

TABLE 1. PRACTICAL COMBUSTION RATES FOR RELATIVELY SMALL COAL-FIRED HEATING BOILERS OPERATING ON NATURAL DRAFT OF FROM $\frac{1}{4}$ IN. TO $\frac{1}{2}$ IN. WATER

Sq. Ft. GRATE	KIND OF COAL	LB. OF COAL PER Sq. Ft. GRATE PER HOUR
Up to 4	No. 1 Buckwheat Anthracite	3
5 to 9	No. 1 Buckwheat Anthracite	3½
10 " 14	No. 1 Buckwheat Anthracite	4
15 " 19	No. 1 Buckwheat Anthracite	4½
20 " 25	No. 1 Buckwheat Anthracite	5
Up to 9	Anthracite Pea	5
10 to 19	Anthracite Pea	5½
20 " 25	Anthracite Pea	6
Up to 4	Anthracite Nut and Larger	5
5 to 9	Anthracite Nut and Larger	6
10 " 14	Anthracite Nut and Larger	7
15 " 19	Anthracite Nut and Larger	8
20 " 25	Anthracite Nut and Larger	9
Up to 4	Bituminous	4
5 to 14	Bituminous	7
15 and above	Bituminous	10

surface and grate area) corresponding by heating surface to the estimated design load as defined in Section V of the CODE OF MINIMUM REQUIREMENTS, being the sum of items (A), (B) and (C) in Paragraph 1. (This is the same (1), (2) and (3) on page 264 of this chapter.)

BOILER RATINGS

The use of boilers the output of which has been determined in accordance with the boiler testing code No. 3 of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS is recommended.

A method sometimes used for estimating the approximate reasonable output of a boiler where more accurate and reliable test data are not available, is as follows:

The output in B.t.u. is obtained by multiplying together the square feet of grate surface by an assumed rate of combustion (in pounds of coal per square foot of grate per hour) by the B.t.u. value of the fuel (per pound) by the efficiency of the boiler (at the load and rate of combustion assumed).

This gives an approximate rating. For data on rates of combustion, see Table 1, also Chapter 10, Heating by Coal, and Chapter 14, Chimneys.

Ordinary heating boiler efficiencies for normal rate of combustion usually range between 55 per cent and 75 per cent.

Gas-Fired Boiler Ratings

The rating of gas boilers, in contrast to that of coal boilers is a comparatively simple matter. The following conditions of rating established by the American Gas Association have been generally accepted:

1. The boiler must deliver rated output without chimney connection.
2. There must be no carbon monoxide formed when the gas pressure in service line is normal, 50 per cent below normal, or 50 per cent above normal.
3. The boiler must have an efficiency of at least 75 per cent at rated output.
4. Gas pressure drop in all valves and fittings must not exceed 1 in. of water.

The maximum B.t.u. input or gas that can be burned may be determined by the manufacturer but is checked by the American Gas Association laboratory before being approved. An arbitrary efficiency of 80 per cent is assumed in computing the output rating from the B.t.u. input.

The actual B.t.u. delivered by any gas boiler when burning gas at the rated B.t.u. input will vary from the A.G.A. output rating in the direct proportion of the actual efficiency with the gas being burned to the assumed efficiency of 80 per cent.

Oil-Fired Boiler Ratings

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.

Coal boilers converted to oil may have as high or a higher rating and as high or higher efficiency than with coal.

To inaugurate unproved terminology:

Size means physical dimensions, in contradistinction to rating or output.

Rating means the output of the boiler; the work which it performs.

TYPES OF BOILERS

Broadly speaking, three types of boilers are commonly used—sectional, fire-tube and water-tube.

Sectional boilers may be of the rectangular pattern with vertical sections, or of the round pattern with horizontal sections. They are usually constructed of cast iron; and on account of their sectional construction and the usual practice of being shipped knocked down and assembled on the job, they are easily handled through small openings at any stage of construction. Their design also facilitates the removal and replacing of damaged parts as well as an increase or decrease in capacity by the addition or removal of sections.

Cast iron boilers usually are limited to operating pressures of 15 lb. steam or 30 lb. water, excepting when used for hot water supply, in which case the boilers are built for operation at city pressure and are tested at pressures two and one-half times the operating pressure.

Fire-tube boilers may be of the horizontal tubular brickset pattern, the horizontal tubular firebox pattern (with or without supplementary brick setting), the vertical tubular brickset pattern or the vertical tubular firebox pattern.

Fire-tube steel boilers may be built for high or low pressure, but when used for heating with consequent usual low-pressure operation, they generally are built according to the A. S. M. E. Steel Plate Heating Boiler Code which limits working pressure to 15 lb. per square inch for steam boilers, or 250 deg. Fahr. or 160 lb. per square inch for water boilers. In construction they may be riveted or welded. Where higher operating pressures are required, boilers of the same dimensions as low-pressure boilers can be obtained at a comparatively small increase in cost.