RETROFIT GUIDELINES

RS-51 Ultra-Low GWP Refrigerant

Converting R404A/R507A Systems to RS-51 (R470B)

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Minimal changes needed to equipment when replacing R404A and R507

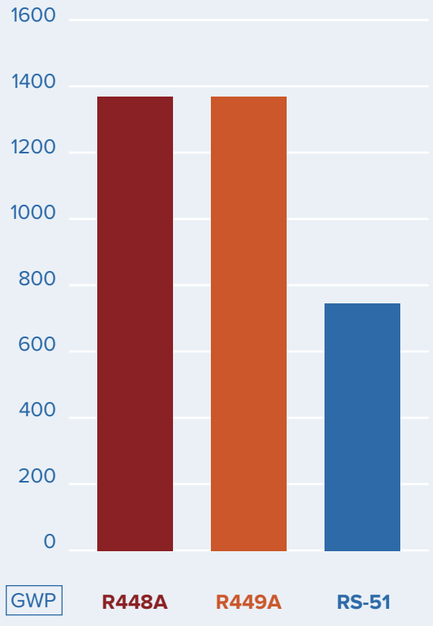
Higher energy efficiency than R448A and R449A

Similar performance to R404A and R507

Compatible with R404A and R507 lubricants

Non-flammable and low toxicity

RS-51 SUMMARY CHART



INTRODUCTION

RS-51 (R470B) provides an easy and straightforward retrofit option to replace R404A and R507 in existing equipment at low cost. No changes to hardware or lubricant are necessary so that the overall costs of conversion are kept to a minimum and the purchase of new equipment is avoided. RS-51 has similar properties to R404A including coefficient of performance, cooling capacity, pressures and other metrics. RS-51's much lower direct Global Warming Potential (GWP) means that users will achieve a smaller carbon footprint. This is a crucial benefit considering the current global environmental concerns and regulations, currently implemented by the EPA and individual states.

RS-51 is a non-flammable drop-in replacement for R404A and R507 with a GWP less than 80% of R404A with similar thermodynamic performance. The GWP of RS-51 is approximately 40% less than R448A and R449A.

APPLICATIONS

RS-51 can replace R404A/R507 in many of the applications where these refrigerants are found including supermarkets, cold stores, freezers, ice machines, refrigerated transport, beer cellars, freezer cabinets, transportation of foodstuffs, freeze dryers and other environments.

NO OIL CHANGE

RS-51 is compatible with the same (POE) lubricants which are commonly used with R404A and R507, so there is no need to change the oil when converting from R404A and R507 to RS-51.

RETROFIT PROCEDURE TO REPLACE R404A OR R507

Replacing R404A or R507 with RS-51 essentially follows the procedure specified by the equipment manufacturer for a refrigerant change. Since RS-51 is zeotropic, it is very important that liquid — not vapor — refrigerant be added to the system.

- ☐ 1. Ensure the right equipment is available, e.g. recovery unit and cylinders, container for recovered lubricant, vacuum pump, weighing scales, replacement drier, etc.
- ☐ 2. Before removing the R404A or R507, operate the unit under standard operating conditions and record the pressures, temperatures, and any other relevant measurable data to establish unit performance. Typically, the appropriate standard conditions for setting up the unit will have already been specified by the equipment supplier.
- ☐ 3. Recover and weigh the R404A or R507 from the unit. The weight should be within the range specified by equipment manufacturer.
- ☐ 4. Replace the filter/drier and evacuate the system.
- ☐ 5. As in the case of R404A and R507, RS-51 should be used with a polyol ester lubricant.
- ☐ 6. Before operating the unit, charge the unit with liquid RS-51. The weight added at this stage should be approximately 10% lower than the R404A or R507 charge specified by the equipment manufacturer.
- ☐ 7. Operate the unit under conditions similar to those used in Step 2, closely watching the liquid line sight glass, the compressor oil level sight glass, and the suction superheat.
- ☐ 8. RS-51 has approximately a 30% lower mass liquid flow rate than R404A and R507, so that it may be necessary to close the expansion device relative to its setting for R404A or R507.
- ☐ 9. The evaporator superheat should be checked and changed as necessary by adjusting the TX valve.
- ☐ 10. Due to the difference in mass flow of RS-51 versus R404A and R507A, the existing TXV's power element will need to be changed to an R134a power element of similar temperature range. Consult the valve manufacturer to confirm the proper replacement element. A R404a valve, both adjustable and non-adjustable, will not work with RS-51. Alternatively, the existing TXVs can be replaced with an R-134a valve of similar capacity to the existing R404A or R507A valve. If the system has an electronic expansive device, select the parameters applicable to R134a.

  Note: If liquid is observed in the suction line sight glass or the suction superheat is lower than required, close the TX valve further. If the equipment manufacturer recommends charging R404A or R507 by evaporator superheat or liquid sub-cooling, use the same amount of superheat or sub-cooling for RS-51.
- ☐ 11. If a liquid line sight-glass is fitted, charge to a full glass gradually adding more liquid RS-51 until only liquid is passing through the expansion valve. Do not overcharge the system.
- ☐ 12. If more refrigerant is added, re-adjust the expansion device superheat setting as required.
- ☐ 13. Check system thoroughly for leaks.
- ☐ 14. Remove all R404A or R507A labels and clearly label system 'RS-51'.

Warning: It is highly recommended that the thermostatic expansion valve be checked and adjusted to compensate for small differences in the pressure temperature relationship of the replacement refrigerant when compared to the original refrigerant. Failure to check and adjust the valve could allow liquid refrigerant to enter the compressor and damage bearings and other compressor components.

RS-51 – EXPANSION VALVE SETUP

When retrofitting an application with RS-51, it is likely that you will need to change the expansion valve to one suitable for RS-51. This is due to the difference in mass flow rate between R404A and RS-51. The procedure will vary depending on what type of expansion valve you have.

1. **Manual Thermal Expansion Valve (TXV)**
   See Retrofit Procedure Instruction No. 10 on the previous page.

2. **Electronic Expansion Valve (EEV)**
   For the purposes of setting up an EEV to use RS-51 as a refrigerant, there are two types of EEV: those that only allow selecting a refrigerant from a pre-determined list, and those that allow a custom refrigerant to be programmed into the EEV.

   A. **EEV that only allows selection from a pre-determined list**
   In this case, please select R134a as the refrigerant as this most closely matches the mass flow rate of RS-51.

   B. **EEV that allows a custom refrigerant to be programmed**
   Your EEV will allow you to set the Antoine equation coefficients for a custom refrigerant. The Antoine equation describes the relationship between vapor pressure and temperature and is as follows:

   $\ln p = \ln A - \ln B / (C + T)$

   p = vapor pressure
   T = temperature
   A,B,C = component specific constants

   Please use the following RS-51 values for the coefficients:

A	10.38071
B	-2236.99
C	247.1348

SUMMARY

The best possible match is reached when you use an EEV where it's possible to set the Antoine Equation coefficients as this will most closely mirror the RS-51 thermodynamic values. If this is not possible, then set the expansion valve to that of R134a, using an EEV or TXV.

RS SERIES OF REFRIGERANTS PRESSURE/TEMPERATURE CHARTS

RS Series Pressure/Temperature charts indicate both liquid bubble point and vapor dew point of the RS Series Refrigerant.

Liquid Bubble Point: This is the temperature which the liquid refrigerant will begin to vaporize at the given pressure. Below this temperature, the liquid refrigerant will be sub-cooled.

Vapor Dew Point: This is the temperature at which refrigerant vapor will begin to condense at the given pressure. Above this temperature, the refrigerant vapor will be superheated.

Evaporator Vapor Superheat: To determine evaporator superheat, measure the suction line temperature at the outlet pipe of the evaporator and measure the suction pressure at the outlet pipe of the evaporator. Using the Pressure/Temperature chart, determine the vapor dew point for the measured suction pressure. Subtract the determined dew point from the actual temperature and this difference is the evaporator superheat.

Condenser Liquid Sub-Cooling: To determine condenser sub-cooling, measure the temperature of the outlet pipe of the condenser and measure the condenser pressure at the outlet pipe of the condenser. Using the Pressure/Temperature chart, determine the liquid bubble point for the measured condenser pressure. Subtract the measured temperature from the determined bubble point and this difference is the condenser liquid sub-cooling.

RS-51 (R470B) Pressure/Temperature Comparison

*Values shown: "PSIG" / *Denotes "HG" (Mercury)*

TEMPERATURE		RS-51 LIQUID BUBBLE PT.	RS-51 VAPOR DEW PT.	R404A Bold = Bubble Point	R507A
°F	°C	PSIG	PSIG	PSIG	PSIG
-50	-45.6	15.2	*15.4	*0.1	1.0
-48	-44.4	16.5	*14.7	0.7	1.7
-46	-43.3	18.0	*13.6	1.6	2.6
-44	-42.2	19.4	*12.6	2.4	3.5
-42	-41.1	20.9	*11.6	3.3	4.4
-40	-40.0	22.5	*10.6	4.3	5.4
-38	-38.9	24.1	*9.4	5.3	6.4
-36	-37.8	25.7	*8.1	6.3	7.5
-34	-36.7	27.5	*6.9	7.4	8.6
-32	-35.6	29.2	*5.5	8.5	9.8
-30	-34.4	31.0	*4.1	9.6	11.0
-28	-33.3	32.9	*2.6	10.8	12.2
-26	-32.2	34.8	*1.2	12.0	13.5
-24	-31.1	36.8	0.2	13.3	14.8
-22	-30.0	38.9	1.0	14.6	16.2
-20	-28.9	41.0	1.9	16.0	17.6
-18	-27.8	43.1	2.8	17.4	19.1
-16	-26.7	45.4	3.7	18.9	20.6
-14	-25.6	47.6	4.7	20.4	22.2
-12	-24.4	50.0	5.7	22.0	23.8
-10	-23.3	52.4	6.7	23.6	25.5
-8	-22.2	54.9	7.8	25.3	27.3
-6	-21.1	57.4	8.9	27.0	29.1
-4	-20.0	60.0	10.1	28.8	30.9
-2	-18.9	62.7	11.3	30.7	32.8
0	-17.8	65.5	12.5	32.6	34.8
2	-16.7	68.3	13.9	34.6	36.9
4	-15.6	71.2	15.2	36.6	39.0
6	-14.4	74.1	16.6	38.7	41.1
8	-13.3	77.1	18.1	40.9	43.4
10	-12.2	80.3	19.6	43.1	45.7
12	-11.1	83.4	21.2	45.4	48.1

TEMPERATURE		RS-51 LIQUID BUBBLE PT.	RS-51 VAPOR DEW PT.	R404A Bold = Bubble Point	R507A
°F	°C	PSIG	PSIG	PSIG	PSIG
14	-10.0	86.7	22.8	47.8	50.5
16	-8.9	90.0	24.5	50.2	53.0
18	-7.8	93.4	26.2	52.7	55.6
20	-6.7	96.9	28.0	55.3	58.3
22	-5.6	100.5	29.8	57.9	61.0
24	-4.4	104.1	31.8	60.7	63.8
26	-3.3	107.9	33.7	63.5	66.7
28	-2.2	111.7	35.8	66.3	69.7
30	-1.1	115.6	37.9	69.3	72.7
32	0.0	119.5	40.1	72.3	75.9
34	1.1	123.6	42.3	75.5	79.1
36	2.2	127.7	44.6	78.7	82.4
38	3.3	132.0	47.0	82.0	85.8
40	4.4	136.3	49.5	85.3	89.2
42	5.6	140.7	52.1	88.8	92.8
44	6.7	145.2	54.7	92.4	96.5
46	7.8	149.8	57.4	96.0	100.2
48	8.9	154.5	60.2	99.8	104.1
50	10.0	159.2	63.0	**103.6**	108.0
52	11.1	164.1	66.0	**107.5**	112.0
54	12.2	169.1	69.0	**111.5**	116.2
56	13.3	174.1	72.1	**115.7**	120.4
58	14.4	179.3	75.3	**119.9**	124.8
60	15.6	184.5	78.6	**124.2**	129.2
62	16.7	189.8	82.0	**128.6**	133.7
64	17.8	195.3	85.5	**133.2**	138.4
66	18.9	200.8	89.1	**137.8**	143.1
68	20.0	206.4	92.8	**142.5**	148
70	21.1	212.2	96.5	**147.4**	153
72	22.2	218.0	100.4	**152.4**	158.1
74	23.3	223.9	104.4	**157.4**	163.3
76	24.4	230.0	108.5	**162.6**	168.6

TEMPERATURE		RS-51 LIQUID BUBBLE PT.	RS-51 VAPOR DEW PT.	R404A Bold = Bubble Point	R507A
°F	°C	PSIG	PSIG	PSIG	PSIG
78	25.6	236.1	112.7	**167.9**	174.1
80	26.7	242.4	117.0	**173.4**	179.6
82	27.8	248.7	121.4	**178.9**	185.3
84	28.9	255.1	126.0	**184.6**	191.1
86	30.0	261.7	130.6	**190.4**	197.1
88	31.1	268.4	135.4	**196.3**	203.1
90	32.2	275.1	140.3	**202.4**	209.3
92	33.3	282.0	145.3	**208.5**	215.6
94	34.4	289.0	150.4	**214.8**	222.1
96	35.6	296.1	155.7	**221.3**	228.7
98	36.7	303.3	161.1	**227.9**	235.4
100	37.8	310.6	166.7	**234.6**	242.3
102	38.9	318.0	172.3	**241.4**	249.3
104	40.0	325.6	178.1	**248.4**	256.5
106	41.1	333.2	184.1	**255.6**	263.8
108	42.2	340.9	190.1	**262.9**	271.2
110	43.3	348.8	196.4	**270.3**	278.8
112	44.4	356.8	202.8	**277.9**	286.6
114	45.6	364.9	209.3	**285.6**	294.5
116	46.7	373.1	216.0	**293.5**	302.6
118	47.8	381.4	222.8	**301.6**	310.8
120	48.9	389.8	229.8	**309.8**	319.2
122	50.0	398.3	237.0	**318.2**	327.8
124	51.1	407.0	244.3	**326.7**	336.5
126	52.2	415.7	251.8	**335.4**	345.4
128	53.3	424.6	259.5	**344.3**	354.5
130	54.4	433.6	267.4	**353.4**	363.8
132	55.6	442.7	275.4	**362.7**	373.2
134	56.7	451.9	283.6	**372.1**	382.9
136	57.8	461.2	292.1	**381.7**	392.7
138	58.9	470.6	300.7	**391.6**	402.7
140	60.0	480.2	309.5	**401.6**	413.0

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