SPORLAN

PRESSURE-TEMPERATURE CHART
at Sea Level

PSIG	TEMPERATURE °F REFRIGERANT					
	R22	R32	R134a	R513A	R515B	R1234yf
5*	-48	-67	-22	-28	-9	-28
4*	-47	-66	-20	-27	-8	-27
3*	-45	-65	-19	-25	-6	-25
2*	-44	-63	-18	-24	-5	-24
1*	-43	-62	-16	-23	-3	-22
0	-41	-61	-15	-21	-2	-21
1	-39	-59	-12	-19	1	-18
2	-36	-56	-10	-16	4	-16
3	-34	-54	-7	-14	6	-13
4	-32	-52	-5	-11	8	-11
5	-30	-50	-3	-9	11	-9
6	-28	-48	-1	-7	13	-6
7	-26	-47	1	-5	15	-4
8	-24	-45	3	-3	17	-2
9	-22	-43	5	-1	19	0
10	-20	-42	7	1	21	1
11	-19	-40	8	3	23	3
12	-17	-39	10	4	25	5
13	-15	-37	12	6	26	7
14	-14	-36	13	8	28	8
15	-12	-34	15	9	30	10
16	-11	-33	16	11	31	12
17	-9	-32	18	12	33	13
18	-8	-30	19	14	34	15
19	-7	-29	21	15	36	16
20	-5	-28	22	17	37	18
21	-4	-27	24	18	39	19
22	-3	-25	25	19	40	21
23	-1	-24	26	21	41	22
24	0	-23	27	22	43	23
25	1	-22	29	23	44	25
26	2	-21	30	24	45	26
27	4	-20	31	26	47	27
28	5	-19	32	27	48	28
29	6	-18	33	28	49	30
30	7	-17	35	29	50	31
31	8	-16	36	30	51	32
32	9	-15	37	32	53	33
33	10	-14	38	33	54	34
34	11	-13	39	34	55	35
35	12	-12	40	35	56	36
36	13	-11	41	36	57	37
37	14	-10	42	37	58	39
38	15	-9	43	38	59	40
39	16	-8	44	39	60	41
40	17	-7	45	40	61	42
42	19	-6	47	42	63	44
44	21	-4	49	44	65	46
46	23	-3	51	46	67	47
48	24	-1	52	47	69	49
50	26	1	54	49	71	51
52	28	2	56	51	73	53
54	29	4	57	52	74	55
56	31	5	59	54	76	56
58	32	6	60	56	78	58
60	34	8	62	57	79	60
62	35	9	64	59	81	61
64	37	10	65	60	82	63
66	38	12	66	62	84	64
68	40	13	68	63	86	66
70	41	14	69	65	87	67
72	42	15	71	66	88	69
74	44	17	72	67	90	70
76	45	18	73	69	91	71
78	46	19	75	70	93	73
80	47	20	76	71	94	74
85	51	23	79	75	97	77
90	54	25	82	78	100	81
95	56	28	85	81	104	84
100	59	30	88	84	106	87
105	62	33	90	86	109	89
110	64	35	93	89	112	92
115	67	37	96	92	115	95
120	69	40	98	94	117	98
125	72	42	100	97	120	100
130	74	44	103	99	122	103
135	76	46	105	101	125	105
140	78	48	107	104	127	107
145	81	50	109	106	130	110
150	83	52	112	108	132	112
155	85	53	114	110	134	114
160	87	55	116	112	136	116
165	89	57	118	114	138	118
170	91	59	120	116	140	120
175	92	60	121	118	142	122
180	94	62	123	120	144	124
185	96	64	125	122	146	126
190	98	65	127	124	148	128
195	100	67	129	126	150	130
200	101	68	130	127	152	132
205	103	70	132	129	154	134
210	105	71	134	131	155	135
220	108	74	137	134	159	139
230	111	77	140	137	162	142
240	114	80	143	141	165	145
250	117	82	146	144	169	149
260	120	85	149	147	172	152
275	124	88	153	151	176	156
290	128	92	157	155	180	160
305	132	95	161	159	184	164
320	136	99	165	163	188	168
335	139	102	169	166	192	172
350	143	105	172	170	196	176
365	146	108	176	174	199	179
380	150	111	179	177	203	183
400	154	115	183	181	207	187
420	158	118	187	185	212	192
440	162	122	191	189	216	196
460	166	125	195	193	220	200
480	169	128	198	197	223	*
500	173	132	202	200	227	*

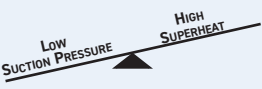
MAKE A SYSTEMATIC ANALYSIS

Based on the complaint and measurements taken

Changing Parts Might Be The First Reaction BUT...
1. May not be necessary and...
2. Does not always solve the problem

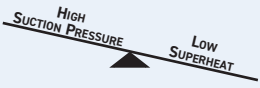
SUPERHEAT AND SUCTION PRESSURE

symptoms can provide the real cause



POSSIBLE CAUSES

1. Moisture, dirt, wax
2. Undersized valve
3. High superheat adjustment
4. Gas charge condensation
5. Dead thermostatic element charge
6. Wrong thermostatic charge
7. Evaporator pressure drop — no external equalizer
8. External equalizer location
9. Restricted or capped external equalizer
10. Low refrigerant charge
11. Liquid line vapor
    a. Vertical lift
    b. High friction loss
    c. Long or small line
    d. Plugged drier or strainer
12. Low pressure drop across valve
    a. Same as #11 above
    b. Undersized distributor nozzle or circuits
    c. Low condensing temperature

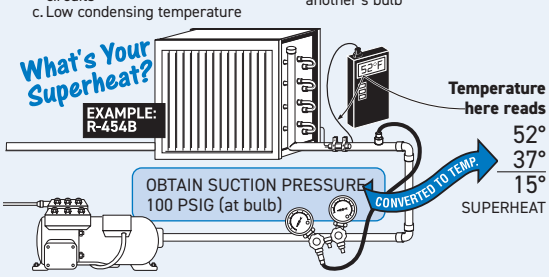


POSSIBLE CAUSES

1. Oversized valve
2. TEV seat leak
3. Low superheat adjustment
4. Bulb installation
    a. Poor thermal contact
    b. Warm location
5. Wrong thermostatic charge
6. Bad compressor – low capacity
7. Moisture, dirt, wax
8. Incorrectly located external equalizer

POSSIBLE CAUSES

1. Low load
    a. Not enough air
    b. Dirty air filters
    c. Air too cold
    d. Coil icing
2. Poor air distribution
3. Poor refrigerant distribution
4. Improper compressor-evaporator balance
5. Evaporator oil logged
6. Flow from one TEV affecting another's bulb



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PRESSURE-TEMPERATURE CHART

at Sea Level

PSIG	TEMPERATURE °F — REFRIGERANT											
	R407F		R410A		R448A		R449A		R452A		R454B	
	Dew Point	Bubble Point	Dew Point	Bubble Point	Dew Point	Bubble Point	Dew Point	Bubble Point	Dew Point	Bubble Point	Dew Point	Bubble Point
5*	-46	-58	-67	-67	-46	-58	-47	-57	-52	-59	-64	-65
4*	-45	-56	-65	-66	-45	-56	-45	-56	-51	-58	-62	-64
3*	-43	-55	-64	-64	-44	-55	-44	-54	-50	-56	-61	-63
2*	-42	-53	-63	-63	-42	-54	-43	-53	-48	-55	-60	-61
1*	-41	-52	-62	-62	-41	-52	-41	-52	-47	-54	-58	-60
0	-39	-51	-60	-61	-40	-51	-40	-50	-46	-52	-57	-59
1	-37	-48	-58	-58	-37	-49	-38	-48	-43	-50	-55	-57
2	-35	-46	-56	-56	-35	-46	-35	-45	-41	-48	-52	-54
3	-33	-44	-54	-54	-33	-44	-33	-43	-39	-45	-50	-52
4	-30	-42	-52	-52	-31	-42	-31	-41	-36	-43	-48	-50
5	-28	-40	-50	-50	-29	-40	-29	-39	-34	-41	-46	-48
6	-27	-38	-48	-48	-27	-38	-27	-37	-32	-39	-44	-46
7	-25	-36	-46	-46	-25	-36	-25	-35	-31	-37	-42	-44
8	-23	-34	-44	-45	-23	-34	-23	-33	-29	-36	-41	-43
9	-21	-32	-43	-43	-21	-32	-21	-32	-27	-34	-39	-41
10	-20	-31	-41	-41	-20	-31	-20	-30	-25	-32	-37	-39
11	-18	-29	-39	-40	-18	-29	-18	-28	-24	-31	-36	-38
12	-16	-27	-38	-38	-17	-27	-17	-27	-22	-29	-34	-36
13	-15	-26	-36	-37	-15	-26	-15	-25	-20	-27	-33	-35
14	-13	-24	-35	-35	-13	-24	-13	-24	-19	-26	-31	-33
15	-12	-23	-34	-34	-12	-23	-12	-22	-17	-24	-30	-32
16	-11	-22	-32	-32	-11	-21	-11	-21	-16	-23	-28	-30
17	-9	-20	-31	-31	-9	-20	-9	-19	-15	-22	-27	-29
18	-8	-19	-30	-30	-8	-19	-8	-18	-13	-20	-26	-28
19	-7	-17	-28	-29	-7	-17	-7	-16	-12	-19	-24	-26
20	-5	-16	-27	-27	-5	-16	-5	-15	-10	-18	-23	-25
21	-4	-15	-26	-26	-4	-15	-4	-14	-9	-16	-22	-24
22	-3	-14	-25	-25	-3	-13	-3	-13	-8	-15	-21	-23
23	-2	-12	-24	-24	-2	-12	-1	-11	-7	-14	-19	-22
24	0	-11	-22	-23	0	-11	0	-10	-6	-13	-18	-20
25	1	-10	-21	-21	1	-10	1	-9	-4	-11	-17	-19
26	2	-9	-20	-20	2	-9	2	-8	-3	-10	-16	-18
27	3	-8	-19	-19	3	-8	3	-7	-2	-9	-15	-17
28	4	-7	-18	-18	4	-6	4	-6	-1	-8	-14	-16
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37	13	2	-9	-10	13	3	13	4	8	1	-5	-7
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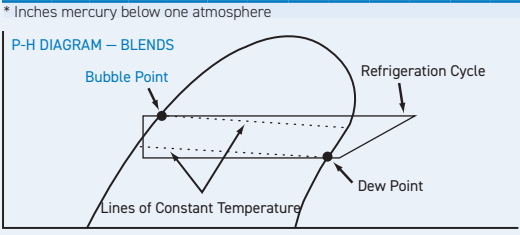
39	15	4	-8	-8	15	5	15	5	10	3	-3	-5
40	16	5	-7	-7	16	6	16	6	11	4	-2	-4
42	17	7	-5	-5	18	7	18	8	13	6	-1	-3
44	19	9	-3	-4	20	9	20	10	15	8	1	-1
46	21	10	-2	-2	21	11	21	12	16	9	3	1
48	22	12	0	0	23	12	23	13	18	11	4	2
50	24	14	1	1	24	14	25	15	20	13	6	4
52	25	15	3	3	26	16	26	17	21	14	7	5
54	27	17	4	4	28	17	28	18	23	16	9	7
56	28	18	6	6	29	19	29	20	24	17	10	8
58	30	20	7	7	30	20	31	21	26	19	12	10
60	31	21	9	8	32	22	32	23	27	20	13	11
62	33	23	10	10	33	23	33	24	29	22	15	12
64	34	24	11	11	35	24	35	25	30	23	16	14
66	35	25	13	12	36	26	36	27	31	24	17	15
68	37	27	14	14	37	27	38	28	33	26	19	16
70	38	28	15	15	39	28	39	29	34	27	20	18
72	39	29	16	16	40	30	40	31	35	28	21	19
74	40	30	17	17	41	31	41	32	37	30	22	20
76	42	32	19	18	42	32	43	33	38	31	24	21
78	43	33	20	20	44	34	44	34	39	32	25	22
80	44	34	21	21	45	35	45	36	40	33	26	24
85	47	37	24	24	48	38	48	39	43	36	29	26
90	50	40	26	26	51	41	51	41	46	39	31	29
95	52	43	29	29	53	43	53	44	49	42	34	32
100	55	45	31	31	56	46	56	47	51	45	37	34
105	57	48	34	34	58	49	59	49	54	47	39	37
110	60	50	36	36	61	51	61	52	57	50	41	39
115	62	53	39	38	63	53	63	54	59	52	44	41
120	64	55	41	41	65	56	66	57	61	54	46	44
125	66	57	43	43	68	58	68	59	64	57	48	46
130	69	59	45	45	70	60	70	61	66	59	50	48
135	71	61	47	47	72	62	72	63	68	61	52	50
140	73	63	49	49	74	65	74	66	70	63	54	52
145	75	66	51	51	76	67	76	68	72	65	56	54
150	77	68	53	53	78	69	78	70	74	67	58	56
155	78	69	55	54	80	71	80	72	76	69	60	58
160	80	71	56	56	82	73	82	74	78	71	62	60
165	82	73	58	58	84	74	84	75	80	73	64	61
170	84	75	60	60	85	76	86	77	82	75	66	63
175	86	77	62	61	87	78	88	79	83	77	67	65
180	87	79	63	63	89	80	89	81	85	79	69	67
185	89	80	65	65	91	82	91	83	87	80	71	68
190	91	82	67	66	92	83	93	84	89	82	72	70
195	92	84	68	68	94	85	94	86	90	84	74	71
200	94	85	70	69	96	87	96	88	92	85	75	73
205	95	87	71	71	97	88	98	89	93	87	77	75
210	97	88	73	72	99	90	99	91	95	89	78	76
220	100	92	76	75	102	93	102	94	98	92	81	79
230	103	95	78	78	105	96	105	97	101	95	84	82
240	105	97	81	81	107	99	108	100	104	98	87	85
250	108	100	84	84	110	102	111	103	107	101	90	87
260	111	103	86	86	113	105	113	106	109	103	92	90
275	115	107	90	90	117	109	117	110	113	108	96	94
290	118	111	94	94	120	112	121	114	117	111	100	97
305	122	114	97	97	124	116	124	117	121	115	103	101
320	125	118	101	100	127	120	128	121	124	119	107	104
335	128	121	104	104	131	123	131	124	128	122	110	108
350	132	125	107	107	134	127	135	128	131	126	113	111
365	135	128	110	110	137	130	138	131	134	129	116	114
380	138	131	113	113	140	133	141	134	137	132	119	117
400	141	135	117	116	144	137	145	138	141	136	123	121
420	145	139	120	120	148	141	148	142	145	140	127	125
440	149	143	124	124	151	145	152	146	148	144	130	128
460	152	146	127	127	155	149	155	150	152	148	134	132
480	155	150	131	130	158	152	159	153	155	152	137	135
500	158	153	134	134	161	156	162	157	158	155	140	138

* Inches mercury below one atmosphere

P-H DIAGRAM — BLENDS



To detemine superheat, use Dew Point values. To determine subcooling, use Bubble Point values.

APPROXIMATE PRESSURE CONTROL SETTINGS

Pressure - Pounds Per Square Inch Gauge

APPLICATION	TEMPERATURE RANGE (°F)	EVAPORATOR TD (°F)	REFRIGERANT							
			22		448A		454B		513A	
			Out	In	Out	In	Out	In	Out	In
Beverage Cooler	35 to 38	15	41	66	42	69	67	103	21	38
Floral Cooler Produce Cooler Smoked Meat Cooler Meat Reach Thru Service Deli Seafood	32 to 35	15	38	62	39	64	63	97	19	35
Multi-Deck Fresh Meat	26 to29	15	32	54	33	56	54	86	15	30
Frozen Glass Door Frozen Walk-In	-10 to 0	10	9	24	9	24	21	43	0	10
Frozen Ice Cream Frozen Food - Open Type	-30 to -20	10	0	10	-	-	7	23	-	-

Pressure control settings assume a suction line pressure loss equivalent to 2°F.

CARRYING CAPACITY OF REFRIGERATION LINES

Tons of Refrigeration - 200 Feet Equivalent Pipe Length

TYPE L COPPER TUBE O.D. Inches	REFRIGERANT							
	22		448A		454B		513A	
	Liquid Line	Suction Line	Liquid Line	Suction Line	Liquid Line	Suction Line	Liquid Line	Suction Line
	20°F Evap.		20°F Evap.		20°F Evap.		20°F Evap.	
3/8	1.06	0.08	1.03	0.07	1.53	0.13	0.67	0.04
1/2	2.54	0.19	2.46	0.18	3.64	0.30	1.60	0.10
5/8	4.80	0.35	4.65	0.34	6.82	0.57	3.02	0.20
7/8	12.7	0.94	12.3	0.90	18.1	1.51	8.01	0.52
1-1/8	25.9	1.92	25.0	1.83	36.5	3.08	16.4	1.07
1-3/8	45.3	3.37	43.5	3.20	63.8	5.38	28.6	1.86
1-5/8	71.6	5.32	69.1	5.08	101	8.51	45.2	2.97
2-1/8	149	11.1	143	10.6	209	17.7	94.5	6.16
2-5/8	263	19.6	253	18.7	369	31.4	167	10.9
3-1/8	421	31.4	404	29.9	590	50.0	267	17.5
3-5/8	626	46.7	601	44.4	874	74.3	396	26.1
4-1/8	883	65.8	848	62.8	1233	105	559	36.7

Refrigerants values are based on 100°F liquid temperature and the stated evaporator temperature. Both suction and liquid line values are based on a pressure drop equivalent to 1°F change in saturation temperature. For additional information on refrigerant line sizing, consult ASHRAE's Refrigeration Handbook or equipment manufacturer.

Parker

SPORLAN

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