H_t = heat above room temperature carried away by the flue products, Btu per hour.

q = hourly gas heat input, Btu per hour.

Radiant heaters are required to have a radiant efficiency of not less than 28 percent.

Design Considerations

Some factors important in the design of gas heaters are:

1. Proper design of the burner head, port sizes and locations so that the flame will not lift, float, or flash back, and be excessively noisy in operation.
2. Proper venting of combustion chamber for relief of forces resulting from ignition of an explosive mixture of gas and air.
3. Protection of valve handles to prevent excessive temperature rise during operation.
4. Insulation and baffling of heater to prevent over-heating of walls and floor.

INSTALLATION OF SPACE HEATERS

The two most important considerations involved in the installation of a space heater are safety and chimney draft. The items of chimney details and flue connections which should have special attention, are outlined in Chapter 17, Chimneys and Draft Calculations. In all cases, it is recommended that installation be made in accordance with the current National Building Code.

REFERENCES

[1] *I=B=R* Testing and Rating Code for Low Pressure Heating Boilers, July 1952, (*Institute of Boiler and Radiator Manufacturers*).

[2] Testing and Rating Code for Boiler-Burner Units, 1956 (*Mechanical Contractors Association of America*).

[3] *I=B=R* Ratings for Cast-Iron Boilers May 10, 1955 (*Institute of Boiler and Radiator Manufacturers*).

[4] Engineering Standards, Part II, Net Square Feet Radiation Loads in 70 Deg Fahr, Recommended for Low Pressure Heating Boilers, 1956 (*Mechanical Contractors Association of America*).

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

[6] Gravity Code and Manual for the Design and Installation of Gravity Warm Air Heating Systems, Manual No. 5, Fifth Ed., (*National Warm Air Heating and Air Conditioning Association*).

[7] Recommended forms for municipal installation and fire codes are included in Manual 7—Code and Manual for design and Installation of Warm Air Winter Air Conditioning Systems, Fourth Edition, (*National Warm Air Heating and Air Conditioning Association*).

[8] The Development of a Design of Smokeless Stove for Bituminous Coal, by B. A. Landry and R. A. Sherman, presented at the 1948 Annual Meeting of the *ASME*.

[9] American Standard Approval Requirements for Gas Fired Room Heaters, *ASA* Z21.11, 1954 (*American Standards Association*).

[10] American Standard Listing Requirements for: Automatic Pilots, Z21.20, 1951, Gas Appliance Thermostats Z21.23, 1941, Domestic Gas Appliance Pressure Regulators, Z21.18, 1936, with addenda effective June 15, 1935, July 8, 1938, Automatic Valves for Gas Appliances, Z21.21, 1952 (*American Standards Association*).

CHAPTER 17

CHIMNEYS AND DRAFT CALCULATIONS

Draft Definitions, Theoretical Natural Draft, Factors Affecting Natural Draft, Available Draft, Required Draft; Industrial Chimneys, Available Draft for the Industrial Chimney, Determining Industrial Chimney Sizes; Residential Chimneys, Available Draft for Residential Chimneys, Short Chimneys, Determining Residential Chimney Sizes, Draft Requirements of Appliances, Chimneys for Gas Appliances; Recommendations of the National Board of Fire Underwriters; General Considerations

DRAFT is the pressure difference associated with the movement of flue gases through a flue or chimney. Natural draft is caused and measured by the difference in weight of a column of flue gas within the flue and a corresponding column of air of equal dimension outside the flue. Natural draft is always negative and is expressed in inches of water gage.

When the movement of air is supplied by a fan, the draft is said to be forced or induced. When the fan is located so as to push the flue gases through the flue, the draft is forced. When the fan is located so as to draw the flue gases through the flue, the draft is induced.

THEORETICAL NATURAL DRAFT

Theoretical natural draft is produced solely by the difference in weight of the column of flue gases within the flue and that of a corresponding column of air of equal dimensions outside the flue. In the determination of theoretical natural draft, no allowance is made for friction or other positive or negative effects. Theoretical natural draft is expressed by the following formula:

$$D_t = 2.96\, H B_o \left(\frac{\rho_o}{T_o} - \frac{\rho_c}{T_c} \right) \qquad (1)$$

where

D_t = theoretical draft, inches of water.

H = height of flue or chimney, feet.

B_o = barometric pressure, inches of mercury.

ρ_o = density of air at 0 F and 1 atmosphere pressure, pounds per cubic foot.

ρ_c = density of flue gas at 0 F and 1 atmosphere pressure, pounds per cubic foot.

T_o = temperature of air surrounding the chimney, Fahrenheit absolute.

T_c = temperature of the gases, average or effective, in the chimney, Fahrenheit absolute.

Theoretical natural draft may also be expressed by the following simplified formula in which it is assumed that the densities of the flue gas and of the air are equal at the same temperature and pressure:

$$D_t = \frac{\rho H (T_c - T_o)}{5.2 T_c} \qquad (2)$$

where:

ρ = mean density of atmospheric air, pounds per cubic foot.