Air Temperature: Overheating is detrimental to the quality of ventilation, and is believed to be one of the most objectionable conditions of civilization.

Dry-bulb temperatures for ventilated rooms are given in Chapter 2, under Inside Temperatures (p. 8).

Automatic temperature control in ventilating plants is discussed under Automatic Heat Control, Chapter 17 and under Air Conditioning and Cooling, Chapter 7.

Injurious substances, such as gases and fumes, may be of the utmost importance. These are handled usually by mechanical exhaust ventilation with effective distribution of inlets to the exhaust ducts. This phase of ventilation involves, in one way or another, nearly all of the other items.

Table 1. Quantity of Air Required for Ventilation Based on Square Feet of Floor Space

Type of Building	Room	Cu. Ft. of Air per Minute per Square Foot of Floor Area
Schools	Classrooms	2.0
	Assembly Rooms	1.5
	Gymnasia	1.5
	Picture Machine Booths	1.5
	Dining Rooms	1.5
	Kitchens	2.0
	Corridors	0.5
	Wardrobes and Lockers	2.0
	Toilet, Bath, etc.	2.0
Theaters	Seating Spaces	2.0
	Toilets, etc.	2.0
	Picture Machine Booths	2.0
Hotels	Assembly Rooms	2.0
	Dining Rooms	1.5
	Kitchens	4.0
Hospitals	Wards	1.0
	Dining Rooms	1.5
	Toilets	2.0
	Kitchens	4.0

Relative humidity bears an intimate relationship to air movement and temperature. These relations are described under Physiological Effects of Ventilation in this chapter.

The effective temperature index fixes no limits for relative humidity. The practical limits, however, are 30 per cent during the winter and 60 per cent during the summer.

Air motion is important and is intimately associated with the temperature and humidity in producing Effective Temperature as discussed under Physiological Effects of Ventilation in this chapter.

Air purity or cleanliness has to do with human health, both from the standpoint of freedom from dust and other suspended substances, and

from the standpoint of freedom from bacteria and other infectious media carried along with the dirt in air.

Odors are often removed by plentiful air supply and efficient distribution. In special cases this may be facilitated by other means, such as by the use of Ozone.

Air distribution within the space to be ventilated is of the utmost importance, and is closely correlated with effective temperature. When the air can be so conditioned and distributed that it may achieve maximum contact with each person in a room, the volume per person may be much less than that set forth in Table 1.

VENTILATION DESIGN

In the practical work of engineers who design mechanical ventilating systems, and of architects and owners who have to pass upon these systems, the one item which is the basis of all calculations and layouts, is the quantity of air to be handled by the ventilating system to produce the results desired. The functions of the air handled in connection with ventilated spaces are: (1) to supply the necessary oxygen for respiration; (2) to keep the dilution of objectionable substances down to the proper proportion, and (3) to maintain the proper effective air temperature.

It has been estimated that an adult at rest will breathe 0.25 cu. ft. of air per minute and exhale 0.01 cu. ft. of CO_2 in the same period, or at the rate of 0.6 cu. ft. per hour, thus removing about 5 per cent of the oxygen from the air actually breathed. This does not necessarily indicate the effect on the air in the room occupied. The same air may be rebreathed for a limited time without apparent harmful effect.

The air handled by the ventilating system may consist entirely of air taken from the outside or it may consist partly of new air and partly of recirculated air. In any duct system and in all ordinary buildings there is in any event a considerable air change due to leakage.

HEAT FROM OCCUPANTS, LIGHTS, EQUIPMENT

In a crowded place of assemblage the heat given off by the occupants, together with that given off by the lighting and power equipment, may be, and frequently is, more than the normal heat loss through the structure to the outside air, even in winter under cold climatic conditions. This means that in order to preserve an equilibrium of effective temperature the entering air must be cooler than the leaving air, so that the problem in such enclosures is usually one of cooling and ventilating, rather than one of heating and ventilating.

A typical case for winter might show about 300 B.t.u. of body heat, plus 100 B.t.u. per person from light, etc., being given up to the building against about 200 B.t.u. heat loss from the building, per person per hour. This would mean that 200 B.t.u. per person must be carried away by the ventilation.

If the flow of air is upward, or from the side, so as to bring the incoming air into direct contact with the occupants, the temperature of the incoming air should not be more than 5 deg. below the temperature of the air leaving the occupant, otherwise the conditions will be drafty and uncom-