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August 31, 2023

Linda Kildahl
Department of Ecology
Air Quality Program
P.O. Box 47600
Olympia, WA 98504-7600

RE: Chapter 173-443WAC HYDROFLUOROCARBONS (HFCs) AND OTHER FLUORINATED GREENHOUSE GASES

Dear Ms. Kildahl,

The Chemours Company FC, LLC ("Chemours") appreciates the opportunity to comment on the Department of Ecology's ("Department's") proposal to amend Chapter 173-443 WAC, Hydrofluorocarbons (HFCs). Chemours has developed and commercialized a portfolio of low global warming potential ("GWP") products that utilize hydrofluoroolefin ("HFO") technology. HFO-based products, in addition to low GWP HFCs, can provide environmentally preferable and sustainable solutions in multiple end-uses that are currently dependent on higher GWP HFCs, including for refrigeration, air conditioning, foam blowing agents and propellants.

Substantial Duplication of Regulations under the AIM Act

During the timeframe in which the Department was granted the authority and began the rulemaking process to further reduce hydrofluorocarbon emissions, several key actions have occurred at the Federal level, thus creating substantial duplication between the proposed regulation and the regulations being proposed and implemented under the AIM Act. While we commend Washington State's proactive approach in lieu of definitive Federal action to address these emissions, the Department now has an opportunity to refrain from administering or enforcing provisions of the proposed rule that are substantially duplicative of requirements being imposed by the United States Environmental Protection Agency (EPA). Such refrain will reduce burden on the Department, ensure broader consistency for regulated stakeholders, and most importantly, does not jeopardize achieving the same emission reductions objectives. To cite a specific example, the Washington State provisions for new refrigeration equipment for ice rinks (new and existing facilities) and new refrigeration equipment for room air conditioners and residential dehumidifiers would be the same as Federal provisions, only implemented one year sooner.

Definitions

The following definitions should be modified to provide clarity to regulated stakeholders.

The current definition of "cumulative replacement" does not include the three-year time period to determine when the threshold for "new" equipment has been reached. The three-year time period component should be included in the final definition of cumulative replacement.

Generally, it is inappropriate to qualify GWP values relative to a specific value as being high or low. There is variability in the GWP values of refrigerants depending on the specific end-use application. Indirect emissions related to the energy efficiency of the system represents 70 percent of the total impact of the system. Over the lifetime of the equipment, refrigerant classified as having a high GWP according to this definition could actually contribute to lower overall emissions. In context of the refrigerant management program (RMP), the department should refer to pounds of refrigerant with a GWP greater than a specific value rather than describe it as a high GWP refrigerant.

The definition of "new refrigeration equipment" should be changed or clarified to ensure the enablement of retrofit options for existing equipment.

New Refrigeration Equipment

Refrigerant Retrofits are win-wins for the environment, retailers, and consumers.

Enabling retrofit opportunities for refrigeration equipment is essential to meeting the emissions reductions objectives. The Department must either clarify the definition of new refrigeration equipment or provide more definitive guidance regarding changes to a system that would meet the new equipment criteria.

Retailers need to have the ability to make gradual changes or renovations to their sites to stay in business. Take an example of a supermarket owner, who has 10 stores. To stay competitive, retailers are frequently changing their store layout to adapt to changes in customer needs. Completely replacing a refrigeration system requires a significant capital investment. Such a result would be especially problematic when serving a food desert community, where there is already limited access to fresh foods. Enabling retrofit opportunities offers a lower cost option to meet regulatory requirements while continuing to serve the community.

Retailers with existing systems using higher GWP refrigerants like R-404A or R-22 are feeling the impact of the HFC phasedown under the AIM Act. Under these circumstances, retrofitting a store instead of installing new equipment is the more feasible option, especially when the equipment itself is in good condition and not in need of replacement. The options and benefits of such a retrofit, using the example of a R-404A to R-449A conversion, are summarized in a short educational video sponsored by Chemours (Figure 1).[1]

[1] Checkup with Dr. Chuck, Episode 12, "Converting R-22 or R-404A systems to Opteon™ XP40 (R-449A)

Figure 1 – Retrofit video

During a remodel, a R-404A system can be converted to R-448A/R-449A with only minor system adjustments. Figure 2 shows an example of a retailer converting their systems to lower GWP refrigerants and reducing the Greenhouse Gas Potential (GHGp) of the refrigerants by more than 50%. The detailed calculations for this example are included in Appendix I. Additionally, facilities can realize an 8–9% decrease in energy consumption, as demonstrated in a case study conducted at Raley's Supermarkets (Appendix II). In contrast, requiring adoption of an entirely new refrigeration system could have the retailer staying with R-404A refrigerant as the cost of a new refrigeration systems would be too expensive (possibly $1M additional investment versus $50K for a refrigerant conversion to lower GWP refrigerants).

Scenario:
Small grocery store owner
10 stores = nearly 93M GHGp
3 stores all R-22 systems
7 stores R-404/507 systems
Average store refrigernat charge = 2,500-lbs
Goal: Retrofit (convert) all stores within 3.5-years to lower GWP refrigerants, achieving a total of approximately 50% reduction in potential GHG emissions.

	Goal	Actual	Actual
GOALS	15% YOY reduction	Retrofit Reduction	% reduction
GHGp GOAL Yr 1	13,903,125	13,656,869	-14.7%
GHGp GOAL Yr 2	11,817,656	13,656,869	-17.3%
GHGp GOAL Yr 3	10,045,008	13,656,869	-20.9%
GHGp GOAL Yr 4	8,538,257	6,312,500	-12.2%
Total 3.5-year reduction			
(Estimated / Actual)	44,304,046	47,283,107	-51%

Figure 2 – Results of case study in collaboration with a retailer using 10 stores.

In Conclusion, we ask the Department to ensure the definition of new refrigeration equipment permits retrofit options as a cost-effective means to reduce Scope 1 GHGp emissions by as much as 50% and improve the energy efficiency of these systems, which is a win for the environment and for Washington state consumers.

To recap, the benefits of a retrofit to lower GWP refrigerants are:

1. An R-404A system can undergo conversion to R-448A/R-449A with only minor adjustments to the system, as explained in Chemours' "Checkup with Dr. Chuck" video (Figure 1) or by others in industry (Appendix III).
2. When retailers transition their systems to refrigerants featuring lower GWP values (e.g., R-404A to R-448A/R-449A), it leads to a reduction of over 50% in the Greenhouse Gas Potential (GHGp) of the refrigerants, as illustrated in the example in Figure 2. For additional details, please refer to the comprehensive excel spreadsheet provided.
3. Through the conversion from R-404A to R-449A, facilities can achieve an 8–9% reduction in energy consumption. This assertion is substantiated by evidence and findings from a case study conducted at Raley's Supermarkets (Appendix II)

- Lower cost for retailers – helps get existing equipment to the end of its useful life.

- Approximately 50% reduction in potential greenhouse gas emissions (GHGp)
    - Approximately a 50% decrease in potential Scope 1 emissions and 8–9% reduction in energy consumption.
- More thorough "leak repairs" done during retrofit conversion

Retail Food Refrigeration (including chillers)

Rather than impose a 150 GWP limit for all types of retail food refrigeration equipment, Chemours would recommend the Department incorporate a 300 GWP limit in the final rule for several reasons. First, stand-alone refrigeration units typically incorporate a lower charge (ranging from 1 to 30 pounds) and are less likely to leak than other systems. Also, in such applications, refrigerants between 150 and 300 GWP can offer a significant energy efficiency benefit over < 150 GWP alternatives. Given the increasing efficiency demands for these types of systems this is a key consideration.

Also, in such applications, refrigerants between 150 and 300 GWP can offer a significant energy efficiency benefit and should be a primary focus. Ultimately, the majority of refrigerants with a GWP spanning from 150 to 300 additionally carry an A2L safety classification as per ASHRAE Standard 34. This classification inherently enforces the utilization of smaller charge capacities and necessitates heightened safety measures to mitigate the risk of leaks from systems.

Industrial Process Refrigeration

The Department should not finalize the GWP limits for Industrial Process Refrigeration ("IPR") as proposed, but rather tailor such limitations depending on the type of equipment that is involved. Chemours proposes that all IPR applications be split into different operating temperature ranges with different GWP limitations. Therefore, the Department should change its approach to IPR and establish limits based on temperature application.

IPR applications primarily employ flooded evaporators due to the relative efficiency per heat transfer area as well as the limitations of direct expansion technology in the temperature and capacity ranges present in IPR. In addition, IPR applications employ both positive displacement and dynamic (i.e., centrifugal) compressors. In particular, centrifugal compressors are employed due to their wide operating range, high reliability, and energy efficiency gains over positive displacement designs at rated capacities. Absent of any major technology innovations, both flooded evaporator designs and centrifugal compressor designs require a refrigerant selection that is azeotropic or near azeotropic (i.e., no temperature glide). R-410A represents the highest glide azeotrope that has been successful in low temperature IPR applications employing flooded evaporators and/or centrifugal compressors.

- For refrigerant evaporating temperatures down to –25C (note the distinct difference between refrigerant evaporating temperature and evaporator process leaving temperature), a GWP limit of <700 would be feasible. This would enable fluids like R-513A, which have been demonstrated to be successful to date.

- For refrigerant evaporating temperatures <-25C to >-45C, a GWP limit of <2200 would be feasible. This is in line with the European F-Gas regulation and enables R-410A which has been demonstrated to be successful to date in low temperature IPR. A concession to the <2200 GWP would be <700 with the caveat that fluids in this range which meet the needs of IPR will have a minimum classification of A2L. However, equipment manufacturers have yet to demonstrate the viability of such fluids in industrial machines. Moreover, the widespread implementation of A2Ls in existing industrial facilities poses a challenge that is not yet fully understood. Process hazards analyses would be required for each application to determine the viability of a flammable refrigerant in an area that is not electrically classified (as is many industrial settings).

Chemours would be glad to discuss our comments on the proposed rule or answer any additional questions.

Sincerely,

Schuyler Pulleyn
Regulatory Consultant
The Chemours Company

Attachments:

Appendix I: Retrofit Benefits – Supermarket Systems

Appendix II: Raley's Supermarkets Champions the Transition to Non-Ozone Depleting, Reduced Carbon Footprint Refrigerants with Opteon™ XP40 (R-449A)

Appendix III: Refrigerant Changeover Guidelines HFC R-404A/R-407A/C/F to R-448A/R-449A

Appendix I

Calculation of Supermarket System retrofit benefits in terms of GWP reduction

Scenario:

Small grocery store owner
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3 stores all R-22 systems
7 stores R-404/507 systems
Average store refrigernat charge = 2,500-lbs
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GHGp GOAL Yr 4	8,538,257	6,312,500	-12.2%
Total 3.5-year reduction (Estimated / Actual)	44,304,046	47,283,107	-51%

INPUT BASELINE

Assumptions		Total Refrigerant Amount
# of R-22 stores or whses	3	
# of R-404A stores or whses	7	
# of R-134a stores or whses	0	
Average lbs of R-22	2,500	7,500
Average lbs of R-404A	2,500	17,500
Average lbs of R-134a	0	0
Average lbs of other		

Initial Charge	AR4 - 100		
GWP >1400 Refrigerants	GWP	Total Charge in all locations	GHGp
R-404A	3,922	17,500	68,635,000
R-402A	2,788	0	-
R-408A	3,432	0	-
R-407A	2,107	0	-
R-410A	2,088	0	-
R-507A	3,985	0	-
R-407C	1,774	0	-
R-22	1,810	7,500	13,575,000
R-134a	1,430	0	-
Total Charge		30,000	

GHGp Reduction Potential

GWP <1400 Refrigerants	GWP (AR4 - 100 yr.)	Total charge retrofitted	# stores to retrofit	Total lbs retrofitted	New GHGp	Reduction	**Year 1**	
R-22 to R-449A	1,397	2,500	1	2,500	3,492,500	1,032,500	#1 of 4 R-22 facilities converted	
R-404A to R-449A	1,397	2,500	2	5,000	6,985,000	12,625,000	#1 & #2 of 6 facilities converted	
R-134a to R-513A	631	0			0	-631	#1 & #2 of 6 facilities converted	
CO2	1	0			0			
					10,477,500	13,656,869	79,030,631	Remainig GHGp reduction potential
	GWP						**Year 2**	
R-22 to R-449A	1,397	2,500	1	2,500	3,492,500	1,032,500	#2 of 4 R-22 facilities converted	
R-404A to R-449A	1,397	2,500	2	5,000	6,985,000	12,625,000	#3 & #4 of 6 facilities converted	
R-134a to R-513A	631	0			0	-631	#3 & #4 of 6 facilities converted	
CO2	1	0			0			
					10,477,500	13,656,869	65,373,762	Remainig GHGp reduction potential
	GWP						**Year 3**	
R-22 to R-449A	1,397	2,500	1	2,500	3,492,500	1,032,500	#3 of 4 R-22 facilities converted	
R-404A to R-449A	1,397	2,500	2	5,000	6,985,000	12,625,000	#4 & #5 of 6 facilities converted	
R-134a to R-513A	631	0			0	-631	#4 & #5 of 6 facilities converted	
CO2	1	0			0			
					10,477,500	13,656,869	51,716,893	Remainig GHGp reduction potential
	GWP						**Year 4**	
R-22 to R-449A	1,397	2,500	0	0	0	0	#4 of 4 R-22 facilities converted	
R-404A to R-449A	1,397	2,500	1	2,500	3,492,500	6,312,500		
R-134a to R-513A	631	0			0	0		
CO2	1	0			0			
					3,492,500	6,312,500	45,404,393	Remainig GHGp reduction potential
	GWP						**Year 5**	
R-22 to R-449A	1,397	0		0	0			
R-404A to R-449A	1,397			0	0			
R-134a to R-513A	631				0			
CO2	1	0			0			
					0			
					34,925,000	47,283,107	45,404,393	**New GHGp potential; a reduction of over 50%**

Appendix II

Opteon™ XP40

Refrigerant

Raley's Supermarkets Champions the Transition to Non-Ozone Depleting, Reduced Carbon Footprint Refrigerants with Opteon™ XP40 (R-449A)

Background

Raley's Supermarkets is a family owned chain that takes pride in its leadership and commitment to environmental sustainability. In addition to sustainability projects like reducing energy usage from lighting, the installation of solar panels, and generating natural gas from store waste, Raley's is also leading the industry in its transition to non-ozone depleting, low global warming potential (GWP) refrigerants.

When Raley's corporate engineering and energy groups considered the future of commercial refrigeration in light of new regulations and their own sustainability goals, they consulted with technical experts from long-time refrigerant producer Chemours (formerly DuPont Performance Chemicals) for the latest developments and low GWP options.

Chemours™

LOW GWP ©

After the teams met, Raley's quickly identified an initial test store in Santa Rosa, CA for conversion to the newest low GWP refrigerant from Chemours, Opteon™ XP40 (R-449A). XP40 is a hydrofluoroolefin (HFO) blend that has zero ozone depletion potential (ODP) and a >65% reduction in GWP over the incumbent R-404A refrigerant. The team's project goals were to understand the retrofit details, validate operational performance, and measure energy performance of the new HFO refrigerant.

Opteon™ XP40 Refrigerant

Opteon™ XP40 is a nonflammable, low GWP refrigerant based on new HFO technology that offers excellent performance along with improved environmental and energy properties.

Opteon™ XP40 Properties

ASHRAE Number	R-449A
Lubricant	POE
Boiling Point	-46.0 °C (-50.7 °F)
Safety Classification	A1
Temperature Glide	-4 K (-7 °R)

Overview of Refrigeration System and Conversion to Opteon™ XP40 (R-449A)

The refrigeration system in Raley's Santa Rosa store provides both low temperature (frozen food) and medium temperature (produce, meat, dairy) refrigeration, as well as air conditioning and hot water for the store. The system was originally designed to operate using R-404A refrigerant.

The Santa Rosa conversion project was completed overnight in October 2014 by PMC Mechanical Inc., following retrofit guidelines provided by Chemours. Because the refrigeration system was already operating on POE oil, no lubricant change was required. Additionally, no change out of seals or gaskets was needed. After startup on XP40, the only major work required was to check and adjust the superheat on the individual TXVs, due to the lower mass flow rate of XP40 vs. R-404A. The existing valves were turned down to obtain the proper superheat and prevent liquid flood back. The system cases and walk-ins quickly pulled down to temperature and have operated reliably since the conversion.

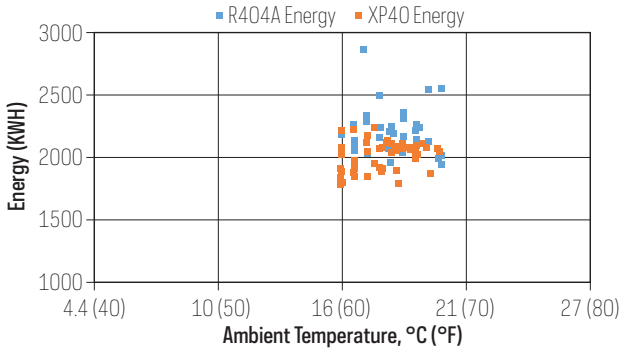
Operational and Energy Performance

The table below provides operational data measured at similar ambient conditions for the system prior to, as well as at 1 week and 6 months, post-conversion to Opteon™ XP40. XP40 is shown to be operating as expected and consistently over this time frame.

	Daily Average Value		
	Pre-Retrofit October 2014 R-404A	1 Week Post-Retrofit November 2014 XP40 (R-449A)	6 Months Post-Retrofit April 2015 XP40 (R-449A)
Condensing Pressure, barg (psig)	11.389 (167.3)	11.300 (166)	11.368 (167)
Discharge Temperature, °C (°F)	60.2 (140.3)	72.1 (161.8)	74.4 (165.9)
Ambient Temperature, °C (°F)	19.7 (67.4)	17.6 (63.6)	16.7 (62)
Medium Temperature Suction Pressure, barg (psig)	3.662 (53.8)	3.336 (49)	3.322 (48.8)
Medium Temperature Suction Temperature, °C (°F)	12.2 (54)	17.2 (62.9)	19.2 (66.5)
Low Temperature Suction Pressure, barg (psig)	1.103 (16.2)	0.837 (12.3)	0.837 (12.3)

Energy performance of the system has also been monitored since the conversion. Below is a plot of daily energy usage (KWH) vs. average daily temperature for selected days in the 16-20 °C (60-68 °F) range for R-404A as well as XP40. Reduced energy usage on the order of 8-9% is observed.

Total Energy Usage for Days at 16-20 °C (60-68 °F)



After one year of operation, a sample of the refrigerant and lubricant were collected from the system and submitted for analysis. Laboratory results for both the POE oil and XP40 showed them to be clean and acid-free, with no indication of degradation.

Conclusion

The refrigeration system for the entire store at the Raley's Supermarket in Santa Rosa, CA was successfully converted from R-404A refrigerant to low GWP HFO-based Opteon™ XP40 (R-449A). The system has now been operating as expected for over one year with all parties pleased with the results. Raley's has plans to convert other stores from R-404A to XP40 in the future; where other than making adjustments to the system controller set points and medium temperature TXVs, they plan on changing low temperature TXVs to fully optimize efficiency.

"Year after year, we've been recognized nationally by the Environmental Protection Agency (EPA) GreenChill program as a sustainability innovator within the grocery industry," said Randy Walthers, Raley's Manager of Energy and Utilities, who captained the team that has improved energy efficiencies throughout the company. "Raley's is proud of our continued focus on sustainability, and we have even more plans going forward. It's about doing what's right," Randy added.

For more information on the Opteon™ family of refrigerants, or other refrigerants products, visit opteon.com or call (800) 235-7882.

C-10616 (6/16)

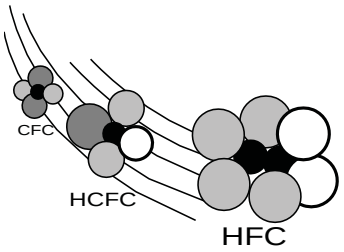
Appendix III

Copeland™
brand products

Refrigerant Changeover Guidelines HFC R-404A/R-407A/C/F to R-448A/R-449A

Leading the Industry with Environmentally Responsible Refrigerant Solutions

EMERSON™
Climate Technologies



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 U.L. listing of the system. However, once the decision has been made to make the change from 404A or 407a to R-448A or R-449A, 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 systems 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.2170-2172).

2. Emerson Climate Technologies, Inc. lubricant recommendation for use with R-448A/R-449A is a Polyol Ester (POE).For a complete list of lubricants approved by Emerson Climate Technologies, Inc. refer to Form 93-11. These are the only POE lubricants approved for use in Copeland™ brand compressors and are available from all authorized Emerson Climate Technologies, Inc. wholesalers. The use of any other POE lubricant may void the compressor warranty.

3. R-448A/R-449A can be used in either low or medium temperature systems. **R-448A/R-449A should not be mixed with any other refrigerant!**

4. The expansion valve may need to be adjusted to have the correct evaporator superheat. Emerson recommends 20° superheat @ the compressor measured 6 inches from in the compressor suction inlet.

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, Inc. ADK are compatible with either R-404A/R-407A or R-448A/R-449A.

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

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

6. Pressure regulators such as EPR valves may have to be reset. Contact the EPR manufacturer for the correct settings.

WARNING: IT IS POSSIBLE THAT EXCESS PRESSURE BUILD-UP ON MODELS INDICATED COULD RESULT IN THE COMPRESSOR BURSTING UNLESS THE PRESSURE RELIEF VALVE SPECIFIED HAS BEEN PROPERLY INSTALLED ON THE ORIGINALLY BUILT COPELAND™ COMPRESSOR.

7. Systems that use a low pressure controller to maintain space temperature may need to have the cut in and cut out points changed. Although R-448A/R-449A does exhibit “glide”, the glide with R-448A/R-449A is approximately 8°F, please see PT Chart below for setting Cut-in and Cut-out pressures.

8. Mineral oil lubricants, such as 3GS, must not be used as the compressor lubricant with R-448A/ R-449A. Polyol Ester (POE) lubricant, for a complete list of lubricants approved by Emerson Climate Technologies, Inc., refer to Form 93-11, are the only lubricants that can be used in a Copeland brand compressor when using R-448A/R-449A. Before starting the changeover, it is suggested that at least the following items be readily available:

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 POE lubricant
13. R-448A/R-449A pressure temperature chart
14. R-448A/R-449A refrigerant

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.

CHANGEOVER PROCEDURE

1. For low temperature Copeland compressors liquid injection may be required. Please review the application bulletin for the specific compressor in your system for part numbers and injection setup.

Consult your Emerson Climate Technologies, Inc. wholesaler for the proper part numbers.

2. The system should be thoroughly leak tested with the R-404A/R-407A refrigerant still in the system. All leaks should be repaired before the R-448A/R-449A refrigerant is added.

3. It is advisable that the system operating conditions be recorded with the R-404A/R-407A still in the system. This will provide the base data for comparison when the system is put back into operation with the R-448A/R-449A.

I. Systems with service valves

a. Disconnect electrical power to system.

b. Front seat the service valves to isolate the compressor.

c. Properly remove the R-404A/R-407A from the compressor.

d. Replace the liquid line filter-drier.

e. Evacuate it to 250 microns. A vacuum decay test is suggested to assure the system is dry and leak free.

f. Recharge the system with R-448A/R-449A.

II. Systems without service valves

a. Disconnect electrical power to system.

b. Properly remove the R-404A/R-407A from the system.

c. Replace the liquid line filter-drier.

d. Recharge the system with R-448A/R-449A.

4. Be advised that POEs are very hygroscopic. They will very quickly absorb moisture from the air once the container is opened.

5. Charge the system with the R-448A/R-449A. Charge to 80% of the refrigerant removed in item 4. R-448A/R-449A must leave the charging cylinder in the liquid phase. It is suggested that a sight glass be connected between the charging hose and compressor suction service valve. This will permit adjustment of the cylinder valve to assure the refrigerant enters the compressor in the vapor state.

6. Operate the system. Record the data and compare to the data taken in item 2. Check and adjust the TEV superheat setting if necessary. Make adjustments to other controls as needed. Additional R-448A/R-449A may have to be added to obtain optimum system performance.

7. Properly label the components. Tag the compressor with the refrigerant used (R-448A/R-449A) and the lubricant used.

8. 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-448A and/or R-449A only. *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

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-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**

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