

TABLE 3. PRACTICAL COMBUSTION RATES FOR COAL-FIRED HEATING BOILERS OPERATING AT MAXIMUM LOAD ON NATURAL DRAFT, OF FROM  $\frac{1}{8}$  IN. TO  $\frac{1}{2}$  IN. WATER<sup>a</sup>

| KIND OF COAL               | SQ FT GRATE  | LB OF COAL PER SQ FT GRATE PER HOUR |
|----------------------------|--------------|-------------------------------------|
| No. 1 Buckwheat Anthracite | Up to 4      | 3                                   |
|                            | 5 to 9       | 3½                                  |
|                            | 10 to 14     | 4                                   |
|                            | 15 to 19     | 4½                                  |
|                            | 20 to 25     | 5                                   |
| Anthracite Pea             | Up to 9      | 5                                   |
|                            | 10 to 19     | 5½                                  |
|                            | 20 to 25     | 6                                   |
| Anthracite Nut and Larger  | Up to 4      | 8                                   |
|                            | 5 to 9       | 9                                   |
|                            | 10 to 14     | 10                                  |
|                            | 15 to 19     | 11                                  |
|                            | 20 to 25     | 13                                  |
| Bituminous                 | Up to 4      | 9.5                                 |
|                            | 5 to 14      | 12                                  |
|                            | 15 and above | 15.5                                |

<sup>a</sup>Steel boilers usually have higher combustion rates for grate areas exceeding 15 sq ft than those indicated in this table.

The boiler selected should have a grate area not less than that determined by Formula 1. With small boilers, where it is desired to provide sufficient coal capacity for approximately an eight-hour firing period plus a 20 per cent reserve for igniting a new charge, more grate area may be required depending upon the depth of the fuel pot.

#### Selection of Gas-Fired Boilers

After determining the *net load* for the installation, gas designed boilers can usually be selected from manufacturers' tables of *net load ratings* which are based on piping and pickup allowances varying from 56 per cent for boilers of 200 sq ft and less to 35 per cent for boilers of 4000 sq ft and larger. If the piping and pickup load or other factors create an unusual load, a boiler should be selected which has an *A.G.A. output rating* equal to the maximum output required. Detailed recommendations for selection of gas designed boilers are given in the *A.G.A. publication, Comfort Heating*<sup>a</sup>.

#### SPACE LIMITATIONS

Boiler rooms should, if possible, be situated at a central point with respect to the building and should be designed for a maximum of natural light. The space in front of the boilers should be sufficient for firing, stoking, ash removal and cleaning or renewal of flue tubes, and should be at least 3 ft greater than the length of the tubes.

A space of at least 3 ft should be allowed on at least one side of every boiler for convenience of erection and for accessibility to the various dampers, cleanouts and trimmings. The space at the rear of the boiler

<sup>a</sup>Comfort Heating, 1938, pp. 35 to 39 (*American Gas Association*).

should be ample for the chimney connection and for cleanouts. With large boilers the rear clearance should be at least 3 ft in width.

The boiler room height should be sufficient for the location of boiler accessories and for proper installation of piping. In general the ceiling height for small steam boilers should be at least 3 ft above the normal boiler water line. With vapor heating, especially, the height above the boiler water line is of vital importance.

When steel boilers are used, space should be provided for the removal and replacement of tubes.

#### CONNECTIONS AND FITTINGS

Steam outlet connections should be the full size of the manufacturers' tapings in order to keep the velocity of flow through the outlet reasonably low and to avoid fluctuation of the water line and undue entrainment of moisture, and should extend vertically to the maximum height available above the boiler. A steam velocity in boiler outlets not exceeding 25 to 30 fps at maximum load is recommended unless data are available to show that a higher velocity is satisfactory.

Particular attention should be given to *fittings connections* to secure conformity with the *A.S.M.E. Boiler Construction Code for Low Pressure Heating Boilers*. Attention is called in particular to pressure gage piping, water gage connections and safety valve capacity.

*Steam gages* should be fitted with a water seal and a shut-off, consisting of a cock with either a tee or lever handle which is parallel to the pipe when the cock is open. Connections to *steam gage siphons* shall be of non-ferrous metal when smaller than 1 in. pipe size and longer than 5 ft between siphon and point of connection of pipe to boiler, and also when smaller than ½ in. pipe size and shorter than 5 ft.

Each steam or vapor boiler must have at least one *water gage* glass and two or more *gage cocks* located within the range of the visible length of the glass. The water gage fittings or gage cocks may be directly connected to the boiler, if so located by the manufacturer, or may be mounted on a separate water column. No connections, except for combustion regulators, drains or steam gages, should be placed on the pipes connecting the water column and the boiler. If the water column or gage glass is connected to the boiler by pipe and fittings, a cross, tee or equivalent, in which a cleanout plug or a drain valve and piping may be attached, should be placed in the water connection at every right-angle turn to facilitate cleaning. The water line in steam boilers should be carried at the level specified by the boiler manufacturer.

*Safety valves* must be capable of discharging all the steam that can be generated by the boiler without allowing the pressure to rise more than 5 lb above the maximum allowable working pressure of the boiler. This should be borne in mind particularly in the case of boilers equipped with mechanical stokers or oil burners where the amount of grate area has little significance as to the steam generating capacity of the boiler.

Where a *return header* is used on a cast-iron sectional boiler to distribute the returns to both rear tapings, it is advisable to provide full size plugged tees instead of elbows where the branch connections enter the return tapings. This facilitates cleaning sludge from the bottom of the boiler sections through the large plugged openings. An equivalent clean-out plug should be provided in the case of a single return connection.

*Blow-off or drain connections* should be made near the boiler and so