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TECH DIGEST

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Forane® FX-56

Forane® FX-56 is a low ozone depleting blend of HCFC refrigerants R-22, R-124 and R-142b. Forane FX-56 is formulated to closely resemble the properties of R-12.

Retrofit

FX-56 is a refrigerant alternative for retrofit of R-12 in low to medium temperature systems where removal of mineral oil is difficult. These systems typically consist of hermetically sealed systems for transport refrigeration, food storage, and vending/beverage systems applications.

FX-56 provides a slightly higher capacity than R-12 and R-134a in lower temperature applications.

Lubrication

For intended applications, FX-56 is sufficient for use with mineral, alkylbenzene or polyolester oils. Miscibility is important for proper oil return to the compressor. Changing the existing lubricant is not required in most cases. (*See Retrofit Section*)

Charging

Forane FX-56 must be introduced into equipment or systems only as a liquid. Charging as a vapor will change the composition of the blend slightly, and affect the performance of the system.

Follow charging instructions on the cylinder. The approximate FX-56 charge for most applications will be 85-90% of the original (R-12) charge.

If a leak were to occur in a cylinder or in the vapor space of a system at rest, fractionation of the blend may cause a permanent change in composition of the refrigerant charge.

Performance

Evaporator pressures using FX-56 are similar to operating pressures for R-12. For higher temperatures at the condenser, FX-56 exhibits slightly higher (10-20 psig) pressures.

Equal or better heat transfer characteristics are obtained when using FX-56. Temperature glide can be compensated when using FX-56 in most direct expansion evaporators.

This brochure provides a broad description of properties and technical information to determine if Forane FX-56 meets your system needs.

Forane® FX-56: Basic Property Data

Chemical Formula:	R-22	($CHClF_2$)- 60 wt.%
	R-124	(CF_3CHClF)- 25 wt.%
	R-142b	(CH_3CClF_2)- 15 wt.%
Average Molecular Weight:		97.45
Bubble Point @ 1 atm:		- 29.6°F
Density of Saturated Liquid @ 80°F:		76.1 lb./cu. ft.
Density of Saturated Vapor @ b.p.:		0.306 lb./cu. ft.
Critical Temperature:		224.6°F
Critical Pressure:		652.5 psig
Saturated Liquid Pressure at 80°F:		106.2 psig
Latent Heat of Vaporization:		97.3 BTU/lb.
Specific Heat of Liquid @ 80°F:		0.535 BTU/lb. °F
Specific Heat of Vapor @ 1 atm:		0.336 BTU/lb. °F
Maximum Temperature Glide:		15.2°F
Flammability Limit:		non-flammable
Ozone Depletion Potential (ODP):		0.05
Halocarbon Greenhouse Warming Potential (HGWP):		0.3

Definition of Terms

Since Forane® FX-56 is a zeotropic blend, it is important the terms Bubble Point, Dew Point, Fractionation, and Glide are understood.

FX-56 (°F)		R-22	R-124	R-142b
Dew	Bubble	(°F)	(°F)	(°F)
6.3	-8.2	-20.0	33.9	39.8

TABLE 1: FX-56 and component saturation temperatures at 10 psig.

Bubble Point
(Saturated Liquid Temperature)

The temperature at which FX-56 (at constant pressure) begins to evaporate. In other words, the Bubble Point is the temperature where the first bubble of vapor appears in liquid FX-56. The bubble point is equivalent to the boiling point for single component refrigerants. From Table 1, at 10 psig, the Bubble Point for FX-56 is -8.2 °F. The graph in Figure 1 plots the Bubble temperatures for various pressures. The Bubble Point temperature is indicated in Figure 1 as point 1. At operating conditions to the left of the Bubble Point line, the refrigerant is a subcooled liquid.

Dew Point
(Saturated Vapor Temperature)

The temperature where condensation begins (at constant pressure), which corresponds to the condensation point of a single component refrigerant. This is also the temperature at which the last droplet of liquid evaporates and saturated gas exists. Table 1 lists the Dew Point temperature of 6.3°F at 10 psig. This point is shown as Point 2 in Figure 1. At operating conditions to the right of this line, the refrigerant is at a superheated vapor state.

Bubble Point and Dew Point are used to describe the behavior of zeotropic blends in an evaporator and condenser. "Boiling Point" is not appropriate since the temperature of the blend changes as it evaporates or condenses.

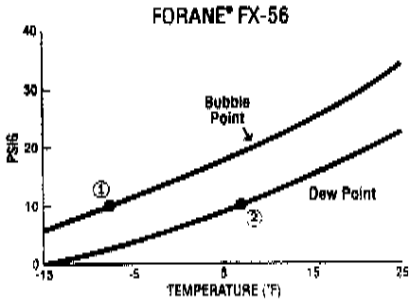


FIGURE 1:
FX-56 pressure-temperature graph

Fractionation

The change in composition of a refrigerant blend when it changes phase from liquid to vapor (evaporation) or from vapor to liquid (condensation). For FX-56, fractionation occurs between its Bubble and Dew Points (points 1 and 2). Since the components of FX-56 evaporate (or condense) at different rates in the evaporator (or condenser), the composition of FX-56 constantly changes between the Bubble and Dew Points. Once the temperature passes the Dew Point (or to the right of the Dew Point line), the refrigerant is in a superheated vapor state.

Glide

The difference in temperature between the evaporator outlet and inlet due to fractionation of the blend. Theoretically, this can be calculated by finding the difference between the Dew and Bubble temperatures at constant pressure. Actual measurements may differ slightly depending on the state of the liquid refrigerant at either end of the evaporator (or condenser). Pressure losses through the evaporator may also affect glide. At most common system pressures, FX-56 has a temperature glide of 10-12°F.

Typical Behavior of FX-56 in the Evaporator

This example describes typical conditions for achieving an average evaporator temperature of 0°F. (See Figure 2)

① Before the expansion valve, FX-56 is at a saturated liquid state. For example, if the pressure of FX-56 is at 15.3 psig, the temperature of FX-56 is 2°F. This point is on the Bubble point line of the curve (sat. liquid state).

② As the temperature increases, FX-56 begins to evaporate. The resulting vapor that forms first contains more of the higher pressure component (R-22). As the vapor separates from the liquid, the remaining liquid shifts in composition towards the less volatile components (more R-124 and R-142b than R-22). As the composition of the liquid (or vapor) changes, the Bubble Point temperature (or Dew Point temperature) of the remaining refrigerant changes as well, causing a temperature glide.

③ Fractionation continues as the lesser volatile components (R-124, R-142b) boil more rapidly along with the remaining R-22. For FX-56 at 15.3 psig, the temperature is 15°F.

④ FX-56 has completely evaporated and has returned to its original composition.

Retrofitting with FX-56

Retrofitting R-12 systems to FX-56 is recommended where R-134a is not practical. Systems where mineral oil removal is difficult are good candidates for FX-56. These include vending/beverage machines, transport, restaurant, and home refrigeration systems. Retrofit projects should be included as part of an overall refrigerant management program.

RETROFIT PROCEDURES

1. Gather baseline data from system using R-12.
2. Recover existing R-12 charge.
3. Mineral oil removal is not necessary in most cases. If oil miscibility becomes a concern at lower temperatures (less than 0°F), oil return can be improved by using at least 30% alkylbenzene lubricant mixed with mineral oil. FX-56 is fully miscible with pure alkylbenzene or polyolester lubricants.
4. Replace filter driers.
5. Evacuate system using a deep vacuum.
6. Charge FX-56 refrigerant in the liquid phase only. (Approximately 85-90% of original charge).
7. Properly mark and identify FX-56 refrigerant charge on the system.
8. Start system and adjust expansion valve for proper superheat settings if applicable.

Setting System Temperature Using FX-56

It is important to gather baseline data prior to retrofitting systems with new refrigerants such as FX-56.

Setting System Temperatures:

- From baseline data using R-12, take the desired evaporator temperature using R-12 and add 5°F. This gives the Dew Point (vapor) temperature for FX-56 (outlet of evaporator). The 5°F compensates for the glide across the evaporator when using FX-56.

EXAMPLE: Evaporator operating temperature using R-12: 10°F

10°F + 5°F (½ of FX-56 glide) = 15°F Dew Point (vapor) temperature at evaporator outlet (if 0°F superheat).

- Using the pressure-temperature chart for FX-56 (the pressure temperature chart in this brochure can be used), the Dew Point pressure at 15°F is 15.3 psig. This pressure is equal to your suction pressure of the compressor.
- Notice that the vapor temperature of FX-56 at the outlet is higher than the operating temperature of R-12. In contrast, at the evaporator inlet, the temperature of FX-56 (liquid) is colder than the R-12 operating condition. The average temperature across the evaporator is 10°F.

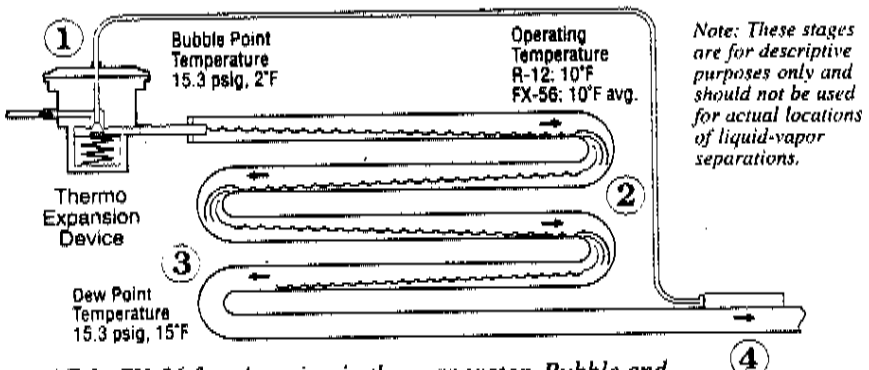


FIGURE 2: FX-56 fractionation in the evaporator. Bubble and Dew Point temperatures for FX-56 at 15.3 psig.

Forane® FX-56: Pressure Temperature Chart

Temp (°F)	Bubble (Liquid) Pressure (psig)	Dew (Vapor) Pressure (psig)	R-12 (psig)
-30	**0.4**	**9.9**	**5.5**
-25	1.9	**6.8**	**2.3**
-20	4.1	**3.7**	0.6
-15	6.5	0.2	2.4
-10	8.8	2.1	4.5
-5	11.7	4.3	6.7
0	14.5	6.5	9.2
5	17.9	9.3	11.8
10	21.3	12.0	14.6
15	25.3	15.3	17.7
20	29.4	18.5	21.0
25	34.1	22.3	24.6
30	38.8	26.1	28.4
35	44.1	30.6	32.6
40	49.5	35.0	37.0
45	55.5	40.2	41.7
50	61.6	45.4	46.7
55	68.6	50.6	52.0
60	75.6	55.7	57.7
65	83.5	63.4	63.8
70	91.4	71.1	70.2
75	100.1	78.9	77.0
80	108.8	86.7	84.2
85	118.9	95.6	91.8
90	128.9	104.3	99.8
95	139.9	114.3	108.3
100	151.0	124.1	117.2
105	163.0	135.2	126.6
110	175.0	146.3	136.4
115	188.4	158.7	146.8
120	201.8	171.1	157.7
125	216.7	185.0	169.1
130	231.6	198.9	181.0
135	247.7	214.0	193.5
140	263.9	229.1	206.6

Bold Numerals - Inches Hg. Below 1 ATM

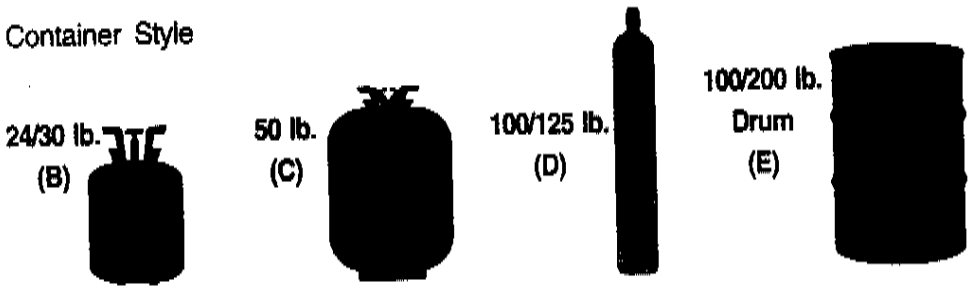
Elf Atochem Cylinder Identification

TYPE	COLOR CODE	SIZES NET LBS.
FX-56	Tan	30 (B)

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)
R-134a (CF_3CH_2F)	Light Blue	30 (B), 125 (D)
FX-10	Medium Purple	24 (B), 100 (D)

Container Style



For Additional Forane® FX-56 Literature, Training Guides and Case Histories, call

1-800-343-7940

For Retrofit Assistance, call

1-800-RETRO 94

(1-800-738-7694)

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