have no interior walls, the infiltration losses are calculated by using one-half of the total crack, in which case the entire infiltration loss should be considered.

REFERENCES

A.S.H.V.E. RESEARCH REPORTS:

No. 686—Air Leakage, by F. C. Houghten and C. C. Schrader (A.S.H.V.E. TRANSACTIONS, Vol. 30, 1924, p. 105).

No. 704—Air Leakage Around Window Openings, by C. C. Schrader (A.S.H.V.E. TRANSACTIONS, Vol. 30, 1924, p. 313).

No. 786—Infiltration Through Plastered and Unplastered Brick Walls, by F. C. Houghten and Margaret Ingels (A.S.H.V.E. TRANSACTIONS, Vol. 33, 1927, p. 377).

No. 803—*Air Leakage on Metal Windows* in a Modern Office Building, by F. C. Houghten and M. E. O'Connell (A.S.H.V.E. TRANSACTIONS, Vol. 34, 1928, p. 321).

No. 815—Air Leakage Through a Pivoted Metal Window, by F. C. Houghten and M. E. O'Connell (A.S.H.V.E. TRANSACTIONS, Vol. 34, 1928, p. 519).

No. 826—Air Infiltration Through Various Types of *Brick Wall* Construction, by G. L. Larson, D. W. Nelson and C. Braatz (A.S.H.V.E. TRANSACTIONS, Vol. 35, 1929, p. 183).

No. 851—Air Infiltration Through Various Types of Wood Frame Construction, by G. L. Larson, D. W. Nelson and C. Braatz (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930, p. 99).

No. 909—Air Infiltration Through Double-Hung Wood Windows, by G. L. Larson, D. W. Nelson and R. W. Kubasta (A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931, p. 571).

No. 936—Investigation of Air Outlets in Class Room Ventilation, by G. L. Larson, D. W. Nelson and R. W. Kubasta (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932, p. 463).

No. 994—Wind Velocities Near a Building and Their Effect on Heat Loss, by F. C. Houghten, J. L. Blackshaw and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 40, 1934, p. 387).

No. 1069—Heating Requirements of an Office Building as Influenced by the Stack Effect, by F. C. Houghten and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 43, 1937, p. 437).

Neutral Zone in Ventilating, by J. E. Emswiler (A.S.H.V.E. TRANSACTIONS, Vol. 32, 1926, p. 59).

Effect of Frame Calking and Storm Sash on Infiltration Around and Through Windows, by W. M. Richtmann and C. Braatz (A.S.H.V.E. TRANSACTIONS, Vol. 34, 1928, p. 547).

The Weathertightness of Rolled Section Steel Windows, by J. E. Emswiler and W. C. Randall (A.S.H.V.E. TRANSACTIONS, Vol. 34, 1928, p. 527).

Pressure Differences Across Windows in Relation to Wind Velocity, by J. E. Emswiler and W. C. Randall (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930, p. 83).

Flue Action in Tall Buildings, by H. L. Alt (*Heating, Piping and Air Conditioning*, May, 1932).

Air Infiltration Through Steel Framed Windows, by D. O. Rusk, V. H. Cherry and L. Boelter (*Heating, Piping and Air Conditioning*, October, 1932).

Influence of Stack Effect on the Heat Loss in Tall Buildings, by Axel Marin (A.S.H.V.E. TRANSACTIONS, Vol. 40, 1934, p. 377).

Fuel Saving Resulting from the Use of Storm Windows and Doors, by A. P. Kratz and S. Konzo (A.S.H.V.E. TRANSACTIONS, Vol. 42, 1936, p. 87).

The Infiltration Problem of Multiple Entrances, by A. M. Simpson and K. B. Atkinson (A.S.H.V.E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, June, 1936).

Infiltration Characteristics of Entrance Doors, by A. M. Simpson (*Refrigerating Engineering*, June, 1936).

Chapter 7

HEATING LOAD

Heat Demand Design Factors, Method of Procedure, Inside and Outside Temperatures, Wind Velocity Effects, Auxiliary Heat Sources, Wall Condensation, Heat Loss Computation

TO design any system of heating, the maximum probable heat demand must be accurately estimated in order that the apparatus installed shall be capable of maintaining the desired temperature at all times. The factors which govern this maximum heat demand—most of which are seldom, if ever, in equilibrium—include the following:

1. Outside temperature. 2. Rain or snow. 3. Sunshine or cloudiness. 4. Wind velocity.	*Outside Conditions (The Weather)*
5. Heat transmission of exposed parts of building. 6. Infiltration of air through cracks, crevices and open doors and windows. 7. Heat capacity of materials. 8. Rate of absorption of solar radiation by exposed materials.	*Building Construction*
9. Inside temperatures. 10. Stratification of air. 11. Type of heating system. 12. Ventilation requirements. 13. Period and nature of occupancy. 14. Temperature regulation.	*Inside Conditions*

The *inside conditions* vary from time to time, the physical properties of the *building construction* may change with age, and the *outside conditions* are changing constantly. Just what the worst combination of all of these variable factors is likely to be in any particular case is therefore conjectural. Because of the nature of the problem, extreme precision in estimating heat losses at any time, while desirable, is hard of attainment.

The procedure to be followed in determining the heat loss from any building can be divided into seven consecutive steps, as follows:

1. Determine on the inside air temperature, at the breathing line or the 30-in. line, which is to be maintained in the building during the coldest weather. (See Table 1.)

2. Determine on an outside air temperature for design purposes, based on the minimum temperatures recorded in the locality in question, which will provide for all but the most severe weather conditions. Such conditions as may exist for only a few consecutive hours are readily taken care of by the heat capacity of the building itself. (See Table 2.)

3. Select or compute the heat transmission coefficients for outside walls and glass; also for inside walls, floors, or top-floor ceilings, if these are next to unheated space; include roof if next to heated space. (See Chapter 5.)