

- 3 • What is the normal rating range of each type of boiler?
- Cast-iron boilers are rated at from 200 to 18,000 sq ft EDR.
 - Steel boilers are rated at from 300 to 50,000 sq ft EDR.
- 4 • a. What is meant by direct boiler heating surface?
b. What is meant by indirect boiler heating surface?
- Direct boiler heating surface is that boiler surface upon which the fire shines, namely, the walls of the firebox and the crown sheet.
 - Indirect boiler heating surface is that boiler surface not exposed to the direct rays of the fire and over which heated gases pass after they have been in contact with the direct surface. Indirect surface is generally known as convective surface.
- 5 • What is the average heat transmission rate in heating boilers in Btu per sq ft of heating surface per hour?
3500 for coal burning boilers; 4200 for oil burning boilers.
- 6 • What factors contribute to economical fuel operation in low pressure boilers burning coal or oil?
- Proper furnace volume for complete combustion.
 - Arrangement of heating surfaces in series to create a turbulent and scrubbing contact of gases against the convective surfaces.
 - Rapid internal water circulation which will remove steam bubbles from the water side of heating surfaces and allow other steam bubbles to be formed. Rapid disengagement of steam bubbles increases the steam generating efficiency of each unit area of heating surface, and thereby lowers flue gas temperatures.
- 7 • What equipment is usually directly attached to a low pressure heating boiler?
- For coal burning steam boilers: water column, water gage, tri-cocks, steam gage, lever pop safety valve, boiler damper regulator.
For coal burning hot water boilers: damper regulator, altitude gage, thermometer, relief valve.
For oil burning boilers, the damper regulators are omitted and the following additional equipment is usually attached: automatic water feeder, low water cutout, a pressure control, and a water temperature control. These are generally furnished by the oil burner manufacturer and do not come with the boiler.
- 8 • What general precautions regarding the boiler should be taken to make sure a proposed heating installation will work properly?
- Select the right size and type of boiler.
 - Be sure the combustion space is proper for the type of fuel burned.
 - Allow sufficient space around the boiler for cleaning.
 - Secure proper height and area of chimney and connecting breeching.
 - Clean the boiler thoroughly and provide surface blowoff connections and bottom blowoff connections for periodic cleaning after operation is begun.
 - See that the boiler heating surface is cleaned at regular periods.
 - Check flue gas temperatures and make a flue gas analysis at least once a month.
 - Secure information and advice from boiler manufacturer.
- 9 • Below what temperature should the water in direct water heaters be maintained to reduce scale formation and corrosion?
140 F.
- 10 • a. What is the heat equivalent of a boiler horsepower?
b. How many square feet of heating surface are usually required per boiler horsepower?
- 33,471.9 Btu per hour.
 - 10 sq ft.

Chapter 26

CHIMNEYS AND DRAFT CALCULATIONS

Natural Draft, Mechanical Draft, Characteristics of Natural Draft Chimneys, Determining Chimney Sizes, General Equation, Chimney Construction, Chimneys for Gas Heating

THE design and construction of a chimney is so important a part of the heating engineer's work that a general knowledge of draft characteristics and calculations is essential.

Draft, in general, may be defined as the pressure difference between the atmospheric pressure and that at any part of an installation through which the gases flow. Since a pressure difference implies a head, draft is a static force. While no element of motion is inferred, yet motion in the form of circulation of gases throughout an entire boiler plant installation is the direct result of draft. This motion is due to the pressure difference, or unbalanced pressure, which compels the gases to flow. Draft is often classified into two kinds according to whether it is created thermally or artificially, viz, (1) natural or thermal draft, and (2) artificial or mechanical draft.

Natural Draft

Natural draft is the difference in pressure produced by the difference in weight between the relatively hot gases inside a natural draft chimney and an equivalent column of the cooler outside air, or atmosphere. Natural draft, in other words, is an unbalanced pressure produced thermally by a natural draft chimney as the pressure transformer and a temperature difference. The intensity of natural draft depends, for the most part, upon the height of the chimney above the grate bar level and also the temperature difference between the chimney gases and the atmosphere.

A typical natural draft system consists essentially of a relatively tall chimney built of steel, brick, or reinforced concrete, operating with the relatively hot gases which have passed through the boilers and accessories and from which all the heat has not been extracted. Hot gases are an essential element in the operation of a natural draft system, although inherently a heat balance loss.

A natural draft chimney performs the two-fold service of assisting in the creation of draft by aspiration and also of discharging the gases at an elevation sufficient to prevent them from becoming a nuisance.

Natural draft is quite advantageous in installations where the total loss of draft due to resistances is relatively low and also in plants which have practically a constant load and whose boilers are seldom operated above