DETERMINING BOILER CAPACITY REQUIRED FOR A PARTICULAR INSTALLATION

First determine from the boiler manufacturer whether his complete line of boilers has been tested and rated according to the A. S. H. & V. E. Boiler Testing Code. Look for the evidence of such testing in his catalog as to fuel capacity, evaporative power and on the smaller boilers, length of firing period. The net amount of radiation should be increased by about 20 per cent for line losses to determine the total heating load on the boiler. The smaller the boiler, the greater the handicaps it usually must operate under, such as poor draft, dirty coal, sooty heating surface, incompetent attention, etc. To offset those handicaps on boilers used for residence heating, a factor of safety of 50 to 100 per cent should be figured above the total load in determining boiler capacity. In larger size installations the operating conditions are more favorable where a factor of safety of 25 to 75 per cent is ample. Under standard code operating conditions any code rated boiler should be able to develop at least its full rated capacity.

IMPORTANCE OF DRAFT

The capacity a boiler is capable of developing depends more upon the amount of draft available than upon any other factor. Assuming that a chimney is smoke tight and well built according to the Model Chimney Ordnance mentioned, the intensity of the draft depends upon the height of the chimney, and the quantity or amount of draft depends principally upon the effective area of the chimney. According to their height, heating chimneys are divided into three classes, the erratic, uncertain and reliable. Chimneys less than 36 ft. high are erratic in their action. The head produced by such a low height is so small that the least unfavorable condition or interference practically puts the chimney out of commission.

Chimneys between 36 ft. and 64 ft. in height are in the doubtful zone, sometimes good and sometimes bad. The head produced by this relatively low height is frequently offset by slight unfavorable conditions that may be difficult to locate. Chimneys over 64 ft. in height are usually reliable, because as a rule the chimney is designed by an engineer and must be well built to sustain such a heavy load and the height is such as to produce considerable head or force to offset unfavorable weather conditions, etc. Chimneys in this class produce about 0.009 in. draft per ft. of height in zero weather with 600 deg. in the stack according to the formula:

$$P \text{ equal } H\left(\frac{7.6}{To} - \frac{7.9}{Ts}\right)$$

where

P = draft pressure in inches of water.
H = height of chimney in feet.
To = absolute temperature of outside air.
Ts = absolute temperature of stack gases.

An approximate rule often applied to chimneys over 64 ft. high, as regards rate of combustion is:

Rate Combustion for Hard Coal = $1\frac{1}{2}\sqrt{H}$ to $2\sqrt{H}$;

Rate Combustion for Soft Coal = $2\sqrt{H}$ to $3\sqrt{H}$;

Where H = height of chimney in feet.

In the absence of a chimney size formula based on research data, the formula given in *Kent's Hand Book* is about the best available.

$$R = 333\ E\sqrt{H}$$

where

R = steam rated capacity of boiler in square feet.
E = effective area of stack in square feet which should not extend within 2 in. of stack walls.
$\sqrt{H}$ = square root of height in feet measured from center of breeching connection to stack. The height of stacks less than 65 ft. should not be less than 30 times the diameter or width of stack.

The rate of combustion in heating boilers ranges from 5 lb. to over 20 lb. of coal per sq. ft. of grate per hr., according to the height of the stack. Large heating boilers are being attached to stacks 100 ft. to 300 ft. high. Small round boilers require from 0.1 in. to 0.2 in. of draft at the smoke outlet, according to the number of intermediate sections placed between the firepot and dome sections. Medium size boilers require from 0.15 in. to about 0.5 in. of draft. Smokeless boilers require from 0.4 in. to 1.0 in. of draft to develop their rated capacity. Such conditions as nature of fuel, condition of firebed, amount of excess air used and condition of the flue travel very materially increases or decreases the draft required to develop the rated capacity of any boiler.

FACTORS DETERMINING RATED CAPACITY OF HEATING BOILERS

There are three, and only three major factors that can ever enter into the proper equation for determining the rated capacity of any heating boiler. These factors are as given in the A. S. H. & V. E. Boiler Testing Code as follows:

$$\frac{C \times H}{T} = \text{boiler capacity per hr. in B.t.u..}$$

C = number of pounds of dry fuel consumed (during the firing period).
T = duration of firing period in hrs.
H = total B.t.u. available at the boiler outlet per pound of dry fuel.

Hence the available fuel in pounds, times the efficiency of the boiler in heat units per pound of fuel burned, divided by the length of firing period in hours, is the only boiler capacity rule that has any engineering merit to it. The hit or miss boiler capacity rules, based on grate area and heating surface cannot be applied to any two complete lines of boilers of