vided the boiler manufacturer guarantees it to be capable of operating at a maximum output of not less than 150 per cent of net load rating with over-all efficiency of not less than 75 per cent with at least two different makes of each type of standard commercial burner recommended by the boiler manufacturer. If the heat loss from the piping system exceeds 20 per cent of the installed radiation, the excess is to be considered as a part of the net load.

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 upon piping and pick-up allowances recommended by the *American Gas Association.*

The boilers selected from such tables will include a piping and pick-up allowance varying from 57 per cent for net loads of 500 sq ft steam equivalent direct radiation or less to 40 per cent for net loads of 1000 sq ft steam equivalent direct radiation or greater. Detailed recommendations for selection of gas designed boilers are given in the *A.G.A.* publication, Comfort Heating[8].

If the piping and pick-up load or other factors create an unusual load, a boiler should be selected which has an *A.G.A.* ouput rating equal to the maximum output required.

CONVERSION TO GAS FIRING

The conversion of a coal or oil boiler to gas burning is simpler than the reverse since little furnace volume need be provided for the proper combustion of gas. If a solid fuel boiler of 500 sq ft (or less) capacity is converted to gas burning, the necessary heat input units should be approximately double the connected load. Assuming a combustion efficiency of 75 per cent for a conversion installation the boiler ouput would be $2 \times 0.75 = 1.5$ times the connected load, which allows 50 per cent for piping tax and pick up.

A wide range of gas conversion burners in input ratings up to 400,000 Btu per hour is available, all certified for compliance with American Standard Listing Requirements for Gas Conversion Burners, sponsored by the *A.G.A.* Such burners should be installed as specified by American Standard Requirements for Installation of Conversion Burners in House Heating and Water Heating Appliances. These requirements give full directions for inspection and preparation of the existing heating plant, including the sizing and installation of the flue connection, together with other important details based on accepted practice. In converting large boilers to gas fuel, determination of the required Btu input should be based on a detailed consideration of the requirements and characteristics of the connected load. Installation should conform to provisions of American Standard Requirements for Installation of Gas-Burning Equipment in Power Boilers.

If dampers are found in the breeching, they should be locked in position so that they will not interfere with the normal operation of the gas burner

[8]Comfort Heating, 1938, pp. 35 to 39 (*American Gas Association*).

at maximum flow. In the case of large boiler conversions, automatic damper regulators proportion the position of the flue dampers to the amount of gas flowing and may be substituted for existing dampers.

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 flues, and should be at least 3 ft greater than the length of the boiler firebox.

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 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' tappings in order to keep the velocity of flow through the outlet reasonably low and avoid fluctuation of the water line and undue entrainment of moisture, and should extend vertically to the maximum height available above the boiler.

Particular attention should be given to *fitting 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. *Steam gage connections* should be of copper or brass when smaller than 1 in. *I.P.S.*[9] if the gage is more than 5 ft from the boiler connection, and also in any case where the connection is less than ½ in. *I.P.S.*

Each steam or vapor boiler should 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

[9]*A.S.M.E.* Code. Identification of Piping Systems.