REFRIGERATION REVIEW

Air Units and Hand Expansion Valves

Over the years I occasionally run into a situation where it becomes a defining moment for the refrigeration cycle. To create the refrigerating effect in an evaporator, the pressure must be provided at a level below the saturated relationship of the refrigerant. More simply put, the pressure must be lowered below the boiling point of the refrigerant. If the pressure is higher than the boiling point of the fluid, evaporation no longer occurs. Direct expansion (DX) systems create the pressure drop required to permit the compressor suction to maintain pressure below the boiling point of the refrigerant. As is well known, the reverse is true in a condenser where the pressure is raised above the boiling point of the fluid, thereby causing the gas to condense from a gas to a liquid.

These are the fundamental relationships in the refrigeration cycle. The occurrence I want to describe quite often happens during the start up of a refrigeration system, and particularly during start up of an air unit. I have had several occasions where an air unit didn't respond as refrigeration technicians thought it should, and basically the air unit either wasn't responding, or didn't appear to have capacity. The natural response in a recirculated system is to open the hand expansion valve (HEV) to provide more refrigerant. HEVs have a wide range of capacity, and in order to create the refrigerating effect there must be a pressure drop across the HEV to permit the boiling point of the refrigerant to be reached. What I have seen on several occasions is the HEV being opened all the way (say, 5 turns), which would provide more liquid refrigerant, but also provide the refrigerant at a higher pressure. It would provide so much liquid that it would basically pressurize the coil with whatever recirculated pump pressure was being provided. If 20-30 psig was being provided for the liquid and it pressurized the coil circuits at 25-30 psig, then boiling and evaporation would not occur and you

would only have some sensible heat of the liquid being removed.

One of the best examples I can remember was an isolated air unit that had a 60’ branch line off the main header. Both the air unit and pipe were warm, and when the technician tried to start the air unit and couldn’t get a satisfactory response, he opened the HEV all the way, and between the liquid line being hot and flashing off, and the coil being hot, the coil became pressurized with liquid and would not refrigerate. I suggested the HEV be choked down to half a turn and wait several hours for the liquid line to cool off and the refrigerating effect to start taking place in the air unit which, in the next several hours did occur, and the unit did start responding to design temperatures. I have seen this occur in several startup situations, and time and time again I find the HEV has been opened wide open which would cause the coil to do what we call “live brining”, and not be able to reach the boiling point of the suction pressure.

Below is a chart showing the saturated temperature to pressure relationship for ammonia. For any given temperature on the chart, if the pressure is higher than that listed, the ammonia will not reach boiling point.

Temp F	Pressure	
	psia	psig
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-50	7.67	14.3*
-49	7.91	13.8*
-48	8.16	13.3*
-47	8.42	12.8*
-46	8.68	12.2*
-45	8.95	11.7*
-44	9.23	11.1*
-43	9.51	10.6*
-42	9.81	10.0*
-41	10.1	9.3*
-40	10.41	8.7*
-39	10.72	8.1*
-38	11.04	7.4*
-37	11.37	6.8*
-36	11.71	6.1*
-35	12.05	5.4*
-34	12.41	4.7*
-33	12.77	3.9*
-32	13.14	3.2*
-31	13.52	2.4*
-30	13.9	1.6*
-29	14.39	.8*
-28	**14.71**	**0**
-27	15.12	0.4
-26	15.55	0.8
-25	15.98	1.3
-24	16.24	1.7
-23	16.88	2.2
-22	17.34	2.6
-21	17.81	3.1
-20	18.39	3.6
-19	18.79	4.1
-18	19.3	4.6
-17	19.81	5.1
-16	20.34	5.6
-15	20.88	6.2
-14	21.43	6.7
-13	21.99	7.3
-12	22.56	7.9
-11	23.15	8.5
-10	23.74	9.0
-9	24.35	9.7
-8	24.97	10.3
-7	25.61	10.9
-6	26.26	11.6
-5	26.92	12.2
-4	27.59	12.9
-3	28.28	13.6
-2	28.93	14.3
-1	29.69	15.0
0	30.42	15.7
1	31.16	16.5
2	31.92	17.2
3	32.69	18.0
4	33.47	18.8
5	34.27	19.6
6	35.09	20.4
7	35.92	21.2
8	36.77	22.1
9	37.63	22.9
10	38.51	23.8
11	39.4	24.7
12	40.31	25.6
13	41.24	26.5
14	42.18	27.5
15	**43.14**	**28.4**
16	44.12	29.4
17	45.12	30.4
18	46.13	31.4
19	47.16	32.5
20	**48.21**	**33.5**
21	49.28	34.6
22	50.36	35.7
23	51.47	36.8
24	52.59	37.9
25	53.73	39.0
26	54.9	40.2
27	56.08	41.4
28	57.28	42.6
29	58.5	43.8
30	59.74	45.0
31	61	45.3
32	62.29	47.6
33	63.59	48.9
34	64.91	50.2
35	66.26	51.6
36	67.63	52.9
37	69.02	54.3
38	70.43	55.7
39	71.87	57.2
40	73.32	58.6
41	74.8	60.1
42	76.31	61.6
43	77.83	63.1
44	79.38	64.7
45	80.96	66.3
46	82.55	67.9
47	84.18	69.5
48	85.82	71.1
49	87.49	72.8