Ventilation and Air Flow

Ventilation air, as defined in American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 62.1, is that air used for providing acceptable indoor air quality. When people or animals are present in buildings, ventilation air is necessary to dilute odors and limit the concentration of carbon dioxide and airborne pollutants such as dust, smoke, and volatile organic compounds (VOCs). Ventilation air is often delivered to spaces by mechanical systems which may also heat, cool, humidify and dehumidify the space. Air movement into buildings can occur due to uncontrolled infiltration of outside air through the building fabric or the use of deliberate natural ventilation strategies. Advanced air filtration and treatment processes such as scrubbing, can provide ventilation air by cleaning and / or recirculating a proportion of the air inside a building.

Ventilation is one of the most important engineering controls available to the building manager for improving or maintaining the quality of the air in the occupational work environment. Broadly defined, ventilation is a method of controlling the environment with air flow.

The sense of thermal comfort (or discomfort) results from an interaction between air temperature, relative humidity, and air movement.

Air flow is also important for ensuring air moves from clean to dirty and out. In general, the air flow patterns should move from 'clean' spaces into 'more dirty' areas. A good rule of thumb is to keep air flowing from clean to dirty, so that children are not breathing polluted air. This is particularly important for places such as janitorial closets where cleaning supplies are often stored, unused locker rooms with dry traps and leaking sewer gases, and boiler rooms with back drafting heating appliances.

(See Thermal Comfort – Relative Humidity and Air Temperature.)

What is ventilation?

An air flow measurement tells you how fast the air is moving. If you know the cross section area this measurement will tell you Cubic Feet Per Minute (CFM), which is a measurement of ventilation. Ventilation rates can be measured indirectly with a carbon dioxide meter, but there are limitations of using a carbon dioxide meter. One important limitation is that the room must be occupied to get a meaningful measurement using a carbon dioxide meter.

Why measure the air flow?

Air flow can be used to calculate ventilation is the mixing of outside air with inside air. The purpose of the mixing is to keep pollutants and carbon dioxide at the appropriate levels. The American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc (ASHRAE) issues guidelines to ensure the levels of carbon dioxide and other indoor

air pollutants are kept at appropriate levels. These guidelines can be reviewed in the Carbon Dioxide section.

When designing air flows you want to move polluted air to the outside. You also want to keep air from places like the science classroom, kitchen, and restrooms from flowing into office space or classroom space. This can also be called “source control”.

In addition to being an important part of ventilation, air movement contributes to the perception of comfort. Room occupants will be more comfortable with some air movement.

How do I measurement air movement?

There are several ways to measure the air movement. Select the procedure and device that gives you the information you need. You can use Google to find any of the following:

Smoke Puffer

The Smoke Puffer cannot be used to measure a ventilation rate, but it does give an indication of the direction of air flows, which is another important consideration for proper ventilation. Chemical smoke can be helpful in evaluating HVAC systems, tracking potential contaminant movement, and identifying pressure differentials. Chemical smoke moves from areas of higher pressure to areas of lower pressure if there is an opening between them (e.g., door, utility penetration). Because it is heatless, chemical smoke is extremely sensitive to air currents. Investigators can learn about airflow patterns by observing the direction and speed of smoke movement. Puffs of smoke released at the shell of the building (by doors, windows, or gaps) will indicate whether the HVAC systems are maintaining interior spaces under positive pressure relative to the outdoors.

Safety

The Smoke Puffer uses a reactive chemical to produce smoke. The chemical is an acid and must be used with caution. Avoid inhaling smoke from the Smoke Puffer. Use the Smoke Puffer only under adult supervision.

Wizard Stick

Similar to the Smoke Puffer, except that the Wizard Stick does not use toxic chemicals.

Anemometer or air flow meter (Velocity Measurements)
Airflow in large ductwork can be estimated by measuring air velocity using an anemometer. Measure the air velocity in the ductwork and calculate the outdoor airflow in cubic feet per minute (CFM) at the outdoor air intake of the air handling unit or other convenient location. Additional measurements and calculations are required to get air flow.

Flow Hood
Flow-hoods measure airflow in cubic feet per minute (CFM) at a diffuser or grill. Taking the measurement is simply a matter of holding the hood up to the diffuser and reading the airflow value.

Carbon Dioxide Measurements

See the carbon dioxide section for more details. Carbon dioxide measurements for ventilation should be collected away from any source that could directly influence the reading (e.g., hold the sampling device away from exhaled breath). As with many other measurements of indoor air conditions, it is advisable to take one or more readings in "control" locations to serve as baselines for comparison. Readings from outdoors and from areas in which there are no apparent IAQ problems are frequently used as controls. In general, the room must be occupied to get a meaningful measurement using a carbon dioxide meter. Measurements taken in unoccupied areas will not give useful information about the ventilation.

What are normal levels that I might find?

Carbon Dioxide Concentrations

Concentration (ppm)	**Approximate Ventilation Rate (cfm/person)**	**Air Quality**
380		Outdoor
800	20	
1,000	15	
1,100		Good
1,400	10	Poor
2,400	5	Unacceptable

What standards are there for air flow?

There are no EPA standards for air movement, but there are Occupational Safety and Health Administration (OSHA) and American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) guidelines.

Ventilation is addressed in specific OSHA standards for the general industry, shipyard employment, long-shoring, and the construction industry. There are two basic categories of ventilation in the OSHA standards: general exhaust ventilation (dilution ventilation) and local exhaust ventilating. OSHA is focused on providing guidelines for industry, but these basic categories also apply in residential or school building settings. For example, local exhaust ventilating might be used in the bathroom or kitchen.

ASHRAE Standards specify that outside air for ventilation purposes should be introduced at the lowest volume necessary to maintain adequate indoor air quality. ASHRAE Standard 62-l989, Ventilation for Acceptable Indoor Air Quality, specifies the outdoor air ventilation requirements at a minimum of 15 cfm per person in non-smoking areas, regardless of occupant usage, and a minimum of 60 cfm per person for smoking areas. Also the concentration of CO2 should not exceed 1,000 parts per million in conditioned spaces.

Notes about ventilation.
Be aware that exhaust fans can make lots of noise without moving any air.

Houses with appliances vented to the outside need to be tested for back-draft if the sum of the cfm ratings of the two largest exhaust fans is greater than 15 cfm per 100 square feet of habitable space.