CONFINED SPACE VENTILATION

Presented by:
Mark Niksic
Engineering Manager,
Portable & Fabric Products
T.A. Pelsue Company

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The danger of a confined space is invisible, but just as potentially deadly as a more visible menace. Only by taking the necessary steps to ensure a safe breathing environment can we hope to avoid personal injury or death when working in these areas.

There are many tools available to facilitate the safe entry and temporary occupancy of confined spaces. These range from atmospheric test instruments, ventilators, heaters, explosion proof lighting, self-contained breathing apparatus, and man/material lifts.

The supply of fresh air to workers in a confined space is imperative. Many situations utilize a self-contained breathing apparatus, or SCBA; but when an SCBA is impractical, the confined space must be ventilated.

In choosing a ventilator, the selection is dictated by job requirements and possible conditions that might be encountered on that job. Is a high pressure ventilator needed? What volume of air per unit of time will be required? Is the confined space atmosphere potentially explosive? What power source is readily available? Are there any noise restrictions?

Along with these factors, you must also consider the capabilities and limitations of each type of ventilator design.

There are three major groups of ventilator designs in use today: the centrifugal, the axial, and the air ejector.

Centrifugal ventilators are usually driven by an electric motor or gasoline engine. They are noted for their moderate to high static pressure capabilities, good air delivery and ruggedness. Centrifugal ventilators are noisier than other types of ventilators and are usually a little heavier (average weight, 40-80 lbs). The three distinct styles of centrifugal ventilators are: the Forward Curved Ventilator, the Backward Curved Ventilator, and the Straight or Radial Ventilator.

The Forward Curved

Sometimes known as a "squirrel cage", the forward curved centrifugal ventilator has the impellar blades inclined in the direction of rotation. This type of ventilator design must be housed in a scroll shape.

The fans have small space requirements, low tip speeds, and are relatively quiet in operation. Choose this type for low to moderate static pressure applications.

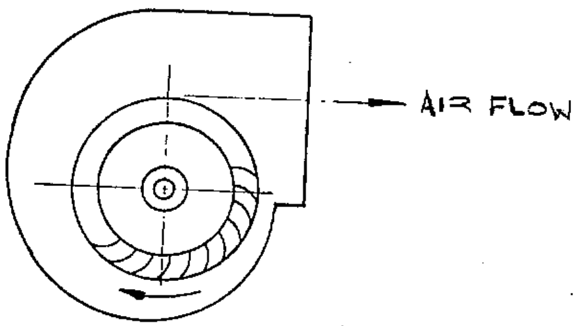

Figure1 - Forward Curved Ventilator

The Backward Curved

This type of ventilator has the impellars inclined away from the direction of rotation. The backward curved ventilator usually has a high tip speed and will develop high static pressures. Because of the blade shape, this style has a tendency to build up materials on its blades and should only be used in areas of clean air.

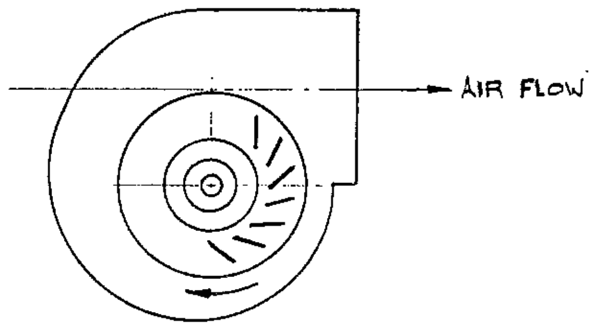

Figure 2 - Backward Curved Ventilator

The Straight or Radial

This is the most rugged of the three types. Not as common as the other two, the straight or radial ventilator is used where high dust conditions might exist.

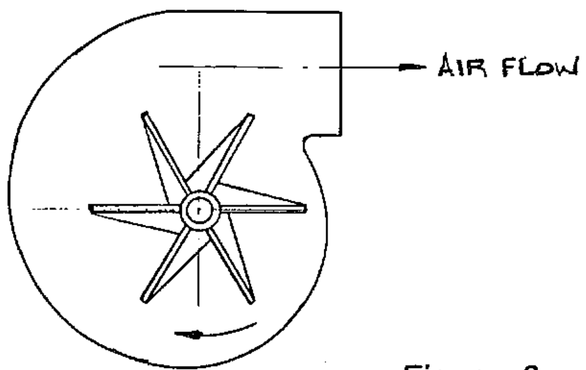

Figure 3 - Straight or Radial Ventilator

Axial ventilators are used for moving high volumes of air against relatively low static pressures. They are usually powered by small electric motors and are quieter and lighter than their centrifugal cousins (average weight, 20-35 lbs). The axial style of a ventilator is commonly seen in three distinct types.

The Propellar

This type is similar to a standard house fan. The propellar ventilator is used for moving large quantities of air against a very low static pressure. They are usually mounted in a wall or ceiling and do not have attached duct work .

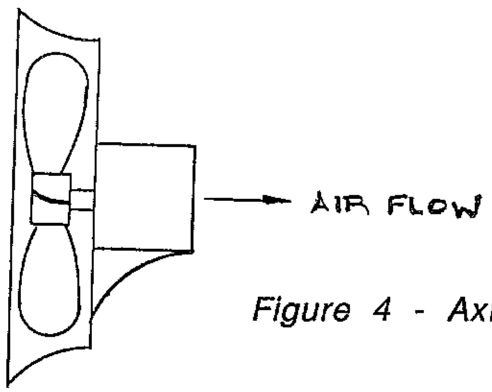

Figure 4 - Axial Ventilator - Propeller

The Tube Axial

This is similar to the propellar design, however, it has more blades and is enclosed in a cylindrical housing to improve pressure capabilities .

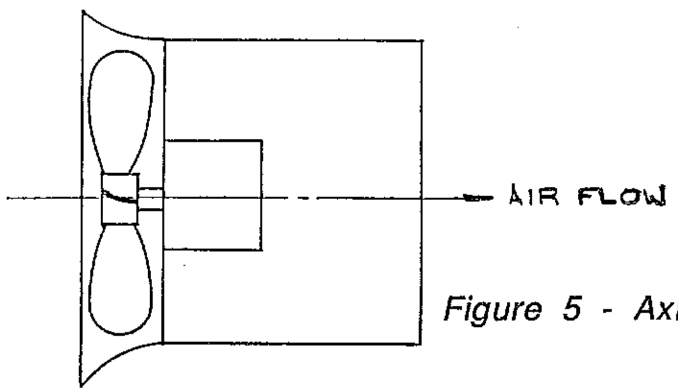

Figure 5 - Axial Ventilator - Tube Axial

The Vane Axial

This is the most efficient ventilator of the axial designs and uses straighteners in its housing to improve the flow characteristics and pressure capabilities .

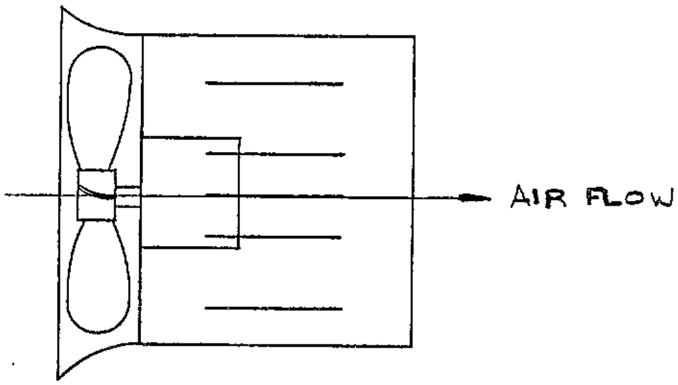

Figure 6 - Axial Ventilator - Vane Axial

The air ejector is the third type of ventilator. In industrial and outside plant confined space applications, one type in particular, the Venturi, is commonly used. These ventilators have no moving parts and operate by having either compressed air or steam admitted into a side inlet, thereby creating a *ventur* effect in which large amounts of surrounding air enter through the inlet and exit the other end of the ventilator at high velocity.

These ventilators are commonly used in areas of high residue that would clog a centrifugal or axial design or in applications requiring explosion proof ventilation. A venturi ventilator requires compressed air or steam in the pressure range of 40 to 80 psi and in volumes of 30 to 350 SCFM.

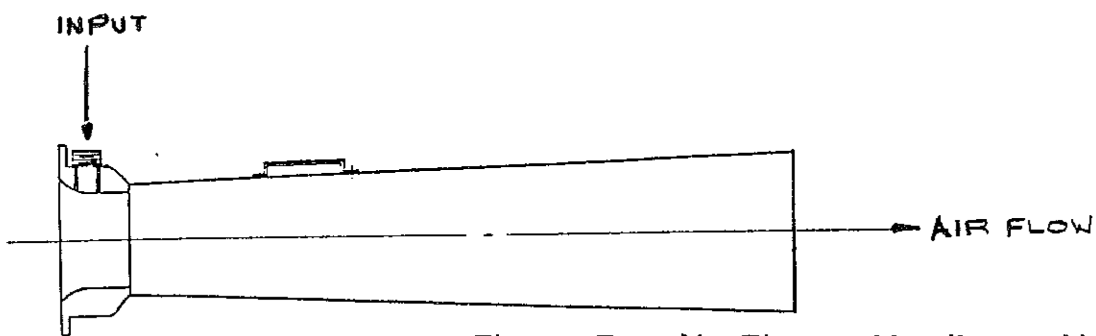

Figure 7 - Air Ejector Ventilator- Venturi

Hoses or ducts are used to convey air from the source to the confined space. These are typically made from a lightweight, flexible fabric, come in various diameters and lengths, and are collapsible for compact storage.

The most common size of ventilator hose in confined space applications is an 8-inch diameter in a 15 or 25 foot length.

Manufacturers can supply ventilator hoses in 10" and 12" diameters; however, these sizes take up more room in an already tight confined space entry opening and may impede material handling or worker retrieval in an emergency.

Most ventilator hoses have the air flow direction marked on one end. Blowing air against internal seams will greatly reduce the rated performance of the ventilator, so it is important to attach the hose correctly.

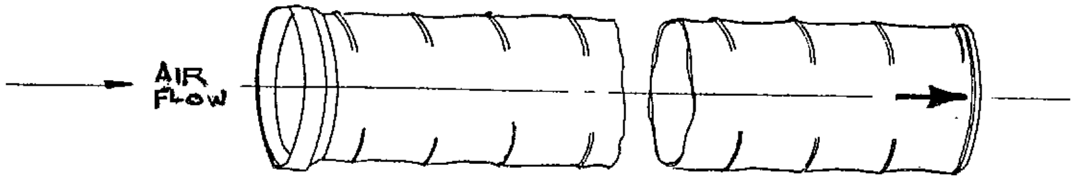

Figure 8 - Ventilation Hose

Various support equipment should be used at a confined space entry point, depending upon the circumstances and the area in which the work is taking place.

Traffic guards, cones, tents, and lighting should all be considered. A man/material lift should be readily available. When selecting equipment, safety should be the number one consideration inside and outside the confined space .

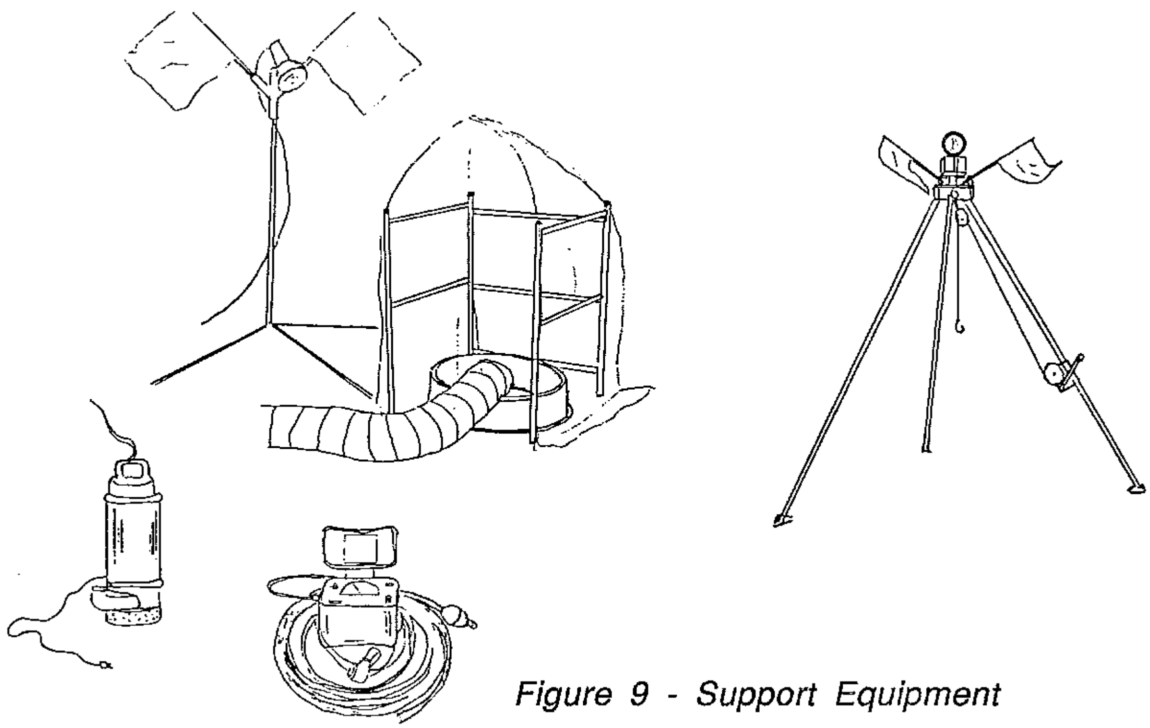

Figure 9 - Support Equipment

Any confined space that has:

(1) limited openings for entry and exit,

(2) unfavorable natural ventilation, or

(3) is not designed for continuous worker occupancy,

must be tested for atmospheric conditions, purged, then tested again prior to entry. The confined space must also be continuously ventilated and tested during worker occupancy.

This must be done to eliminate three potentially deadly atmospheric conditions: oxygen deficient atmosphere, flammable or explosive atmosphere, and toxic atmosphere.

If a confined spacehas less than 19.5% available oxygen, it is classified as oxygen deficient,. This condition can be caused by chemical formation of carbon dioxide or by absorption of the oxygen into crevices or ducts.

The atmosphere may become flammable or explosive due to biological decay leading to Methane, or from coatings or solvents used or stored in the confined space. Dust in the proper concentrations can also be explosive.

A toxic atmosphere can result from the storage of solvents or chemicals that, even though may have been removed, still pose a hazard due to absorption into the walls. Toxic gases can also be caused by work being performed in the confined space such as welding, degreasing or painting.

If water is present in the confined space, be sure to test for an explosive atmosphere prior to removal of the water by an electric pump. Then, test for all atmospheric conditions again after the confined space is empty since gases may have seeped into the space left vacant by the water.

Ventilator Set-up: Initial Purge

For the initial purge of the confined space, set the ventilator at least five feet away and upwind of the entry, facing the inlet of the ventilator into the wind. This will assure a clean, fresh air supply.

Attach the flexible hose on to the ventilator outlet and feed the other end of the hose into the confined space. The hose should hang straight down with the outlet facing the bottom of the confined space at least one foot below the ceiling and at least two feet above the floor.

For side entry confined spaces, lay the hose on the floor with the end of the hose at least 2 feet from the far wall. Be sure the ventilator is out of the path of the purged air escaping from the entry .

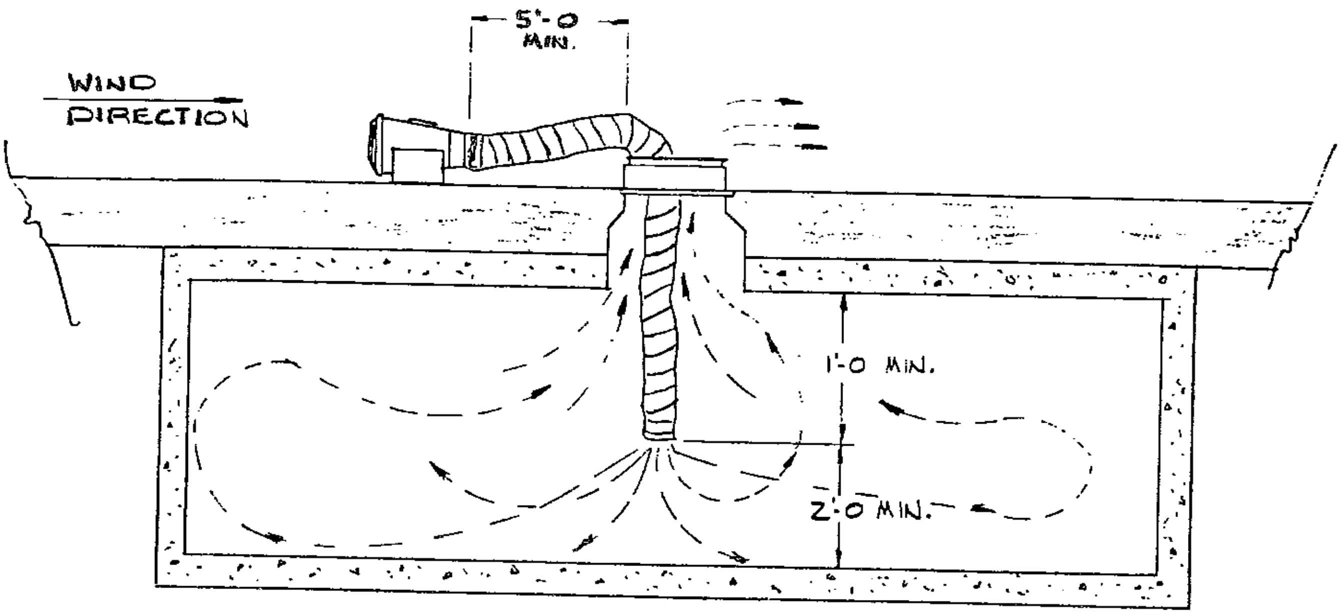

Figure 10 - Ventilator Set-up

In purging or ventilating a confined space, it has been proven more effective to "blow air into" rather than "draw air out of" the area. There are several reasons for this.

First, blowing air into the confined space causes turbulence which tends to dislodge pockets of bad air. Secondly, by applying positive pressure to the confined space, it helps eliminate the chance of gas seepage through crevices or ducts back into the work area. Third, blowing air into the confined space reduces the chance of flammable gases being drawn across the ventilator motor, particularly in the case of an axial ventilator where the motor lies directly in the air path.

The time required for a complete purge of the confined space is dependent upon the size of the area, the types of gases to be exhausted and the performance of the ventilator. The Bell companies supply a purge chart indicating minimum times for purging based on the area size and the ventilator performance.

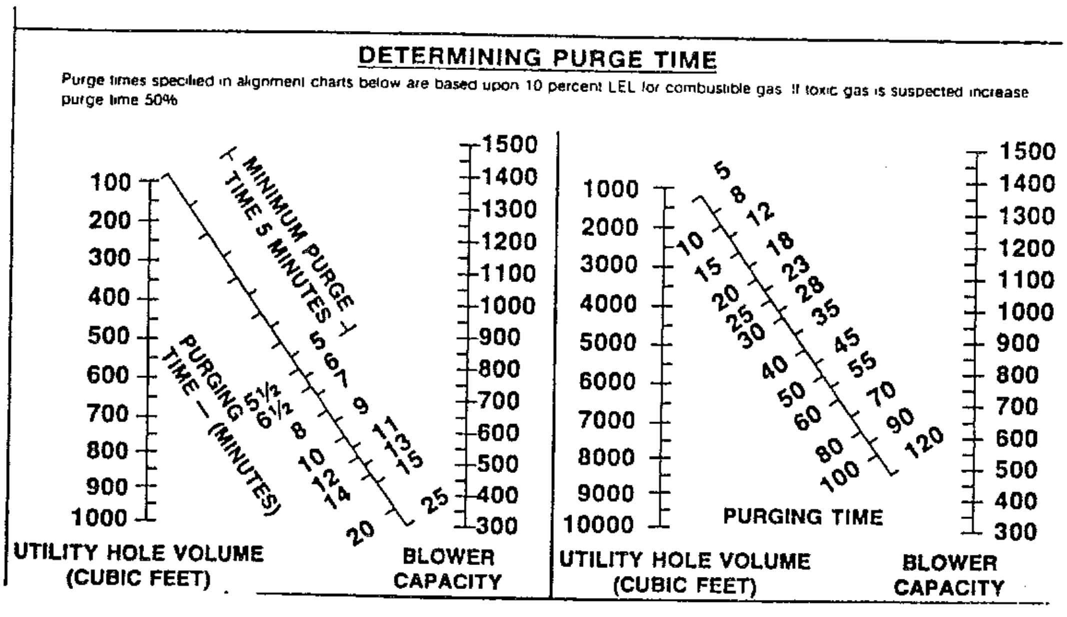

Figure 11 - Purge Chart

Manufacturers performance ratings for ventilators are determined at independent laboratories based on the AMCA 210-67 test code for air moving devices. Typical ratings include free air CFM, 1-90° bend in hose CFM, and 2-90° bends in hose CFM . Also, the static pressure capability is usually listed or available from the manufacturer.

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PELSUE

MODEL 1240 SERIAL NO. 00165
2-SPEED, 115 VAC, 60 Hz., 1 HP.
CERTIFIED PERFORMANCE
PER AT&T E.L. 2723, P.L. 2709

	HIGH	LOW
FREE AIR	1509 CFM	994.5 CFM
1-90° BEND	1031 CFM	679 CFM
2-90° BENDS	868 CFM	584 CFM

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Figure 12 - Rating Plate

In most cases, the purged air escaping from the confined space should pose no public health threat nor cause any other dangerous situation. This is because the purged air will be highly diluted due to the sheer volume of the outside atmosphere. If the gases in the confined space are potentially lethal or explosive in small quantities, the local authorities should be notified. In any case, all local codes must be followed as in handling any hazardous or flammable material.

Immediately after the determined purge time has been completed, retest the confined space for all atmospheric conditions.

Ventilation of the confined space should continue after purging and while the area is worker occupied to insure a safe working environment. With the ventilator set on its lowest speed and taking into consideration the number of bends in the duct (usually no more than two), you should be able to maintain a good air exchange rate.

Bell standards specify a ventilator to be capable of no less than 345 CFM with 2-90° bends in a 15 foot length of 8-inch diameter duct. Since most utility manholes for the phone industry are 400 cubic feet, this translates to one total air exchange every 1 minute, 10 seconds.

The very largest of the manholes listed by the Bell companies are 10,000 cubic feet. Using the same ventilator as before, we would achieve a total air exchange twice every hour. The controlling factor on how often the confined space air must be exchanged will be established by the constant monitoring of the atmosphere.

Remember, the number of air exchanges is not based on confined space size, but on the atmospheric conditions in the confined space.

There is no doubt that confined spaces can be hazardous; but there are steps we can take to make the environment safer:

- Select the appropriate ventilator taking into consideration job requirements and potential conditions that might be encountered on that job.

- Before entering any confined space, test the atmosphere, ventilated, then test again.

- Ensure that three potentially deathly atmospheric conditions do not exist.

- Make safety the number one consideration inside and outside of the confined space.

These simple steps can help reduce some of the hazards of working in a confined space.

GLOSSARY

ASPHYXIATING =	An atmosphere which contains less than 19.5 percent oxygen
CFM =	Cubic feet per minute, the term used to designate the air moving capability of a specific ventilator
CONFINED SPACE =	An enclosure that meets three criteria: 1. Limited openings for entry and exit 2. Unfavorable natural ventilation 3. Not designed for continuous worker occupancy
FLAMMABLE =	Atmospheres which pose a hazard because flammable or explosive gases, vapors or dusts are present at a concentration greater than 10 percent of their lower flammable limit
PURGE =	To do a complete air exchange in a confined space prior to entry. Normally, a purge is considered complete when atmospheric tests indicate the air is of suitable quality to sustain life. The minimum time for an initial purge is 5 minutes. Employer supplied charts should be followed.
SP =	Static pressure, used to describe the amount of force needed to overcome the applications resistance. Usually this resistance is caused by restrictions in the duct, such as bends. Static pressure is measured in inches of water
TOXIC =	An atmosphere containing poisonous gases or vapors from sources such as benzene, carbon monoxide, or hydrogen sulfide
VENTILATION =	The continuous introduction of clean ambient air into a confined space during worker occupancy
VENTILATOR =	A machine designed for moving quantities of air. Axial, centrifugal and venturi are all types of ventilators

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