

Steel Boilers

Steel heating boilers may be classified as (1) horizontal return tubular (H.R.T.) boilers, (2) portable (self contained) firebox boilers with either water tubes or fire tubes and (3) water-tube boilers of the power type.

The H.R.T. boiler is the oldest type and consists of a horizontal cylindrical shell with fire tubes, enclosed in brickwork to form the furnace and combustion chamber. All heating surfaces and the interior of the boiler are accessible for both cleaning and inspection. Horizontal return tubular boilers should be suspended from structural columns and beams independent of the brick setting.

Portable firebox boilers are the more generally used type of steel heating boilers, their outstanding characteristic being the water-jacketed firebox which eliminates virtually all brickwork. They are shipped in one piece from the factory and come to the job ready for immediate hook-up to piping. They may be of welded or riveted construction and have either water or fire tubes. Manufacturers' catalogs usually list heating surface as well as grate area. The elimination of brickwork also makes this type the most compact of steel boilers as well as the lowest in first cost.

Water-tube boilers. For large heating loads water-tube boilers are quite frequently used. They usually require more head room than other types of boilers but require considerably less floor space and make possible a much higher rate of evaporation per square foot of heating surface, with proper setting, baffling and draft. Water-tube boilers used for heating purposes are brick set, supported on structural steel columns and with the brick setting encased in an insulated steel housing to prevent air infiltration and to minimize heat losses. For large heating loads at a high rate of evaporation, such boilers should be operated at pressures above 15 lb per square inch with a pressure reducing valve on the connection to the heating main.

The tubes of a water-tube boiler may be baffled vertically or horizontally for directing the flow of hot gases over the tubes. In choosing between the two, the matter of heat absorption is of prime importance with flexibility and cost of maintenance of secondary consideration. Investigations by the U. S. Bureau of Mines show that¹:

1. A boiler in which the heating surface is arranged to give long gas passages of small cross-section will be more efficient than a boiler in which the gas passages are short and of larger cross-section.
2. The efficiency of a water-tube boiler increases as the free area between individual tubes decreases and as the length of the gas pass increases.
3. By inserting baffles so that the heating surface is arranged in series with respect to the gas flow, the boiler efficiency will be increased.

Dead pockets develop in the gas travel due to eddy currents and short circuiting which make parts of the heating surface inactive. Baffling which will minimize such pockets and the inactive heating surface will of course increase the capacity and efficiency.

Magazine Feed Boilers

A special type of boiler has been developed for the burning of small sizes of anthracite known as the *magazine feed boiler*. These are built of

both cast-iron and steel, and have a large fuel carrying capacity which results in longer firing periods than would be the case with the standard types using buckwheat sizes of coal. Special attention must be given to insure adequate draft and proper chimney sizes and connections.

Smokeless Boilers

Smokeless combustion of the more volatile bituminous coals may be obtained by the use of down-draft furnaces, dutch-oven furnaces, specially-designed ignition arches and mechanical stokers. See Chapter 16, Fuels, and Chapter 17, Mechanical Stokers.

Hot Water Supply Boilers

Boilers for hot water supply are classified as direct, if the water heated passes through the boiler, and as indirect, if the water heated does not come in contact with the water or steam in the boiler.

Direct heaters are built to operate at the pressures found in city supply mains and are tested at pressures from 200 to 300 lb per square inch. The life of direct heaters depends almost entirely on the scale-making properties of the water supplied. If water temperatures are maintained below 140 F the life of the heater will be much longer than if higher temperatures are used, owing to decreased scale formation and minimized corrosion below 140 F. Direct water heaters in some cases are designed to burn refuse and garbage.

Indirect heaters generally consist of steam boilers in connection with heat exchangers of coil or tube heaters which transmit the heat from the steam to the water. This type of installation costs more than a direct system, but has the following advantages:

1. The boiler operates at low pressure. Water hammer and cold water shocks are not transmitted to the boiler.
2. The boiler is protected from scale and corrosion.
3. The scale is formed in the heat exchanger in which the parts to which the scale is attached can be cleaned or replaced. The accumulation of scale does not affect efficiency although it will affect the capacity of the heat exchanger.
4. Water hammer due to formation of steam is minimized especially if the steam supply to the heater is under automatic control.
5. Discoloration of water may be prevented if the water supply comes in contact only with non-ferrous metal.

Construction Code

All boilers for low pressure heating of whatever type, and of cast-iron or steel construction, are generally built in accordance with the Rules for the Construction of Low Pressure Heating Boilers of the A.S.M.E. Boiler Construction Code and such boilers are universally accepted by authorities except in Massachusetts and Canada where local codes prevail. Under the A.S.M.E. Code, boilers may be operated at a working pressure of 15 lb for steam and 30 lb for hot water heating. Steel boilers under this Code may also be built for 160 lb water pressure when the temperature of the water in the boiler does not exceed 250 F. Steel boilers of the riveted type may also be built under the A.S.M.E. Power Boiler Construction Code or local codes, for higher operating pressures with the same external dimensions as low pressure boilers.

¹See U. S. Bureau of Mines Bulletin No. 18, The Transmission of Heat into Steam Boilers.