

## HCFC Retrofit Guidelines

HCFC-22 to R448A

Solstice® N40

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## Preface

HCFC-22 (R22) is a high-capacity refrigerant employed in many medium- and low- temperature refrigeration systems. As supermarket owners work to comply with present regulations, as well as reduce their carbon footprint, existing refrigeration equipment may need to be either replaced or retrofitted with an alternative refrigerant. The selection of a retrofit refrigerant depends, in part, upon retrofit objectives that may include factors such as efficiency, first cost, regulatory compliance and capacity. By following equipment manufacturers’ recommendations and Honeywell’s guidelines outlined in this publication, service technicians can readily retrofit many existing R22 medium- and low-temperature refrigeration systems to R448A.

## Introduction

As the commercial refrigeration industry continues the move away from the use of ozone depleting and high global warming potential (GWP) hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs), refrigerant service personnel will play a key role in the transition to 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 R448A.

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, review the Material Safety Data Sheet (MSDS) for safety information on the specific refrigerant you choose.

## Solstice® Refrigerants

ASHRAE number, components and applications appear in the table below.

Refrigerant	Type	Replaces	Applications	Comments
Solstice N40 (R448A)	Blend R32 R125 R1234yf R134a R1234ze	R22 R404A R507 R407A	Supermarket freezers, coolers, display cases. Liquid (DX) chillers. Warehouse refrigeration	Among the most efficient R22 replacements. Close mass flow match. Lowest GWP value compared to available alternatives. Little to no adjustment to TXVs. Make appropriate control adjustments.

## R448A is not a “Drop-in” Replacement

R448A is an HFO-blended refrigerant that utilizes synthetic lubricants. Check with the compressor manufacturer to determine if the existing lubricant is acceptable. The retrofit procedures listed here have been developed by Honeywell to address these issues and to help technicians perform successful retrofits of R22 systems utilizing positive-displacement (reciprocating, rotary, scroll or screw) compressors. Many retrofits have demonstrated the suitability of most installed R22 valves to operate satisfactorily with R448A. Electronic expansion devices

will require a software upgrade to accommodate R448A. Pay particular attention to systems that utilize non-adjustable thermal expansion valves (TXVs). Consult the valve manufacturer for suitability and conversion kits to obtain proper superheat setting with R448A.

## Retrofit Procedures

**System preparation:** When 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 a Solstice refrigerant.

### 2. Isolate R22 Refrigerant Charge

The HCFC refrigerant charge should be isolated 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 operating R22 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 R448A to be charged to the system.

### 3. Choose Compressor Lubricant

In most instances, the lubricant in use with R22 is not suitable for use with R448A and a change to a synthetic lubricant is required. 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 (proceed to Step 4). If the system is clean, proceed to Step 11.

#### 4. 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. Most installations require a single compressor oil change.

#### 5. 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.

#### 6. Recharge Compressor with Polyol Ester Lubricant

Check with the compressor manufacturer for the recommended lubricant. Add to the compressor the same volume of 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.

#### 7. Reinstall the Compressor

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

#### 8. Evaluate the Expansion Device

Due to the relatively close mass flow of R448 and R22, little to no adjustment of the TXVs is expected. Non-adjustable valves may need to be replaced or retrofitted. Consult the valve manufacturer to confirm the suitability of the original

valve when using R448A. For systems equipped with a capillary tube refer to the table below for recommendations. Always consult the manufacturer of the equipment prior to retrofitting.

**Capillary Tube Length  
(Relative to R22, same diameter)**

R448A	Low Temperature	Medium Temperature
	0.7–1.0	0.8–1.0
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 HFC-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 Refrigerant

When replacing R22 with R448A, use the same charging procedures that you would use for the refrigerant being

replaced. When working with R448A, 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. **Never vapor charge the system with vapor from a 400 series refrigerant cylinder.** 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 R448A require a slightly lower charge size than R22.

For expansion valves or optimized capillary tube systems, the typical charge size relative to the R22 being replaced appears below.

**Relative Charge Size**

Solstice N40 Refrigerant	R22
R448A	98%

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 R448A relative to R22 are given below.

**Comparative Suction and Discharge Pressure Versus R22**

	Suction	Discharge
R448A	0–10 psig higher	0–40 psig higher

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. 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. It is Honeywell's recommendation to use the average value when setting condensing and evaporating temperatures. Use average of bubble and dew points when setting operating suction pressure, evaporator pressure regulators and fan cycling controls. For systems utilizing microprocessor controllers, be certain to load the pressure temperature curve (average) for R448A.

### 14. Label Components and System

After retrofitting the system with R448A, label the system components to identify the refrigerant 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 Wholesaler.

## Retrofit Checklist

- |   |  |
|---|--|
| <p>1. Record baseline data on original system performance. _____</p> <p>2. Recover refrigerant charge using appropriate recovery equipment. _____</p> <p>3. Record the amount of refrigerant recovered. _____</p> <p>4. Choose compressor lubricant. Consult the compressor manufacturer's data to verify that the same synthetic grade and weight is suitable for use with R448A, this is generally the case. _____</p> <p>5. If required, drain the existing lubricant from the compressors, separators and oil reservoirs. _____</p> <p>6. Measure volume of lubricant removed. _____</p> <p>7. Change lubricant filters if present. _____</p> <p>8. Recharge the system with polyol ester lubricant, use the same volume that was removed. _____</p> <p>9. Evaluate the expansion devices; consult the valve manufacturers for recommendations. No change is necessary in most cases. _____</p> | <p>10. Evaluate and replace all elastomer seals including receiver float, alarm and level control gaskets. _____</p> <p>11. Replace filter driers and suction filters. _____</p> <p>12. Leak-check the system. _____</p> <p>13. Evacuate the system. _____</p> <p>14. Charge the system with the new refrigerant. In the case of R448A, remove only liquid from the charging cylinder. Initial charge should be approximately 98% of the R22 charge by weight. Record the amount of refrigerant charged. _____</p> <p>15. Check system operation and adjust TXVs and operating controls. The discharge pressure of R448A is slightly higher and condenser fan and ambient controls may require adjustment. _____</p> <p>16. Adjust refrigerant charge if necessary. _____</p> <p>17. Label components and the system with the type of refrigerant and lubricant. _____</p> |
|---|--|

## Pressure-Temperature Charts

R22 – SI	
Temperature (°C)	Pressure (bar–g)
-50	<b>10.9</b>
-45	<b>5.4</b>
-40	0.04
-35	0.31
-30	0.63
-25	1.00
-20	1.44
-15	1.95
-10	2.53
-5	3.20
0	3.97
5	4.83
10	5.80
15	6.88
20	8.09
25	9.43
30	10.9
35	12.5
40	14.3
45	16.3
50	18.4
55	20.7
60	23.3
65	26.0
70	29.0
75	32.2
80	35.6

R22 – IP	
Temperature (°F)	Pressure (psig)
-50	<b>6.1</b>
-45	<b>2.7</b>
-40	0.6
-35	2.6
-30	4.9
-25	7.4
-20	10.2
-15	13.2
-10	16.5
-5	20.1
0	24.0
5	28.3
10	32.8
15	37.8
20	43.1
25	48.8
30	55.0
35	61.5
40	68.6
45	76.1
50	84.1
55	92.6
60	102
65	111
70	121
75	132
80	144
85	156
90	168
95	182
100	196
105	211
110	226
115	243
120	260
125	278
130	297
135	317
140	337

N40 – SI			
Temperature (°C)	P <sub>sub</sub> (bar–g)	P <sub>dew</sub> (bar–g)	P <sub>avg</sub> (bar–g)
-50	<b>5.44</b>	<b>12.3</b>	<b>8.86</b>
-45	0.05	<b>6.92</b>	<b>3.41</b>
-40	0.33	<b>0.35</b>	0.08
-35	0.66	0.26	0.46
-30	1.06	0.59	0.83
-25	1.52	0.97	1.25
-20	2.06	1.42	1.74
-15	2.68	1.95	2.32
-10	3.40	2.57	2.99
-5	4.22	3.28	3.75
0	5.15	4.09	4.62
5	6.19	5.02	5.61
10	7.36	6.07	6.72
15	8.67	7.25	7.96
20	10.1	8.58	9.36
25	11.7	10.1	10.9
30	13.5	11.7	12.6
35	15.5	13.5	14.5
40	17.6	15.6	16.6
45	20.0	17.8	18.9
50	22.5	20.3	21.4
55	25.3	23.0	24.1
60	28.3	25.9	27.1
65	31.5	29.2	30.4
70	35.0	32.8	33.9
75	38.8	36.9	37.8
80	42.7	41.5	42.1

N40 – IP			
Temperature (°F)	P <sub>sub</sub> (psig)	P <sub>dew</sub> (psig)	P <sub>avg</sub> (psig)
-50	0.27	<b>7.57</b>	<b>3.51</b>
-45	2.39	<b>4.16</b>	0.17
-40	4.73	<b>0.35</b>	2.28
-35	7.31	1.91	4.61
-30	10.2	4.22	7.19
-25	13.3	6.78	10.0
-20	16.7	9.61	13.2
-15	20.4	12.7	16.6
-10	24.5	16.1	20.3
-5	28.9	19.8	24.4
0	33.7	23.9	28.8
5	38.9	28.3	33.6
10	44.5	33.1	38.8
15	50.6	38.4	44.5
20	57.1	44.0	50.5
25	64.0	50.1	57.0
30	71.5	56.7	64.1
35	79.5	63.7	71.6
40	88.0	71.2	79.6
45	97.1	79.4	88.2
50	107	88.0	97.4
55	117	97.3	107
60	128	107	118
65	140	118	129
70	152	129	140
75	165	141	153
80	179	154	166
85	193	167	180
90	208	181	195
95	224	196	210
100	241	212	227
105	259	229	244
110	278	247	262
115	297	266	282
120	318	286	302
125	339	306	323
130	362	329	345
135	386	352	369
140	410	376	393

NOTE: Numbers in blue indicate in Hg

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