

# Find Air Properties Quickly

By William SISSON, NIPAK, Inc.

In combustion calculations and heat balances it is often necessary to know the amount of water vapor in the air as well as other properties. This nomogram provides an easy way to determine the properties of air at different temperatures and elevations. It is based on the following equations:

$$p_v = p_w - B(t_d - t_w)/2700$$

$$R = p_v/p_d$$

$$W = p_v/1.61(B - p_v)$$

$$d_m = (B - 0.38 p_v)/0.7541(t_d + 460)$$

$$\Delta t = t_d - t_w$$

where:

$p_v$  = actual vapor pressure in inches of mercury (corresponds to dew point temperature).

$t_w$  = wet bulb temperature, F.

$t_d$  = dry bulb temperature, F. +

$p_w$  = vapor pressure, in. Hg, corresponding with  $t_w$ .

$p_d$  = vapor pressure, in. Hg, corresponding with  $t_d$ .

$B$  = total pressure (barometric pressure), in. Hg.

$W$  = specific humidity, lb water vapor/lb dry air.

$R$  = relative humidity (calculated as a decimal).

$d_m$  = density of mixture, lb/cu ft.

$\Delta t$  = wet-bulb depression, F.

Example: At an altitude of 1800 ft above sea level the barometric pressure is 28 in. Hg, dry bulb temperature is 90 F, and wet-bulb temperature is 80 F. Determine the actual vapor pressure, the dew point, the relative humidity, the specific humidity, and the density of the mixture of air.

Solution:

1. Align 1800 ft (28 in. Hg) on A-B scale with wet bulb depression of 10 ( $\Delta t = 90 - 80$ ) on F scale and mark where line crosses Pivot Line No. 1.

2. Connect marked point with 80 F wet bulb temperature on J scale. Read actual vapor pressure as 0.93 in. Hg and dew point as 76.5 F where line crosses H-I scales.

3. To find relative humidity, connect 0.93 in. Hg on H scale with 90 F dry bulb temperature on E-1 scale. Extend the line to the C scale and read relative humidity as 65.3%.

4. To find specific humidity, connect 0.93 in. Hg on H scale with 28 in. Hg on D scale. Read specific humidity as 0.0212 lb water vapor/lb dry air where the line crosses the G scale.

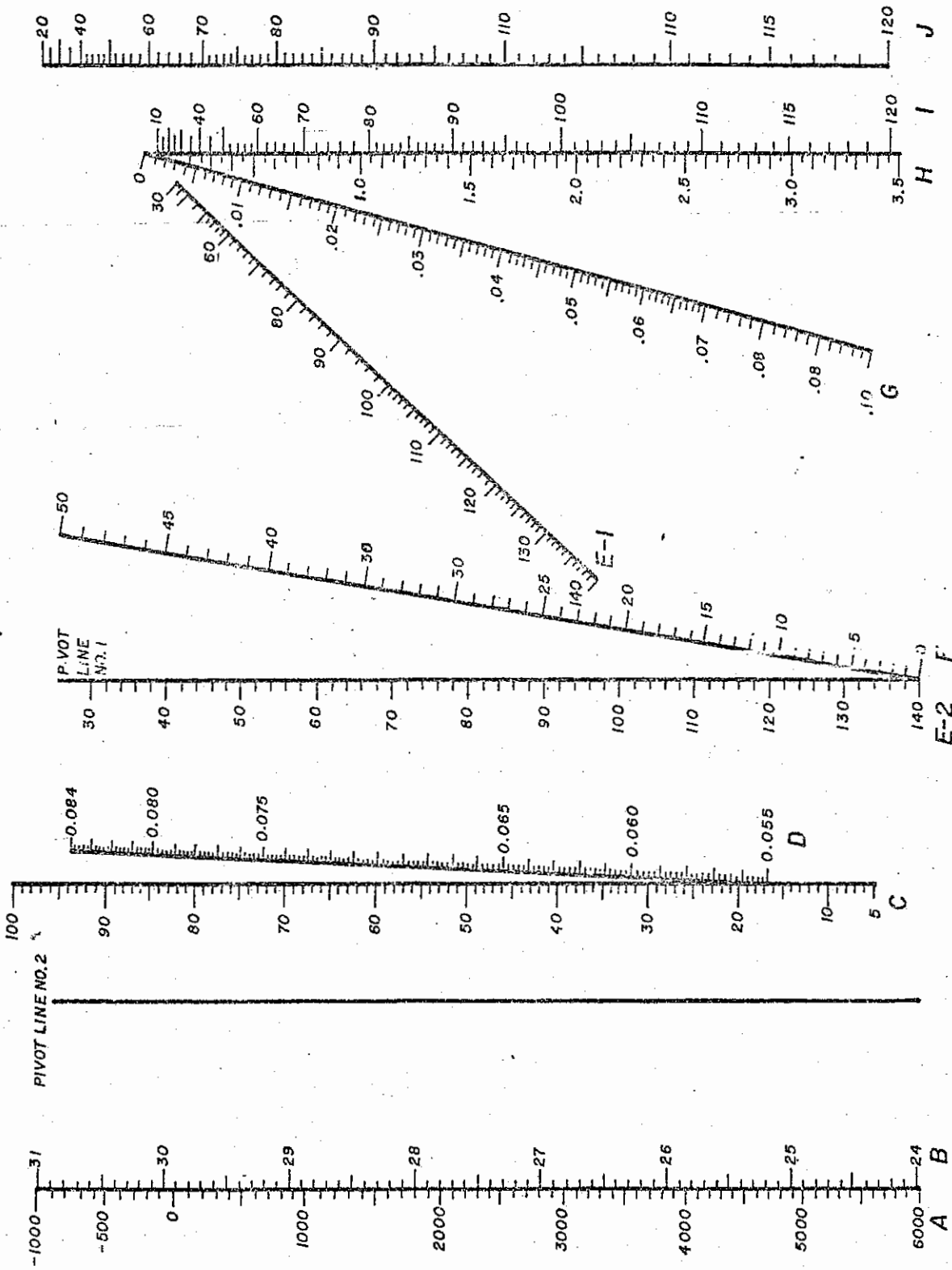
5. To determine mixture density, connect point where line crossed Pivot Line No. 2 in Step 4 with 90 F dry bulb temperature on E-2 scale. Read density of mixture as 0.0666 lb/cu ft where line crosses D scale.

If it is desired to obtain specific humidity in grains of water vapor per pound of dry air, simply multiply by 7000:  $0.0212 \times 7000 = 148.4$  grains. **END**

To obtain an extra copy of this article, circle 804 on Reader Service Card.

**NOTE:**

- A - ELEVATION ABOVE SEA LEVEL, FT.
- B - BAROMETRIC PRESS., IN. Hg.
- C - RELATIVE HUMIDITY, %
- D - MIXTURE DENSITY, LB/CU FT
- E2 - DRY BULB TEMPERATURE, °F (NO.2)
- F - WET BULB DEPRESSION (td - tw)
- E1 - DRY TEMPERATURE, °F (NO.1)
- G - SPEC. HUMIDITY, LB WATER/LB DRY AIR
- H - ACTUAL VAPOR PRESS., IN. Hg.
- I - DEW POINT, °F
- J - WET BULB TEMP., °F



FIND PROPERTIES OF AIR THE EASY WAY

ments with freely dubbling beds. Matsen and Tarmy [8] have shown that in slugging beds, the full width of

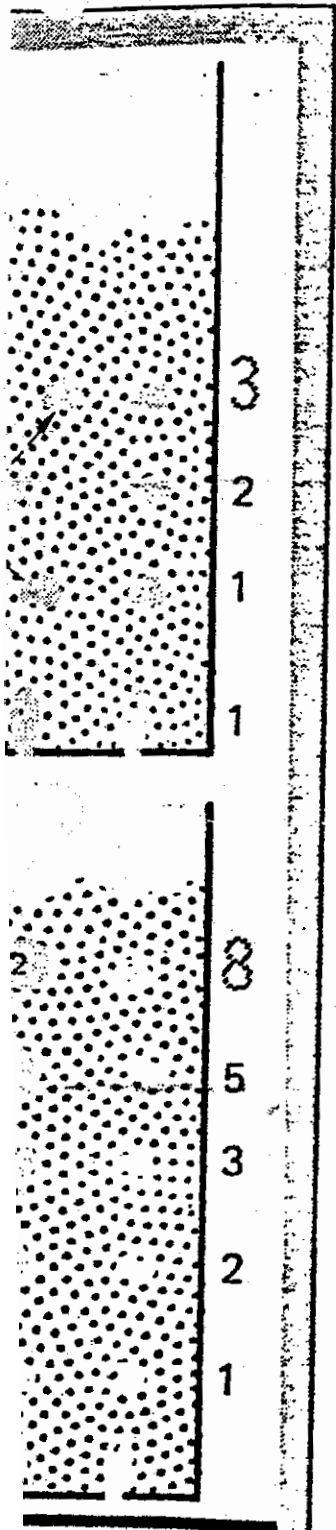
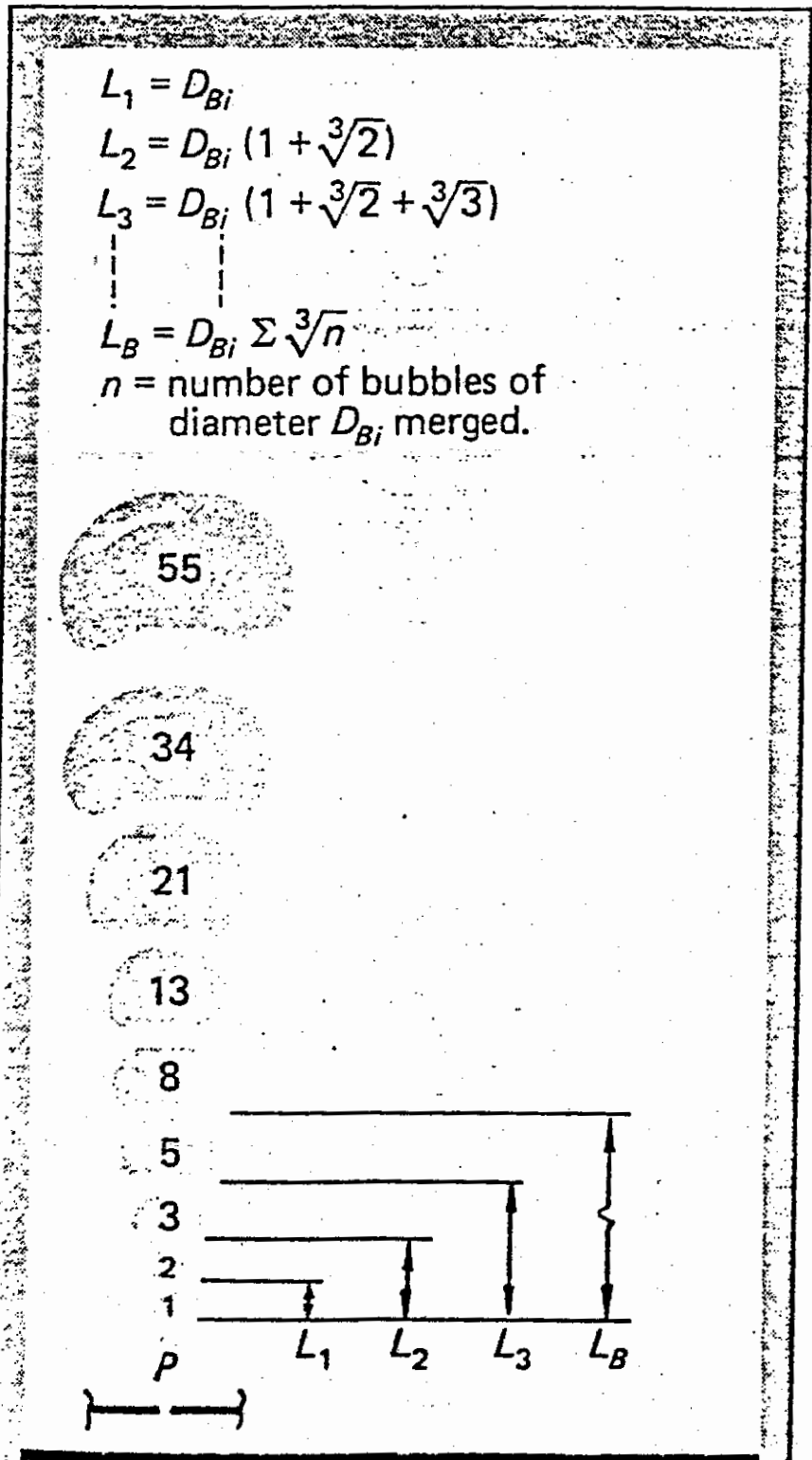


Fig. 8



Bubble growth corresponds to Fibonacci series Fig. 9

FLUIDIZATION