Table 9. Weight of Saturated and Partly Saturated Air[a]

Dry-Bulb Temp Deg F	Weight of Saturated Air for Various Barometric and Hygrometric Conditions—Pounds per Cubic Foot							Approx. Average Increase in Weight per Deg Wet-Bulb Depression
	Barometric Pressure Inches of Mercury						Increase In Weight Per 0.1 in. Rise in Barometer	
	28.5	29.0	29.5	30.0	30.5	31.0		
30	0.07703	0.07839	0.07974	0.08110	0.08245	0.08381	0.00027	0.000017
32	0.07671	0.07806	0.07940	0.08075	0.08210	0.08345	0.00027	0.000017
34	0.07638	0.07772	0.07907	0.08041	0.08175	0.08310	0.00027	0.000018
36	0.07605	0.07739	0.07873	0.08007	0.08141	0.08274	0.00027	0.000018
38	0.07573	0.07706	0.07840	0.07973	0.08106	0.08239	0.00027	0.000019
40	0.07541	0.07674	0.07806	0.07939	0.08072	0.08205	0.00027	0.000019
42	0.07509	0.07641	0.07773	0.07905	0.08038	0.08170	0.00026	0.000020
44	0.07477	0.07609	0.07740	0.07872	0.08004	0.08135	0.00026	0.000020
46	0.07445	0.07576	0.07707	0.07838	0.07970	0.08101	0.00026	0.000021
48	0.07413	0.07544	0.07674	0.07805	0.07936	0.08066	0.00026	0.000021
50	0.07381	0.07512	0.07642	0.07772	0.07902	0.08032	0.00026	0.000022
52	0.07350	0.07479	0.07609	0.07739	0.07868	0.07998	0.00026	0.000023
54	0.07318	0.07447	0.07576	0.07706	0.07835	0.07964	0.00026	0.000023
56	0.07287	0.07415	0.07544	0.07673	0.07801	0.07930	0.00026	0.000024
58	0.07255	0.07383	0.07512	0.07640	0.07768	0.07896	0.00026	0.000025
60	0.07224	0.07352	0.07479	0.07607	0.07734	0.07862	0.00026	0.000026
62	0.07193	0.07320	0.07447	0.07574	0.07701	0.07828	0.00026	0.000027
64	0.07161	0.07288	0.07414	0.07541	0.07668	0.07794	0.00026	0.000028
66	0.07130	0.07256	0.07382	0.07508	0.07634	0.07760	0.00026	0.000029
68	0.07098	0.07224	0.07350	0.07475	0.07601	0.07727	0.00026	0.000030
70	0.07067	0.07192	0.07317	0.07442	0.07568	0.07693	0.00026	0.000031
72	0.07035	0.07160	0.07285	0.07410	0.07534	0.07659	0.00025	0.000032
74	0.07004	0.07128	0.07252	0.07377	0.07501	0.07625	0.00025	0.000033
76	0.06972	0.07096	0.07220	0.07343	0.07467	0.07591	0.00025	0.000034
78	0.06940	0.07064	0.07187	0.07310	0.07434	0.07557	0.00025	0.000036
80	0.06909	0.07032	0.07155	0.07277	0.07400	0.07523	0.00025	0.000037
82	0.06877	0.07000	0.07122	0.07244	0.07366	0.07489	0.00024	0.000039
84	0.06845	0.06967	0.07089	0.07211	0.07333	0.07454	0.00024	0.000040
86	0.06812	0.06934	0.07056	0.07177	0.07299	0.07420	0.00024	0.000042
88	0.06780	0.06901	0.07022	0.07143	0.07264	0.07385	0.00024	0.000043
90	0.06748	0.06868	0.06989	0.07109	0.07230	0.07351	0.00024	0.000045
92	0.06715	0.06835	0.06955	0.07075	0.07195	0.07316	0.00024	0.000047
94	0.06682	0.06801	0.06921	0.07041	0.07161	0.07280	0.00024	0.000049
96	0.06648	0.06768	0.06887	0.07006	0.07126	0.07245	0.00024	0.000051
98	0.06615	0.06734	0.06853	0.06972	0.07091	0.07209	0.00024	0.000053
100	0.06581	0.06700	0.06818	0.06937	0.07055	0.07174	0.00024	0.000055

[a]Approximate average decrease in weight per 0.1 F rise in dry-bulb temperature equals 0.000017 lb per cubic foot.

32 F; and the relative proportions of the three phases depend upon the location of the state point within the wedge. Below the wedge, the mixture consists of saturated vapor and saturated solid.

The curved lines in the single vapor-phase region to the right of the saturation curve are lines of constant per cent saturation. Lines of constant dew-point are, of course, horizontal straight lines of constant humidity ratio. At point B, for example, the dry-bulb temperature is 60 F, the thermodynamic wet-bulb is 50 F, the dew-point is 40.8 F, the degree of saturation is 48.6 per cent, the humidity ratio is 0.00536 lb per pound dry air, and the enthalpy is $14.85 + (1000 \times 0.00536) = 20.21$ Btu per pound dry air.

With the aid of the Mollier diagram, it is easy to throw the definition of thermodynamic wet-bulb, Equation 20, into a more familiar form. Consider the three points 1, 2, 3, Fig. 2. Point 3 is located with respect to points 1 and 2 so that $W_3 = W_1$ and $t_3 = t_2$. Points 1 and 2, being on

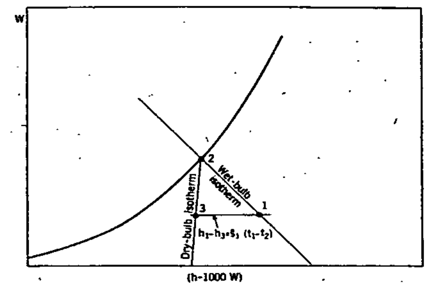

Fig. 2. Diagram Illustrating Thermodynamic Wet-Bulb Temperature

a line of constant thermodynamic wet-bulb, satisfy Equation 20; thus,

$$h_1 - h_3 + (W_2 - W_1)\, h'_{w,2} = h_2 - h_3$$

where h_3 has been subtracted from both sides. Under Dalton's Law, $h_2 - h_3 = (W_2 - W_1)\, h_{w,2}$; moreover, $h_1 - h_3$ may be replaced by $\bar{s}_1 (t_1 - t_2)$ where $\bar{s}_1$ is often referred to as *mean humid heat* and may be calculated with good approximation from

$$\bar{s}_1 = 0.240 + 0.444\, W_1 \qquad (21)$$

Finally, introducing latent heat of vaporization at the wet-bulb temperature, namely, $(h_{fg})_2 = (h_w - h'_w)_2$, Equation 20 becomes, after omitting the subscript 2,

$$\frac{t_1 - t'}{W_s - W_1} = \frac{h_{fg}}{\bar{s}_1} \qquad (22)$$

it being understood that W_s is the saturation humidity ratio and h_{fg}, the latent heat, at the wet-bulb temperature t'. Equation 22 was derived by Carrier [1].

Example 12. Work Example 10 using Equation 22.

Solution. A trial-by-error method is involved. Taking 48 F as a trial value of t', $(80 - 48) \div (0.007072 - 0) = 4520$; but $1066.7 \div 0.240 = 4440$. The trial value must, therefore, be revised upward, the final solution being 48.26 F as in Example 10.