

Retrofit Guidelines

R-404A/R-507A to: R-448A

Solstice® N40

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Preface

R-404A is a high-capacity refrigerant employed in a majority of installed medium- and low-temperature refrigeration systems. R-404A and R-507A refrigeration systems utilizing synthetic lubricants have proven to be reliable performers. However, as facility owners work to reduce their carbon footprint, existing refrigeration equipment may need to be either replaced with new equipment or retrofitted with alternative refrigerants. The selection of a retrofit fluid depends, in part, upon retrofit objectives that may include factors such as efficiency, first cost, global warming potential (GWP) and capacity. By following equipment manufacturers’ recommendations and Honeywell’s guidelines outlined in this publication, service technicians can readily retrofit many existing R-404A and R-507A medium- and low-temperature direct expansion refrigeration systems to R-448A.

Introduction

As the industry continues the move away from the use of high GWP HFCs, refrigerant service personnel will play a key role in the transition to reduced GWP alternatives through retrofitting. Honeywell has produced this guide to help service technicians better understand the various technical and operational aspects of carrying out retrofit procedures using R-448A.

Although the information can be helpful as a general guide, it should not be used as a substitute for the equipment manufacturer's specific recommendations. Also, retrofitting should be considered system specific. Since systems can differ in condition and configuration, retrofit actions applied to one system will not necessarily result in the same level of success in another system. For this reason, Honeywell strongly recommends contacting the equipment manufacturer for detailed information on retrofitting the specific model under consideration. Also, refer to the Material Safety Data Sheet (MSDS) for safety information on the specific Solstice® Refrigerant you will use.

Solstice® Refrigerants

ASHRAE number, constituents and applications of Solstice N40 (R-448A) appear in the table below.

Solstice Refrigerant	Blend	Replaces	Applications
R-448A	R-32 R-125 R-1234yf R-134a R-1234ze	R-404A R-507 R-407A HCFC-22	Supermarket: freezers, coolers, display cases Liquid (DX) chillers Warehouse refrigeration
Comments			
Among the most efficient R-404A / R-507A replacements Lowest GWP non-flammable replacement for R-404A. Matches capacity with about 30% lower mass flow than R-404A.			

R-448A is not a “Drop-in” Replacement

R-448A is an HFO-blended refrigerant that utilizes synthetic lubricants. The mass flow differences, as well as the slightly higher discharge temperature in low-temperature applications, should be evaluated. Check with the compressor manufacturer to determine if the existing lubricant is acceptable. Consult the compressor manufacturer regarding acceptable discharge temperature

as well. Consult with your compressor manufacturer if any type of discharge temperature mitigation, in the form of liquid injection or desuperheating, would have to be added to the installation. The retrofit procedures listed here have been developed by Honeywell to address these issues and to help technicians perform successful retrofits of R-404A/R-507A systems utilizing positive-displacement (reciprocating, rotary, scroll or screw) compressors. When considering replacement of R-404A/R-507A with a refrigerant having lower mass flow relative to R-404A/R507A , such as R-448A, first confirm that the existing piping is acceptable. It is recommended that piping sizing be checked to determine that pressure drops and velocities would be acceptable with the new refrigerant. Checking piping sizing will confirm that capacity and efficient oil return are not being negatively affected. Consult with your TXV manufacturer to determine suitability of the installed TXV with R-448A. Numerous retrofits have demonstrated the suitability of installed valves to operate satisfactorily with R-448A. TXV adjustment may be needed to obtain adequate superheat. Electronic expansion devices may require little to no adjustment once the PT curve for R-448A is programmed into the controller. Pay particular attention to systems that utilize non adjustable TXVs. Consult the valve manufacturer for suitability and conversion kits to obtain proper superheat setting with R-448A.

Retrofit Procedures

A word about system preparation: In retrofitting an existing refrigeration system, material compatibility and the condition of the existing seals and gaskets must be taken into account. Heat set, compression set, and seal shrinkage can all impact the condition of an existing seal or gasket. When the system is put under vacuum, the sealing device can be displaced, creating the potential for leakage.

1. Record Baseline Data

Before making any hardware changes, compare current system operating data with normal operating data. Correct any deficiencies and record final data as a performance baseline. Data should include temperature and pressure measurements throughout the system including the evaporator, compressor suction and discharge, condenser and expansion device. These measurements will be useful when adjusting the system with an alternative Solstice refrigerant.

2. Evaluate the Expansion Device

Due to the difference in mass flow of R-448A as compared to R-507A and R-404A, the replacement refrigerant requires that the existing thermostatic expansion valves be adjusted. In rare cases, particularly in low temperature applications, the TXV may need to be changed. Non adjustable valves may need to be replaced or retrofitted. Consult the valve manufacturer to confirm the suitability of the original valve when using R-448A. For systems equipped with a capillary tube, refer to the table below for recommendations.

Always consult the manufacturer of the equipment prior to retrofitting.

3. Isolate R-404A/R-507A Refrigerant Charge

Isolate the HFC refrigerant charge from the system by pumping it down into the receiver. If no receiver is present, the refrigerant must be removed from the system using a recovery machine capable of meeting or exceeding the required levels of evacuation. The charge must be collected in a recovery cylinder.

DO NOT VENT THE REFRIGERANT

Knowing the recommended R-404A/R-507A refrigerant charge size for the system is helpful. If it is not known, weigh the entire amount of refrigerant removed. This amount can be used as a guide for the initial quantity of Solstice® refrigerant to be charged to the system.

4. Choose Compressor Lubricant

In most instances, the lubricant in use with R-404A or R-507A is suitable for use with R-448A. Honeywell recommends using a miscible lubricant approved by the compressor manufacturer. Differences among lubricants make it difficult to assume that they are interchangeable. Check with the compressor manufacturer for the correct viscosity grade and brand for the compressor in the system being retrofitted. If the lubricant is contaminated or an acid test indicates high levels of acidity, then a lubricant change is warranted, go to step 5. If the system is clean, go to step 12.

5. Drain the Lubricant

Many small hermetic compressors do not have oil drains, making it necessary to remove the compressor from the system to drain the lubricant. In this case, the best point in the system to drain the lubricant is the suction line of the compressor. Small hand-operated pumps are available which permit insertion of a tube into the compressor suction line. For compressors with an access port, the same hand-operated pump can be used to remove lubricant without removing the compressor from the system.

For larger systems, the oil should be drained from multiple points in the system. Pay particular attention to low spots in the system and piping close to evaporators.

6. Measure Existing Lubricant

Measure and record the volume of the lubricant removed from the system. Compare this amount with the amount recommended by the manufacturer to ensure that the majority of lubricant has been removed. This volume also will be used as a guide to determine the amount of new lubricant to add in the next step.

7. Recharge Compressor with Polyol Ester Lubricant

Check with the compressor manufacturer for the recommended lubricant. Add to the compressor the same volume of (e.g., polyol ester) lubricant as the volume of oil drained in Step 5. Follow the lubricant manufacturer's suggestion for handling polyol ester lubricant. For example, it is recommended that polyol ester lubricant be pumped rather than poured to avoid pick-up of atmospheric moisture. Likewise, systems charged with polyol ester lubricant should not be left open to the atmosphere for more than 10 to 15 minutes. Note that evacuation will not remove moisture from polyol ester lubricant. A filter drier is the only effective means to remove moisture from polyol ester lubricant.

8. Reinstall the Compressor

Reinstall the compressor following standard service practices recommended by the manufacturer.

**Capillary Tube Length
(Relative to R-404A, same diameter)**

R-448A	Low Temperature	Medium Temperature
	1.8 – 2.2	1.6 to 2.0
Retrofit Conditions		
100°F Liquid Temperature at Expansion Device Inlet		
110°F Condensing Temperature		
25°F Compressor Suction Temperature		
Low Evaporating Temperature: -25°F		
Medium Evaporating Temperature: + 20°F		

9. Replace the Filter Drier

Following system maintenance, a recommended service practice is to replace the filter drier. There are two types of filter driers commonly used in refrigeration equipment—loose-fill and solid-core.

Check with your wholesaler to make sure the replacement filter drier is compatible with the Solstice® refrigerant being used.

When changing to an HFO-miscible lubricant, particularly to a more polar lubricant such as polyol ester, it may be beneficial to add a suction line filter.

10. Reconnect the System and Evacuate

Use normal service practices to reconnect and evacuate the system. To remove air and other non-condensables, Honeywell recommends evacuating the system to a full vacuum of 1,000 microns or less from both sides of the system. However, attempting to evacuate a system with the pump connected only to the low-side of the system will not adequately remove moisture and non-condensables such as air. Use a good electronic gauge to measure the vacuum. An accurate reading cannot be made with a refrigeration gauge.

11. Check the System for Leaks

Check the system for leaks using normal service practices.

12. Charge System with Solstice N40 (R-448A) Refrigerant

When replacing R-404A/R-507A with R-448A use the same charging procedures that you would use for the refrigerant being replaced. When working with R-448A, it is important to remember that it is a blend refrigerant. It is essential that blend refrigerants be liquid-charged by removing only liquid from the cylinder. **Always remove any 400 series refrigerant from the cylinder in liquid form. Use caution when charging liquid into the low side of a refrigeration system.**

Vapor-charging may result in the wrong refrigerant composition and could damage the system.

A throttling valve should be used to control the flow of refrigerant to the suction side to ensure that the liquid is converted to vapor prior to entering the system.

NOTE: To prevent compressor damage, do not charge liquid into the suction line of the unit.

Systems being charged with R-448A require a slightly larger charge size than R-404A/R-507A.

For expansion valves or optimized capillary tube systems, the typical charge size relative to the R-404A/R-507A being replaced appears below.

Relative Charge Size

Solstice Refrigerant	R-404A or R-507A Replacement
R-448A	105%

As part of general procedure, Honeywell recommends initially charging the system with 85 percent by weight of the original charge.

13. Check System Operation

Start the system and allow conditions to stabilize. If the system is undercharged, add refrigerant in increments of 5 percent by weight of the original charge. Continue until desired operating conditions are achieved.

Compressor suction and discharge pressures for R-448A relative to R-404A are given below.

Comparative Suction and Discharge Pressure Versus R-404A

	Suction	Discharge
R-448A	0-5 psi (0-35kPa) lower	0-15 psi lower

It may be necessary to reset the pressure cutouts to compensate for the different pressures of the replacement refrigerant. This procedure should be done carefully to avoid exceeding the recommended operating limits of the compressor and other system components. The use of an unoptimized capillary tube will make the system more sensitive to charge and/or operating conditions. As a result, system performance will change more quickly if the system is overcharged (or undercharged). To avoid overcharging, it is best to charge the system by first measuring the operating conditions (including discharge and suction pressures, suction line temperature, compressor amps, superheat) instead of using the liquid line sight glass as a guide.

For blend refrigerants, pressure-temperature data will include bubble pressure and dew pressure data. To determine superheat, use the dew pressure column.

NOTE: Make sure that your instruments that you use for pressure and temperature readings are calibrated. When adjusting superheat it is critical that your pressure and temperature readings are as accurate as possible.

To determine subcooling, use the bubble pressure column. To find average evaporating or condensing temperature, find the measured pressure in both the bubble and dew columns and take the average of the two corresponding temperatures. Honeywell recommends using the average value when setting condensing and evaporating temperatures. Use average when setting operating suction pressure, evaporator pressure regulators and fan cycling

controls. Systems utilizing micro processor controllers will need to have the pressure temperature curve of R-448A loaded into the software. Honeywell recommends loading the average values. If subcooling or superheat control points need to be met using the controller, offsets will need to be programmed.

14. Label Components and System

After retrofitting the system with R-448A, label the system components to identify the specific refrigerant (R-448A) and specify the type of lubricant (by brand name) in the system. This will help ensure that the proper refrigerant and lubricant will be used to service the equipment in the future.

Unit Charge labels are available through your Honeywell Refrigerants wholesaler.

Retrofit Checklist

- | | |
|--|--|
| 1. Record baseline data on original system performance. _____ | 11. Replace filter driers and suction filters. _____ |
| 2. Recover refrigerant charge using appropriate recovery equipment. _____ | 12. Leak check the system. _____ |
| 3. Record the amount of refrigerant recovered. _____ | 13. Evacuate the system. _____ |
| 4. Choose compressor lubricant. Consult the compressor manufacturer's data to verify that the same synthetic grade and weight is suitable for use with R-448A. This is generally the case. _____ | 14. Charge the system with the new refrigerant. In the case of R-448A, remove only liquid from the charging cylinder. Initial charge should be approximately 85% of the R-404A charge by weight. Record the amount of refrigerant charged. _____ |
| 5. If required, drain the existing lubricant from the compressors, separators and oil reservoirs. _____ | 15. Make sure that your instruments that you use for pressure and temperature readings are calibrated. When adjusting superheat it is critical that your pressure and temperature readings are as accurate as possible. _____ |
| 6. Measure amount (volume) of lubricant removed. _____ | 16. Check system operation and adjust TXVs and operating controls. The discharge pressure of R-448A is slightly higher and condenser fan and ambient controls may require adjustment. _____ |
| 7. Change lubricant filters if present. _____ | 17. Adjust refrigerant charge if necessary, final charge should not exceed 107% of the original charge. _____ |
| 8. Recharge the system with polyol ester lubricant, use the same amount (volume) that was removed. _____ | 18. Label components and the system with the type of refrigerant and lubricant. _____ |
| 9. Evaluate the expansion devices; consult the valve manufacturers for recommendations. No change is necessary in most cases. _____ | |
| 10. Evaluate and replace all elastomer seals including receiver float, alarm and level control gaskets. _____ | |

Honeywell Refrigerants® Temperature/Pressure Tables

Genetron® AZ-50® (R-507A)							
		R-404A			R-448A		
	Bubble/Dew	Bubble	Dew	Average	Bubble	Dew	Average*
Temperature (°F)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)
-40	5.4	4.9	4.3	4.6	4.7	-0.2	1.8
-38	6.4	5.9	5.3	5.6	5.7	0.6	2.6
-36	7.5	7.0	6.3	6.7	6.8	1.5	3.6
-34	8.6	8.0	7.4	7.7	7.9	2.4	4.6
-32	9.8	9.2	8.5	8.9	9.0	3.3	5.6
-30	11.0	10.3	9.6	10.0	10.2	4.2	6.6
-28	12.2	11.5	10.8	11.2	11.4	5.2	7.7
-26	13.5	12.8	12.0	12.4	12.6	6.3	8.8
-24	14.8	14.1	13.3	13.7	13.9	7.3	9.9
-22	16.2	15.4	14.6	15.0	15.3	8.4	11.2
-20	17.6	16.8	16.0	16.4	16.6	9.36	20.0
-18	19.1	18.3	17.4	17.9	18.2	10.8	13.8
-16	20.6	19.8	18.9	19.4	19.7	12.1	15.1
-14	22.2	21.3	20.4	20.9	21.2	13.4	16.5
-12	23.8	22.9	22.0	22.5	22.8	14.7	17.9
-10	25.5	24.6	23.6	24.1	24.5	16.1	19.5
-8	27.3	26.3	25.3	25.8	26.6	17.9	22.3
-6	29.1	28.0	27.0	27.5	28.0	19.1	22.7
-4	30.9	29.8	28.8	29.3	29.9	20.6	24.3
-2	32.8	31.7	30.7	31.2	31.8	22.2	26.0
0	34.8	33.7	32.6	33.2	33.7	23.9	27.8
2	36.9	35.7	34.6	35.2	35.8	25.6	29.7
4	39.0	37.7	36.6	37.2	38.7	27.4	31.6
6	41.1	39.8	38.7	39.3	40.0	29.3	33.6
8	43.4	42.0	40.9	41.5	42.2	31.2	35.6
10	45.7	44.3	43.1	43.7	44.5	33.1	37.7
12	48.1	46.6	45.4	46.0	46.9	35.2	39.9
14	50.5	49.0	47.8	48.4	49.3	37.3	42.1
16	53.0	51.5	50.2	50.9	51.8	39.4	44.4
18	55.6	54.0	52.7	53.4	54.4	41.7	46.8
20	58.3	56.6	55.3	56.0	57.1	44.0	49.2
22	61.0	59.3	58.0	58.7	59.8	46.4	51.8
24	63.8	62.0	60.7	61.4	62.6	48.8	54.3
26	66.7	64.8	63.5	64.2	65.5	51.3	57.0

Genetron® AZ-50® (R-507A)							
		R-404A			R-448A		
	Bubble/Dew	Bubble	Dew	Average	Bubble	Dew	Average*
Temperature (°F)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)
28	69.7	67.8	66.4	67.1	68.4	53.9	59.7
30	72.7	70.7	69.3	70.0	71.5	56.6	62.6
32	75.9	73.8	72.4	73.1	74.6	59.4	65.5
34	79.1	77.0	75.5	76.3	77.8	62.2	68.4
36	82.4	80.2	78.7	79.5	81.1	65.1	71.5
38	85.8	83.5	82.0	82.2	84.5	68.1	74.7
40	89.2	86.9	85.4	86.2	88.0	71.2	77.9
42	92.8	90.4	88.8	89.6	91.6	74.4	83.0
44	96.5	94.0	92.4	93.2	95.2	77.7	86.5
46	100.2	97.6	96.0	96.8	99.0	81.0	90.0
48	104.1	101.4	99.8	100.6	102.9	84.5	93.7
50	108.0	105.3	103.6	104.5	106.8	88.0	97.4
52	112.0	109.2	107.5	108.4	110.8	91.7	101.3
54	116.2	113.3	111.6	112.5	115.0	95.4	105.2
56	120.4	117.4	115.7	116.6	119.2	99.2	109.2
58	124.7	121.7	119.9	120.8	123.6	103.2	113.4
60	129.2	126.0	124.2	125.1	128.0	107.2	117.6
62	133.7	130.5	128.7	129.6	132.6	111.3	122.0
64	138.4	135.0	133.2	134.1	137.3	115.6	126.5
66	143.1	139.7	137.8	138.8	142.0	119.9	131.0
68	148.0	144.4	142.6	143.5	146.9	124.4	135.7
70	153.0	149.3	147.4	148.4	151.9	129.0	140.5
72	158.1	154.3	152.4	153.4	157.0	133.7	145.4
74	163.3	159.4	157.5	158.5	162.2	138.5	150.4
76	168.6	164.6	162.7	163.7	167.6	143.4	155.5
78	174.1	169.9	168.0	169.0	173.0	148.4	160.7
80	179.6	175.4	173.4	174.4	178.6	153.6	166.1
82	185.3	181.0	179.0	180.0	184.3	158.8	171.6
84	191.1	186.7	184.6	185.7	190.1	164.3	177.2
86	197.1	192.5	190.4	191.5	196.1	169.8	183.0
88	203.1	198.4	196.4	197.4	202.2	175.4	188.8
90	209.3	204.5	202.4	203.5	208.4	181.2	194.8
92	215.6	210.7	208.6	209.7	214.7	187.2	201.0
94	222.1	217.0	214.9	216.0	221.2	193.2	207.2
96	228.7	223.4	221.3	222.4	227.7	199.4	213.6
98	235.4	230.0	227.9	229.0	234.5	205.8	220.2
100	242.3	236.8	234.6	242.6	241.3	212.3	226.8

Honeywell Refrigerants Temperature/Pressure Tables (cont'd)

Genetron® AZ-50® (R-507A)							
		R-404A			R-448A		
	Bubble/Dew	Bubble	Dew	Average	Bubble	Bubble	Average*
Temperature (°F)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)	Pressure (psig)
102	249.3	243.6	241.5	242.6	248.4	218.9	233.7
104	256.5	250.6	248.5	249.6	255.5	225.7	240.6
106	263.8	257.8	255.6	256.7	262.8	232.6	247.7
108	271.2	265.1	262.9	264.0	270.2	239.7	255.0
110	278.8	272.5	270.4	271.5	277.8	246.9	262.4
112	286.6	280.1	278.0	279.1	285.5	254.3	269.9
114	294.5	287.9	285.7	286.8	293.4	261.9	277.7
116	302.6	295.8	293.6	294.7	301.4	269.9	285.5
118	310.8	303.8	301.7	302.8	309.6	277.5	293.6
120	319.2	312.0	309.9	311.0	317.9	285.6	301.8
122	327.8	320.4	318.3	319.4	326.4	293.8	310.1
124	336.5	329.0	326.8	327.9	335.1	302.2	318.7
126	345.4	337.7	335.5	336.6	343.9	310.8	327.4
128	354.5	346.6	344.4	345.5	352.8	319.6	336.2
130	363.8	355.6	353.5	354.6	362.0	328.5	345.2
132	373.2	364.9	362.8	363.9	371.3	337.7	354.3
134	382.9	374.3	372.2	373.3	380.7	347.0	363.9
136	392.7	383.9	381.9	382.9	390.4	356.6	373.9
138	402.7	393.7	391.7	392.7	400.2	366.3	383.3
140	413.0	403.7	401.7	402.7	410.2	376.3	393.3
142	423.4	413.9	411.9	412.9	420.3	386.5	403.4
144	434.1	424.3	422.4	423.4	430.7	396.8	413.8
146	444.9	434.9	433.1	434.0	441.2	407.5	424.4
148	456.1	445.7	443.9	444.8	451.9	418.3	435.1
150	467.4	456.8	455.1	456.0	462.8	429.4	446.1

*Table includes weighted average 40/60 for use 40°F and below and 50/50 average above 40°F. More accurate system operation is achieved with these values when using moderate glide blends.

Dew point values – use when calculating superheat
Bubble point values – use when calculating sub cooling
Average values – use when setting control points and when determining the average condensing and evaporating temperature/pressure.

Honeywell Refrigerants Temperature/Pressure Tables SI Units

Genetron® AZ-50® (R-507A)						
		R-404A		R-448A		
		Liquid	Vapor	Liquid	Vapor	Average*
Temperature (°C)	Pressure (barg)	Pressure (barg)	Pressure (barg)	Pressure (barg)	Pressure (barg)	Pressure (barg)
-40	0.4	0.3	0.3	0.3	0.0	0.1
-39	0.4	0.4	0.4	0.4	0.0	0.2
-38	0.5	0.5	0.4	0.5	0.1	0.2
-37	0.6	0.5	0.5	0.5	0.1	0.3
-36	0.6	0.6	0.6	0.6	0.2	0.4
-35	0.7	0.7	0.6	0.7	0.3	0.4
-34	0.8	0.7	0.7	0.7	0.3	0.5
-33	0.9	0.8	0.8	0.8	0.4	0.5
-32	0.9	0.9	0.8	0.9	0.4	0.6
-31	1.0	1.0	0.9	1.0	0.5	0.7
-30	1.1	1.1	1.0	1.1	0.6	0.8
-29	1.2	1.1	1.1	1.1	0.7	0.8
-28	1.3	1.2	1.2	1.2	0.7	0.9
-27	1.4	1.3	1.3	1.3	0.8	1.0
-26	1.5	1.4	1.4	1.4	0.9	1.1
-25	1.6	1.5	1.5	1.5	1.0	1.2
-24	1.7	1.6	1.6	1.6	1.1	1.3
-23	1.8	1.7	1.7	1.7	1.1	1.4
-22	1.9	1.8	1.8	1.8	1.2	1.5
-21	2.0	1.9	1.9	1.9	1.3	1.6
-20	2.1	2.1	2.0	2.1	1.4	1.7
-19	2.2	2.2	2.1	2.2	1.5	1.8
-18	2.4	2.3	2.2	2.3	1.6	1.9
-17	2.5	2.4	2.3	2.4	1.7	2.0
-16	2.6	2.5	2.5	2.5	1.8	2.1
-15	2.8	2.7	2.6	2.7	2.0	2.2
-14	2.9	2.8	2.7	2.8	2.1	2.4
-13	3.0	2.9	2.9	3.0	2.2	2.5
-12	3.2	3.1	3.0	3.1	2.3	2.6
-11	3.3	3.2	3.1	3.2	2.4	2.8
-10	3.5	3.4	3.3	3.4	2.6	2.9
-9	3.6	3.5	3.4	3.6	2.7	3.0
-8	3.8	3.7	3.6	3.7	2.8	3.2
-7	4.0	3.8	3.8	3.9	3.0	3.3
-6	4.1	4.0	3.9	4.0	3.1	3.5

Honeywell Refrigerants Temperature/Pressure Tables SI Units (cont'd)

Genetron® AZ-50® (R-507A)		R-404A		R-448A		
		Liquid	Vapor	Liquid	Vapor	Average*
Temperature (°C)	Pressure (barg)	Pressure (barg)	Pressure (barg)	Pressure (barg)	Pressure (barg)	Pressure (barg)
-5	4.3	4.2	4.1	4.2	3.3	3.7
-4	4.5	4.4	4.3	4.4	3.4	3.8
-3	4.7	4.5	4.4	4.6	3.6	4.0
-2	4.8	4.7	4.6	4.8	3.8	4.2
-1	5.0	4.9	4.8	4.9	3.9	4.3
0	5.2	5.1	5.0	5.1	4.1	4.5
1	5.4	5.3	5.2	5.3	4.3	4.7
2	5.6	5.5	5.4	5.5	4.4	4.9
3	5.8	5.7	5.6	5.8	4.6	5.1
4	6.1	5.9	5.8	6.0	4.8	5.3
5	6.3	6.1	6.0	6.2	5.0	5.7
6	6.5	6.3	6.2	6.4	5.2	6.0
7	6.7	6.6	6.4	6.6	5.4	6.2
8	7.0	6.8	6.7	6.9	5.6	6.4
9	7.2	7.0	6.9	7.1	5.8	6.6
10	7.4	7.3	7.1	7.4	6.1	6.8
11	7.7	7.5	7.4	7.6	6.3	7.1
12	8.0	7.8	7.6	7.9	6.5	7.3
13	8.2	8.0	7.9	8.1	6.8	7.6
14	8.5	8.3	8.1	8.7	7.0	7.8
15	8.8	8.5	8.4	8.7	7.2	8.1
16	9.0	8.8	8.7	9.0	7.5	8.3
17	9.3	9.1	9.0	9.2	7.8	8.6
18	9.6	9.4	9.2	9.5	8.0	8.9
19	9.9	9.7	9.5	9.8	8.3	9.1
20	10.2	10.0	9.8	10.1	8.6	9.4
21	10.5	10.3	10.1	10.4	8.9	9.7
22	10.8	10.6	10.4	10.8	9.1	10.0
23	11.1	10.9	10.8	11.1	9.4	10.3
24	11.5	11.2	11.1	11.4	9.7	10.6
25	11.8	11.5	11.4	11.7	10.1	11.0
26	12.2	11.9	11.7	12.1	10.4	11.3
27	12.5	12.2	12.1	12.4	10.7	11.6
28	12.9	12.6	12.4	12.8	11.0	12.0
29	13.2	12.9	12.8	13.1	11.4	12.3

Genetron® AZ-50® (R-507A)		R-404A		R-448A		
		Liquid	Vapor	Liquid	Vapor	Average*
Temperature (°C)	Pressure (barg)	Pressure (barg)	Pressure (barg)	Pressure (barg)	Pressure (barg)	Pressure (barg)
30	13.6	13.3	13.1	13.5	11.7	12.6
31	14.0	13.6	13.5	13.9	12.1	13.0
32	14.3	14.0	13.9	14.3	12.4	13.4
33	14.7	14.4	14.3	14.7	12.8	13.7
34	15.1	14.8	14.6	15.1	13.2	14.1
35	15.5	15.2	15.0	15.5	13.5	14.5
36	16.0	15.6	15.4	15.9	13.9	14.9
37	16.4	16.0	15.9	16.3	14.3	15.3
38	16.8	16.4	16.3	16.7	14.7	15.7
39	17.2	16.8	16.7	17.2	15.1	16.2
40	17.7	17.3	17.1	17.6	15.6	16.6
41	18.1	17.7	17.6	18.1	16.0	17.0
42	18.6	18.2	18.0	18.5	16.4	17.5
43	19.1	18.6	18.5	19.0	16.9	17.9
44	19.5	19.1	19.0	19.5	17.3	18.4
45	20.0	19.6	19.4	20.0	17.8	18.9
46	20.5	20.1	19.9	20.4	18.3	19.3
47	21.0	20.6	20.4	20.9	18.7	19.8
48	21.5	21.1	20.9	21.5	19.2	20.3
49	22.1	21.6	21.4	22.0	19.7	20.8
50	22.6	22.1	21.9	22.5	20.3	21.3
51	23.1	22.6	22.5	23.0	20.8	21.9
52	23.7	23.2	23.0	23.6	21.3	22.4
53	24.3	23.7	23.6	24.1	21.8	22.9
54	24.8	24.3	24.1	24.7	22.4	23.5
55	25.4	24.8	24.7	25.3	23.0	24.1
56	26.0	25.4	25.3	25.9	23.5	24.6
57	26.6	26.0	25.9	26.4	24.1	25.2
58	27.2	26.6	26.5	27.0	24.7	25.8
59	27.8	27.2	27.1	27.7	25.3	26.4
60	28.5	27.8	27.7	28.3	25.9	27.1

*Table includes 40/60 average values to 4C and below for accurate low side control settings and 50/50 5C and above. More accurate system operation is achieved with moderate glide blends using these values.

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March 2016 version 8
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