December 2007

A collection of short pointed topical papers.

# Cold W·A·R·

Whether it's Air Conditioning or Refrigeration

SPORLAN

# Refrigerant Isomers

by: Garth Denison
Senior Application Engineer

If you are viewing a copy, but would like to receive the monthly Cold W.A.R. directly, e-mail **ColdWarSVD@parker.com** to join our mailing list.

The Sporlan Division of Parker Hannifin assumes no obligation or liability for any advice furnished or for any results obtained with respect to this information. All such advice is given and accepted at users risk. This disclosure of information herein is not a license to operate under, or a recommendation to infringe any patent of Sporlan Division of Parker Hannifin or others.

® Registered trademark of Sporlan Division of Parker Hannifin, Washington, MO 63090 USA
© Copyright 2003 by Sporlan Division of Parker Hannifin, Washington, MO 63090 USA

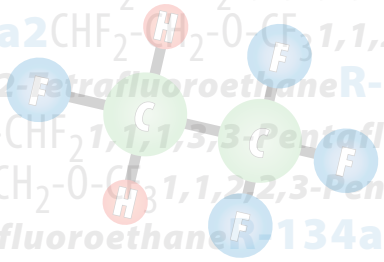
This document may be copied and distributed for educational purposes only.

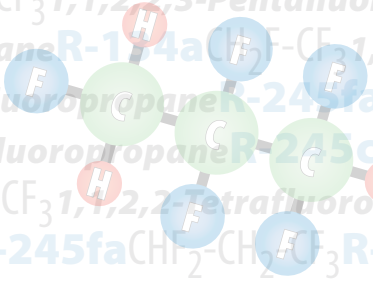
Cold W.A.R. Issue 066

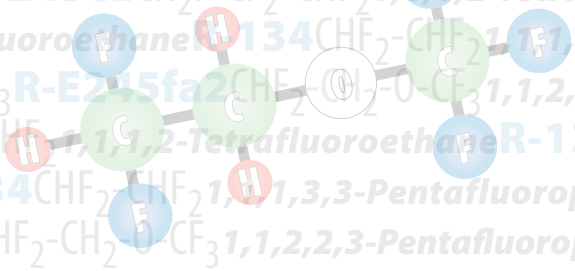
# ANSI / ASHRAE 34 - *Refrigerant Isomers*

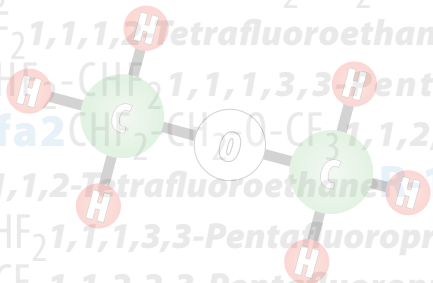
## *What's an Isomer?*

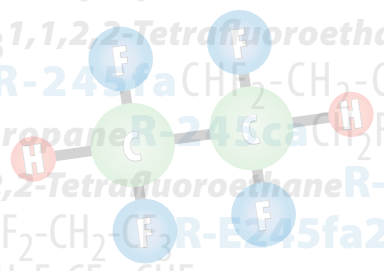
Chemical compounds that have the same molecular formula and molecular weight but different structural formulas and properties are called *isomers*.











# ANSI / ASHRAE 34 - *Refrigerant Isomers*

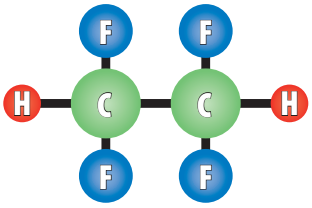
## *Ethane based refrigerants: (2 carbon chain)*

Refrigerants that are ethane based will have the same Arabic number, with the most symmetrical one indicated by the number alone. As the isomers becomes more and more unsymmetrical, successive lowercase letters are appended (example a, b or c).

Symmetry is determined by first summing the atomic mass of Br, Cl, F or H atoms attached to each carbon atom. One sum is subtracted from the other. The smaller the absolute value in the difference, the more symmetrical the isomer.

*The **two** isomers of tetrafluoroethane*

***1,1,2,2- Tetrafluoroethane***
**R-134**



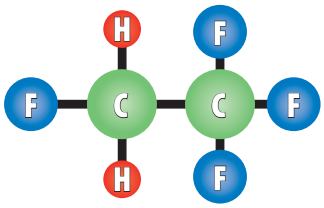

$CHF_2$-$CHF_2$

**Attached Mass Delta**
39 - 39 = 0

**Molecular Weight**

| | |
|---|---|
| **C** | 12.0 |
| **H** | 1.0 |
| **Cl** | 35.5 |
| **F** | 19.0 |

***1,1,1,2- Tetrafluoroethane***
**R-134a**




$CH_2F$-$CF_3$

**Attached Mass Delta**
57 - 21 = 36

# ANSI / ASHRAE 34 - *Refrigerant Isomers*

## *Propane based refrigerants: (3 carbon chain)*

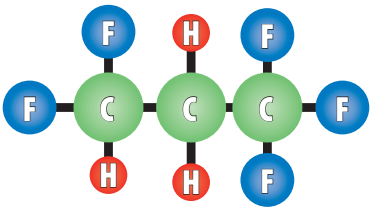
Refrigerants that are propane based will have the same Arabic number, with the isomer distinguished by **two** appended **lowercase** letters. The **first** appended letter indicates the substitution of the **central** carbon atom.

| Letter | Represents |
|---|---|
| **a** | $CCl_2$ |
| **b** | CClF |
| **c** | $CF_2$ |
| **d** | CClH |
| **e** | CFH |
| **f** | $CH_2$ |

The **second** appended letter indicates the relative symmetry of the substituents of the **end** carbon atoms (C1 and C3). Symmetry is determined by first summing the atomic masses of the Cl, F and H atoms attached to the C1 and C3 carbon atoms. One sum is subtracted from the other; the smaller the absolute value of this difference, the more symmetrical the isomer. In contrast to the ethane based series, the most symmetrical Isomer has a second appended letter, this is the letter "a" (as opposed to no appended letter for ethane isomers); increasingly asymmetrical isomers are assigned successive letters. Appended letters are omitted when no isomers are possible, and the number alone represents the molecular structure unequivocally.

*The **two** isomers of pentafluoropropane*

***1,1,1,3,3- Pentafluoropropane***
**R-245fa**



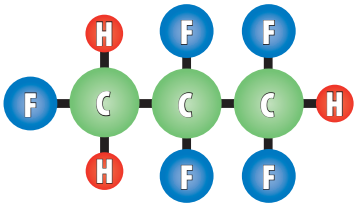

$CHF_2$-$CH_2$-$CF_3$

**Attached Mass Delta**
57 - 39 = 18

**Molecular Weight**

| | |
|---|---|
| **C** | 12.0 |
| **H** | 1.0 |
| **Cl** | 35.5 |
| **F** | 19.0 |

***1,1,2,2,3-Pentafluoropropane***
**R-245ca**



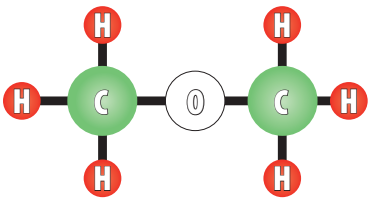

$CH_2F$-$CF_2$-$CHF_2$

**Attached Mass Delta**
39 - 21 = 18

# ANSI / ASHRAE 34 - *Refrigerant Isomers*

## *Ether based refrigerants: (2 or 3 carbon chain containing 1 oxygen)*

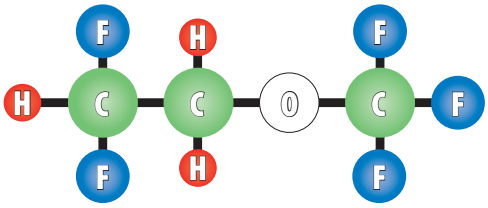
1. Refrigerants that are Ether based will have an oxygen between two carbons.
2. Ether based refrigerants shall be designated with the prefix **"E"** immediately preceding their number.
3. Except for the following differenced, the root number designations for the hydrocarbon atoms shall be determined according to the current Standard 34.
4. Two carbon, dimethyl ethers require no further suffixes. Example R-E170
5. Three carbon, straight chained ethers require the following:
    a. The first appended lower case letter indicates the substitution of the central atom.
    b. The second appended lower case letter indicates the relative symmetry.
    c. An additional integer identifying the first carbon to which the oxygen ether is attached, will be appended to the suffix letters.




***R-E170***

***Dimethyl ether***
$CH_3$-O-$CH_3$

***Three carbon, straight chained ethers***




***R-E245fa2***
$CHF_2$-$CH_2$-O-$CF_3$

**Example:**
***R-E218ca1***
$CF_3$-O-$CF_2$-$CF_3$

**Where**
**R** is representative of **"Refrigerant"**
**E** is representing an **"Ether"** based refrigerant
**218** is representing the hydrocarbon structure
**c** is representing the atoms attached to the central carbon
**a** is representing the end carbons symmetry
**1** is representing the carbon to which the oxygen is first attached