proportion of the actual efficiency with the gas being burned to the assumed efficiency of 80 per cent.

Oil-Fired Boilers

The output of a boiler with oil fuel will depend upon the combined efficiency of the boiler and burner and the quantity of oil that can be burned properly within the space provided in the boiler.

Oil burner ratings in use at present have been obtained either from tests with typical burners or have been obtained by multiplying the coal rating by a constant.

BOILER SELECTION

Ordinarily, especially in residence heating and in other small installations, the information upon which the boiler is selected is meager. This information usually covers the heat output of radiators under normal temperatures, the kind of fuel, whether anthracite or bituminous coal, oil or gas, and in a few cases the amount of heat-emitting surface in the piping. Successful selection of a boiler based only upon this information requires good judgment and the boiler usually must be selected large enough to deliver the required quantity of heat under the most adverse conditions of attention, fuel, draft, etc.

A boiler usually is selected from the manufacturer's catalog with a rating 80 to 100 per cent in excess of the manufacturer's rating expressed in equivalent square feet of direct radiation.

The following items taken from the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS CODE OF MINIMUM REQUIREMENTS FOR THE HEATING AND VENTILATION OF BUILDINGS cover information which should be available for intelligent boiler selection:

1. The estimated heat emission in B.t.u. per hour of the connected radiation (direct, indirect or blast) to be installed, as previously determined by calculations given in Chapters 3, 4 and 5 of THE GUIDE.

2. The estimated maximum heat in B.t.u. per hour required to supply water heaters or other apparatus to be connected to the boiler.

3. The estimated heat emission in B.t.u. per hour of the piping connecting the radiation and other apparatus to the boiler.

4. The estimated increase in the normal load in B.t.u. per hour due to starting up cold radiation, etc. This percentage of increase to be based on the sum of items (1), (2) and (3) shall not be assumed less than the following:

Sum of (1), (2) and (3):

Up to	100,000	B.t.u. add 65 per cent.
100,000 to	200,000	B.t.u. add 60 per cent.
200,000 to	600,000	B.t.u. add 55 per cent.
600,000 to	1,200,000	B.t.u. add 50 per cent.
1,200,000 to	1,800,000	B.t.u. add 45 per cent.
Above	1,800,000	B.t.u. add 40 per cent.

Other things to be considered are:

5. The kind and amount of attention available. Attention is least skillful and least frequent for owner-operated residence installations and generally increases in skill as well as frequency as size of boiler increases. Local fuels and types of firing service must be considered carefully in this connection.

6. The kind of fuel to be used, including size and characteristics.

7. Size and height of the available chimney.

With definite requirements as given by items 1 to 4 available, the boiler performance information, obtained according to AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS PERFORMANCE TEST CODE NO. 3 FOR STEAM HEATING SOLID FUEL BOILERS, can be used for selection of the proper size of solid fuel burning boiler.

Other Factors in Selection of Boiler

As it will usually be found that several boilers will meet the specifications, the final selection of the boiler will be effected by other considerations as follows:

(*a*) Dimensions of boiler; (*b*) Height of water line; (*c*) Durability under service; (*d*) Convenience in firing and cleaning; (*e*) Type of controls; (*f*) Adaptability to changes in fuel and kind of attention; (*g*) The output required during the greater part of the season.

In large installations the use of several smaller boiler units instead of one larger one will obtain greater flexibility and economy by permitting the operation of a required number of units according to heat requirements at the best operating efficiency.

Numerical Value of Maximum Hourly Output

Experience with gas-fired boilers, which are rated on B.t.u. output and which can only slightly exceed the rated output, but which require no chimney draft, has shown that a continuous output capacity of 25 per cent in excess of the normal heat loss of radiation, plus piping, is ample for all direct radiator installations. This corresponds to an output of 40 to 60 per cent in excess of the normal heat loss of the radiation, depending upon the proportion of piping to radiation.

Gas-fired boilers rated according to the *American Gas Association* method and having, therefore, *A.G.A. Ratings* are selected in the majority of direct radiator installations, according to the table of selection factors given in Chapter 17, page 279.

Upon the basis of gas-fired boiler experience, a coal-fired boiler which could deliver a continuous average output of 25 per cent in excess of radiation and piping would be amply large for any job. This is true for an oil-fired boiler, provided the known output of the combination of boiler, burner, and chimney is used.

Where test data are not available for the contemplated combination of boiler and oil burner, economical performance may be obtained by selecting a boiler in which the heat absorbed per square foot of boiler heating surface at the maximum continuous output is approximately 4,000 B.t.u. per hour. It should be ascertained that the burner selected has sufficient combustion space to permit the burning of the required quantity of the available oil fuel.

In the case of coal-fired boilers, however, it is necessary to make additional allowance for the following conditions not due to boiler construction which may obtain at the time when the maximum pick-up load occurs: (*a*) insufficient draft; (*b*) poor quality of fuel; (*c*) fuel bed not in good condition; (*d*) inferior quality of attention; (*e*) necessity of firing a charge of fuel that will last for a long period; (*f*) dirty flues.

The conditions (*a*) to (*f*) inclusive, reduce the output obtainable to a