

ATMOSPHERIC PRESSURE

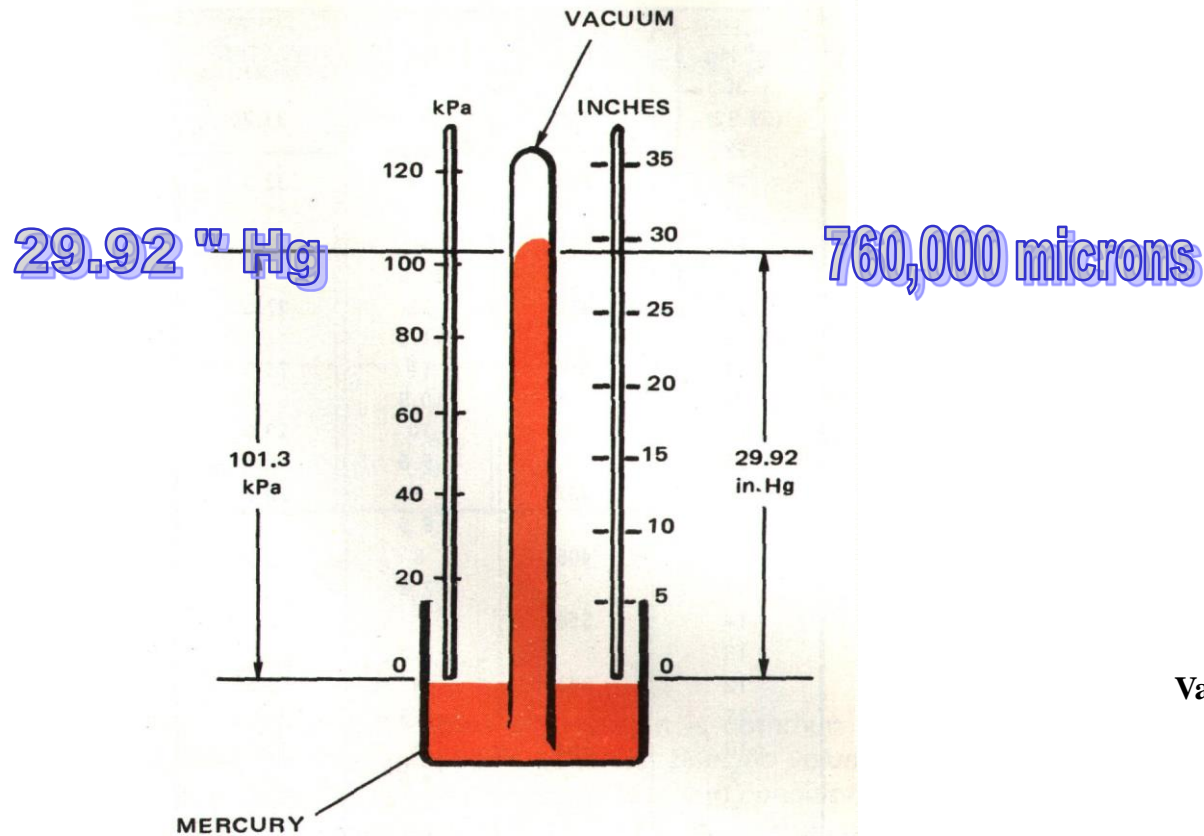
is

14.7 PSI

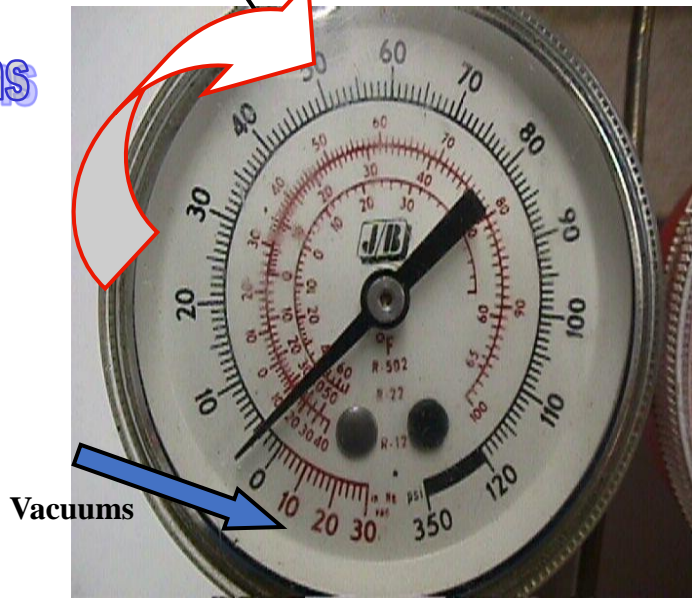
Pounds per Square Inch

0 PSIG

Pounds per Square Inch Gauge



Positive Pressures



Other scales for measuring a vacuum

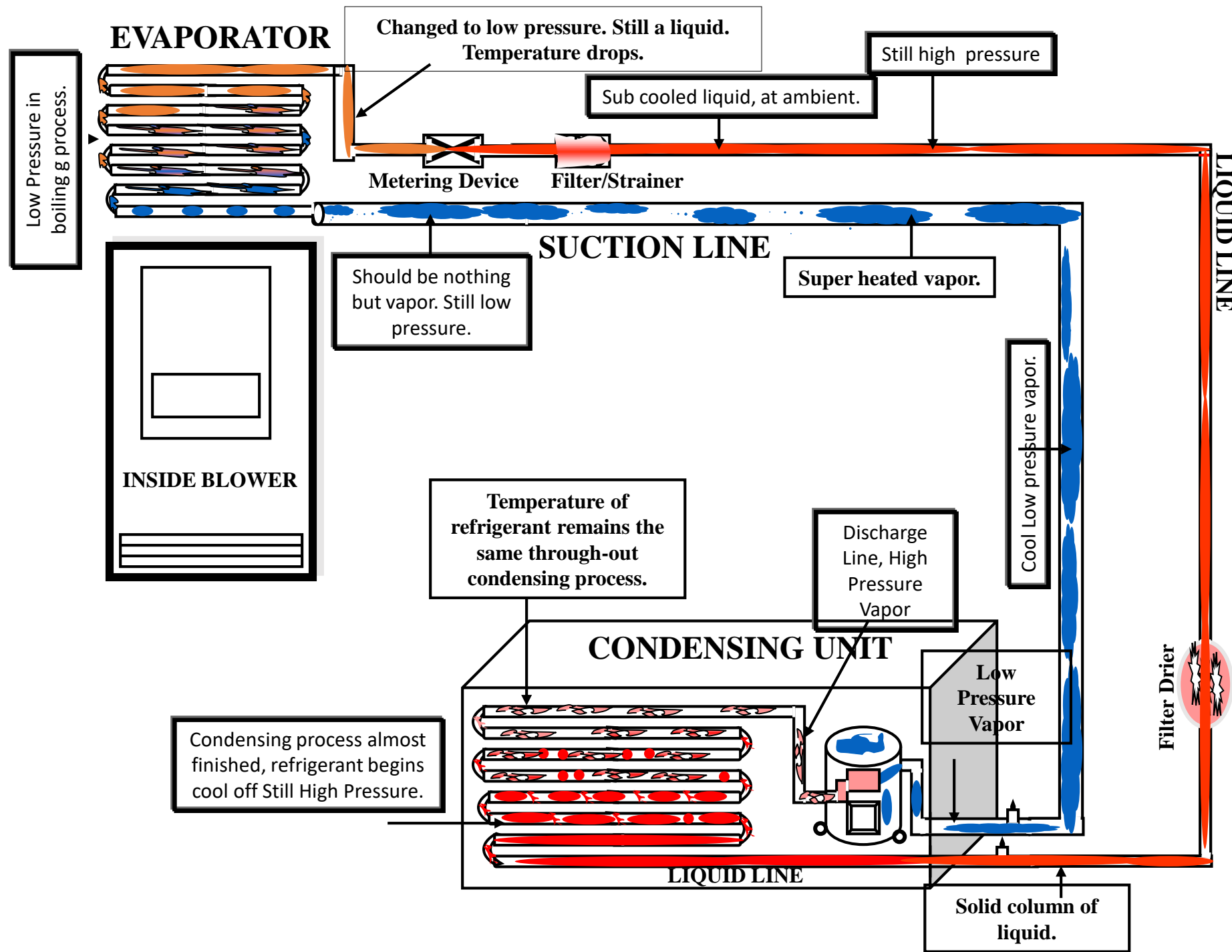
760,000 microns is equal to 14.7 psia

29.92 inches of mercury is a perfect vacuum. All 14.7 psia of atmosphere has been evacuated.

Vacuum	Torr (mm Mercury)	Micron	psia, (lb/in ²) abs	Inches Mercury Absolute	Inches Mercury Gauge	kPa abs
0.0	760.0	760,000	14.7	29.92	0.00	101.4
1.3	750.0	750,000	14.5	29.5	0.42	99.9
1.9	735.6	735,600	14.2	28.9	1.02	97.7
7.9	700.0	700,000	13.5	27.6	2.32	93.5
21.0	600.0	600,000	11.6	23.6	6.32	79.9
34.0	500.0	500,000	9.7	19.7	10.22	66.7
47.0	400.0	400,000	7.7	15.7	14.22	53.2
50.0	380.0	380,000	7.3	15.0	14.92	50.8
61.0	300.0	300,000	5.8	11.8	18.12	40
74.0	200.0	200,000	3.9	7.85	22.07	26.6
87.0	100.0	100,000	1.93	3.94	25.98	13.3
88.0	90.0	90,000	1.74	3.54	26.38	12
89.5	80.0	80,000	1.55	3.15	26.77	10.7
90.8	70.0	70,000	1.35	2.76	27.16	9.3
92.1	60.0	60,000	1.16	2.36	27.56	8
93.0	51.7	51,700	1.00	2.03	27.89	6.9
93.5	50.0	50,000	0.97	1.97	27.95	6.7
94.8	40.0	40,000	0.77	1.57	28.35	5.3
96.1	30.0	30,000	0.58	1.18	28.74	4
96.6	25.4	25,400	0.49	1.00	28.92	3.4
97.4	20.0	20,000	0.39	0.785	29.14	2.7
98.7	10.0	10,000	0.193	0.394	29.53	1.3
99.0	7.6	7,600	0.147	0.299	29.62	1.0
99.9	1.0	1,000	0.01934	0.03937	29.88	0.13
99.9	0.75	750	0.0145	0.0295	29.89	0.1
99.99	0.10	100	0.00193	0.00394	29.916	0.013
99.999	0.01	10	0.000193	0.000394	29.9196	0.0013
100	0.00	0	0	0	29.92	0

It takes about 25,400 microns To equal 1 inch of mercury.

• $1 \text{ psi (lb/in}^2\text{)} = 6,894.8 \text{ Pa (N/m}^2\text{)} = 6.895 \times 10^{-3} \text{ N/mm}^2 = 6.895 \times 10^{-2} \text{ bar}$



Vapor Pressure Chart

Design Temperatures

Temp°F	11	12	22	38	114	500	502	134a	23
-50	28.9	15.4	6.2	—	27.1	12.8	0.2	18.7	29.2
-45	28.7	13.3	2.7	—	26.6	10.3	1.9	16.9	29.0
-40	28.4	11.0	0.5	—	26.0	7.6	4.1	14.8	28.9
-35	28.1	8.4	2.6	—	25.4	4.6	5.5	12.5	28.7
-30	27.8	5.5	4.9	—	24.7	1.9	9.2	9.7	28.5
-25	27.4	2.3	7.4	—	23.9	1.1	11.1	7.4	28.2
-20	27.0	0.6	10.1	—	23.1	3.2	13.3	5.7	27.9
-15	26.5	2.4	13.2	—	22.3	5.4	18.8	4.1	27.4
-10	26.0	4.5	16.5	—	21.5	7.8	22.6	1.9	27.0
-5	25.4	6.7	20.0	—	20.6	10.4	26.7	4.1	26.5
0	24.8	8.9	23.9	—	19.7	13.3	31.1	6.5	25.9
5	24.1	11.1	28.2	—	18.8	16.4	36.0	9.0	25.3
10	23.4	13.3	32.9	—	17.9	19.7	41.0	11.4	24.6
15	22.1	17.7	37.7	—	17.2	23.3	46.5	15.0	23.7
20	21.1	21.0	43.0	—	16.4	27.2	52.5	18.4	22.8
25	19.9	24.6	48.7	—	15.6	31.5	58.8	22.1	21.8
30	18.6	28.4	54.9	—	14.7	36.0	65.6	26.0	20.7
35	17.2	32.5	61.5	—	13.8	40.8	72.8	30.3	19.5
40	15.6	36.9	68.5	—	12.9	46.0	80.5	35.0	18.1
45	13.9	41.6	76.0	—	12.0	51.6	88.7	40.0	16.6
50	12.0	46.6	84.0	—	11.1	57.7	97.9	45.0	15.0
55	10.0	51.9	92.5	—	10.2	64.3	107.6	50.0	13.3
60	7.8	57.4	101.6	—	9.3	71.4	117.9	55.0	11.6
65	5.4	63.7	111.2	—	8.4	78.9	128.7	60.0	9.9
70	2.7	70.2	121.4	—	7.5	86.8	139.9	65.0	8.2
75	0.0	76.9	132.1	—	6.6	95.1	151.4	70.0	6.6
80	1.5	84.7	143.4	—	5.7	103.9	163.1	75.0	5.0
85	3.2	91.1	155.2	—	4.8	113.0	175.0	80.0	3.4
90	4.9	99.1	167.5	—	3.9	122.5	187.1	85.0	1.8
95	6.8	108.2	181.8	—	3.0	132.5	200.4	90.0	0.2
100	8.8	117.1	195.9	—	2.1	143.1	216.2	124.1	6.1
105	10.9	126.5	210.7	—	1.2	154.2	231.7	134.9	8.1
110	13.2	136.4	226.3	—	0.3	165.9	247.9	146.3	10.3
115	15.6	146.7	242.7	—	0.4	178.3	264.9	158.4	12.6
120	18.3	157.6	259.9	—	0.7	191.2	282.7	171.1	15.1
125	21.0	169.0	277.9	—	1.0	204.8	301.4	184.5	17.7
130	24.0	180.9	296.8	—	1.3	217.0	320.8	198.7	20.6
135	27.1	193.5	316.5	—	1.6	231.9	341.2	213.6	23.6
140	30.4	206.5	337.2	—	1.9	247.4	362.6	229.3	26.8
145	34.0	220.2	358.8	—	2.2	263.7	385.0	245.7	30.2
150	37.7	234.5	381.5	—	2.5	280.7	408.4	263.0	33.8

Pressure/Temperature Chart

Temp (°F)	R-134a Liquid Pressure	R-134a Vapor Pressure	R-407C Liquid Pressure	R-407C Vapor Pressure	R-410A Liquid Pressure
-50	1.6	0.6	12.4	17.2	2.9
-45	1.1	2.7	9.7	15.2	0.4
-40	3.3	5.0	6.8	13.1	2.5
-35	5.6	7.6	3.5	10.7	4.8
-30	8.4	10.4	0.0	8.1	7.3
-25	11.1	13.4	2.0	5.1	10.1
-20	14.1	16.8	4.1	1.9	13.1
-15	17.5	20.5	6.5	0.8	16.5
-10	21.2	24.5	9.0	2.8	20.1
-5	25.2	28.8	11.8	4.9	24.0
0	29.5	33.5	14.8	7.2	28.3
5	34.1	38.5	17.9	9.7	33.0
10	39.0	43.8	21.0	12.4	38.0
15	44.8	49.9	25.5	15.4	43.5
20	50.7	56.2	29.6	18.7	49.3
25	57.0	63.0	34.0	22.2	55.7
30	63.7	70.3	38.7	26.0	62.5
35	71.0	78.1	43.8	30.1	69.8
40	78.7	86.4	49.2	34.5	77.6
45	87.0	95.2	54.9	39.2	86.0
50	95.8	104.5	61.0	44.3	94.9
55	105.1	114.3	67.4	49.8	104.5
60	114.9	124.6	74.1	55.6	114.6
65	125.6	136.6	81.8	61.9	125.4
70	136.8	149.6	89.5	68.6	136.9
75	148.7	163.7	97.7	75.8	149.1
80	161.2	178.8	106.4	83.4	162.1
85	174.3	194.9	115.6	91.5	175.8
90	188.0	212.1	125.4	100.2	190.2
95	203.1	230.4	135.3	109.4	205.5
100	218.7	250.9	146.0	119.2	221.6
105	235.4	273.4	157.2	129.6	238.5
110	252.1	297.7	169.0	140.6	256.4
115	270.2	323.9	181.4	152.3	275.1
120	289.1	351.1	194.4	164.7	294.7
125	308.9	382.3	208.0	177.8	315.2
130	329.7	414.5	222.3	191.6	336.7
135	351.5	448.8	237.2	206.3	359.2
140	374.3	495.2	252.9	221.8	382.6
145	398.1	543.7	269.3	238.2	407.0
150	423.0	604.4	286.4	255.5	432.4

Low side boiling point 38°F

High side condensing point (energy eff.) 105°F

115° to 120°

Conventional condensing temp.

38 to 40 deg. boiling

100 to 120 deg. condensing

85 to 90 deg. outside

70 to 75 deg. inside

Pressure Temperature Chart

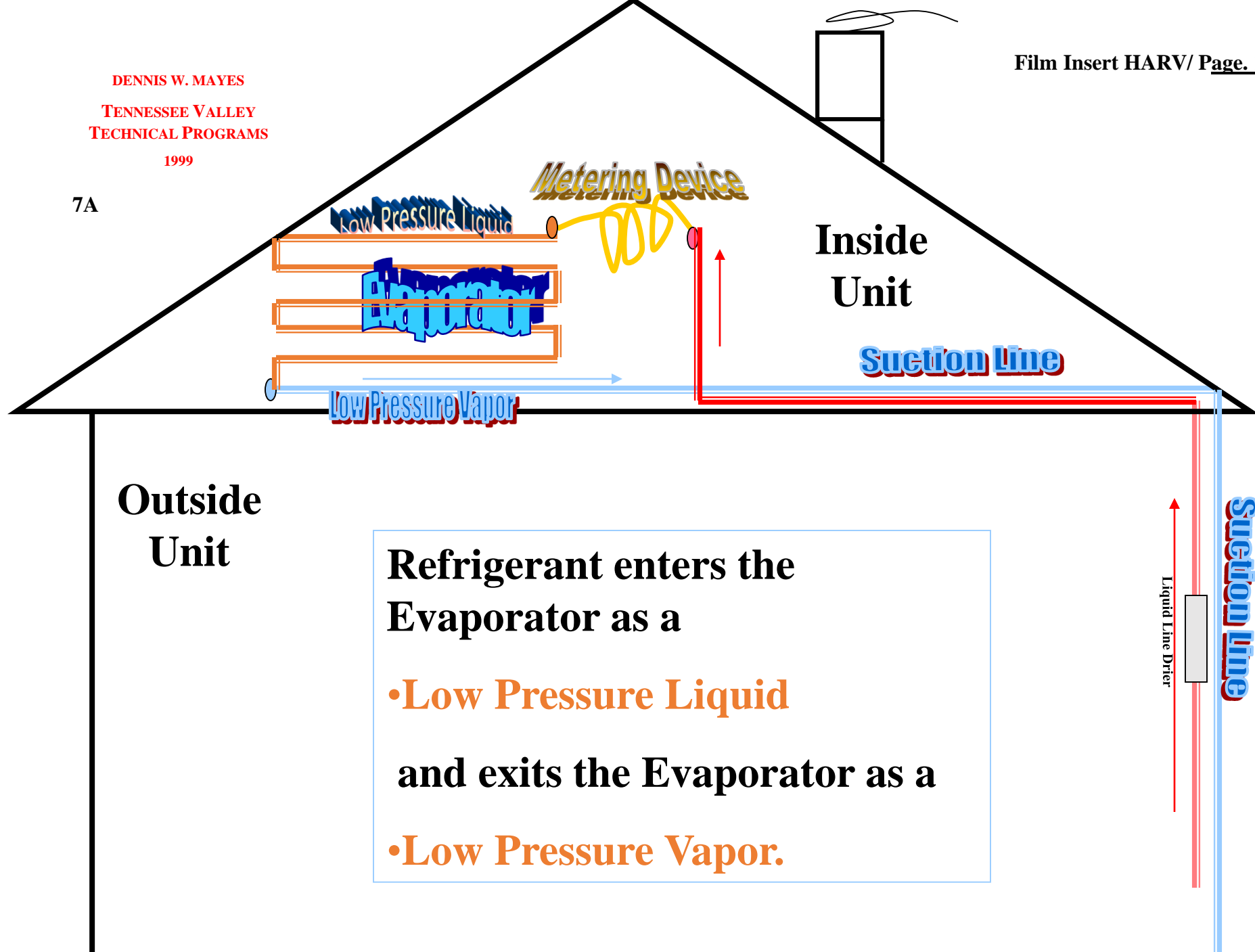
Temp		R-12	R-22	R-123	R-134a	Temp		MP 39 R-401A	HP 80 R-402A	HP 62 R-404A	FX 10 R-408A	FX 56 R-409A	AZ-20 R-410A			
°F	°C					°F	°C	Liquid	Vapor	Liquid	Vapor	Liquid	Liquid	Liquid	Vapor	
-50	-45.6	15.4	6.2	29.2	18.4	-50	-45.6	-	-	-	-	0.6	1.6	12.4	17.2	5.0
-45	-42.8	13.3	2.7	29.0	16.6	-45	-42.8	-	-	-	-	2.7	1.1	9.7	15.2	7.0
-40	-40.0	11.0	0.5	28.9	14.7	-40	-40.0	8.1	13.2	6.8	6.3	5.0	3.3	6.8	13.1	11.6
-35	-37.2	8.4	2.6	28.7	12.3	-35	-37.2	5.1	10.7	9.6	9.1	7.6	5.6	3.5	10.7	14.9
-30	-34.4	5.5	4.9	28.4	9.7	-30	-34.4	1.7	7.9	12.6	12.1	10.4	8.2	0.0	8.1	18.5
-25	-31.7	2.3	7.4	28.1	6.8	-25	-31.7	1.0	4.8	16.0	15.4	13.4	11.0	2.0	5.1	22.5
-20	-28.9	0.6	10.1	27.8	3.6	-20	-28.9	3.0	1.4	19.6	18.9	16.8	14.1	4.1	1.9	26.9
-15	-26.1	2.4	13.2	27.4	0.1	-15	-26.1	5.2	1.2	23.6	22.9	20.5	17.5	6.5	0.8	31.6
-10	-23.3	4.5	16.4	27.0	2.0	-10	-23.3	7.7	3.3	27.9	27.1	24.5	21.2	9.0	2.8	36.8
-5	-20.6	6.7	20.0	26.5	4.1	-5	-20.6	10.3	5.5	32.6	31.7	28.8	25.2	11.8	4.9	42.5
0	-17.8	9.1	24.0	25.9	6.5	0	-17.8	13.2	8.0	37.6	36.7	33.5	29.5	14.8	7.2	48.6
5	-15.0	11.8	28.2	25.3	9.1	5	-15.0	16.3	10.7	43.1	42.1	38.6	34.2	18.1	9.7	55.2
10	-12.2	14.6	32.7	24.6	11.9	10	-12.2	19.7	13.7	49.0	48.0	44.0	39.3	21.7	12.5	62.3
15	-9.4	17.7	37.7	23.7	15.1	15	-9.4	23.4	16.9	55.3	54.2	49.9	44.8	25.5	15.4	70.0
20	-6.7	21.0	43.0	22.8	18.4	20	-6.7	27.4	20.4	62.1	60.9	56.2	50.7	29.6	18.7	78.3
25	-3.9	24.6	48.7	21.8	22.1	25	-3.9	31.7	24.2	69.3	68.1	63.0	57.0	34.0	22.2	87.2
30	-1.1	28.4	54.9	20.7	26.1	30	-1.1	36.4	28.3	77.1	75.8	70.3	63.7	38.7	26.0	96.8
35	1.7	32.5	61.4	19.5	30.4	35	1.7	41.3	32.8	85.4	84.0	78.1	71.0	43.8	30.1	107.0
40	4.4	36.9	68.5	18.1	35.1	40	4.4	46.6	37.6	94.2	92.8	86.4	78.7	49.2	34.5	118.0
45	7.2	41.6	76.0	16.6	40.0	45	7.2	52.4	42.7	104.0	102.0	95.2	87.0	54.9	39.2	130.0
50	10.0	46.7	84.0	15.0	45.4	50	10.0	58.5	48.2	114.0	112.0	104.7	95.8	61.0	44.3	142.0
55	12.8	52.0	92.5	13.1	51.2	55	12.8	65.0	54.1	124.0	123.0	114.7	105.1	67.6	49.8	156.0
60	15.6	57.7	101.6	11.2	57.4	60	15.6	71.9	60.4	136.0	134.0	125.3	115.1	74.5	55.6	170.0
65	18.3	63.7	111.0	9.0	64.0	65	18.3	79.3	67.2	147.0	146.0	136.6	125.6	81.8	61.9	185.0
70	21.1	70.1	121.4	6.6	71.1	70	21.1	87.1	74.4	160.0	158.0	148.6	136.8	89.5	68.6	201.0
75	23.9	76.9	132.0	4.0	78.6	75	23.9	95.4	82.1	173.0	171.0	161.2	148.7	97.7	75.8	217.0
80	26.7	84.1	144.0	1.2	86.7	80	26.7	104.0	90.2	187.0	185.0	174.6	161.2	106.4	83.4	235.0
85	29.4	91.7	156.0	0.9	95.1	85	29.4	114.0	98.9	202.0	200.0	188.8	174.4	115.5	91.5	254.0
90	32.2	99.7	168.4	2.5	104.2	90	32.2	123.0	108.0	218.0	215.0	203.7	188.4	125.2	100.2	274.0
95	35.0	108.0	182.0	4.2	113.8	95	35.0	134.0	118.0	233.0	232.0	219.4	203.1	135.3	109.4	295.0
100	37.8	117.0	196.0	6.1	124.1	100	37.8	145.0	128.0	251.0	249.0	235.9	218.7	146.0	119.2	317.0
105	40.6	127.0	211.0	8.1	134.9	105	40.6	156.0	139.0	269.0	267.0	253.4	235.0	157.2	129.6	341.0
110	43.3	136.0	226.4	10.3	146.3	110	43.3	169.0	151.0	288.0	286.0	271.7	252.1	169.0	140.6	365.0
115	46.1	147.0	243.0	12.6	158.4	115	46.1	181.0	163.0	308.0	305.0	290.9	270.2	181.4	152.3	391.0
120	48.9	158.0	260.0	15.1	171.1	120	48.9	195.0	176.0	328.0	326.0	311.1	289.1	194.4	164.7	418.0
125	51.7	169.0	278.4	17.7	184.5	125	51.7	209.0	189.0	350.0	347.0	332.3	308.9	208.0	177.8	446.0
130	54.4	181.0	296.8	20.6	198.7	130	54.4	224.0	203.0	372.0	370.0	354.5	329.7	222.3	191.6	476.0
135	57.2	193.0	317.0	23.6	213.6	135	57.2	239.0	218.0	396.0	393.0	377.8	351.5	237.2	206.3	507.0
140	60.0	207.0	337.3	26.8	229.3	140	60.0	255.0	234.0	420.0	418.0	402.2	374.3	252.9	221.8	539.0
145	62.8	220.0	359.0	30.2	245.7	145	62.8	272.0	250.0	446.0	443.0	427.7	398.1	269.3	238.2	573.0
150	65.6	235.0	381.0	33.8	263.0	150	65.6	299.0	267.0	472.0	470.0	454.4	423.0	293.0	286.4	608.0

Black figures = psig
Red figures in italics = inches Hg. Below 1 ATM

Black figures = psig
Red figures in italics = inches Hg. Below 1 ATM

DENNIS W. MAYES
TENNESSEE VALLEY
TECHNICAL PROGRAMS
1999

7A



Refrigerant enters the Evaporator as a

- Low Pressure Liquid

and exits the Evaporator as a

- Low Pressure Vapor.

Refrigerant enters the
Condenser as a

- High Pressure Vapor
- and exits the Condenser
as a
- High Pressure Liquid

7K

Metering Device
Metering Device

Inside
Unit

Outside
Unit

Discharge Line

High Pressure Vapor

Condenser

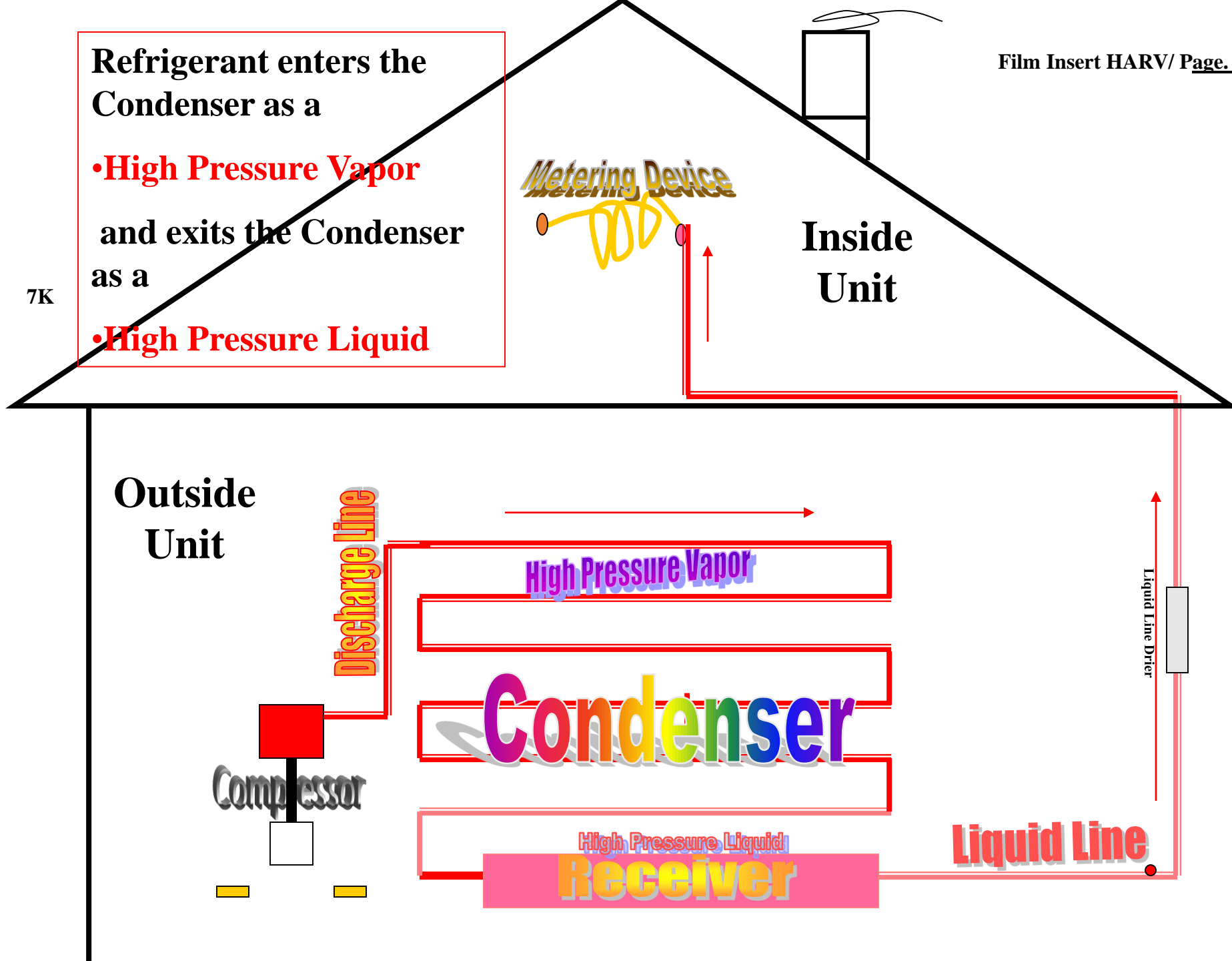
High Pressure Liquid

Receiver

Liquid Line

Liquid Line Drier

Compressor



Superheat for A/C with fixed Orifice R-22 (Table 4)

Evaporator Inlet Air Temperature Fahrenheit **Wet Bulb**

	54	56	58	60	62	64	66	68	70	72	74
Outside Air Temperature DB											
60	13	17	18	20	24	26	28	30	33	36	39
65	11	13	15	17	18	22	25	28	30	33	36
70	8	11	12	14	16	18	22	25	28	30	33
75	5	7	10	12	14	16	18	23	26	28	30
80		4	6	8	12	14	16	18	23	27	28
85			4	6	8	12	14	17	20	25	27
90				4	6	9	12	15	18	22	25
95					4	7	11	13	16	20	23
100						5	8	11	14	18	20
105						4	6	8	12	15	19
110							5	7	11	14	18
115								5	8	13	16

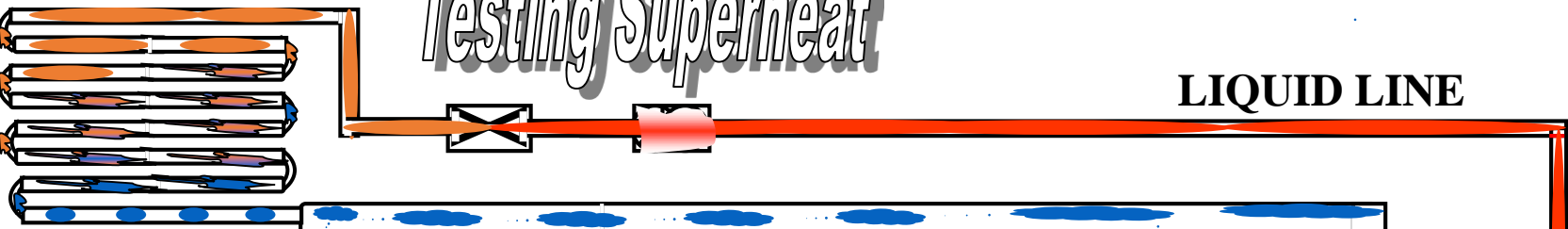
As the temperature outside goes up the superheat goes down.

As the indoor temperature goes up the superheat also goes up.

EVAPORATOR

Testing Superheat

LIQUID LINE

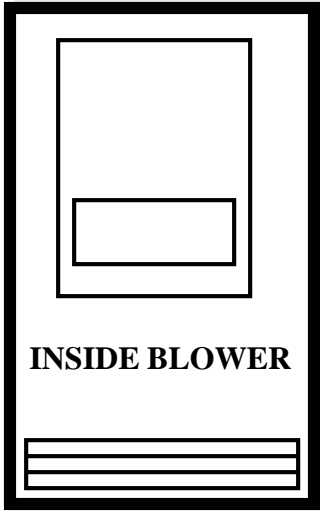


SUCTION LINE

SUPERHEAT READING, ABOUT 12 DEGREES AT THIS LOCATION AND WITH AN OUTSIDE AMBIENT TEMPERATURE AROUND THE CONDENSER OF 85 DEGREES.

WHEN CHARTS ARE NOT AVAILABLE

If the outside temperatures are higher, expect the superheat to be lower. If the inside temperature is higher expect the superheat to be higher

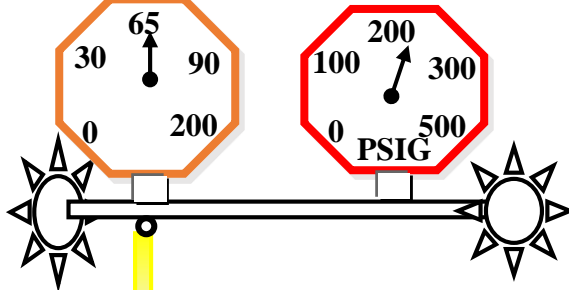


INSIDE BLOWER

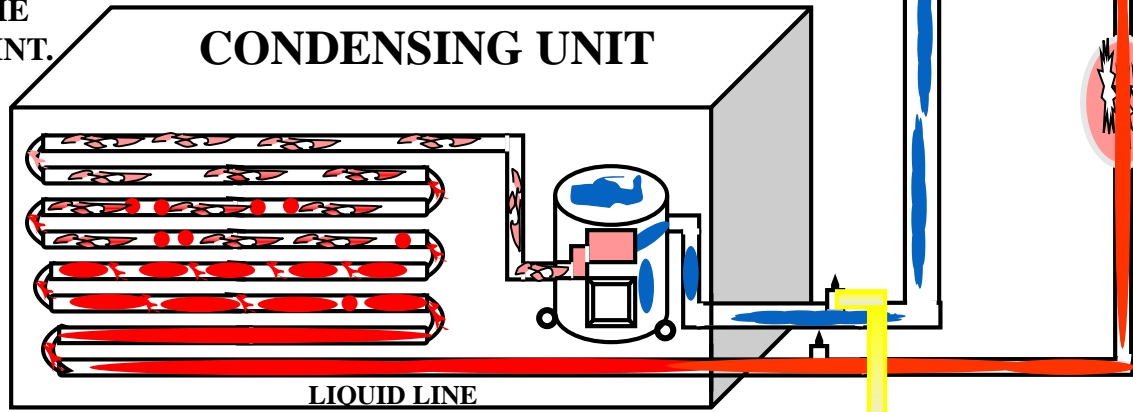
INSIDE OCCUPANT AREA 70 TO 72 DEGREES DRY BULB.

TO DETERMINE THE TEMPERATURE OF THE ENTERING REFRIGERANT, CONVERT THE LOW SIDE PRESSURE TO ITS BOILING POINT.

AT 65 PSIG R-22 BOILS AT 38 DEG.



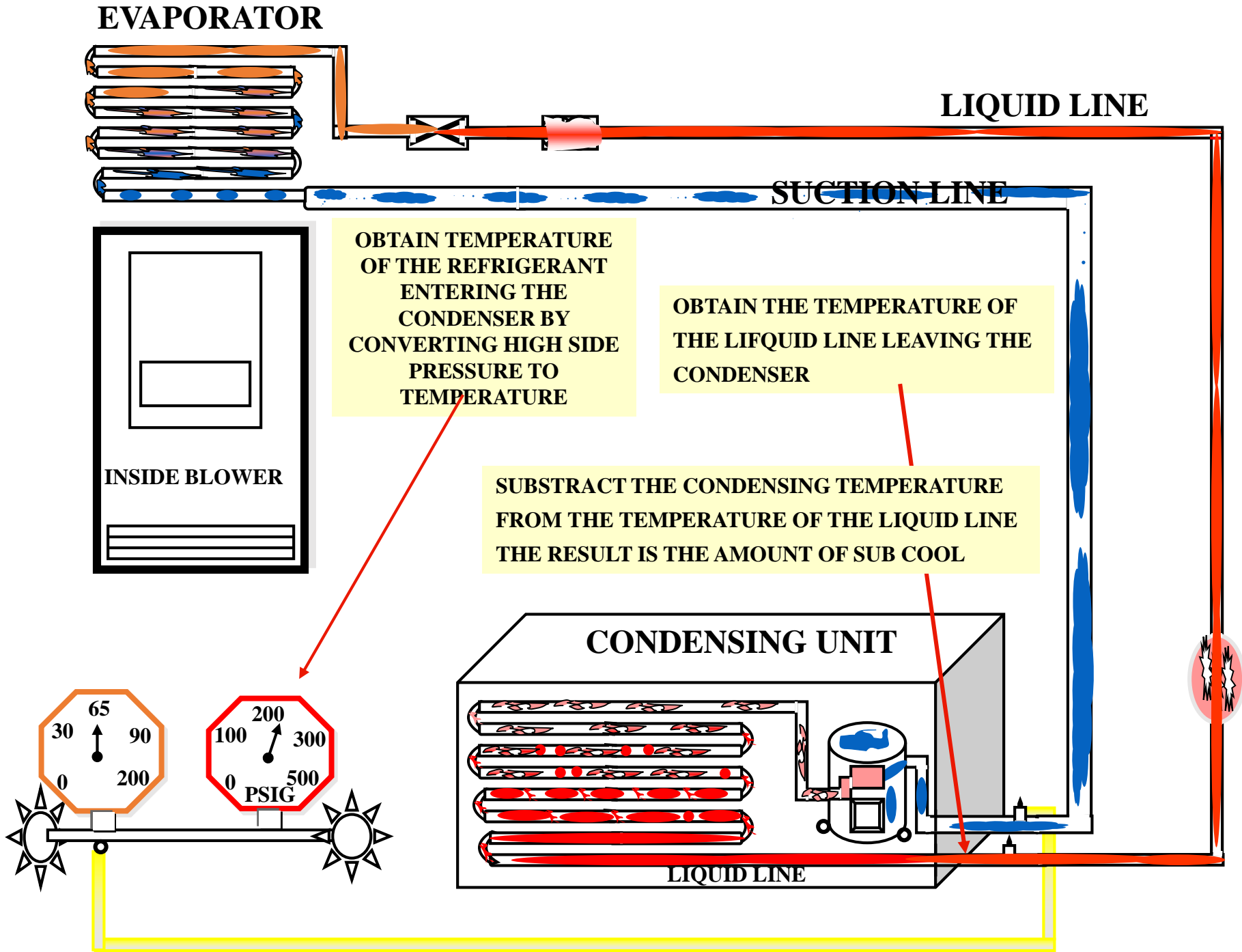
CONDENSING UNIT



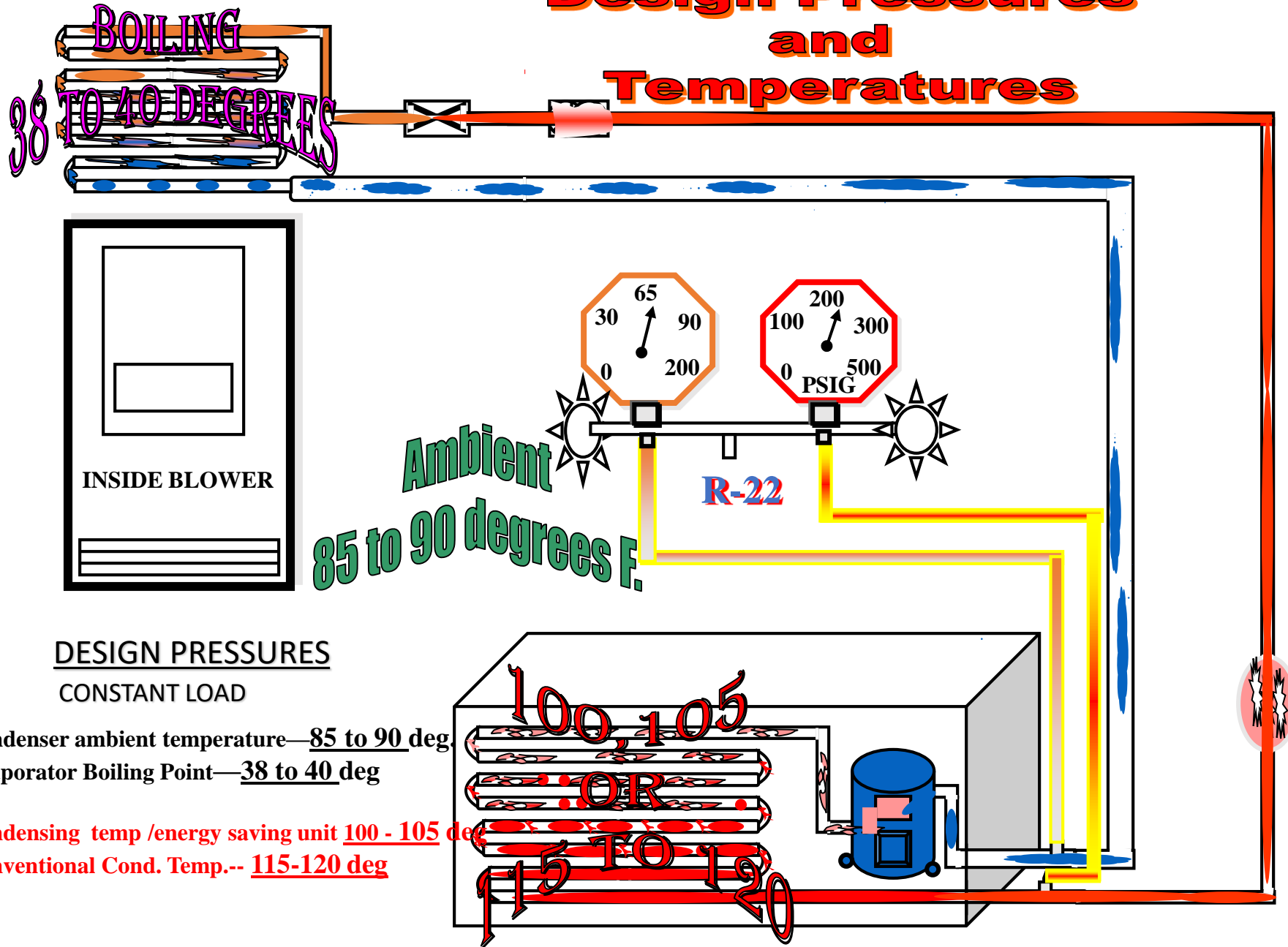
LIQUID LINE

Sub-cooling for A/C with TXV R-22

Evaporator Inlet Air Temperature	Fahrenheit					Wet Bulb			
	57	59	61	63	65	67	69	71	73
Outside Air Temperature DB									
75	31	30	29	27	25	23	21	19	17
80	30	29	26	24	23	21	19	17	15
85	28	27	24	22	21	19	18	16	14
90	27	25	22	20	19	17	16	14	12
95	25	23	20	19	17	15	13	11	9
100	23	20	18	16	14	12	10	8	6
105	20	18	16	14	12	10	8	6	4
110	18	15	13	11	9	7	5	3	1
115	15	13	11	9	7	5	3	1	0



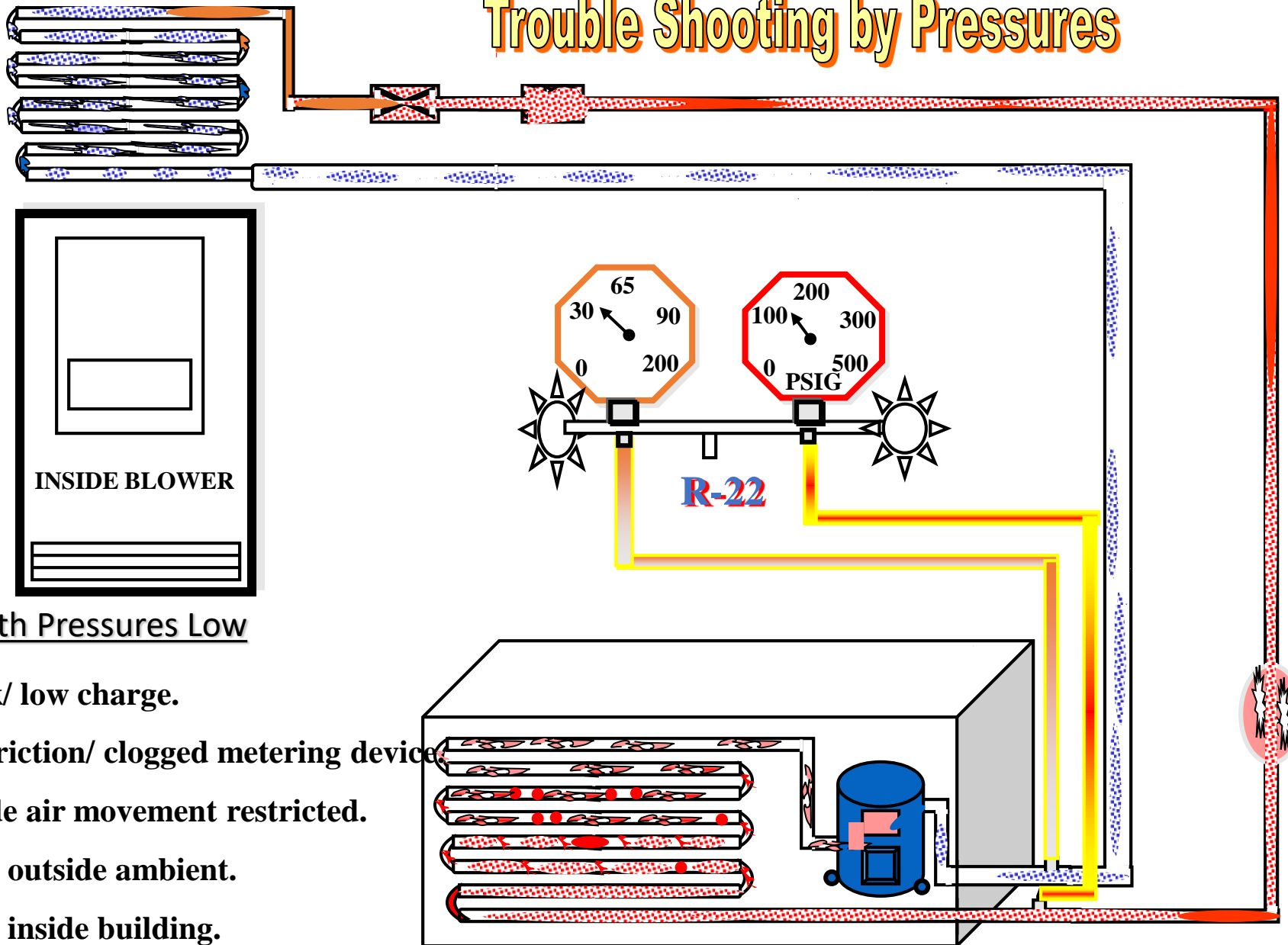
Design Pressures and Temperatures



DESIGN PRESSURES CONSTANT LOAD

- Condenser ambient temperature—85 to 90 deg
- Evaporator Boiling Point—38 to 40 deg
- Condensing temp /energy saving unit 100 - 105 deg
- Conventional Cond. Temp.-- 115-120 deg

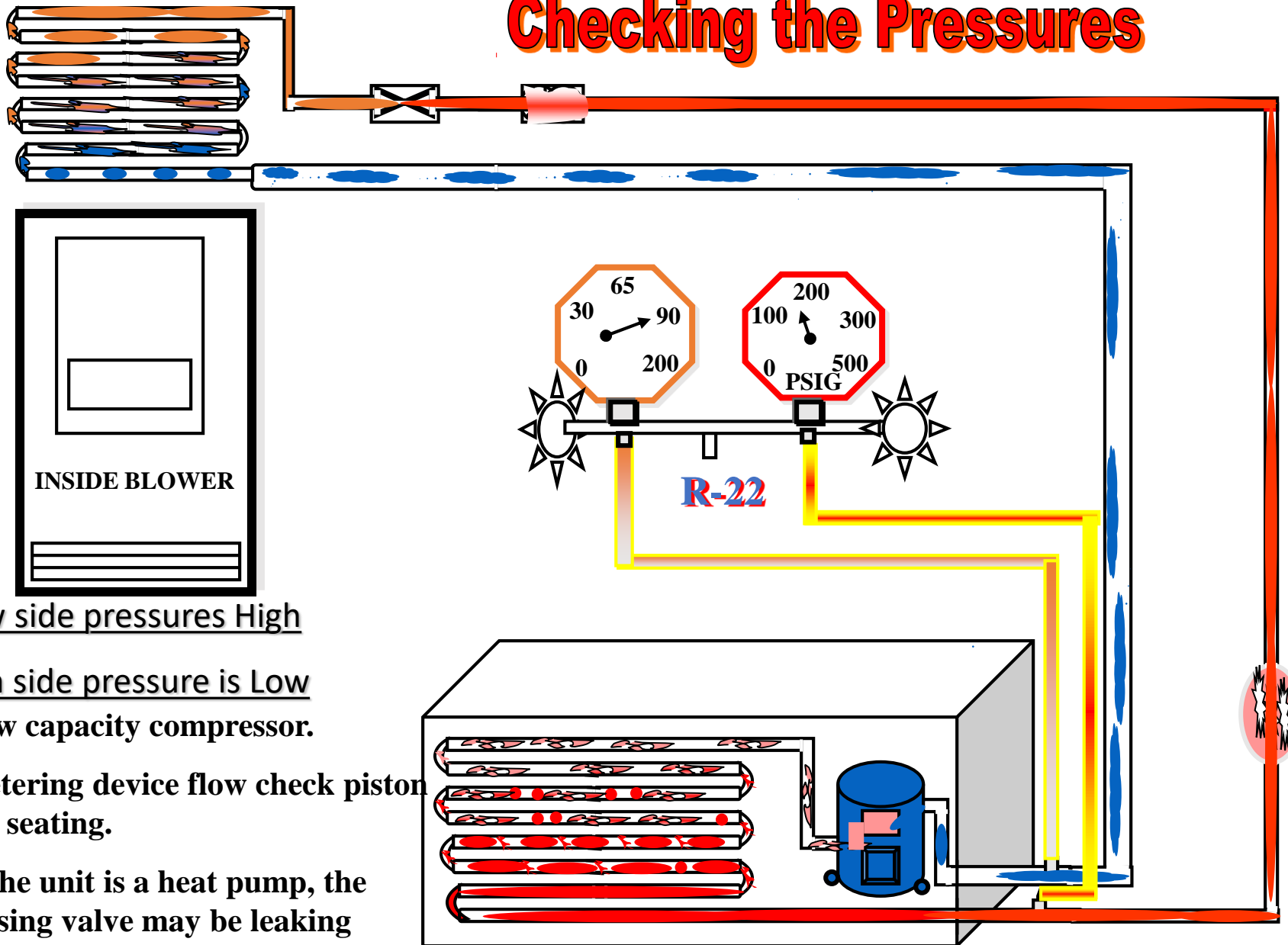
Trouble Shooting by Pressures



Both Pressures Low

1. Leak/ low charge.
2. Restriction/ clogged metering device
3. Inside air movement restricted.
4. Cold outside ambient.
5. Cold inside building.

Checking the Pressures

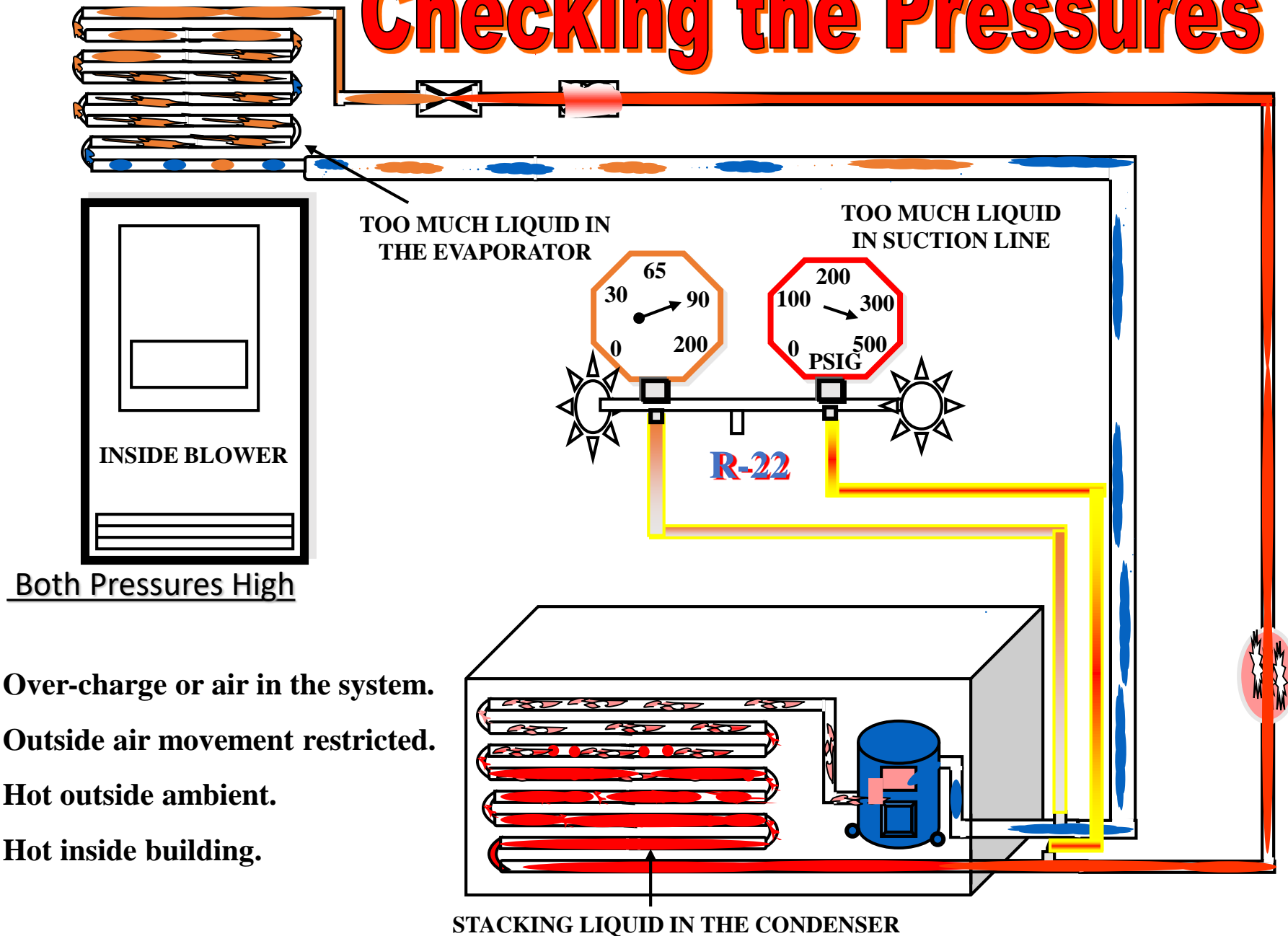


Low side pressures High

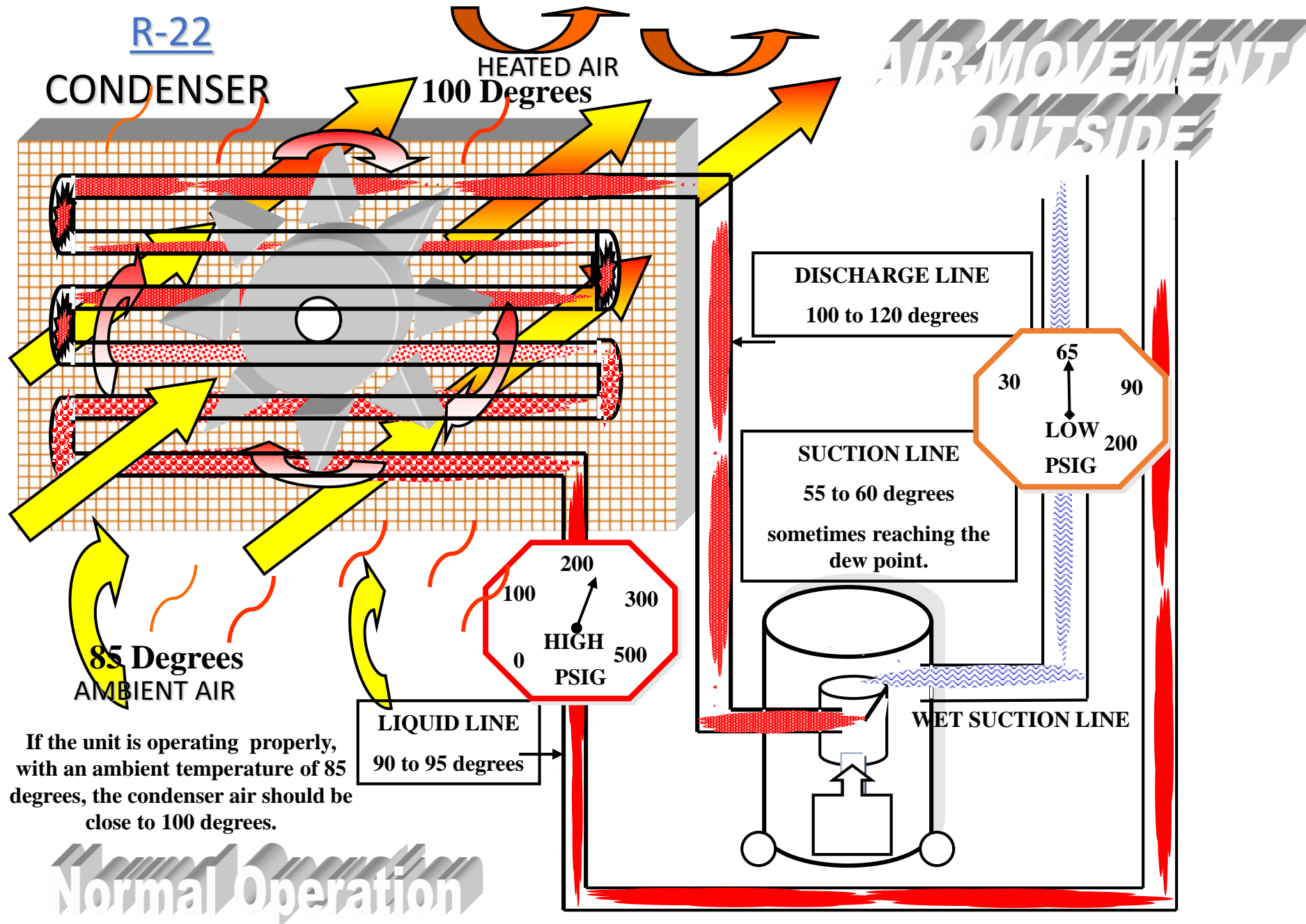
High side pressure is Low

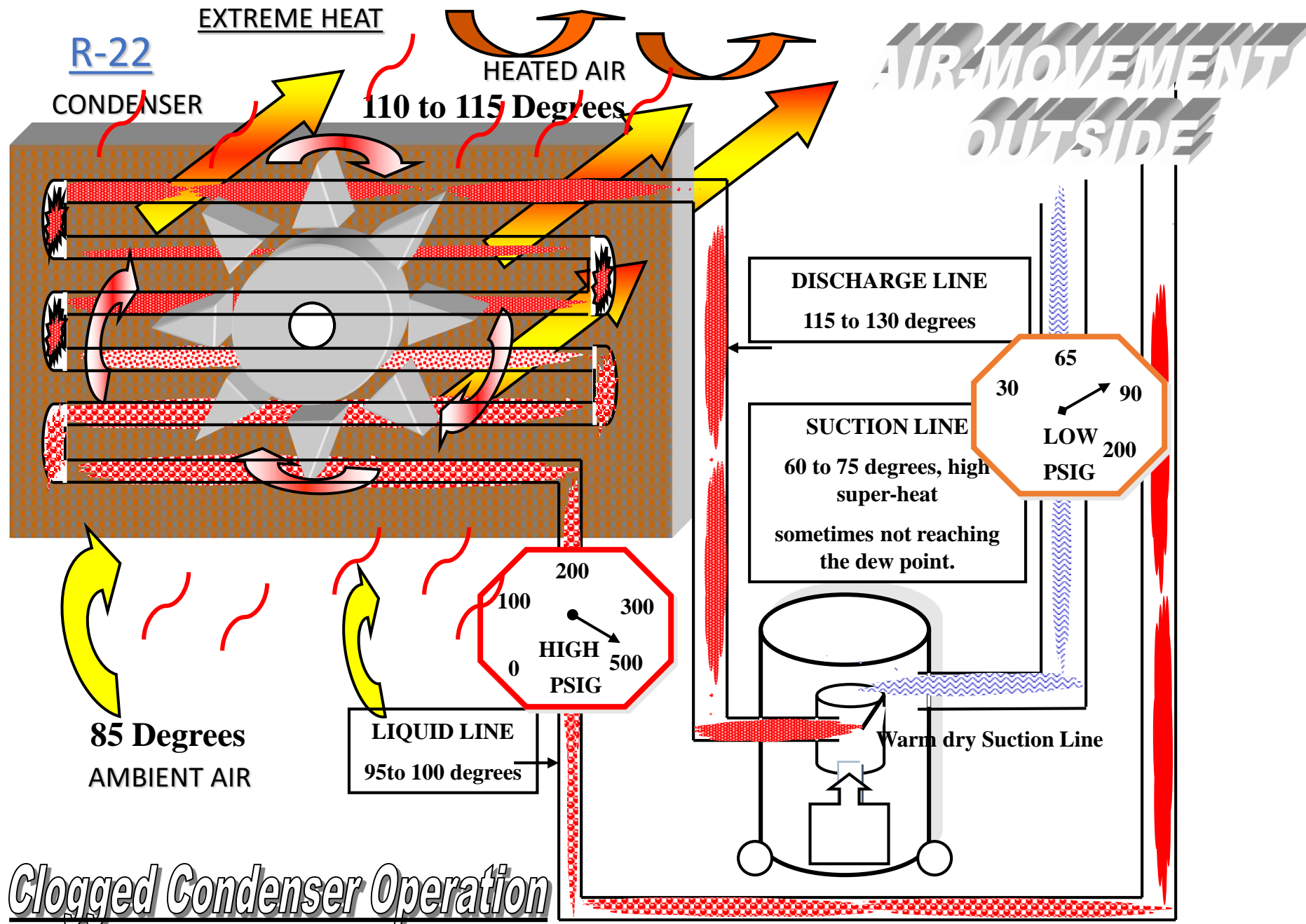
1. Low capacity compressor.
2. Metering device flow check piston is not seating.
3. If the unit is a heat pump, the reversing valve may be leaking through from the high side to the low side.

Checking the Pressures

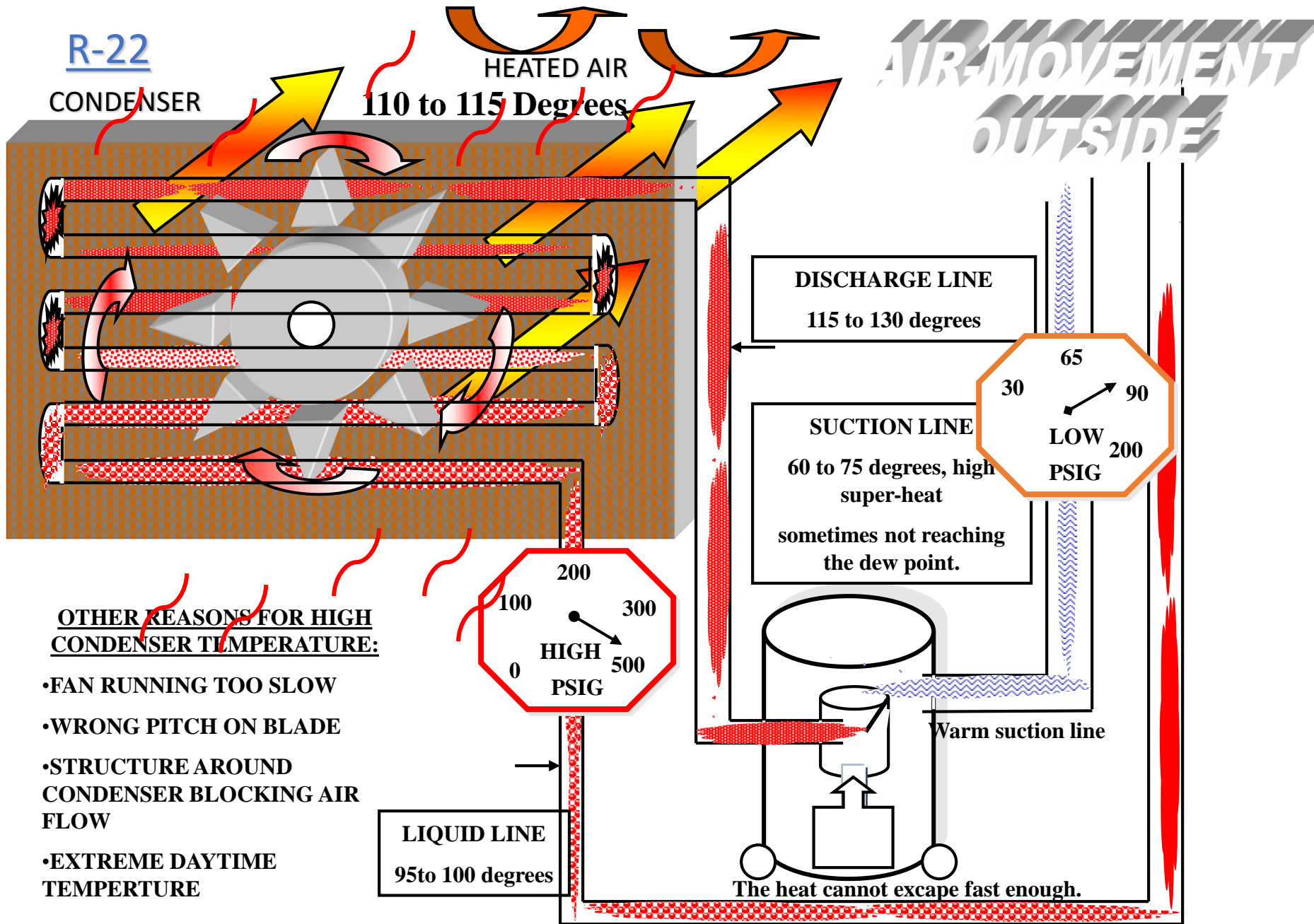


1. Over-charge or air in the system.
2. Outside air movement restricted.
3. Hot outside ambient.
4. Hot inside building.





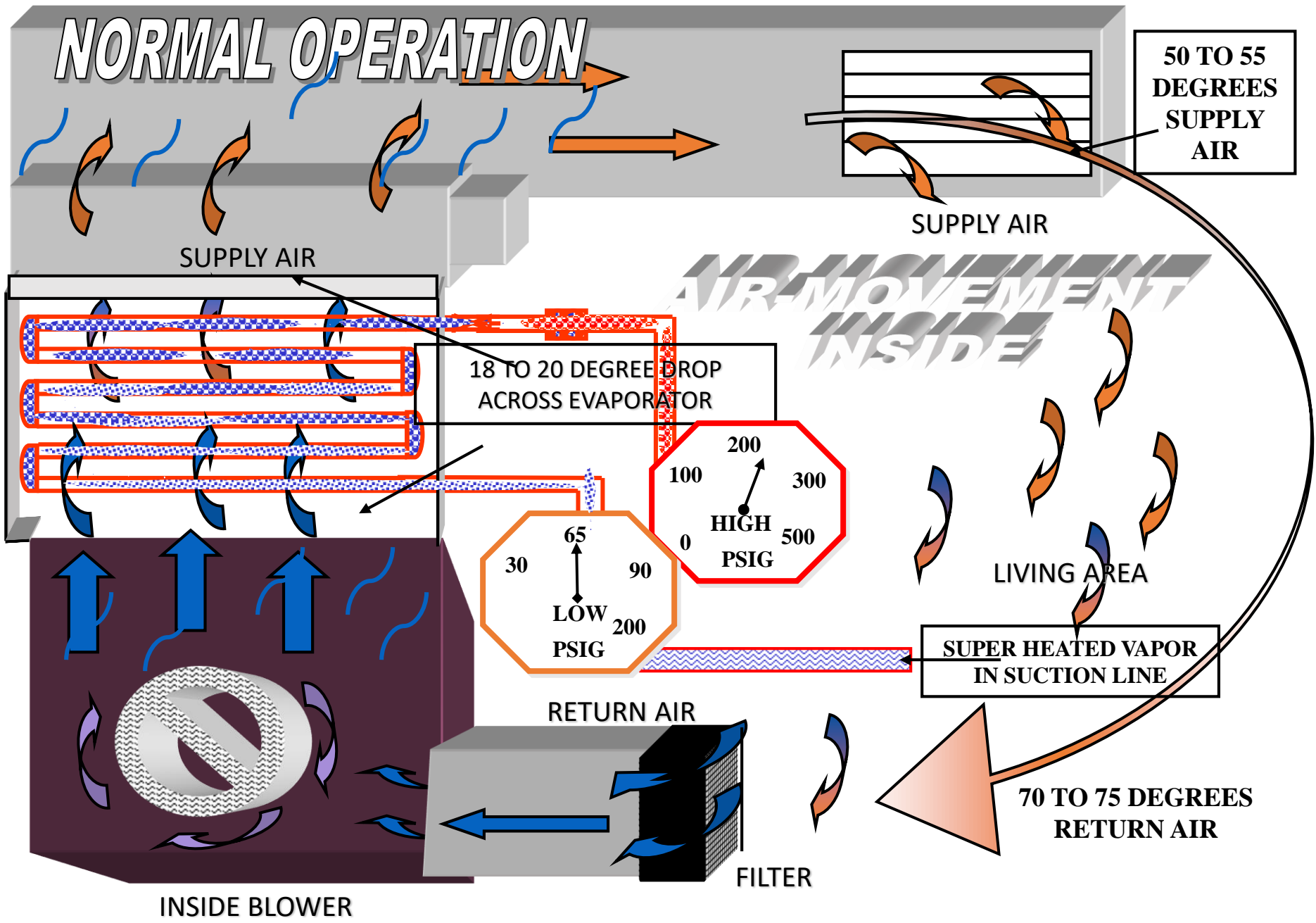
Condensing is still taking place further down the liquid line.

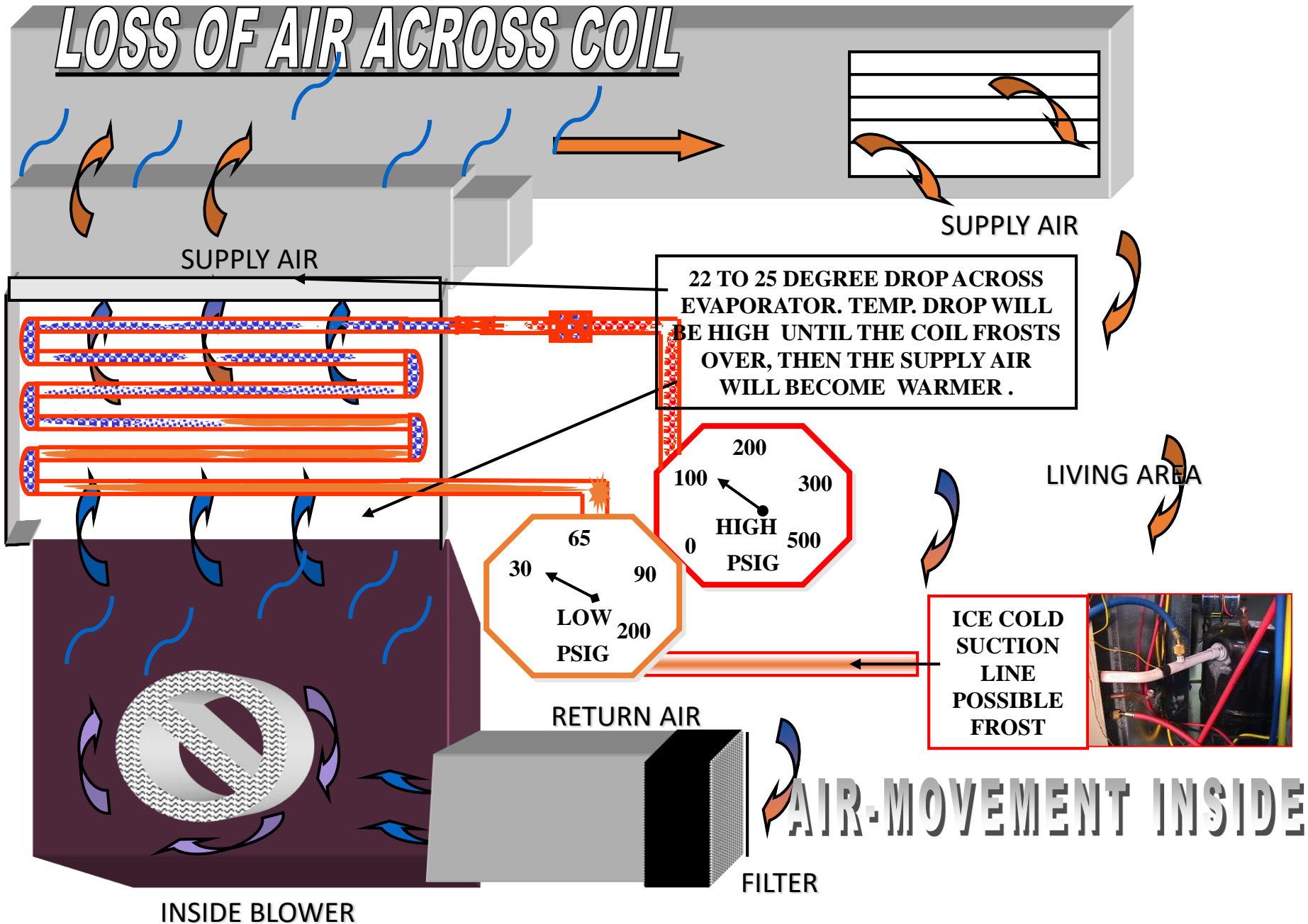


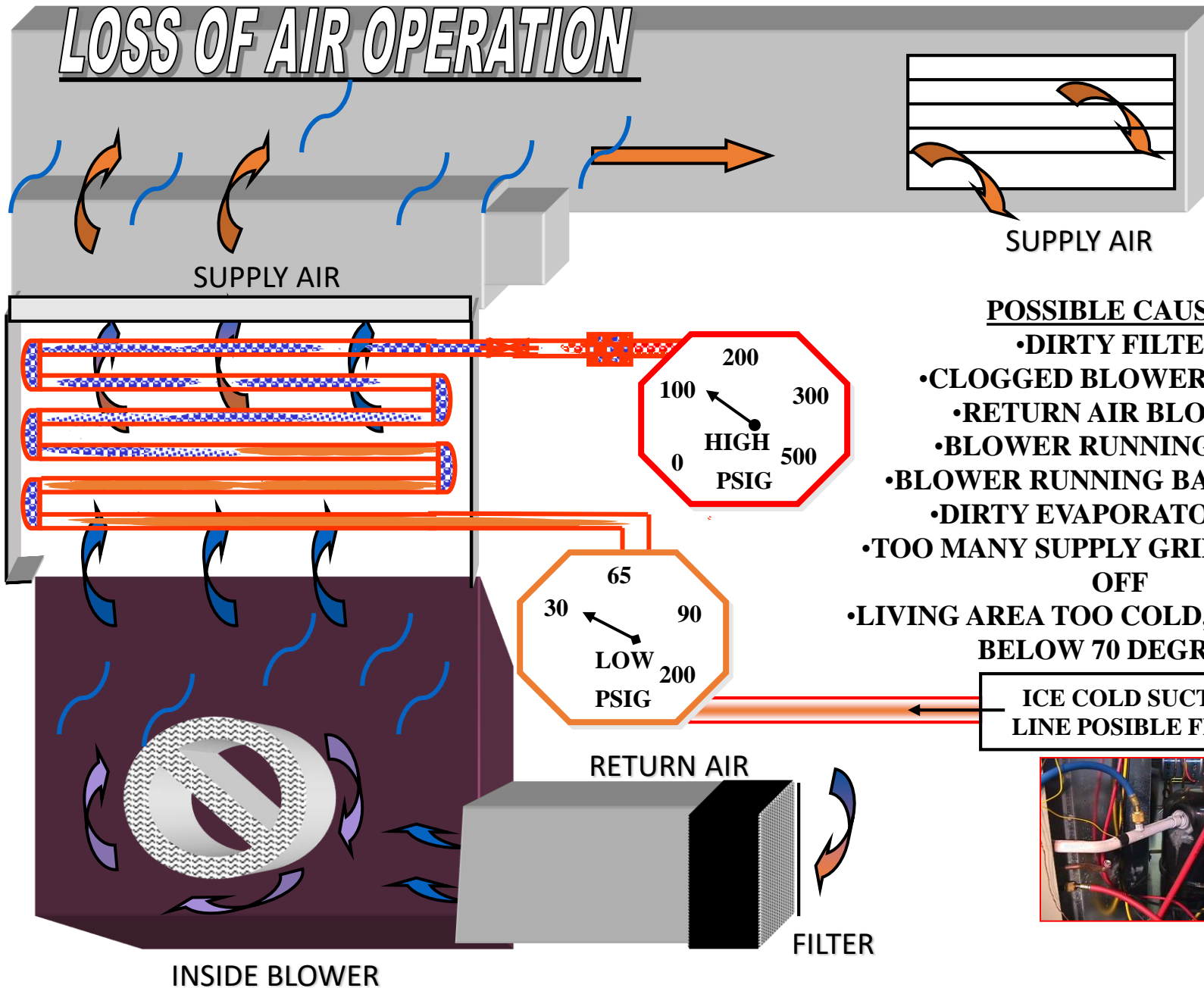
OTHER REASONS FOR HIGH CONDENSER TEMPERATURE:

- FAN RUNNING TOO SLOW
- WRONG PITCH ON BLADE
- STRUCTURE AROUND CONDENSER BLOCKING AIR FLOW
- EXTREME DAYTIME TEMPERTURE

Condensing is still taking place further down the liquid line.







POSSIBLE CAUSES:

- DIRTY FILTER
- CLOGGED BLOWER WHEEL
- RETURN AIR BLOCKED
- BLOWER RUNNING SLOW
- BLOWER RUNNING BACKWARDS
- DIRTY EVAPORATOR COIL
- TOO MANY SUPPLY GRILLS CLOSED OFF
- LIVING AREA TOO COLD, RETURN AIR BELOW 70 DEGREES

