FLUKE®

Pressure - Temperature Chart

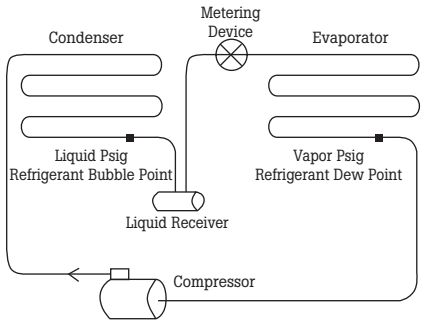
All pressures shown are in PSIG; Red print = Vacuum (inches of Mercury)

°F	12	22	502	134a	401A (MP39) VAP DP	401A (MP39) LIQ BP	401B (MP66) VAP DP	401B (MP66) LIQ BP	402A (HP80) VAP DP	402A (HP80) LIQ BP	404A (HP62) (FX70)	408A (FX10)	409A (FX56) VAP DP	409A (FX56) LIQ BP	410A (AZ20)
-40	11.0	0.5	4.1	14.5	14.3		12.8		5.6		4.6	2.8	13.1		11.6
-38	10.0	1.3	5.0	13.7	13.4		11.8		6.7		5.6	3.7	12.1		12.9
-36	8.9	2.2	6.0	12.8	12.4		10.7		7.8		6.6	4.6	11.1		14.2
-34	7.8	3.0	7.0	11.8	11.4		9.6		8.9		7.7	5.6	10.1		15.6
-32	6.7	4.0	8.1	10.8	10.3		8.5		10.0		8.8	6.6	9.1		17.0
-30	5.5	4.9	9.2	9.7	9.2		7.3		11.3		9.9	7.6	8.1		18.5
-28	4.3	5.9	10.3	8.6	8.1		6.0		12.5		11.1	8.7	6.9		20.1
-26	3.0	6.9	11.5	7.7	6.9		4.7		13.8		12.4	9.8	5.6		21.7
-24	1.6	7.9	12.7	6.2	5.6		3.3		15.2		13.3	11.0	4.4		23.4
-22	0.3	9.0	14.0	4.9	4.3		1.9		16.6		15.0	12.2	3.1		25.1
-20	0.6	10.1	15.3	3.6	2.9		0.4		18.0		16.4	13.4	1.9		26.9
-18	1.3	11.3	16.7	2.3	1.5		0.6		19.5		17.8	14.7	1.0		28.9
-16	2.1	12.5	18.1	0.8	0.0		1.3		21.1		19.3	16.1	0.0		30.1
-14	2.8	13.8	19.5	0.3	0.8		2.2		22.7		20.8	17.5	1.0		32.8
-12	3.7	15.1	21.0	1.1	1.6		3.0		24.4		22.4	18.9	1.9		34.8
-10	4.5	16.5	22.6	1.9	2.4		3.9		26.1		24.0	20.4	2.8		36.8
-8	5.4	17.9	24.2	2.8	3.2		4.8		27.9		25.7	22.0	3.7		39.1
-6	6.3	19.3	25.8	3.6	4.1		5.8		29.7		27.4	23.6	4.6		41.4
-4	7.2	20.8	27.5	4.5	5.0		6.8		31.6		29.2	25.2	5.4		43.8
-2	8.2	22.4	29.3	5.5	6.0		7.8		33.5		31.1	26.9	6.3		46.2
0	9.2	24.0	31.1	6.5	7.0		8.9		35.6		33.0	28.7	7.2		48.6
2	10.2	25.6	32.9	7.5	8.0		10.0		37.6		35.0	30.5	8.3		51.2
4	11.2	27.3	34.9	8.5	9.1		11.1		39.8		37.0	32.3	9.3		53.9
6	12.3	29.1	36.9	9.6	10.2		12.3		42.0		39.1	34.3	10.4		56.6
8	13.5	30.9	38.9	10.8	11.3		13.5		44.3		41.3	36.3	11.4		59.5
10	14.6	32.8	41.0	12.0	12.5		14.8		46.6		43.5	38.3	12.5		62.3
12	15.8	34.7	43.2	13.1	13.7		16.1		49.0		45.8	40.4	13.7		65.4
14	17.1	36.7	45.4	14.4	15.0		17.4		51.5		48.2	42.6	15.0		68.5
16	18.4	38.7	47.7	15.7	16.3		18.8		54.0		50.6	44.9	16.2		71.6
18	19.7	40.9	50.0	17.0	17.6		20.3		56.7		53.1	47.2	17.5		75.0
20	21.0	43.0	52.5	18.4	19.0		21.8		59.4		55.7	49.5	18.7		78.3
22	22.4	45.3	54.9	19.9	20.5		23.3		62.2		58.4	52.0	20.2		81.9
24	23.9	47.6	57.5	21.4	22.0		24.9		65.0		61.1	54.5	21.6		85.5
26	25.4	49.9	60.1	22.9	23.5		26.5		68.0		63.9	57.1	23.1		89.2
28	26.9	52.4	62.8	24.5	25.1		28.2		71.0		66.8	59.8	24.5		93.0
30	28.5	54.9	65.6	26.1	26.7		30.0		74.1		69.7	62.5	26.0		96.8
32	30.1	57.5	68.4	27.8	28.4		31.8		77.3		72.8	65.3	27.7		100.9
34	31.7	60.1	71.3	29.5	30.1		33.6		80.5		75.9	68.2	29.4		105.0
36	33.4	62.8	74.3	31.3	31.9		35.5		83.9		79.1	71.2	31.1		109.2
38	35.2	65.6	77.4	33.2	33.7		37.5		87.3		82.4	74.2	32.8		113.6
40	36.9	68.5	80.5	35.1	35.6		39.5		90.9		85.7	77.4	34.5		118.0
42	38.8	71.5	83.8	37.0	37.6		41.6		94.5		89.2	80.6	36.5		122.8
44	40.7	74.5	87.0	39.1	39.6		43.7		98.2		92.7	83.9	38.4		127.6
46	42.7	77.6	90.4	41.1	41.7		45.9		102.0		96.4	87.3	40.4		132.4
48	44.7	80.7	93.9	43.3	43.8		48.2		106.0		100.1	90.7	42.3		137.2
50	46.7	84.0	97.4	45.5	46.0	**57.7**	50.5	**62.3**	110	**114**	104.5	95.8	44.3	**61.0**	142.0
52	48.8	87.3	101.0	47.7	47.0	**60.2**	52.3	**64.9**	115	**118**	109.5	99.7	46.6	**63.7**	147.2
54	51.0	90.8	104.8	50.1	49.0	**62.8**	54.7	**67.0**	119	**123**	113.5	103.5	48.8	**66.4**	152.4
56	53.2	94.3	108.6	52.3	51.5	**65.4**	57.3	**70.4**	124	**127**	117.7	107.4	51.1	**69.1**	158.0
58	55.4	97.9	112.4	55.0	54.0	**68.1**	60.0	**73.7**	128	**131**	121.9	111.2	53.3	**71.8**	164.0
60	57.7	101.6	116.4	57.5	56.0	**70.9**	62.5	**76.2**	133	**136**	126.2	115.1	55.6	**74.5**	170.0
62	60.1	105.4	120.4	60.1		**73.8**		**79.2**		**140.7**	130.7	119.4		**77.5**	176.0
64	62.5	109.3	124.6	62.7		**76.7**		**82.3**		**145.4**	135.2	123.8		**80.5**	182.0
66	65.0	113.2	128.8	65.5		**79.7**		**85.5**		**150.3**	139.9	128.1		**83.5**	188.2
68	67.6	117.3	133.2	68.3		**82.8**		**88.7**		**155.4**	144.7	132.5		**86.5**	191.4
70	70.2	121.4	137.6	71.2		**85.9**		**92.0**		**160.5**	149.5	136.8		**89.5**	201.0
72	72.9	125.7	142.2	74.2		**89.1**		**95.4**		**165.7**	154.5	141.7		**92.9**	207.4
74	75.6	130.0	146.8	77.2		**92.4**		**98.9**		**171.1**	159.6	146.6		**96.3**	213.8
76	78.4	134.5	151.5	80.3		**95.8**		**102.4**		**176.6**	164.8	151.4		**99.6**	220.6
78	81.3	139.0	156.3	83.5		**99.2**		**106.0**		**182.2**	170.1	156.3		**103.0**	227.8
80	84.2	143.6	161.2	86.8		**102.7**		**109.7**		**187.9**	175.6	161.2		**106.4**	235.0
82	87.2	148.4	166.2	90.2		**106.3**		**113.5**		**193.7**	181.2	166.6		**110.2**	242.6
84	90.2	153.2	171.4	93.6		**110.0**		**117.4**		**199.7**	186.8	172.1		**114.0**	250.2
86	93.3	158.2	176.6	97.1		**113.8**		**121.4**		**205.8**	192.7	177.5		**117.8**	258.0
88	96.5	163.2	181.9	100.7		**117.7**		**125.4**		**212.0**	198.6	183.0		**121.6**	266.0
90	99.8	168.4	187.4	104.4		**121.6**		**129.6**		**218.3**	204.6	188.4		**125.2**	274.0
92	103.1	173.7	192.9	108.2		**125.6**		**133.8**		**224.8**	210.8	194.5		**129.4**	282.4
94	106.5	179.1	198.6	112.1		**129.7**		**138.2**		**231.4**	217.2	200.5		**133.5**	290.8
96	110.0	184.6	204.3	116.1		**133.9**		**142.6**		**238.2**	223.6	206.6		**137.7**	299.4
98	113.5	190.2	210.2	120.1		**138.2**		**147.1**		**245.1**	230.2	212.6		**141.8**	308.2
100	117.2	195.9	216.2	124.3		**142.6**		**151.7**		**252.1**	236.9	218.7		**146.0**	317.0
102	120.9	201.8	222.3	128.5		**147.1**		**156.4**		**259.3**	243.8	225.4		**150.6**	326.2
104	124.7	207.7	228.5	132.9		**151.7**		**161.2**		**266.6**	250.8	232.1		**155.2**	335.4
106	128.5	213.8	234.9	137.3		**156.4**		**166.1**		**274.0**	257.9	238.7		**159.8**	345.0
108	132.4	220.0	241.3	142.8		**161.1**		**171.1**		**281.6**	265.2	245.4		**164.4**	355.0
110	136.4	226.4	247.9	146.5		**166.0**		**176.3**		**289.4**	272.6	252.1		**169.0**	365.0
112	140.5	232.8	254.6	151.3		**171.0**		**181.5**		**297.3**	280.2	259.5		**174.1**	375.4
114	144.7	239.4	261.5	156.1		**176.0**		**186.8**		**305.3**	287.9	266.9		**179.2**	385.8
116	148.9	246.1	268.4	161.1		**181.2**		**192.2**		**313.6**	295.7	274.3		**184.2**	396.4
118	153.2	252.9	275.5	166.1		**186.5**		**197.7**		**321.9**	303.8	281.7		**189.3**	407.2
120	157.7	259.9	282.7	171.3		**191.8**		**203.1**		**330.4**	311.9	289.1		**194.4**	418.0
122	162.2	267.0	290.1	176.6		**197.3**		**209.1**		**339.1**	320.3	297.2		**200.0**	429.2
124	166.7	274.3	297.6	182.0		**202.9**		**215.0**		**348.0**	328.8	305.3		**205.6**	440.4
126	171.4	281.6	305.2	187.5		**208.6**		**221.0**		**357.0**	337.4	313.5		**211.1**	452.0
128	176.2	289.1	312.9	193.1		**214.4**		**227.1**		**366.2**	346.2	321.6		**216.7**	464.0
130	181.0	296.8	320.8	198.9		**220.3**		**233.3**		**375.5**	355.2	329.7		**222.3**	476.0
132	185.9	304.6	328.9	204.7		**226.3**		**239.6**		**385.0**	364.3	338.6		**228.4**	488.4
134	191.0	312.5	337.1	210.7		**232.5**		**246.0**		**394.7**	373.6	347.5		**234.5**	500.8
136	196.1	320.6	345.4	216.8		**238.7**		**252.6**		**404.5**	383.1	356.5		**240.7**	513.4
138	201.3	328.9	353.9	223.0		**245.1**		**259.3**		**414.6**	392.8	365.4		**246.8**	526.2
140	206.6	337.3	362.6	229.4		**251.6**		**266.1**		**424.8**	402.6	374.3		**252.9**	539.0

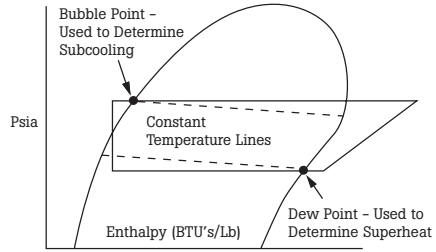
For additional information visit
www.fluke.com/hvac

12/2001 1265816 D-ENG-N Rev B

Refrigeration Cycle



Pressure–Enthalpy (PH) Diagram for Refrigerant Blends



Measuring superheat and subcooling using Fluke meters:

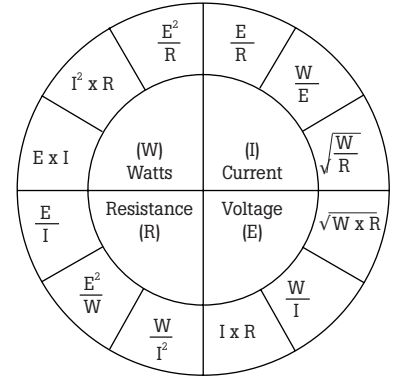
To measure superheat:

1) Measure suction pressure with the Fluke PV350 Pressure Module and your digital multimeter (DMM). Convert pressure to temperature using your PT chart.
2) Measure the pipe temperature at the outlet of the evaporator with the Fluke 80PK-8 Pipe Clamp and your temperature meter.
3) Subtract the difference in temperatures to obtain superheat.

To measure subcooling:

1) Measure liquid line pressure (or discharge pressure if there is no liquid line access valve) with the Fluke PV350 Pressure Module and your DMM. Convert the pressure to temperature using your PT chart.
2) Measure the pipe temperature at the outlet of the condenser with the Fluke 80PK-8 Pipe Clamp and your temperature meter.
3) Subtract the difference in temperatures to obtain subcooling.

Ohms Law Wheel



Handy electrical formulas

Single Phase (1Ø) Power

$$KW = \frac{I \times E \times PF}{1000} \qquad I = \frac{Hp \times 746}{\{E \times (\%\ effic.) \times PF\}}$$

Three Phase (3Ø) Power

$$Watts = E \times I \times \sqrt{3} \times Power\ Factor\ (PF)$$

$$I = \frac{Watts}{E \times \sqrt{3} \times PF} \qquad E = \frac{Watts}{I \times \sqrt{3} \times PF}$$

Handy HVAC Formulas

BTUH (sensible heat) = CFM x 1.08 x ΔT

BTUH (latent heat) = CFM x 4750 x (Humidity Ratio Diff.)

BTUH (total heat) = CFM x 4.5 x (Enthalpy Difference)

BTUH (hydronic) = 500 x GPM x ΔT

CFM = FPM x (Duct Area in square feet)

FPM = 4005 x ($\sqrt{VP}$) VP = TP – SP

$$\text{Motor Sheave Pitch} = \frac{\text{Required Fan RPM x Fan Sheave Pitch}}{\text{Motor RPM}}$$

$$CFM2 = CFM1 \times \frac{RPM2}{RPM1} \qquad RPM2 = RPM1 \times \frac{CFM2}{CFM1}$$

$$RPM2 = RPM1 \times \sqrt[3]{\frac{BHP2}{BHP1}} \qquad BHP2 = BHP1 \times \left(\frac{RPM2}{RPM1}\right)^3$$

$$RPM2 = RPM1 \times \sqrt{\frac{SP2}{SP1}} \qquad SP2 = SP1 \times \left(\frac{RPM2}{RPM1}\right)^2$$

BTUH =	British Thermal Units per Hour	CFM =	Cubic Feet Per Minute
FPM =	Feet Per Minute	RPM =	Revolutions Per Minute
VP =	Velocity Pressure	SP =	Static Pressure
TP =	Total Pressure	BHP =	Brake Horsepower
ΔT =	Temperature Difference ($T_1 - T_2$)		