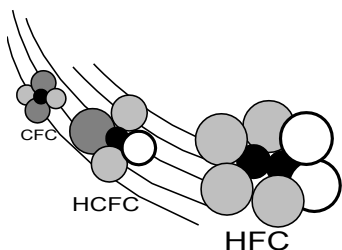


# Refrigerant Changeover Guidelines CFC-12 to R-401A

Leading the Industry with Environmentally  
Responsible Refrigerant Solutions







Emerson 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 need 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-401A, 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 UL Standard for Field Conversion/Retrofit of Alternate Refrigerants in Refrigeration and Air Conditioning Equipment (UL 2170-2172).

2. The lubricant that Emerson recommends for use with R-401A is a mixture of 50% mineral oil and 50% alkylbenzene. Emerson approved Polyol Ester lubricants can also be used with R-401A if the system is expected to be changed in the near future to an HFC refrigerant such as HFC-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-401A, refer to item 11 in this section. For a complete list of all lubricants approved by Emerson refer to Form 93-11.

3. R-401A should be used only in systems where the saturated suction temperature is maintained at -10°F or higher. It should not be mixed with any other refrigerant!

4. The expansion valve may need to be changed. When used with R-401A, the existing R-12 valve 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 ADK, are compatible with either R-12 or R-401A.

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

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

6. R-401A 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-401A, 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 35°F refrigerated space usually requires that the refrigerant temperature in the evaporator be approximately 25°F. Using R-401A, the liquid entering the evaporator may be as cold as 21°F, and the vapor temperature before superheat may be 29°F. Taking the saturated vapor pressure at 29°F gives us the exit pressure at the evaporator of 24.8 psig. Considering a 2 psig pressure drop in the suction line, the pressure control cut-out should be set at 22.8 psig.

The cut-in point will be based on the vapor pressure/temperature value. Let's assume that the space temperature can rise to 37°F before the compressor is turned on. 37°F vapor pressure is 31.6 psig. Set the cut-in at 32 psig.

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

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:

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

The pressure measured at the TEV bulb is 30 psig. The Pressure/Temperature (P/T) chart shows that the saturated vapor temperature for 30 psig is 35.2°F. If the actual refrigerant temperature measured is 45.0°F, the superheat is 9.8°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 140 psig is measured at the condenser coil outlet. From the P/T chart, 140 psig is 100.2°F saturated liquid temperature. If the actual refrigerant temperature is 95°F, the liquid is subcooled 5.2°F.

10. Systems using R-401A 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 recommends the following lubricant choices:

- a. A mixture of 3GS Mineral Oil (MO) and Shrieve Zerol 200TD, Soltex AB200A, Suniso AKB 200A or Fuchs Reniso SP46 Alkyl Benzene (AB) with a minimum of 50% AB
- b. Shell 22-12 or Fuchs Reniso Triton MS46
- 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

12. 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-401A pressure temperature chart
14. R-401A 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-401A 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-401A.

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-401A (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 500 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-401A 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 500 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-401A) and the lubricant used. The proper color code for R-401A is Coral Red PMS (Paint Matching System) 177.

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-401A only, not for refrigerants which are similar to R-401A. 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

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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).



## R0401A Saturated Vapor/Liquid Pressure/Temperature 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
1	-13.7	-24.3	51	55.8	45.7	101	90.3	80.3	151	113.9	105.1
2	-9.8	-22.0	52	56.7	46.5	102	91.3	80.9	152	114.3	105.5
3	-7.4	-18.5	53	57.5	48.2	103	91.8	81.5	153	114.8	106.0
4	-5.1	-16.2	54	58.3	49.1	104	91.4	82.0	154	115.2	106.4
5	-2.9	-14.0	55	59.1	49.6	105	92.0	82.6	155	115.6	106.8
6	-0.8	-11.9	56	60.0	50.2	106	92.5	83.1	156	116.0	107.2
7	1.2	-9.8	57	60.8	50.7	107	93.0	83.7	157	116.4	107.7
8	3.2	-7.8	58	61.5	51.5	108	93.5	84.2	158	116.8	108.1
9	5.1	-5.9	59	62.3	52.2	109	94.1	84.8	159	117.2	108.6
10	6.9	-4.1	60	63.1	53.1	110	94.7	85.3	160	117.6	108.9
11	8.7	-2.3	61	63.9	53.9	111	95.2	85.9	161	118.0	109.3
12	10.4	-0.5	62	64.6	54.6	112	95.7	86.4	162	118.4	109.7
13	12.1	1.2	63	65.4	55.4	113	96.2	86.9	163	118.8	110.1
14	13.7	2.8	64	66.1	56.2	114	96.7	87.4	164	119.2	110.6
15	15.3	4.4	65	66.9	57.0	115	97.2	88.0	165	119.6	111.0
16	16.8	6.0	66	67.6	57.7	116	97.7	88.5	166	120.0	111.4
17	18.3	7.5	67	68.3	58.4	117	98.2	89.0	167	120.4	111.8
18	19.8	9.0	68	69.1	59.2	118	98.7	89.5	168	120.8	112.2
19	21.2	10.5	69	69.8	59.9	119	99.2	90.0	169	121.2	112.6
20	22.6	11.9	70	70.5	60.6	120	99.7	90.5	170	121.6	113.0
21	24.0	13.3	71	71.2	61.3	121	100.2	91.0	171	122.0	113.4
22	25.4	14.7	72	71.9	62.0	122	100.7	91.5	172	122.4	113.8
23	26.7	16.0	73	72.6	62.8	123	101.2	92.0	173	122.8	114.2
24	28.0	17.3	74	73.2	63.5	124	101.7	92.5	174	123.2	114.6
25	29.2	18.6	75	73.9	64.1	125	102.2	93.0	175	123.6	115.0
26	30.5	19.9	76	74.6	64.8	126	102.6	93.5	176	124.0	115.4
27	31.7	21.1	77	75.3	65.5	127	103.0	94.0	177	124.3	115.8
28	32.9	22.3	78	76.0	66.2	128	103.5	94.5	178	124.7	116.2
29	34.0	23.5	79	76.6	66.9	129	104.1	95.0	179	125.1	116.5
30	35.2	24.7	80	77.2	67.5	130	104.6	95.5	180	125.4	116.9
31	36.3	25.9	81	78.4	68.2	131	105.0	97.2	181	125.8	117.2
32	37.4	27.0	82	78.8	68.8	132	105.5	96.4	182	126.2	117.5
33	38.5	28.1	83	79.1	69.5	133	105.9	96.9	183	126.6	118.1
34	39.6	29.2	84	79.8	70.1	134	106.4	97.4	184	126.9	118.5
35	40.7	30.3	85	80.4	70.8	135	106.9	97.9	185	127.3	118.5
36	41.7	31.3	86	81.0	71.4	136	107.3	98.3	186	127.6	119.2
37	42.7	32.4	87	81.6	72.5	137	107.8	98.8	187	128.0	119.6
38	43.8	33.4	88	82.2	72.6	138	108.2	99.2	188	128.4	120.0
39	44.8	34.4	89	82.8	73.2	139	108.7	99.7	189	128.7	120.4
40	45.8	35.5	90	83.4	73.9	140	109.1	100.2	190	129.1	120.8
41	46.7	36.4	91	84.0	74.5	141	109.5	100.6	191	129.5	121.1
42	47.7	37.4	92	84.6	75.1	142	110.0	101.0	192	129.8	121.5
43	48.6	38.4	93	85.2	75.7	143	110.4	101.5	193	130.2	121.8
44	49.6	39.3	94	85.8	76.3	144	110.9	101.9	194	130.6	122.2
45	50.5	40.3	95	86.4	76.9	145	111.3	102.4	195	130.9	122.6
46	51.4	41.2	96	87.0	77.5	146	111.8	102.9	196	131.3	122.9
47	52.3	42.1	97	87.5	78.0	147	112.2	103.3	197	131.6	123.3
48	53.2	43.0	98	88.1	78.6	148	112.6	102.9	198	132.0	123.7
49	54.1	43.9	99	88.7	79.2	149	113.0	104.2	199	132.3	124.0
50	54.7	44.8	100	89.2	79.8	150	113.4	104.7	200	132.7	124.6

## R0401A Saturated Vapor/Liquid Temperature/Pressure Chart

Temp. °F	Vapor Pressure PSIG	Liquid Pressure PSIG	Temp. °F	Vapor Pressure PSIG	Liquid Pressure PSIG	Temp. °F	Vapor Pressure PSIG	Liquid Pressure PSIG
-10	1.9	6.9	40	34.4	44.7	90	101.4	119.0
-9	2.3	7.4	41	35.3	45.8	91	103.2	121.0
-8	2.7	7.9	42	36.3	46.9	92	105.1	123.0
-7	3.2	8.4	43	37.3	48.0	93	106.9	125.0
-6	3.6	9.0	44	38.2	49.0	94	108.8	127.0
-5	4.0	9.5	45	39.2	50.2	95	110.7	129.0
-4	4.5	10.0	46	40.3	51.4	96	112.6	131.1
-3	4.9	10.6	47	41.3	52.5	97	114.6	133.2
-2	5.4	11.1	48	42.3	53.7	98	116.6	135.4
-1	5.9	11.7	49	43.4	54.9	99	118.6	137.5
0	6.4	12.3	50	44.5	56.1	100	120.6	139.7
1	6.9	12.9	51	45.6	57.4	101	122.6	141.9
2	7.4	13.5	52	46.7	58.6	102	124.7	144.1
3	7.9	14.1	53	47.8	59.9	103	126.8	146.3
4	8.4	14.7	54	48.9	61.1	104	128.9	148.6
5	9.0	15.4	55	50.0	62.4	105	131.0	150.9
6	9.5	16.0	56	51.2	63.7	106	133.1	153.2
7	10.0	16.6	57	52.4	65.1	107	135.3	155.5
8	10.6	17.3	58	53.6	66.4	108	137.5	157.9
9	11.2	18.0	59	54.8	67.8	109	139.8	160.2
10	11.8	18.9	60	56.1	69.1	110	142.0	162.4
11	12.4	19.4	61	57.3	70.5	111	144.3	165.1
12	13.0	20.0	62	58.6	71.9	112	146.6	167.5
13	13.5	20.8	63	59.9	73.4	113	148.9	170.0
14	14.2	21.5	64	61.2	74.8	114	151.3	172.5
15	14.8	22.2	65	62.5	76.3	115	153.6	175.0
16	15.5	23.0	66	63.8	77.7	116	156.0	177.6
17	16.1	23.7	67	65.2	79.2	117	159.5	180.1
18	16.8	24.5	68	66.5	80.8	118	160.9	182.8
19	17.4	25.3	69	67.9	82.3	119	163.4	185.4
20	18.1	26.0	70	69.3	83.9	120	165.9	188.0
21	18.8	26.9	71	70.7	85.4	121	168.4	190.7
22	19.5	27.7	72	72.1	87.0	122	171.0	193.4
23	20.3	28.6	73	73.6	88.6	123	174.6	196.1
24	21.0	29.4	74	75.1	90.2	124	176.2	198.9
25	21.7	30.3	75	76.6	91.9	125	178.8	201.7
26	22.5	31.1	76	78.1	93.6	126	181.5	204.5
27	23.3	32.0	77	79.7	95.2	127	184.2	207.3
28	24.0	32.9	78	81.2	97.0	128	186.9	210.2
29	24.8	33.8	79	82.8	98.7	129	189.7	213.1
30	25.6	34.7	80	84.4	100.4	130	192.5	216.0
31	26.4	35.7	81	86.0	102.2			
32	27.3	36.6	82	87.6	104.0			
33	28.1	37.6	83	89.3	105.8			
34	29.0	38.6	84	91.0	107.6			
35	29.8	39.6	85	92.6	109.4			
36	30.7	40.6	86	94.4	111.3			
37	31.6	41.6	87	96.1	113.2			
38	32.5	42.6	88	97.8	115.1			
39	33.4	43.7	89	99.6	117.0			

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