TROUBLESHOOTING OF A GEOTHERMAL HEAT PUMP

John Riffe

Geothermal Tech. & Field Support

Auer Steel & Heating Supply Co.

WSHP/GSHP Unit

- Heat Pump Components

  -Compressor

  -Refrigerant Reversing Valve

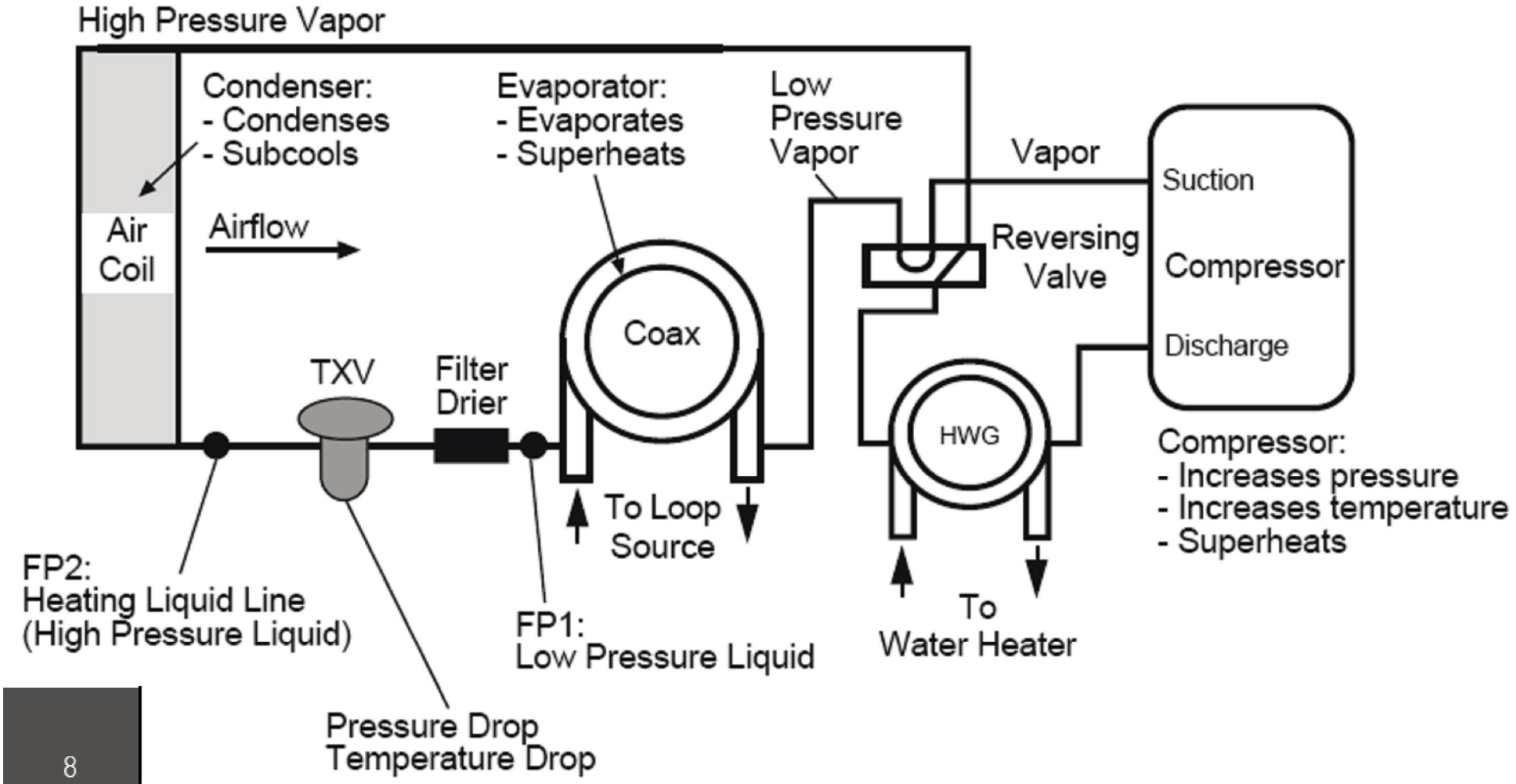
  -Fluid Heat Exchanger (Coax)

  -Metering Device (TXV)

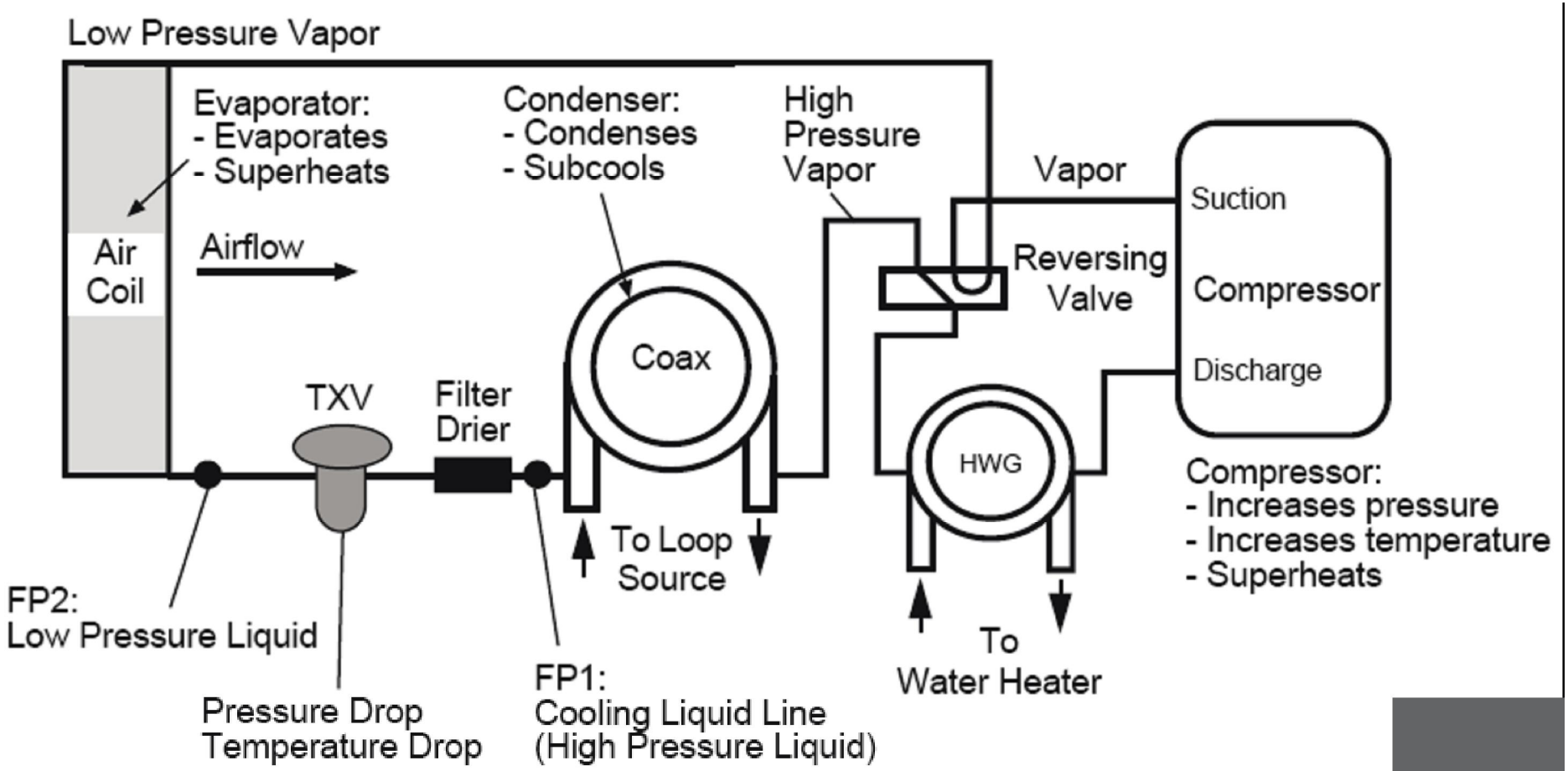
  -Air Heat Exchanger (Air Coil)

  - Electrical Controls

Typical Water Source Refrigeration Circuit (Heating Cycle)



Typical Water Source Refrigeration Circuit (Cooling Cycle)



Unit Sequence Of Operation

Table 6b: Unit Operation

T-stat signal	TT	TS/GS	TS/GS
	ECM fan	ECM fan	PSC fan
G	Fan only	Fan only	Fan only
G, Y or Y1	Stage 1 heating[1]	Stage 1 heating[3]	Stage 1 heating[5]
G, Y1, Y2	Stage 2 heating[1]	Stage 2 heating[3]	Stage 2 heating[5]
G, Y1, Y2, W	Stage 3 heating[1]	Stage 3 heating[3]	N/A
G, W	Emergency heat	Emergency heat	Emergency heat
G, Y or Y1, O	Stage 1 cooling[2]	Stage 1 cooling[4]	Cooling[6]
G, Y1, Y2, O	Stage 2 cooling[2]	Stage 2 cooling[4]	N/A

1 Stage 1 = 1st stage compressor, 1st stage fan operation
Stage 2 = 2nd stage compressor, 2nd stage fan operation
Stage 3 = 2nd stage compressor, auxiliary electric heat, 2nd or 3rd stage fan operation (depending on fan settings)

2 Stage 1 = 1st stage compressor, 1st stage fan operation, reversing valve
Stage 2 = 2nd stage compressor, 2nd stage fan operation, reversing valve

3 Stage 1 = compressor, 1st stage fan operation
Stage 2 = compressor, 2nd stage fan operation
Stage 3 = compressor, auxiliary electric heat, 2nd or 3rd stage fan operation (depending on fan settings)

4 Stage 1 = compressor, 1st stage fan operation, reversing valve
Stage 2 = compressor, 2nd stage fan operation, reversing valve

5 Stage 1 = compressor, fan
Stage 2 = compressor, auxiliary electric heat, fan

6 Cooling = compressor, fan, reversing valve

Performance Check

Heat of Extraction/Rejection

A great deal can be learned about unit performance by checking the heat of extraction (water side capacity in heating) and heat of rejection (water side capacity in cooling). If the unit is performing within 90% of catalog then no further analysis should be performed. However, if it isn't performing up to standard, then it makes sense to take a look at the refrigeration system; using superheat and subcooling measurements to determine performance is advised.

Heat of Extraction, sometimes called heat of absorption, refers to the amount of heat extracted from the water source through the refrigeration effect. This in turn can then be compared to catalog data for a performance check. The equation for heat of extraction is shown below. Flow is estimated as described earlier.

Heat of Extraction (Btuh) = Flow (gpm) x (Tin - T out) x Factor

Heat of Extraction/Rejection

Water Side Performance Check Benefits:

- No refrigeration gauges needed
- Verifies equipment performance by measuring amount of heat being rejected (HR) and extracted (HE)
- Simple Tools - Water pressure gauge and digital thermometer
- Compare field numbers to factory Product Catalog Data Tables – Properly Operating units will be within +/-10 of Factory Data Table conditions/capacity

Heat of Extraction/Rejection Formula

Q (BTUH) = dT X GPM X Fluid Factor
(HE and HR)

- **Delta T:** Temperature Difference between Entering and Leaving Water (EWT - LWT = dT)
- **GPM:** Pressure Differential between Water In and Water Out at unit coax. This pressure differential can be converted to GPM using a pressure drop table for each unit at the correct EWT (Water In – Water Out = dP)
- **Fluid Factor** is the ability of a solution to transfer heat in a certain period of time.

*ALWAYS Turn Desuperheater Hot Water Generator off before checking equipment performance

Antifreeze Factors

Antifreeze Capicity Factors	Temp	Specific Gravity	Density	Specific Heat	Capacity Factor
Water	32°	1.000	62.42	1.00	501
20% Methanol	30°	.979	61.11	1.00	490
25% Ethanol	30°	.980	61.17	1.05	515
30% Propelyne Glycol	30°	1.027	64.11	.94	483
23% Ethyl Glycol	30°	1.030	64.29	.93	480
30% GS4	30°	1.100	68.66	.91	501
1.2 LB. Reactol/NaCl	30°	1.108	69.16	.85	471
1.2 LB CaCl	30°	1.135	70.85	.79	451

All data based on 15° freeze protection. All percentages are per volume

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Note: Four (4) Most Common Fluids used today

Note: Also known as Fluid Factor

Training Supplement Section 1, Table 10 page 57

Water Side Unit Performance

HE/HR = dT X GPM X Fluid Factor

- HE/HR = _____ X _____ X _____
- HE/HR = _____BTU's
- Specification is_____BTU's

ALWAYS Turn Desuperheater (Hot Water Generator) off before checking unit performance

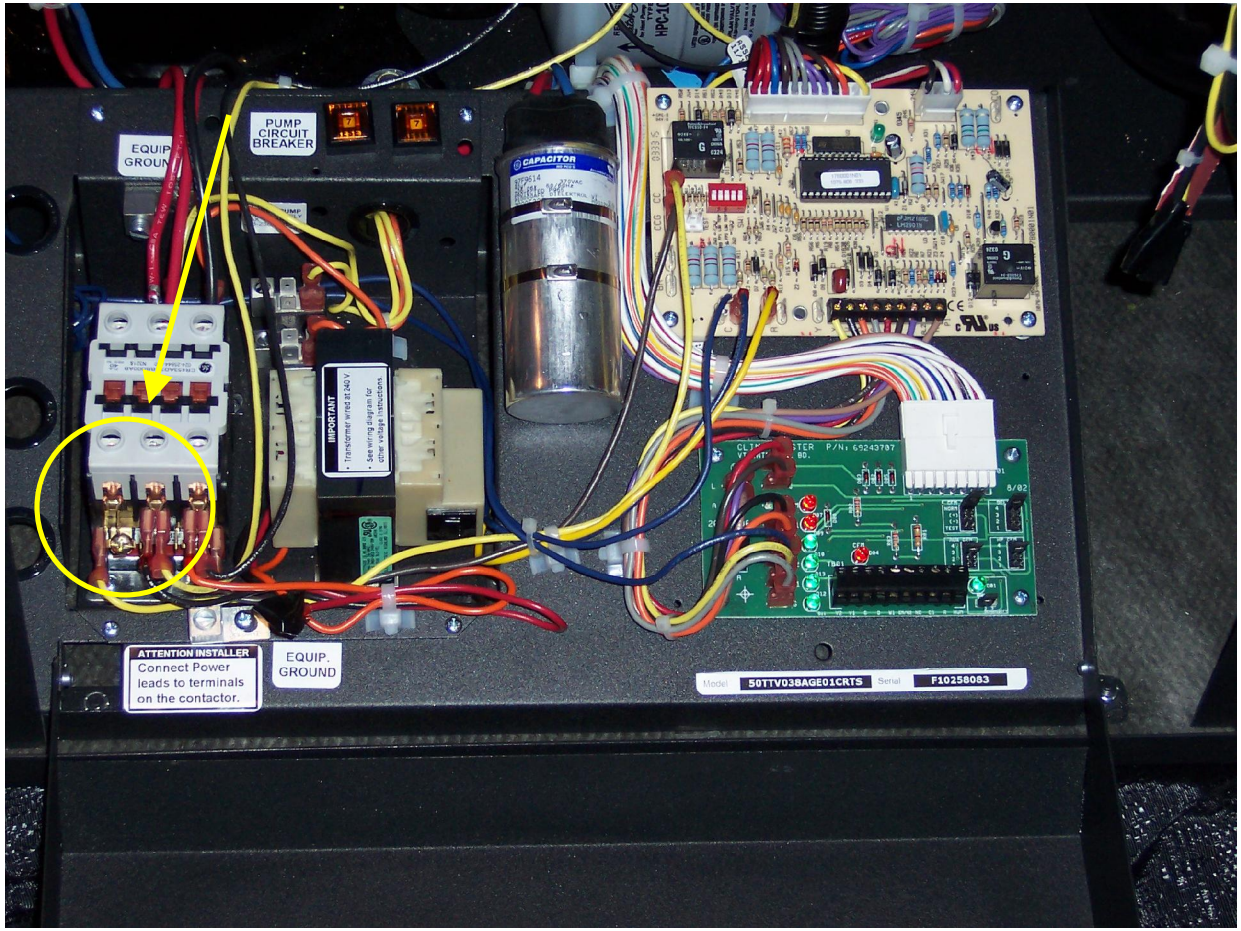
Diagnostic Performance Check

Disconnect HWG Pump

Remove Wires from HWG Terminal Blocks

Before

Taking Field Data Measurements

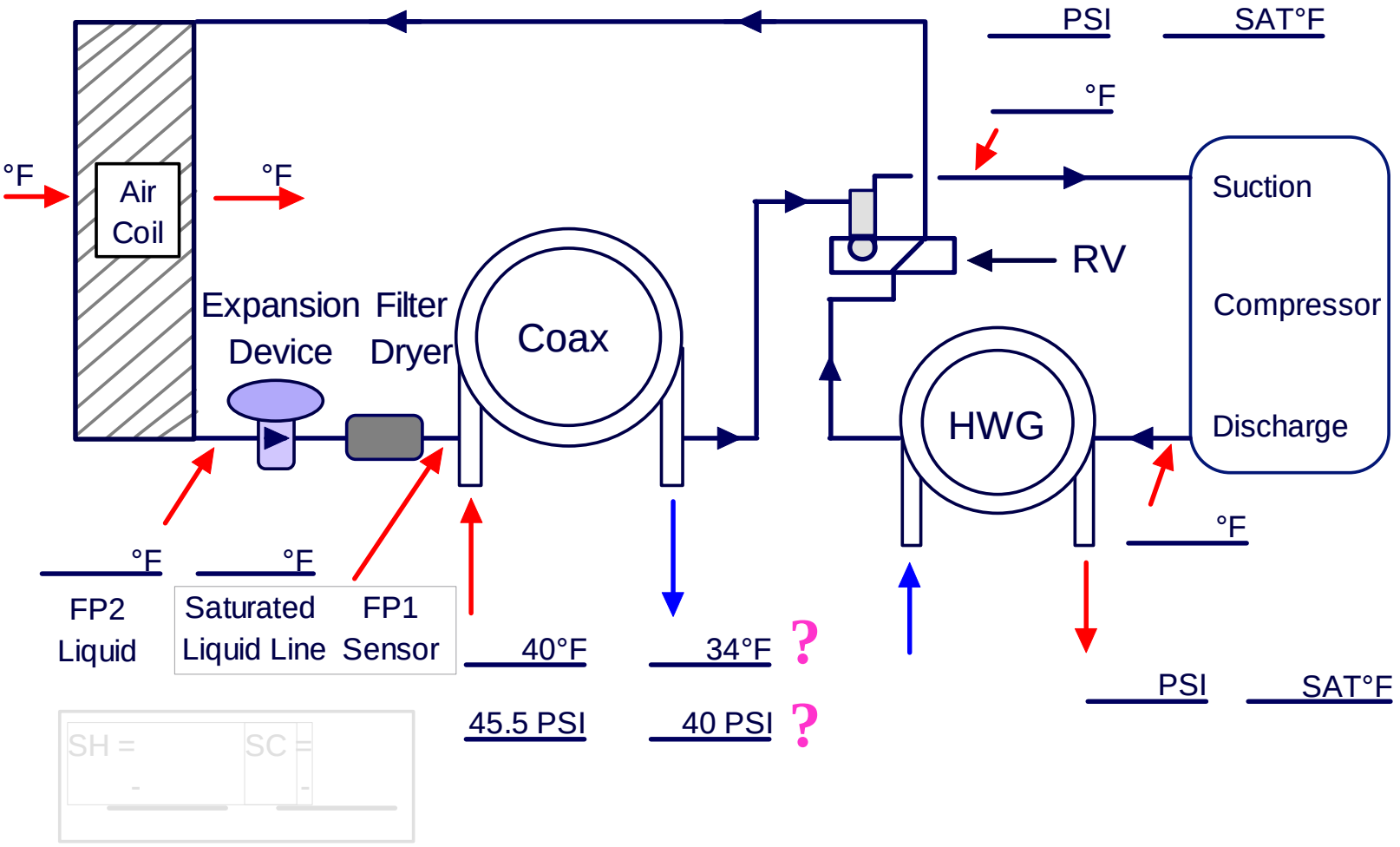


Diagnostics Performance Checks

Allow the unit to operate for 15 minutes before taking temperatures or pressures.

Using The Field Data Information - Heating Cycle

YDV038 unit - Full Load - 1250 CFM Air Flow - Methanol



Use hand out

Water Side Unit Performance Check

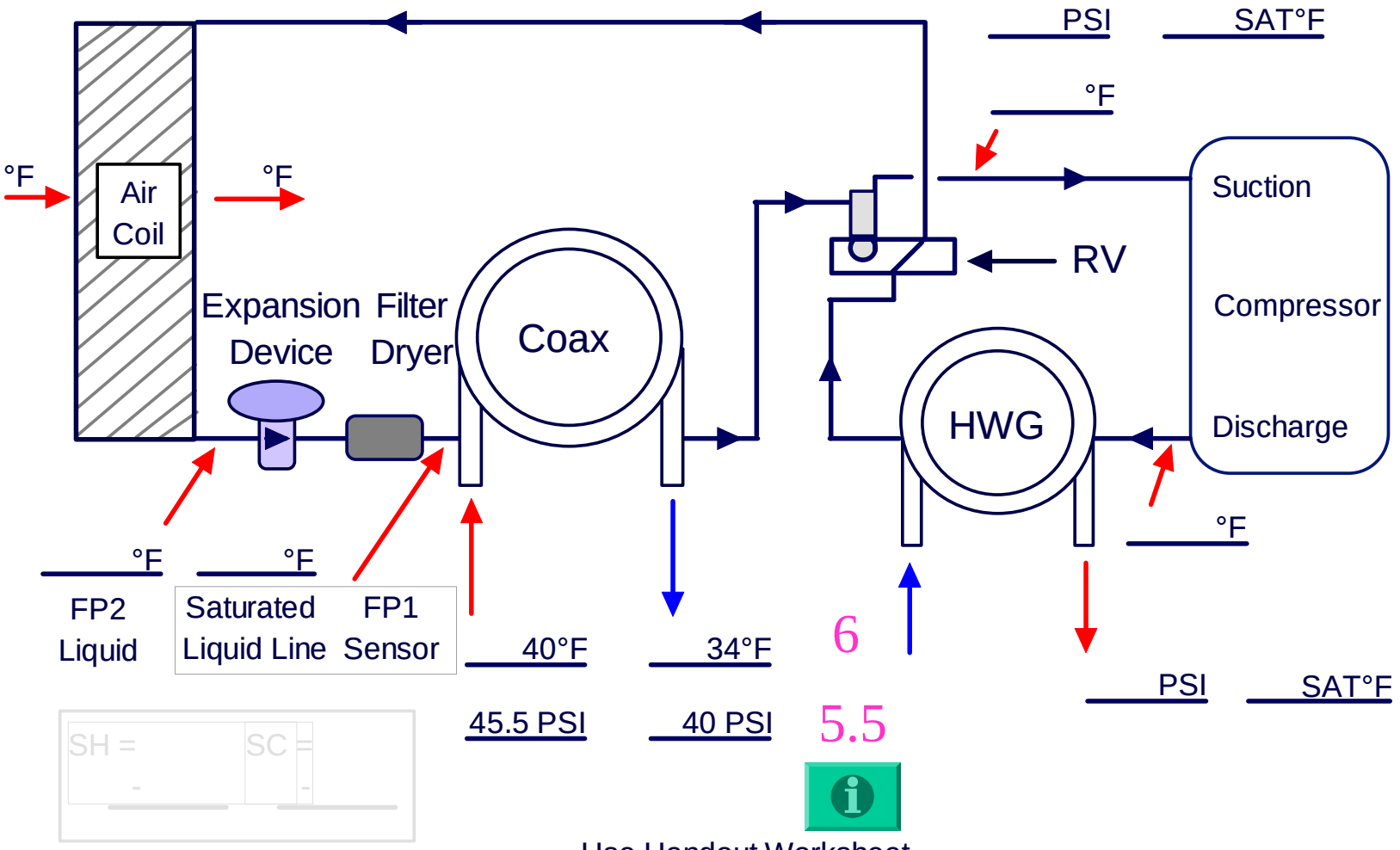
HE/HR = dT X GPM X Fluid Factor

- HE = 6 X _____ X _____
- HE = _____BTU's
- Spec. is_____BTU's

ALWAYS Turn Desuperheater (Hot Water Generator) off before checking unit performance

Using The Field Data Information - Heating Cycle

YDV038 unit - Full Load - 1250 CFM Air Flow - Methanol



YDV 038 Full Load 1250 CFM Heating Data Table

YDV038 FULL LOAD 1250 CFM

EWT °F	GPM	WPD		Cooling - EAT 80/67 °F							Heating - EAT 70°F						
		PSI	FT	Airflow CFM	TC	SC	kW	HR	EER	HWC	Airflow CFM	HC	kW	HE	LAT	COP	HWC
20	4.5	2.0	4.6	1080 1250	Operation not recommended						Operation not recommended						
	6.8	3.4	7.8	1080 1250													
	9.0	5.9	13.7	1080 1250							1080 1250	25.7 26.2	2.26 2.18	18.0 18.7	92.0 89.4	3.33 3.51	2.9 2.5
30	4.5	1.7	3.9	1080 1250	43.2 44.1	27.7 30.1	1.55 1.61	48.5 49.6	27.8 27.3		1080 1250	27.9 28.4	2.31 2.22	20.1 20.8	94.0 91.1	3.55 3.74	3.0 2.6
	6.8	3.3	7.6	1080 1250	43.4 44.3	27.8 30.1	1.45 1.51	48.4 49.4	29.9 29.4		1080 1250	29.2 29.7	2.33 2.25	21.2 22.0	95.0 92.0	3.67 3.87	3.0 2.6
	9.0	5.7	12.1	1080 1250	43.6 44.4	27.8 30.1	1.40 1.45	48.3 49.4	31.2 30.6		1080 1250	29.9 30.4	2.35 2.26	21.9 22.7	95.7 92.5	3.74 3.94	2.9 2.5
40	4.5	1.5	3.5	1080 1250	42.5 43.3	27.8 30.1	1.70 1.77	48.3 49.4	25.0 24.5		1080 1250	31.8 32.4	2.39 2.30	23.7 24.5	97.3 94.0	3.91 4.12	3.1 2.7
	6.8	3.2	7.3	1080 1250	43.1 43.9	27.9 30.2	1.59 1.66	48.5 49.6	27.0 26.5		1080 1250	33.3 33.9	2.42 2.33	25.1 25.9	98.6 95.1	4.04 4.26	3.0 2.6
	9.0	5.4	12.5	1080 1250	43.3 44.1	27.9 30.3	1.54 1.60	48.5 49.6	28.1 27.6		1080 1250	34.2 34.8	2.44 2.35	25.9 26.8	99.3 95.8	4.11 4.33	3.0 2.6
50	4.5	1.3	3.1	1080 1250	41.3 42.1	27.4 29.7	1.86 1.93	47.6 48.7	22.2 21.8	1.4 1.4	1080 1250	35.8 36.4	2.48 2.39	27.4 28.3	100.7 97.0	4.24 4.47	3.2 2.8
	6.8	3.1	7.1	1080 1250	42.2 43.0	27.7 30.0	1.75 1.82	48.1 49.2	24.2 23.7	1.2 1.2	1080 1250	37.6 38.2	2.52 2.43	29.0 29.9	102.2 98.3	4.37 4.61	3.2 2.8
	9.0	5.2	12.0	1080 1250	42.6 43.4	27.8 30.1	1.69 1.75	48.3 49.4	25.2 24.8	1.0 1.0	1080 1250	38.6 39.3	2.55 2.46	29.9 30.9	103.1 99.1	4.44 4.68	3.1 2.7
60	4.5	1.2	2.8	1080 1250	39.7 40.5	26.7 29.0	2.03 2.11	46.7 47.7	19.6 19.2	1.9 1.9	1080 1250	39.9 40.6	2.58 2.49	31.1 32.1	104.2 100.1	4.53 4.78	3.5 3.0
	6.8	2.9	6.8	1080 1250	40.8 41.6	27.2 29.5	1.91 1.98	47.3 48.4	21.4 21.0	1.6 1.7	1080 1250	42.0 42.7	2.64 2.54	33.0 34.0	106.0 101.6	4.66 4.92	3.4 3.0
	9.0	5.0	11.6	1080 1250	41.4 42.2	27.4 29.7	1.85 1.92	47.7 48.8	22.4 22.0	1.4 1.4	1080 1250	43.2 43.9	2.67 2.58	34.1 35.1	107.0 102.5	4.74 5.00	3.4 2.9
70	4.5	1.1	2.5	1080 1250	37.9 38.7	26.0 28.2	2.23 2.32	45.5 46.6	17.0 16.7	2.5 2.6	1080 1250	44.1 44.8	2.70 2.60	34.9 36.0	107.8 103.2	4.79 5.05	3.8 3.3
	6.8	2.9	6.6	1080 1250	39.2 40.0	26.5 28.7	2.09 2.17	46.3 47.4	18.7 18.4	2.2 2.2	1080 1250	46.5 47.3	2.77 2.67	37.0 38.2	109.8 105.0	4.92 5.19	3.7 3.2
	9.0	4.8	11.0	1080 1250	39.8 40.6	26.8 29.0	2.02 2.10	46.7 47.8	19.7 19.3	1.8 1.9	1080 1250	47.9 48.7	2.81 2.71	38.3 39.4	111.0 106.1	4.99 5.26	3.7 3.2

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Product Information TT Series Catalog page 15

Water Side Unit Performance Check

HE/HR = dT X GPM X Fluid Factor

- HE = dT X GPM X Fluid Factor
- HE = 6 X 9 gpm X 20 % methanol _____
- HE = _____BTU's
- Specification is_____BTU's

ALWAYS Turn Desuperheater (Hot Water Generator) off before checking equipment performance

Water Side Performance Check

Antifreeze Capicity Factors	Temp	Specific Gravity	Density	Specific Heat	Capacity Factor
Water	32°	1.000	62.42	1.00	501
20% Methanol	30°	.979	61.11	1.00	490
25% Ethanol	30°	.980	61.17	1.05	515
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All data based on 15° freeze protection. All percentages are per volume

10-24-02Vcb

Training Supplement Section 1, Table 10 page 57

Water Side Unit Performance Check

HE/HR = dT X GPM X Fluid Factor

- HE = 6 X 9 gpm X 490
- HE = _____ BTU's
- Specification is_____ BTU's

ALWAYS Turn Desuperheater (Hot Water Generator) off before checking equipment performance

Water Side Unit Performance Check

HE/HR = dT X GPM X Fluid Factor

- HE = 6 X 9 gpm X 490
- HE = 26,460 BTU's
- Specification is_____ BTU's

ALWAYS Turn Desuperheater (Hot Water Generator) off before checking equipment performance.

YDV 038 Full Load 1250 CFM Heating Data Table

YDV038 FULL LOAD 1250 CFM

EWT °F	GPM	WPD		Cooling - EAT 80/67 °F							Heating - EAT 70°F						
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	9.0	5.9	13.7	1080 1250							1080 1250	25.7 26.2	2.26 2.18	18.0 18.7	92.0 89.4	3.33 3.51	2.9 2.5
30	4.5	1.7	3.9	1080 1250	43.2 44.1	27.7 30.1	1.55 1.61	48.5 49.6	27.8 27.3		1080 1250	27.9 28.4	2.31 2.22	20.1 20.8	94.0 91.1	3.55 3.74	3.0 2.6
	6.8	3.3	7.6	1080 1250	43.4 44.3	27.8 30.1	1.45 1.51	48.4 49.4	29.9 29.4		1080 1250	29.2 29.7	2.33 2.25	21.2 22.0	95.0 92.0	3.67 3.87	3.0 2.6
	9.0	5.7	12.1	1080 1250	43.6 44.4	27.8 30.1	1.40 1.45	48.3 49.4	31.2 30.6		1080 1250	29.9 30.4	2.35 2.26	21.9 22.7	95.7 92.5	3.74 3.94	2.9 2.5
40	4.5	1.5	3.5	1080 1250	42.5 43.3	27.8 30.1	1.70 1.77	48.3 49.4	25.0 24.5		1080 1250	31.8 32.4	2.39 2.30	23.7 24.5	97.3 94.0	3.91 4.12	3.1 2.7
	6.8	3.2	7.3	1080 1250	43.1 43.9	27.9 30.2	1.59 1.66	48.5 49.6	27.0 26.5		1080 1250	33.3 33.9	2.42 2.33	25.1 25.3	98.6 95.1	4.04 4.26	3.0 2.6
	9.0	5.4	12.5	1080 1250	43.3 44.1	27.9 30.3	1.54 1.60	48.5 49.6	28.1 27.6		1080 1250	34.2 34.8	2.44 2.35	25.9 26.8	99.3 95.8	4.11 4.33	3.0 2.6
50	4.5	1.3	3.1	1080 1250	41.3 42.1	27.4 29.7	1.86 1.93	47.6 48.7	22.2 21.8	1.4 1.4	1080 1250	35.8 36.4	2.48 2.39	27.4 28.3	100.7 97.0	4.24 4.47	3.2 2.8
	6.8	3.1	7.1	1080 1250	42.2 43.0	27.7 30.0	1.75 1.82	48.1 49.2	24.2 23.7	1.2 1.2	1080 1250	37.6 38.2	2.52 2.43	29.0 29.9	102.2 98.3	4.37 4.61	3.2 2.8
	9.0	5.2	12.0	1080 1250	42.6 43.4	27.8 30.1	1.69 1.75	48.3 49.4	25.2 24.8	1.0 1.0	1080 1250	38.6 39.3	2.55 2.46	29.9 30.9	103.1 99.1	4.44 4.68	3.1 2.7
60	4.5	1.2	2.8	1080 1250	39.7 40.5	26.7 29.0	2.03 2.11	46.7 47.7	19.6 19.2	1.9 1.9	1080 1250	39.9 40.6	2.58 2.49	31.1 32.1	104.2 100.1	4.53 4.78	3.5 3.0
	6.8	2.9	6.8	1080 1250	40.8 41.6	27.2 29.5	1.91 1.98	47.3 48.4	21.4 21.0	1.6 1.7	1080 1250	42.0 42.7	2.64 2.54	33.0 34.0	106.0 101.6	4.66 4.92	3.4 3.0
	9.0	5.0	11.6	1080 1250	41.4 42.2	27.4 29.7	1.85 1.92	47.7 48.8	22.4 22.0	1.4 1.4	1080 1250	43.2 43.9	2.67 2.58	34.1 35.1	107.0 102.5	4.74 5.00	3.4 2.9
70	4.5	1.1	2.5	1080 1250	37.9 38.7	26.0 28.2	2.23 2.32	45.5 46.6	17.0 16.7	2.5 2.6	1080 1250	44.1 44.8	2.70 2.60	34.9 36.0	107.8 103.2	4.79 5.05	3.8 3.3
	6.8	2.9	6.6	1080 1250	39.2 40.0	26.5 28.7	2.09 2.17	46.3 47.4	18.7 18.4	2.2 2.2	1080 1250	46.5 47.3	2.77 2.67	37.0 38.2	109.8 105.0	4.92 5.19	3.7 3.2
	9.0	4.8	11.0	1080 1250	39.8 40.6	26.8 29.0	2.02 2.10	46.7 47.8	19.7 19.3	1.8 1.9	1080 1250	47.9 48.7	2.81 2.71	38.3 39.4	111.0 106.1	4.99 5.26	3.7 3.2

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Product Information - TT page 15

Water Side Unit Performance Check

HE/HR = dT X GPM X Fluid Factor

- HE = 6 X 9 gpm X 490
- HE = 26,460 BTU's
- Specification is 26,800 BTU's

ALWAYS Turn Desuperheater (Hot Water Generator) off before checking equipment performance

DIAGNOSTIC PERFORMANCE CHECK

When to use refrigerant gauges?

On start up of split system geothermal.

If water side performance check is out of range and external factors are ruled out.

Air flow, Water flow, and

Operating conditions.

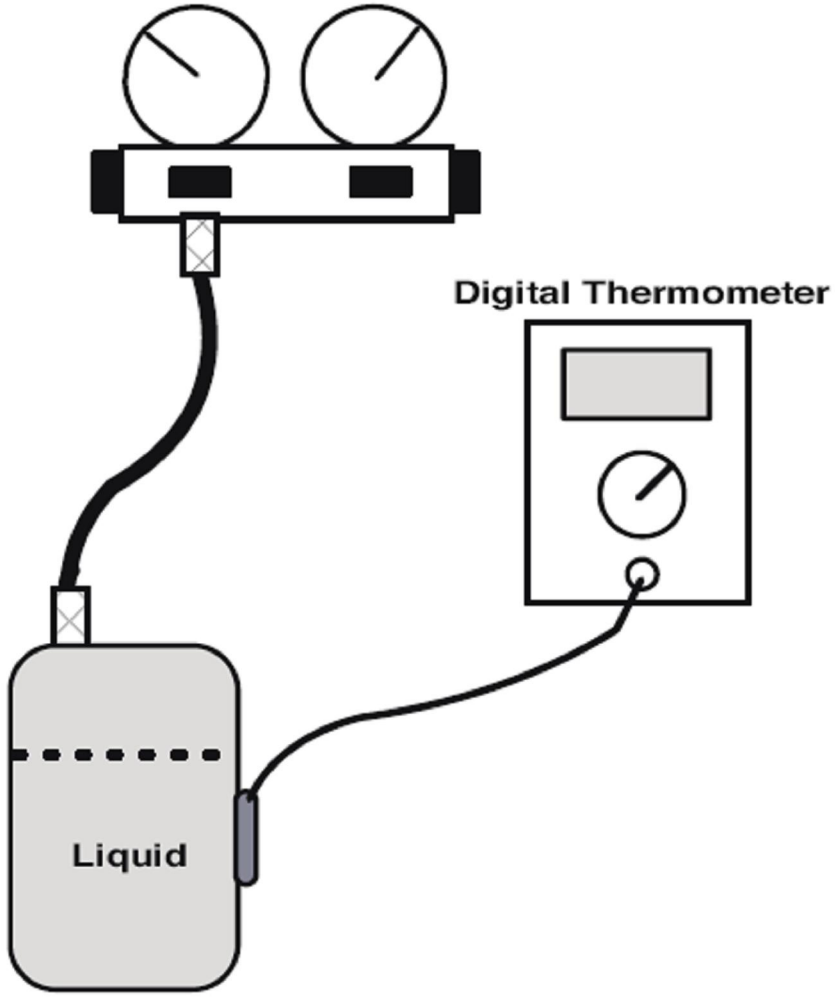
Refrigeration Troubleshooting

Figure 13: Calibrating Service Gauges

Note: Do this with two different temperature/pressure refrigerant samples for best gauge adjustment and accuracy.

Procedure:

1. Mount digital thermometer sensor at liquid portion of cylinder to read an accurate temperature.
2. Once the temperature is known, use the P/T chart to convert known refrigerant temperature to proper refrigerant pressure (PSI).
3. Adjust service gauge to match known pressure at that temperature.
4. This procedure needs to be repeated again, against another known temperature and pressure to verify gauge is properly calibrated.

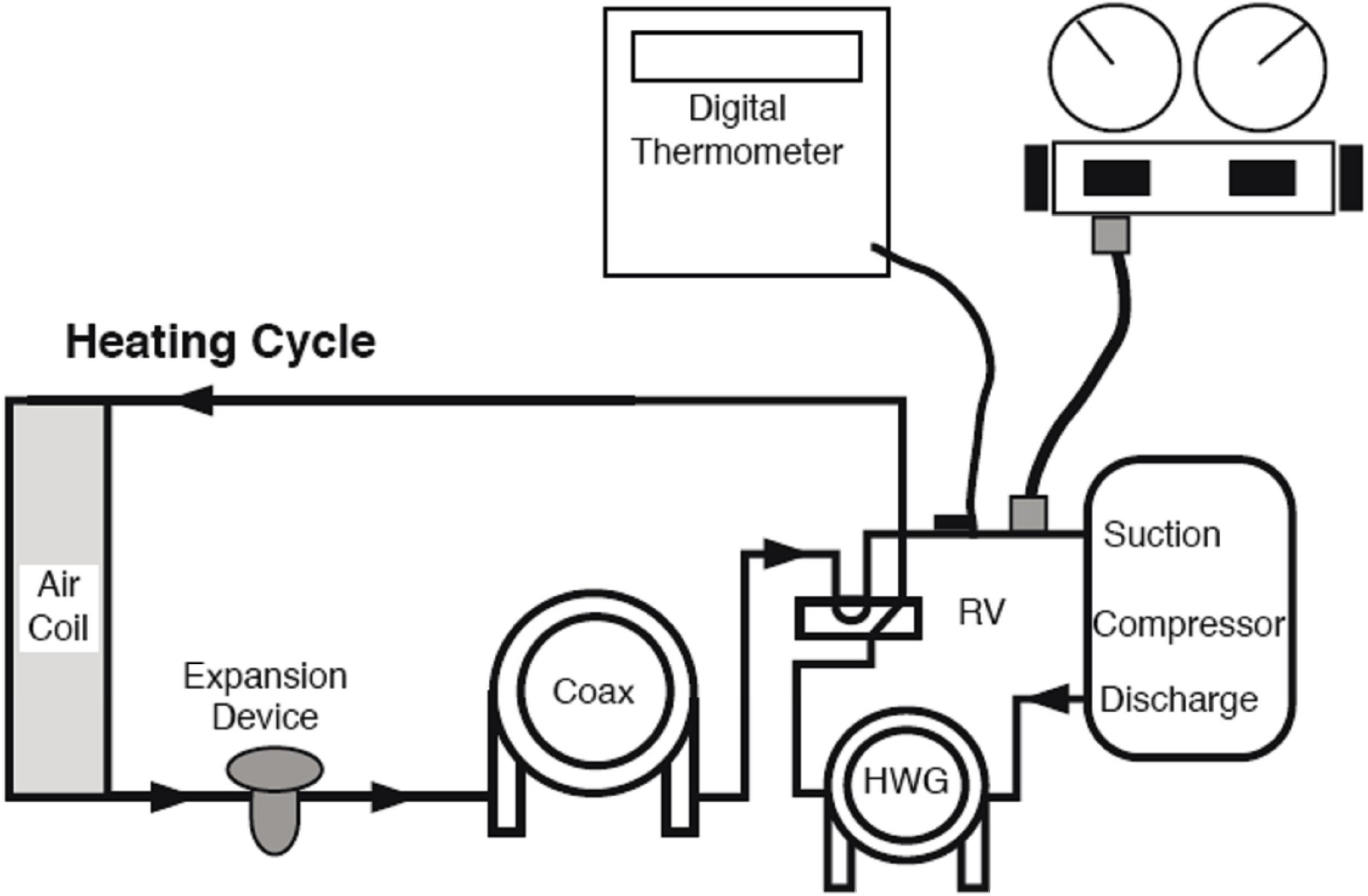


R410A - R22

(°F)	PSIG		(°F)	PSIG		(°F)	PSIG		(°F)	PSIG		(°F)	PSIG	
	R410A	R22		R410A	R22		R410A	R22		R410A	R22		R410A	R22
-40	11.6	0.5	0	48.7	23.9	40	118.0	68.5	80	235.3	143.6	120	417.7	259.8
-39	12.2	0.9	1	49.9	24.8	41	120.3	69.9	81	239.0	145.9	121	423.2	263.4
-38	12.9	1.3	2	51.2	25.6	42	122.6	71.4	82	242.7	148.3	122	428.8	266.9
-37	13.5	1.7	3	52.5	26.4	43	125.0	72.9	83	246.5	150.7	123	434.5	270.5
-36	14.2	2.2	4	53.8	27.3	44	127.3	74.5	84	250.3	153.2	124	440.2	274.2
-35	14.9	2.6	5	55.2	28.2	45	129.7	76.0	85	254.1	155.6	125	445.9	277.9
-34	15.6	3.0	6	56.6	29.1	46	132.3	77.6	86	258.0	158.1	126	451.8	281.6
-33	16.3	3.5	7	58.0	30.0	47	134.6	79.1	87	262.0	160.6	127	457.6	285.3
-32	17.0	3.9	8	59.4	30.9	48	137.1	80.7	88	266.0	163.2	128	463.5	289.1
-31	17.8	4.4	9	60.9	31.8	49	139.6	82.4	89	270.0	165.8	129	469.5	292.9
-30	18.5	4.9	10	62.3	32.8	50	142.2	84.0	90	274.1	168.4	130	475.6	296.7
-29	19.3	5.4	11	63.8	33.7	51	144.8	85.7	91	278.2	171.0	131	481.6	300.6
-28	20.1	5.8	12	65.4	34.7	52	147.4	87.3	92	282.3	173.6	132	487.8	304.5
-27	20.9	6.4	13	66.9	35.7	53	150.1	89.1	93	286.5	176.3	133	494.0	308.5
-26	21.7	6.9	14	68.6	36.7	54	152.8	90.8	94	290.8	179.0	134	500.2	312.0
-25	22.5	7.4	15	70.0	37.7	55	155.6	92.5	95	295.1	181.7	135	506.5	316.0
-24	23.4	7.9	16	71.7	38.7	56	158.2	94.3	96	299.4	184.5	136	512.9	320.0
-23	24.2	8.5	17	73.3	39.8	57	161.0	96.1	97	303.8	187.3	137	519.3	324.0
-22	25.1	9.0	18	75.0	40.8	58	163.9	97.9	98	308.2	190.1	138	525.8	328.0
-21	26.0	9.6	19	76.6	41.9	59	166.7	99.7	99	312.7	193.0	139	532.4	333.0
-20	26.9	10.1	20	78.3	43.0	60	169.6	101.6	100	317.2	195.9	140	539.0	337.0
-19	27.8	10.7	21	80.1	44.1	61	172.6	103.5	101	321.8	198.8	141	545.6	341.0
-18	28.7	11.3	22	81.8	45.3	62	175.5	105.4	102	326.4	201.7	142	552.3	345.0
-17	29.7	11.9	23	83.6	46.4	63	178.5	107.3	103	331.0	204.7	143	559.1	350.0
-16	30.7	12.5	24	85.4	47.6	64	181.6	109.2	104	335.7	207.7	144	565.9	354.0
-15	31.7	13.2	25	87.3	48.7	65	184.3	111.2	105	340.5	210.7	145	572.8	358.0
-14	32.7	13.8	26	89.1	49.9	66	187.7	113.2	106	345.3	213.8	146	579.8	363.0
-13	33.7	14.4	27	91.0	51.1	67	190.9	115.2	107	350.1	216.8	147	586.8	367.0
-12	34.7	15.1	28	92.9	52.4	68	194.1	117.2	108	355.0	222.0	148	593.8	372.0
-11	35.8	15.8	29	94.9	53.6	69	197.3	119.3	109	360.0	223.1	149	601.0	376.0
-10	36.8	16.5	30	96.8	54.9	70	200.6	121.4	110	365.0	226.3	150	608.1	381.0
-9	37.9	17.2	31	98.8	56.2	71	203.9	123.5	111	370.0	229.5	151	615.4	386.0
-8	39.0	17.9	32	100.8	57.5	72	207.2	125.6	112	375.1	232.7	152	622.7	390.0
-7	40.2	18.6	33	102.9	58.8	73	210.6	127.8	113	380.2	236.0	153	630.1	395.0
-6	41.3	19.3	34	105.0	60.1	74	214.0	130.0	114	385.4	239.3	154	637.5	400.0
-5	52.4	20.0	35	107.1	61.5	75	217.4	132.2	115	390.7	242.7	155	645.0	405.0
-4	43.7	20.8	36	109.2	62.8	76	220.9	134.4	116	396.0	246.0	156	652.5	409.0
-3	44.9	21.6	37	111.4	64.2	77	224.4	136.7	117	401.3	249.4	157	660.2	414.0
-2	46.1	22.4	38	113.6	65.6	78	228.0	138.9	118	406.7	252.9	158	667.3	419.0
-1	47.3	23.1	39	115.8	67.0	79	231.6	141.3	119	412.2	256.3	159	675.6	424.0
11/16/05vcb												160	683.4	429.0

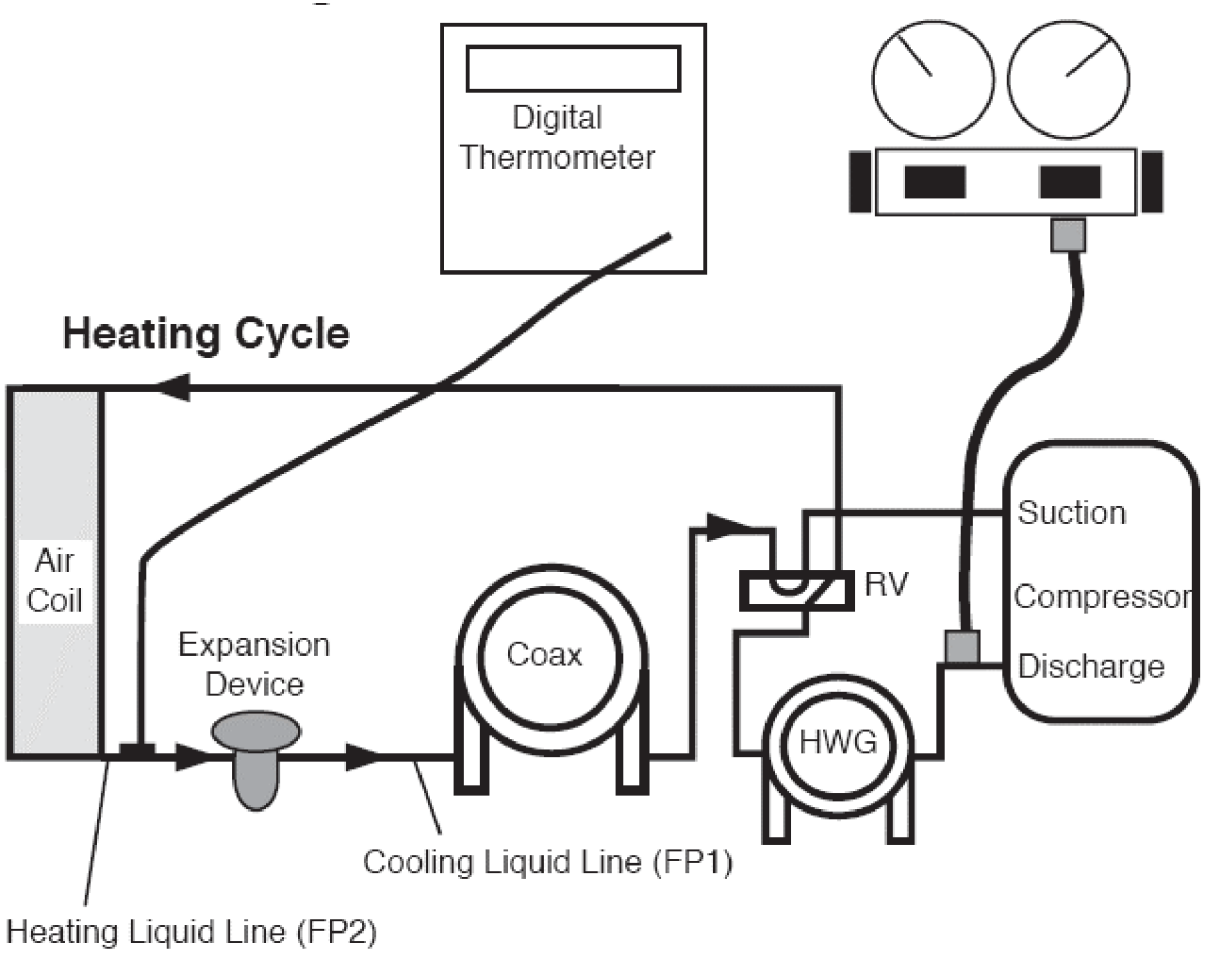
Measuring SuperHeat

Suction Line Temperature (-) minus Suction Saturation Temperature



Measuring Subcooling

Subcooling = High Pressure Saturation Temperature (-) minus Liquid Line Temperature



Thermostatic Expansion Valve (TXV)

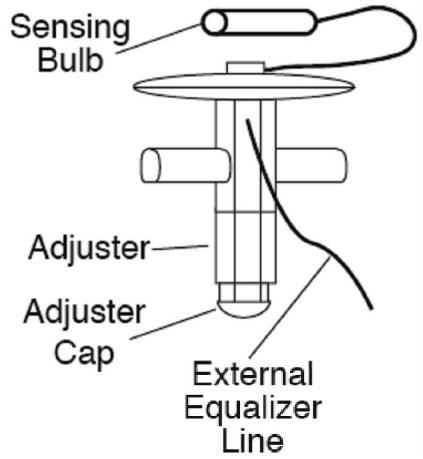
What Are Thermostatic Expansion Valves

Thermostatic expansion valves are in essence a mechanical variable orifice. The valve measures superheat and adjusts refrigerant flow to allow a specified superheat at the compressor. The valve uses the following to measure superheat:

- Bulb pressure (to estimate suction line temperature)
- Suction line pressure
- Spring pressure (as superheat adjustment)

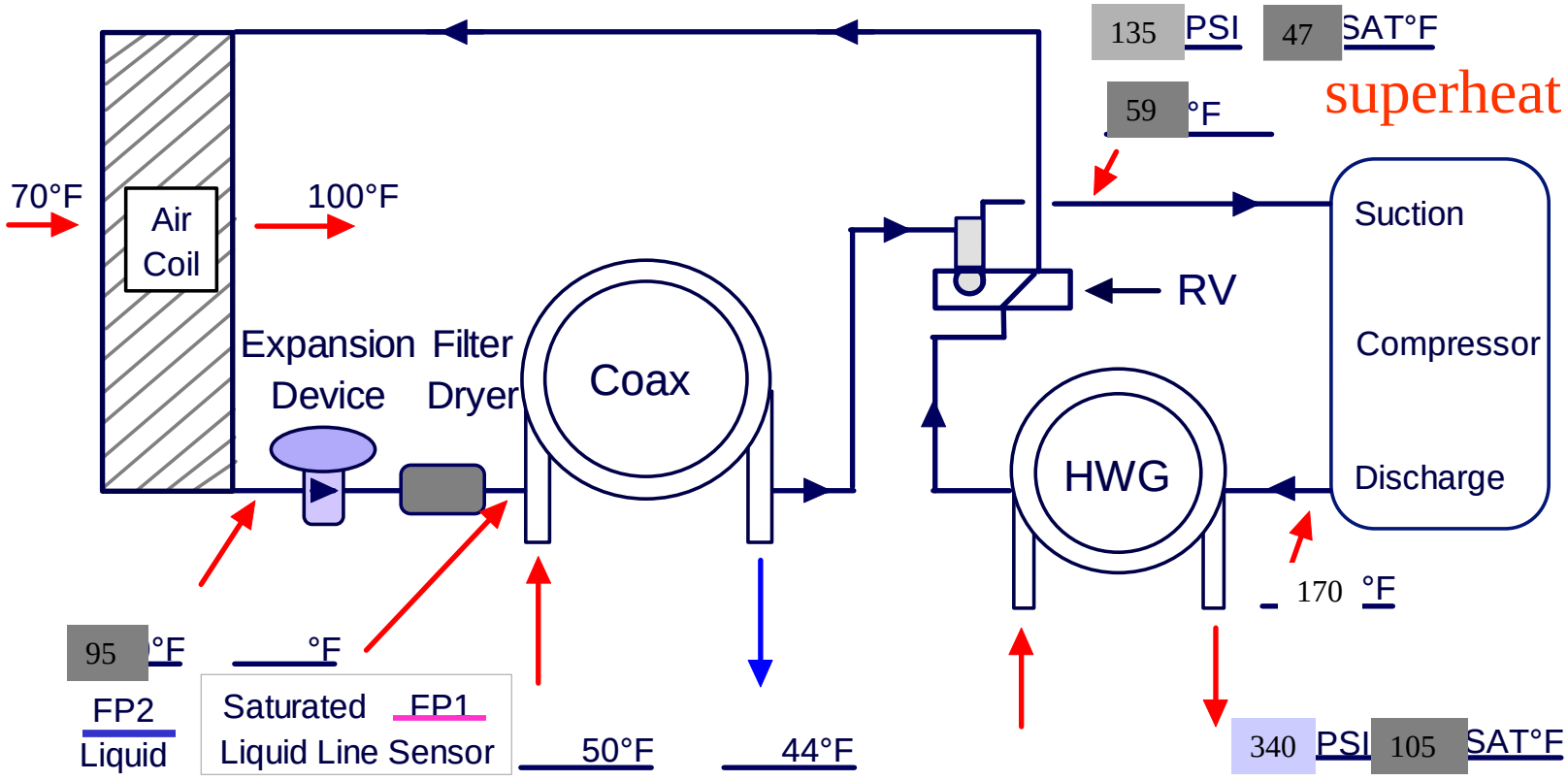
Figure 6 shows a cross section of a thermostatic expansion valve for reference.

Figure 14: Adjusting TXVs



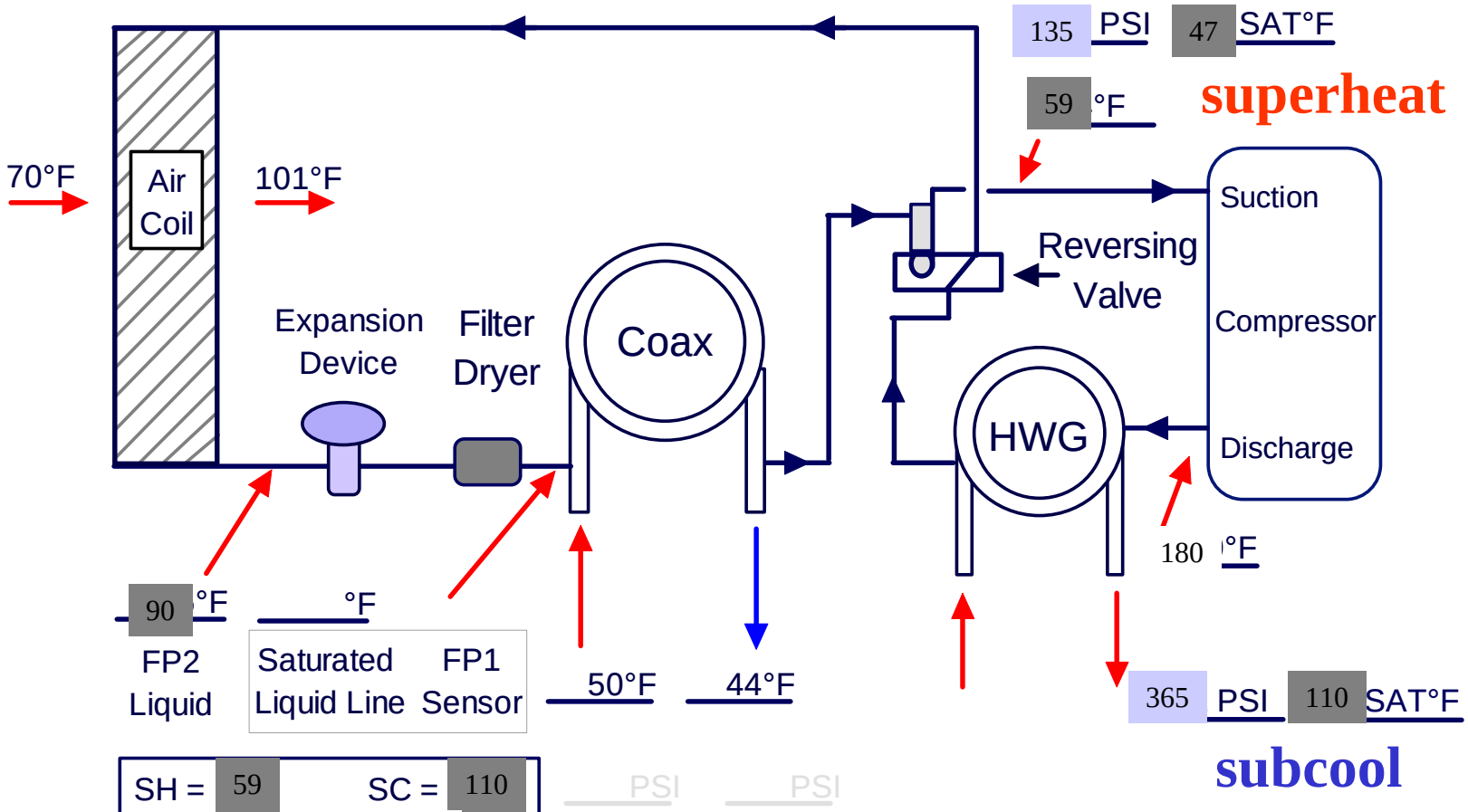
Properly Charged

TXV System – Heating Cycle



Over Charged

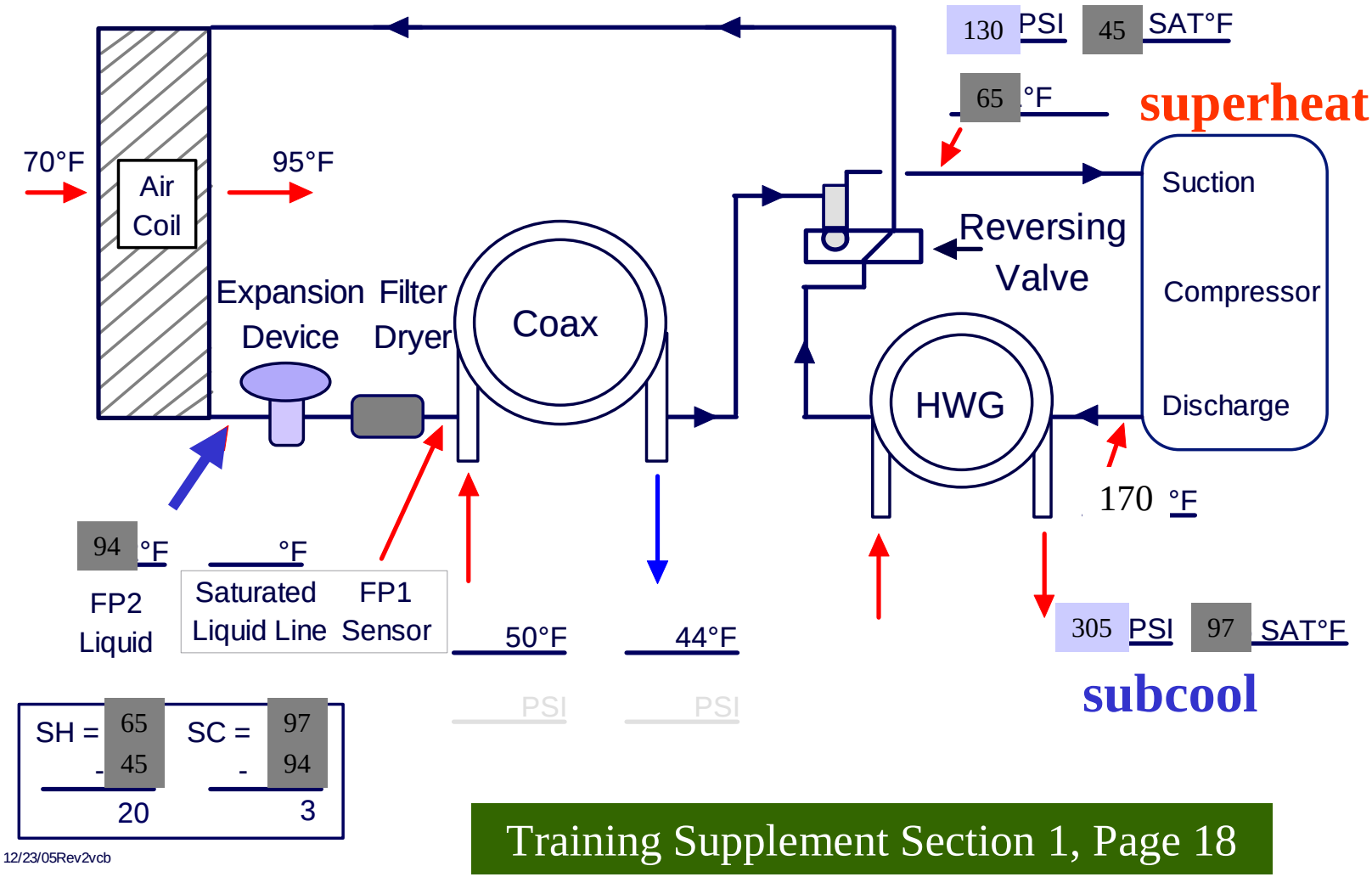
TXV System – Heating Mode



Note SH
Is the same

Under Charged

TXV System – Heating Mode



12/23/05Rev2vcb

Thermostatic Expansion Valve (TXV) Troubleshooting

Overcharged System
- High subcooling
- Superheat will be maintained by expansion valve at valve setting
- Basically no change in capacity

Undercharged System
- Low subcooling
- High superheat
- Lower capacity

TXV Stuck Closed (or Restriction)
- High superheat
- High subcooling

TXV Stuck Open
- Low superheat
- Low subcooling

Typical Operating Condition Chart

When checking need to know EWT

038		Full Load Cooling - without HWG active						Full Load Heating - without HWG active					
		Suction Pressure PSIG	Discharge Pressure PSIG	Super-heat	Sub-cooling	Water Temp Rise F	Air Temp Drop F DB	Suction Pressure PSIG	Discharge Pressure PSIG	Super-heat	Sub-cooling	Water Temp Drop F	Air Temp Rise F DB
	1.5	120-130	156-176	25-30	9-14	22.1-24.1	18-24	69-79	293-313	7-12	14-19	8.9-10.9	17-23
		119-129	148-168	25-30	8-13	16.8-18.8	19-25	73-83	297-317			6.7-8.7	18-24
	3	119-129	138-158	25-30	8-13	10.5-12.5	19-25	76-86	300-320	7-12	14-19	4.5-6.5	19-25
50	1.5	129-139	225-245	15-20	10-15	21.9-23.9	18-24	96-106	322-342	10-15	17-22	12.2-14.2	23-29
	2.25	128-138	211-231	15-20	9-14	16.1-18.1	19-25	100-110	326-346	10-15	17-22	9.3-11.3	24-30
	3	128-138	197-217	15-20	9-14	10.3-12.3	19-25	105-115	331-351	10-15	17-22	6.4-8.4	24-30
70	1.5	136-146	302-322	9-14	13-18	21.5-23.5	18-24	123-133	352-372	11-16	19-24	15-17	28-35
	2.25	135-145	283-303	9-14	12-17	15.8-17.8	19-25	129-139	358-378	11-16	19-24	11.6-13.6	29-36
	3	135-145	265-285	9-14	12-17	10-12	19-25	135-145	364-384	11-16	19-24	8.2-10.2	30-37
90	1.5	140-150	390-410	7-12	13-18	20.5-22.5	17-23	157-167	390-410	13-18	18-23	21-23	36-44
	2.25	140-150	369-389	8-13	8-13	14.9-16.9	17-23	169-179	399-419	13-18	16.5-21.5	15.5-17.5	37-45
	3	140-150	349-369	8-13	8-13	9.3-11.3	17-23	181-191	408-428	14-19	15-20	10.5-12.5	39-47
110	1.5	145-155	488-508	7-12	13-18	19-21	17-23						
	2.25	145-155	467-487	8-13	8-13	14-16	17-23						
	3	145-155	447-467	8-13	8-13	9-11	17-23						

IOM:A
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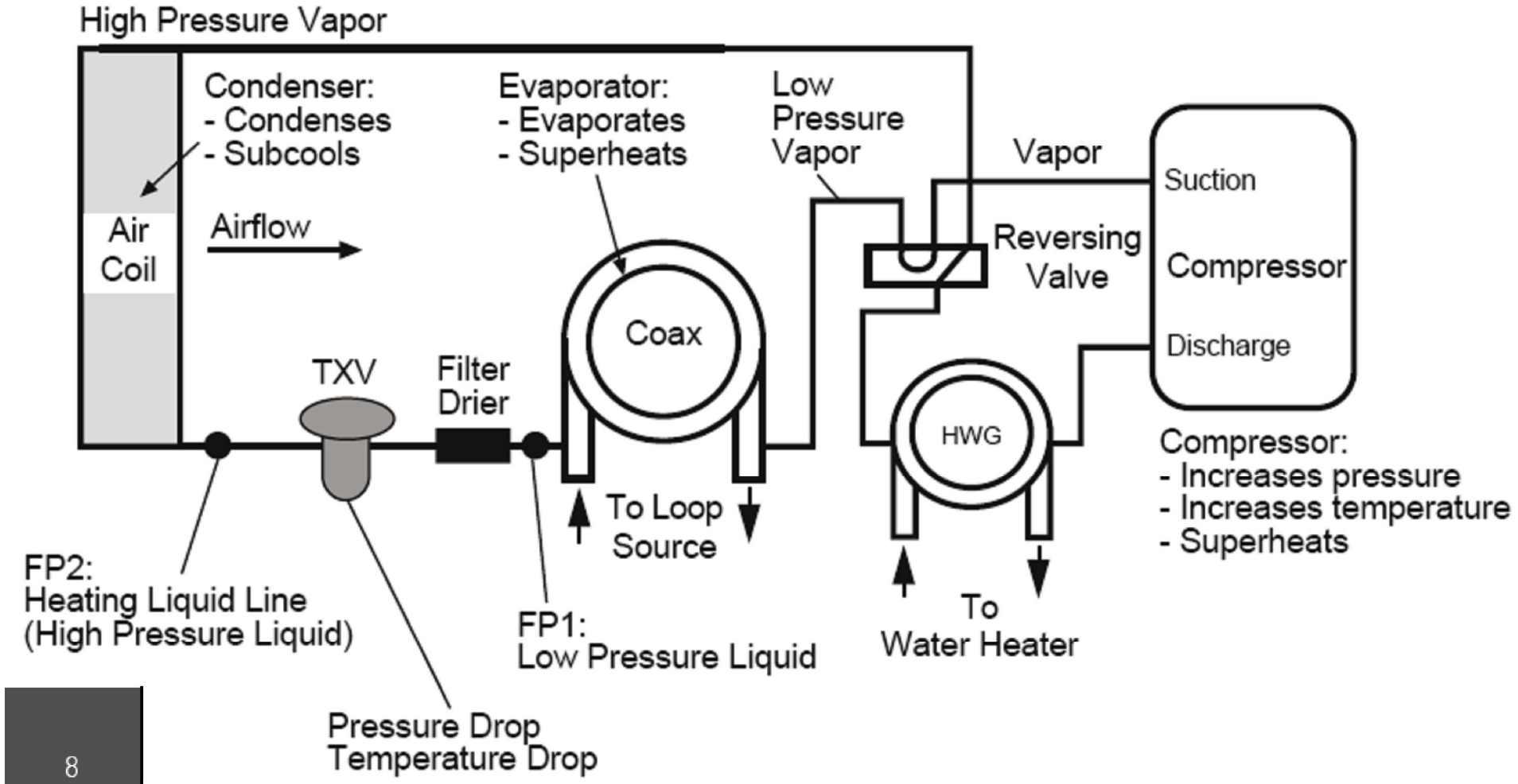
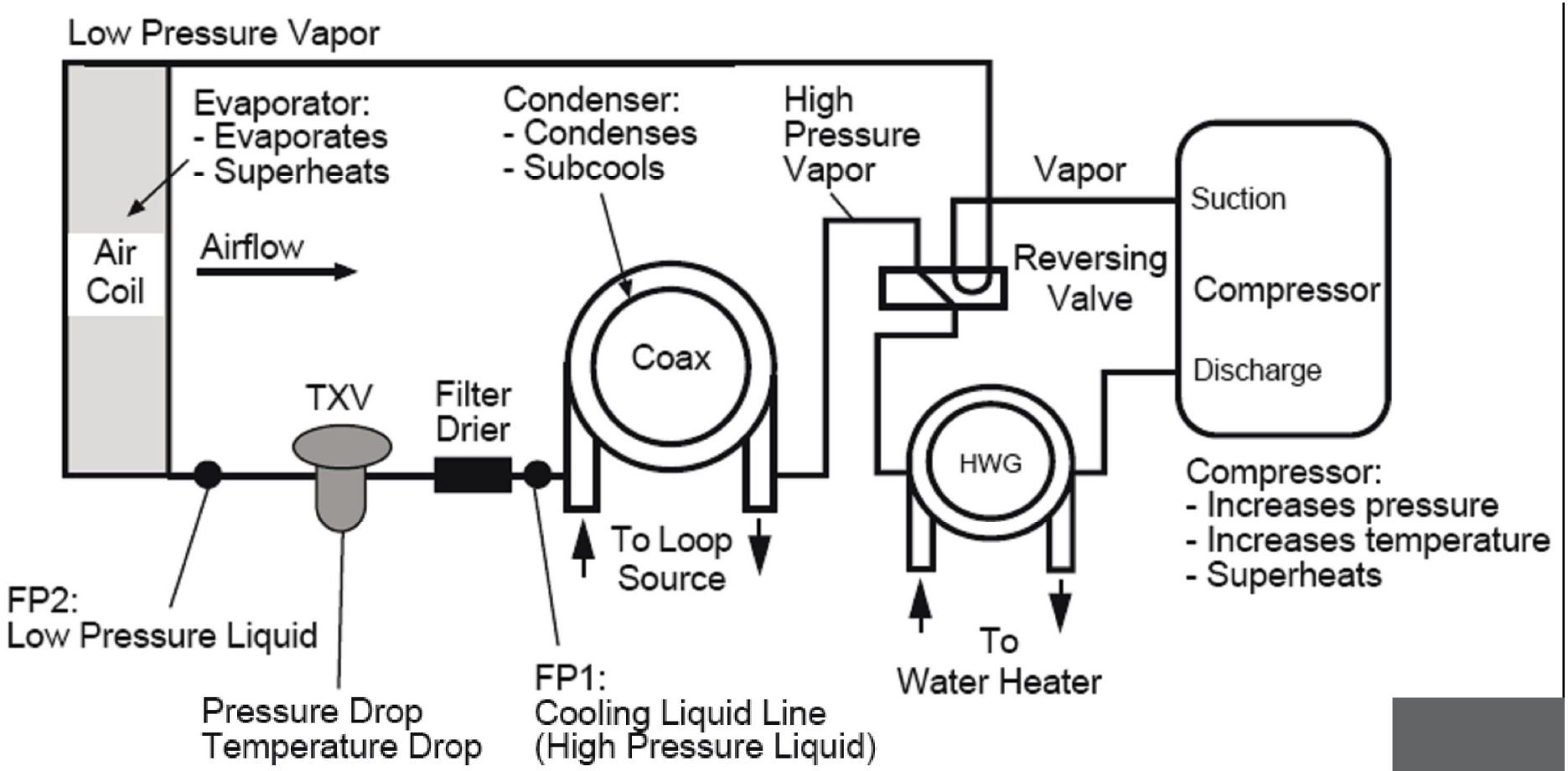
Look in Installation, Operation & Maintenance Manual for unit operating chart for the unit your working on

Typical Water Source Refrigeration Circuit Faults (Heating Cycle)



Typical Water Source Refrigeration Circuit Faults (Cooling Cycle)



HIGH PRESSURE FAULT

WATER FLOW IN COOLING MODE

Check flow and water temperature

AIR FLOW IN HEATING MODE

Check air flow and air temperature

OVERCHARGED WITH REFRIGERANT

Check sub cooling/superheat

BAD HIGH PRESSURE SWITCH

Ohm out switch

LOW PRESSURE FAULT

WATER FLOW IN HEATING MODE

Check flow and water temperature

AIR FLOW IN COOLING MODE

Check air flow and air temperature

INSUFFICIENT CHARGE

Check sub cool/superheat & look for leaks

LOW PRESSURE FAULT

INADEQUATE ANTIFREEZE LEVEL

Check antifreeze density with hydrometer

BAD LOW PRESSURE SWITCH

Ohm out switch

REFRIGERATION GUIDE

TROUBLESHOOTING	HEAD PRESSURE	SUCTION PRESSURE	COMP AMP DRAW	SUPER HEAT	SUB COOLING	AIR DELTA T	WATER DELTA T
LOW AIR FLOW HEATING	HIGH	HIGH	HIGH	HIGH/NORMAL	LOW	HIGH	LOW
LOW WATER FLOW HEATING	LOW/NORMAL	LOW/NORMAL	LOW	LOW	HIGH	LOW	HIGH
LOW EAT HEATING	LOW	LOW	LOW	NCRMAL	HIGH	NORMAL	HIGH/NORMAL
HIGH EAT HEATING	HIGH	HIGH	HIGH	NCRMAL/HIGH	NORMAL/LOW	LOW	NORMAL
HIGH AIR FLOW HEATING	LOW	LOW	LOW	LOW	HIGH	LOW	LOW
HIGH WATER FLOW HEATING	NORMAL	LOW	NORMAL	HIGH	NORMAL	NORMAL	LOW
SCALED COAXIAL HEATING	LOW	LOW	LOW	NCRMAL/LOW	HIGH	LOW	LOW
LOW AIR FLOW COO_ING	LOW	LOW	LOW	LOW/NORMAL	HIGH	HIGH	LOW
LOW WATER FLOW COOLING	HIGH	HIGH	HIGH	HIGH	LOW	LOW	HIGH
LOW EAT COOLING	LOW	LOW	LOW	NCRMAL/LOW	HIGH	LOW	LOW
HIGH AIR FLOW COOLING	LOW	HIGH	NORMAL	HIGH	LOW	LOW	NORMAL
HIGH WATER FLOW COOLING	LOW	LOW	LOW	LOW	HIGH	NORMAL	LOW
HIGH EAT COOLING	HIGH	HIGH	HIGH	HIGH	LOW	LOW	HIGH
SCALED COAXIAL CCOLING	HIGH	HIGH	HIGH	NCRMAL/LOW	LOW	LOW	LOW
UNDER CHARGED	LOW	LOW	LOW	HIGH	LOW	LOW	LOW
OVER CHARGED	HIGH	HIGH	HIGH	NCRMAL	HIGH	NORMAL/LOW	NORMAL
RESTRICTED TXV	HIGH	LOW	NORMAL/LOW	HIGH	HIGH	LOW	LOW
TXV BULB LOSS OF CHARGE	HIGH	LOW	LOW	HIGH	HIGH	LOW	LOW
TXV STUCK OPEN	LOW	HIGH	NORMAL/HIGH	LOW	LOW	LOW	LOW
COMPRESSOR VALVES	LOW	HIGH	LOW	HIGH	NORMAL/HIGH	LOW	LOW

Thank you for attending!