

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

^aApproximate average decrease in weight per 0.1 F rise in dry-bulb temperature equals 0.000017 lb per cubic foot.

pound of dry air. Since most air conditioning processes are of the steady flow type in which the thermal energy convected with the fluid is its enthalpy, the third is most simply expressed in terms of enthalpy per pound of dry air. It is clear, therefore, that humidity ratio W and enthalpy per pound of dry air h are fundamental coordinates. Their use for the purpose of graphical representation is due to Mollier [3]. A convenient modification of the Mollier diagram devised by Goff is obtained by taking humidity ratio W as ordinate and *reduced enthalpy* ($h - 1000W$) as abscissa, as shown in the chart enclosed in the envelope attached to the inside back cover of this book.

The reasons for the use of the difference ($h - 1000W$) as abscissa instead of h itself in the Mollier Diagram for Moist Air are the following:

(1) it amounts to plotting on oblique coordinates and thus reduces to convenient proportions a diagram which would otherwise take the form of a scroll; (2) by the choice of the factor 1000 the necessary multiplication reduces to shifting the decimal point; (3) the ease with which the ordinate W can be multiplied by 1000 and added to the abscissa to obtain the enthalpy h makes it unnecessary to complicate the chart by a family of isenthalpic lines.

In the Mollier diagram, the lines inclined upward and slightly to the right are lines of constant (dry-bulb) temperature. They are straight under Dalton's Law but actually have slight curvature. The lines inclined upward to the left are lines of constant thermodynamic wet-bulb and are straight by definition. The dry-bulb and wet-bulb lines meet at the saturation curve and coincide in the region to the left of this curve. This region is divided into three sub-regions by the narrow *wedge* with apex at the junction of the 32 F wet-bulb and dry-bulb lines. Above the wedge, the mixture consists of two distinct phases, saturated vapor and saturated liquid. At point A, for example, the temperature is 60 F and the vapor phase contains 0.01103 lb of water vapor per pound of dry air from

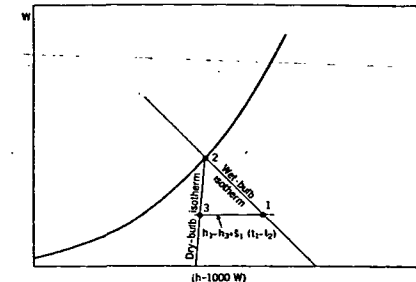


FIG. 2. DIAGRAM ILLUSTRATING THERMODYNAMIC WET-BULB TEMPERATURE

Table 6. From the Mollier diagram, $W = 0.016$ lb, leaving 0.00497 lb per pound dry air in the liquid phase. The total enthalpy of the mixture is $10.51 + (1000 \times 0.016) = 26.51$ Btu per pound dry air of which $15.34 + (1000 \times 0.01103) = 26.37$ Btu per pound dry air is contributed by the vapor phase.

Within the wedge, the mixture consists of three distinct phases, saturated vapor, saturated solid and saturated liquid. The temperature is 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