Table 2 .... SBI Net Rating Data for *Table 2* Steel Boilers—Oil-Fired[a]

SBI Net Rating			SBI Gross Output	Minimum Furnace Volume	Minimum Heating Surface
Steam		Water			
Sq Ft	Btuh	Btuh	Btuh	Cu Ft	Sq Ft
(1)	(2)	(3)	(4)	(5)	(6)
275	66,000	74,000	99,000	2.5	16
320	77,000	87,000	115,000	2.9	19
400	96,000	108,000	144,000	3.6	24
550	132,000	149,000	198,000	5.0	32
700	168,000	189,000	252,000	6.4	41
900	216,000	243,000	324,000	8.2	53
1100	264,000	297,000	396,000	10.0	65
1300	312,000	351,000	468,000	11.8	77
1500	360,000	405,000	540,000	13.6	88
1800	432,000	486,000	648,000	16.4	106
2200	528,000	594,000	792,000	20.0	129
2600	624,000	702,000	936,000	23.6	153
3000	720,000	810,000	1,080,000	27.3	177
3500	840,000	945,000	1,260,000	31.8	206
4000	960,000	1,080,000	1,440,000	36.3	236
4500	1,080,000	1,215,000	1,620,000	40.9	265
5000	1,200,000	1,350,000	1,800,000	45.4	294

[a] Stoker-Fired and Gas-Fired SBI Net Rating not greater than oil-fired rating. Hand-Fired Net SBI Rating (Steam) not greater than 14 times the square feet of heating surface.

Table 3 .... SBI Gross Output and SBI Net Rating Data for *Table 3* Steel Boilers

SBI Gross Output	SBI Net Ratings		
	Water	Steam	Steam
Btuh	Btuh	Btuh	Sq Ft
99,000	74,000	66,000	275,000
115,000	87,000	77,000	320,000
144,000	108,000	96,000	400,000
198,000	149,000	132,000	550,000
252,000	189,000	168,000	700,000
324,000	243,000	216,000	900,000
396,000	297,000	264,000	1,100,000
504,000	378,000	336,000	1,400,000
648,000	486,000	432,000	1,800,000
792,000	594,000	528,000	2,200,000
1,008,000	756,000	672,000	2,800,000
1,260,000	945,000	840,000	3,500,000
1,512,000	1,134,000	1,008,000	4,200,000
1,800,000	1,350,000	1,200,000	5,000,000

Table 4 .... Minimum Stack Dimensions for *Table 3* Oil-Burning Boilers and Boiler-Burner Units

Rectangular			Round	
Firing Rate Not Over	Nominal Dimensions	Inside Dimensions of Liner	Firing Rate Not Over	Inside Dia of Liner
Gph	Inches	Inches	Gph	Inches
2.1	8 × 8	6¾ × 6¾	1.3	6
3.5	8 × 12	6¾ × 10¼	1.8	7
5.3	12 × 12	9¾ × 9¾	2.5	8
7.7	12 × 16	9¼ × 13¼	4.7	10
11.5	16 × 16	13¼ × 13¼	5.6	11
15.0	16 × 20	13 × 17	7.0	12
21.0	20 × 20	16¾ × 16¾	12.0	15
26.0	20 × 24	16¼ × 20¼	19.0	18

height, and the draft in the stack are all subject to the limits established in the code. Tests are run using anthracite coal of standard specification. Bituminous coal and coke ratings are the same as for anthracite.

For automatically-fired boilers, the number of boilers of a series to be tested, the flue gas temperature and analysis, the minimum overall efficiency, the draft loss through the boiler, and the heat release in the combustion chamber are subjected to limitation by the code.[1] Oil-fired boiler ratings are established by tests using gun-type oil burners and commercial grade No. 2 fuel oil. Stoker-fired ratings are based on the *Gross I = B = R Output* obtained by oil-fired tests. Gas-fired ratings for boilers having gross outputs greater than 300,000 Btu per hour, where no *A.G.A. Rating* is published, are based on the *Gross I = B = R Output* obtained by oil-fired tests. Gas-fired ratings for boilers having gross outputs less than 300,000 Btu per hour, where no *A.G.A. Rating* is published, are established by gas-fired tests with atmospheric, single-port-type burners using natural or manufactured gas or a mixture of these two gases. The *A.G.A. Output Rating* of a gas-designed boiler may be used in determining the *Net I = B = R Rating*.

The *Net I = B = R Rating* is determined from the *Gross I = B = R Output* by applying specified *Piping and Pickup Factors* which range from 2.36 to 1.40 for hand-fired boilers, and from 1.56 to 1.288 for automatically-fired steam boilers, and from 1.333 to 1.288 for automatically-fired hot water boilers. In all cases, the factor decreases as the boiler size increases. Table 5 is abstracted from the 1951 I = B = R Boiler Rating Tables in the code and illustrates the relationship between *Net I = B = R Rating* and *Gross I = B = R Output*.

The American Gas Association rates gas designed boilers at 80 percent of the A.G.A. *Input Rating*. These ratings are determined by performance tests described in the *A.G.A. Approval Requirements for Central Heating Appliances*.

The Mechanical Contractors Association of America has adopted a method, based on their physical characteristics, for rating boilers that are not rated in accordance with the SBI or I = B = R Codes. Ratings are expressed on a Net Load basis in square feet of steam radiation.

The MCAA has also adopted a *Testing and Rating Code for Boiler-Burner Units*.[2] The purpose of this Code is to provide a basis of rating commercial sizes of steel heating boiler-burner units fired with oil or gas fuel. This code allows a higher rating than is permissible under the SBI Code. A gross output is established with certain limiting factors applying to flue gas temperature, carbon dioxide, efficiency, and quality of steam. This output is divided by 1.5 to determine the *net rating*.

BOILER EFFICIENCY

The term efficiency, as used for guarantee 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.

The following efficiencies apply to current designs of boilers operated under favorable conditions at their gross output ratings. Some older boilers, designed primarily for hand firing, may have lower efficiencies when automatically-fired.

Anthracite, hand-fired	60 to 75 percent
Bituminous coal, hand-fired	50 to 65 percent
Stoker-fired	60 to 75 percent
Oil- and gas-fired	70 to 80 percent

Higher efficiencies for hand-fired bituminous coal may be obtained by careful firing of either a regular or a smokeless boiler.

RATING OF BOILERS

In referring to boiler rating, it is necessary to know the basis on which the rating has been established in order to understand the exact meaning of the term. The following example will illustrate the meaning of three ratings which might be established for the same boiler.

Assume that an installation has the following loads determined in accordance with the section Selection of Boilers:

Net Load	1000 sq ft of steam radiation
Piping Tax	200 sq ft of steam radiation
Design Load	1200 sq ft of steam radiation
Pickup Allowance	240 sq ft of steam radiation
Maximum or Gross Load	1440 sq ft of steam radiation

Table 5 .... I = B = R Boiler Rating Table[a]

Hand-Fired							Automatic-Fired							
Gross I = B = R Output	Net I = B = R Rating		Piping and Pickup Factor	Time Available Fuel Will Last,	Maximum Stack Height[c]	Minimum Stack Area[b]	Gross I = B = R Output	Net I = B = R Rating			Piping and Pickup Factor		Minimum Stack Area[b]	Maximum Allowable Draft Loss
	Steam and water	Steam						Water	Steam		Water	Steam		
MBh	MBh	Sq Ft		Hr	Ft	Sq In.	MBh	MBh	MBh	Sq Ft			Sq In.	In. W.G.[b]
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
57	24	100	2.360	7.50	29.0	50	37	28	24	100	1.333	1.560	50	0.044
218	96	400	2.268	6.32	36.5	50	146	110	96	400	1.333	1.525	50	0.058
359	168	700	2.139	5.73	42.0	54	251	188	168	700	1.333	1.492	50	0.072
489	240	1000	2.039	5.32	46.0	82	352	264	240	1000	1.333	1.466	52	0.084
614	312	1300	1.967	4.99	49.0	110	451	338	312	1300	1.333	1.444	73	0.096
735	384	1600	1.914	4.73	52.0	135	547	410	384	1600	1.333	1.424	95	0.108
854	456	1900	1.872	4.49	54.5	160	642	482	456	1900	1.333	1.408	115	0.118
970	528	2200	1.837	4.34	56.5	185	736	552	528	2200	1.333	1.394	135	0.130
1083	600	2500	1.805	4.24	59.0	207	829	622	600	2500	1.333	1.382	155	0.141
1192	672	2800	1.774	4.15	61.0	231	920	690	672	2800	1.333	1.369	173	0.152
1298	744	3100	1.744	4.07	63.0	253	1011	758	744	3100	1.333	1.359	192	0.162
1401	816	3400	1.717	4.00	64.5	275	1101	826	816	3400	1.333	1.349	211	0.172
1502	888	3700	1.691	4.00	66.5	296	1189	892	888	3700	1.333	1.339	230	0.183
1599	960	4000	1.666	4.00	68.0	315	1278	960	960	4000	1.331	1.331	249	0.192
1726	1056	4400	1.634	4.00	70.0	337	1394	1056	1056	4400	1.320	1.320	274	0.206
1849	1152	4800	1.605	4.00	71.5	358	1509	1152	1152	4800	1.310	1.310	297	....
1968	1248	5200	1.577	4.00	73.0	376	1624	1248	1248	5200	1.301	1.301	318	....
2086	1344	5600	1.552	4.00	74.5	393	1739	1344	1344	5600	1.294	1.294	339	....
2197	1440	6000	1.526	4.00	76.0	409	1858	1440	1440	6000	1.290	1.290	359	....
2307	1536	6400	1.502	4.00	77.5	425	1978	1536	1536	6400	1.288	1.288	377	....
2415	1632	6800	1.482	4.00	79.0	438	2102	1632	1632	6800	1.288	1.288	395	....
2470	1680	7000	1.470	4.00	79.5	446	2164	1680	1680	7000	1.288	1.288	405	....
2605	1800	7500	1.447	4.00	81.5	464	2318	1800	1800	7500	1.288	1.288	426	....
2738	1920	8000	1.426	4.00	83.0	481	2473	1920	1920	8000	1.288	1.288	446	....
2874	2040	8500	1.409	4.00	85.0	497	2628	2040	2040	8500	1.288	1.288	467	....
3024	2160	9000	1.400	4.00	87.0	515	2782	2160	2160	9000	1.288	1.288	486	....
3192	2280	9500	1.400	4.00	89.0	535	2937	2280	2280	9500	1.288	1.288	504	....
3360	2400	10000	1.400	4.00	91.5	555	3091	2400	2400	10000	1.288	1.288	522	....
4032	2880	12000	1.400	4.00	99.0	634	3709	2880	2880	12000	1.288	1.288	596	....
4704	3360	14000	1.400	4.00	106.5	712	4328	3360	3360	14000	1.288	1.288	668	....
5376	3840	16000	1.400	4.00	112.5	789	4946	3840	3840	16000	1.288	1.288	740	....
6048	4320	18000	1.400	4.00	118.0	863	5564	4320	4320	18000	1.288	1.288	810	....
6720	4800	20000	1.400	4.00	120.0	900	6182	4800	4800	20000	1.288	1.288	877	....

[a] Extracted from Rating Table in 1951 edition of *I = B = R Testing and Rating Code for Low Pressure Cast Iron Heating Boilers.*
[b] To be specified in catalog. [c] Maximum stack height which may be shown in catalog.