

REFRIGERANT APPLICATION SUMMARY

ASHRAE # (TRADE NAME)	COMPONENTS (WEIGHT %)	CHARGING (%ORIGINAL)	APPLICATION COMMENTS
Very Low Temperature and Cascade Refrigeration (R-13 and R-503 type)			
R-23	pure	95%	R-13 systems can retrofit to R-23 (but suffer higher heat at discharge) or R-508B (but the pressures are different). R-503 systems should use R-508B. R-13B1 systems can operate with R-403B, but often in vacuum conditions.
R-508B SUVA 95	23/116	13: 105-110% 503: 90-95%	
R-403B ISCEON 69L	290/22/218 (5/56/39)	N/A	
Low-Medium Temperature Refrigeration (R-502 type)			
R-22	pure	100-105%	<p>Overall Concerns: Discharge temperature is important - can't tolerate large increase. Higher discharge pressure can affect controls. Oil return is traditionally a problem in 502 low temp. Most blends are very low glide (no problems).</p> <p>Retrofit Recommendations (in order of preference based on performance/ease of use): R-408A Closest match to R-502 properties and performance. Slightly higher dis. Temp. R-402A Higher discharge pressure, lower discharge temperature than 408A. R-402B Similar discharge pressure, higher discharge pressure. Good for ice machines. All retrofit blends should consider oil change to AB in order to improve oil circulation. R-404A or R-507 can be used to retrofit, however mineral oil must be flushed, POE used. R-22 Refrigeration Options. R-404A or R-507 can be used to retrofit, however mineral oil must be flushed, POE used, and system components (valves, etc.) may need to be changed. R-417A Warmer temps with existing oils. Loses performance and needs POE at low temp. Long Term HFC Options. R-404A and R-507 Off the shelf equipment, interchangeable with each other.</p>
R-402A (HP 80)	125/290/22 (60/2/38)	95-100%	
R-402B (HP 81)	125/290/22 (38/2/60)	95-100%	
R-404A (HP62,FX70)	125/143a/134a (44/52/4)	85-90%	
R-408A (FX 10)	125/143a/22 (7/46/47)	85-90%	
R-507 (AZ 50)	125/143a (50/50)	85-90%	
Low-Medium Temperature Refrigeration (R-12 type)			
R-22	pure	N/A	<p>Overall Concerns: Match R-12 evaporator conditions (slightly higher discharge pressures OK). Oil return must be addressed. Temperature glide not a problem in most applications.</p> <p>Retrofit Recommendations (in order of preference based on performance/ease of use): R-409A Better at lower temperatures, maintains performance, higher discharge T and P. R-414B Better at warmer temperatures, lower discharge temp than 409A. R-401A Good overall performance, need AB oil below 30F coil temps. R-416A Biggest change in properties, poor low temp performance NRI does not carry. R-406A Very similar to R-414B. Freeze 12, Freezone, RB 276: Similar to 416A (134a based, not good in low temp)</p>
R-134a	pure	90%	
R-401A (MP 39)	22/152a/124 (53/13/34)	80-85%	
R-401B (MP 66)	22/152a/124 (61/11/28)	80-85%	
R-409A (FX 56)	22/124/142b (60/25/15)	80-85%	
Medium-High Temperature Refrigeration (R-12 type)			
R-414B (HOT SHOT)	22/600a/124/142b (50/1.5/39/9.5)	80-85%	<p>Overall Concerns: Higher application temps will drive up head pressure and discharge temp. These blends will lessen the abuse on the system but cost some capacity. Retrofit Recommendations (in order of NRI preference based on performance/ease of use): R-414B, 416A Lower, or no, R-22 cuts down on discharge temperature/pressure. R-401A, R-401B, R-409A for R-12 or R-500 air conditioning (direct expansion systems)</p>
R-416A (FRIGC FR12)	134a/124/600 (59/39/2)	90-95%	
Air Conditioning (R-22 type)			
R-407C (SUVA9000)	32/125/134a (23/25/52)	95-100%	<p>Overall Concerns: R-22 availability and price make retrofitting a less attractive option, however it is possible to use R-407C (POE flush) or R-417A for retrofitting.</p> <p>New Equipment is being designed around R-410A (higher efficiency models), although it is possible that the R-22 "look alike" blends may be used also. Decision time frame depends on the new Energy Efficiency guidelines from DOE. (Residential, 2006)</p>
R-410A (AZ 20)	32/125 (50/50)	N/A	
R417A (NU-22)	125/134a/600a (46.6/50/3.4)	95-100%	
High Ambient and Centrifugal Chillers			
R-124	pure	N/A	<p>R-114 high ambient AC can use R-124 or very large R-134a systems. Centrifugal chillers require major equipment upgrades to retrofit to another refrigerant. Chiller manufacturers will need to be consulted for such jobs.</p>
R-123	pure	N/A	

Kansas City
 816-842-5400
 800-322-9675
 Fax: 816-842-2681

Lenexa
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REFRIGERANT PROPERTIES SUMMARY

ASHRAE # (TRADE NAME)	COMPONENTS (WEIGHT %)	TYPE	TEMP. GLIDE (F)	LUBRICANTS	COMMENTS
R-123	pure	HCFC	0	MINERAL OIL or ALKYL BENZENE	Similar to R-11 - low pressure centrifugal chillers.
R-124	pure	HCFC	0	MINERAL OIL or ALKYL BENZENE	Similar to R-114 - high ambient air conditioning.
R-134a	pure	HFC	0	POLYOLESTER	HFC - new systems, med temp refrig, auto AC. Retrofit involves oil flushing.
R-22	pure	HCFC	0	MINERAL OIL or ALKYL BENZENE	New refrigeration systems, retrofit R-12 systems involves equipment changes. Standard for AC.
R-23	pure	HFC	0	POLYOLESTER	Properties similar to R-13; runs hotter on discharge side. Very low temperature refrigeration.
R-401A (MP 39)	22/152a/124 (53/13/34)	HCFC BLEND	8	ALKYL BENZENE OR MO/AB MIX	Retrofit blend for R-12; higher glide and discharge pressure/temp.
R-401B (MP 66)	22/152a/124 (61/11/28)	HCFC BLEND	8	ALKYL BENZENE OR MO/AB MIX	Retrofit blend for R-12 at lower temperatures (boost to capacity <-20F), also similar to R-500
R-402A (HP 80)	125/290/22 (60/2/38)	HCFC BLEND	2.5	ALKYL BENZENE OR MO/AB MIX	Retrofit blend for R-502; higher discharge pressure than 502.
R-402B (HP 81)	125/290/22 (38/2/60)	HCFC BLEND	2.5	ALKYL BENZENE OR MO/AB MIX	Retrofit blend for R-502 in ice machines; higher discharge temp.
R-403B ISCEON 69L	290/22/218 (5/56/39)	HCFC BLEND	2.5	MINERAL OIL or ALKYL BENZENE	Has been used successfully in 13B1 type equipment. (Lower evaporator pressures - in vacuum)
R-404A (HP62,FX70)	125/143a/134a (44/52/4)	HFC BLEND	1.5	POLYOLESTER	HFC blend - long term new or retrofit for R-502 (oil flush required).
R-407C (SUVA9000)	32/125/134a (23/25/52)	HFC BLEND	10	POLYOLESTER	HFC blend; similar properties to R-22, higher glide. Potential new equipment or retrofit for AC.
R-408A (FX 10)	125/143a/22 (7/46/47)	HCFC BLEND	1	MINERAL OIL or ALKYL BENZENE	Retrofit blend for R-502. Very close property match, slightly higher discharge temp.
R-409A (FX 56)	22/124/142b (60/25/15)	HCFC BLEND	12	MINERAL OIL or ALKYL BENZENE	Retrofit blend for R-12; higher glide and discharge pressure/temp. Similar to R-500 at AC temps.
R-410A (AZ 20)	32/125 (50/50)	HFC BLEND	0.2	POLYOLESTER	HFC blend for new AC systems; higher pressures, new equipment only.
R-414B (HOT SHOT)	22/600a/124/142b (50/1.5/39/9.5)	HCFC BLEND	12	MINERAL OIL or ALKYL BENZENE	Retrofit blend for R-12; lower R-22 content blend, lower head pressure. Approved for auto AC.
R-416A (FRIGC FR12)	134a/124/600 (59/39/2)	HCFC BLEND	2.5	POLYOLESTER	Retrofit blend for R-12; lower R-22 content blend, lower head pressure. Approved for auto AC.
R417A (NU-22)	125/134a/600a (46.6/50/3.4)	HFC BLEND	6	MINERAL OIL, AB, OR POE	HFC blend; similar properties to R-22, higher glide. Potential new equipment or retrofit for AC, refrig,
R-507 (AZ 50)	125/143a (50/50)	HFC BLEND	0	POLYOLESTER	HFC blend - long term new or retrofit for R-502 (oil flush required).
R-508B SUVA 95	23/116	HFC BLEND	0	POLYOLESTER	Properties similar to R-503; can be used for R-503 or R-13 very low temp systems.

PRESSURE/TEMPERATURE CHART

Temp. °F	R11	R113	R114	R123	R124	R500
-20	27.0	29.1	22.9	27.8	16.1	3.2
-15	26.5	28.9	21.8	27.4	14.1	5.4
-10	26.0	28.7	20.6	26.9	12.0	7.8
-5	25.4	28.5	19.3	26.4	9.6	10.4
0	24.7	28.2	17.8	25.9	6.9	13.3
5	23.9	27.9	16.2	25.2	3.9	16.4
10	23.1	27.6	14.4	24.5	0.6	19.7
15	22.1	27.2	12.4	23.8	1.6	23.4
20	21.1	26.8	10.2	22.8	3.5	27.3
25	19.9	26.3	7.8	21.8	5.7	31.5
30	18.6	25.8	5.2	20.7	8.1	36.0
35	17.2	25.2	2.3	19.5	10.5	40.9
40	15.6	24.5	0.4	18.1	13.2	46.1
45	13.9	23.8	2.0	16.6	16.1	51.6
50	12.0	22.9	3.8	14.9	19.2	57.6
55	10.0	22.2	5.8	13.0	22.6	63.9
60	7.8	21.0	7.9	11.2	26.3	70.6
65	5.4	19.9	10.1	8.9	30.2	77.8
70	2.8	18.7	12.6	6.5	34.4	85.4
75	0.0	17.3	15.2	4.1	38.9	93.5
80	1.5	15.9	18.0	1.2	43.7	102
85	3.2	14.3	20.9	0.9	48.8	111
90	4.9	12.5	24.1	2.5	54.2	121
95	6.8	10.6	27.5	4.3	60.0	131
100	8.8	8.6	31.2	6.1	66.1	141
105	10.9	6.4	35.0	8.1	72.6	152
110	13.2	4.0	39.1	10.3	79.5	164
115	15.6	1.4	43.4	12.6	86.8	177
120	18.2	0.7	48.0	15.1	94.5	189
125	21.0	2.2	52.8	17.8	103	203
130	24.0	3.7	58.0	20.6	111	217
135	27.1	5.4	63.4	23.6	120	232
140	30.4	7.2	69.1	26.8	130	248
145	34.0	9.2	75.1	30.2	140	-
150	37.7	11.2	81.4	33.9	150	-

Temp. °F	R13	R23	R503	R508B	R403B
-120	4.5	4.0	3.1	3.1	25.4
-115	0.3	0.3	6.0	6.0	24.5
-110	2.1	2.9	9.3	9.3	23.4
-105	4.7	5.8	12.9	12.9	22.2
-100	7.6	9.0	16.9	16.9	20.9
-95	10.8	12.7	21.4	21.4	19.3
-90	14.3	16.7	26.3	26.4	17.5
-85	18.2	21.3	31.8	31.8	15.5
-80	22.5	26.3	37.7	37.8	13.2
-75	27.2	31.8	44.2	44.4	10.6
-70	32.3	37.9	51.3	51.5	7.8
-65	37.8	44.6	59.0	59.3	4.6
-60	43.9	52.0	67.3	67.8	1.0
-55	50.4	60.0	76.4	76.9	1.5
-50	57.5	68.7	86.1	86.8	3.6
-45	65.1	78.1	96.6	97.5	6.0
-40	73.3	88.3	108	109	8.6

Temp. °F	R13	R23	R503	R508B	R403B
-35	82.1	99.4	120	121	11.4
-30	91.6	111	133	135	14.5
-25	102	124	147	149	17.9
-20	113	138	161	164	21.6

Temp. °F	R22	R407C		R417A		R410A
		Liquid	Vapor	Liquid	Vapor	
-40	0.5	3.0	4.4	0.5	4.2	11.6
-35	2.6	5.4	0.6	2.4	0.8	14.9
-30	4.9	8.0	1.8	4.5	1.5	18.5
-25	7.4	10.9	4.1	6.9	3.6	22.5
-20	10.1	14.1	6.6	9.4	5.9	26.9
-15	13.2	17.6	9.4	12.2	8.4	31.7
-10	16.5	21.3	12.5	15.2	11.2	36.8
-5	20.1	25.4	15.9	18.5	14.3	42.5
0	24.0	29.9	19.6	22.0	17.6	48.6
5	28.2	34.7	23.6	25.9	21.2	55.2
10	32.8	39.9	28.0	30.0	25.1	62.3
15	37.7	45.6	32.8	34.5	29.3	70.0
20	43.0	51.6	38.0	39.3	33.9	78.3
25	48.8	58.2	43.6	44.5	38.9	87.3
30	54.9	65.2	49.6	50.8	44.2	96.8
35	61.5	72.6	56.1	56.0	49.9	107
40	68.5	80.7	63.1	62.4	56.1	118
45	76.0	89.2	70.6	69.2	62.7	130
50	84.0	98.3	78.7	76.4	69.8	142
55	92.6	108	87.3	87.2	77.3	155
60	102	118	96.8	95.7	85.4	170
65	111	129	106	105	93.9	185
70	121	141	117	114	103	201
75	132	153	128	124	113	217
80	144	166	140	134	123	235
85	156	180	153	146	134	254
90	168	195	166	157	145	274
95	182	210	181	170	158	295
100	196	226	196	183	170	317
105	211	243	211	197	184	340
110	226	261	229	211	198	365
115	243	280	247	225	212	391
120	260	300	266	241	227	418
125	278	321	286	258	244	446
130	297	342	307	275	261	476
135	317	365	329	293	279	507
140	337	389	353	312	297	539
145	359	-	-	-	-	573
150	382	-	-	-	-	608

Temp. °F	R12	R134a	R401A		R401B	
			Liquid	Vapor	Liquid	Vapor
-40	11.0	14.8	8.1	13.2	6.5	11.8
-35	8.4	12.5	5.1	10.7	3.3	9.1
-30	5.5	9.9	1.7	7.9	0.2	6.1
-25	2.3	6.9	1.0	4.8	2.1	2.8
-20	0.6	3.7	3.0	1.4	4.3	0.5
-15	2.4	0.6	5.2	1.2	6.6	2.5
-10	4.5	1.9	7.7	3.3	9.2	4.7
-5	6.7	4.0	10.3	5.5	12.0	7.1
0	9.2	6.5	13.2	8.0	15.1	9.7

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Temp. °F	R12	R134a	R401A		R401B	
			Liquid	Vapor	Liquid	Vapor
5	11.8	9.1	16.3	10.7	18.4	12.6
10	14.6	11.9	19.7	13.7	22.0	15.8
15	17.7	15.0	23.4	16.9	25.9	19.2
20	21.0	18.4	27.4	20.4	30.1	23.0
25	24.6	22.1	31.7	24.2	34.6	27.0
30	28.5	26.1	36.4	28.3	39.5	31.4
35	32.6	30.4	41.3	32.8	44.8	36.1
40	37.0	35.0	46.6	37.6	50.4	41.1
45	41.7	40.1	52.4	42.7	56.4	46.6
50	46.7	45.5	58.5	48.2	62.8	52.4
55	52.0	51.3	65.0	54.1	69.6	58.7
60	57.7	57.5	71.0	60.4	76.0	65.4
65	63.8	64.1	79.3	67.2	84.7	72.5
70	70.2	71.2	87.1	74.4	92.9	80.1
75	77.0	78.8	95.4	82.1	102	88.2
80	84.2	86.8	104	90.2	111	96.8
85	91.8	95.4	114	98.9	121	106
90	99.8	104	123	108	131	116
95	108	114	134	118	142	126
100	117	124	145	128	153	137
105	127	135	156	139	166	148
110	136	147	169	151	178	160
115	147	159	181	163	192	173
120	158	171	195	176	206	187
125	169	185	209	189	220	201
130	181	199	224	203	236	216
135	194	214	239	218	252	231
140	207	229	255	234	269	248
145	220	246	272	250	287	265
150	234	263	290	267	305	283

Temp. °F	R409A		R414B		R416A	
	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor
-30	0.2	9.9	0.0	9.7	12.1	13.4
-25	1.8	2	1.9	6.8	9.6	11.0
-20	3.9	3.8	4.0	3.6	6.7	8.3
-15	6.2	0.3	6.3	0.0	3.5	5.3
-10	8.7	1.7	8.8	2.0	0.0	2.0
-5	11.4	3.8	11.5	4.1	1.9	0.8
0	14.4	6.1	14.5	6.5	4.0	2.8
5	17.6	8.6	17.7	9.0	6.3	5.0
10	21.1	11.4	21.2	11.9	8.9	7.4
15	24.9	14.4	25.0	14.9	11.6	10.0
20	29.0	17.6	29.0	18.3	14.6	12.8
25	33.4	21.2	33.4	21.9	17.8	15.9
30	38.1	25.0	38.1	25.8	21.4	19.3
35	43.2	29.2	43.1	30.0	25.2	22.9
40	48.6	33.6	48.5	34.6	29.3	26.8
45	54.4	38.5	54.3	39.5	33.7	31.1
50	60.6	43.6	60.4	44.8	38.4	35.6
55	67.2	49.2	67.0	50.4	43.5	40.5
60	74.2	55.2	73.9	56.5	49.0	45.7
65	81.7	61.5	81.3	62.9	54.8	51.3
70	89.6	68.4	89.1	69.8	61.1	57.3
75	98.0	75.6	97.4	77.1	67.7	63.7
80	107	83.4	106	85.0	74.8	70.6
85	116	91.6	116	93.3	82.3	77.8
90	126	100	125	102	90.3	85.5

Temp. °F	R409A		R414B		R416A	
	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor
95	137	110	136	111	98.8	93.7
100	148	120	146	121	108	102
105	159	130	158	132	117	112
110	172	141	170	143	127	121
115	184	153	183	155	138	132
120	198	165	196	167	149	143
125	212	178	210	180	161	154
130	227	192	224	193	173	166
135	242	207	239	208	186	179
140	258	222	255	223	200	192
145	-	-	272	239	214	206
150	-	-	289	255	229	221

Temp. °F	R404A	R507	R502	R402A	R402B	R408A
	-40	4.3	5.5	4.1	6.3	3.6
-35	6.8	8.2	6.5	9.1	6.0	5.1
-30	9.5	11.1	9.2	12.1	9.0	7.6
-25	12.5	14.3	12.1	15.4	12.0	10.4
-20	15.7	17.8	15.3	18.9	15.4	13.5
-15	19.3	21.7	18.8	22.9	18.6	16.8
-10	23.2	25.8	22.6	27.1	22.6	20.4
-5	27.5	30.3	26.7	31.7	27.0	24.4
0	32.1	35.2	31.1	36.7	31.0	28.7
5	37.0	40.5	35.9	42.1	36.0	33.3
10	42.4	46.1	41.0	48.0	42.0	38.3
15	48.2	52.2	46.5	54.2	47.0	43.7
20	54.5	58.8	52.4	60.9	54.0	49.5
25	61.2	65.8	58.8	68.1	60.0	55.8
30	68.4	73.3	65.6	75.8	67.0	62.5
35	76.1	81.3	72.8	84.0	75.0	69.7
40	84.4	89.8	80.5	92.8	83.4	77.4
45	93.2	98.9	88.7	102	91.6	85.6
50	103	109	97.4	112	100	94.3
55	113	119	107	123	110	104
60	123	130	116	134	120	114
65	135	141	127	146	133	124
70	147	154	138	158	143	135
75	159	167	149	171	155	147
80	173	180	161	185	170	159
85	187	195	174	200	183	173
90	202	210	187	215	198	186
95	218	226	201	232	213	201
100	234	244	216	249	230	217
105	252	262	232	267	247	233
110	270	281	248	286	262	250
115	289	301	265	305	283	268
120	310	322	283	326	303	287
125	331	344	301	347	323	307
130	353	368	321	370	345	327
135	377	393	341	393	-	349
140	401	419	363	418	-	372
145	426	446	-	443	-	-
150	453	475	-	470	-	-