surface) are rated in square feet (steam) on the basis of heating surface with limitations set for grate area, furnace volume, and furnace height. The residential boilers (defined as those having not more than 177 sq ft of heating surface) are rated on tests for oil-fired boilers, with limitations in relation to heating surface and testing conditions. Stoker-fired and gas-fired *residential* boilers are rated (*SBI* Net Rating) not in excess of the oil-fired rating. Hand-fired residential boilers are rated (*SBI* Net Rating) not greater than 14 times the heating surface.

Tables 1 and 2 show the *SBI* ratings of residential and commercial steel boilers respectively.

The *Institute of Boiler and Radiator Manufacturers* has adopted a Code[5] for rating cast-iron heating boilers based upon performance obtained under controlled test conditions. This Code applies to all sectional cast-iron heating boilers except those of magazine feed type.

The *Gross I = B = R* Output is obtained by test and is subject to certain limiting factors. For hand fired boilers, the number of boilers of a series to be tested, the minimum over-all efficiency, the minimum time limit (the time an *Available Fuel Charge* will last when burned at a rate which will produce the *Gross I = B = R Output*), the chimney area and 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 coal.

For automatically fired boilers, the number of boilers of a series to be tested, the flue gas temperature and analysis, the minimum over-all efficiency, the draft loss through the boiler, and the heat release in the combustion chamber are subjected to limitation by the Code[5]. Automatically fired boiler ratings are established by oil fired tests using gun type oil burners and commercial grade No. 2 fuel oil. Stoker fired and gas fired ratings (where no *A.G.A.* Rating is published) are based on the *Gross I = B = R Output* obtained by oil fired tests.

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 boilers. In both cases, the factor decreases as the boiler size increases. Table 3 is abstracted from the *I = B = R 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* has adopted a method of rating gas designed boilers based upon performance under tests. This is described in Approval Requirements for Central Heating Gas Appliances.

The *Heating, Piping and Air Conditioning Contractors National Association* has adopted a method of rating boilers based on their physical characteristics for those 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.

BOILER EFFICIENCY

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.

TABLE 3. *I=B=R* RATING TABLE

Net *I=B=R* Rating			Hand-Fired					Automatic-Fired			
Sq Ft Steam	1000 Btu	Piping Factor	Piping and Pickup[a] Factor	Gross *I=B=R* Output 1000 Btu	Time Available Fuel Will Last, Hr	Maximum Stack Height[b] Ft	Minimum Stack Area[b] Sq In.	Piping and Pickup[a] Factor	Gross *I=B=R* Output 1000 Btu	Minimum Stack Area[b] Sq In.	Maximum Allowable Draft Loss
1	2	3	4	5	6	7	8	9	10	11	12
100	24.0	1.300	2.360	56.6	7.50	29.0	50.0	1.560	37.4	50.0	0.044
250	60.0	1.293	2.341	140.5	6.77	33.0	50.0	1.548	92.9	50.0	0.051
400	96.0	1.275	2.268	217.7	6.32	36.5	50.0	1.525	146.4	50.0	0.058
550	132.0	1.260	2.201	290.5	5.99	39.5	50.0	1.507	198.9	50.0	0.065
700	168.0	1.248	2.139	359.4	5.73	42.0	54.0	1.492	250.7	50.0	0.072
850	204.0	1.236	2.084	425.1	5.50	44.0	68.5	1.478	301.5	50.0	0.078
1000	240 0	1.225	2.039	489.4	5.32	46.0	82.0	1.466	351.8	52.0	0.084
1150	276	1.215	2.001	552	5.15	47.5	95.5	1.454	401	63.0	0.090
1300	312	1.205	1.967	614	4.99	49.0	110.0	1.444	451	73.5	0.096
1450	348	1.198	1.939	675	4.85	50.5	122.5	1.434	499	84.0	0.102
1600	384	1.190	1.914	735	4.73	52.0	135.0	1.424	547	95.0	0.108
1750	420	1.182	1.891	794	4.60	53.0	147.0	1.416	595	105.0	0.113
1900	456	1.177	1.872	854	4.49	54.5	160.0	1.408	642	115.0	0.118
2050	492	1.169	1.855	913	4.41	55.5	172.0	1.401	689	125.0	0.124
2200	528	1.162	1.837	970	4.34	56.5	185.0	1.394	736	135.0	0.130
2350	564	1.158	1.821	1027	4.29	58.0	196.0	1.388	783	145.0	0.136
2500	600	1.152	1.805	1083	4.24	59.0	207.5	1.382	829	155.0	0.141
2650	636	1.148	1.789	1138	4.19	60.0	219.0	1.376	875	165.0	0.146
2800	672	1.142	1.774	1192	4.15	61.0	231.0	1.369	920	173.5	0.152
2950	708	1.139	1.759	1245	4.11	62.0	242.0	1.364	966	183.5	0.157
3100	744	1.136	1.744	1298	4.07	63.0	253.0	1.359	1011	192.5	0.162
3250	780	1.132	1.730	1349	4.03	64.0	264.0	1.354	1056	202.5	0.167
3400	816	1.129	1.717	1401	4.00	64.5	275.0	1.349	1101	211.5	0.172
3550	852	1.128	1.704	1452	4.00	65.5	286.0	1.344	1145	221.0	0.178
3700	888	1.122	1.691	1502	4.00	66.5	296.0	1.339	1189	230.0	0.183
3850	924	1.121	1.678	1550	4.00	67.5	306.0	1.335	1234	239.5	0.188
4000	960	1.120	1.666	1599	4.00	68.0	315.0	1.331	1278	249.0	0.192
4200	1008	1.120	1.650	1663	4.00	69.0	326.0	1.325	1336	261.5	0.200
4400	1056	1.120	1.634	1726	4.00	70.0	337.0	1.320	1394	274.0	0.206
4600	1104	1.120	1.620	1788	4.00	70.5	349.0	1.314	1451	285.5	——
4800	1152	1.120	1.605	1849	4.00	71.5	358.0	1.310	1509	297.0	——
5000	1200	1.120	1.590	1908	4.00	72.5	367.0	1.305	1566	308.0	——
5200	1248	1.120	1.577	1968	4.00	73.0	376.0	1.301	1624	318.5	——
5400	1296	1.120	1.564	2027	4.00	74.0	385.0	1.297	1681	329.5	——
5600	1344	1.120	1.552	2086	4.00	74.5	393.0	1.294	1739	339.0	——
5800	1392	1.120	1.539	2142	4.00	75.5	402.0	1.291	1797	350.0	——
6000	1440	1.120	1.526	2197	4.00	76.0	409.0	1.290	1858	359.0	——
6200	1488	1.120	1.514	2253	4.00	77.0	417	1.289	1918	369	——
6400	1536	1.120	1.502	2307	4.00	77.5	425	1.288	1978	377	——
6600	1584	1.120	1.491	2362	4.00	78.0	431	1.288	2040	386	——
6800	1632	1.120	1.480	2415	4.00	79.0	438	1.288	2102	395	——
7000	1680	1.120	1.470	2470	4.00	79.5	446	1.288	2164	405	——
7500	1800	1.120	1.447	2605	4.00	81.5	464	1.288	2318	426	——
8000	1920	1.120	1.426	2738	4.00	83.0	481	1.288	2473	446	——
8500	2040	1.120	1.409	2874	4.00	85.0	497	1.288	2628	467	——
9000	2160	1.120	1.400	3024	4.00	87.0	515	1.288	2782	486	——
9500	2280	1.120	1.400	3192	4.00	89.0	535	1.288	2937	504	——
10000	2400	1.120	1.400	3360	4.00	91.5	555	1.288	3091	522	——
11000	2640	1.120	1.400	3696	4.00	95.0	595	1.288	3400	560	——
12000	2880	1.120	1.400	4032	4.00	99.0	634	1.288	3709	596	——
13000	3120	1.120	1.400	4368	4.00	103.0	673	1.288	4019	633	——
14000	3360	1.120	1.400	4704	4.00	106.5	712	1.288	4328	668	——
15000	3600	1.120	1.400	5040	4.00	109.5	751	1.288	4637	704	——
16000	3840	1.120	1.400	5376	4.00	112.5	789	1.288	4946	740	——
17000	4080	1.120	1.400	5712	4.00	115.5	827	1.288	5255	776	——
18000	4320	1.120	1.400	6048	4.00	118.0	863	1.288	5564	810	——
19000	4560	1.120	1.400	6384	4.00	120.0	899	1.288	5873	844	——
20000	4800	1.120	1.400	6720	4.00	120.0	900	1.288	6182	877	——

[a] Includes pickup allowance and correction for difference between test and operating conditions.
[b] To be specified in catalog.