Tetrachlorodifluoroethane	CCl_3CClF_2	203.8
113	1, 1, 2-Trichlorotrifluoroethane	CCl_2FCClF_2	187.4
113a	1, 1, 1-Trichlorotrifluoroethane	CCl_3CF_3	187.4
114	1, 2-Dichlorotetrafluoroethane	$CClF_2CClF_2$	170.9
114a	1, 1-Dichlorotetrafluoroethane	CCl_2FCF_3	170.9
114B2	1, 2-Dibromotetrafluoroethane	$CBrF_2CBrF_2$	259.9

* This proposal is based on the systems used in the United States of America by Chemical Abstracts. Countries may use their own designations for chemical names or formulas. Local practice may be observed.

** The compounds methane, ethane, and propane appear in the halocarbon section in their proper numerical positions, although these products are not halocarbons.

*** The use of *mono*, where enclosed by parentheses, is optional, since only one compound is possible based on the chemical name or formula.