AIR CONDITIONING SYSTEMS – HIGH AMBIENT APPLICATIONS HCFC TO HFO BLEND

Retrofit Guideline

R-124 to Solstice® N15
(R-515B)

Honeywell

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PREFACE

R-124 was a refrigerant employed for use in chillers and cooling systems in high ambient conditions. R-124 is an HCFC and, as such, is regulated in the United States under the HCFC phaseout mandated through the Clean Air Act. This includes a ban on the production or import of any HCFC starting in 2020. In Canada, the ozone-depleting substances and halocarbon alternative regulations mandates that, starting 1 January 2020, no HCFC, whether reclaimed or virgin, can be imported.

Businesses that use high ambient air conditioning will need an economical solution to comply with regulations, as well as reduce their carbon footprint. These entities may need to either replace existing equipment or retrofit with an alternative refrigerant. The selection of a retrofit refrigerant depends, in part, upon retrofit objectives that include factors such as efficiency, first cost, compatibility, power requirements, regulatory compliance, and capacity. Technicians may follow equipment manufacturers' recommendations and Honeywell's guidelines outlined in this publication to help retrofit existing R-124 refrigeration systems to R-515B.

R-515B is a good choice for new equipment and retrofits of R-124 in high ambient conditions. This is due to its high capacity, compatible efficiency, reduced GWP, and low discharge temperatures in high ambient conditions.

INTRODUCTION

The commercial refrigeration industry continues to move away from the use of ozone-depleting and high global-warming-potential (GWP) refrigerants.

Refrigeration contractors and technicians play a key role in the transition to alternatives through retrofitting. Honeywell has produced this guide to help contractors and technicians better understand the various technical and operational aspects of carrying out retrofit procedures using R-515B in high-ambient equipment.

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 Safety Data Sheet (SDS) for safety information on the specific refrigerant you choose.

R-515B IS NOT A "DROP-IN" REPLACEMENT

R-515B utilizes synthetic lubricants. The mineral oil typically contained in R-124 systems will need to be changed. The O-rings in the R-124 systems may also experience degradation due to the removal of chlorine contained in these refrigerants.

The retrofit procedures listed here have been developed by Honeywell to address these issues and to help technicians perform successful retrofits utilizing positive-displacement (reciprocating, rotary, scroll or screw) compressors.

REFRIGERANT COMPARISONS

Refrigerant comparisons appear in the chart below.

Refrigerant	Type	Replaces	Ozone Depletion Potential (ODP)	Global Warming Potential (GWP)	Discharge Temperature (65.6°C condensing)
ALTERNATIVE REFRIGERANT					
Solstice® N15 (R-515B)	HFO/HFC Blend R-1234ze R-227ea	R-124	0.0	299	173°F
RETROFITTED REFRIGERANT					
R-124*	HCFC R-124		0.022	527	175°F

* US Production and import cease in 2020

RETROFIT PROCEDURES SUMMARY

A successful retrofit includes several steps to produce a low maintenance and efficient system. The steps outlined below have been developed based on the experience of Honeywell's technical team. This guide is only a recommendation.

The first step is a systematic survey. We recommend a system survey to identify existing conditions that impact the retrofit, as well as identifying system upgrades that can be completed cost-effectively during the retrofit. A refrigerant retrofit is an ideal time to increase the life cycle and efficiency of the mechanical system. During the survey you may also identify components that may need to be replaced or added to match the new refrigerant, and to reduce future leaks.

The second step includes activities to prepare for the retrofit. Preparation includes facility coordination and procurement of needed parts. This step shortens the downtime during the retrofit as well as reducing overall risk. The final step is the actual retrofit.

RETROFIT PROCEDURES DETAILED

STEP 1 - SITE SURVEY

1. Compressors

- Record manufacturer, model, and serial numbers
- Identify failed compressors, failed fans, and any capillary control lines
- Identify discharge temperature mitigation devices (if any)
- Contact the compressor manufacturer to determine any seals that need to be changed as well as the recommended oil
- R-515B will have a higher capacity than R-124. This means it will also have up to 30% higher amperage. It is important to review compressor amperages and wire sizes and to change breakers and wires as needed. Overall unit MCA and MOP should also be reviewed.

2. System issues

Review the system to identify any items that impact system operation. Some example areas to identify include failed condenser fans, clogged evaporator coils, degraded condensers, poor insulation, obsolete components, etc.

3. Review expansion valves

- In general, R-124 valves will have a strong closing force when used with R-515B. This is due to the higher evaporator pressure with R-515B as compared to R-124. This will likely make it difficult to open the valve enough to create a superheat (starved coil).
- We recommend contacting the expansion valve supplier for recommendations. Electronic valves can be a good choice.

4. Review pressure relief valves

- R-515B relief valves require ~1.5% higher capacity than R-124 valves. In most cases, the existing valve will be adequate. Regardless, the size should be reviewed. Please refer to manufacturers' literature for sizing guidelines.
- Honeywell recommends replacing the relief valves to ensure they are in good working order.

5. Check system high side design pressure

- It is important to check that the system meets the ASHRAE 15 standard for system design pressure. The system design pressure is typically located on the system data tag.
- R-515B will run at higher discharge pressures than R-124. Review the PT chart (p. 8) for pressures.
- If the system design pressure is greater than the ASHRAE calculated values for your 1% dry bulb condition, the system meets the ASHRAE guideline.
- ASHRAE 15 states that the system design pressure shall be 30°F (16.7°C) higher than the highest summer 1% design dry-bulb temperature for the location but not lower than 122°F (50°C). (The retailer's design consultant will be able to provide the 1% dry bulb ratings for your location).

6. Identify seals and O-rings for replacement

- Chlorine-based refrigerants such as R-124 can result in elastomer seal failure when the chlorine-based refrigerant is removed.
- When retrofitting from an HCFC to an HFO refrigerant, the material compatibility and the condition of existing seals and gaskets should also 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.

- We recommend replacing the entire component, or the O-ring / seal, in the following areas:
  - Schrader valves and caps
  - Receiver level indicators and alarms
  - Heat reclaim and condenser splitting valves
  - Evaporator Pressure Regulators (EPRs)
  - Solenoid valves
  - Pilot hoses
  - Ball valves

7. Record baseline data

Record baseline data to identify issues, and as a reference for post-retrofit performance

8. Line sizes

- Review refrigerant line sizes, especially horizontal suction and riser lines
- In general, lines sized for R-124 will work well with R-515B. The suction lines may be slightly oversized. If the horizontal suction line is properly sloped this will not present an issue. Suction riser velocities may be lower than recommended for proper oil return.
- Contact Honeywell for specific conditions

9. Test oil and refrigerant

- Test oil to identify any signs of serious system issues
- If the recovered refrigerant is to be used in other systems, or otherwise re-used, we recommend testing it for purity
- Retain survey as a reference and to drive the scope of work

STEP 2 - PREPARATION

1. Facility coordination

- We recommend meeting with facility leader and managers. Items to discuss include:
  - Retrofit dates and times
  - Facility hours

2. Order parts and refrigerant

3.Technician training

- Ensure that technicians are trained in setting to superheat
- Refer to the pressure-temperature chart on page 8.

4. System changes

Perform any activities identified in the survey that can be safely done before the retrofit. This includes any valves that can be isolated without a system pump down, compressor changes, pilot lines, control adjustments, coil cleaning, etc.

5. Change oil from mineral to POE.

- In most instances, the lubricant used with R-124 s not suitable for use with R-515B. A change to a synthetic lubricant is required. Honeywell recommends using a miscible lubricant approved by the compressor manufacturer.
- 95% of POE oil is recommended. This may take several oil changes.
  - Change suction and liquid filters and driers
  - Upgrade controller with R-515B pressure/temperature curves as applicable
  - Leak check and repair

STEP 3 - RETROFIT

1. Remind facility personnel the day prior to retrofit.
2. Recover existing refrigerant. Use Green Chill guidelines at www.epa.gov/ green chill to recover refrigerant.
3. A record amount of refrigerant removed, including refrigerant previously removed.
4. Break vacuum from the recovery machine.
5. Replace seals, gaskets, and valves as needed.
6. Replace expansion valves as determined in survey.
7. Modify compressors and electrical as determined in the survey.
8. Replace driers and filters.
9. Evacuate system
   - Honeywell recommends evacuating the system to 500 microns from both sides of the system. 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 micron gauge to measure the vacuum. An analog refrigeration gauge will not provide an accurate measurement.
   - Repair any leaks
10. Charge system
    - Use a throttling valve to control the flow of refrigerant if charging 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 compressor.
    - Systems being charged with R-515B require approximately 13% lower charge than R-124.
    - 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
11. Adjust expansion valves
    - Adjusting valves is a very important part of any retrofit. Properly adjusted valves will prevent compressor damage, ensure proper temperatures, and result in an efficient system.
    - Most valves will require some adjustments
12. Adjust pressure controls. All mechanical controls should be reviewed for adjustment. This includes safety controls, EPR valves, holdback valves, etc.
13. Label Components and System
    - After retrofitting the system with R-515B, 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.
    - Contact Honeywell wholesaler for labels, PT charts, etc.

R-515B, R-124, R-134a			
	Solstice® 515B (R-515B)	Genetron® R-124 (R-124)[1]	Genetron® R-134a (R-134a)
Temperature (°F)	Pressure (psig)		
0	0.7	-3.3	6.5
2	1.5	-2.7	7.5
4	2.3	-2.1	8.5
6	3.1	-1.5	9.6
8	3.9	-0.8	10.8
10	4.8	-0.2	11.9
12	5.7	0.5	13.1
14	6.6	1.2	14.4
16	7.6	2.0	15.7
18	8.6	2.8	17.0
20	9.6	3.6	18.4
22	10.7	4.4	19.9
24	10.7	5.2	21.3
26	13.0	6.1	22.9
28	14.2	7.0	24.5
30	15.4	8.0	26.1
32	16.6	8.9	27.8
34	17.9	10.0	29.5
36	19.3	11.0	31.3
38	20.7	12.1	33.1
40	22.1	13.2	35.0
42	23.6	14.3	37.0
44	25.1	15.5	39.0
46	26.7	16.7	41.1
48	28.3	18.0	43.2
50	29.9	19.3	45.4
52	31.6	20.6	47.7
54	33.4	22.0	50.0
56	35.2	23.4	52.4
58	37.1	24.8	54.9
60	39.0	26.3	57.4
62	40.9	27.9	60.0
64	42.9	29.4	62.7
66	45.0	31.1	65.4
68	47.2	32.7	68.2
70	49.3	34.4	71.1
72	51.6	36.2	74.1
74	53.9	38.0	77.1
76	56.2	39.9	80.2
78	58.7	41.8	83.4
80	61.2	43.7	86.7
82	63.7	45.7	90.0
84	66.3	47.8	93.5

R-515B, R-124, R-134a			
	Solstice® 515B (R-515B)	Genetron® R-124 (R-124)[1]	Genetron® R-134a (R-134a)
Temperature (°F)	Pressure (psig)		
86	69.0	49.9	97.0
88	71.7	52.1	100.6
90	74.6	54.3	104.3
92	77.4	56.5	108.1
94	80.4	58.9	112.0
96	83.4	61.3	115.9
98	86.5	63.7	120.0
100	89.7	66.2	124.2
102	92.9	68.8	128.4
104	96.2	71.4	132.7
106	99.6	74.1	137.2
108	103.1	76.8	141.7
110	106.6	79.6	146.4
112	110.3	82.5	151.1
114	114.0	85.4	156.0
116	117.8	88.4	160.9
118	121.6	91.5	166.0
120	125.6	94.6	171.2
122	129.6	97.8	176.5
124	133.8	101.1	181.8
126	138.0	104.4	187.4
128	142.3	107.9	193.0
130	146.7	111.3	198.7
132	151.2	114.9	204.6
134	155.7	118.5	210.6
136	160.4	122.2	216.7
138	165.2	126.0	222.9
140	170.1	129.9	229.2
142	175.0	133.8	235.7
144	180.1	137.9	242.3
146	185.3	142.0	249.0
148	190.5	146.2	255.9
150	195.9	150.4	262.9
152	201.4	154.8	270.1
154	207.0	159.2	277.3
156	212.7	163.7	284.8
158	218.5	168.3	292.3
160	224.4	173.0	300.0
162	230.4	177.8	307.9
164	236.5	182.7	315.9
166	242.8	187.7	324.1
168	249.2	192.7	332.4
170	255.7	197.9	340.8

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