TABLE NO. 6

CORRESPONDING VELOCITIES FOR DRY AIR AT VARIOUS PRESSURES AND TEMPERATURES 29.92 INCHES BAROMETER

Pressure		Temperature Degrees Fahr.									
Ounces	Inches	50°	60°	70°	80°	100°	150°	200°	300°	500°	550°
.1	.1734	1635	1653	1667	1683	1714	1788	1860	1996	2244	2410
.2	.3468	2313	2338	2358	2380	2424	2530	2632	2824	3174	3405
.3	.5202	2833	2864	2888	2915	2969	3098	3223	3458	3887	4175
.4	.6936	3272	3307	3335	3367	3428	3578	3722	3994	4489	4850
.5	.8670	3658	3698	3729	3765	3833	4000	4162	4466	5019	5395
.6	1.0400	4007	4051	4085	4124	4199	4382	4559	4892	5498	5900
.7	1.2140	4329	4375	4412	4454	4535	4733	4924	5283	5938	6380
.8	1.3870	4626	4677	4716	4761	4848	5059	5263	5647	6347	6820
.9	1.5605	4907	4960	5002	5050	5142	5366	5582	5990	6733	7250
1.0	1.7340	5172	5229	5273	5323	5420	5656	5884	6314	7098	7625
1.1	1.9073	5426	5485	5531	5584	5685	5933	6172	6623	7444	8000
1.2	2.0808	5664	5725	5774	5828	5935	6194	6443	6914	7772	8350
1.3	2.2540	5896	5960	6011	6068	6179	6448	6708	7198	8090	8700
1.4	2.4275	6120	6186	6238	6297	6412	6692	6962	7470	8396	9020
1.5	2.6010	6335	6404	6457	6520	6638	6928	7207	7733	8692	9345
1.6	2.7742	6543	6614	6670	6734	6856	7155	7444	7987	8977	9650
1.8	3.1210	6942	7017	7076	7143	7274	7591	7897	8473	9524	10220
2.0	3.4680	7315	7395	7457	7528	7665	8000	8322	8930	10037	10780
2.2	3.8145	7672	7755	7820	7894	8038	8462	8727	9364	10525	11300
2.4	4.1615	8012	8099	8168	8245	8396	8762	9115	9781	10995	11800
2.6	4.5080	8338	8429	8500	8581	8737	9118	9486	10179	11440	12280
2.8	4.8550	8654	8748	8822	8906	9068	9464	9845	10564	11873	12750
3.0	5.2020	8960	9057	9134	9220	9388	9798	10193	10938	12293	13200

$$V = V_o \sqrt{\frac{b_o}{b}} \qquad (25)$$

or where we wish to correct for both temperature and barometer

$$V = V_o \sqrt{\frac{460 + t}{460 + t_o}} \times \sqrt{\frac{b_o}{b}} \qquad (26)$$

In the above formulae V represents the velocity of the air at temperature t degrees Fahr. and barometer b, while V_o is the corresponding velocity at temperature t_o and barometer b_o.

Relation of Altitude to the Properties of Air

The diagram, Fig 2, shows graphically the effect of different altitudes on the properties of air, and the two lines of relative air velocity and of air pressure and density are especially convenient in fan calculation.

As an illustration of the use of this diagram assume a case where a fan is to handle 150,000 A. P. M. at 0.5 inch static pressure at an altitude of 5000 feet. We must determine what sea level conditions correspond to these conditions at the given altitude and so be able to select a fan of the required capacity. From the chart we find the relative pressure at this altitude is 0.825, so that sea level pressure corresponding to 0.5 inch at 5,000 feet altitude will be $0.5 \div 0.825 = 0.6$ inch. The horsepower required to operate this fan will be 82.5 per cent. of the rated horsepower as given in the fan tables for the corresponding pressure of 0.6 inch static.

Any given amount of air as commonly specified will be increased in volume by this same ratio when we consider an altitude of say 5000 feet. Thus if we ordinarily require a definite quantity of air for a certain purpose this volume should be divided by 0.825 to determine the capacity required if the apparatus is to be installed at an altitude of 5000 feet, and a fan selected to handle this greater volume.

Effect of Temperature on the Volume of Air

Air at constant pressure changes its volume almost exactly in proportion to its absolute temperature (460 + temperature deg. Fahr.). The table No. 1 gives the relative volume of a given quantity of air at various temperatures as compared to the volume at 70°. For instance, the volume at 160° will be 1.17 times the volume at 70°. Expressed as a formula for use with other temperatures than those given in the table we will have, where Q is the volume at temperature t and Q_o the volume at t_o

$$Q = Q_o\left(\frac{460 + t}{460 + t_o}\right) \qquad (27)$$

The effect of temperature on the various properties of air is shown graphically by the diagram, Fig. 3. As air at 70° is commonly used as a standard, these curves give the various relationships relative to air at 70°. Inasmuch as fan tables are usually based on air at 70° F., the upper curve of this diagram is especially applicable to fan calculations. Thus we see that if the air to be handled by a fan is at 140°, the velocity and fan speed would have to be increased to 106.5 per cent. of that given in the tables. Or if the velocity remains the same, the pressure and weight of air handled at 140° will be only 88 per cent. of the rated capacity.

Effect of Humidity on Velocity

It may be noted that the tables herein given, consider the various properties of dry air at the standard temperature and barometric pressure. But as a matter of fact, atmospheric air is not dry, so that a correction is necessary in order to reduce the actual observed velocity to the standard condition of dry air. This may be accomplished by means of the following relation, the cubic feet per pound of air being determined from the Psychrometric Charts, Figs. 6 and 7.

$$\frac{\text{Actual vel.}}{\text{Vel. Dry Air}} = \sqrt{\frac{\text{Cu. ft. per lb. air as observed}}{\text{Cu. ft. per lb. dry air}}} \qquad (28)$$