Opteon™ XP40
Refrigerant (R-449A)

Opteon™ XP40 Retrofit Guidelines to Replace R-402A (HP80) and R-408A

Introduction

Opteon™ XP40 (R-449A) is a low global warming potential (GWP) hydrofluoro-olefin (HFO)-based refrigerant developed as a direct replacement for HCFC-22 (R-22) and R-404A/R-507 in positive displacement, direct expansion, low- and medium-temperature commercial and industrial applications.

Opteon™ XP40 can also be used as a replacement for "service" blends, such as Freon™ HP80 (R-402A) and Freon™ 408A. Because R-402A and R-408A contain a significant percentage of R-22, these blends are subject to the same availability and cost constraints impacting pure R-22, which is being phased out under the Montreal Protocol.

R-402A and R-408A were designed and used as replacements for R-502 in low- and medium-temperature refrigeration systems in the early 1990s. Most systems operating on R-402A and R-408A today are likely to be quite old, and system replacement with new equipment should always be considered as a first step.

Opteon™ XP40 is a HFC/HFO blend of HFC-32/HFC-125/HFC-134a/HFO-1234yf (24.3/24.7/25.7/25.3 wt%) with an ANSI/ASHRAE Standard 34 refrigerant designation of R-449A. It is commercially available around the world for both retrofit of existing (R-22, R-402A, R-408A, R-404A, R-507) equipment, as well as a suitable option for new equipment.

Opteon™ XP40 offers the best overall balance of performance, cost, safety, and sustainability as a class A1 refrigerant with a GWP of 1282 and zero ozone depletion potential (ODP).

Using these retrofit guidelines, existing R-402A and R-408A direct expansion refrigeration systems can be converted to operate using Opteon™ XP40, allowing the equipment to continue to function safely and efficiently with a greatly reduced environmental impact.

Important Safety Information

Like all Freon™ and Opteon™ refrigerants, Opteon™ XP40 is safe to use when handled properly. However, any refrigerant can cause injury or even death when mishandled. Please review the following guidelines and consult the product Safety Data Sheet (SDS), including proper personal protective equipment recommendations, before using any refrigerant. At a minimum, appropriate hand (gloves) and eye (safety glasses) protection should be used.

- Do not work in high concentrations of refrigerant vapors. Always maintain adequate ventilation in the work area. Do not breathe vapors. Do not breathe lubricant mists from leaking systems. Ventilate the area well after any leak before attempting to repair equipment.
- Do not use handheld leak detectors to check for breathable air in enclosed working spaces. These detectors are not designed to determine if the air is safe to breathe. Use oxygen monitors to ensure adequate oxygen is available to sustain life.
- Do not use flames or halide torches to search for leaks. Open flames (e.g., halide or brazing torches) in the presence of any fluorocarbon refrigerant can decompose the refrigerant, forming hazardous acidic compounds. Halide torches are not effective as leak detectors for HFO or HFC refrigerants, as they only detect the presence of chlorine in the refrigerant. Chlorine is not present in Opteon™ XP40, and, consequently, these detectors will not detect the presence of this refrigerant. Use an electronic leak detector specifically designed for the refrigerants you are using.

If you detect a visible change in the size or color of a flame when using brazing torches to repair equipment, stop work immediately and leave the area. Ventilate the work area well, and stop any refrigerant leaks before resuming work. These flame effects may be an indication of very high refrigerant concentrations, and continuing to work without adequate ventilation may result in injury or death.

Chemours™

LOW GWP

Table 1: Comparison of Performance Data for R-402A Alternatives

R-402A Alternatives – Low-Temperature Conditions -20 °F Evaporator, 110 °F Condenser, 100 °F Liquid Line, 30 °F Suction Temp., 70% Isentropic Efficiency						
Refrigerant	Relative Capacity	Relative COP	Relative Mass Flow	Suction Pressure (psia)	Discharge Pressure (psia)	Discharge Temperature (°F)
R-502	1.00	1.00	1.00	29.7	260.6	220.0
R-402A (HP80)	1.10	0.97	0.93	33.4	303.3	222.5
R-449A (XP40)	0.96	0.98	0.72	26.4	277.1	242.3
R-402A Alternatives – Medium-Temperature Conditions 20 °F Evaporator, 110 °F Condenser, 100 °F Liquid Line, 50 °F Suction Temp., 70% Isentropic Efficiency						
R-502	1.00	1.00	1.00	66.3	260.6	174.0
R-402A (HP80)	1.12	0.97	0.94	75.6	303.3	176.0
R-449A (XP40)	1.02	0.98	0.73	63.2	277.1	187.3

Table 2: Comparison of Performance Data for R-408A Alternatives

R-408A Alternatives – Low-Temperature Conditions -20 °F Evaporator, 110 °F Condenser, 100 °F Liquid Line, 30 °F Suction Temp., 70% Isentropic Efficiency						
Refrigerant	Relative Capacity	Relative COP	Relative Mass Flow	Suction Pressure (psia)	Discharge Pressure (psia)	Discharge Temperature (°F)
R-502	1.00	1.00	1.00	29.7	260.6	220.0
R-408A	1.03	1.01	0.74	28.8	266.2	242.8
R-449A (XP40)	0.96	0.98	0.72	26.4	277.1	242.3
R-408A Alternatives – Medium-Temperature Conditions 20 °F Evaporator, 110 °F Condenser, 100 °F Liquid Line, 50 °F Suction Temp., 70% Isentropic Efficiency						
R-502	1.00	1.00	1.00	66.3	260.6	174.0
R-408A	1.04	1.01	0.75	65.6	266.2	187.6
R-449A (XP40)	1.02	0.98	0.73	63.2	277.1	187.3

Overexposure to high concentrations of refrigerant vapor can cause asphyxiation or cardiac arrest. Please read all safety information before handling any refrigerant

Refer to the Opteon™ XP40 SDS for more specific safety information. The "Safety of Freon™ Refrigerants" bulletin also provides additional information for safe handling of refrigerants.

Flammability

Opteon™ XP40 is nonflammable. It has been assigned an A1 safety classification under the ANSI/ASHRAE Standard 34. However, as with all HFC-containing blends, Opteon™ XP40 should not be mixed with air to check for system leaks.

General Retrofit Considerations: R-402A and R-408A to Opteon™ XP40

Expected Performance of Opteon™ XP40 vs. R-402A and R-408A

Tables 1 and 2, based on thermodynamic cycle analysis, provide a comparison of R-402A and R-408A vs. Opteon™ XP40 across several key performance factors. Actual performance for a specific system depends on several factors, including equipment conditions and operating environment.

As mentioned before, R-402A and R-408A were designed as replacements for R-502 in low- and medium-temperature refrigeration systems. Refrigeration systems containing R-402A and R-408A were likely at one time retrofitted from R-502. These older systems might have "obsolete" seals that are not compatible with synthetic lubricants. Special consideration should be taken when deciding to retrofit these systems to Opteon™ XP40.

System Modifications

Lubricant

Most R-402A and R-408A systems use mineral oil (MO) or alkylbenzene (AB) lubricants; however, there may be some systems operating with polyolester (POE) lubricants.

POE lubricants are recommended for use in most HFO and HFC systems. If the R-402A or R-408A system currently uses POE lubricant, the POE lubricant currently in the system should be suitable for use with Opteon™ XP40. If there are questions about the POE lubricant or tests indicate that it is contaminated or has a high acid number, then the lubricant should be changed. Consult with the compressor manufacturer for specific recommendations on viscosity and brand of lubricant.

Special care should be taken when handling POE lubricants due to their tendency to absorb water. Contact with air should be minimized, and the lubricant should be stored in a sealed metal container.

Changing to POE lubricant is recommended when converting to Opteon™ XP40 from a system with MO or AB lubricant. To achieve equivalent miscibility after retrofitting the system, the residual MO/AB lubricant should be ~5 wt% or less. Allowable residual MO/AB lubricant is highly dependent on system configuration and operating conditions. If the system shows signs of poor heat transfer in the evaporator or poor oil return to the compressor, it may be necessary to further reduce the residual MO/AB.

A series of successive lubricant changes using POE can normally reduce the MO/AB concentration to adequate levels. Lubricant manufacturers have developed field test methods for determining the weight percent of MO in POE lubricant. Contact the lubricant manufacturer for the recommended test method.

Filter Drier

Change the filter drier during the retrofit. This is a routine system maintenance practice. There are two types of filter driers commonly used, solid core and loose filled. Replace the drier with the same type currently in use in the system. The drier label will show which refrigerants can be used with that drier. Select a drier specified to work with HFO refrigerants. (Many driers sold today are "universal"–they will work with most fluorocarbon refrigerants.) Check with your Chemours Refrigerants Distributor for the correct drier to use in your system.

Elastomeric Seals

R-22 and, to a lesser extent, R-22-containing refrigerant blends, such as R-402A and R-408A, interact relatively strongly with many elastomers, causing significant swelling and often, over time, a measurable increase in hardness. Opteon™ XP40, like other HFO or HFC refrigerants, does not have as strong of an effect on elastomers commonly used as seals in refrigeration systems. Thus, when performing an R-402A/R-408A retrofit to an HFO/HFC alternative, it is possible for leaks to occur at elastomeric seals that have been previously exposed to R-402A/R-408A refrigerant. This is not a problem attributable specifically to the use of Opteon™ XP40. Such seal leaks have been reported when replacing R-22-containing blends with other HFC refrigerants, such as R-407A/C or R-404A. Components commonly affected are Schrader core seals, liquid level receiver gaskets, solenoid valves, ball valves, flange seals, and some shaft seals on open drive compressors. Leaks do not occur in every system retrofitted, and, in practice, it is difficult to predict whether such leaks will occur. (As a rule of thumb: the older the system, the higher the probability that leaks will be observed after a retrofit.)

Consequently, it is recommended to change elastomeric seals and gaskets as a matter of course during a retrofit, particularly any system-critical seals (those that would require removal of the refrigerant charge to allow seal replacement, e.g., liquid receiver, refrigerant high pressure side, etc.). It is also recommended to have spare seals for other components available during restart of the system. The same type of seal can be used; it should just be a new one that has not previously been used with an R-22-containing refrigerant. A rigorous leak check regime pre- and post-retrofit will minimize any refrigerant losses. Obviously, any seals found to be leaking before the retrofit takes place should be replaced during the retrofit.

Compressor

Overall system performance (capacity and energy efficiency) will be similar when operating on Opteon™ XP40 as to that when using R-402A or R-408A.

Compressor suction and discharge pressures for Opteon™ XP40 will differ from R-402A or R-408A, and it may be necessary to adjust set points and cutouts to avoid exceeding the operating limits of the compressor. Consult with the specific system manufacturer for guidance.

Opteon™ XP40 has a modestly higher (+24-25 °R) discharge temperature than R-402A. Consult the compressor manufacturer for details regarding operation of your specific compressor on Opteon™ XP40.

Opteon™ XP40 has a comparable (+2-3 °R) discharge temperature relative to R-408A. Again, you should consult with your compressor manufacturer for details regarding operation of your specific compressor on Opteon™ XP40.

Compatibility

Retrofitting systems with Copeland 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 (UL 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. Please consult Emerson's "Refrigerant Changeover Guidelines" for specific information, https://opi.emersonclimate.com/CPID/GRAPHICS/Types/AEB/95-14.pdf

It is recommended that Carlyle reciprocating compressors manufactured before 1994 be retrofitted with a higher flow oil pump. This pump is designed for heavier POE lubricants. See section 2.4 of the Carlyle "06D/E Application Guide," http://www.utcccs-cdn.com/hvac/docs/2002/Public/09/574-069.pdf

Expansion Device

Opteon™ XP40 has a lower mass flow rate (-23-30%) than R-402A, but should be within the usable range of a properly sized and installed R-402A expansion device and should not require replacement. Some adjustment to the expansion valve(s) may be needed to reset the superheat following conversion of the system. For a conservative approach, it is recommended that the thermostatic element be replaced with a R-449A/R-407A type element. Use the pressure-temperature chart (dew point [saturated vapor] values) at the end of this guide for correct measurement and setting of evaporator superheat. If you have further questions, consult with the expansion device manufacturer for correct valve sizing and superheat adjustments.

Opteon™ XP40 has a slightly higher mass flow rate (-5%) than R-408A, but should be within the usable range of a properly sized and installed R-408A expansion device; thus, not requiring replacement. Some adjustment to the expansion valve(s) may be needed to reset the superheat following conversion of the system. Use the pressure-temperature chart (dew point [saturated vapor] values) at the end of this guide for correct measurement and setting of evaporator superheat. If you have further questions, consult with the expansion device manufacturer for correct valve sizing and superheat adjustments.

Line Sizing

Opteon™ XP40 has lower mass flow rates and density than R-402A. It is recommended that the existing refrigerant line sizing be checked to verify that the system pressure drops and line velocities are acceptable with the new refrigerant. Correct pipe sizing is important to ensure adequate refrigeration capacity and sufficient oil return to the compressor

Opteon™ XP40 has slightly lower mass flow rates and density than R-408A. It is recommended that the existing refrigerant line sizing be checked to verify that the system pressure drops and line velocities are acceptable with the new refrigerant. Correct pipe sizing is important to ensure adequate refrigeration capacity and sufficient oil return to the compressor.

Condenser and Evaporator

Due to the differences in suction pressure between Opteon™ XP40 and R-402A or R-408A, it may be necessary to reset evaporator pressure regulators (EPRs) and cutouts to properly operate the system. The discharge pressure of Opteon™ XP40 is modestly higher than R-402A and slightly lower than R-408A and may require adjustments to condenser fans and head pressure controls.

Opteon™ XP40 is a blend refrigerant; therefore, when setting superheat, the dew point (saturated vapor) in the pressure-temperature chart should be used. Similarly, the bubble point (saturated liquid) should be used for measuring subcooling.

System Controls

Many supermarkets use refrigeration control systems and methodologies that rely on the pressure-temperature relationship of a specific refrigerant for proper operation. For optimal performance, during conversions from R-402A or R-408A to Opteon™ XP40 (although the controls will likely function adequately), they should be updated for operation using Opteon™ XP40 refrigerant properties. Consult with the control system manufacturer for guidance on updating refrigerant data or operating instructions when using Opteon ™ XP40.

Retrofit R-402A (HP80)/R-408A Systems to Opteon™ XP40

The following detailed steps are the recommended procedure for retrofitting R-402A/R-408A systems to Opteon™ XP40:

1. **Establish Baseline Performance with R-402A/R-408A**
   Collect system performance data while R-402A/R-408A refrigerant is in the system. Check for correct refrigerant charge and operating conditions. The baseline data of temperatures and pressures at various points in the system (evaporator, condenser, compressor suction and discharge, evaporator vapor superheat, and condenser liquid subcool) at normal operating conditions will be useful in noting any deficiencies in system operation and when optimizing operation of the system with Opteon™

XP40. A System Data Sheet is included at the back of this bulletin to record baseline data.

2. Drain/Charge System Lubricant

Where MO or AB oil is the existing lubricant in the system, it must be drained. This may require removing the compressor from the system, particularly with small hermetic compressors that have no oil drain. In this case, the lubricant can be drained from the suction line of the compressor. In most small systems, 90-95% of the lubricant can be removed from the compressor in this manner. Larger systems may require drainage from additional points in the system, particularly low spots around the evaporator, to remove most of the lubricant. In systems with an oil separator, any lubricant present in the separator should also be drained. In all cases, measure the volume of lubricant removed from the system. Compare to the compressor/system specifications to ensure that most of the lubricant has been removed. Polyol ester lubricant is recommended for use with Opteon™ XP40. To achieve equivalent miscibility to R-402A/R-408A/MO, the residual mineral oil should be about 5 wt% or less of the total lubricant used in the system. In larger systems, this amount of residual mineral oil can be achieved by using a flushing technique. Three or more lubricant flushes may be required. Lubricant flushes involve:

- Draining existing lubricant from the system, as described above.
- Selecting a polyol ester lubricant with similar viscosity to the existing lubricant.
- Charging an amount of polyol ester equal to the amount of lubricant removed.
- Running the system with R-402A/R-408A for thorough mixing of polyol ester/existing lubricant (48 to 72 hours of operation may be required).

Repeat these steps two more times. On the last flush, R-402A/R-408A will be replaced with the retrofit refrigerant.

3. Remove the R-402A/R-408A Charge into Recovery Cylinders

Remove the entire R-402A/R-408A refrigerant from the system into a recovery cylinder(s). Use a recovery device capable of pulling 10-15 in Hg vacuum (50-67 kPa absolute). Weigh the amount removed to use as a guide for the quantity of Opteon™ XP40 to be charged to the system.

4. Replace Filter Drier and Critical Elastomeric Seals/ Gaskets

It is routine practice to replace the filter drier during system maintenance. Replacement filter driers are available that are compatible with Opteon™ XP40. While the system is empty, check and replace any elastomeric seals that may be near the end of their serviceable life. Even if they were not previously leaking, the change of swell characteristics when changing to any new refrigerant and the general disturbance to the system may cause worn seals to leak after retrofit. Components commonly affected are Schrader core seals, liquid level receiver gaskets, solenoid valves, ball valves, flange seals, and some shaft seals on open drive compressors; but, all external seals in contact with the refrigerant should be viewed as a potential leak source post-retrofit. Field experience has shown that the older the system, the greater the likelihood of seal and gasket leaks. It is recommended to change any system critical seals (e.g., those that require removal of the refrigerant charge to allow seal replacement, e.g., liquid receiver, condenser system) as a matter of course and to have spare seals for other components available during the retrofit should any seal failure occur. A rigorous leak check regime pre- and post-retrofit will minimize any refrigerant losses.

5. Perform Other System Modifications

Perform any system modifications or upgrades as needed for the system.

6. Evacuate System and Check for Leaks

To remove air or other non-condensable gases and any residual moisture from the system, evacuate the system to full vacuum (<1000 microns [<29.88 in Hg vacuum] [<1.33 mbar]). If the system is not able to hold vacuum, it may be an indication of a leak. After vacuum test, pressurize the system with dry nitrogen, taking care not to exceed the system design maximum pressure, and check for leaks. Do not use mixtures of refrigerant and air to check for leaks, as these mixtures can become combustible. After leak checking, remove residual nitrogen with a vacuum pump.

7. Charge System with Opteon™ XP40

Opteon™ XP40 is a blend; so, it is important to remove liquid only from the charging cylinder. (If the cylinder does not have a valve with a dip tube, invert the cylinder so that the valve is underneath the cylinder.) The proper cylinder position is often indicated by arrows on the cylinder and the cylinder box. Once liquid is removed from the cylinder, the refrigerant can be allowed to enter the refrigeration system as liquid or vapor as desired.

WARNING: Do not charge liquid refrigerant into the suction line. This can cause irreversible damage to the compressor. Use the manifold gauges or a throttling valve to flash the liquid refrigerant to a vapor prior to entering the suction line.

In general, refrigeration systems will require a slightly smaller charge size of Opteon™ XP40 than the original R-402A/R-408A charge. The optimum charge will vary depending on the system design and operating conditions. The initial charge should be approximately 85% of the standard charge size for R-402A/R-408A. After startup and adjustment, the final charge amount will be approximately 95% of the R-402A/R-408A charge.

8. Start Up System and Check Operation

- Monitor and adjust TXV and/or charge size to achieve optimum superheat/subcooling.
- Monitor oil levels in compressor. Add oil as required to maintain proper levels.

9. Label System with New Refrigerant and Lubricant

Appendix A.

Table 3: Condenser Set Points

R-402A (HP80) (psig)	R-408A (psig)	Average Condenser Temp. (°F)	Opteon™ XP40 (psig)	R-402A (HP80) (psig)	R-408A (psig)	Average Condenser Temp. (°F)	Opteon™ XP40 (psig)
187.0	161.4	80	166.4	292.6	255.0	111	266.6
189.9	164.0	81	168.8	296.5	258.6	112	270.1
192.8	166.6	82	171.2	300.6	262.1	113	273.6
195.8	169.2	83	174.6	304.6	265.7	114	278.2
198.8	171.9	84	178.2	308.7	269.4	115	281.8
201.8	174.6	85	180.4	312.8	273.0	116	285.3
204.9	177.3	86	182.6	317.0	276.8	117	290.0
208.0	180.0	87	186.2	321.2	280.5	118	293.6
211.1	182.8	88	189.0	325.5	284.3	119	297.0
214.3	185.6	89	192.0	329.8	288.1	120	301.8
217.5	188.4	90	194.4	334.1	291.9	121	306.4
220.7	191.3	91	197.8	338.5	295.8	122	310.0
223.9	194.2	92	201.2	342.9	299.7	123	314.6
227.2	197.1	93	203.6	347.4	303.7	124	318.2
230.6	200.1	94	207.1	351.9	307.7	125	322.9
233.9	203.0	95	210.6	356.5	311.7	126	327.6
237.3	206.0	96	213.5	361.1	315.8	127	332.4
240.8	209.1	97	217.6	365.7	319.9	128	335.8
244.2	212.2	98	219.9	370.4	324.1	129	340.6
247.7	215.3	99	223.4	375.1	328.3	130	345.3
251.3	218.4	100	226.8	379.9	332.5	131	350.0
254.8	221.6	101	230.4	384.7	336.8	132	354.8
258.4	224.8	102	233.8	389.5	341.1	133	359.5
262.1	228.0	103	237.4	394.4	345.4	134	364.2
265.8	231.3	104	240.8	399.4	349.8	135	369.0
269.5	234.6	105	244.4	404.4	354.3	136	375.0
273.2	237.9	106	247.9	409.4	358.8	137	378.4
277.0	241.3	107	251.4	414.5	363.3	138	383.2
280.9	244.6	108	254.8	419.7	367.8	139	388.0
284.7	248.1	109	258.4	424.9	372.4	140	394.0
288.6	251.5	110	261.9				

After converting from R-22 to Opteon™ XP40, the condensing pressure can be determined by locating the desired average condenser temperature (or R-402A or R-408A pressure setting) on this chart and determining the new set point required for equivalent operation with Opteon™ XP40.

Table 4: Evaporator Set Points

R-402A (HP80) (psig)	R-408A (psig)	Average Condenser Temp. (°F)	Opteon™ XP40 (psig)	R-402A (HP80) (psig)	R-408A (psig)	Average Condenser Temp. (°F)	Opteon™ XP40 (psig)
15.1	11.0	-25	8.9	49.1	40.6	11	38.1
15.8	11.6	-24	9.5	50.4	41.7	12	39.2
16.5	12.2	-23	10.1	51.6	42.8	13	40.3
17.2	12.9	-22	10.7	52.9	43.9	14	41.4
18.0	13.5	-21	11.3	54.2	45.0	15	42.5
18.7	14.2	-20	11.9	55.5	46.2	16	43.7
19.5	14.8	-19	12.6	56.8	47.3	17	44.9
20.2	15.5	-18	13.2	58.2	48.5	18	46.1
21.0	16.2	-17	13.9	59.6	49.7	19	47.3
21.8	16.9	-16	14.6	61.0	50.9	20	48.5
22.6	17.6	-15	15.3	62.4	52.2	21	49.7
23.5	18.3	-14	16.0	63.8	53.4	22	51.0
24.3	19.0	-13	16.7	65.3	54.7	23	52.3
25.2	19.8	-12	17.4	66.7	56.0	24	53.6
26.0	20.5	-11	18.1	68.2	57.3	25	54.9
26.9	21.3	-10	18.9	69.7	58.6	26	56.3
27.8	22.1	-9	19.7	71.3	59.9	27	57.6
28.7	22.9	-8	20.5	72.8	61.3	28	59.0
29.7	23.7	-7	21.2	74.4	62.7	29	60.4
30.6	24.5	-6	22.1	76.0	64.1	30	61.8
31.6	25.3	-5	22.9	77.6	65.5	31	63.3
32.5	26.2	-4	23.7	79.2	66.9	32	64.7
33.5	27.0	-3	24.6	80.9	68.4	33	66.2
34.5	27.9	-2	25.4	82.6	69.8	34	67.7
35.6	28.8	-1	26.3	84.3	71.3	35	69.3
36.6	29.7	0	27.2	86.0	72.8	36	70.8
37.7	30.6	1	28.1	87.8	74.4	37	72.4
38.7	31.5	2	29.0	89.5	75.9	38	74.0
39.8	32.5	3	30.0	91.3	77.5	39	75.6
40.9	33.5	4	30.9	93.1	79.1	40	77.2
42.0	34.4	5	31.9	95.0	80.7	41	78.9
43.2	35.4	6	32.9	96.8	82.3	42	80.5
44.3	36.4	7	33.9	98.7	84.0	43	82.2
45.5	37.4	8	34.9	100.6	85.7	44	84.0
46.7	38.5	9	36.0	102.6	87.4	45	85.7
47.9	39.5	10	37.0				

After converting from R-22 to Opteon™ XP40, the evaporator temperature can be set by locating the desired average evaporator temperature (or R-402A or R-408A evaporator pressure) on this chart and determining the new set point required for Opteon™ XP40 to achieve an equivalent average evaporator temperature.

Appendix B.

Table 5: Opteon™ XP40 Pressure-Temperature Data (Eng)

P (psig)	Sat Liq T (°F)	Sat Vap T (°F)	P (psig)	Sat Liq T (°F)	Sat Vap T (°F)	P (psig)	Sat Liq T (°F)	Sat Vap T (°F)
-4.7	-64.11	-53.41	145.3	67.61	76.48	295.3	114.7	122.1
-1.7	-54.85	-44.24	148.3	68.82	77.66	298.3	115.5	122.9
1.3	-47.16	-36.63	151.3	70.02	78.83	301.3	116.2	123.6
4.3	-40.53	-30.07	154.3	71.20	79.99	304.3	116.9	124.3
7.3	-34.68	-24.28	157.3	72.37	81.13	307.3	117.7	125.0
10.3	-29.43	-19.09	160.3	73.52	82.25	310.3	118.4	125.7
13.3	-24.64	-14.35	163.3	74.66	83.36	313.3	119.1	126.4
16.3	-20.24	-10.00	166.3	75.78	84.46	316.3	119.8	127.0
19.3	-16.16	-5.96	169.3	76.89	85.54	319.3	120.6	127.7
22.3	-12.34	-2.19	172.3	77.99	86.61	322.3	121.3	128.4
25.3	-8.76	1.35	175.3	79.07	87.66	325.3	122.0	129.1
28.3	-5.38	4.69	178.3	80.14	88.70	328.3	122.7	129.7
31.3	-2.17	7.85	181.3	81.20	89.73	331.3	123.4	130.4
34.3	0.87	10.87	184.3	82.25	90.75	334.3	124.1	131.1
37.3	3.78	13.74	187.3	83.29	91.76	337.3	124.7	131.7
40.3	6.57	16.49	190.3	84.31	92.76	340.3	125.4	132.4
43.3	9.24	19.12	193.3	85.32	93.74	343.3	126.1	133.0
46.3	11.81	21.66	196.3	86.32	94.71	346.3	126.8	133.7
49.3	14.28	24.10	199.3	87.32	95.68	349.3	127.4	134.3
52.3	16.67	26.45	202.3	88.30	96.63	352.3	128.1	134.9
55.3	18.98	28.73	205.3	89.27	97.57	355.3	128.8	135.5
58.3	21.21	30.93	208.3	90.23	98.51	358.3	129.4	136.2
61.3	23.38	33.06	211.3	91.18	99.43	361.3	130.1	136.8
64.3	25.48	35.13	214.3	92.13	100.34	364.3	130.7	137.4
67.3	27.52	37.14	217.3	93.06	101.25	367.3	131.4	138.0
70.3	29.51	39.10	220.3	93.99	102.15	370.3	132.0	138.6
73.3	31.45	41.01	223.3	94.90	103.03	373.3	132.7	139.2
76.3	33.33	42.86	226.3	95.81	103.91	376.3	133.3	139.8
79.3	35.17	44.67	229.3	96.71	104.78	379.3	133.9	140.4
82.3	36.97	46.44	232.3	97.6	105.7	382.3	134.6	141.0
85.3	38.73	48.16	235.3	98.5	106.5	385.3	135.2	141.6
88.3	40.44	49.85	238.3	99.4	107.4	388.3	135.8	142.2
91.3	42.12	51.50	241.3	100.2	108.2	391.3	136.4	142.8
94.3	43.77	53.12	244.3	101.1	109.0	394.3	137.0	143.4
97.3	45.38	54.70	247.3	101.9	109.8	397.3	137.6	143.9
100.3	46.96	56.25	250.3	102.8	110.7	400.3	138.2	144.5
103.3	48.50	57.77	253.3	103.6	111.5	403.3	138.8	145.1
106.3	50.02	59.26	256.3	104.5	112.3	406.3	139.4	145.6
109.3	51.52	60.72	259.3	105.3	113.1	409.3	140.0	146.2
112.3	52.98	62.16	262.3	106.1	113.9	412.3	140.6	146.7
115.3	54.42	63.57	265.3	106.9	114.6	415.3	141.2	147.3
118.3	55.83	64.96	268.3	107.7	115.4	418.3	141.8	147.9
121.3	57.23	66.32	271.3	108.5	116.2	421.3	142.4	148.4
124.3	58.60	67.66	274.3	109.3	117.0	424.3	143.0	148.9
127.3	59.94	68.98	277.3	110.1	117.7	427.3	143.6	149.5
130.3	61.27	70.28	280.3	110.9	118.5	430.3	144.1	150.0
133.3	62.57	71.55	283.3	111.7	119.2	433.3	144.7	150.6
136.3	63.86	72.81	286.3	112.4	119.9	436.3	145.3	151.1
139.3	65.13	74.05	289.3	113.2	120.7	439.3	145.9	151.6
142.3	66.38	75.27	292.3	114.0	121.4	442.3	146.4	152.1

Table 6: Opteon™ XP40 Temperature-Pressure Data (Eng)

Temp (°F)	Sat Liq P (psig)	Sat Vap P (psig)	Temp (°F)	Sat Liq P (psig)	Sat Vap P (psig)	Temp (°F)	Sat Liq P (psig)	Sat Vap P (psig)
-40	4.6	-0.1	24	62.2	49.2	88	201.4	176.3
-39	5.1	0.3	25	63.6	50.4	89	204.5	179.2
-38	5.6	0.7	26	65.1	51.7	90	207.6	182.1
-37	6.1	1.1	27	66.5	53.0	91	210.7	185.0
-36	6.6	1.6	28	68.0	54.3	92	213.9	188.0
-35	7.1	2.0	29	69.5	55.7	93	217.1	191.0
-34	7.7	2.5	30	71.1	57.0	94	220.4	194.1
-33	8.2	2.9	31	72.6	58.4	95	223.6	197.2
-32	8.8	3.4	32	74.2	59.8	96	226.9	200.3
-31	9.4	3.9	33	75.8	61.2	97	230.3	203.5
-30	10.0	4.3	34	77.4	62.7	98	233.7	206.7
-29	10.6	4.8	35	79.0	64.1	99	237.1	209.9
-28	11.2	5.3	36	80.7	65.6	100	240.5	213.2
-27	11.8	5.8	37	82.4	67.1	101	244.0	216.5
-26	12.4	6.4	38	84.1	68.6	102	247.5	219.8
-25	13.1	6.9	39	85.8	70.1	103	251.1	223.2
-24	13.7	7.5	40	87.5	71.7	104	254.6	226.6
-23	14.4	8.0	41	89.3	73.3	105	258.3	230.1
-22	15.1	8.6	42	91.1	74.9	106	261.9	233.5
-21	15.8	9.2	43	92.9	76.5	107	265.6	237.1
-20	16.5	9.8	44	94.7	78.2	108	269.3	240.6
-19	17.2	10.4	45	96.6	79.9	109	273.1	244.2
-18	17.9	11.0	46	98.5	81.6	110	276.9	247.9
-17	18.7	11.6	47	100.4	83.3	111	280.7	251.6
-16	19.4	12.2	48	102.3	85.0	112	284.6	255.3
-15	20.2	12.9	49	104.3	86.8	113	288.5	259.0
-14	21.0	13.5	50	106.3	88.6	114	292.5	262.8
-13	21.8	14.2	51	108.3	90.4	115	296.5	266.7
-12	22.6	14.9	52	110.3	92.2	116	300.5	270.6
-11	23.4	15.6	53	112.3	94.1	117	304.5	274.5
-10	24.2	16.3	54	114.4	96.0	118	308.6	278.5
-9	25.1	17.0	55	116.5	97.9	119	312.8	282.5
-8	26.0	17.8	56	118.7	99.8	120	317.0	286.5
-7	26.8	18.5	57	120.8	101.8	121	321.2	290.6
-6	27.7	19.3	58	123.0	103.8	122	325.4	294.8
-5	28.6	20.0	59	125.2	105.8	123	329.7	298.9
-4	29.6	20.8	60	127.4	107.8	124	334.1	303.2
-3	30.5	21.6	61	129.7	109.9	125	338.5	307.4
-2	31.5	22.5	62	132.0	112.0	126	342.9	311.8
-1	32.4	23.3	63	134.3	114.1	127	347.3	316.1
0	33.4	24.1	64	136.6	116.2	128	351.8	320.5
1	34.4	25.0	65	139.0	118.4	129	356.4	325.0
2	35.4	25.9	66	141.4	120.6	130	361.0	329.5
3	36.5	26.8	67	143.8	122.8	131	365.6	334.0
4	37.5	27.7	68	146.3	125.1	132	370.2	338.6
5	38.6	28.6	69	148.7	127.4	133	374.9	343.3
6	39.7	29.5	70	151.3	129.7	134	379.7	348.0
7	40.8	30.5	71	153.8	132.0	135	384.5	352.7
8	41.9	31.4	72	156.3	134.4	136	389.3	357.5
9	43.0	32.4	73	158.9	136.8	137	394.2	362.4
10	44.2	33.4	74	161.6	139.2	138	399.1	367.2
11	45.3	34.4	75	164.2	141.6	139	404.1	372.2
12	46.5	35.5	76	166.9	144.1	140	409.1	377.2
13	47.7	36.5	77	169.6	146.6	141	414.2	382.2
14	49.0	37.6	78	172.3	149.2	142	419.3	387.3
15	50.2	38.7	79	175.1	151.7	143	424.4	392.5
16	51.4	39.8	80	177.9	154.3	144	429.6	397.7
17	52.7	40.9	81	180.7	157.0	145	434.8	403.0
18	54.0	42.0	82	183.6	159.6	146	440.1	408.3
19	55.3	43.2	83	186.5	162.3	147	445.4	413.7
20	56.7	44.3	84	189.4	165.1	148	450.8	419.1
21	58.0	45.5	85	192.3	167.8	149	456.2	424.6
22	59.4	46.7	86	195.3	170.6	150	461.7	430.2
23	60.8	47.9	87	198.3	173.4			

Checklist for Opteon™ XP40 Retrofit

☐ Establish baseline performance while operating on 402A or R-408A (see data sheet for recommended data).

☐ Consult the original equipment manufacturer of the system components for their recommendation on the following:
- Plastics compatibility
- Elastomeric compatibility
- Lubricant (viscosity, manufacturer, additives)
- Thermal expansion device sizing
- Retrofit procedures to sustain warranty, if applicable

☐ If POE lubricant in system: Check quality of existing POE oil and change necessary. If MO or AB lubricant in system: Remove 90–95% MO or AB lubricant from the system.
- Measure amount of lubricant removed and record. _____
- Charge POE lubricant. Run system for at least 8 hours.
- Recharge with amount equivalent to amount of MO removed.
- Repeat lubricant drain and POE charging until MO content is less than 5%.

☐ Replace filter drier and elastomeric seals/gaskets.
- Check and replace elastomeric seals and gaskets that cannot be replaced without removing refrigerant.
  - Components commonly affected are Schrader core seals, liquid level receiver gaskets, solenoid valves, ball valves, flange seals, or shaft seals on open drive compressors; but, all external seals in contact with the refrigerant should be viewed as a potential post-retrofit leak source.

☐ Complete system modifications (e.g., TXV, line sizing, etc.) based on engineering analysis.

☐ Reconnect system, and evacuate with vacuum pump to full vacuum (<1000 microns [<29.88 in Hg vacuum] [<1.33 mbar]).

☐ Leak check system (re-evacuate system following leak check).

☐ Charge system with Opteon™ XP40 (R-449A) refrigerant.
- Initially charge ~85% by weight of original equipment manufacturer specified R-402A or R-408A charge.
- Amount of refrigerant charged: _____

☐ Start up equipment, and adjust charge until desired operating conditions are achieved.
- If low in charge, add in increments of 2–3% by weight
- Amount of refrigerant charged: _____
- Total refrigerant charged: _____

☐ Label components and system for type of refrigerant and lubricant.

☐ Conversion is complete!

System Data Sheet

Type of System/Location: _____

Equipment Mfg.: _____ Compressor Mfg.: _____

Model No.: _____ Model No.: _____

Serial No.: _____ Serial No.: _____

Date of Manufacture: _____ Date of Manufacture: _____

Original Charge Size: _____ Lubricant Type: _____

Lubricant Charge Size: _____ Drier Mfg.: _____

Drier Type: _____ Condenser Cooling Medium: _____

Expansion Device (check one):

☐ Capillary Tube: _____ ☐ Expansion Valve: _____

If Expansion Valve:

Manufacturer: _____ Model No.: _____

Control/Set Point: _____ Location of Sensor: _____

Other System Controls (e.g., Head Pressure Control): _____

_____

Date/Time				
Refrigerant				
Charge Size (lb)				
Ambient Temperature (°F)				
Compressor				
Suction Temperature (°F)				
Suction Pressure (psig)				
Discharge Temperature (°F)				
Discharge Pressure (psig)				
Evaporator				
Coil Air/H_2O In T (°F)				
Coil Air/H_2O Out T (°F)				
Operating Service Temperature (°F)				
Condenser				
Coil Air/H_2O In T (°F)				
Coil Air/H_2O Out T (°F)				
Superheat and Subcool (derived values)				
Refrigerant T at Superheat Ctl. Pt. (°F)				
Calculated Superheat (°R)				
Expansion Device Inlet T (°F)				
Calculated Subcool (°R)				
Motor Amps If Rack: Total				

For more information on the Opteon™ portfolio of refrigerants , or other Chemours refrigerants products, visit opteon.com, call (800) 235-7882, or follow us on Twitter@RefrigChemours.

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