

7. Radiation and all other unaccounted for losses.

Since the radiation and convection losses from a heating appliance are not usually determined by direct measurement, they, together with any other losses not measured, are determined by subtracting the total of items 1 to 6 inclusive from the heat of combustion of the fuel. Frequently, when there is CO in the flue gases there also will be small amounts of unburned hydrogen and hydrocarbon gases in the products of combustion. The loss represented by these unburned gases may easily be as large as that resulting from the presence of carbon monoxide. In this event item 7 of the heat balance would also include this unmeasured loss.

Symbols used in Equations 10 to 14 inclusive are:

- h_1 = heat loss in the dry chimney gases, Btu per pound of fuel.
- h_2 = heat loss in water vapor from combustion of hydrogen, Btu per pound of fuel.
- h_3 = heat loss in water vapor in combustion air, Btu per pound of fuel.
- h_4 = heat loss from incomplete combustion of carbon, Btu per pound of fuel.
- h_5 = heat loss from unburned carbon in the ash, Btu per pound of fuel.
- w_g = weight of dry flue gas per pound of fuel (from Equation 6), pounds.
- c_p = mean specific heat of flue gases at constant pressure (c_p ranges from 0.242 to 0.254 for flue gas temperatures from 300 F to 1000 F)², Btu per pound.
- t_g = temperature of flue gases at exit of heating device, Fahrenheit degrees.
- t_a = temperature of combustion air, Fahrenheit degrees.
- H_2 = percentage of hydrogen in fuel by weight from ultimate analysis of fuel as fired.

1091.8 = enthalpy of saturated water vapor at a temperature of 70 F, Btu per pound.

M = humidity ratio of combustion air, pounds of water vapor per pound of dry air.

w_a = weight of combustion air per pound of fuel used, pounds, from Equations 1, 2, 8, and 9.

C = weight of carbon burned per pound of fuel corrected for carbon in ash, pounds.

$$C = \frac{WC_u - W_a C_a}{100 W} \quad (15)$$

where—

C_u = percentage of carbon in the fuel by weight from the ultimate analysis.

CO, CO_2 = percentages of CO, CO_2 in flue gases by volume.

W_a = weight of ash and refuse, pounds.

C_a = per cent of combustible in ash by weight (combustible in ash is usually considered to be carbon).

W = weight of fuel used, pounds.

The flue gas losses listed as items 2, 3, and 4 of the heat balance may be determined with considerable accuracy from the curves shown in Fig. 1² in many cases. The values of the losses plotted for fuel oil were computed from the ultimate analysis of a typical fuel oil used in domestic burners, while those plotted for the several ranks of coal were computed from the typical ultimate analyses shown in Table 1. The curves for medium volatile bituminous coal may be used for high volatile bituminous coal with negligible error. No curves are shown for gaseous fuel because various natural gases and manufactured gases vary considerably in their composition.

FIRING METHODS FOR ANTHRACITE

An anthracite fire should never be poked or disturbed, as this serves to bring ash to the surface of the fuel bed where it may melt into clinker.

Egg size is suitable for large fire-pots (grates 24 in. and over) if the fuel

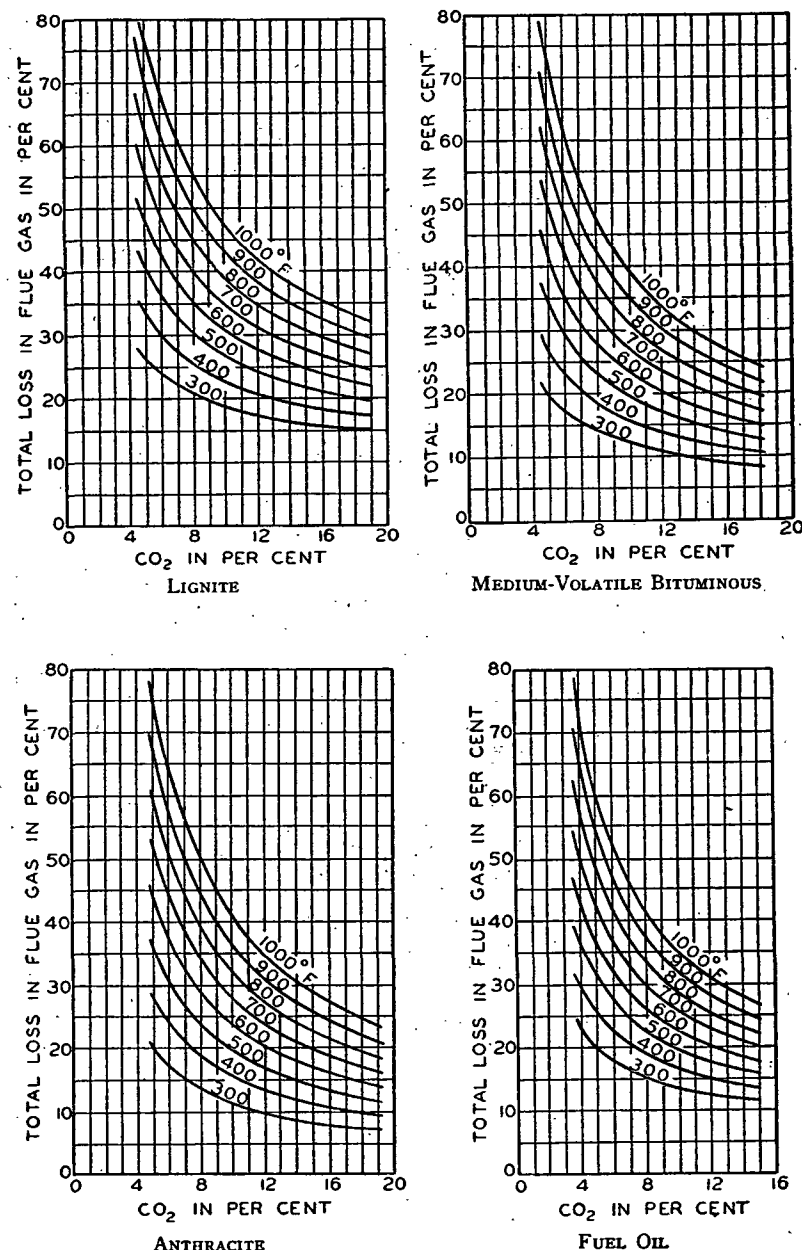


FIG. 1. FLUE GAS LOSSES WITH VARIOUS FUELS²