Burning Oil Fuel[3] is intended to provide a standard method for conducting and reporting tests to determine the heating efficiency and performance characteristics when oil fuel is used with steam heating boilers. In 1938 the Society adopted a Standard Code for Testing Stoker-Fired Steam Heating Boilers[4] which is intended to provide a test method for determining the efficiency and performance characteristics of any stoker

TABLE 2. STEEL HEATING BOILER STANDARD RATINGS[a]

HAND-FIRED RATING						MECHANICALLY-FIRED RATING				
Catalog			Net Load	Heating Surface Sq Ft	Grate Area Sq Ft	Catalog			Net Load	Furnace Volume, Oil, Gas or Bituminous Coal Cu Ft
Steam Radiation Sq Ft	Water Radiation Sq Ft	Btu per Hour in Thousands	Steam Radiation Sq Ft			Steam Radiation Sq Ft	Water Radiation Sq Ft	Btu per Hour in Thousands	Steam Radiation Sq Ft	
1,800	2,880	432	1,389	129	7.9	2,190	3,500	525	1,695	15.7
2,200	3,520	528	1,702	158	8.9	2,680	4,280	643	2,089	19.2
2,600	4,160	624	2,020	186	9.7	3,160	5,050	758	2,461	22.6
3,000	4,800	720	2,335	215	10.5	3,650	5,840	876	2,853	26.1
3,500	5,600	840	2,732	250	11.4	4,250	6,800	1,020	3,335	30.4
4,000	6,400	960	3,135	286	12.2	4,860	7,770	1,166	3,830	34.8
4,500	7,200	1,080	3,540	322	13.4	5,470	8,750	1,312	4,330	39.1
5,000	8,000	1,200	3,945	358	14.5	6,080	9,720	1,459	4,834	43.5
6,000	9,600	1,440	4,770	429	16.4	7,290	11,660	1,749	5,850	52.1
7,000	11,200	1,680	5,608	500	18.1	8,500	13,600	2,040	6,885	60.8
8,500	13,600	2,040	6,885	608	20.5	10,330	16,520	2,479	8,490	73.8
10,000	16,000	2,400	8,197	715	22.5	12,150	19,440	2,916	10,125	86.8
12,500	20,000	3,000	10,417	893	25.6	15,180	24,280	3,643	12,650	108.5
15,000	24,000	3,600	12,500	1,072	28.4	18,220	29,150	4,372	15,183	130.2
17,500	28,000	4,200	14,584	1,250	30.9	21,250	34,000	5,100	17,708	151.8
20,000	32,000	4,800	16,667	1,429	33.2	24,290	38,860	5,829	20,242	173.5
25,000	40,000	6,000	20,834	1,786	37.4	30,360	48,570	7,286	25,300	216.9
30,000	48,000	7,200	25,000	2,143	41.2	36,430	58,280	8,743	30,359	260.3
35,000	56,000	8,400	29,167	2,500	44.7	42,500	68,000	10,200	35,417	303.6

[a]Adopted by the *Steel Heating Boiler Institute* in cooperation with the *Bureau of Standards, United States Department of Commerce Simplified Practice Recommendations R 167-35.*

or boiler combination burning any type of solid fuel such as anthracite or bituminous coal.

The *Steel Heating Boiler Institute* has adopted a method for the rating of low pressure boilers based on their physical characteristics and expressed in square feet of steam or water radiation or in Btu per hour as given in Table 2. The detailed requirements of this code were outlined in Chapter 13 of THE GUIDE 1939.

The *Institute of Boiler and Radiator Manufacturers* has adopted a method of rating cast-iron heating boilers based upon performance obtained under tests. This code[5] now applies to sectional boilers having a grate width of 41 in. or less. Eventually the Institute intends to include all sizes of cast-iron boilers in this program of testing and rating.

[3]See A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931, p. 23.

[4]See A.S.H.V.E. TRANSACTIONS, Vol. 44, 1938, p. 366.

[5]*I=B=R* Testing and Rating Code for Low Pressure Heating Boilers (*Institute of Boiler and Radiator Manufacturers.*)

BOILER OUTPUT AND EFFICIENCY

Boiler ratings are usually expressed either as gross output or net load. The gross output is the quantity of heat available at the boiler nozzle with the boiler normally insulated. This output is stated in Btu per hour or square feet equivalent direct radiation. The gross output of large heating boilers is frequently stated in terms of boiler horsepower.

Net load is the total amount of radiation that normally can be supplied with heat by the boiler. It is expressed in the same units as gross output and is equal to the gross output less allowances for piping losses and pick up.

The term *efficiency* as used for guarantees of boiler performance is usually construed as follows:

1. *Solid Fuels.* The efficiency of the *boiler* alone is the ratio of the heat absorbed by the water and steam in the boiler per pound of combustible burned on the grate to the calorific value of 1 lb of combustible as fired. The *combined* efficiency of *boiler, furnace and grate* is the ratio of the heat absorbed by the water and steam in the boiler per pound of fuel as fired to the calorific value of 1 lb of fuel as fired.

2. *Liquid and Gaseous Fuels.* The *combined* efficiency of boiler, furnace and burner is the ratio of the heat absorbed by the water and steam in the boiler per pound or cubic foot of fuel to the calorific value of 1 lb or cubic foot of fuel respectively.

Solid fuel boilers usually show an efficiency of 50 to 75 per cent when operated under favorable conditions at their rated capacities. Oil- or gas-fired boiler-burner units usually show an efficiency of 70 to 80 per cent.

SELECTION OF BOILERS

Factors Involved in Boiler Selection

The *maximum design load* on a boiler is the sum of the following four items:

1. *Radiation Load.* The estimated heat emission in Btu per hour of the connected radiation (direct, indirect, or central fan) to be installed.

The connected radiation is determined by calculating the heat losses for each room in accordance with data given in Chapters 4, 5, and 6. The sum of the calculated heat losses for all the rooms represents the total required heat emission of the connected radiation expressed in Btu per hour. As practically all boilers are now rated on a Btu basis, it is unnecessary to convert the radiation load to equivalent square feet of equivalent radiation.

2. *Hot Water Supply Load.* The estimated maximum heat in Btu per hour required to heat water for domestic use.

When the hot water supply is heated by the building heating boiler, this load must be taken into consideration in sizing the boiler. A common practice is to add 240 Btu per hour to the radiation load for each gallon of storage tank capacity. For more specific information see Chapter 46.

3. *Piping Tax.* The estimated heat emission in Btu per hour of the piping connecting the radiation and other apparatus to the boiler.

It is common practice to consider the piping tax in average house heating systems to be equal to 25 per cent of the net load (items 1 and 2). In large jobs, or where there is much bare pipe, it is better to compute the heat emission from both bare and covered pipe surface in accordance with data in Chapter 18. The estimated heat loss from the pipe should be added to the net load when estimating the gross boiler output.

4. *Warming-Up Allowance.* The estimated increase in the normal load in Btu per hour caused by the heating up of cold radiation.