Table 3. Weights of Saturated and Partly Saturated Air for Various Barometric and Hygrometric Conditions[a,b]

Pounds per Cubic Foot

Dry-Bulb Temperature Deg F	Barometric Pressure—Inches 26: Wt. per Cu Ft Saturated Air	26: Decr's Wt. per Deg Inc. Dry-Bulb	26: Incr's Wt. per 0.1" Rise in Bar.	27: Wt. per Cu Ft Saturated Air	27: Decr's Wt. per Deg Inc. Dry-Bulb	27: Incr's Wt. per 0.1" Rise in Bar.	28: Wt. per Cu Ft Saturated Air	28: Decr's Wt. per Deg Inc. Dry-Bulb	28: Incr's Wt. per 0.1" Rise in Bar.	29: Wt. per Cu Ft Saturated Air	29: Decr's Wt. per Deg Inc. Dry-Bulb	29: Incr's Wt. per 0.1" Rise in Bar.	30: Wt. per Cu Ft Saturated Air	30: Decr's Wt. per Deg Inc. Dry-Bulb	30: Incr's Wt. per 0.1" Rise in Bar.	Approx. Average Increase in Weight per Deg Wet-Bulb Depression
0	0.07500	0.00016	0.00029	0.07788	0.00016	0.00029	0.08077	0.00017	0.00029	0.08365	0.00018	0.00029	0.08654	0.00019	0.00029	0.000015
10	0.07338	0.00016	0.00028	0.07620	0.00016	0.00028	0.07903	0.00017	0.00028	0.08185	0.00018	0.00028	0.08468	0.00018	0.00028	0.000016
20	0.07180	0.00016	0.00028	0.07456	0.00016	0.00028	0.07733	0.00017	0.00028	0.08009	0.00018	0.00028	0.08286	0.00018	0.00028	0.000017
30	0.07027	0.00015	0.00027	0.07297	0.00016	0.00027	0.07569	0.00016	0.00027	0.07839	0.00017	0.00027	0.08110	0.00017	0.00027	0.000019
40	0.06879	0.00015	0.00026	0.07143	0.00015	0.00027	0.07409	0.00016	0.00027	0.07675	0.00016	0.00027	0.07942	0.00017	0.00027	0.000021
50	0.06732	0.00015	0.00026	0.06992	0.00015	0.00026	0.07252	0.00016	0.00026	0.07512	0.00016	0.00026	0.07773	0.00016	0.00026	0.000023
60	0.06588	0.00015	0.00026	0.06843	0.00015	0.00026	0.07098	0.00015	0.00026	0.07353	0.00016	0.00026	0.07609	0.00016	0.00026	0.000026
70	0.06442	0.00015	0.00025	0.06692	0.00015	0.00025	0.06943	0.00015	0.00025	0.07193	0.00016	0.00025	0.07440	0.00016	0.00025	0.000029
80	0.06297	0.00015	0.00025	0.06542	0.00015	0.00025	0.06789	0.00015	0.00025	0.07034	0.00015	0.00025	0.07280	0.00016	0.00025	0.000034
90	0.06146	0.00015	0.00024	0.06388	0.00016	0.00024	0.06629	0.00016	0.00024	0.06870	0.00016	0.00024	0.07112	0.00017	0.00024	0.000039
100	0.05991	0.00016	0.00024	0.06228	0.00016	0.00024	0.06465	0.00016	0.00024	0.06703	0.00017	0.00024	0.06939	0.00018	0.00024	0.000044
110	0.05828	0.00016	0.00023	0.06060	0.00017	0.00023	0.06293	0.00017	0.00023	0.06526	0.00018	0.00023	0.06759	0.00019	0.00023	0.000051
120	0.05653	0.00018	0.00023	0.05882	0.00018	0.00023	0.06111	0.00018	0.00023	0.06339	0.00019	0.00023	0.06569	0.00020	0.00023	0.000059
130	0.05467	0.00019	0.00023	0.05692	0.00019	0.00023	0.05917	0.00019	0.00023	0.06142	0.00020	0.00023	0.06367	0.00022	0.00023	0.000068
140	0.05262	0.00021	0.00022	0.05483	0.00021	0.00022	0.05704	0.00021	0.00022	0.05925	0.00022	0.00022	0.06147	0.00024	0.00022	0.000078
150	0.05036	0.00023	0.00022	0.05253	0.00023	0.00022	0.05471	0.00023	0.00022	0.05689	0.00024	0.00022	0.05906	0.00026	0.00022	0.000090
160	0.04788	0.00025	0.00022	0.05001	0.00025	0.00022	0.05216	0.00026	0.00021	0.05430	0.00026	0.00021	0.05644	0.00029	0.00021	0.000103
170	0.04509	0.00028	0.00021	0.04720	0.00028	0.00021	0.04931	0.00029	0.00021	0.05141	0.00031	0.00021	0.05352	0.00033	0.00021	0.000118
180	0.04197	0.00031	0.00021	0.04404	0.00031	0.00021	0.04611	0.00032	0.00021	0.04818	0.00034	0.00021	0.05026	0.00036	0.00021	0.000134
190	0.03845	0.00035	0.00021	0.04049	0.00036	0.00021	0.04253	0.00036	0.00021	0.04457	0.00037	0.00021	0.04662	0.00038	0.00021	0.000153
200	0.03449	0.00040	0.00020	0.03650	0.00040	0.00020	0.03851	0.00040	0.00020	0.04052	0.00041	0.00020	0.04254	0.00041	0.00020	0.000173

[a]From *Fan Engineering.*

[b]A convenient and accurate chart for quickly determining the weight of air under any condition of dry-bulb, wet-bulb, and pressure is *A Chart for Determining the Weight of Moist Air in Pounds per Cubic Foot,* by John E. Younger. Published in *Mechanical Engineering,* June, 1925.

pressure and volume of a gas is a constant, or $PV = C$, when T is kept constant. Any change in the pressure and volume of a gas at constant temperature is called an *isothermal change.*

Charles' Law refers to the relation among pressure, volume, and temperature of a gas and may be stated as follows: *The volume of a given weight of gas varies directly as the absolute temperature at constant pressure, and the pressure varies directly as the absolute temperature at constant volume.* Hence, when heat is added at constant volume, V_c, the resulting equation is $\frac{P_2}{P_1} = \frac{T_2}{T_1}$, or, for the same temperature range at constant pressure, P_c, the relation is $\frac{V_2}{V_1} = \frac{T_2}{T_1}$.

In general, for any weight of gas, W, since volume is proportional to weight, the relation among P, V, and T is

$$PV = WRT \tag{3}$$

where

P = the absolute pressure of the gas, pounds per square foot.
V = the volume of the weight W, cubic feet.
W = the weight of the gas, pounds.
R = a constant depending on the nature of the gas. The average value of R for air is 53.34.
T = the absolute temperature, degrees Fahrenheit.

This is the characteristic equation for a perfect gas, and while no gases are perfect in this sense, they conform so nearly that Equation 3 will apply to most engineering computations.

HUMIDITY

Humidity is the water vapor mixed with dry air in the atmosphere. *Absolute humidity* has a multiplicity of meanings, but usually the term refers to the weight of water vapor per unit volume of space occupied, expressed in grains or pounds per cubic foot. With this meaning, absolute humidity is nothing but the actual density of the water vapor in the mixture and might better be so called. A study of Keenan's Steam Tables[2] indicates that water vapor, either saturated or super-heated, at partial pressures lower than 4 in. of mercury may be treated as a gas with a gas constant R of 1.21 in the characteristic equation of the gas $pV = wR\,(t + 460)$. Within such limits, the density (d) of water vapor is

$$d = \frac{w}{V} = \frac{e}{1.21\,(t + 460)} \text{ (pounds per cubic foot)} \tag{4a}$$

$$= \frac{5785\,e}{t + 460} \text{ (grains per cubic foot)} \tag{4b}$$

where

e = actual partial pressure of vapor, inches of mercury.
t = dry-bulb temperature, degrees Fahrenheit.

[2]Published by *American Society of Mechanical Engineers,* see abstract in Table 6.