

TABLE 3. WEIGHTS OF SATURATED AND PARTLY SATURATED AIR FOR VARIOUS BAROMETRIC AND HYGROMETRIC CONDITIONS, b
Pounds per Cubic Foot

Dry-Bulb Temperature Above Dew Point	Barometric Pressure—Inches												Approx. Average Increase in Weight per Cubic Foot per 0.1° Rise in Bar.			
	26			27			28			29				30		
	Wt. per Cu. Ft. Sat. unat. Air	Deer's Wt. Inc. Dry-Bulb	Incr's Wt. per 0.1° Rise in Bar.	Wt. per Cu. Ft. Sat. unat. Air	Deer's Wt. Inc. Dry-Bulb	Incr's Wt. per 0.1° Rise in Bar.	Wt. per Cu. Ft. Sat. unat. Air	Deer's Wt. Inc. Dry-Bulb	Incr's Wt. per 0.1° Rise in Bar.	Wt. per Cu. Ft. Sat. unat. Air	Deer's Wt. Inc. Dry-Bulb	Incr's Wt. per 0.1° Rise in Bar.		Wt. per Cu. Ft. Sat. unat. Air	Deer's Wt. Inc. Dry-Bulb	Incr's Wt. per 0.1° Rise in Bar.
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	0.00015
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	0.00016
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	0.00017
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	0.00019
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	0.00021
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	0.00023
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	0.00026
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	0.00029
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	0.00034
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	0.00039
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	0.00044
110	0.05838	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	0.00051
120	0.05683	0.00018	0.00023	0.05892	0.00018	0.00023	0.06111	0.00018	0.00023	0.06339	0.00019	0.00023	0.06569	0.00020	0.00023	0.00059
130	0.05526	0.00019	0.00023	0.05728	0.00019	0.00023	0.05917	0.00019	0.00023	0.06142	0.00020	0.00023	0.06367	0.00022	0.00023	0.00068
140	0.05367	0.00021	0.00022	0.05563	0.00021	0.00022	0.05704	0.00021	0.00022	0.05925	0.00022	0.00022	0.06147	0.00024	0.00022	0.00078
150	0.05203	0.00023	0.00022	0.05393	0.00023	0.00022	0.05541	0.00023	0.00022	0.05769	0.00024	0.00022	0.05996	0.00026	0.00022	0.00090
160	0.04988	0.00025	0.00022	0.05178	0.00025	0.00022	0.05321	0.00026	0.00021	0.05549	0.00029	0.00021	0.05764	0.00032	0.00021	0.00103
170	0.04788	0.00028	0.00021	0.04972	0.00028	0.00021	0.04931	0.00029	0.00021	0.05141	0.00031	0.00021	0.05352	0.00033	0.00021	0.00118
180	0.04597	0.00031	0.00021	0.04780	0.00031	0.00021	0.04611	0.00032	0.00021	0.04818	0.00034	0.00021	0.05026	0.00036	0.00021	0.00134
190	0.04419	0.00035	0.00021	0.04603	0.00036	0.00021	0.04423	0.00036	0.00021	0.04657	0.00037	0.00021	0.04862	0.00038	0.00021	0.00153
200	0.04249	0.00040	0.00020	0.04436	0.00040	0.00020	0.04251	0.00040	0.00020	0.04482	0.00041	0.00020	0.04687	0.00041	0.00020	0.00173

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.

CHAPTER 1—FUNDAMENTALS OF HEATING AND AIR CONDITIONING

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

$$PV = WRT \quad (3)$$

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 Tables² 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 (δ) of water vapor is

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

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

where

e = actual partial pressure of vapor, inches of mercury.

t = dry-bulb temperature, degrees Fahrenheit.

²Published by American Society of Mechanical Engineers, see abstract in Table 7.