TABLE NO. 3

WEIGHTS OF SATURATED AND PARTLY SATURATED AIR FOR VARIOUS BAROMETRIC AND HYGROMETRIC CONDITIONS—Pounds per Cubic Foot

Dry Bulb Temperature Degrees Fahr.	Barometric Pressure—Inches: 26			27			28			29			30			Approx. Aver'g Increase in Weight per Degree Wet Bulb Depression
	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Incr's Wt. per 0.1" Rise in Bar.	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Incr's Wt. per 0.1" Rise in Bar.	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Incr's Wt. per 0.1" Rise in Bar.	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Incr's Wt. per 0.1" Rise in Bar.	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Incr's Wt. per 0.1" Rise in Bar.	
0	.07500	.00016	.00029	.07788	.00016	.00029	.08077	.00017	.00029	.08365	.00018	.00029	.08654	.00019	.00029	.000015
10	.07338	.00016	.00028	.07620	.00016	.00028	.07903	.00017	.00028	.08185	.00018	.00028	.08468	.00018	.00028	.000016
20	.07180	.00016	.00028	.07456	.00016	.00028	.07733	.00017	.00028	.08009	.00018	.00028	.08286	.00018	.00028	.000017
30	.07027	.00015	.00027	.07297	.00016	.00027	.07569	.00016	.00027	.07839	.00017	.00027	.08110	.00017	.00027	.000019
40	.06879	.00015	.00026	.07143	.00015	.00027	.07409	.00016	.00027	.07675	.00016	.00027	.07942	.00017	.00027	.000021
50	.06732	.00015	.00026	.06992	.00015	.00026	.07252	.00016	.00026	.07512	.00016	.00026	.07773	.00016	.00026	.000023
60	.06588	.00015	.00026	.06843	.00015	.00026	.07098	.00015	.00026	.07353	.00016	.00026	.07609	.00016	.00026	.000026
70	.06442	.00015	.00025	.06692	.00015	.00025	.06943	.00015	.00025	.07193	.00016	.00025	.07440	.00016	.00025	.000029
80	.06297	.00015	.00025	.06542	.00015	.00025	.06789	.00015	.00025	.07034	.00015	.00025	.07280	.00016	.00025	.000034
90	.06146	.00015	.00024	.06388	.00016	.00024	.06629	.00016	.00024	.06870	.00016	.00024	.07112	.00017	.00024	.000039
100	.05991	.00016	.00024	.06228	.00016	.00024	.06465	.00016	.00024	.06703	.00017	.00024	.06939	.00018	.00024	.000044
110	.05828	.00016	.00023	.06060	.00017	.00023	.06293	.00017	.00023	.06526	.00018	.00023	.06759	.00019	.00023	.000051
120	.05653	.00018	.00023	.05882	.00018	.00023	.06111	.00018	.00023	.06339	.00019	.00023	.06569	.00020	.00023	.000059
130	.05467	.00019	.00023	.05692	.00019	.00023	.05917	.00019	.00023	.06142	.00020	.00023	.06367	.00022	.00023	.000068
140	.05262	.00021	.00022	.05483	.00021	.00022	.05704	.00021	.00022	.05925	.00022	.00022	.06147	.00024	.00022	.000078
150	.05036	.00023	.00022	.05253	.00023	.00022	.05471	.00023	.00022	.05689	.00024	.00022	.05906	.00026	.00022	.000090
160	.04788	.00025	.00022	.05001	.00025	.00022	.05216	.00026	.00021	.05430	.00026	.00021	.05644	.00029	.00021	.000103
170	.04509	.00028	.00021	.04720	.00028	.00021	.04931	.00029	.00021	.05141	.00031	.00021	.05352	.00033	.00021	.000118
180	.04197	.00031	.00021	.04404	.00031	.00021	.04611	.00032	.00021	.04818	.00034	.00021	.05026	.00036	.00021	.000134
190	.03845	.00035	.00021	.04049	.00036	.00021	.04253	.00036	.00021	.04457	.00037	.00021	.04662	.00038	.00021	.000153
200	.03449	.00040	.00020	.03650	.00040	.00020	.03851	.00040	.00020	.04052	.00041	.00020	.04254	.00041	.00020	.000173

Example. As an example of the use of the table No. 3 we will assume a case where it is desired to find the weight in pounds per cubic foot of air at a temperature of 83° dry- and 68° wet-bulb (or a depression of 15°) when the barometric pressure is 29.40 inches. From the table No. 3 we find that the weight of saturated air at 80° and 29.00 inch barometer is 0.07034 lb. per cu. ft. Also the decrement to be subtracted is 0.00015 lb. per degree of temperature above 80°. That is, the weight at 83° and 29.00 inches would be 0.07034 — $(3 \times 0.00015) = 0.06989$ lb. per cu. ft. The increment is to be added per 0.1" increase in barometer above 29.00 inches is 0.00025, so that the weight of the saturated mixture at 83° and 29.40 inches will be $0.06989 + (4 \times 0.00025) =$ 0.07089 lb. per cu. ft. From the last column in the table we find the increase in weight for each degree wet-bulb depression for a temperature of 83° to be $0.000034 + 0.3 \ (0.000039 - 0.000034) = 0.0000355$.

Then the weight of moist air at 83°, 15° wet-bulb depression, and 29.40 inch barometer will be

$$0.07034 - 0.00045 + 0.001 + 0.00053 = 0.07142 \text{ lb. per cu. ft.}$$

Specific Heat of Air

The specific heat of air is the ratio of the heat required to raise the temperature of a given weight of air through one degree as compared to the heat required to raise the temperature of the same weight of water from 62 to 63 degrees Fahr., i. e., it is the B. t. u. required to raise one pound of air one degree Fahr.

The specific heat of air may be expressed as either of two factors, specific heat at constant pressure or at constant volume. It is the specific heat at constant pressure that is ordinarily referred to. The factors commonly used heretofore have been those determined by Renault—specific heat at constant pressure $= 0.2375$, and at constant volume $= 0.1689$. But recent investigation tends to show that the value 0.2375 is too low, and that it should be $C_p = 0.24112 + 0.000009\,t$ or for ordinary purposes approximately 0.2415.*

For the specific heats of various substances see the table on page 15(.

Relation of Velocity to Pressure

The laws governing the flow or air are perhaps less understood than almost any other branch of engineering data. The flow of air under high pressures must necessarily be investigated thermodynamically and the formulae are more or less complicated. For ordinary fan work, however, where air is at low pressure but slight error is introduced if the same formulae are applied to the flow of air as are commonly used for the flow of water. The basic formula for such calculations is

$$V_s = \sqrt{2gh} \qquad (10)$$

where V_s = velocity in ft. per second, or

$$V = 60\sqrt{2\,gh} \qquad (11)$$

where V = velocity in ft. per min.

g = acceleration due to gravity in feet per second

h = head in ft. causing flow

But we also have

$$h = h'\frac{d}{12W} \qquad (12)$$

where h' = head expressed in in. of water

d = density of water

W = weight of air in lbs. per cu. ft.

* "Rational Psychrometric Formulae," by Willis H. Carrier, Am. Soc. Mech. Engrs., December, 1911, also W. F. G. Swan, Phil. Trans. Royal Soc., Series A, Vol. 210, pp. 199-238.