to the chimney should not be located opposite each other. The connection from the larger device should be reasonably low, and that from the smaller, up near the ceiling, so that each device can be serviced as well as possible, regardless of the treatment of the other.

Even where such precautions are taken, there is, under unusual conditions, some possibility of flow of combustible gases from one appliance into another. Reverse flow of cooled gases has been demonstrated in a chimney at very low rates of flow.[7] Under certain similar quiescent conditions, accidental discharge of combustible gases from a defective device into a chimney could result in flow of these gases counter current into the combustion chamber of another device attached to the same chimney. If ignition occurred in this second device, an explosion could result.

Excessive height in a chimney does no harm, but means for controlling the draft are more than ordinarily essential if the chimney is too tall. Coal-burning devices often have air leaks around the firebox, and the draft doors sometimes fit so poorly that the fire cannot be controlled at a low rate. The simplest remedy for such cases is the barometric damper which admits air into the flue pipe and thus reduces draft.

Where a chimney serves a fireplace, it is important that no other heating device be connected to it unless the fireplace is effectively sealed.

REFERENCES

[1] A Study of Flow Phenomena in the Wake of Smokestacks, by R. H. Sherlock and B. A. Stalker (*Department of Engineering Research, University of Michigan, Bulletin* No. 29, 1941).

[2] *Notes on Power Plant Design*, by E. F. Miller and James Holt (*Massachusetts Institute of Technology*, 1930).

[3] Friction Factors for Pipe Flow, by L. F. Moody (*A.S.M.E. Transactions*, Vol. 66, 1944, p. 671).

[4] *Mechanical Engineers' Handbook*, Eleventh Edition, by R. T. Kent, Editor in Chief (John Wiley and Sons, Inc.).

[5] *Handbook of Building Construction*, by G. A. Hool and N. C. Johnson (McGraw-Hill Book Co., Inc., New York, 1929).

[6] Observed Performance of Some Experimental Chimneys, by R. S. Dill, P. R. Achenbach and J. T. Duck (A.S.H.V.E. TRANSACTIONS, Vol. 48, 1942, p. 351).

[7] Performance of Residential Chimneys, by L. B. Schmitt and R. B. Engdahl (A.S.H.V.E. TRANSACTIONS, Vol. 55, 1949, p. 241).

[8] Performance of Fourteen Masonry Chimneys Under Steady State Conditions, by P. R. Achenbach and S. D. Cole (A.S.H.V.E. TRANSACTIONS, Vol. 55, 1949, p. 129).

[9] A Theoretical and Experimental Investigation of the Performance of Some Short Flues Under Steady-State Conditions, by Robert D. Thulman and William H. Shenkle (Thesis at *Massachusetts Institute of Technology*, June 1951).

[10] Physics of Chimneys; by P. R. Achenbach (*Physics Today*, Vol. 2, No. 12, Dec. 1949).

[11] Performance of Masonry Chimneys for Houses, by Robert K. Thulman (*Housing and Home Finance Agency, Technical Paper No. 18*, Aug. 1949).

[12] *National Bureau of Standards Commercial Standards*: CS101-43 Oil-Burning Space Heaters Equipped With Vaporizing Pot-Type Burners, CS75-42 Automatic Mechanical Oil Burners Designed for Domestic Installations, CS(E)104-43 Warm Air Furnaces Equipped With Vaporizing Pot-Type Burners; CS109-44 Solid-Fuel Burning Forced Air Furnaces, CS113-44 Oil-Burning Floor Furnaces Equipped With Vaporizing Pot-Type Burners.

[13] American Standard Installation of Gas Piping and Gas Appliances in Buildings (*American Standards Association*, Z21.30-1950).

[14] *Comfort Heating*, 1938, p. 71 (*American Gas Association*).

[15] Fire Hazard Tests with Masonry Chimneys, by Nolan D. Mitchell (*National Fire Protection Association Quarterly*, Oct. 1949).

[16] Chimneys and Draft (Chapter 32 in *Winter Air Conditioning*, by S. Konzo, published by *National Warm Air Heating and Air Conditioning Association*, 1939).

CHAPTER 18

ESTIMATING FUEL CONSUMPTION FOR SPACE HEATING

Bases of Fuel Estimates; Season Efficiency; Calculated Heat Loss Method: Computation and Application, Examples and Solutions, Short Methods for Estimating Heat Loss; Degree-Day Method: Computation and Application, Unit Fuel Consumption per Degree-Day, Estimating Consumption for Various Fuels, Examples and Solutions, Degree-Day as an Operating Unit; Industrial Degree-Days; Maximum Demand and Load Factors

IT IS often necessary to estimate the anticipated heat requirements and fuel consumptions of heating plants for either short or long terms of operation. There are various general methods for estimating these conditions, and frequently the methods can be so modified as even to become useful in evaluating the effectiveness of heat production or fuel utilization during plant operation.

In applying a consumption-estimating method to a particular building, it is well to note that the bases of the methods may vary as to reliability. For example:

1. Records of past heat requirements or fuel consumption of the particular building are a better basis for estimates than are averages from records of similar buildings.

2. In the absence of past records for a particular building, the data from similar plants in the same locality may become very helpful.

3. Averages of consumption taken from many types of plants in many types of buildings in various localities can only produce an average estimate which may prove to be very inaccurate as applied to the particular building being considered.

4. Estimates based upon computed heat losses (without benefit of operating data) are wholly dependent, of course, on the degree to which the computation represents the actual facts.

Where unusual operating conditions exist due to factors such as excessive ventilation, abnormal inside temperatures and heat gains from external sources, or where, in the case of proposed buildings of unusual design, no information is available regarding former consumption, it is necessary to estimate fuel consumption from the computed heat losses.

In preparing fuel consumption estimates it is well to realize that any estimating method used will produce a more reliable result over a long period operation than over a short period. Nearly all of the methods in common use will give trustworthy results over a full *annual* heating season, and in some cases such estimates will prove consistent within themselves for monthly periods. As the period of the estimate is shortened, there is more chance that some factor not allowed for in the estimating method will become dominant, and thus give discrepant and even ridiculous results.

The Calculated Heat-Loss Method, and the Degree-Day Method of estimating fuel requirements are illustrative of all methods used. Both methods are based upon an estimate of seasonal efficiency. The former is also based upon an estimate of average seasonal temperature. Neither method takes into account factors which are difficult to evaluate, such as