UNDERSTANDING UNIT VENTILATORS

by Joseph T. Kohler, Ph.D., P.E.

Introduction.

Unit Ventilators are a traditional method of heating, ventilating and cooling classrooms. They were developed more than 60 years ago specifically for this application, and have stood the test of time. There are still many schools with 1950 vintage unit ventilators providing comfortable and properly ventilated classroom environments.

Unfortunately, unit ventilators have developed a bad reputation in some circles. This is often due to a misunderstanding of how unit ventilators operate and to poor maintenance. This technical note will provide a description of unit ventilators, a discussion of how they operate, and a summary of some of the advantages of unit ventilators compared to other methods of heating and ventilating classrooms.

What is a Unit Ventilator?

A unit ventilator consists of a heating coil, fan assembly, dampers, filter and controls contained in a metal cabinet. Unit ventilators are usually located on the outside wall of classrooms, although they are sometimes suspended at or above the ceiling level.

Outdoor air is brought directly into the cabinet via a grille located on the outside wall of the classroom. The unit ventilator is designed to mix room air with outside air, heat the air if necessary, and deliver it to the classroom through a grille located in the top of the unit ventilators. The proportion of outside air is controlled by the position of the fresh air damper. This damper can be adjusted to provide as much or as little fresh air as desired. A typical unit ventilator will circulate a total of 1000 or 1250 cfm (cubic feet per minute) of air, of which a minimum of 400 cfm is outdoor air. With a unit ventilator, 100% of the airflow can be outside air when it is needed for "free cooling" (also called "economizer cooling").

With any system, it is necessary to balance the air flow in the building, i.e., to exhaust an amount of air equal to the fresh air supply. In a unit ventilator system, this is often accomplished by a "gravity" relief damper in the outside wall, which automatically opens to relieve the proper amount of stale air. Sometimes, exhaust is accomplished with a ducted exhaust fan system.

How a Unit Ventilator Operates.

The key to a unit ventilator is a straightforward control sequence designed to automatically provide heating or cooling as required. To understand the controls, it is essential to understand the heating and cooling requirements of a typical classroom. At night a classroom requires heating, especially in the early morning when the temperature setpoint is raised in preparation for the school day. However, at some point in the day the combination of internal heat gains from students and lights, along with solar gains, may cause the classroom to need cooling instead of heating. This can occur even during a cold winter day.

Unit ventilator controls will provide hot water to the coil to heat the room to the desired temperature at the beginning of the school day, but keep the outside air damper closed until occupants are scheduled to arrive. Then the outside air damper will open to the preset minimum ventilation
position to assure an adequate supply of fresh air.

As internal and solar gains increase, the unit ventilator will gradually turn off heat to the coil and then begin to further open the outside air damper to bring in more cool air to keep the classroom from overheating. The temperature of this air supplied to the room is often near 65° F, slightly cooler than the room temperature. A properly operating unit ventilator should be able to keep a room within a couple of degrees, plus or minus, of the thermostat's heating set point. *It is essential to realize that it is entirely proper for a unit ventilator to deliver cool air, even on a cold winter day.*

**Vertical Projection Ventilation.**

Floor mounted unit ventilators provide what is referred to as Vertical Projection Ventilation. Fresh air is mixed with room air and projected vertically near the outside wall/window of the classroom, and then across the ceiling and to the inside wall of the classroom. This achieves very thorough distribution of the fresh air, without creating drafts (except immediately above the unit ventilator). Vertical Projection Ventilation is a very effective means of providing heating, ventilation and cooling to the classroom.

**Advantages of Unit Ventilators.**

The ability to heat, ventilate and cool individual classrooms from a single piece of equipment is unique to unit ventilators. Alternative systems, such as those employing baseboard radiation with central ducted fresh air ventilation, do not have full ability to cool classrooms. (Typical central ventilation systems supply only, say, 400 cfm of outside air per classroom, not the full 1000 or 1250 cfm.) Classrooms with these systems are prone to overheating, especially in the spring and fall.

Another advantage of unit ventilators is that there is virtually no ductwork involved. The fresh air enters the unit ventilator directly from the outdoors. Each room has its own independent system. There is no need to be concerned with dust or mold in long runs of supply air ductwork with unit ventilator systems. Stale air is often relieved directly through the outside wall. The slight positive pressure in classrooms reduces the possibility of radon entering the room.

A third advantage of unit ventilators is that the amount of outside air can be easily adjusted. For example, if building codes change to require more outside air, or the occupancy of a classroom is increased, or the use is changed to a classroom requiring more ventilation (e.g., a science or art classroom), the minimum position of the unit ventilator's outdoor air damper can be adjusted accordingly.

A fourth advantage of unit ventilator systems is that it is simple to adapt the system to summer cooling by circulating chilled water through the mains. This is applicable only to new systems which have the appropriate pipe insulation and condensate drains in the unit ventilators.

A final advantage is simple maintenance. Like all systems, unit ventilators require periodic maintenance and regular filter changes to insure proper operation. However, any maintenance or repair affects one room only, and involves small, readily available components. Properly maintained unit ventilators have provided more than a half century of service in classrooms throughout the country.