Refrigerant changeover guidelines

HCFC R-22 to HFC R-407A/F/H, R-448A or R-449A
for medium and low temperature applications

HCFC R-22 to HFC R-407C
for high, medium and low temperature applications

HCFC R-22 to HFC R-427A
for medium and low temperature applications

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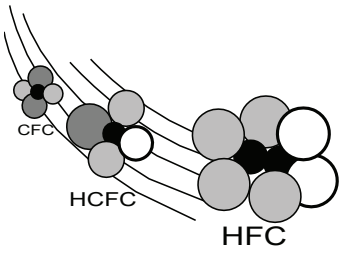

Emerson does not advocate the wholesale changeover of HCFC refrigerants to HFCs. If a system is not leaking refrigerant to the atmosphere, and is operating properly, there is no technical reason to replace the HCFC refrigerant. In fact, changing the refrigerant may void the U.L. listing of the unit. However, once the decision has been made to make the change from R-22 to HFC R-407A/C/F/H, R-448A, R-449A or R-427A 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 U.L. Standard For Field Conversion/Retrofit Of Alternate Refrigerants In Refrigeration And Air Conditioning Equipment (U.L. 2170).

   Emerson Climate Technologies does not recommend retrofitting Discus compressors prior to the release of the Delta Reed design of the suction valve. For the 3D models, the design change took place in 1999 and for the 4D and 6D model compressors, in 2003. The combination of HFC refrigerants and POE oil may cause increased wear in the older Floating Reed design.

2. The only lubricants approved by Emerson for use with R-407A/C/F/H, R-448A, R-449A and R-427A are Polyol Ester lubricants. Please refer to bulletin 93-11 for a complete list of approved oils. These lubricants are available from all authorized Copeland Wholesalers. The use of other POE lubricants may void the compressor warranty

3. Compressor capacity will be comparable to R-22 in medium temperature applications.

4. R-407A/C/F/H, R-448A, R-449A and R-427A should be used only in systems that currently use R-22. It should not be mixed with R-22 or any other refrigerant. In extended medium and low temperature applications, Demand Cooling™ is required.

5. The capacity of the existing R-22 thermal expansion valve (TEV) will be approximately the same when using R-407A/C/F/H, R-448A, R-449A or R-427A. However, the superheat setting must be checked and may have to be readjusted after the system is put back into operation. Emerson Climate Technologies recommends a superheat of 20°F at the inlet of the compressor to avoid possible liquid refrigerant flood back concerns. Consult with the TEV manufacturer for correct sizing and superheat settings. R-407F/H is only applicable in Copeland Discus low and medium temperature applications and with select Copeland Scroll refrigeration models (ZF/ZB) at this time.

6. Filter-driers must be changed at the time of conversion. This is proper air conditioning, refrigeration practice.

   Solid core driers such as Emerson ADK are compatible with R-22, R-407A/C/F/H, R-448A, R-449A and R-427A.

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

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

7. Because of glide, pressure regulators such as EPR valves may have to be reset. Contact the EPR manufacturer for the correct settings. Systems with receivers may experience some fractionation of the refrigerant in the receiver and have somewhat lower capacity.

8. R-407A/C/F/H, R-448A, R-449A and R-427A exhibit higher pressures than R-22 at normal condensing temperatures. This may require adjusting the high pressure safety controls to operate as intended.

9. Systems that use a low pressure controller to maintain space temperature may need to have the cut in and cut out points changed. With R-407A/C/F/H, R-448A, R-449A and R-427A the pressure settings 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 is approximately 10°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 70°F air conditioned space usually requires that the refrigerant temperature in the evaporator be approximately 45°F. Using R-407C, the liquid entering the evaporator may be as cold as 40°F and the vapor temperature before superheat may be 50°F. Some pocket Pressure-Temperature charts give a midpoint evaporator temperature versus pressure. This may be used for the initial setting of the pressure activated room temperature controller. If the midpoint data is not available, subtract five degrees from the desired average

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.

evaporator temperature, (in this case 45°F - 5°F = 40°F) and set the initial pressure setting for the corresponding bubble point (liquid) pressure shown on the P/T chart (in this case 40°F = 79 psig).

10. Due to refrigerant glide, it is important that when measuring and/or adjusting TEV superheat, the pressure and SATURATED VAPOR (Dew Point) TABLES be used. Example: The pressure measured at the TEV bulb is 79 psig. The Pressure/ Temperature (P/T) chart shows that the saturated vapor temperature, at the dew point, of R-407C for 79 psig is = 51°F. If the actual refrigerant temperature is 60°F the superheat is 9°F.

    To measure sub-cooling at the condenser outlet or at the TEV inlet to verify that a solid column of liquid is present, measure the pressure and the temperature at the location that the sub-cooling information is needed. Compare it to the SATURATED LIQUID (Bubble Point) TABLES. Example: A pressure of 250 psig is measured at the condenser outlet. From the R-407C chart, 250 psig is = 108°F saturated liquid temperature. If the actual refrigerant temperature is 98°F, the liquid is sub-cooled 10°F.

11. Systems using R-407A/C/F/H, R-448A, R-449A or R-427A may have a higher system pressure drop than with R-22. 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.

12. Mineral oil lubricant, such as 3GS, cannot be used as the compressor lubricant. Emerson recommends the following lubricant choices: Polyol Ester (POE).

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

    a. Safety glasses
    b. Gloves
    c. Refrigerant service gauges
    d. Electronic thermometer
    e. Vacuum pump capable of pulling 250 microns
    f. Thermocouple micron gauge
    g. Leak detector
    h. Refrigerant recovery unit including refrigerant cylinder
    i. Proper container for removed lubricant
    j. New liquid control device
    k. Replacement liquid line filter-driers(s)
    l. New (POE) lubricant approved by Emerson: Polyolester Oil (Copeland Ultra 32-3MAF,Lubrizol Emkarate RL32-3MAF, Parker EMKARATE RL32-3MAF/ (Virginia) LE323MAF, Nu Calgon 4314-66 (EMKARATE RL32-3MAF)*
    m. R-407A/C/F/H, R-448A, R-449A or R-427A pressure temperature chart
    n. R-407A/C/F/H, R-448A, R-449A or R-427A refrigerant

NOTE: Refer to 93-11 for the latest approved refrigerant/lubricants list.

CHANGEOVER PROCEDURE

NOTE: 1. R-407A/C/F/H, R-448A, R-449A and R-427A is not compatible with the seal material used in the R-22 Moduload unloading system. If your system has Moduload, the valve plate assembly MUST be changed.

Consult your Emerson wholesaler for the proper part numbers.

1. The system should be thoroughly leak tested with the R-22 still in the system. All leaks should be repaired before the R-407A/C/F/H, R-448A, R-449A or R-427A refrigerant is added.

2. It is advisable that the system operating conditions be recorded with the R-22 still in the system. This will provide the base data for comparison when the system is put back into operation with the R-407A/C/F/H, R-448A, R-449A or R-427A.

3. The system should be electrically shut off 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-407A/C/F/H, R-448A, R-449A and R-427A (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 lubricant removed to determine if further cleanup or flushing is warranted.

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 Emerson wholesaler can provide the technician with the information.

    The use of a refractometer is highly recommended to determine the amount of mineral oil left in the system after installation of POE oil.

    Because mineral oils are not miscible with R-407A/ C/F/H, R-448A, R-449A or R-427A, they may log in the evaporator resulting in system capacity loss. It is for this reason that the flushing process must be done with the R-22 in the system. Copeland recommends flushing to a maximum of no more than 5% residual mineral oil in the system for effective system performance. System design plays a significant role in oil return and logging. In some systems, it may be possible to achieve adequate

system performance even with residual mineral oil up to 10%. As long as system performance is not compromised, residual mineral oil in the range of 5 to 10% is acceptable.

NOTE: 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 one percent mineral oil in systems employing these types surfaces.

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 any system components are changed if necessary. Install the correct liquid line filter-drier. Driers must be compatible with the refrigerant and lubricant.
7. 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.
8. Once the compressor is installed and the system is closed, the system must be evacuated to 250 microns or lower.
9. REFRIGERANT CHARGING WITH 'ZEOTROPES'. R-407A/C/F/H, R-448A, R-449A and R-427A are zeotropic mixtures. 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 approximately 80 percent of the amount of refrigerant removed from the system.
10. Start the system and observe its operation. Additional refrigerant may have to be added to obtain optimum performance. Note: On systems with long liquid lines, the sight glass should be installed near the expansion valve to avoid erroneous flash gas indication caused by pressure drop or ambient temperature.

    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 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.
11. Operate the system and record the operating conditions. Compare this data to the data taken in item 2 this section. Check and adjust the TEV superheat setting if necessary. Make adjustments to other controls as needed.
12. Properly label the components. Tag the compressor with the refrigerant used (R-407A/C/F/H, R-448A, R-449A, R-427A) and the lubricant used. The proper color code for R-407A is bright green, R-407C is chocolate brown, R-407F is light green,R-407H is light purple, R-448A is blue, R-449A is grayish blue and R-427A is Green. **NOTE:** Beginning 2021, refrigerant cylinders may all revert to a gray color with a label attached to the top designating the refrigerant type.
13. Clean up and properly dispose of the 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-407A/C/F/H, R-448A, R-449A and R-427A, not for refrigerants which are similar to R-407A/C/F/H, R-448A, R-449A or R-427A. Other refrigerants may not be compatible with the materials used in our compressors or the lubricants recommended in this bulletin resulting in unacceptable reliability and durability of the compressor

ADDENDUM

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⚠ 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).

Saturated Vapor/Liquid Temperature/Pressure Chart

Temperature		R-22	R-407A Liquid pressure	R-407A Vapor pressure	R-407C Liquid pressure	R-407C Vapor pressure	R-407F Liquid pressure	R-407F Vapor pressure	R-407H Liquid pressure	R-407H Vapor pressure	R-427A Liquid pressure	R-427A Vapor pressure
°F	°C											
-40	-40	0.5	3.9	***1***	3	***4.4***	4.9	***0.4***	3.56	***1.68***	2.2	***5.1***
-35	-37.2	2.6	6.4	1	5.4	***0.6***	7.5	1.9	6.02	0.25	4.5	***1.5***
-30	-34.4	4.9	9.2	3.3	8	1.8	10.4	4.2	8.74	2.40	7.0	1.3
-25	-31.7	7.4	12.2	5.8	10.9	4.1	13.6	6.8	11.73	4.79	9.7	3.5
-20	-28.9	10.1	15.6	8.5	14.1	6.6	17.1	9.7	15.01	7.44	12.8	6.0
-15	-26.1	13.2	19.2	11.5	17.6	9.4	20.9	12.9	18.60	10.35	16.1	8.7
-10	-23.3	16.5	23.2	14.9	21.3	12.5	25.1	16.4	22.52	13.56	19.7	11.7
-5	-20.6	20.1	27.5	18.5	25.4	15.9	29.6	20.2	26.78	17.09	23.6	15
0	-17.8	24	32.2	22.5	29.9	19.6	34.5	24.4	31.41	20.94	27.9	18.7
5	-15	28.2	37.3	26.9	34.7	23.6	39.8	28.9	36.43	25.15	32.6	22.6
10	-12.2	32.8	42.8	31.6	39.9	28	45.6	33.9	41.86	29.74	37.6	26.9
15	-9.4	37.7	48.7	36.7	45.6	32.8	51.8	39.3	47.71	34.72	43	31.5
20	-6.7	43	55.1	42.3	51.6	38	58.5	45.1	54.02	40.12	48.8	36.6
25	-3.9	48.8	62	48.3	58.2	43.6	65.6	51.4	60.80	45.97	55	42.1
30	-1.1	54.9	69.3	54.8	65.2	49.6	73.3	58.2	68.07	52.28	61.7	48
35	1.7	61.5	77.2	61.8	72.6	56.1	81.6	65.5	75.86	59.08	68.9	54.3
40	4.4	68.5	85.6	69.4	80.7	63.1	90.4	73.4	84.20	66.40	76.6	61.2
45	7.2	76	94.6	77.4	89.2	70.6	99.7	81.8	93.09	74.27	84.8	68.5
50	10	84	104	86.1	98.3	78.7	109.7	90.8	102.58	82.69	93.6	76.4
55	12.8	92.6	114	95.3	108	87.3	120.4	100.5	112.67	91.72	102.9	84.8
60	15.6	102	125	105	118	96.8	131.7	110.8	123.41	101.36	112.8	93.8
65	18.3	111	137	116	1219	106	143.7	121.8	134.80	111.66	123.3	103.4
70	21.1	121	149	127	141	117	156.4	133.5	146.88	122.63	134.4	113.7
75	23.9	132	162	139	153	128	169.9	146	159.67	134.31	158.6	136.1
80	26.7	144	175	152	166	140	184.1	159.2	173.20	146.73	158.6	136.1
85	29.4	156	190	165	180	153	199.1	173.3	187.49	159.92	171.8	148.4
90	32.2	168	205	179	195	166	215	188.2	202.57	173.92	185.7	161.5
95	35	182	221	194	210	181	231.7	203.9	218.47	188.75	200.3	175.3
100	37.8	196	238	210	226	196	249.3	220.6	235.21	204.45	215.8	189.9
105	40.6	211	255	227	243	211	267.8	238.3	252.83	221.06	232	205
110	43.3	226	274	245	261	229	287.2	256.9	271.35	238.61	249.1	221.7
115	46.1	243	293	264	280	247	307.6	276.6	290.79	257.16	276	238.9
120	48.9	260	314	284	300	266	329	297.4	311.20	276.73	285.8	257.1
125	51.7	278	335	305	321	286	351.5	319.3	332.60	297.37	305.5	276.3
130	54.4	297	358	327	342	307	375	342.4	355.02	319.14	326.2	296.5
135	57.2	317	382	350	365	329	399	366.8	378.50	342.09	347.8	317.8
140	60	337	406	375	389	353	425.4	392.4	403.06	366.27	170.5	346.3
145	62.8	359	432	401	–	–	452.4	419.5	428.75	391.74	394.1	363.9
150	65.6	382	459	428	–	–	480.6	448	455.59	418.59	418.9	388.8

R-448A Temperature/Pressure Chart

Sat Temp	Pressure	
°F	Vapor	Liquid
-50	7.58	**0.27**
-48	6.26	**1.09**
-46	4.89	**1.94**
-44	3.44	**2.83**
-42	1.94	**3.76**
-40	0.36	**4.72**
-38	0.63	**5.72**
-36	1.47	**6.77**
-34	2.35	**7.85**
-32	3.27	**8.98**
-30	4.22	**10.15**
-28	5.21	**11.37**
-26	6.25	**12.63**
-24	7.32	**13.93**
-22	8.44	**15.29**
-20	9.60	**16.70**
-18	10.81	**18.15**
-16	12.06	**19.66**
-14	13.36	**21.22**
-12	14.71	**22.83**
-10	16.11	**24.50**
-8	17.57	**26.23**
-6	19.07	**28.01**
-4	20.63	**29.86**
-2	22.24	**31.76**
0	23.91	**33.72**
2	25.63	**35.75**
4	27.42	**37.84**
6	29.26	**40.00**
8	31.17	**42.23**
10	33.14	**44.52**
12	35.17	**46.88**
14	37.28	**49.31**
16	39.44	**51.82**
18	41.68	**54.40**
20	43.99	**57.05**
22	46.36	**59.78**
24	48.82	**62.59**
26	51.34	**65.47**
28	53.94	**68.44**
30	56.62	**71.49**
32	59.38	**74.62**
34	62.22	**77.84**
36	65.14	**81.14**
38	68.14	**84.53**
40	71.24	**88.01**
42	74.41	**91.58**
44	77.68	**95.24**
46	81.03	**99.00**
48	84.48	**102.85**
50	88.02	**106.79**
52	91.66	**110.84**

Sat Temp	Pressure	
°F	Vapor	Liquid
54	95.39	**114.98**
56	99.22	**119.23**
58	103.16	**123.58**
60	107.19	**128.03**
62	111.33	**132.59**
64	115.57	**137.25**
66	119.93	**142.02**
68	124.39	**146.91**
70	128.96	**151.90**
72	133.65	**157.01**
74	138.45	**162.23**
76	143.37	**167.57**
78	148.40	**173.03**
80	153.56	**178.61**
82	158.84	**184.31**
84	164.25	**190.13**
86	169.78	**196.08**
88	175.45	**202.15**
90	181.24	**208.36**
92	187.17	**214.69**
94	193.23	**221.15**
96	199.44	**227.75**
98	205.78	**234.48**
100	212.27	**241.34**
102	218.90	**248.35**
104	225.68	**255.50**
106	232.61	**262.78**
108	239.69	**270.22**
110	246.93	**277.79**
112	254.33	**285.52**
114	261.88	**293.39**
116	269.61	**301.41**
118	277.50	**309.59**
120	285.56	**317.92**
122	293.79	**326.41**
124	302.20	**335.06**
126	310.79	**343.86**
128	319.56	**352.83**
130	328.52	**361.96**
132	337.67	**371.26**
134	347.02	**380.73**
136	356.57	**390.37**
138	366.32	**400.18**
140	376.28	**410.16**
142	386.45	**420.32**
144	396.84	**430.66**
146	407.46	**441.17**
148	418.31	**451.87**
150	429.40	**462.75**

Red (in of HG) = Vacuum
Black (psig) = Vapor
Bold (psig) = Liquid

R-449A Temperature/Pressure Chart

Sat Temp	Pressure	
°F	Vapor	Liquid
-50	7.39	**0.31**
-48	6.06	**1.12**
-46	4.67	**1.98**
-44	3.22	**2.87**
-42	1.70	**3.80**
-40	0.12	**4.76**
-38	0.75	**5.76**
-36	1.60	**6.81**
-34	2.48	**7.89**
-32	3.40	**9.02**
-30	4.36	**10.19**
-28	5.36	**11.41**
-26	6.40	**12.67**
-24	7.48	**13.98**
-22	8.61	**15.33**
-20	9.77	**16.74**
-18	10.99	**18.20**
-16	12.25	**19.70**
-14	13.55	**21.26**
-12	14.91	**22.88**
-10	16.31	**24.55**
-8	17.77	**26.27**
-6	19.28	**28.06**
-4	20.84	**29.90**
-2	22.46	**31.80**
0	24.14	**33.77**
2	25.87	**35.79**
4	27.66	**37.88**
6	29.51	**40.04**
8	31.42	**42.26**
10	33.40	**44.55**
12	35.44	**46.91**
14	37.55	**49.35**
16	39.72	**51.85**
18	41.96	**54.43**
20	44.28	**57.08**
22	46.66	**59.81**
24	49.12	**62.61**
26	51.65	**65.49**
28	54.25	**68.46**
30	56.94	**71.51**
32	59.70	**74.63**
34	62.55	**77.85**
36	65.47	**81.15**
38	68.48	**84.54**
40	71.58	**88.01**
42	74.76	**91.58**
44	78.03	**95.24**
46	81.39	**98.99**
48	84.84	**102.83**
50	88.38	**106.78**
52	92.02	**110.82**

Sat Temp	Pressure	
°F	Vapor	Liquid
54	95.76	**114.96**
56	99.59	**119.20**
58	103.52	**123.54**
60	107.56	**127.99**
62	111.70	**132.54**
64	115.95	**137.20**
66	120.30	**141.96**
68	124.76	**146.84**
70	129.33	**151.83**
72	134.02	**156.93**
74	138.82	**162.15**
76	143.73	**167.48**
78	148.77	**172.93**
80	153.92	**178.50**
82	159.20	**184.19**
84	164.60	**190.00**
86	170.13	**195.94**
88	175.79	**202.01**
90	181.58	**208.20**
92	187.50	**214.52**
94	193.56	**220.97**
96	199.76	**227.56**
98	206.09	**234.28**
100	212.57	**241.13**
102	219.19	**248.13**
104	225.96	**255.26**
106	232.88	**262.53**
108	239.95	**269.95**
110	247.18	**277.51**
112	254.57	**285.22**
114	262.11	**293.08**
116	269.82	**301.09**
118	277.69	**309.25**
120	285.74	**317.57**
122	293.96	**326.04**
124	302.35	**334.67**
126	310.92	**343.45**
128	319.68	**352.40**
130	328.62	**361.52**
132	337.75	**370.80**
134	347.08	**380.24**
136	356.61	**389.86**
138	366.33	**399.65**
140	376.27	**409.61**
142	386.42	**419.74**
144	396.79	**430.06**
146	407.39	**440.55**
148	418.22	**451.22**
150	429.28	**462.08**

Red (in of HG) = Vacuum
Black (psig) = Vapor
Bold (psig) = Liquid

About Emerson

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