AVAILABLE DRAFT FOR THE RESIDENTIAL CHIMNEY

Equations 3 and 4 cannot readily be used for computing the available draft for residential chimneys because of the relatively greater importance of friction losses, cooling of the gases, and soot deposits in small chimneys. Eddy currents and simultaneous flow both upward and downward can occur in a residential chimney for very low flue-gas velocities.

At present, it is best to rely on actual test data for determining the available draft of residential chimneys. Fig. 4 shows the available draft of nominal 9 × 9-in. and 9 × 13-in. masonry chimneys with an ambient temperature of 0 F for a range of effective heights from 5 to 32 ft, a range of entering flue-gas temperatures from 200 to 1000 F, and for mass flow rates of 83 and 300 lb per hr. Fig. 5 shows the same information for an

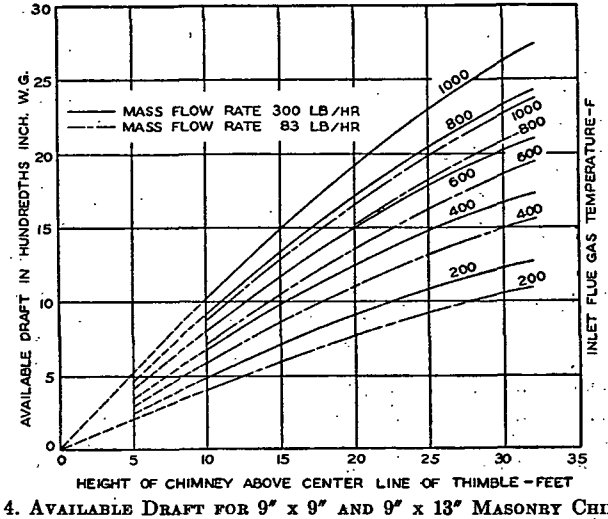

FIG. 4. AVAILABLE DRAFT FOR 9″ x 9″ AND 9″ x 13″ MASONRY CHIMNEYS
(Ambient Temperature 0 F)

ambient temperature of 60 F. The available drafts produced by 9 × 9-in. and 9 × 13-in. masonry chimneys are equal for practical purposes over the range of mass flow from 83 to 300 lb per hr.[6] In tests of these chimneys the smaller chimney produced slightly greater drafts in the lower end of the range of mass flow rates whereas the larger chimney produced slightly higher drafts in the upper end of the range.

The chimney height for heating plants that operate on an *on-off* or *high-fire low-fire* cycle should be selected to produce the desired draft from Fig. 5 since this class of heating system is required to operate at rated input for short periods when the outdoor temperature is 60 F. Heating plants whose fuel-burning rate is gradually increased as the outdoor temperature decreases are not required to operate at rated input except when outdoor temperatures approach design conditions. For such systems, the chimney height should be selected from Fig. 4 which shows the available draft for an outdoor temperature of 0 F since this is likely to be the more critical condition with respect to chimney draft. The available draft for outdoor temperatures between 0 F and 60 F can be obtained by interpolation from Figs. 4 and 5 with only slight error.

Fig. 6 is a graphical representation of the available draft for a 13-ft brick chimney with a nominal 8 × 8-in. flue liner[7] over a wide range of mass flow rates and for inlet flue-gas temperatures ranging from 200 to 1000 F. This family of curves is a typical group of performance curves showing that there is a certain mass flow rate that produces a maximum available draft for any flue-gas temperature.

The following approximate method may alternately be used to determine the available draft for small residential chimneys, from 10 to 25 ft in height and with internal cross-section areas from 35 to 55 sq in., with a maximum probable error of ± 15 percent at the same flow and temperature conditions. This method is based on the chimney efficiencies[7] shown in Fig. 7 and the ideal draft computed from the chimney inlet temperature.

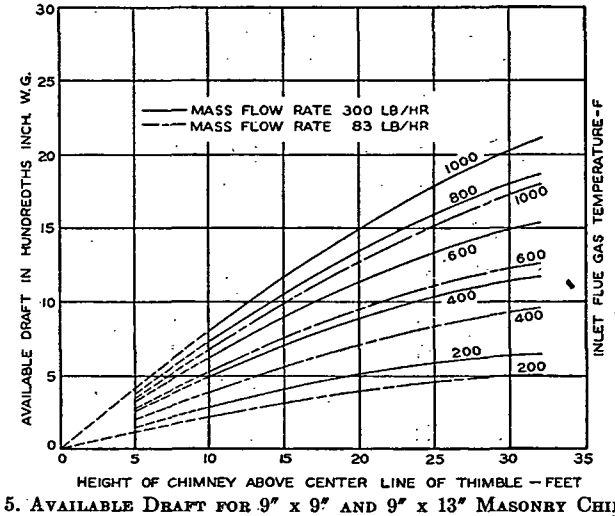

FIG. 5. AVAILABLE DRAFT FOR 9″ x 9″ AND 9″ x 13″ MASONRY CHIMNEYS
(Ambient Temperature 60 F)

The available draft may be expressed as:

$$D_a = n_c D_i \tag{13}$$

where

n_c = chimney efficiency taken from Fig. 7 at the desired conditions of temperature and flow.

D_i = ideal draft, calculated from Equation 14, assuming that the barometric pressure is 29.92 in Hg, and the ambient temperature is 60 F.

$$D_i = 0.2554 B_o H \left(\frac{1}{T_o} - \frac{1}{T_i}\right) \tag{14}$$

where

B_o = barometric pressure, inches of mercury.

H = chimney height, feet.

T_i = chimney inlet temperature, Fahrenheit degrees, absolute.

T_o = ambient air temperature, Fahrenheit degrees, absolute.