SHIPCO® PUMPS

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Properties of Saturated Steam

Source: Handbook of Chemistry & Physics

	Total pressure (Gauge pressure plus atmospheric pressure)		Heat of vaporization		Specific volume		
Temperature, degrees Centigrade	Torr	Pounds per square inch	Calories per kilogram	B.T.U. per pound	Cubic meters per kilo	Cubic feet per pound	Temperature, degrees Fahrenheit
0	4.579	0.0886	595.4	1071.7	206.3	3304	32
2	5.290	0.1023	594.4	1069.9	180.0	2884	35.6
4	6.097	0.1179	593.3	1068.0	157.2	2518	39.2
6	7.011	0.1356	592.3	1066.1	137.7	2206	42.8
8	8.042	0.1555	591.2	1064.2	120.9	1937	46.4
10	9.205	0.1780	590.2	1062.3	106.3	1703	50
12	10.513	0.2033	589.1	1060.4	93.7	1502	53.6
14	11.980	0.2317	588.1	1058.5	82.9	1327	57.2
16	13.624	0.2635	587.0	1056.6	73.3	1174	60.8
18	15.460	0.2990	585.9	1054.7	65.1	1041	64.4
20	17.51	0.3386	584.9	1052.8	57.8	926	68
22	19.79	0.3827	583.9	1051.0	51.5	824	71.6
24	22.32	0.4316	582.8	1049.1	45.92	735	75.2
26	25.13	0.4860	581.8	1047.2	41.05	657	78.8
28	28.25	0.5463	580.7	1045.2	36.74	589	82.4
30	31.71	0.6132	579.6	1043.3	32.95	528	86
32	35.53	0.6871	578.6	1041.4	29.62	474.7	89.6
34	39.75	0.7687	577.4	1039.4	26.62	426.5	93.2
36	44.40	0.8586	576.4	1037.5	23.98	384.2	96.8
38	49.51	0.9574	575.3	1035.5	21.65	346.8	100.4
40	55.13	1.0661	574.2	1033.5	19.57	313.5	104
42	61.30	1.1854	573.1	1031.5	17.69	283.3	107.6
44	68.05	1.3159	571.9	1029.4	16.01	256.5	111.2
46	75.43	1.4587	570.8	1027.4	14.54	233.0	114.8
48	83.50	1.6147	569.6	1025.3	13.21	211.7	118.4
50	92.30	1.7849	558.4	1023.2	12.02	192.6	122
52	101.88	1.9701	567.3	1021.2	10.96	175.5	125.6
54	112.30	2.172	566.2	1019.1	10.00	160.3	129.2
56	123.61	2.390	565.1	1017.1	9.14	146.5	132.8
58	135.89	2.627	563.9	1015.1	8.36	134.0	136.4
60	149.19	2.885	562.8	1013.1	7.66	122.8	140
62	163.58	3.163	561.7	1011.0	7.03	112.7	143.6
64	179.13	3.464	560.5	1008.9	6.46	103.5	147.2
66	195.92	3.789	559.3	1006.8	5.94	95.1	150.8
68	214.02	4.139	558.2	1004.7	5.47	87.6	154.4
70	233.53	4.516	556.9	1002.5	5.04	80.7	158
72	254.5	4.921	555.8	1000.4	4.647	74.4	161.6
74	277.1	5.358	554.6	998.3	4.294	68.8	165.2
76	301.3	5.826	553.4	996.2	3.973	63.7	168.8
78	327.2	6.327	552.3	994.1	3.676	58.8	172.4
80	355.1	6.867	551.1	991.9	3.404	54.5	176
82	384.9	7.443	549.9	989.8	3.156	50.6	179.6
84	416.7	8.058	548.7	987.6	2.929	46.92	183.2
86	450.8	8.717	547.4	985.4	2.723	43.62	186.8
88	487.1	9.419	546.2	983.2	2.534	40.59	190.4
90	525.8	10.167	544.9	980.9	2.358	37.77	194
92	567.1	10.966	543.7	978.7	2.197	35.19	197.6
94	611.0	11.815	542.5	976.5	2.050	32.86	201.2
96	657.7	12.718	541.2	974.2	1.913	30.67	204.8
98	707.3	13.678	539.9	971.9	1.787	28.64	208.4
100	760.0	14.697	538.7	969.7	1.671	26.78	212
102	815.9	15.778	537.4	967.3	1.564	25.06	215.6
104	875.1	16.923	536.2	965.1	1.465	23.47	219.2
106	937.9	18.137	534.9	962.8	1.374	22.01	222.8
108	1004.3	19.420	533.6	960.5	1.289	20.64	226.4
110	1074.5	20.777	532.3	958.1	1.209	19.37	230

NPSH *Net Positive Suction Head as related to Condensate and Boiler Feed Pumps*

The available NPSH is essentially the measure of how close the water in the suction passage of the pump is to boiling, with the attendant formation of steam within the impeller, thus diminishing the pump's performance.

Water boils at 212˚F at sea level because the vapor pressure at 212˚F is equal to the atmospheric pressure, that is 14.7PSI absolute, or 14.7PSIA. If this condition occurred in the pump suction, the available NPSH would be zero (Fig. 1).

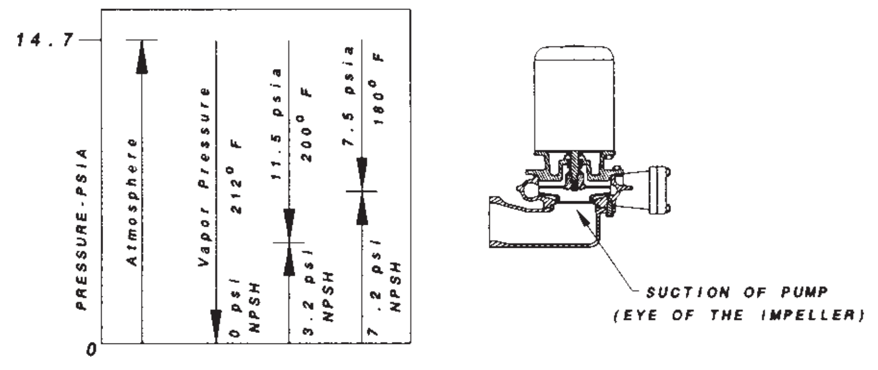

FIG. 1

The vapor pressure of water for any temperature can be obtained from steam tables. The vapor pressure for 200˚F is 11.5PSI, so 14.7 - 11.5 = 3.2PSI NPSH. It is conventional to express NPSH in FT. of water and as 1PSI = 2.31 FT., then 3.2PSI X 2.31 FT./PSI = 7.39 FT. In a similar example, the vapor pressure for 180˚F is 7.5PSI, so the NPSH equals 14.7 - 7.5 = 7.2PSI, then 7.2PSI X 2.31 FT./PSI = 16.63FT. NPSH (Fig.1).

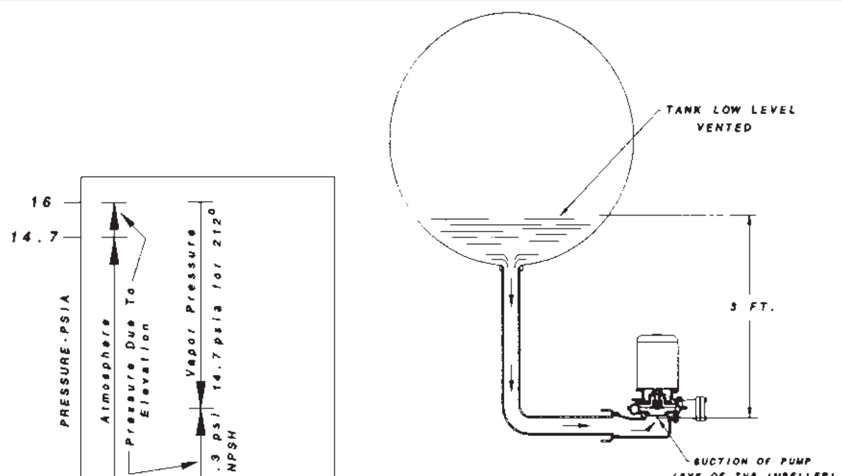

FIG. 2

In a steam system where steam traps are leaking or where there is reevaporation through high pressure traps, or where heating is done in a deaerating boiler feed pump, condensate can go to 212˚F, but no higher as long as the tank holding the water is vented to atmospheric pressure. Since these temperatures are frequently encountered, a very good way to increase the NPSH available to the pump is to elevate the tank above the pump with the temperature being the same 212˚F, thus increasing the static pressure on the suction. In (Fig. 2) a 1.3PSI increase in pressure is assumed for example. The elevation and the NPSH would be 1.3PSI X 2.31 FT./PSI = 3FT.

We have been considering the NPSH **available** to the pump, but various physical designs of pumps have various NPSH **requirements.** A conventional pump with an 8 or 10FT. NPSH requirement means the tank needs to be elevated about 1 floor above the pump to work well. A specially designed hot water pump with an NPSH requirement of 2 or 3FT. requires substantially less elevation of the tank.

In the case of a tank such as a deaerating boiler feed pump that is operating at 5.3PSI gauge pressure (above atmosphere), the pressure in the tank would be 14.7PSI + 5.3PSI (or) 20PSI absolute. This is also the vapor pressure of the boiling water with a temperature of 228˚F. Since the total pressure is higher, but the vapor pressure is increased by the same amount, the receiver in (Fig. 3) needs to be elevated for the static pressure to provide the required NPSH of pump. The only NPSH, or pressure available to the pump is the static pressure. The internal pressure is offset by the vapor pressure.

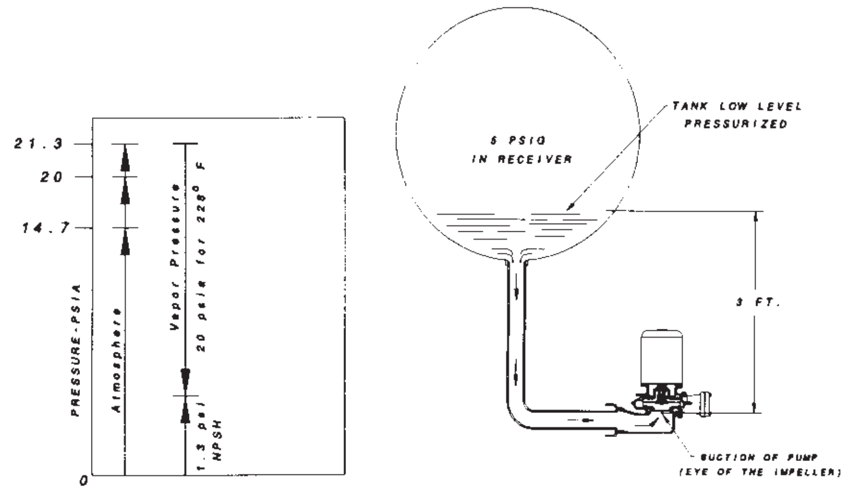

FIG.3

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