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Refrigerant Changeover Guidelines CFC-12 to R-401B/R-409A

Leading the Industry with Environmentally Responsible Refrigerant Solutions

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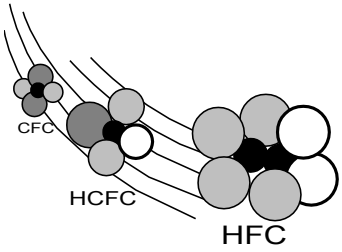

Emerson Climate Technologies, Inc. does not advocate the wholesale changeover of CFC refrigerants to HCFCs or HFCs. If a system is not leaking refrigerant to the atmosphere, and is operating properly, there is no technical reason to replace the CFC refrigerant. In fact, changing the refrigerant may void the UL listing of the unit; however, once the decision has been made to make the change from CFC-12 (R-12) to the interim R-401B, the following guidelines are recommended.

CONSIDERATIONS

1. Retrofitting systems that employ compressors manufactured prior to 1973 is not recommended. This is due to the different materials used in motor insulation that have not been evaluated for compatibility with the new refrigerants and lubricants. Failure to heed this advice will violate the proposed UL Standard for Field Conversion/ Retrofit of Alternate Refrigerants in Refrigeration and Air Conditioning Equipment (UL 2170-2172).

2. The lubricant that Emerson Climate Technologies, Inc. recommends for use with R-401B/409A is a mixture of 50% mineral oil and 50% alkylbenzene. Emerson Climate Technologies, Inc. approved Polyol Ester lubricants can also be used with R-401B/409A if the system is expected to be changed in the near future to an HFC refrigerant such as R-134a. This will eliminate the need of having to flush the system again when making the R-134a retrofit.

For a list of other lubricants approved for use with R-401B/409A, refer to item 11 in this section. For a complete list of all lubricants approved by Emerson Climate Technologies, Inc. refer to Form 93-11.

3. R-401B/409A should be used only in systems where the saturated suction temperature is maintained at +25°F or lower. It should not be mixed with any other refrigerant!

4. The expansion valve may need to be changed. valve When used with R-401B/409A, the existing R-12 will have approximately 25% more capacity. Oversized expansion valves can result in hunting and refrigerant floodback. Consult with the thermostatic expansion valve manufacturer for the correct valve and size.

5. Filter driers must be changed at the time of conversion. This is proper air conditioning/refrigeration practice.

a. Solid core driers, such as Emerson Climate Technologies ADK, are compatible with either R-12 or R-401B/409A.

b. Compacted bead driers can use an XH6 or XH9 molecular sieve material, such as found in the Emerson Climate Technologies EK or EKH series.

c. If a loose fill type drier is to be used, an XH9 molecular sieve is required.

6. R-401B exhibits marginally higher pressures than R-12 at normal condensing temperatures. We do not believe this will require readjustment of safety controls; however, you should verify this with the system manufacturer or component suppliers.

7. Systems that use a low pressure controller to maintain space temperature may have to have the cut-out and cut-in points changed. With R-401B, the pressure setting must reflect an average temperature of the refrigerant in the evaporator. Because of refrigerant glide, the refrigerant entering the evaporator for a specific suction pressure will be approximately 8°F colder than the refrigerant vapor at the outlet of the evaporator (not considering superheat). Therefore, the average refrigerant temperature will be at a midpoint pressure/ temperature equivalent.

Example: A -5°F refrigerated space usually requires that the refrigerant temperature in the evaporator be approximately -15°F. Using R-402B, the liquid entering the evaporator may be as cold as -19°F, and the vapor temperature before superheat may be -11°F. Taking the saturated vapor pressure at -11°F gives us the exit pressure at the evaporator of 3.3 psig. Considering a 2 psig pressure drop in the suction line, the pressure control cut-out should be set at 1.3 psig.

The cut-in point will be based on the vapor pressure/ temperature value. Let's assume that the space temperature can rise to -2°F before the compressor is turned on. 2°F vapor pressure is 7.6 psig. Set the cut-in at 8 psig.

8. Because of glide, pressure regulators such as EPRs may have to be reset. Contact the EPR manufacturer for correct settings.

WARNING: Use only Emerson Climate Technologies, Inc. approved refrigerants and lubricants in the manner prescribed by Emerson Climate Technologies, Inc. In some circumstances, other refrigerants and lubricants may be dangerous and could cause fires, explosions or electrical shorting. Contact Emerson Climate Technologies, Inc., Sidney, Ohio for more information.

9. Due to refrigerant glide, it is important that when measuring and/or adjusting TEV superheat, the pressure and SATURATED VAPOR TABLES be used. Example: The pressure measured at the TEV bulb is 7 psig. The Pressure/Temperature (P/T) chart shows that the saturated vapor temperature for 7 psig is -3.2°F. If the actual refrigerant temperature measured is 6°F, the superheat is 6.2°F.

To measure subcooling at the condenser outlet or at the TEV inlet to verify that a solid column of liquid is present, measure the pressure and the refrigerant temperature at the location that the subcooling information is needed. Compare it to the saturated liquid temperature from the SATURATED LIQUID TABLES. Example: A pressure of 175 psig is measured at the condenser coil outlet. From the P/T chart, 175 psig is 110.2°F saturated liquid temperature. If the actual refrigerant temperature is 105°F, the liquid is subcooled 5.2°F.

10. Systems using R-401B/409A may have a lower system pressure drop than when using R-12. Because of the lower pressure drop, pilot-operated solenoid valves and pressure regulators may not operate. Check with the manufacturer of any pressure regulators and pilot- operated solenoid valves used in the system to be sure that they will operate properly. These controls may have to be downsized.

11. Mineral oil lubricant only, such as 3GS, cannot be used as the compressor lubricant. Emerson Climate Technologies, Inc. recommends the following lubricant choices:

a. A mixture of 3GS Mineral Oil (MO) and Shrieve Zerol 200 TD, Soltex AB200A, Crompton Suniso AKB 200A or Fuchs Reniso SP46 Alkyl Benzene (AB) with a minimum of 50% AB

b. Shell 22-12 or Fuchs Reniso Triton MS 46

c. A mixture of 3GS Mineral Oil (MO) and Polyol Ester (POE), i.e., Copeland™ Ultra 22 CC, Mobil EAL Arctic 22 CC, Uniqema EMKARATE RL 32CF, Copeland™ Ultra 32CC or Uniqema RL32-3MAF with a minimum of 50% POE

4. 100% Copeland™ Ultra 22 CC, Mobil EAL Arctic 22 CC, Uniqema EMKARATE RL 32CF, Copeland™ Ultra 32CC or Uniqema RL32-3MAF

Before starting the changeover, it is suggested that at least the following items be ready:

1. Safety glasses
2. Gloves
3. Refrigerant service gauges
4. Electronic thermometer
5. Vacuum pump capable of pulling 250 microns
6. Thermocouple micron gauge
7. Leak detector
8. Refrigerant recovery unit, including refrigerant cylinder
9. Proper container for removed lubricant
10. New liquid control device
11. Replacement liquid line filter drier(s)
12. New lubricant
13. R-401B/409A pressure temperature chart
14. R-401B/409A refrigerant

CHANGEOVER PROCEDURE

1. The system should be thoroughly leak tested with the R-12 refrigerant still in the system. All leaks should be repaired before the R-401B/409A refrigerant is added.

2. It is recommended that system operating conditions be recorded with the R-12 still in the system. This will provide the base data for comparison when the system is put back into operation with the R-401B/409A.

3. The system should be shut off electrically and the refrigerant properly removed from the system. Measure the quantity of refrigerant removed. This will provide a guide for recharging the system with R-401B/409A (see item 9 this section).

4. The mineral oil must be removed from the compressor crankcase. Hermetic compressors will have to be removed from the piping and the lubricant drained out through the suction stub. It is advisable to do an acid test on the oil.

5. Measure the amount of lubricant removed. It should be within 4 to 6 ounces of the compressor's factory oil charge. The lubricant charge is indicated on the name plate of the compressors. If the lubricant charge is unknown, an Authorized Copeland™ Wholesaler can provide the technician with the information.

If the amount of lubricant removed is less than 50% of the factory charge, it will be necessary to flush the excess lubricant from the system.

Those systems that have oil separators, oil reservoirs, oil floats and suction line accumulators must have the oil drained from them. If the liquid control device is going to be replaced, it is advisable that the suction line, liquid line and evaporator coil be blown clean using properly regulated dry nitrogen.

NOTE: Properly dispose of the lubricant.

6. Before the new lubricant is installed into the compressor, be sure all leaks are repaired and liquid control devices and any other system components are changed. Install the correct liquid line filter drier. Driers must be compatible with the refrigerant and lubricant.

7. Be advised that POEs are very hygroscopic. They will very quickly absorb moisture from the air once the container is opened. Once the lubricant is added to the compressor, the compressor should be quickly installed. Like an open container, an open compressor with POE will absorb moisture. Add the correct amount of lubricant to the compressor. It is important that the system contain at least 50% POE. On systems using enhanced surfaces in the heat exchanger, excessive mineral oil can adversely effect the heat transfer due to logging. Therefore, it is desirable to have no more than 20% mineral oil in systems employing these types of surfaces.

8. Once the compressor is installed and the system is closed, the system must be evacuated to 250 microns or lower. A vacuum decay test is suggested at this time to ensure the system is dry and free of leaks.

9. REFRIGERANT CHARGING WITH "NEAR AZEOTROPES." Refrigerant R-401B/409A is a near azeotropic mixture. It is important that during initial charging or "topping off" a system that the refrigerant be removed from the charging cylinder in the liquid phase. Many of the cylinders for the newer refrigerants use a dip tube so that in the upright position liquid is drawn from the cylinder. DO NOT vapor charge out of a cylinder unless the entire cylinder is to be charged into the system. Refer to charging instructions provided by the refrigerant manufacturer.

With the system in a 250 micron or lower vacuum, liquid can be charged into the system "high side." The initial charge should be about 80% of the amount of refrigerant removed from the system.

Put the system into operation and observe its performance. Additional refrigerant may have to be added to the operating system to obtain optimum performance.

When adding refrigerant to an operating system, it may be necessary to add the refrigerant through the compressor suction service valve. Because the refrigerant leaving the refrigerant cylinder must be in the liquid phase, care must be exercised to avoid damage to the compressor. It is suggested that a sight glass be connected between the charging hose and the compressor suction service valve. This will permit you to adjust the cylinder hand valve so that liquid can leave the cylinder while allowing vapor to enter the compressor.

10. Operate the system and record the operating conditions. Compare this data to the base data taken in item 2. Check and adjust the expansion valve superheat setting if necessary. Make adjustments to other controls as needed.

11. Properly label the components. Tag the compressor with the refrigerant used (R-401B) and the lubricant used. The proper color code for R-401B is Light Gray Green PMS (Paint Matching System) 413.

12. Clean up and properly dispose of removed lubricant. Check local and state laws regarding the disposal of refrigerant lubricants. Recycle or reclaim the removed refrigerant.

CAUTION: These guidelines are intended for use with R-401B/409A only, not for refrigerants which are similar to R-401B/409A. *Other refrigerants may not be compatible with the materials used in our compressors or the lubricants recommended in this bulletin; their use may result in unacceptable reliability and durability of the compressor.*

Note: Videos on retrofitting are available from your Authorized Copeland™ Wholesaler. Ask for VT-025.

ADDENDUM

The contents of this publication are presented for informational purposes only and are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. Emerson Climate Technologies, Inc. and/or its affiliates (collectively "Emerson"), as applicable, reserve the right to modify the design or specifications of such products at any time without notice. Emerson does not assume responsibility for the selection, use or maintenance of any product. Responsibility for proper selection, use and maintenance of any Emerson product remains solely with the purchaser or end user.

⚠ CAUTION POE must be handled carefully and the proper protective equipment (gloves, eye protection, etc.) must be used when handling POE lubricant. POE must not come into contact with any surface or material that might be harmed by POE, including without limitation, certain polymers (e.g. PVC/CPVC and polycarbonate).

R-401B Saturated Vapor/Liquid Pressure/Temperature Chart

Pressure PSIG	Vapor Temp. °F	Liquid Temp. °F	Pressure PSIG	Vapor Temp. °F	Liquid Temp. °F
(13)	-40.5	-51.1	38	39.0	29.6
(12)	-38.8	-49.1	39	40.0	30.6
(11)	-36.5	-47.1	40	41.0	31.6
(10)	-34.6	-45.2	45	45.7	35.4
(9)	-32.8	-43.4	50	50.1	40.8
(8)	-31.1	-41.6	55	53.4	45.0
(7)	-29.4	-40.0	60	58.1	49.0
(6)	-27.8	-38.4	65	61.9	52.9
(5)	-26.3	-36.8	70	65.1	56.5
(4)	-24.8	-35.3	75	68.8	60.0
(3)	-23.3	-33.8	80	72.1	63.3
(2)	-21.9	-32.4	85	75.2	66.5
(1)	-20.5	-31.0	90	78.2	69.6
0	-19.2	-29.6	95	81.1	72.5
1	-16.6	-26.9	100	83.9	75.4
2	-14.1	-24.4	105	86.6	76.2
3	-11.7	-22.0	110	89.3	80.9
4	-9.4	-19.7	115	91.8	83.5
5	-7.3	-17.5	120	94.3	86.0
6	-5.2	-15.4	125	96.7	88.5
7	-3.2	-13.4	130	99.1	91.4
8	-1.2	-11.4	135	101.3	93.3
9	0.6	-9.5	140	103.6	95.5
10	2.5	-7.6	145	105.7	98.8
11	4.2	-5.8	150	107.9	100.4
12	5.9	-4.1	155	109.9	102.1
13	7.6	-2.4	160	112.0	104.2
14	9.2	-0.8	165	114.0	106.2
15	10.8	0.8	170	115.9	108.2
16	11.7	2.3	175	117.8	110.2
17	13.8	3.9	180	119.7	112.1
18	15.3	5.3	185	121.4	114.0
19	16.7	6.8	190	123.3	115.9
20	18.1	8.2	195	125.1	117.7
21	19.4	9.6	200	126.8	119.8
22	20.8	10.9	205	128.5	121.2
23	22.1	12.3	210	130.0	123.0
24	23.3	13.6	215	131.8	124.7
25	24.6	14.9	220	133.5	126.3
26	25.8	16.1	225	135.0	128.0
27	27.0	17.3	230	138.6	129.5
28	28.2	18.5	235	138.2	131.1
29	29.4	19.7			
30	30.5	20.9			
31	31.6	22.0			
32	32.7	23.2	( ) Inches Vacuum		
33	33.8	24.3			
34	34.9	25.4			
35	35.9	26.4			
36	37.0	27.5			
37	38.0	28.5			

R0401A Saturated Vapor/Liquid Temperature/Pressure Chart

Press. PSIG	Vapor Temp. °F	Liquid Temp. °F	Press. PSIG	Vapor Temp. °F	Liquid Temp. °F	Press. PSIG	Vapor Temp. °F	Liquid Temp. °F	Press. PSIG	Vapor Temp. °F	Liquid Temp. °F
-40	(12.9)	(7.0)	10	14.5	21.3	60	62.5	75.0	110	155.1	174.5
-39	(12.3)	(6.4)	11	15.1	22.0	61	63.8	76.6	111	157.6	177.0
-38	(11.8)	(5.8)	12	15.8	22.8	62	65.2	78.1	112	160.1	179.7
-37	(11.3)	(5.1)	13	16.5	23.6	63	66.5	79.6	113	162.2	182.3
-36	(10.7)	(4.5)	14	17.1	24.3	64	68.0	81.1	114	165.2	185.0
-35	(10.2)	(3.8)	15	17.8	25.1	65	69.4	82.7	115	167.7	187.7
-34	(9.7)	(3.1)	16	18.5	25.9	66	70.8	84.2	116	170.2	190.4
-33	(9.1)	(2.4)	17	19.2	26.7	67	72.3	85.8	117	172.9	193.1
-32	(8.5)	(1.8)	18	19.9	27.5	68	73.8	87.4	118	175.5	195.9
-31	(7.9)	(1.0)	19	20.7	28.4	69	75.3	89.1	119	178.2	198.7
-30	(7.3)	(0.3)	20	21.4	29.3	70	76.8	90.7	120	180.9	210.5
-29	(6.7)	0.2	21	22.2	30.0	71	78.3	92.4	121	183.5	204.4
-28	(6.1)	0.6	22	22.9	31.0	72	79.9	94.1	122	186.4	207.2
-27	(5.5)	1.0	23	23.7	31.9	73	81.5	95.8	123	189.1	210.3
-26	(4.8)	1.4	24	24.5	32.8	74	83.1	97.5	124	191.9	213.1
-25	(4.2)	1.8	25	25.3	33.7	75	84.7	99.3	125	195.8	216.0
-24	(3.5)	2.2	26	26.1	34.6	76	86.3	101.1	126	197.7	219.0
-23	(2.8)	2.6	27	27.0	35.5	77	88.0	102.8	127	200.6	222.0
-22	(2.1)	3.0	28	27.8	36.5	78	89.6	104.7	128	203.5	225.1
-21	(1.3)	3.4	29	28.9	37.5	79	91.3	106.5	129	206.5	228.2
-20	(0.6)	3.9	30	29.5	38.4	80	93.1	108.3	130	209.5	231.3
-19	0.1	4.3	31	30.4	39.4	81	94.8	110.2			
-18	0.5	4.8	32	31.2	40.6	82	96.6	112.1	( ) Inches Vacuum		
-17	0.8	5.2	33	32.2	41.5	83	98.3	114.0			
-16	1.2	5.7	34	33.2	42.5	84	100.1	116.0			
-15	1.6	6.2	35	34.1	43.6	85	102.0	117.9			
-14	2.0	6.7	36	35.1	44.6	86	103.8	119.4			
-13	2.5	7.2	37	36.0	45.7	87	105.7	121.9			
-12	2.9	7.7	38	37.0	46.8	88	107.6	124.0			
-11	3.3	8.2	39	38.0	47.9	89	109.5	126.0			
-10	3.8	8.7	40	39.0	49.1	90	111.4	128.1			
-9	4.2	9.3	41	40.0	50.2	91	113.4	130.2			
-8	4.7	9.8	42	41.0	51.4	92	115.4	132.3			
-7	5.1	10.4	43	42.1	52.6	93	117.4	134.4			
-6	5.6	10.9	44	43.2	53.7	94	119.4	119.4			
-5	6.1	11.5	45	44.3	55.0	95	121.4	138.8			
-4	6.6	12.1	46	45.4	56.2	96	123.5	123.5			
-3	7.1	12.7	47	46.5	57.4	97	143.2	143.2			
-2	7.6	13.3	48	47.6	58.7	98	127.7	145.5			
-1	8.1	13.9	49	48.8	59.9	99	129.9	147.8			
0	8.7	14.5	50	49.9	61.2	100	132.0	150.1			
1	9.2	15.1	51	51.1	62.5	101	134.2	152.4			
2	9.7	15.8	52	52.3	63.9	102	136.5	154.8			
3	10.3	16.4	53	53.5	65.2	103	138.7	157.1			
4	10.9	17.1	54	54.7	66.5	104	141.0	159.6			
5	11.5	17.8	55	56.0	67.9	105	143.3	162.0			
6	12.0	18.5	56	57.3	69.3	106	145.6	164.4			
7	12.6	19.2	57	58.5	70.7	107	147.9	166.9			
8	13.2	19.9	58	59.8	72.2	108	150.3	169.4			
9	13.9	20.6	59	61.1	73.6	109	152.7	172.0			

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