

$$O_3 = O_1 + S_2 - S_1 \quad (12)$$

where

- $S_1$  = computed static (theoretical) draft, experimental conditions.  
 $S_2$  = computed static (theoretical) draft, standard conditions.  
 $O_1$  = observed draft, experimental conditions.  
 $O_2$  = observed draft corrected to standard conditions.

It will be noted that the observed draft exceeded the computed static draft during some observations on the shorter chimneys. This is mainly attributed to the draft producing effect of the hot gases immediately above the chimney. By means of a manometer it was found that a measurable draft existed in this gas column for some distance above the chimney top. However, the temperatures in the chimney were measured with unshielded thermocouples and the actual gas temperatures may have been higher for this reason than the observed temperatures on which the computations of draft were based. The tests were made in calm weather.

Tests were made at the *National Bureau of Standards* to find the draft produced by round, metal smoke pipe set in a vertical position to act as chimneys. Curves are presented in Fig. 5 showing the computed static or theoretical draft for short chimneys for various heights and temperatures. For this purpose, the density of chimney gases was assumed to be the same as that of air at the same condition, since the error thus introduced was not considered important in this case. The results of the tests showed that the following procedures would yield the available draft for 6-in. flue pipe used as a chimney within 10 per cent for the range shown and for fuel burning rates from about one-quarter to three-quarters of a gallon of oil per hour.

Using the temperature at the smoke collar of the heater, find the static draft corresponding to the available chimney height. Then:

1. If the chimney is bare, multiply the static draft by 0.76 to find the available draft.
2. If the chimney is insulated with 1 in. of air-cell material with a  $\frac{1}{4}$ -in. air space, multiply the static draft by 0.85 to find the available draft.
3. If the chimney is insulated with 1 in. of air-cell material with a 1-in. air space, open

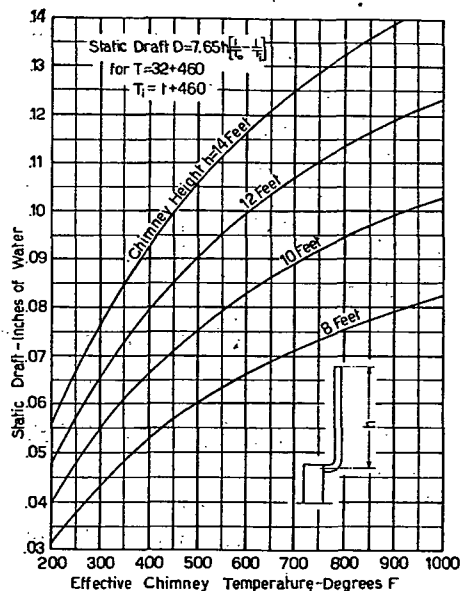


FIG. 5. COMPUTED STATIC DRAFT FOR SHORT CHIMNEYS

at top and bottom for ventilation, multiply the static draft by 0.81 to find the available draft.

4. If the chimney is insulated with 1 in. of air-cell material and has a 1-in. air space closed at top and bottom to prevent ventilation, multiply the static draft by 0.85 to find the available draft.

The use of the 1-in. air-cell asbestos insulation in the tests discussed is not to be construed as an approval of such insulation in all cases in regard to fire resistance. Several laboratories are working on the fire resistance aspects of the problem but definite rules are not yet available. For coal- or oil-burning devices, a bare smoke pipe is probably safe if kept 2 ft or more from any woodwork and the better the pipe is insulated, or the lower its temperature, the nearer it can be placed to combustible materials.

### DRAFT REQUIREMENTS OF DOMESTIC APPLIANCES

Typical flue-gas temperatures and drafts required at rated output for several kinds of domestic heating appliances<sup>4</sup> are contained in Table 3.

TABLE 3. DRAFTS REQUIRED BY TYPICAL DOMESTIC HEATING DEVICES OR APPLIANCES

| DEVICE                                         | DRAFT,<br>INCHES<br>WATER | STACK<br>TEMPERATURE<br>F DEG |
|------------------------------------------------|---------------------------|-------------------------------|
| Space Heater, Oil Burning, Pot Burner.....     | 0.06 to 0.08              | 1000                          |
| Warm Air Furnace, Oil Burning, Pot Burner..... | 0.06                      | 860                           |
| Warm Air Furnace, Hand Fired.....              | 0.06 <sup>b</sup>         | 900                           |
| Floor Furnace, Oil Burning, Pot Burner.....    | 0.06                      | 860                           |
| Mechanical Oil Burner, Less than 5 gph.....    | 0.03 <sup>a</sup>         | .....                         |
| Mechanical Oil Burner, More than 5 gph.....    | 0.05 <sup>a</sup> or less | .....                         |
| Cooking Stove, Solid Fuel.....                 | 0.04 <sup>b</sup>         | 400                           |
| Space Heater, Coal Burning.....                | 0.06 <sup>b</sup>         | 900                           |

<sup>a</sup>Draft in fire-box.

<sup>b</sup>For chestnut sized anthracite.

### CHIMNEYS FOR GAS HEATING

Heating appliances designed to burn gas as well as appliances converted to gas burning, except those equipped with power type burners and excepting conversion burner installations in excess of 400,000 Btu per hour input in large steel boilers, are always equipped with a draft hood attached to the flue outlet of the appliance. This draft hood is required if the appliance is to meet the approval requirements of the *American Gas Association* and the *American Standards Association* and is essential for safe operation. It is designed to prevent excessive chimney draft which would lower appliance efficiency, to prevent a blocked flue or a down draft in the chimney from impairing combustion, to provide a relief opening for the products of combustion during down draft or blocked flue conditions, and to prevent spillage of the products of combustion to the space surrounding the appliance if there is a chimney draft equivalent to that provided by a 3-ft chimney. As the draft hood is designed without moving parts, the relief opening is always open and consequently some air is drawn into the chimney. While the air drawn in lowers the gas temperature in the chimney, it also lowers the dew-point of the gases and tends to prevent condensation.

The installation of conversion burner equipment in large boilers is usually made in accordance with regulations of the local gas company. In such installations a definite chimney draft may be required for proper