

This presentation used CASE* studies from the following



*CASE – Copy And Steal Everything

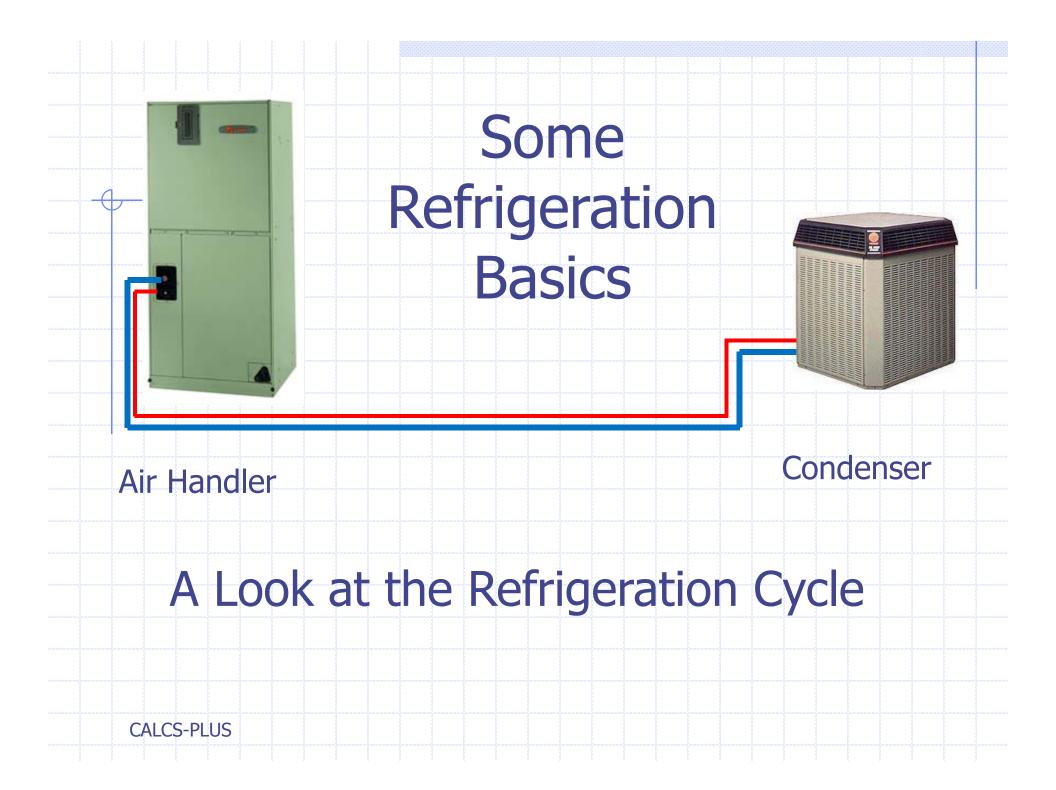
HVAC Systems - What the Rater Needs to Know in the Field

This session provides lessons learned from field inspections of HVAC systems that will help the rater better understand what to look for in assessing buildings. A checklist of items to look for related to the design and installation of systems will be provided so the rater can provide homeowners with an independent assessment of the HVAC system and guidance for improvement.

When a Heat Pump or Air Conditioning system is used in a Rating the HERS Index makes an assumption that the system is working to Manufacturer's specifications and therefore the intended energy benefits will be realized.

As the Rater Certifying the home, how can we be sure the system has been properly commissioned?

What does it take to commission a Heat Pump or Air Conditioner anyway?



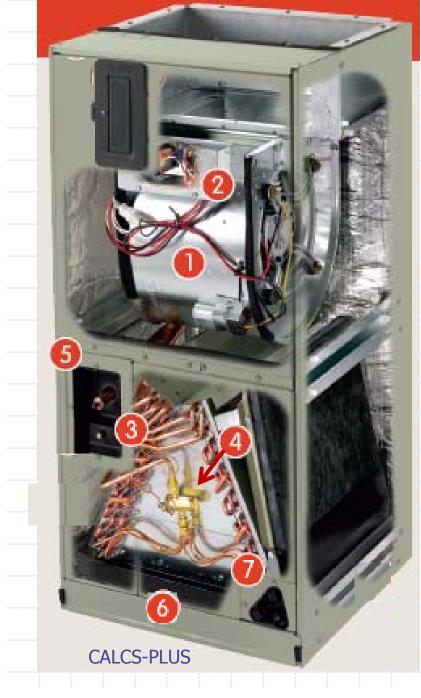


CALCS-PLUS

Inside the Condenser

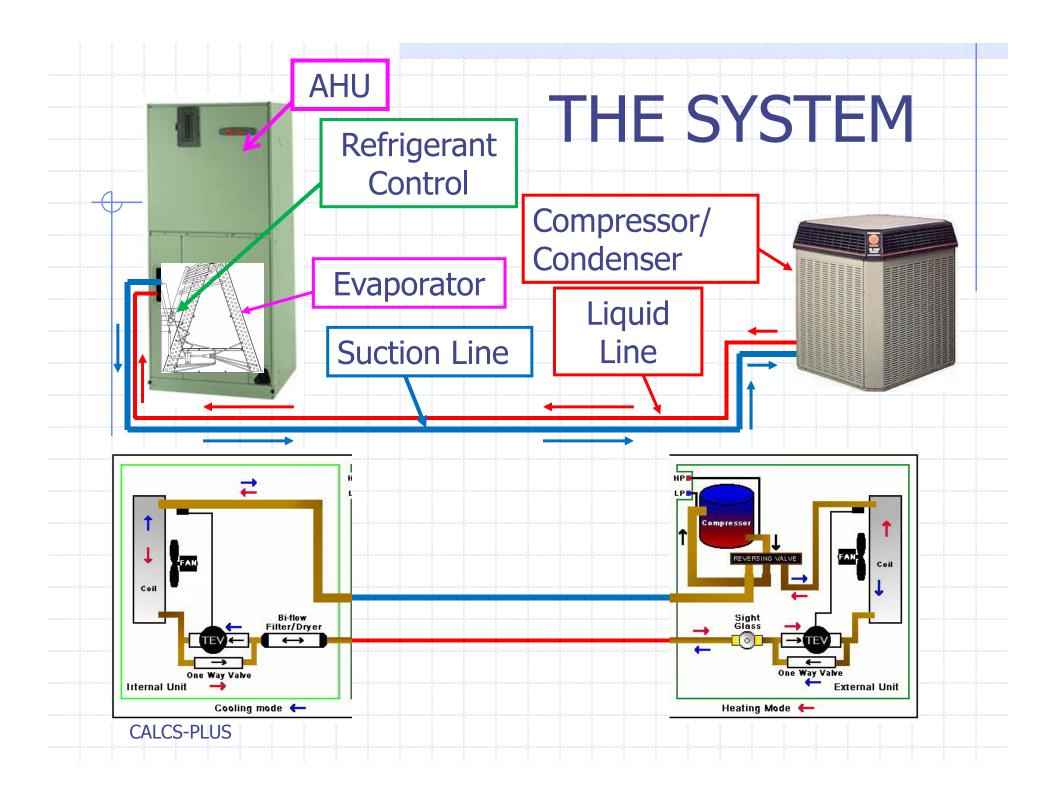
- 1. Compressor (vapor pump)
- 2. Coil Guard
- 3. Control Panel
- 4. Condenser Coil
- 5. Refrigerant Connections
- 6. Reversing Valve

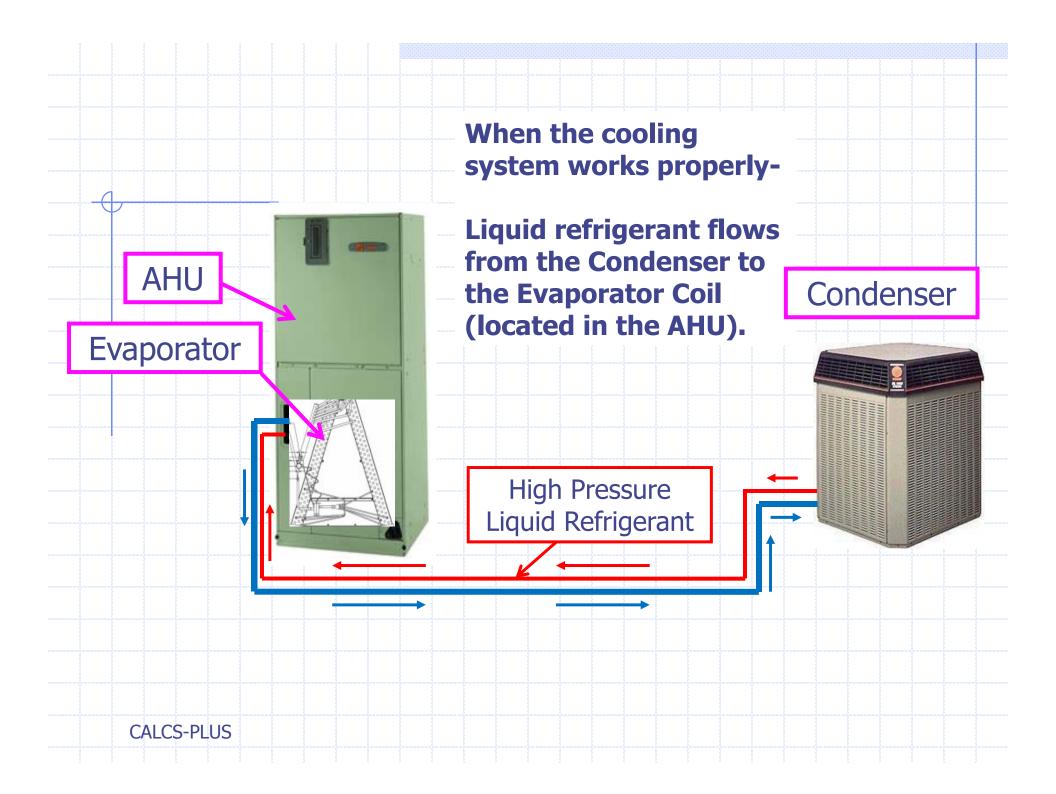


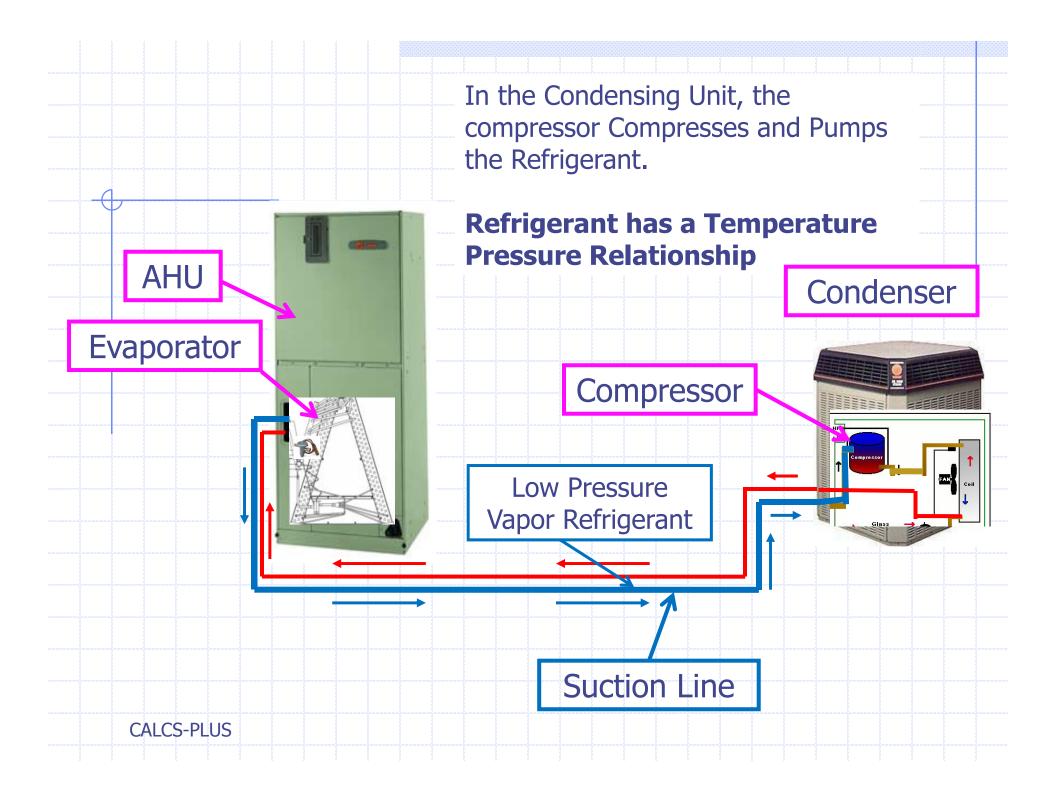


Inside the Air Handler

- 1. Blower & Motor
- 2. Control Panel
- 3. Evaporator Coil
- 4. Metering Device
- 5. Refrigerant Connections
- 6. Filter Access
- 7. Drain Connection







Refrigerant Temperature Pressure Chart

36 10 33.4 62.8 19.4 10.9 31.3 35.5 85 76.4 78.5 56.2 71.2 30.9 109 74.3 62.9 414 31.5 52.9 38 10 35.2 65.6 18.8 12 33.2 37.5 88.5 79.7 81.8 53.9 74.2 32.7 114 77.4 86.3 426 33.4 55.7 40 11.1 36.9 68.5 18.3 13.1 35 39.5 92.1 83.8 85.1 61.7 77.4 34.5 118 80.5 69.6 438 35.3 58.6 42 12.2 38.8 71.5 17.7 14.3 37 41.6 95.7 36.4 88.5 64.6 80.6 36.3 123 83.8 93.4 451 37.3 61.6 44 12.8 40.7 74.5 17.1 15.4 39 43.7 99.5 89.8 91.9 67.6 83.9 38.2 127 87 97 464 39.3 <	F	С	R-12	R-22	R-123	R-124	R-401 A	R-401 B	R-402 A	R-402 B	R-404 A	R-407 C	R-408 A	R-409 A	R-410 A	R-502	R-507	R-508 B	R-134 A	R-717
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86 36.7 93.3 158.2 50 113 208 191 177 117.4 176.6 197.8 97.4 154.5 88 37.8 96.5 163.2 52.1 117 214 197 182 121.2 181.9 203.9 100.7 160.1 90 38.9 99.8 168.4 2.4 54.3 121 130 220 204 203 191 186.4 125.1 274 187.4 210.2 104.5 165.9 92 40 103.1 173.7 56.6 125 227 209.9 194.2 129.1 192.9 216.6 108.2 171.9 94 40.6 106.5 179.1 59 129 234 215 200.1 133.2 198.6 223.1 112.1 178 95 41.1 182 4.2 132 140 235 220 218 206 203 137 295 114 142.1 96 42.2 110 184.6 61.3 133			90.Z	153.Z	0.0	41.0		440		400		477			054	171.4	191.9			149
88 37.8 96.5 163.2 52.1 117 214 197 182 121.2 181.9 203.9 100.7 160.1 90 38.9 99.8 168.4 2.4 54.3 121 130 220 204 203 191 186.4 125.1 274 187.4 210.2 104.5 165.9 92 40 103.1 173.7 56.6 125 227 209.9 194.2 129.1 192.9 216.0 108.2 171.9 94 40.6 106.5 179.1 59 129 234 215 200.1 133.2 198.6 223.1 112.1 178 95 41.1 182 4.2 132 140 235 220 218 206 203 137 295 114 144 <t< td=""><td></td><td></td><td>02.2</td><td>450.0</td><td>U.ŏ</td><td>50</td><td></td><td>119</td><td></td><td>189</td><td></td><td>111</td><td></td><td></td><td>254</td><td>470.0</td><td>407.0</td><td></td><td></td><td>454.5</td></t<>			02.2	450.0	U.ŏ	50		119		189		111			254	470.0	407.0			454.5
90 38.9 99.8 168.4 2.4 54.3 121 130 220 204 203 191 186.4 125.1 274 187.4 210.2 104.5 165.9 92 40 103.1 173.7 56.6 125 227 209.9 194.2 129.1 192.9 216.0 108.2 171.9 94 40.6 106.5 179.1 59 129 234 215 200.1 133.2 198.6 223.1 112.1 178 95 41.1 182 4.2 132 140 235 220 218 206 203 137 295 114 144 96 42.2 110 184.6 61.3 133 240 222 206.2 137.4 204.3 229.8 116.1 184.2 98 43.3 113.5 190.2 63.8 138 247 229 212.3 141.6 210.2 236.6 120.1 190.6 100 44.4 117.2 195.9 6.1 66.3				156.2													197.0			
92 40 103.1 173.7 56.6 125 227 209.9 194.2 129.1 192.9 216.6 106.2 171.9 94 40.6 106.5 179.1 59 129 234 215 200.1 133.2 198.6 223.1 112.1 178 95 41.1 182 4.2 132 140 235 220 218 206 203 137 295 114 144 96 42.2 110 184.6 61.3 133 240 222 206.2 137.4 204.3 229.0 116.1 184.2 98 43.3 113.5 190.2 63.8 138 247 229 212.3 141.6 210.2 236.6 120.1 190.6 100 44.4 117.2 195.9 6.1 66.3 142 152 254 236 235 222 216.6 146 317 216.2 243.5 124.3 197.2 100 44.4 117.2 195.9 6.1 66.3				163.2	0.4			420		204		404			074		203.9			
94 40.6 106.5 179.1 59 129 234 215 200.1 133.2 198.6 223.1 112.1 178 95 41.1 182 4.2 132 140 235 220 218 206 203 137 295 114 114 96 42.2 110 184.6 61.3 133 240 222 206.2 137.4 204.3 229.8 116.1 184.2 98 43.3 113.5 190.2 63.8 138 247 229 212.3 141.6 210.2 236.6 120.1 190.6 100 44.4 117.2 195.9 6.1 66.3 142 152 254 236 235 222 216.6 146 317 216.2 243.5 124.3 197.2 100 44.4 117.2 195.9 6.1 66.3 142 152 254 236 235 222 216.6 146 317 216.2 243.5 124.3 197.2 100					Z.4			130		204		191		123.1	214		210.2			
95 41.1 182 4.2 132 140 235 220 218 206 203 137 295 114 96 42.2 110 184.6 61.3 133 240 222 206.2 137.4 204.3 229.6 116.1 184.2 98 43.3 113.5 190.2 63.8 138 247 229 212.3 141.6 210.2 236.6 120.1 190.6 100 44.4 117.2 195.9 6.1 66.3 142 152 254 236 235 222 216.6 146 317 216.2 243.5 124.3 197.2 Image: the constraint of the														129.1			216.6			
96 42.2 110 184.6 61.3 133 240 222 206.2 137.4 204.3 229.8 116.1 184.2 98 43.3 113.5 190.2 63.8 138 247 229 212.3 141.6 210.2 236.6 120.1 190.6 100 44.4 117.2 195.9 6.1 66.3 142 152 254 236 235 222 216.6 146 317 216.2 243.5 124.3 197.2 • N Check List / Refrigeration SYS / Room CFM / Room Loads / Basics _ PT Chart / 14 </td <td></td> <td></td> <td>106.5</td> <td></td> <td>10</td> <td>59</td> <td></td> <td>4.40</td> <td></td> <td>220</td> <td></td> <td>200</td> <td></td> <td>133.2</td> <td>005</td> <td>198.6</td> <td>223.1</td> <td></td> <td></td> <td>1/8</td>			106.5		10	59		4.40		220		200		133.2	005	198.6	223.1			1/8
98 43.3 113.5 190.2 63.8 138 247 229 212.3 141.6 210.2 236.6 120.1 190.6 100 44.4 117.2 195.9 6.1 66.3 142 152 254 236 235 222 216.6 146 317 216.2 243.5 124.3 197.2 Image: https://www.com/com/com/com/com/com/com/com/com/com/			440	182	4.2	64.2		140		220		206			295	004.0	000.0			404.0
100 44.4 117.2 195.9 6.1 66.3 142 152 254 236 235 222 216.6 146 317 216.2 243.5 124.3 197.2 ▶ ▶ Check List / Refrigeration SYS / Room CFM / Room Loads / Basics _ PT Chart / 20 ●				184.6													229.8			
Check List / Refrigeration SYS / Room CFM / Room Loads / Basics PT Chart / 💭				190.2				450									235.5			
	100	44.4	117.2	195.9	6.1	66.3	142			236		222	216.6	146	317	216.2	243.5		124.3	197.2
	Ch €	eck List 📈	Refrigeration	n SYS 📈 F	Room CFM 🗼	Room Lo	ads 🖌 Basic	s 🔪 PT Cha	rt 🖉											
	idv .																	100%		
		CALC																		
		CALC.	S-PLU	15																
CALCS-PLUS																				

			The second se			
	F	С	R-12	R-22	R-410 A	
	74	29.4	75.6	130		
	75	30			217	
	76	31.1	78.4	134.5	23	
	78	32.2	81.3	139		
	80	33.3	84.2	143.6	235	
K Se Se Se R R R R R	82	34.4	87.2	148.4		
	84	35	90.2	153.2		
	85	35.6			254	
манныныныны	86	36.7	93.3	158.2		
	88	37.8	96.5	163.2		
	90	38.9	99.8	168.4	274	
	92	40	103.1	173.7		
~~~~~	94	40.6	106.5	179.1		
	95	41.1		182	295	
****						

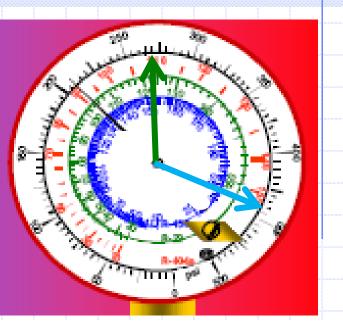
When refrigerant is in it's vapor state there will be a direct pressure temperature relationship. Pressure is measured using a set of Gauges.

Compound Gauge: A gauge that reads pressures above atmospheric pressure in PSIG, and below atmospheric pressure in inches of Mercury column ("Hg) **(Usually Blue)** 

Pressure Gauge: A gauge that reads pressures only above atmospheric pressure in PSIG. (Usually Red)

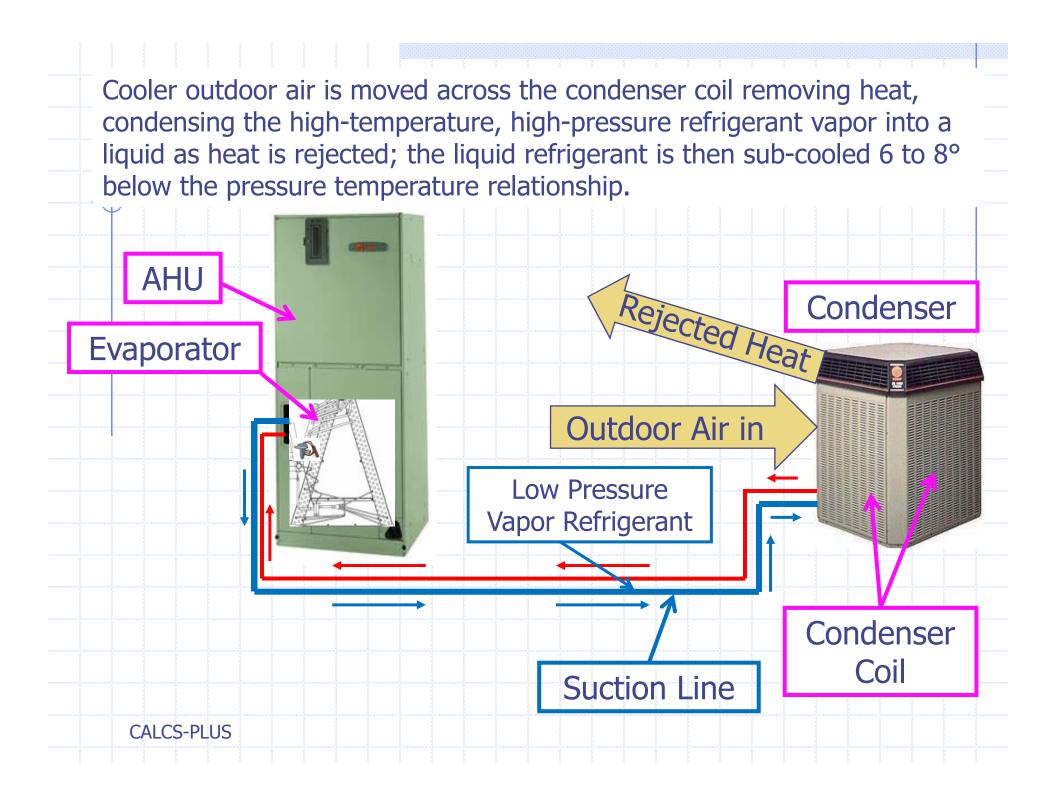
In the compressor, the refrigerant temperature and pressure increase as the vapor is compressed. The hot vapor exits the compressor enters the nearby condenser coil. AHU Condenser **Evaporator** Compressor Low Pressure Vapor Refrigerant Condenser Suction Line Coil CALCS-PLUS

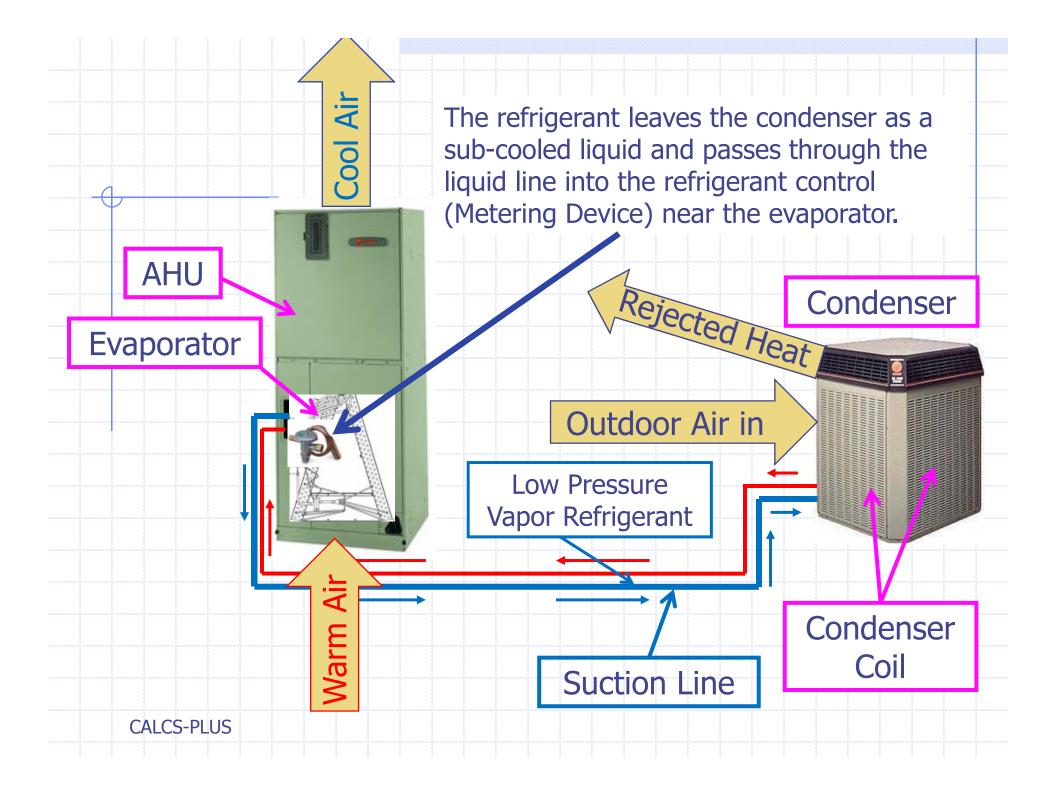
	1 ² 2 5					
	R-410 A	R-22	R-12	С	F	
		232.8	140.5	51.1	112	~~~~~
13		239.4	144.7	51.7	114	
1 🕺	390			52.2	115	
8-1-		246.1	148.8	53.3	116	
		252.9	153.2	54.4	118	
1.3	417	259.9	157.7	55.6	120	*****
		267	162.2	56.7	122	
		274.3	166.7	57.2	124	
	445			57.8	125	
mnerat	The ter	281.6	171.4	58.9	126	
	leaving	289.1	176.2	60	128	
	betwee	296.8	181	61.1	130	
		304.6	185.9	62.2	132	
	the out	312.5	191	62.8	134	

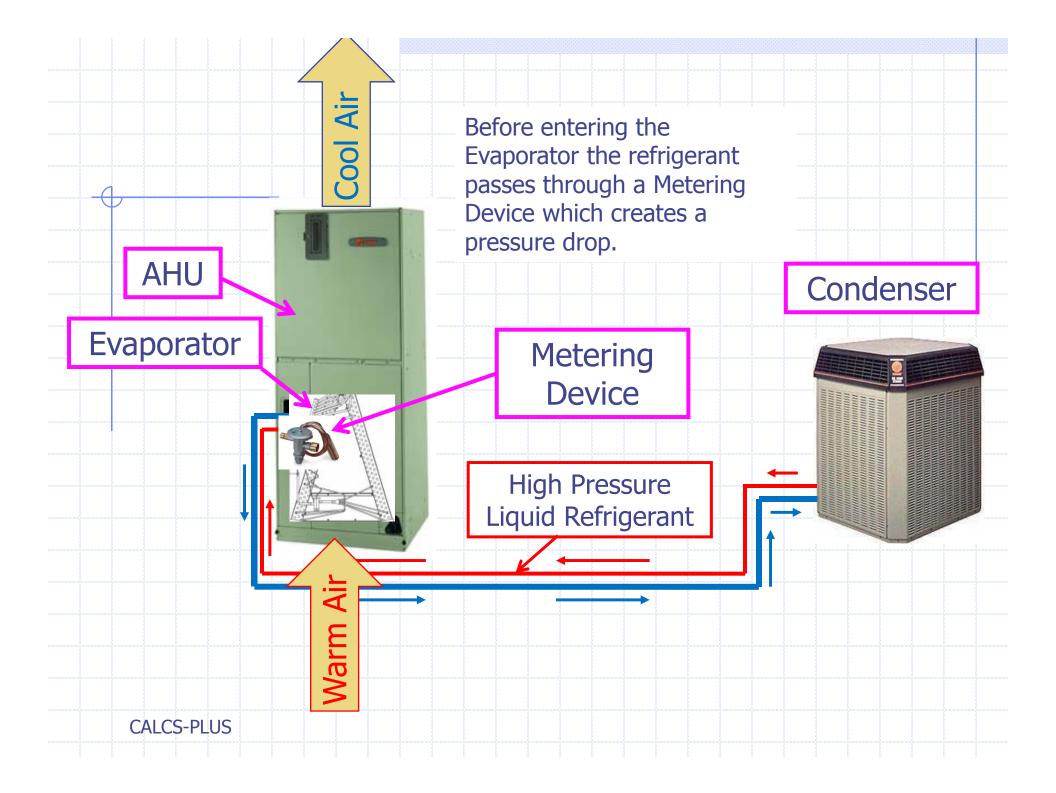


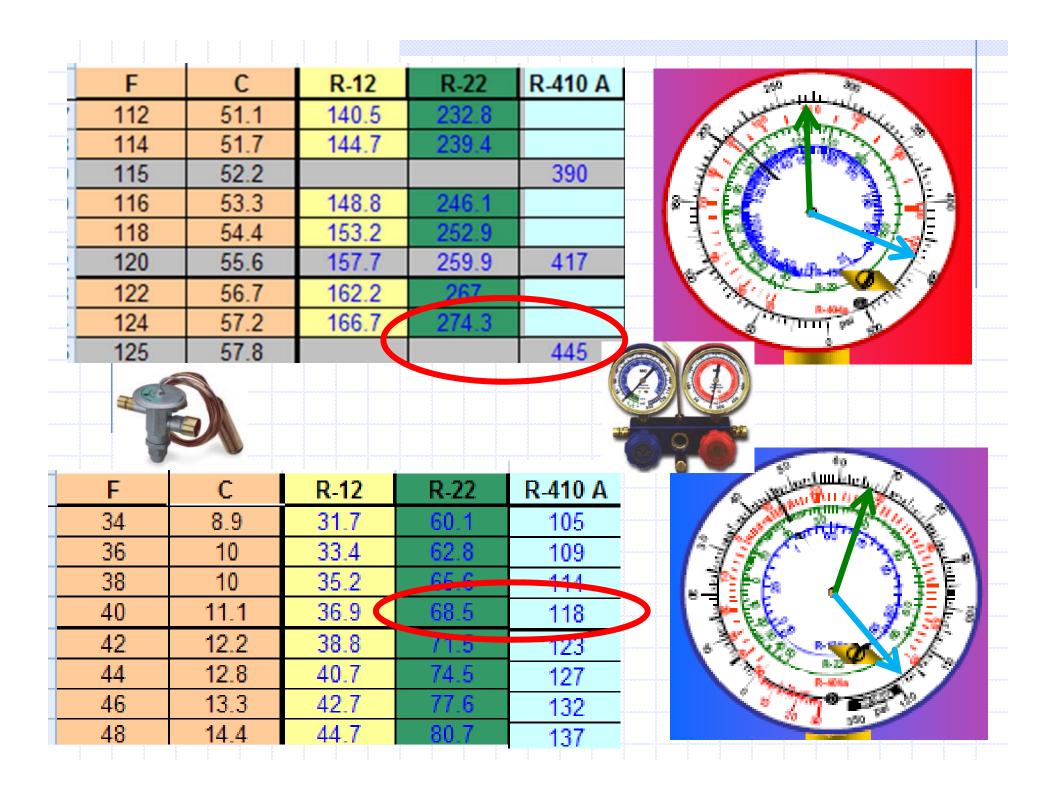
30° warmer for standard efficiency units and as low as 20° for ultra high efficiency equipment.

If the outdoor temperature was 94° the vapor pressure would be (94 + 30= 124°) 274.3 PSIG for R-22 and 443 PSIG for R-410-A

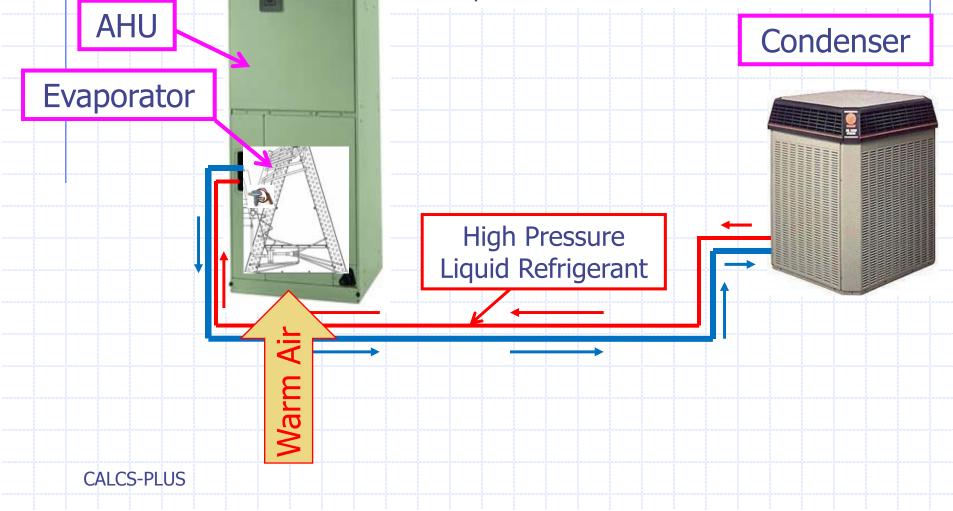




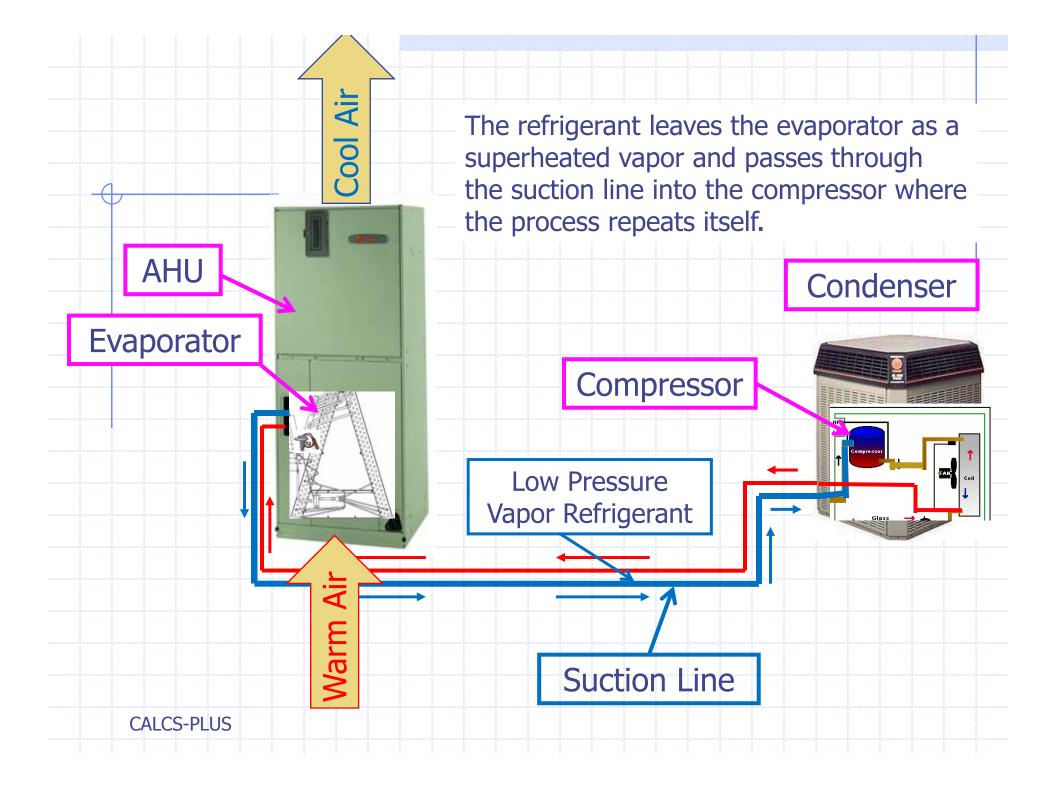




Consequently the drop in pressure has a corresponding drop in temperature. The low pressure liquid refrigerant changes state (liquid to vapor) as it moves through the evaporator coil as it absorbs heat from the air passing over the Evaporator Coil.



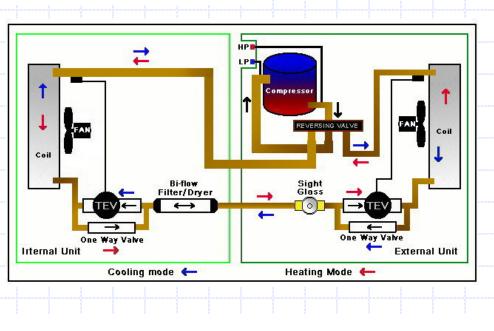
**Cool** Air

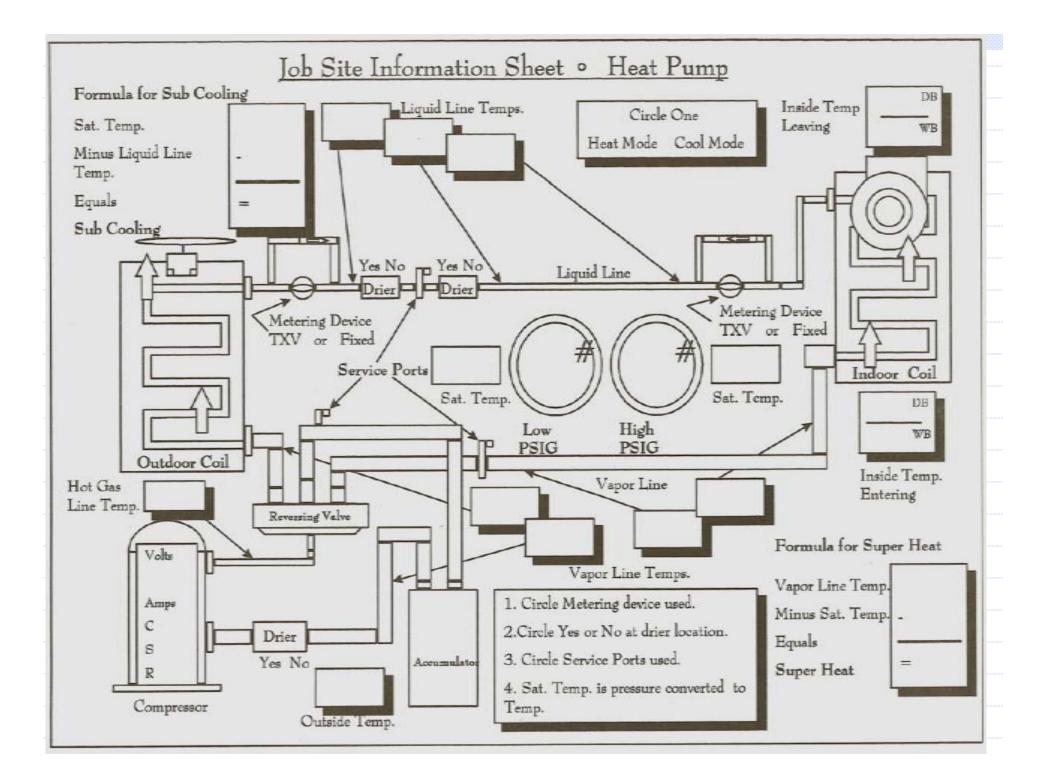


#### For System Commissioning the Measurements that + should be Taken Are:

Suction pressure
Discharge pressure
Saturation temperature
Condensing temperature
Superheat
Sub cooling

- •Compressor Running Load Amps
- Airflow in CFM at Evaporator
  Outdoor dry bulb
  Return air dry bulb
  Return air wet bulb
  Supply air dry bulb
  Supply air wet bulb





#### Some Important Points

In any Heat Pump or Air Conditioning system there are only two components that can be changed or adjusted to decrease or increase the capacity and — efficiency of the System!

1. Airflow

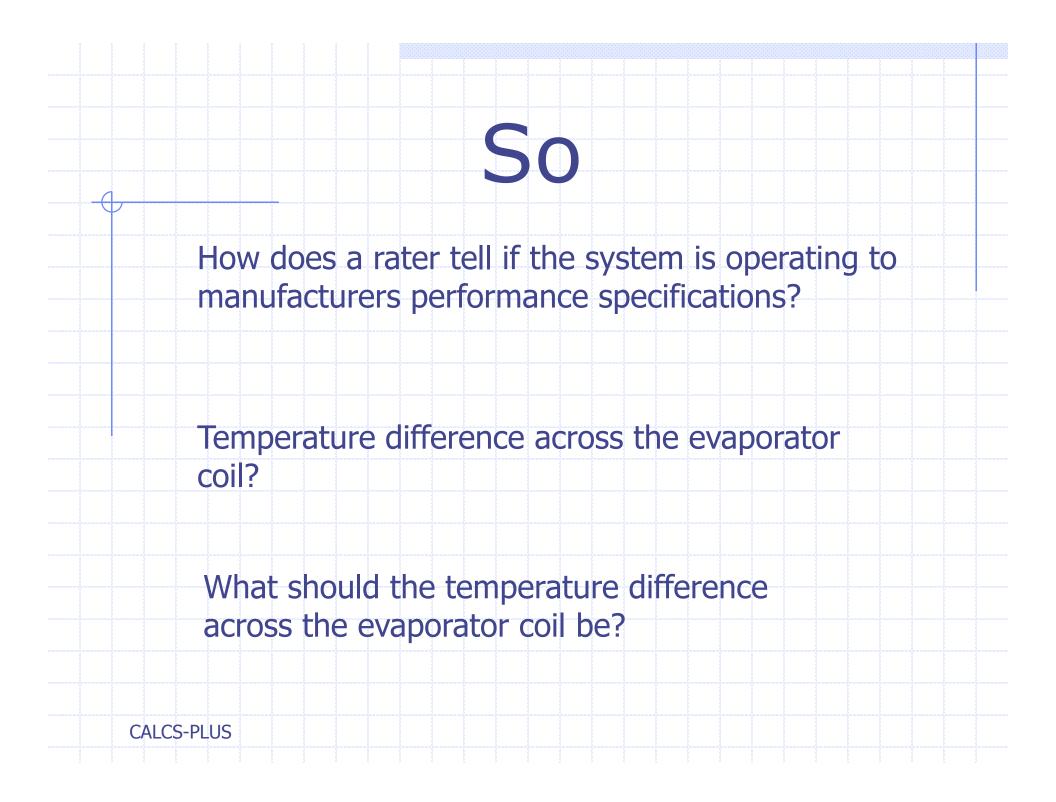
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2. Refrigerant charge

The efficiency of any system can never be higher than manufacturers performance tables; However, the efficiency can be far less!!!!!!

You must have an EPA card to open any refrigeration system. This Includes putting gauges on the system!

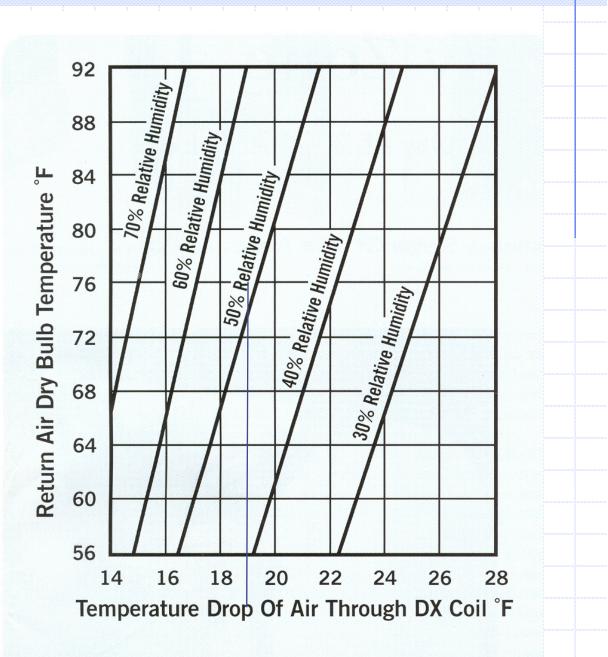




## Temperature Difference Across a DX Coil

The Temperature difference across the evaporator coil is determined by the condition of the entry air.

However, Temperature Difference across the coil doesn't give BTUH output.



**Figure 1.** The temperature difference or drop across A/C coils as a function of return air dry-bulb temperature and relative humidity.

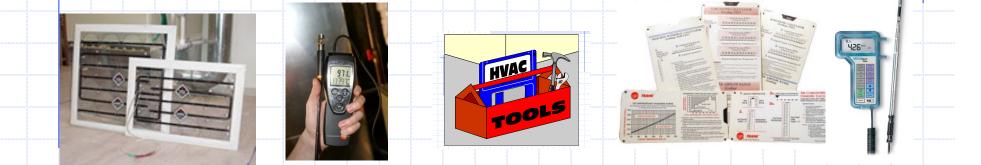
## Gauges are Not Needed to Check System Performance



There is no reason to put gauges on a sealed system after the initial installation and commissioning unless a problem with the mechanical refrigeration circuit is suspected.

If you do not know how the system was designed to operate, there is no need to hook up gauges. The information that you will get will have no more value than the line temperature alone.

The refrigerant charge can be checked very accurately without gauges using equipment we already have in our toolbox and with manufacturers performance data and charging charts.



The capacity in BTUH can be calculated determining if the unit is working at or near capacity with a Psychrometric chart, a digital thermometer, a digital humidity stick, and an airflow measuring devise that will accurately measure airflow across the coil.

At design conditions almost all <u>standard</u> efficiency air conditioners operate with a 40° F evaporator coil temperature and at 125° F condensing coil temperature.

High efficiency and ultra high efficiency air conditioners operate with a 45° F evaporator coil temperature and at ?° F condensing coil temperature.

Temperature drop across a coil will vary with the latent load (humidity). The higher the humidity, the more cooling energy goes to converting water vapor (humidity) to water. The drop can fall within a range of 16° to 24° degrees with ease. To further understand checking the charge without gauges let's work from design conditions. If indoor design conditions are 75°F the coil temperature should be 40°F. The design temperature difference is 35° F (75 – 40 = 35).

For standard efficiency systems this <u>temperature</u> <u>difference</u> will stay the same under all load conditions at the rated CFM. High efficiency equipment will be 30° difference.

	Collect the Do the N Compare the	1ath	
Return DB Return WI Supply DB Supply WI	B or RH DBs	<u>Data</u>	
Grains/Lb CFM x 1.1 CFM x .68 Evaporato Super Hea	Do the Ma s the Evaporator Coil Difference ΔGR x ΔDB = BTU/H Sensible x ΔGR = BTU/H Latent r Coil Temp ECT=(DBr – 3! t = SLT-ECT ir WB Temperature		

**Measured Air Handler CFM** 

Prior to testing any system, make sure the filters, condenser coil, evaporator coil, and blower are clean.

Verify the system airflow is within the desired range required by the manufacture.

If the airflow is not set correctly, the system cannot operate as designed!

Airflow Measurement Methods

Pressure drop across the dry evaporator coil method Total external static pressure method The temperature rise method (Sensible heat formula) Consult Manufacturer's Airflow Performance Chart

### Manufacturer's Airflow Performance Chart

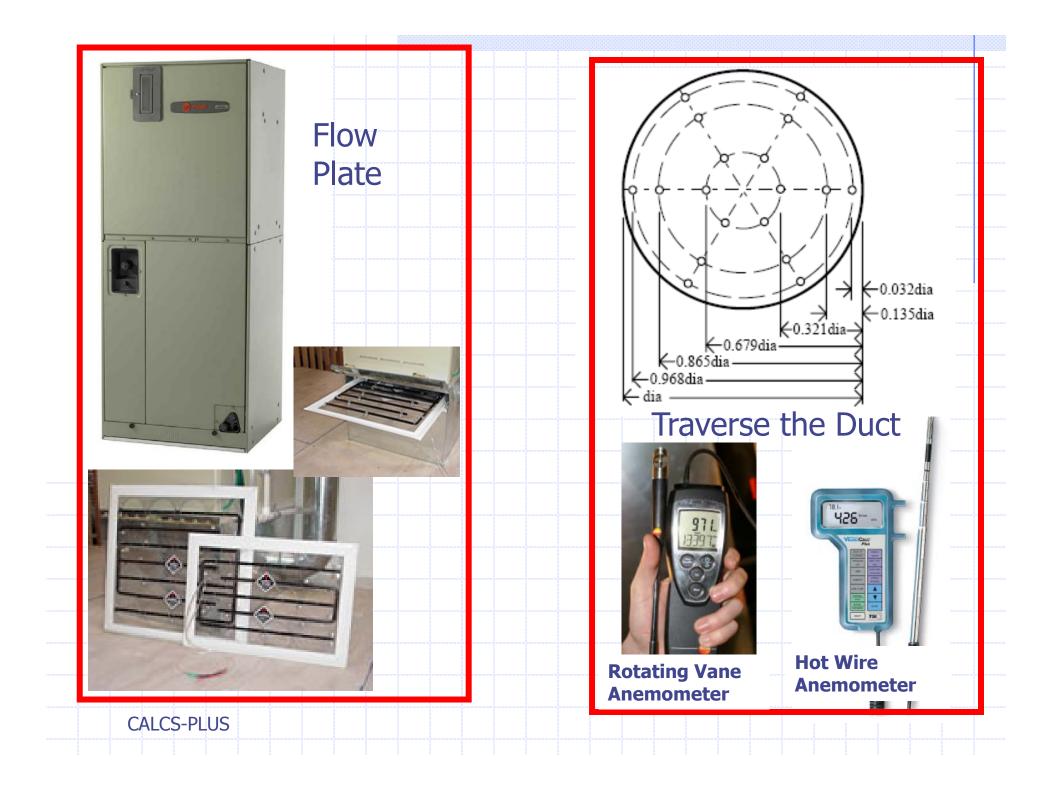
D

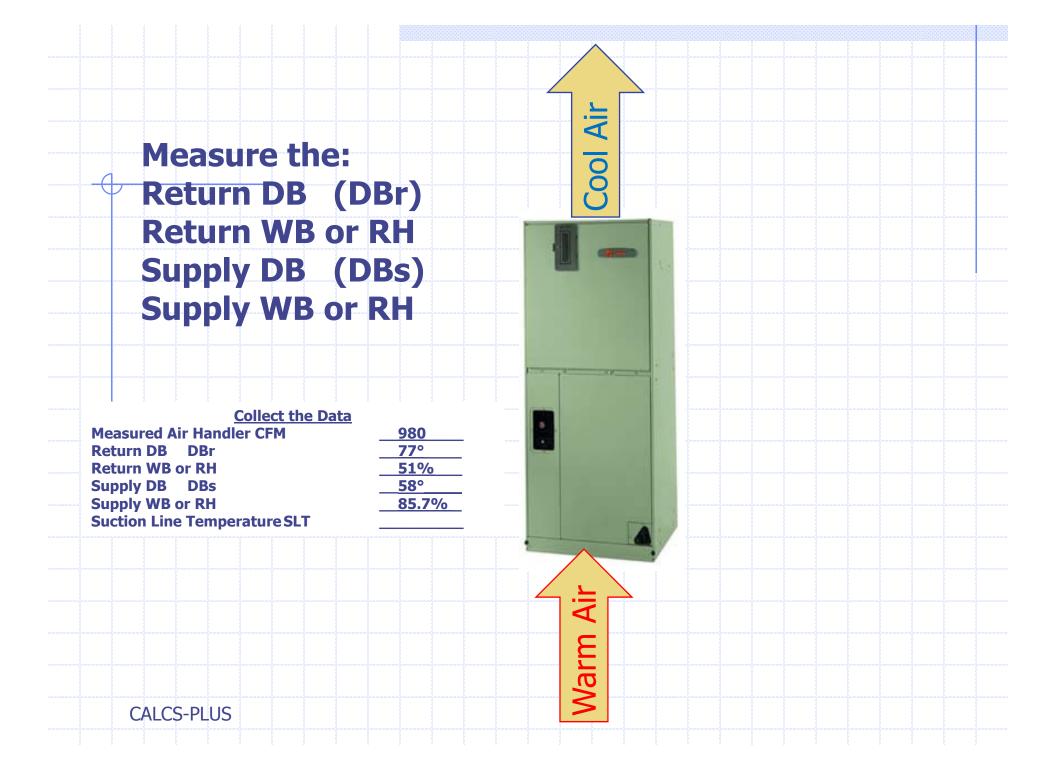
OUTDOOR	Speed	0	DIP SWITCH SETTING					EXTERNA	L STATIC P	RESSURE		
(TONS)	Settings	SETTING	SW 1	SW 2	SW 3	SW 4	Power	0.1	0.3	0.5	0.7	0.9
	Low	350 CFM/ton	ON	ON	OFF	ON	CFM Watts	700 90	700 115	700 155	700 190	660 220
2	Normal	400 CFM/ton	ON	ON	OFF	OFF	CFM Watts	800 110	800 140	800 180	770 230	750 260
	High	450 CFM/ton	ON	ON	ON	OFF	CFM Watts	900 130	900 165	900 220	900 265	900 310
	Low	350 CFM/ton	OFF	ON	OFF	ON	CFM Watts	880 130	880 165	880 215	880 265	880 305
2.5	Normal	400 CFM/ton	OFF	ON	OFF	OFF	CFM Watts	1000 165	1000 215	1000 270	1000 315	880 325
	High	450 CFM/ton	OFF	ON	ON	OFF	CFM Watts	1125 225	1125 285	1125 330	1 100 380	900 340
	Low	350 CFM/ton	ON	OFF	OFF	ON	CFM Watts	1040 170	1040 230	1040 280	1040 330	1000 325
3	Normal	400 CFM/ton	ON	OFF	OFF	OFF	CFM Watts	1160 240	1160 300	1160 350	1 100 385	870 335
	High	450 CFM/ton	ON	OFF	ON	OFF	CFM Watts	1300 325	1300 365	1260 425	1 140 410	750 260 900 310 880 305 880 325 900 340 1000 325 870
	Low	350 CFM/ton	OFF	OFF	OFF	ON	CFM Watts	1225 295	1225 330	1200 385	1070 390	
3.5	Normal	400 CFM/ton	OFF	OFF	OFF	OFF	CFM Watts	1350 365	1350 420	1280 455	1 140 415	
	High	450 CFM/ton	OFF	OFF	ON	OFF	CFM Watts	1400 405	1400 475	1300 460	1 150 430	
NOTES: 1. ** Factory 2. At continu		Airflow values are	approxim	ately 50%	of the liste	d values.	5 5	20	5 R	55 V	74 22	\$

	U	oflow & Dowr	(INCHE	STATIC PRES S OF WATER		ille -
	U			H	orizontal: No E	iller
		(See Notes	)		(See Notes)	liter
		220 Volts			220 Volts	
CFM	ні	MED	LO	н	MED	LC
600			0.72			0.7
650			0.62			0.3
700		0.86	0.51		0.84	0.5
750		0.75	0.40		0.72	0.3
800	0.89	0.65	0.29	0.87	0.62	0.2
850	0.81	0.54	0.18	0.79	0.51	0.
900	0.72	0.43	0.06	0.69	0.40	0.0
900 0.72 950 0.63 1000 0.53	0.32	0.00	0.61	0.30		
1000	0.53	0.21		0.51	0.17	
1050	0.42	0.10		0.40	0.02	
1100	0.31	0.00		0.31		
1150	0.20			0.22		
1200	0.08			0.10		
	600 650 700 750 800 850 900 950 1000 1050 1100 1150	600         650         700         750         800       0.89         850       0.81         900       0.72         950       0.63         1000       0.53         1050       0.42         1100       0.31         1150       0.20         1200       0.08	600       0.00         650       0.86         700       0.86         750       0.75         800       0.89       0.65         850       0.81       0.54         900       0.72       0.43         950       0.63       0.32         1000       0.53       0.21         1050       0.42       0.10         1100       0.31       0.00         1150       0.20       1200         NOTES:       NOTES:	600         0.72           650         0.62           700         0.86         0.51           750         0.75         0.40           800         0.89         0.65         0.29           850         0.81         0.54         0.18           900         0.72         0.43         0.06           950         0.63         0.32         0.00           1000         0.53         0.21         100           1100         0.31         0.00         1150         0.20           1200         0.08         1200         0.08         1200	600         0.72           650         0.62           700         0.86         0.51           750         0.75         0.40           800         0.89         0.65         0.29         0.87           850         0.81         0.54         0.18         0.79           900         0.72         0.43         0.06         0.69           950         0.63         0.32         0.00         0.61           1000         0.53         0.21         0.51         0.51           1050         0.42         0.10         0.40         0.40           1100         0.31         0.00         0.31         0.10           NOTES:         NOTES:         0.10         0.10         0.10	600         0.72         0.72           650         0.62         0.62           700         0.86         0.51         0.84           750         0.75         0.40         0.72           800         0.89         0.65         0.29         0.87         0.62           850         0.81         0.54         0.18         0.79         0.51           900         0.72         0.43         0.06         0.69         0.40           950         0.63         0.32         0.00         0.61         0.30           1000         0.53         0.21         0.51         0.17           1050         0.42         0.10         0.40         0.02           1100         0.31         0.00         0.31         0.02           11200         0.08         0.10         0.10         0.10

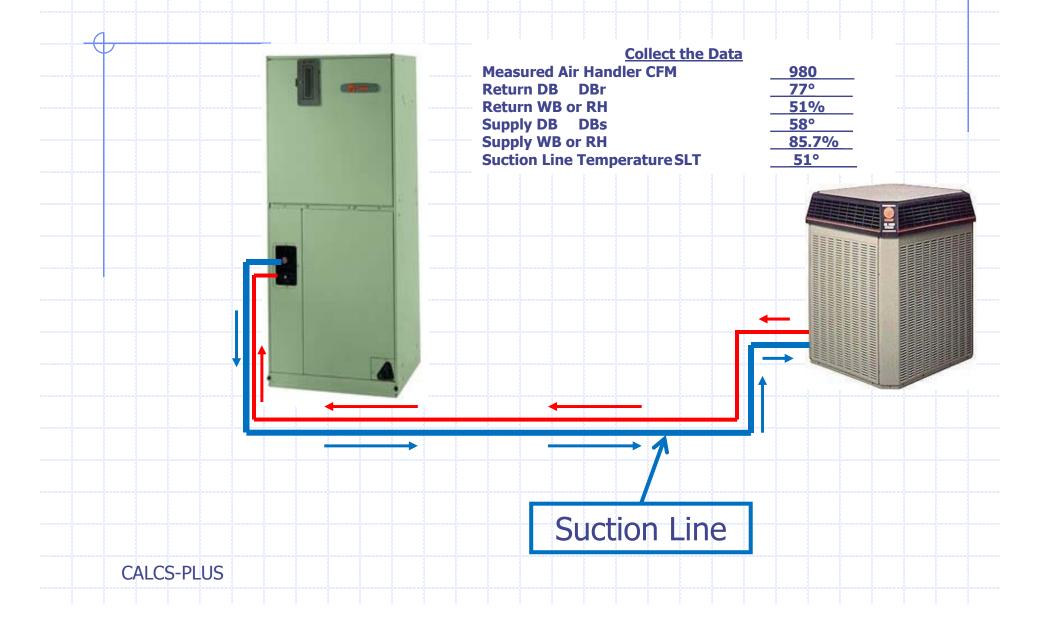
## Airflow The Down and Dirty

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Airflow should be about 400 CFM per ton.
The numbers on the manufacturer's tag (usually) indicates the BTUH
rating and can be converted to CFM.
However nothing replaces Manufacturers Performance Data.
012 (12,000 Btuh) = 400 CFM
018 (18,000 Btuh) = 600 CFM
024 (24,000 Btuh) = 800 CFM
030 (30,000 Btuh) = 1000 CFM
036 (36,000 Btuh) = 1200 CFM
042 (42,000 Btuh) = 1400 CFM
048 (48,000 Btuh) = 1600 CFM
060 (60,000 Btuh) = 2000 CFM ???????
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### **Suction Line Temperature SLT**



### Do the Math

**19°** 

**19°** 

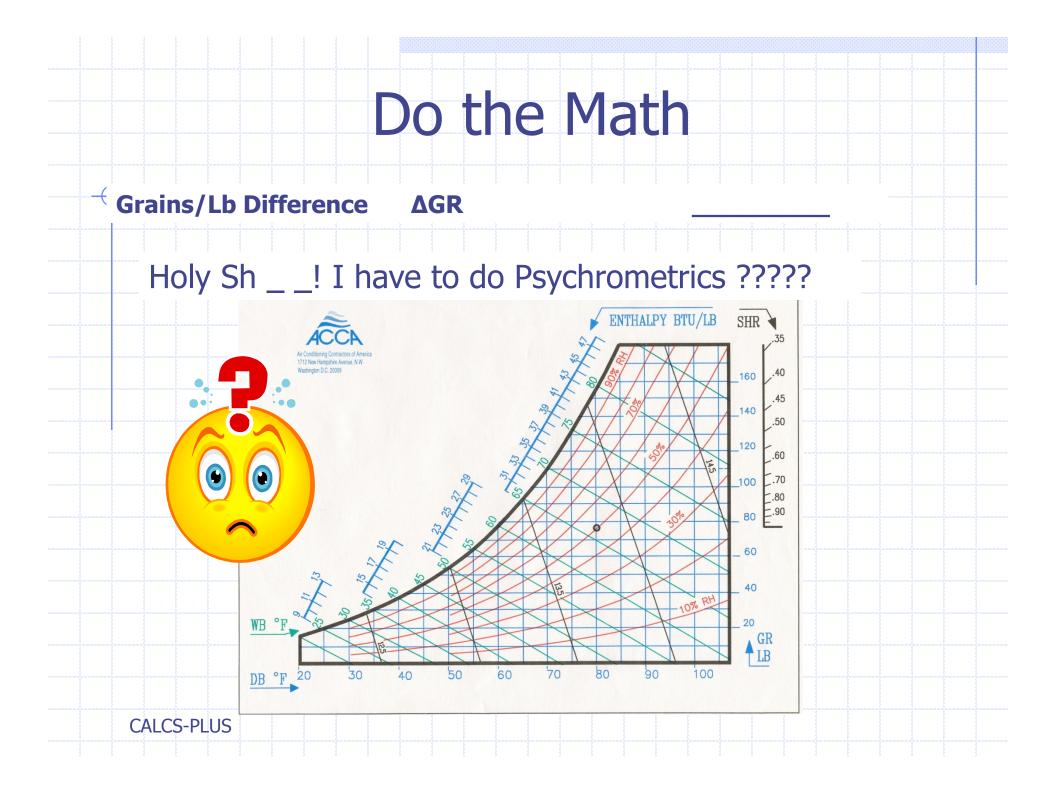
Collect the Data	
Measured Air Handler CFM	980
Return DB DBr	77°
Return WB or RH	51%
Supply DB DBs	<b>58°</b>
Supply WB or RH	85.7%
Suction Line Temperature SLT	<b>51°</b>

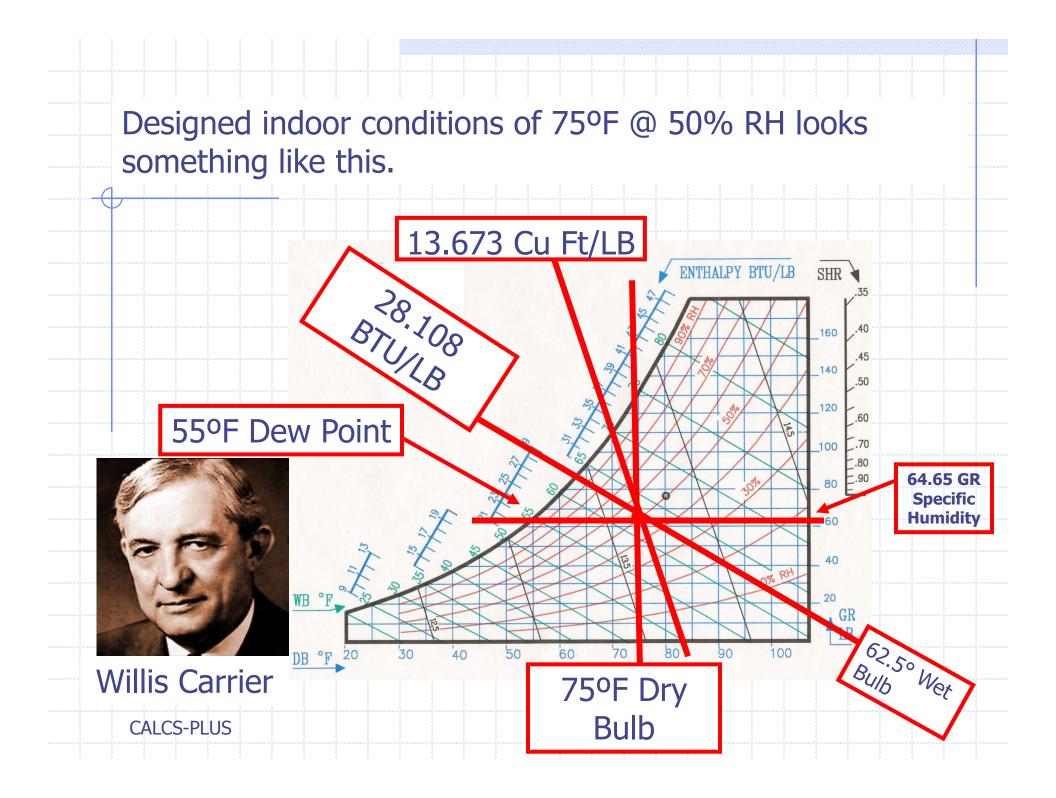
DBr – DBs =  $\Delta$ DB or  $\Delta$ T Lets say the entering air is 77°F The leaving air is 58°F

**ΔDB across the Evaporator Coil** 

### Pretty Simple, Right!

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## **Get a Computer Program!**

### Psychrometrics - State Point

Description:			
Elevation ft 0		Barometric Pressure inHo	29.921
-Psychrometric Properties		Specified	Calculated —
Dry Bulb Temperature	F	75	75
Wet Bulb Temperature	F		62.547
Relative Humidity (%):		50	50
Vapor Pressure	psia		0.21502
Dew Point Temperature	F		55.08
Moisture Content:	Grains/Ib		64.65
Specific Volume	ft*/lb		13.673
Enthalpy	Btu/Ib		28.108
Indoor Desig	an Condit		

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# **Mixed Air Properties**

Psychrometrics - Mixed Air		
Description:		
Elevation ft 0	Barometric Pressure inHg 29.921	
Psychrometric Properties	Source 1 Source 2	Mixed Air
Air Flow Rate ft³/min	1080 120	1200
Dry Bulb Temperature F	75 95	76.935
Wet Bulb Temperature F	<b>62.547 72</b>	63.547
Relative Humidity (%):	50 32.851	48.004
Vapor Pressure psia	0.21502 0.2681	0.22016
Dew Point Temperature F	55.08 61.229	55.73
Moisture Content: Grains	/lb 🗆 64.65 🗖 80.905	66.217
Specific Volume ft³/lb	□ 13.673 □ 14.237	13.728
Enthalpy Btu/Ib		28.826
	Calc	ulate Cl <u>o</u> se
CALCS-PLUS		

Psychrometrics - St	ate Point				
Description: Ente	ring Air Conditions	<b>;</b>		ons	
Elevation ft 0		Barometric Pressure inHg	29.921	Barometric Pressure inHg	29.921
Psychrometric Propert	ies	Specified	Calculated	Specified	Calculated
Dry Bulb Temperature	F	77	77	58	58
Wet Bulb Temperature	E F		64.481		55.473
Relative Humidity (%):		51	51	85.7	85.7
Vapor Pressure	psia		0.23441		0.20451
Dew Point Temperatu	e F		57.464		53.71
Moisture Content:	Grains/Ib		70.572		61.446
Specific Volume	ft³/lb		13.743		13.229
Enthalpy	Btu/lb		29.523		23.461
······		] []			
		<u>C</u> alcula	te <u>Clo</u> se	<u>C</u> alculat	e Cl <u>o</u> se
Col	lect the Data	E S S S S			
Measured Air Handler		980			
Return DB DBr Return WB or RH		<u> </u>			
Supply DB DBs		<u>58°</u>			
Supply WB or RH		85.7%			
Suction Line Temperat	ure SLT	<u>51°</u>			
	ΔDB across	the Evaporator Coil		<u>19°</u>	
	Grains/Lb I			9.11	
		ΔDB = BTU/H Sensi ΔGR = BTU/H Laten			
		Coil Temp ECT=(DBr = SLT-ECT	' – 35)		

# Do the Math

<u>19°</u> 9.11

20,482

6,070

64.5°

#### $\leftarrow \Delta DB \times CFM \times 1.1 = BTU/H Sensible$ $<math>\Delta GR \times CFM \times .68 = BTU/H Latent$

980 x 1.1 x 19 = 20,482 BTU/H 980 x .68 x 9.11 = 6,070 BYU/H Net Output 26,552 BTU/H

CALCS-PLUS CALCS-PLUS

## Do the Math

#### **Evaporator Coil Temp ECT=(DBr – 35)**

ΔDB across the Evaporator Coil	<b>19°</b>
Grains/Lb Difference AGR	9.11
$CFM \times 1.1 \times \Delta DB = BTU/H$ Sensible	20,482
CFM x .68 x $\Delta$ GR = BTU/H Latent	6,070
Evaporator Coil Temp ECT=(DBr – 35)	42°
Super Heat = SLT-ECT	<b>51°</b>
Entering Air WB Temperature	64.5°

Entering Dry Bulb  $(77) - 35^\circ = 42$ 



# Compare the RESULTS

Collect the Dat	a
Measured Air Handler CFM	980
Return DB DBr	<b>77</b> °
Return WB or RH	51%
Supply DB DBs	58°
Supply WB or RH	85.7%
Suction Line Temperature SLT	<b>51°</b>
· · · · · · · · · · · ·	

19° 9.11 20,482 6,070 42° 51° 64.5°

With System Performance Ratings



### System Performance Rating ARI

The Air Conditioning and Refrigeration Institute (ARI, www.ari.org) defines the standards for air-conditioning design.

All equipment in the ARI directory is rated under the same conditions.

**ARI testing Standards:** 95° F Outdoor temperature 80° F Indoor temperature 50% Relative humidity

CALCS-PLUS

Outdoor Model Indoor Model 2TTR3030A1 TWE031E13

Airflow = 1000

Values At ARI Rating Conditions

=	27800	Btuh
=	1020	CFM ~
=	1970	watts
=	236	watts
=	150	watts
=	14.00	
	= = =	= 1970 = 236 = 150

### System Performance Rating Manual J Design Outdoor Model

### **Manual J Design Conditions:**

- 95° F Outdoor temperature
- 75° F Indoor temperature
- 50% Relative humidity

ANE RS	PI	ERFORMAN	ICE

DATA COOLING

Btuh

CFM

watts

watts

watts

February 10, 2007

-- U.S. (ENGLISH) --(Capacities are net in btuh/1000 - indoor fan heat deducted)

Indoor Model

TWE031E13

2TTR3030A1

Airflow = 1000

Va	lues	At	ARI	Rating	Conditions	
				-		

Total Net Capacity = 27800 Airflow = 1020 Compressor Power = 1970 Indoor Fan Power = 236

Outdoor Fan Power

S.E.E.R

Correction Factors - Other Airflows								
Airflow	<u>875</u>	<u>1125</u>						
Total Capacity	0.98	1.02						
Sensible Capacity	0.94	1.06						
Compressor Kw	0.99	1.01						

Rated with 25 feet of 3/4 suction and 5/16 liquid lines.

= 150

= 14.00

	O.D.	I.D.	TOTAL	SENS	SIBLE (	CAPAC	CITY	SYSTEM
	D.B	<u>W.B.</u>	CAP	72	75	<u>78</u>	80	KW
	85	59	26.0	21.3	23.9	26.0	26.0	2.11
	85	63	27.1	17.3	20.0	22.6	24.3	2.12
	85	67	29.2	15.4	15.4	18.9	20.7	2.16
	95	59	24.7	20.7	23.4	24.7	24.7	2.30
	95	63	25.7	16.7	19.4	22.0	23.8	2.31
	95	67	27.7	13.1	15.8	18.4	20.1	2.35
	105	63	24.3	16.2	18.8	21.4	23.2	2.51
	105	67	26.2	12.6	15.2	17.8	19.6	2.55
	105	71	28.3	8.9	11.6	14.2	15.9	2.57
	115	63	23.0	15.7	18.3	20.9	22.7	2.70
	115	67	24.7	12.0	14.7	17.3	19.0	2.75
	<u>115</u>	71	26.7	8.4	<u>11.0</u>	13.6	15.4	<u>2.77</u>
***	95	63	25.7	I.D.D.B =	= 75		19.4	2.31

	O.D.	I.D.	TOTAL	SEN	SIBLE	CAPAC	CITY	SYSTEM	
	D.B	<u>W.B.</u>	CAP	72	75	78	80	KW	
	95	59	24.7	20.7	23.4	24.7	24.7	2.30	TRANE"
50 50 50 50 50	95	63	25.7	16.7	19.4	22.0	23.8	2.31	
	95	67	27.7	13.1	15.8	18.4	20.1	2.35	
	CAI	_CS-PLUS							

	Collected Data							
	Measured Air Handler CFM Return DB DBr Return WB or RH Supply DB DBs Supply WB or RH Suction Line Temperature SLT				<u>980</u> <u>77°</u> 51%			
						<u>58°</u> <u>85.7%</u> <u>51°</u>		
7								
	ΔDB across the Evaporator Coil					<b>19°</b>		
	Grains/Lb Difference $\Delta GR$					9.11		
	$CFM \times .68 \times \Delta GR = BTU/H Latent $ 6,070					20,482		
						<u>    6,070     </u> <u>    42</u> °		
	Super Heat = SLT-ECT $53$ $-33$ $-32$							
	Entering Air WB Temperature				<u>64.5°</u>			
O.D.	I.D.	TOTAL	SEN	SIBLE	CAPAG	CITY	SYSTEM	
<u>D.B</u>	<u>W.B.</u>	CAP	<u>72</u>	75	<u>78</u>	<u>80</u>	KW	
° 95	59	24.7	20.7	23.4	24.7	24.7	2.30	
95	63	25.7	16.7	19.4	22.0	23.8	2.31	
		27.7					2.35	
95								
95								

