

Solstice[®] N40 (R448A) Refrigerant



It's the most energy-efficient, reduced-GWP alternative to R404A available.



Honeywell

Reduced GWP And Higher Energy Efficiency

The superior energy efficiency of Honeywell Solstice® N40 (R448A) makes it a clear winner compared to R404A. Add in its significantly lower global warming potential — more than two-thirds lower — and it's easy to see why Solstice N40 should be your refrigerant choice for years to come. It's a nonflammable (ASHRAE A1) replacement for R404A or R22 in supermarket applications.

- Low- and medium-temp refrigeration applications
- Nonflammable (ASHRAE A1)
- Near drop-in replacement for R404A
- GWP of 1273 is 68% lower than R404A and 34% lower than R407A
- 5-10% higher energy efficiency than R404A
- Equivalent to R22 performance in low and medium-temp applications

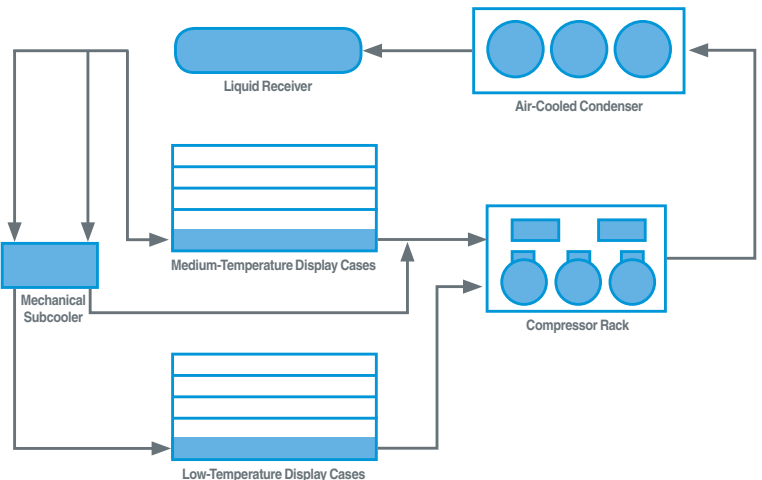
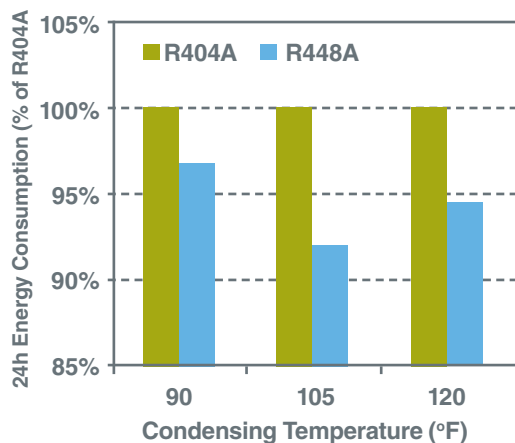
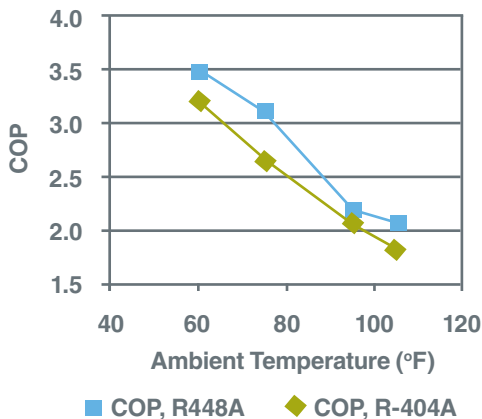
Rapid, Cost-Efficient Adoption

Honeywell has made switching to Solstice N40 (R448A) a breeze. It's a near drop-in replacement, so you don't have to worry about a long learning curve. With Solstice N40, you can get right to work.

- Similar operating pressures as HFCs
- Same lubricant as HFCs (POE)
- Compatible with all system components
- Solstice N40 in approval process for use with Copeland Discus and Scroll, Bitzer, Carlyle

Solstice N40 Is Simply Better

As the charts below show, Solstice N40 (R448A) demonstrates lower energy consumption, increased refrigeration capacity and coefficient of performance (COP) compared to R404A.



Above: In a full-scale supermarket refrigeration experimental evaluation under controlled laboratory conditions at Oak Ridge National Laboratories, Solstice N40 increased system COP by 11.6% and capacity by 7.5% over the ambient temperature range.

Left: In recent laboratory tests at Emerson Climate Technologies, Solstice N40 demonstrated up to 8% lower energy consumption than R404A.

Honeywell Genetron Refrigerants

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Pressure	R404A		Honeywell Solstice N40		
	Liquid (bubble) Temp. (°F)	Vapor (dew) Temp. (°F)	Liquid (bubble) Temp. (°F)	Vapor (dew) Temp. (°F)	Average Temp. (°F)
0	-51.2	-49.9	-50.7	-39.6	-45.2
1	-48.7	-47.4	-48.2	-37.2	-42.7
2	-46.3	-45.0	-45.9	-34.9	-40.4
3	-44.1	-42.8	-43.6	-32.6	-38.1
4	-41.9	-40.6	-41.5	-30.5	-36.0
5	-39.9	-38.6	-39.4	-28.5	-34.0
6	-37.9	-36.6	-37.5	-26.5	-32.0
7	-35.9	-34.7	-35.6	-24.7	-30.1
8	-34.1	-32.8	-33.7	-22.8	-28.3
9	-32.3	-31.1	-32.0	-21.1	-26.5
10	-30.6	-29.3	-30.3	-19.4	-24.8
11	-28.9	-27.7	-28.6	-17.8	-23.2
12	-27.3	-26.1	-27.0	-16.2	-21.6
13	-25.7	-24.5	-25.4	-14.6	-20.0
14	-24.1	-23.0	-23.9	-13.1	-18.5
15	-22.7	-21.5	-22.4	-11.7	-17.0
16	-21.2	-20.0	-21.0	-10.2	-15.6
17	-19.8	-18.6	-19.6	-8.8	-14.2
18	-18.4	-17.2	-18.2	-7.5	-12.8
19	-17.0	-15.9	-16.9	-6.2	-11.5
20	-15.7	-14.6	-15.6	-4.9	-10.2
22	-13.1	-12.0	-13.0	-2.4	-7.7
24	-10.7	-9.6	-10.6	0.1	-5.3
26	-8.3	-7.2	-8.3	2.4	-3.0
28	-6.0	-4.9	-6.0	4.6	-0.7
30	-3.8	-2.7	-3.9	6.7	1.4
32	-1.7	-0.6	-1.8	8.8	3.5
34	0.4	1.4	0.3	10.8	5.5
36	2.3	3.4	2.2	12.7	7.5
38	4.3	5.3	4.1	14.6	9.4
40	6.2	7.2	6.0	16.5	11.2
42	8.0	9.0	7.8	18.2	13.0
43	8.9	9.9	8.7	19.1	13.9
44	9.8	10.8	9.6	20.0	14.8
45	10.6	11.6	10.4	20.8	15.6
46	11.5	12.5	11.3	21.6	16.5
47	12.3	13.4	12.1	22.5	17.3
48	13.2	14.2	12.9	23.3	18.1
49	14.0	15.0	13.7	24.1	18.9
50	14.8	15.8	14.6	24.9	19.7
52	16.4	17.4	16.1	26.5	21.3
54	18.0	19.0	17.7	28.0	22.8
56	19.6	20.5	19.2	29.5	24.4
58	21.1	22.0	20.7	31.0	25.8
60	22.5	23.5	22.2	32.4	27.3
62	24.0	25.0	23.6	33.8	28.7
64	25.4	26.4	25.0	35.2	30.1
66	26.8	27.8	26.4	36.5	31.4
68	28.2	29.1	27.7	37.9	32.8
70	29.5	30.4	29.0	39.2	34.1
73	31.5	32.4	31.0	41.1	36.0
76	33.4	34.3	32.9	42.9	37.9
79	35.3	36.2	34.7	44.7	39.7
82	37.1	38.0	36.5	46.5	41.5
85	38.9	39.8	38.3	48.2	43.3

Pressure	R404A		Honeywell Solstice N40		
	Liquid (bubble) Temp. (°F)	Vapor (dew) Temp. (°F)	Liquid (bubble) Temp. (°F)	Vapor (dew) Temp. (°F)	Average Temp. (°F)
88	40.6	41.5	40.0	49.9	45.0
91	42.3	43.2	41.7	51.6	46.6
94	44.0	44.9	43.3	53.2	48.3
97	45.7	46.5	44.9	54.8	49.9
100	47.3	48.1	46.5	56.4	51.4
104	49.4	50.2	48.6	58.4	53.5
108	51.4	52.2	50.6	60.3	55.5
112	53.4	54.2	52.6	62.3	57.4
116	55.3	56.2	54.5	64.2	59.3
120	57.2	58.0	56.4	66.0	61.2
125	59.5	60.4	58.6	68.2	63.4
130	61.8	62.6	60.9	70.4	65.6
135	64.0	64.8	63.0	72.5	67.8
140	66.1	66.9	65.2	74.6	69.9
145	68.2	69.0	67.2	76.6	71.9
150	70.3	71.0	69.2	78.6	73.9
155	72.3	73.0	71.2	80.5	75.9
160	74.2	75.0	73.2	82.4	77.8
165	76.2	76.9	75.0	84.2	79.6
170	78.0	78.7	76.9	86.0	81.5
175	79.9	80.6	78.7	87.8	83.3
180	81.7	82.4	80.5	89.5	85.0
185	83.4	84.1	82.2	91.2	86.7
190	85.2	85.9	84.0	92.9	88.4
191	85.5	86.2	84.3	93.2	88.8
192	85.8	86.5	84.6	93.6	89.1
193	86.2	86.9	85.0	93.9	89.4
194	86.5	87.2	85.3	94.2	89.8
195	86.9	87.5	85.6	94.5	90.1
196	87.2	87.9	86.0	94.9	90.4
197	87.5	88.2	86.3	95.2	90.7
198	87.9	88.5	86.6	95.5	91.1
199	88.2	88.9	87.0	95.8	91.4
200	88.5	89.2	87.3	96.1	91.7
205	90.2	90.8	88.9	97.7	93.3
210	91.8	92.5	90.5	99.3	94.9
215	93.4	94.0	92.1	100.8	96.4
220	94.9	95.6	93.6	102.3	98.0
225	96.5	97.1	95.2	103.8	99.5
230	98.0	98.6	96.7	105.2	100.9
235	99.5	100.1	98.2	106.6	102.4
240	101.0	101.6	99.6	108.0	103.8
245	102.4	103.0	101.0	109.4	105.2
250	103.8	104.4	102.5	110.8	106.6
255	105.2	105.8	103.9	112.1	108.0
260	106.6	107.2	105.2	113.5	109.3
265	108.0	108.6	106.6	114.8	110.7
270	109.3	109.9	107.9	116.1	112.0
275	110.7	111.2	109.3	117.3	113.3
280	112.0	112.5	110.6	118.6	114.6
305	118.3	118.8	116.9	124.6	120.8
330	124.2	124.7	122.8	130.3	126.6
335	125.4	125.9	124.0	131.4	127.7
340	126.5	127.0	125.1	132.5	128.8
345	127.7	128.1	126.3	133.5	129.9
350	128.8	129.2	127.4	134.6	131.0

July 14, 2015

Honeywell Solstice® Refrigerants Approved For Use By U.S Environmental Protection Agency

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New Solstice®N40 Approved to Aid Conversion of Nearly 30,000 U.S. Supermarkets Ahead of 2016 U.S. EPA Regulations

MORRIS TOWNSHIP, N.J., July 14, 2015 — Honeywell (**NYSE: HON**) announced today that its **Solstice® N40 (R-448A)** refrigerant has been approved for use by the U.S. Environmental Protection Agency (EPA) in applications ranging from stand-alone refrigeration systems to commercial refrigeration.

The EPA also broadened approvals for the company's **Solstice N13 (R-450A)** refrigerant, allowing it to be used in retrofit vending machine applications.

The EPA approved the new refrigerant uses under its Significant New Alternatives Policy (SNAP), which evaluates substitute chemicals and technologies that are safe for the ozone layer. The final rule will be published in the Federal Register in the coming weeks.

"Honeywell has been steadily broadening its range of reduced and low-global-warming replacements for high-global-warming hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFCs), helping customers around the world decrease their global warming footprint and comply with new regulation," said George Koutsaftes, refrigerants business director for Honeywell Fluorine Products. "Solstice N40, Solstice N13 and the entire range of Solstice stationary and mobile refrigerants help customers achieve their environmental goals without sacrificing performance."

Global regulators are increasingly moving to phase out high-global warming refrigerants and, on July 2, the EPA announced landmark regulations that will phase out the use of many of the world's most potent HFCs, such as R-404A, in a variety of applications. The new regulation effective summer 2016 will require supermarkets, the largest consumers of R-404A in the U.S., to discontinue use of R-404A as a retrofit refrigerant. R-404A will also not be permitted for use in new supermarkets beginning January 1, 2017.

The EPA had previously given SNAP approval for Honeywell's Solstice yf, also known as R-1234yf, a low-global-warming replacement for R-134a, which is commonly used for automotive air conditioning. It has also approved Solstice zd (R-1234zd) and Solstice ze (R-1234ze), which can be used in industrial chillers and a wide range of other end uses.

The latest approvals allow Solstice N40 refrigerant to replace R-22 and R-404A in commercial refrigeration applications, including new and retrofit supermarkets, various types of commercial refrigeration equipment, ice machines and refrigerated transportation.

Solstice N40 has a global warming potential (GWP) that is 66 percent lower than R-404A. In supermarket trials conducted in the U.S. and Europe, Solstice N40 demonstrated at least 3 percent lower energy consumption in low-temperature applications and 5 to 16 percent lower energy consumption in medium-temperature refrigeration compared with R-404A. In R-22 retrofit scenarios, Solstice N40 has delivered



Changing State of Refrigerants – Digest 2015-7

The EPA schedules the removal of SNAP on high GWP HFC Refrigerants

What is SNAP?

The Significant New Alternatives Policy (SNAP) Program is EPA's program to evaluate and regulate substitutes for the ozone-depleting chemicals that are being phased out under the Clean Air Act.

The President's 2013 Climate Action Plan (CAP)

The 2013 (CAP) states that the EPA can use its authority under SNAP to encourage the development of low emission technologies and prohibit the use of high GWP chemicals, including HFC refrigerants.

What this means?

A time table has been established to remove selected HFC's from various end-uses including aerosols, blowing agents, Refrigeration and Air Conditioning.

This summary will address Refrigeration and Air Conditioning uses only.

Supermarkets:

Retrofit ban: 7-1-2016

New System: 1-1-2017 R404A, R407B, R421B, R422A, R422C, R422D, R428A, R434A, R507A

Remote Condensing units:

Retrofit ban: 7-1-2016

New System: 1-1-2018 R404A, R407B, R421B, R422A, R422C, R422D, R428A, R434A, R507A

Stand Alone Refrigeration & Vending Machines

Retrofit ban: 7-1-2016 R404A, R507

Stand Alone Medium Temp Refrigeration & Vending Machines (New):

Production Ban: Under 2,200 BTU's 1-1-2019 Over 2,200 BTU's 1-1-2020

R404A, R407A-F, R410A, R417A, R421A-B, R422A-D, R424A, R426A, R428A, R434A, R437A, R438A, R507

Stand Alone Low Temp Refrigeration (New):

Products ban 1-1-2020

R404A, R407A-F, R410A, R417A, R421A-B, R422A-D, R424A, R426A, R428A, R434A, R437A, R438A, R507

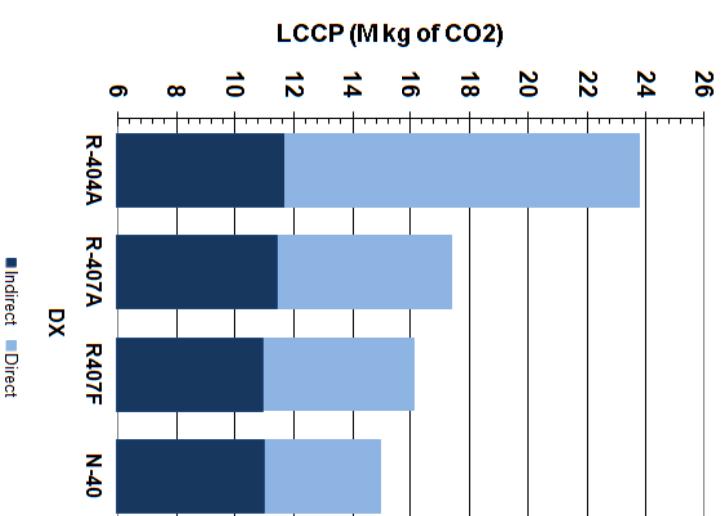
For more info go to <http://www.rsd.net/refrigerantsuite/index.php> or call **800-245-8007 ex 00405**

This data is abridged and for informational purposes only go to www.epa.gov/ozone/snap for the full fact sheet

R404A Replacements for Supermarket Refrigeration

Product	Capacity	Efficiency	GWP
R404A	100%	100%	3943
R407A	90%	100-105%	1923
R407F	100%	105-110%	1674
N-40 (*R448A)	100%	105-110%	1273

*Provisional ASHRAE #

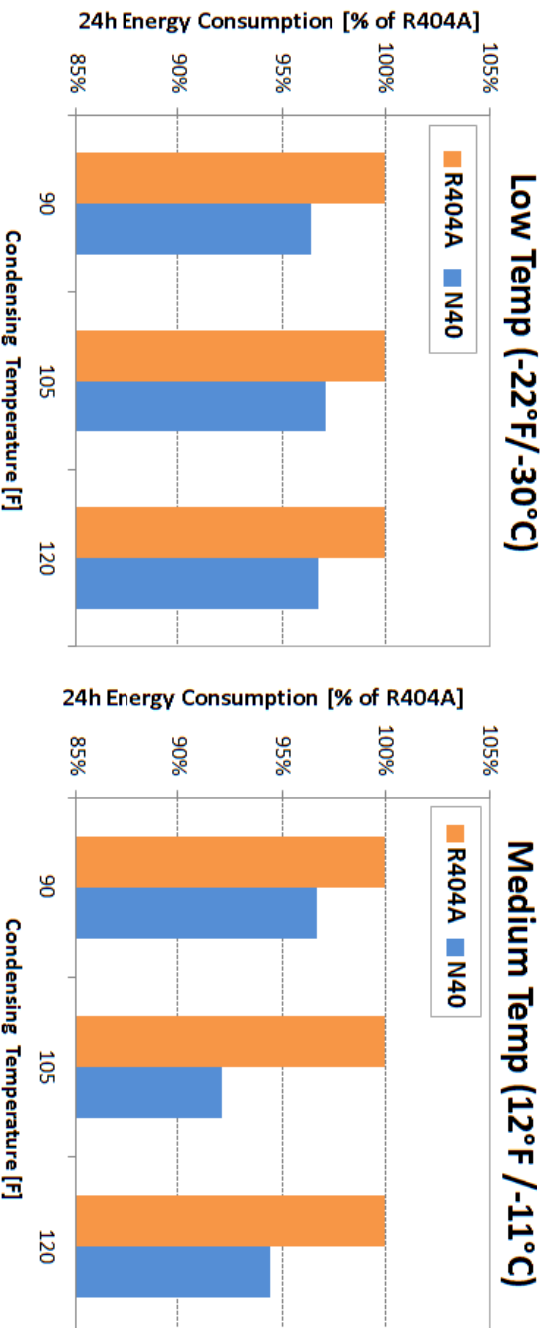


N-40's low discharge temperature allows good coverage of compressor operating envelope

N40 combines low GWP with superior efficiency

N40: First Evaluation at a Mockup Supermarket

Emerson's Supermarket Lab Test Results



- **Low Temp: N-40 Shows About 3% Lower Energy Consumption Than R404A**
- **Medium Temp: N-40 Shows 3% To 8% Lower Energy Consumption Than R404A**

At GWP Of 1380, N40 Is A Good Non Flammable, Near Drop-In Candidate For R404A Replacement And Retrofit



- Centralized DX System With Cases And Food Simulators. Air-Cooled Condensers
- LT rack equipped with Scroll compressors: ZF25, ZF34, ZFD41 (Digital)
- MT rack equipped with scroll compressors: ZB95, ZBD76 (Digital)

N-40: CRADA with the ORNL



Working Fluids: Low Global Warming Potential Refrigerants
2014 Building Technologies Office Peer Review

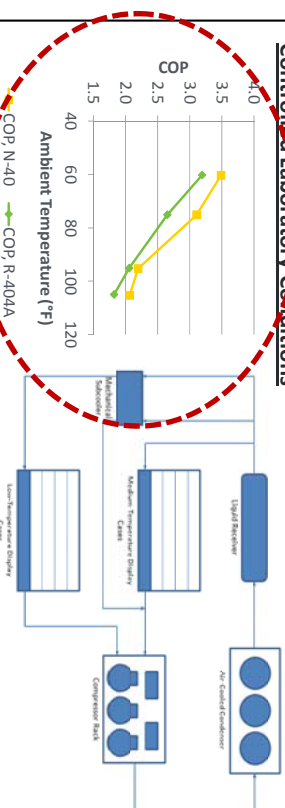
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Omar Abdelaziz, abdelaziz@ornl.gov
Oak Ridge National Laboratory



Progress and Accomplishments

Full-Scale Supermarket Refrigeration Experimental Evaluation under Controlled Laboratory Conditions



- N40 performance over R-404A over the ambient temperature range
 - Reduced compressor power by 3.7%
 - Increased refrigeration capacity by 7.5%
 - Increased system COP by 11.6%



Progress and Accomplishments

Market Impact:

- Based on the favorable results of N-40 and its low GWP (1273), it is expected that it will become the optimal solution for supermarket refrigeration systems
 - The CRADA partner expects to launch it this year (pending some approvals)
 - “Relevant” end users have shown strong support for using N-40 already
- Web-based LCCP tool is highly used: 661 unique users to-date
 - 2012 Purdue Conference Paper on LCCP of Commercial Refrigeration:
 - 154 downloads in the last year only
 - 21 citations
- ASHRAE MTG Alternative Global Warming Refrigerant
 - Growing membership
 - Expanding Program
- AHRI AREP
 - Successful participation in the program

Awards/Recognition:

None



Refrigerants and Lubricants approved for use in Copeland™ compressors

	Refrigerants	Similar to	Application		Preferred	Lubricant choices		Comments
			Retrofit	New		Alternate #1	Alternate #2	
Ozone depleting	CFC R-12		L,M		MIN	AB & MIN	POE-32	Phased out in 1996 Phased out in 1996
	CFC R-502		L,M		MIN	AB & MIN	POE-32	
Interims	HCFC R-22		L,M,H		MIN	AB & MIN	POE-32	No new equipment 2010
	HCFC R-401A	R-12	M,H		AB & MIN	POE-32 & MIN	POE-32	Service only Suva™ MP39
	HCFC R-401B	R-12	L,M		AB & MIN	POE-32 & MIN	POE-32	Service only Suva MP66
	HCFC R-402A	R-502	L,M		AB & MIN	POE-32 & MIN	POE-32	Service only Suva HP80
	HCFC R-402B	R-502	L,M		AB & MIN	POE-32 & MIN	POE-32	Service only Suva HP81
	HCFC R-408A	R-502	L,M		AB & MIN	POE-32 & MIN	POE-32	Service only FX10
	HCFC R-409A	R-12	L,M		AB & MIN	POE-32 & MIN	POE-32	Service only FX56
	HFC R-134a	R-12	M,H		POE-32			
	HFC R-404A	R-502	L,M		POE-32			Suva HP62, Forane™ FX70
	HFC R-507	R-502	L,M		POE-32			Genetron™ AZ50
Non-ozone depleting	HFC R-407A	R-22	L,M		POE-32			Suva 9000/KLEA 66
	HFC R-407C	R-22	L,M,H		POE-32			
	HFC R-407F	R-22	L,M		POE-32			Discus™ and select refrigeration scroll models (ZF/ZB)
	R-448A	R-22	L,M		POE-32			
	R-449A	R-22	L,M		POE-32			
	R-450A	R-12	M,H		POE-32			
	R-513A	R-12	M,H		POE-32			
	HFC R-410A				POE-32			ZP & ZB KCP Copeland Scroll™ models and certain Discus models only
	HFC R-422A/D	R-22	L,M		POE-32	MIN	AB	Discus supermarket racks only
	HFC R-427A	R-22	L,M		POE-32			Discus supermarket racks only
R-744 CO ₂	HFC R-438A	R-22	L,M		POE-32	MIN	AB	Discus supermarket racks only; ISCEON™ MO99
	R-704 helium				PAG			ZC Copeland Scroll models only
					Sub-critical			4MTLS Discus and ZO Copeland Scroll models for CO ₂
					Trans-critical			4MTLS semi-hermetic compressors for medium temp trans-critical applications
								For use with specific Copeland compressors designed for R-290, excluding models manufactured in India
R-290 propane					POE-22			For use with specific Copeland compressors manufactured in India for R-290
					POE-32			

See legend on reverse ➡