



Features and uses of R-404A

R-404A is a ternary mixture consisting of R-125, R-143a and R-134a. Their thermodynamic characteristics constitute as ideal replacement for R-502 for refrigeration sector in new facilities at low and medium temperatures. R-404A is characterized by a remarkable chemical stability and low glide temperature 0.7 ° C. Its classification is **A1 group L1**.

Its main application is in new facilities for low and medium temperatures.

There is also the possibility of converting an installation of R-502 to R-404A, removing 95% of mineral oil or original alkyl benzene, by polyolester oil. It is needed to change the filter drier (molecular sieve recommended XH9 and XH7), the expansion valve by one of R-404A, and over sizing the condenser.

R-404A is a mixture of HFC refrigerants, which are not compatible with traditional lubricants working with R-502. The only lubricant suitable to use with R404A is polyolester oil (POE).

Toxicity and storage

Toxicity of R-404A is very low even with long exposure time. AEL (Allowable Exposure Limit) is 1000 ppm (8-hour TWA). R-404A containers should be stored in a cool and ventilated area away from heat sources. Vapors, in case of leakage tend to accumulate at ground level.

Security

R-404A is not toxic, not flammable, high security. It has been classified as **A1 / group L1**.

Components

Chemical Name	% By weight	CAS No.	EC No.
1,1,1,2- Tetrafluoroethane (R-134a)	4	811-97-2	212-377-0
Pentafluoroethane (R-125)	44	354-33-6	206-557-8
1,1,1-Trifluoroethane (R-143a)	52	420-46-2	206-996-5



Physical Properties

PHYSICAL PROPERTIES	UNITS	R-404 a
Molecular weight	(g/mol)	97.6
Boiling point (at 1,013 bar)	(°C)	-46.5
Sliding boiling (at 1,013 bar)	(K)	0.7
Critical temperature	(°C)	72.1
Critical pressure	(bar abs)	37.32
Critical density	(kg/m ³)	484.5
Liquid density (25°C)	(kg/m ³)	1048
Liquid density (-25°C)	(kg/m ³)	1236
Saturated vapour density (at -15° C)	(kg/m ³)	18.20
Vapour pressure (25°C)	(kPa)	1255
Vapour pressure (-25°C)	(kPa)	255
Latent heat of vaporization (at 1,013 bar)	(kJ/kg)	200
Specific heat of liquid at (25°C) (1,013 bar)	(kJ/kg.K)	1.64
Specific heat of vapour at (25°C) (1,013 bar)	(kJ/kg.K)	0.88
Thermal conductivity of liquid (25°C)	(W/mK)	0.064
Thermal conductivity of steam (1,013 bar)	(W/mK)	0.0143
Solubility in water (25°C)	(Ppm)	Negligible
Flammability Limit (25°C)	(% vol)	None
Toxicity (AEL)	(Ppm)	1000
ODP	-	0
GWP	-	3922*

*According to IPCC-AR4/CIE (Fourth Assessment Report of the Intergovernmental Panel on Climate Change) -2007.

Comparative performance between R-404A and R-502

The thermodynamic properties of R-404A are similar to R-502; this is evidenced in the following example:

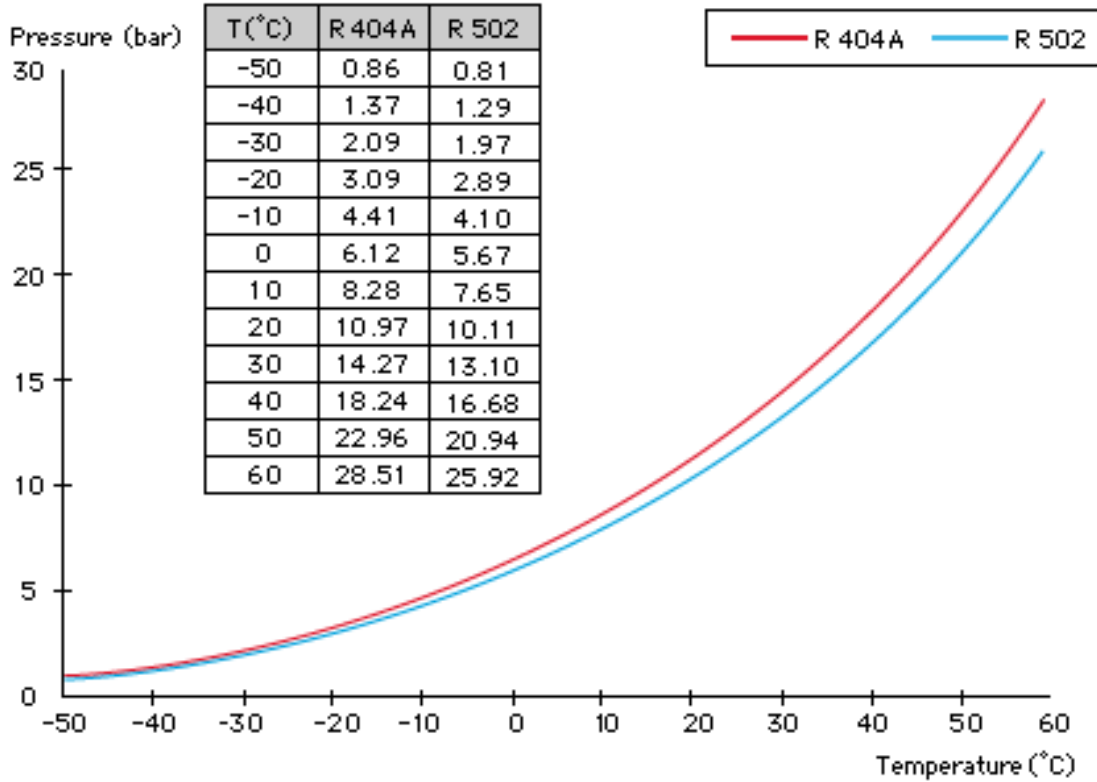
The operating conditions to simulate a real medium temperature cycle, typical of commercial refrigeration.

1. Temperature at Evaporator inlet: -25 ° C
2. Temperature at Condense inlet: 45 ° C
3. Sub cooling: 5 ° C
4. Overheating 45 ° C
5. Isentropic compression coefficient

Example of a commercial refrigeration cycle		R-404A	R-502
Evaporating pressure	(bar)	2.54	2.4
Condensing pressure	(bar)	20.36	18.72
Compression work		8	7.8
Discharge Temperature	(°C)	95	102
COP		1.8	1.9
Net refrigeration capacity	(KJ/Kg)	97	95
Volumetric refrigeration capacity	(KJ/Kg)	1027	1039
Glide Temperature (evap.)	(°C)	0.5	0
Glide Temperature (cond.)	(°C)	0.3	0



Comparison chart temperature / pressure R-502-R-404A



Thermodynamic properties

TEMP. (°C)	ABSOLUTE PRESSURE (kPa)		DENSITY (kg/m ³)		ENTHALPY (kJ/kg)		ENTROPY (kJ/kg.K)	
	BUBBLE	DEW	BUBBLE	DEW	BUBBLE	DEW	BUBBLE	DEW
-50	85.2	82.1	1314.1	4.456	133.1	337.3	0.7318	1.6487
-45	108.6	104.9	1298.8	5.605	139.3	340.6	0.7591	1.6430
-40	136.7	132.5	1283.2	6.975	145.6	343.8	0.7862	1.6380
-35	170.1	165.3	1267.5	8.595	152.4	347.0	0.8150	1.6337
-30	209.5	204.1	1251.7	10.492	159.9	350.3	0.8460	1.6301
-25	255.4	249.3	1235.8	12.692	166.3	353.4	0.8718	1.6271
-20	308.7	301.8	1219.6	15.246	172.8	356.5	0.8975	1.6245
-15	370.1	362.5	1203.2	18.196	179.4	359.6	0.9231	1.6222
-10	440.4	432.1	1186.4	21.593	186.1	362.6	0.9487	1.6202
-5	520.5	511.4	1169.2	25.492	193.0	365.5	0.9743	1.6184
0	611.1	601.3	1151.5	29.960	200.0	368.3	1.0000	1.6168
5	713.3	702.7	1133.0	35.072	207.2	371.0	1.0257	1.6153
10	827.8	816.5	1113.7	40.917	214.5	373.6	1.0515	1.6138
15	955.6	943.6	1093.4	47.605	222.1	376.0	1.0776	1.6123
20	1097.7	1085.1	1071.7	55.267	229.9	378.3	1.1038	1.6106
25	1255.0	1241.8	1048.4	64.066	237.9	380.4	1.1304	1.6087
30	1428.7	1415.0	1023.1	74.210	246.2	382.2	1.1574	1.6065
35	1619.7	1605.6	995.4	85.968	254.8	383.8	1.1848	1.6038
40	1829.2	1814.8	964.7	99.704	263.8	385.0	1.2130	1.6005
45	2058.3	2043.9	930.4	115.926	273.2	385.8	1.2421	1.5964
50	2308.2	2294.0	891.5	135.384	283.2	386.1	1.2723	1.5910



Mollier Diagram

