particularly bituminous or soft coal, from 1 to 2 hour firing periods are generally considered.

In order to determine the effective rating of heating boilers, it is stipulated by the *Heating and Piping Contractors National Association* that the output shall be expressed in terms of square feet of direct radiation load (equivalent to 240 B.t.u. emission per square foot of steam radiation per hour, or 150 B.t.u. for water radiation), as follows:

$$\text{For steam boilers, output} = \frac{W \times H \times E}{240}$$

$$\text{For water boilers, output} = \frac{W \times H \times E}{150}$$

where

W = Average dry fuel burned per hour in lb. for period of test
H = Heat value per lb. of dry fuel in B.t.u.
E = Efficiency of boiler

SELECTION OF HEATING BOILERS

In selecting a boiler for any particular heating installation, there are several important requisites that should be met in order to make sure that the boiler is properly adapted to the conditions under which it will operate:

1. That the material and construction of the boiler be suitable for the service to which it is to be applied.
2. That the boiler be simple in construction, easily assembled, and easily operated.
3. That the boiler be so designed as to permit constant and thorough circulation so as to maintain a fairly even temperature in all parts.
4. That the steam liberating surface be of liberal area to allow for free disengagement of the steam.
5. That the water and steam spaces be properly proportioned so as to maintain even pressure and water line.
6. That the boiler be constructed in accordance with *A. S. M. E.* Boiler Code.
7. That the boiler have a liberal combustion chamber and flues so that combustion may be completed before the gases leave.
8. That all parts of the boiler be accessible for cleaning.
9. That the boiler be properly equipped with high grade gages, safety valves, and other fittings.
10. That draft requirements of the boiler for the conditions of the service be known and met.
11. That the variation in draft requirements under variations in load be given proper consideration.
12. That the capacity of the boiler be properly modified to suit the fuel used.
13. That the outlet openings on the boiler be of sufficient number and of ample size to allow for safe velocity of steam and to prevent carrying excess entrained water.
14. That the available data be sufficient to calculate the rate of combustion.
15. That the heating surface data and the relative proportions of direct and indirect surface are known and properly checked.

TERMINOLOGY

When any question arises concerning *size*, *rating* and *capacity*, it becomes particularly desirable that certain terms may be understood so that all data may be readily translated into comparable form. Among these are the following:

Rate of combustion is the amount of fuel in pounds burned per hour per square foot of grate surface.

Draft requirement, by which is meant the difference of pressure required to overcome the resistances to flow of gases through the fuel bed, flues, ashpit doors, smoke pipe, chimney, etc. This is expressed in inches of water. The data given by manufacturers generally covers the requirement of the boiler alone and does not include smoke pipe, chimney, etc., which should be added for according to conditions.

Heating surface, is any portion of the surface of the boiler which comes into direct contact with heated fuel, flame, or the gases of combustion.

Prime or direct heating surface, is that part of the total surface on which the fire shines or which comes into contact with heated fuel.

Secondary or indirect heating surface, is that part of the total surface which only comes into contact with the gases of combustion.

NUMBER OF UNITS

Reference has been made to the possibility of installing two or more boilers of proportionately less capacity in lieu of one sufficiently large to care for the whole load. Conditions often arise where the amount of installed load requires a draft with one boiler that calls for a height of stack that is not desirable from an artistic point of view. In such cases it is often better to install two or more boilers, instead of one, with especial regard to chimney conditions which will allow one boiler to be run at an overload at times and all boilers used only in the most extreme winter weather.

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 Ordinance for Construction of Chimneys, 1921 (recommended by the *National Board of Fire Underwriters* and approved by the Society), 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.

Size of boiler plant is not the controlling factor of chimney height, but the desired rate of combustion is. There may be the same rate of burning in a small as in a large boiler so that the same height of chimney should be provided in one case as in the other, but the relative chimney areas will, of course, not be the same since that factor is dependent on the quantity of gas to be carried off. The mistake is not infrequently made of assuming that a low chimney will suffice for a small installation, and that a greater height would be needed for a larger plant, although it would be necessary to burn fuel at the same rate in either case.

According to their height, heating plant 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