



Opteon™ XP44

Refrigerant

Opteon™ XP44 Retrofit Guidelines to Replace R-404A/R-507

Introduction

Opteon™ XP44 is a reduced global warming potential (GWP) hydrofluoro-olefin (HFO)-based refrigerant developed to replace R-404A/R-507 in positive displacement, direct expansion low- and medium-temperature systems. It is particularly suitable for transport refrigeration applications that operate over a wide range of ambient temperatures. Opteon™ XP44 is the registered trade name for a blend of HFC-32/HFC-125/HFO-1234yf (11/59/30 wt%) with an ANSI/ASHRAE Standard 34 refrigerant designation of R-452A. It is commercially available for both retrofit of existing R-404A/R-507 equipment as well as a suitable replacement option for these refrigerants in new equipment.

Opteon™ XP44 offers similar energy efficiency and improved environmental properties with a lower GWP* of 1945 vs. R-404A (3943) and R-507 (3985), and has a zero ozone depletion potential (ODP).

Using these retrofit guidelines, many R-404A/R-507 systems can be converted to operate using Opteon™ XP44, allowing existing equipment to continue to operate safely and efficiently with a greatly reduced environmental impact.

Important Safety Information

Like all Freon™ refrigerants, Opteon™ XP44 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 torches 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/HFC refrigerants, as they only detect the presence of chlorine in the refrigerant. Chlorine is not present in Opteon™ XP44, R-404A, or R-507; and, consequently, these detectors will not detect the presence of these refrigerants. Use an electronic leak detector designed to find 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.

*GWP = IPCC Fifth Assessment Report (AR5)

Table 1: Comparison of Performance Data

Low Temperature Conditions									
Expected Performance at $T_{\text{Condenser}} = 104\text{ °F}$, $T_{\text{Evaporator}} = -31\text{ °F}$, Liquid Subcool = 0 °R, Return Gas = 5 °F, Compressor Isentropic Efficiency = 70%									
Refrigerant	Evap P (psig)	Cond P (psig)	Disch T (°F)	Avg. Glide (°R)	Volume Capacity (Btu/ft ³)	Capacity Relative to R-404A	EER (Btu/watt-hour)	EER Relative to R-404A	Mass Flow Relative to R-404A
R-404A	9.5	251	194	0.7	21.7	100%	4.500	100%	100%
Opteon™ XP44	8	247	198	4.1	20.8	96%	4.517	100%	98%
Medium Temperature Conditions									
Expected Performance at $T_{\text{Condenser}} = 104\text{ °F}$, $T_{\text{Evaporator}} = 5\text{ °F}$, Liquid Subcool = 0 °R, Return Gas = 32 °F, Compressor Isentropic Efficiency = 70%									
R-404A	48	251	153	1.3	61.1	100%	8.561	100%	100%
Opteon™ XP44	45.5	247	154	5.4	60.1	98%	8.615	101%	101%

Note: Any refrigerant can be hazardous if used improperly. Hazards include liquid or vapor under pressure as well as frostbite from the escaping liquid.

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™ XP44 SDS for more specific safety information. Safety Bulletin AS-1 also gives additional information for safe handling of refrigerants.

Flammability

Opteon™ XP44 is nonflammable, with an ASHRAE Standard 34 safety classification rating A1. However, as with all HFC-containing blends, Opteon™ XP44 should not be mixed with air to check for system leaks.

General Retrofit Information: R-404A/R-507 to Opteon™ XP44

Expected Performance of Opteon™ XP44 vs. R-404A

Table 1, based on thermodynamic cycle analysis, provides a comparison for R-404A and Opteon™ XP44 for a number of key performance factors. Actual performance for a specific system depends on numerous factors, including equipment conditions and operating environment.

System Modifications

Lubricant

For most systems operating on R-404A/R-507, the polyolester (POE) lubricant currently in the system should be suitable for use with Opteon™ XP44. If there are questions about the lubricant, or tests indicate 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.

Compressor

Overall system performance (capacity and energy efficiency) will be similar when operating on Opteon™ XP44 versus R-404A/R-507.

Compressor suction and discharge pressures for Opteon™ XP44 will differ slightly from R-404A/R-507, 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™ XP44 also has only 2 to 3.5 °R higher discharge temperature than R-404A. Again, you should consult with your compressor manufacturer for details regarding operation of your specific compressor on Opteon™ XP44.

Expansion Device

Opteon™ XP44 has similar mass flow rate to R-404A, and should be within the usable range of a properly sized and installed R-404A expansion device, and not require replacement. Some adjustment to the expansion valve(s) may be needed in order to reset the superheat following conversion of the system. Use the PT 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™ XP44 has similar mass flow rates and higher liquid density compared to R-404A/R-507. It is always 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 in order to ensure adequate refrigeration capacity and sufficient oil return to the compressor.

Condenser and Evaporator

Due to the differences in suction pressure between Opteon™ XP44 and R-404A, it may be necessary to reset evaporator pressure regulators (EPR) and pressure cutouts to properly operate the system. The discharge pressure of Opteon™ XP44 is slightly lower than R-404A, and may require slight adjustments to condenser fans and head pressure controls.

Opteon™ XP44 is a refrigerant blend; therefore, when setting superheat, the dew point (saturated vapor) in the PT chart should be used. Similarly, the bubble point (saturated liquid) should be used for measuring subcooling.

System Controls

Many applications use refrigeration control systems and methodologies that rely on the pressure-temperature relationship of a specific refrigerant for proper operation. During conversions from R-404A/R-507 to Opteon™ XP44, although the controls will likely function adequately, for optimal performance they should be updated for operation using Opteon™ XP44 refrigerant properties. Consult with the control system manufacturer for guidance on updating refrigerant data or operating instructions when using Opteon™ XP44 (R-452A).

Retrofit of R-404A/R-507 Systems to Opteon™ XP44

The following detailed steps are the recommended procedure for retrofitting R-404A/R-507 systems to Opteon™ XP44:

1. Establish Baseline Performance with R-404A/R-507

Collect system performance data while R-404A or R-507 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™ XP44. A System Data Sheet is included at the back of this bulletin to record baseline data.

2. Check Lubricant

For most systems operating on R-404A/R-507, the POE lubricant currently in the system should be suitable for use with Opteon™ XP44. If there are questions about the lubricant, or tests indicate 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 or brand of lubricant.

3. Remove the R-404A/R-507 Charge into Recovery Cylinders

Remove the entire R-404A/R-507 refrigerant from the system into a recovery cylinder(s). Weigh the amount removed to use as a guide for the quantity of Opteon™ XP44 to be charged to the system.

4. Replace Filter Drier

It is routine practice to replace the filter drier during system maintenance.

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™ XP44

Opteon™ XP44 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/or 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 larger charge size of Opteon™ XP44 than the original R-404A or R-507 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-404A or R-507. After startup and adjustment, the final charge amount will be approximately 108% of the R-404A or R-507.

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 I. Opteon™ XP44 Pressure-Temperature Data (Eng)

P	Sat Liq T	Sat Vap T	P	Sat Liq T	Sat Vap T	P	Sat Liq T	Sat Vap T
psig	°F	°F	psig	°F	°F	psig	°F	°F
-2.5	-59.3	-52.5	66	24.1	31.5	190	81.8	88.8
-1.2	-55.9	-49.0	68	25.5	32.9	195	83.5	90.4
0	-52.7	-45.8	70	26.8	34.2	200	85.2	92.1
1	-50.2	-43.3	72	28.1	35.5	205	86.8	93.7
2	-47.9	-40.9	74	29.4	36.8	210	88.4	95.2
3	-45.6	-38.7	76	30.7	38.0	215	90.0	96.8
4	-43.5	-36.5	78	31.9	39.2	220	91.6	98.3
5	-41.5	-34.5	80	33.1	40.5	225	93.1	99.8
6	-39.5	-32.5	82	34.3	41.7	230	94.6	101.3
7	-37.6	-30.6	84	35.5	42.8	235	96.1	102.7
8	-35.8	-28.8	86	36.6	44.0	240	97.6	104.1
9	-34.0	-27.0	88	37.8	45.1	245	99.0	105.5
10	-32.3	-25.3	90	38.9	46.3	250	100.4	106.9
11	-30.7	-23.6	92	40.0	47.4	255	101.8	108.3
12	-29.1	-22.0	94	41.1	48.5	260	103.2	109.6
13	-27.5	-20.4	96	42.2	49.5	265	104.6	111.0
14	-26.0	-18.9	98	43.3	50.6	270	105.9	112.3
15	-24.5	-17.4	100	44.3	51.6	275	107.3	113.6
16	-23.1	-16.0	102	45.4	52.7	280	108.6	114.8
17	-21.7	-14.5	104	46.4	53.7	285	109.9	116.1
18	-20.3	-13.2	106	47.4	54.7	290	111.2	117.3
19	-19.0	-11.8	108	48.4	55.7	295	112.4	118.5
20	-17.7	-10.5	110	49.4	56.7	300	113.7	119.8
21	-16.4	-9.2	112	50.4	57.7	305	114.9	120.9
22	-15.2	-8.0	114	51.3	58.6	310	116.1	122.1
23	-13.9	-6.7	116	52.3	59.6	315	117.3	123.3
24	-12.8	-5.5	118	53.2	60.5	320	118.5	124.4
25	-11.6	-4.3	120	54.2	61.4	325	119.7	125.6
26	-10.4	-3.2	122	55.1	62.4	330	120.9	126.7
27	-9.3	-2.0	124	56.0	63.3	335	122.0	127.8
28	-8.2	-0.9	126	56.9	64.2	340	123.2	128.9
29	-7.1	0.2	128	57.8	65.0	345	124.3	130.0
30	-6.0	1.2	130	58.7	65.9	350	125.5	131.0
32	-3.9	3.3	132	59.6	66.8	355	126.6	132.1
34	-1.9	5.4	134	60.4	67.6	360	127.7	133.1
36	0.1	7.3	136	61.3	68.5	365	128.8	134.2
38	2.0	9.3	138	62.1	69.3	370	129.8	135.2
40	3.8	11.1	140	63.0	70.2	375	130.9	136.2
42	5.6	12.9	142	63.8	71.0	380	132.0	137.2
44	7.4	14.7	144	64.7	71.8	385	133.0	138.2
46	9.1	16.4	146	65.5	72.6	390	134.0	139.2
48	10.7	18.1	148	66.3	73.4	395	135.1	140.1
50	12.3	19.7	150	67.1	74.2	400	136.1	141.1
52	13.9	21.3	155	69.1	76.2	410	138.1	143.0
54	15.5	22.8	160	71.0	78.1	420	140.1	144.8
56	17.0	24.4	165	72.9	80.0	430	142.0	146.6
58	18.5	25.8	170	74.8	81.8	440	144.0	148.4
60	19.9	27.3	175	76.6	83.6	450	145.8	150.1
62	21.4	28.7	180	78.4	85.3	460	147.7	151.8
64	22.8	30.1	185	80.1	87.1	470	149.5	153.5

Opteon™ XP44 Temperature-Pressure Data (Eng)

Temp	Sat Liq P	Sat Vap P	Temp	Sat Liq P	Sat Vap P	Temp	Sat Liq P	Sat Vap P
°F	psig	psig	°F	psig	psig	°F	psig	psig
-44	3.8	0.7	21	61.5	51.6	86	202.4	181.9
-43	4.2	1.1	22	62.9	52.9	87	205.5	184.8
-42	4.7	1.5	23	64.3	54.2	88	208.6	187.7
-41	5.2	2.0	24	65.8	55.5	89	211.8	190.7
-40	5.7	2.4	25	67.3	56.9	90	214.9	193.7
-39	6.3	2.9	26	68.8	58.2	91	218.2	196.8
-38	6.8	3.3	27	70.3	59.6	92	221.4	199.8
-37	7.3	3.8	28	71.8	61.0	93	224.7	202.9
-36	7.9	4.3	29	73.4	62.4	94	228.0	206.1
-35	8.4	4.7	30	75.0	63.8	95	231.3	209.3
-34	9.0	5.2	31	76.6	65.3	96	234.7	212.5
-33	9.6	5.7	32	78.2	66.7	97	238.1	215.7
-32	10.2	6.3	33	79.8	68.2	98	241.5	219.0
-31	10.8	6.8	34	81.5	69.7	99	245.0	222.3
-30	11.4	7.3	35	83.2	71.3	100	248.5	225.7
-29	12.1	7.9	36	84.9	72.8	101	252.0	229.1
-28	12.7	8.4	37	86.6	74.4	102	255.6	232.5
-27	13.3	9.0	38	88.4	76.0	103	259.2	236.0
-26	14.0	9.6	39	90.2	77.6	104	262.9	239.5
-25	14.7	10.2	40	92.0	79.2	105	266.6	243.0
-24	15.4	10.8	41	93.8	80.9	106	270.3	246.6
-23	16.1	11.4	42	95.6	82.6	107	274.0	250.2
-22	16.8	12.0	43	97.5	84.3	108	277.8	253.9
-21	17.5	12.6	44	99.4	86.0	109	281.6	257.6
-20	18.2	13.3	45	101.3	87.8	110	285.5	261.3
-19	19.0	13.9	46	103.2	89.5	111	289.4	265.1
-18	19.8	14.6	47	105.2	91.3	112	293.3	269.0
-17	20.5	15.3	48	107.2	93.2	113	297.3	272.8
-16	21.3	16.0	49	109.2	95.0	114	301.3	276.7
-15	22.1	16.7	50	111.2	96.9	115	305.4	280.7
-14	23.0	17.4	51	113.3	98.8	116	309.5	284.6
-13	23.8	18.1	52	115.4	100.7	117	313.6	288.7
-12	24.6	18.9	53	117.5	102.6	118	317.7	292.7
-11	25.5	19.6	54	119.6	104.6	119	321.9	296.9
-10	26.4	20.4	55	121.8	106.6	120	326.2	301.0
-9	27.3	21.2	56	124.0	108.6	121	330.5	305.2
-8	28.2	22.0	57	126.2	110.6	122	334.8	309.5
-7	29.1	22.8	58	128.4	112.7	123	339.1	313.8
-6	30.0	23.6	59	130.7	114.8	124	343.5	318.1
-5	31.0	24.4	60	133.0	116.9	125	348.0	322.5
-4	31.9	25.3	61	135.3	119.1	126	352.5	326.9
-3	32.9	26.2	62	137.6	121.2	127	357.0	331.4
-2	33.9	27.0	63	140.0	123.4	128	361.5	335.9
-1	34.9	27.9	64	142.4	125.7	129	366.1	340.5
0	35.9	28.8	65	144.8	127.9	130	370.8	345.1
1	37.0	29.8	66	147.3	130.2	131	375.5	349.8
2	38.0	30.7	67	149.8	132.5	132	380.2	354.5
3	39.1	31.7	68	152.3	134.8	133	385.0	359.3
4	40.2	32.6	69	154.8	137.2	134	389.8	364.1
5	41.3	33.6	70	157.4	139.6	135	394.6	369.0
6	42.4	34.6	71	160.0	142.0	136	399.5	373.9
7	43.6	35.6	72	162.6	144.4	137	404.5	378.9
8	44.8	36.7	73	165.3	146.9	138	409.4	384.0
9	45.9	37.7	74	167.9	149.4	139	414.5	389.1
10	47.1	38.8	75	170.7	152.0	140	419.5	394.2
11	48.3	39.9	76	173.4	154.5	141	424.6	399.4
12	49.6	41.0	77	176.2	157.1	142	429.8	404.7
13	50.8	42.1	78	179.0	159.8	143	435.0	410.0
14	52.1	43.2	79	181.8	162.4	144	440.2	415.4
15	53.4	44.4	80	184.6	165.1	145	445.5	420.9
16	54.7	45.5	81	187.5	167.8	146	450.8	426.4
17	56.0	46.7	82	190.5	170.6	147	456.2	432.0
18	57.3	47.9	83	193.4	173.3	148	461.6	437.6
19	58.7	49.1	84	196.4	176.2	149	467.1	443.3
20	60.1	50.4	85	199.4	179.0	150	472.6	449.1

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 ₂ O In T (°F)				
Coil Air/H ₂ O Out T (°F)				
Operating Service Temperature (°F)				
Condenser				
Coil Air/H ₂ O In T (°F)				
Coil Air/H ₂ O 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)				

Checklist for Opteon™ XP44 Retrofit

- Establish baseline performance while operating on R-404A/R-507 (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
- Check quality of existing POE oil and change if necessary
- Complete system modifications (TXV, line sizing, etc.) based on engineering analysis
- Replace filter drier with new drier approved for use with retrofit refrigerant
- 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™ XP44 (R-452A) refrigerant
 - Initially charge -85% by weight of original equipment manufacturer specified R-404A/R-507 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!

For more information on the Opteon™ family of refrigerants , or other Chemours refrigerants products, visit opteon.com, call (800) 235-7882, or follow us on [Twitter@RefrigChemours](https://twitter.com/RefrigChemours).

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