

Class D—85 per cent equipment.—A mechanical system consisting of the following:

1. An accurate air supply with a maximum capacity of 30 c.f.m. per occupant.
2. Gravity exhaust or exhaust openings.
3. Good air distribution.
4. Automatic temperature control.

Class E—80 per cent equipment.

1. A positive air supply with gravity exhaust but without air cleaning devices, humidifying apparatus, temperature or humidity control.
2. Direct-indirect systems with either mechanical or gravity exhaust.
3. Open window or other so-called natural systems of ventilation.

A comprehensive discussion of the requirements of ventilation has been published¹ which suggests the following quantities of air to be supplied, under different conditions, to space used for various purposes as given in Table 90:

TABLE 90. AMOUNT OF NEW AIR TO BE SUPPLIED PER PERSON

	CUBIC FEET PER MINUTE			Number of Air Changes per Hour
	Without Humidification or Recirculation	With Humidification but Without Recirculation	With Humidification and Recirculation	
SCHOOLS—				
Class Rooms.....	30	20	5 to 10	
Assembly Rooms.....	15 to 20	10 to 15	5 to 10	
Gymnasiums.....	30	25	15 to 20	
Toilets.....				10 to 20
Locker Rooms.....				5 to 10
Kitchens.....				20 to 60
Lunch Rooms.....				10 to 20
THEATERS—				
Seating Space.....	30 to 50	20 to 30	10 to 15	
HOSPITALS—				
Wards.....	30 to 40	20 to 30		
Kitchens.....				20 to 60
Dining Rooms.....				10 to 20
Toilets.....				10 to 20
HOTELS—				
Dining Rooms.....				10 to 15
Kitchens.....				20 to 60
Ball Rooms.....				5 to 10
Work Space.....				5 to 10
Assembly Rooms.....	20 to 30	15 to 20	10 to 15	

¹See paper Modern Trend in the Science of Ventilation, Perry West, JOURNAL, A. S. H. & V. E., June, 1924.

VENTILATION REQUIREMENTS

In a crowded place of assemblage the heat given off by the occupants together with that given off by the lighting and power equipment is usually 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 is usually one of cooling and ventilating rather than of heating and ventilating.

A typical case for winter might show about 300 B.t.u. of body heat plus 100 B.t.u. from light etc., being given up to the building against 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 air.

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 (for ceilings 10 ft. or less in height) otherwise the ventilation will be drafty and uncomfortable. This difference may be increased 1 deg. for each 2 ft. of added ceiling height provided the rising air does not come into direct contact with another tier of occupants.

For 10 ft. and lower ceilings the quantity of air per person to dissipate this excess heat is $\frac{200}{60 \times .02 \times 5} = 33$ cu. ft. per person per min.

This amount may be reduced somewhat on the assumption that the component of heat from lights is usually introduced near the ceiling and may be allowed to heat the outgoing air to a greater difference.

In the practical work of engineers who design ventilating systems and of architects and owners who have to pass up on these systems, the one item involving standards which is the basis of all calculations and layouts, is the quantity of air to be handled by the system to be used, for producing 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 CO₂ and other objectionable substances down to the proper point, and (3) to maintain the proper effective air temperature.

The air handled may consist entirely of air taken in from the outside or it may consist partly of new air and partly of recirculated air. On the basis that the air brought in from the outside is for oxygen supply and dilution only. The following cubic feet per minute per person would be required for the ventilation percentages shown, if all other factors are 100 per cent perfect.

TABLE 91. AIR REQUIRED FOR VARIOUS PERCENTAGES OF VENTILATION PERFECTION

PERCENTAGE OF PERFECTION	CU. FT. OF AIR PER MINUTE REQUIRED PER PERSON AT REST	CU. FT. OF AIR PER MINUTE REQUIRED PER PERSON AT HARD WORK
98%	15.0	30.0
96%	7.5	15.0
94%	5.0	10.0
92%	3.75	7.5
90%	3.0	6.0