

The rating of a boiler is the measure of what it will do under certain conditions. The manufacturers' rating is the measure which the manufacturers place upon the performance of their own boilers; this may be given for one or more well defined sorts of conditions or for what the manufacturers may choose to consider average working conditions without definition but in any case the conditions under which ratings have been established should be stated.

The ratings of low pressure boilers are usually stated in terms of the number of square feet of standard cast-iron direct radiation the boiler will supply with steam or hot water, referred to conditions when the plant is heated up and operated under stable conditions with the radiation in still air at 70 deg. fahr. and all proper allowances made for the added load of piping and connections. These ratings are usually for an 8 hour or other stated firing period and for hard coal or other stated fuel with allowance factors for other lengths of firing periods and for other kinds of fuel when the smaller sized boilers are being considered. In connection with most rating the chimney or draft requirements corresponding to the ratings are given.

Unfortunately there are wide differences in the ratings of boilers by the various manufacturers due largely to the fact that there has never been a full and complete cooperation in the establishment of a standard code\* on which to rate. For this reason the selecting of a cast-iron boiler, as far as capacity is concerned, is one of considerable uncertainty unless the manufacturer's guarantee is secured that the boiler will carry the load as existing in that particular installation. The method used by some engineers for handling this is to determine the number of pounds of steam required per hour as a maximum, including all losses, and then calling for a manufacturer's guarantee that the boilers supplied, when fired on 8-hour firing periods with anthracite coal and connected to a chimney of a certain size and height, will deliver the number of pounds of steam necessary at the pressure required. For the larger sizes of boilers and with other fuels, 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

\*Code for Rating of Low Pressure Solid Fuel Steam Heating Boilers reported at A. S. H. & V. E. meeting, June, 1927, accepted as a preliminary draft and to be presented for adoption, January, 1928.

In boiler selection certain allowances should be made if quick heating up is desired but a boiler oversized is not an economical proposition under any condition and when it is considered that the average winter load is approximately one-half of the maximum load it can be seen that the boiler, which is just sufficient, will operate under normal conditions at only 50 per cent of its rating in actual capacity. Some boilers are designed to show a very good efficiency from 40 to 60 per cent of their maximum production and generally speaking a boiler which has its highest efficiency around 50 per cent of its maximum capacity will be the most economical in fuel consumption in the long run.

A great deal has been said at various times about the overload thrown onto a boiler during the time of heating up the system; a large part of this idea is not borne out either in practice or by calculation. The whole matter boils down to a time element and a compromise between having a boiler big enough to heat up in a reasonable length of time and at the same time not so large as to force it to operate at too small a fraction of its load during all normal periods.

#### 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.