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# Forane® 134a

( 1, 1, 1, 2 Tetrafluoroethane )

Forane® 134a is an HFC, zero ozone depletion potential (ODP) refrigerant with properties very similar to R-12. It can be used both as a pure refrigerant in a number of traditional R-12 applications, and as a component in refrigerant blends targeted for R-502 and R-22 applications.

Compressor and system manufacturers have begun to sell new equipment which has been specifically designed for R-134a. In addition, laboratory testing and field trials are confirming that R-134a can work in the retrofit of many existing R-12 and 500 installations.

### New Equipment

Industries which are successfully making the transition from R-12 to R-134a include automotive air conditioning, other specialized air conditioning or climate control applications, positive pressure centrifugal chillers, medium temperature commercial refrigeration, refrigeration appliances, industrial refrigeration plants, and transport refrigeration.

### Retrofit

Applications where R-134a is being proven reliable for retrofitting R-12 systems include R-12 centrifugal chillers, semi-hermetic, reciprocating, and screw refrigeration applications, industrial refrigeration plants, and some hermetic compressor applications. See RETROFIT section for more considerations.

This brochure has been designed to give a broad background of properties and technical considerations to help you determine if Forane 134a will meet your CFC alternatives needs.

## Forane® 134a: Basic Property Data

| | |
|---|---|
| Chemical Formula: | $CF_3CH_2F$ |
| Molecular Weight: | 102.0 |
| Boiling Point @ 1 atm: | - 15.7°F |
| Freezing Point @ 1 atm: | - 149.8°F |
| Density of Saturated Vapor @ b.p.: | 0.325 lb./cu. ft. |
| Density of Saturated Liquid @ 80°F: | 75.35 lb./cu. ft. |
| Critical Temperature: | 213.8°F |
| Critical Pressure: | 590.3 psia |
| Critical Density: | 31.9 lb./cu. ft. |
| Latent Heat of Vaporization @ b.p.: | 92.5 BTU/lb. |
| Specific Heat of Liquid @ 80°F: | 0.35 BTU/lb. °F |
| Specific Heat of Vapor @ 1 atm: | 0.23 BTU/lb. °F |
| Flammability Limits in Air: | non-flammable |
| Workplace Environmental Exposure Level* (WEEL)(8 hour time weighted average): | 1000 ppm |
| Ozone Depletion Potential (ODP) | 0 |
| Halocarbon Greenhouse Warming Potential (HGWP): | 0.27 |

**Established by American Industrial Hygiene Association.*

## Pressure-Temperature Chart

| Temp (°F) | 134a psig | 12 psig |
|---|---|---|
| -50 | * 18.7 | * 15.4 |
| -40 | * 14.8 | * 11.0 |
| -30 | * 9.9 | * 5.5 |
| -20 | * 3.7 | 0.6 |
| -10 | 1.9 | 4.5 |
| 0 | 6.5 | 9.2 |
| 10 | 11.9 | 14.7 |
| 20 | 18.4 | 21.1 |
| 30 | 26.1 | 28.5 |
| 40 | 35.1 | 37.0 |
| 50 | 45.5 | 46.7 |
| 60 | 57.5 | 57.8 |
| 70 | 71.2 | 70.2 |
| 80 | 86.8 | 84.2 |
| 90 | 104.0 | 99.7 |
| 100 | 124.0 | 117.0 |
| 110 | 147.0 | 136.0 |
| 120 | 171.0 | 157.0 |
| 130 | 199.0 | 181.0 |
| 140 | 229.0 | 206.0 |
| 150 | 263.0 | 234.0 |
| 160 | 300.0 | 264.0 |
| 170 | 341.0 | 297.0 |
| 180 | 386.0 | 333.0 |
| 190 | 435.0 | 372.0 |
| 200 | 489.0 | 414.0 |

*Pressures provided in Inches Mercury Vacuum.

For Additional Forane® Literature, Training Guides and Case Histories, call
**1-800-343-7940**

For Retrofit Assistance, call
**1-800-RETRO 94**
(1-800-738-7694)

## Forane® 134a: Engineering Data

| Temp (°F) | psia | Density (lb./cu. ft.) | | Enthalpy (BTU/lb.) | |
|---|---|---|---|---|---|
| | | Liquid | Vapor | Liquid | Vapor |
| -50 | 5.49 | 89.30 | 0.1304 | -2.95 | 95.68 |
| -40 | 7.42 | 88.31 | 0.1727 | 0.00 | 97.18 |
| -30 | 9.85 | 87.31 | 0.2254 | 2.98 | 98.68 |
| -20 | 12.89 | 86.30 | 0.2901 | 5.99 | 100.18 |
| -10 | 16.62 | 85.28 | 0.3688 | 9.04 | 101.67 |
| 0 | 21.16 | 84.23 | 0.4634 | 12.12 | 103.14 |
| 10 | 26.63 | 83.17 | 0.5762 | 15.23 | 104.60 |
| 20 | 33.13 | 82.08 | 0.7097 | 18.38 | 106.04 |
| 30 | 40.80 | 80.96 | 0.8667 | 21.57 | 107.45 |
| 40 | 49.77 | 79.82 | 1.0500 | 24.79 | 108.84 |
| 50 | 60.18 | 78.64 | 1.2630 | 28.05 | 110.20 |
| 60 | 72.17 | 77.43 | 1.5100 | 31.36 | 111.52 |
| 70 | 85.89 | 76.18 | 1.7950 | 34.72 | 112.80 |
| 80 | 101.50 | 74.89 | 2.1230 | 38.13 | 114.03 |
| 90 | 119.10 | 73.54 | 2.5010 | 41.59 | 115.20 |
| 100 | 139.00 | 72.13 | 2.9350 | 45.12 | 116.32 |
| 110 | 161.20 | 70.66 | 3.4340 | 48.71 | 117.36 |
| 120 | 186.00 | 69.10 | 4.0090 | 52.39 | 118.31 |
| 130 | 213.60 | 67.46 | 4.6750 | 56.14 | 119.16 |
| 140 | 244.10 | 65.70 | 5.4490 | 60.00 | 119.88 |
| 150 | 277.70 | 63.81 | 6.3580 | 63.98 | 120.45 |
| 160 | 314.80 | 61.74 | 7.4390 | 68.10 | 120.82 |
| 170 | 355.50 | 59.45 | 8.7470 | 72.40 | 120.93 |
| 180 | 400.30 | 56.83 | 10.3700 | 76.94 | 120.66 |
| 190 | 449.40 | 53.73 | 12.5000 | 81.83 | 119.83 |
| 200 | 503.40 | 49.73 | 15.5200 | 87.31 | 118.00 |

To calculate the Latent Heat of Vaporization, subtract the liquid enthalpy from the vapor enthalpy at the desired temperature.

Temperature Conversion: °C = (°F – 32) x 5/9

Pressure Conversion: psig = psia – 14.7 {P > 14.7}
in. Hg Vacuum = (14.7 – psia) x 2.036

Density Conversion: lb./cu. ft. {water = 62.43 lb./cu. ft.}
lb./gal. = lb./cu. ft. ÷ 7.48
{water = 8.35 lb./gal.}
g/ml = lb./cu. ft. x 0.016
{water = 1 g/ml}

## Performance of Forane® 134a in New Equipment

### LUBRICATION

For all R-134a applications, lubrication is a very important consideration.

- Miscibility between refrigerant and oil is critical for many equipment designs. Miscibility is required to ensure oil return to the compressor.
- R-134a is not miscible with mineral oils. Polyolester (POE) lubricants and poly alkylene glycol (PAG) lubricants have been recommended by various equipment manufacturers to be used with R-134a.
- POE and PAG lubricants will absorb moisture quickly. They must be handled carefully to avoid prolonged exposure to air.

Generally, new equipment will be shipped by the manufacturer with a compatible lubricant already charged. All of the manufacturers' recommendations should be followed.

### SYSTEM PERFORMANCE

#### Climate Control

Chillers and specially designed A/C systems have been engineered to use R-134a while providing energy efficiency equivalent to R-12.

- Manufacturers have successfully introduced products for mobile air conditioning and positive pressure chillers using R-134a.

#### Refrigeration:
Low Temperature

- At lower evaporator temperatures the pressure ratio of R-134a rises in relation to R-12, and the capacity may drop off significantly. Check with equipment manufacturers for specific recommendations regarding the use of their equipment with R-134a at lower application temperatures.
- One alternative for low temperature applications is the use of HFC blends, such as Forane® 404A (FX70), which have been designed to replace R-502 in low temperature refrigeration applications.

#### Refrigeration:
Medium and High Temperature Applications

- R-134a can be used in most medium and high temperature R-12 applications.
- An ideal theoretical cycle analysis using the thermodynamic properties of R-134a shows a slight decrease in capacity and efficiency. When improvements, such as liquid subcooling, are introduced into the equation, the performance of R-134a becomes equal to that of R-12. These improvements are being taken advantage of by equipment manufacturers.

## Retrofitting with Forane® 134a

Retrofitting of R-12 systems to R-134a is recommended when the projected service and material costs to maintain the system with R-12, over the expected lifetime of the system, exceed the cost of retrofit and maintenance with R-134a. A refrigerant management program may also call for the retrofit of equipment over a specific time frame so that other equipment may be serviced by the recovered R-12.

### RETROFIT APPLICATIONS

#### Centrifugal Chillers

R-12 chillers which are retrofitted to R-134a will generally suffer in capacity and efficiency if no changes are made to the equipment. Manufacturers of chillers will provide engineering recommendations and retrofit kits to ensure the best performance from their equipment.

#### Automotive A/C

Key issues are lubrication, flushing, and material compatibility. These will determine how expensive the retrofit job will be.

#### Refrigeration

Larger refrigeration systems can be successfully retrofitted if the following factors are considered:

- Lubricant Flushing - most refrigeration systems require less than 5% residual mineral oil after flushing with POE.
- Compatibility of materials must be checked. Any materials which will cause leaks or failure of the system must be replaced.
- Application Temperature Range - the performance of R-134a should be evaluated at the application temperatures to confirm if it should be used.

#### Refrigeration: Small Hermetic

Only applicable where the compressor is replaced. Key issues are the effect of residual mineral oil on capillary tubes, time/cost of job, and availability of R-22 based service fluids.

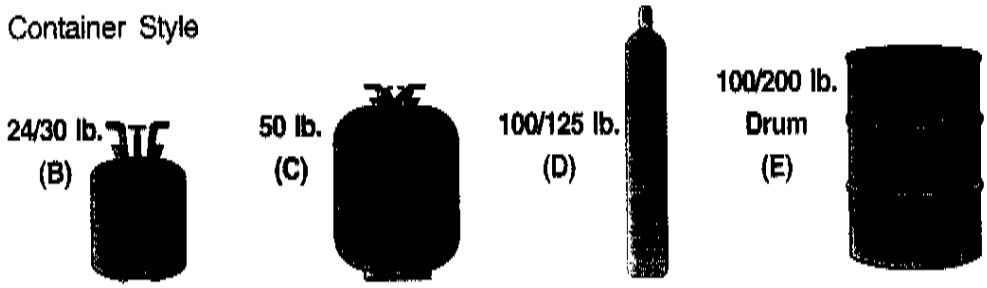
## Elf Atochem Cylinder Identification

| TYPE | COLOR CODE | SIZES NET LBS. |
|---|---|---|
| **R-134a** ($CF_3CH_2F$) | Light Blue | 30 (B), 125 (D) |

Other Forane® Alternative Refrigerants

| TYPE | COLOR CODE | SIZES NET LBS. |
|---|---|---|
| **R-22** ($CHClF_2$) | Green | 30 (B), 50 (C), 125 (D) |
| **R-123** ($CHCl_2CF_3$) | Lt. Blue Grey | 100 (E), 200 (E) |
| **R-404A** | Orange | 24 (B), 100 (D) |
| **FX 56** | Tan | 30 (B) |

Container Style

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