Confined Space Ventilation Basics and Controlling Static Electricity

Confined Space Entry

Do It Right The First Time

Air Systems International, Inc.

Email: sales@airsystems.com

Catalog Request: catalog@airsystems.com

Leading The Safety Industry Since 1984

www.airsystems.com

Picking the Best Fan or Blower for the Job
Axial Fan vs. Centrifugal Blower

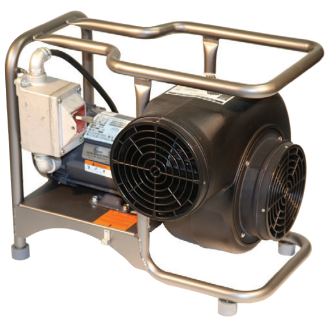
When selecting a fan or blower, all ventilators have two characteristics:

1) **Air flow** - Air volume delivered and measured by cubic feet per minute (CFM).
2) **Air pressure** - Force of air volume is measured by inch of water gauge (WG).


Axial Fans

An axial fan creates high air flow but the blade design develops lower pressure. When used with ducting, the ventilation duct creates air movement resistance and the axial fan becomes inefficient at longer distances. Axial fans are designed with several large paddle blades that develop a large volume of air flow (CFM).

When to use:
Axial fans are lightweight, low cost and best when working at short distances with minimal ducting, preferably 15 to 25 foot flexible ducting.

Centrifugal Blowers

A centrifugal blower uses a “squirrel cage” designed with numerous forward curving blades on a circular wheel. The blades create significant volume (CFM) and very high air pressure (WG).

When to use:
Centrifugal blowers are typically heavier and cost more than axial fans due to the motor required to efficiently run the blades. Centrifugal blowers are used to move air a long distance using long or multiple lengths of duct.


In-Line Axial Fans

The in-line axial fan can be used by itself or used with a fan or blower as a velocity accelerator for long duct distances over the 15 or 25 foot standard duct length.

When to use:
When ventilating at long distances, simply add an in-line fan to the ducting to increase or maintain air flow for long distances. In-line fans can be used with either axial or centrifugal blowers to extend longer ventilation distance.

Blower & Fan Selection Guide Available at www.airsystems.com

VIDEO ONLINE

For Use In Hazardous Locations

Warning: Always select a certified explosion-proof or pneumatic fan/blower when working in hazardous locations.

Special Application Ventilators

Venturi Air Blower

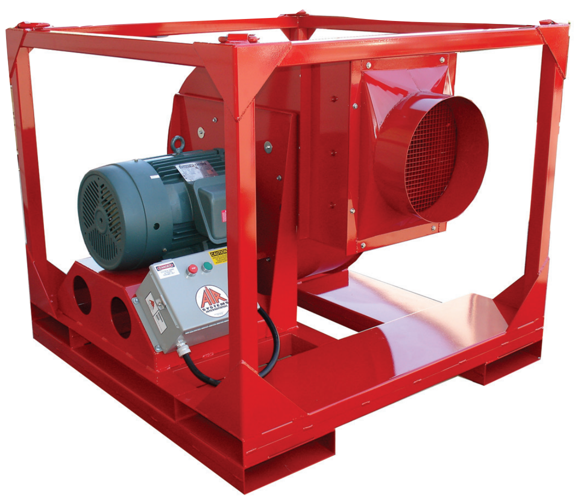
The Venturi air blower operates with a pneumatic air hose and uses no moving parts or blades. Tremendous CFM is created by using a hollow hub that spins air similar to a jet engine.

When to use:
With no mechanical blade, the Venturi is not specifically designed to force air through flexible ducting. The Venturi is primarily used as a suction or push device used on a tank and can be used in conjunction with an axial or centrifugal fan to rapidly remove gases from a tank. Venturi bases are designed to fit American Petroleum Institute (API) standard tanks.

Pneumatic Circular Jet Fan

Pneumatic Circular Jet Fans operate with a pneumatic air hose to ventilate tanks.

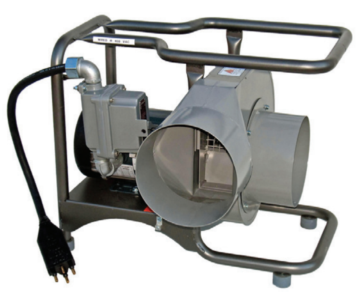
When to use:
The Pneumatic Circular Jet Fan is designed to push air in or remove air from tanks to assist Venturi blowers in rapidly removing gases from the tank. The jet fan bases are designed to fit American Petroleum Institute (API) standard tanks.



Custom Centrifugal Blowers

Custom centrifugal blowers are designed for high air pressure (WG) and high air flow (CFM) measuring thousands of CFM. Large blowers allow ventilationto flow over long distances and establish air manifolds for multiple ventilation at remote areas. A high pressure portable blower can deliver positive or negative air flow while removing dust and/or gases for long distances.

When to use:
Custom blowers for special applications to properly ventilate the work situation.



For a more comprehensive overview of confined space ventilation or custom blower solutions, please contact Air Systems Customer Service Department.

Air Systems International is the Industry Leader in Grade-D Breathing Air Filtration & Confined Space Ventilation

Controlling & Removing Static Electricity During Confined Space Entry Ventilation

By: Dave Angelico, President, Air Systems International, Inc.

The Safety Industry needs a clear well defined "How-To" Standard on the proper procedures for controlling and safely removing electrostatic charges during confined space ventilation.

Working in tanks, manholes and underground vaults are some of the most dangerous and potentially lethal occupations found in the industrial work environment. Federal, State and corporate safety departments have written reams of documents and procedures on how to safely enter a confined space and perform some sort of maintenance, repair or cleaning operation. Good corporate work practices and procedures have existed for years at the industry specific level. The telecommunications companies, chemical, pharmaceutical and oil storage and refineries have long seen the necessity of a "How To" manual for work on their own specific confined space hazards. The current OSHA Standard, 1910.146 **"Permit-required Confined Spaces"**, goes a long way to providing General Industry the safety framework for entering and exiting a confined space and identifying some of the hazards a worker may encounter. This OSHA Standard was the outgrowth of many existing standards that came together to provide minimum guidelines for General Industry to follow. **The one process needed in the OSHA Standard is a specific work practice for the safe removal of static electricity during confined space ventilation and a means to test it.** This work practice should be simple enough for all industry trades to be able to perform.

Meeting Industry Demands

As a manufacturer, we have to be responsive to the wants and needs of our customers. Since the development and marketing of the first Saddle Vent® confined space entry ventilation system in the early 1990's, we have constantly been asked by companies, contractors, military and consultants, **"How do you properly handle the potential problem of static electricity build-up on the plastic surface of the Saddle Vent® and the ducting when you are ventilating a tank or manhole?"** The art and science of ventilation has many textbooks and articles to help in the quest for understanding the many ventilation techniques used in industry. However, the one technical area that is very sketchy involves ventilation with regard to the potential disastrous problems of electrostatic charge build-up. Many of the corporate and government procedures reference that static charges should be removed while ventilating but few tell the worker **"How-To Do It"**. After reviewing a great many standards and procedures, it appears that the best source for understanding this phase of the confined space ventilation procedure comes from an industry specific source, ANSI/API Standards 2015 and 2016, published by the American Petroleum Institute in Washington, D.C.; another excellent source is NFPA 77. These documents provide requirements and actual procedures for safe entry and work in confined spaces and more specifically they address the issues with regard to controlling static electricity. **The one ingredient missing in these standards is the aspect of "How-To Set Up and Test" a complete grounded ventilation system.**

Static Electricity - The Basics

At some time in our lives we have all felt the effect of static electricity build-up. Walking across the living room carpet and touching a metal doorknob or refrigerator and we feel and see the spark of discharged static electricity. Static is generated whenever two dissimilar materials are in relative motion to each other. I recently was filling my car with gasoline and I noticed a Warning Notice on the gas pump. The manufacturer of the gas pump very plainly and simply explained that if I get out of my car to put fuel in the tank, please do not get back in the car with fuel pumping until I touch the front frame of the car and discharge any potential build-up of static electricity or a resulting explosion could occur. About three years ago, a Safety Director at an Ohio hospital complex called me after he purchased an explosion-proof blower system, with a Saddle Vent® and conductive ducting from Air Systems. He asked me how he should test the system to assure he was achieving a good ground and he was dissipating static electricity. He explained to me every ventilation system in their hospital was grounded and had to be tested to assure it had a good ground so no static electricity was able to build up on their fans and blowers. These examples brought to my attention a safety industry need to address the specific treatment of the problem of static electricity being developed with current ventilation products. The standard plastic hose ducting and the original standard polyethylene Saddle Vent® both can generate and hold static charges on the inside and surface of the duct; these two areas are both sources of ignition from static build-up.

Free electrons will be attracted to any other electron deficient nucleus. Movement of electrons from one atom to another constitutes what is referred to as electrical energy, including static electricity. What causes these electrons and static charges to migrate from one atom to another? The movement of static charges is due to such factors as a small change in temperature, atmospheric pressure, relative humidity and the friction of air through a piece of ducting. The energy needed to cause this movement of atoms is surprisingly very low. Even though all matter contains free electrons, these electrons are unable to move freely through materials with high electrical resistance; these items are called nonconductors or insulators. Examples of non-conductors would be glass, certain gases, rubber and many plastic materials. Standard non-conductive vinyl air duct (hose), the traditional industry standard, is used in most confined space ventilation applications and even properly grounded, the displaced electrons can become trapped on the surface of the plastic ducting. When a substance of opposite polarity comes in contact with a non-conductive device, the trapped electrons can flow freely between the two materials. This sudden and rapid transfer of electrons can cause a spark of sufficient intensity to ignite a confined space that may contain industrial solvents, methane gas from decaying material, hydrocarbon residue or fine airborne dust. NIOSH references that a low relative humidity, below 50%, can accelerate the build-up of electrostatic charges creating sufficient energy to ignite flammable atmospheres.

Abrasive blasting operations in confined spaces can cause a tremendous build-up of static charges by the mechanical friction of the blasting material. This static build-up can provide the charge necessary to cause an intense explosion of the dusty space. **NFPA states that if a hazard exists or has a potential to exist, the work environment should be evaluated with regard to the potential of static electricity build-up.**

The following questions need to be asked:

1) Can a static charge be generated?
2) Will the charge be able to accumulate?
3) Can a discharge of static electricity occur?
4) Will an ignitable mixture be present at the site of the discharge?
5) Will the discharge have sufficient energy to ignite the mixture?

The Proper Ventilation System

NFPA, OSHA and ANSI/API Standards reference good work practices in a confined space necessitates continuous ventilation before and during the work performed in a confined space. The objective of a good ventilation system is to gas free the confined space before occupancy and then to stabilize the confined space by providing continuous fresh air to the workers during occupancy. ANSI/API recommends the use of a venturi type eductor air mover or an explosion-proof electric blower. The electric motor and on/off switches must be approved, at a minimum, for use in Class I, Division 1, Group D atmospheres for methane and Class II, Division 1, Groups E, F, and G for dust hazards. Each blower selected must have a metal grounding lug located on the blower. This lug is used to connect the conductive ducting and its wire helix to the blower to form an electrical bond. Ducting should be supplied with fabric manufactured with a conductive coating material and a 12" grounding wire attached to each end of the metal helix inside the duct. The bonding process is simply where components in the ventilation system are connected to form a conductive path that ensures electrical continuity and the flow of static electricity will travel back to a safe grounded source-the electric blower or an earth ground. In performing tank work, the entire blower system is bonded to the tank that is connected to a proper earth ground. ANSI/API Standards 2015 and 2016 provide detail how the use of a venturi style eductor along with an explosion-proof electric blower can be used to accomplish a preferred push/pull method of confined space ventilation. **The one aspect of this ventilation set-up that is missing is how to test the system once it is in place and assure a proper electrical bond has been achieved. (What level or range of resistance, in ohms, are sufficient to remove static charges?)**

Solution: The Conductive Saddle Vent® Ventilation Technique

Test for Conductivity

Part of a good confined space entry program is having met the objectives listed in the OSHA 1910.146 and ANSI/API Standards. One important objective is the aspect of self rescue. The use of the Saddle Vent®, air conduit device, allows the worker to establish continuous ventilation in the confined space without obstructing the entry or egress of the workers. This Saddle Vent® device meets the objective of self-rescue for workers who may encounter a hazardous work environment and need to rapidly egress the confined space. The second key objective of a safe confined space entry ventilation program is to provide a ventilation system that eliminates the build-up of static electricity and its potential ignition hazard. The original Saddle Vent® device and 90 degree elbow is now available in conductive plastic material. This Conductive Saddle Vent® connects to sections of conductive ducting and when properly assembled, forms a complete electrical circuit (bond) from the farthest end of the duct all the way back to the grounded ventilation blower. **Electrostatic charges that traditionally would build up on the surface of the Saddle Vent® and ducting can now be safely removed through the use of conductive plastics; this process is called the Conductive Saddle Vent® Ventilation System.**

Test the Ventilation System for Conductivity

Prior to the start of the ventilation process, the entire Conductive Saddle Vent® Ventilation System should be set-up and tested to assure a complete circuit has been achieved. The ventilation system should include a pneumatic or explosion-proof electric blower, a Conductive Saddle Vent®, conductive duct with attached ground wires on each end; all components should be attached together properly, prior to testing. A lead from a volt/ohm meter should be attached to the farthest end of the ducting and its metal helix and the other lead should be attached to the metal frame or ground lug of the blower. The volt/ohm meter should provide a reading between 50K and 350K ohms and prove the existence of an electrical circuit. This resistance range will provide adequate conductivity for the static charge build-up to drain to a properly grounded source through the blower's electric cord or earth ground.

Conclusion

Confined space entry is hazardous for even the most seasoned professionals. Unfortunately, most of the work done in confined spaces is done on an occasional basis with less than expert workers. It is only a matter of time when all the right conditions of fuel, oxygen and ignition come together to form another newspaper or magazine headline. We believe OSHA needs to seek the guidance and expertise of industry professionals to write additional "How To" procedures to aid and assist the occasional confined space worker on handling and removing static electricity when ventilating. The use of a work specific device like the Conductive Saddle Vent® System will eliminate one more potential hazard from the confined space worker's list of potential problems. The objective of any safety device is to eliminate a hazard or potential hazard and reduce the possibility for catastrophic accidents. This article brings to light an improved 21st century technique for greater worker safety with regard to controlling static electricity in confined space entry ventilation. The atmosphere within a confined space can change very rapidly and deadly; don’t assume a static discharge can’t happen to you or your workers.

Control your work environment - Choose the Conductive Saddle Vent® Ventilation System.

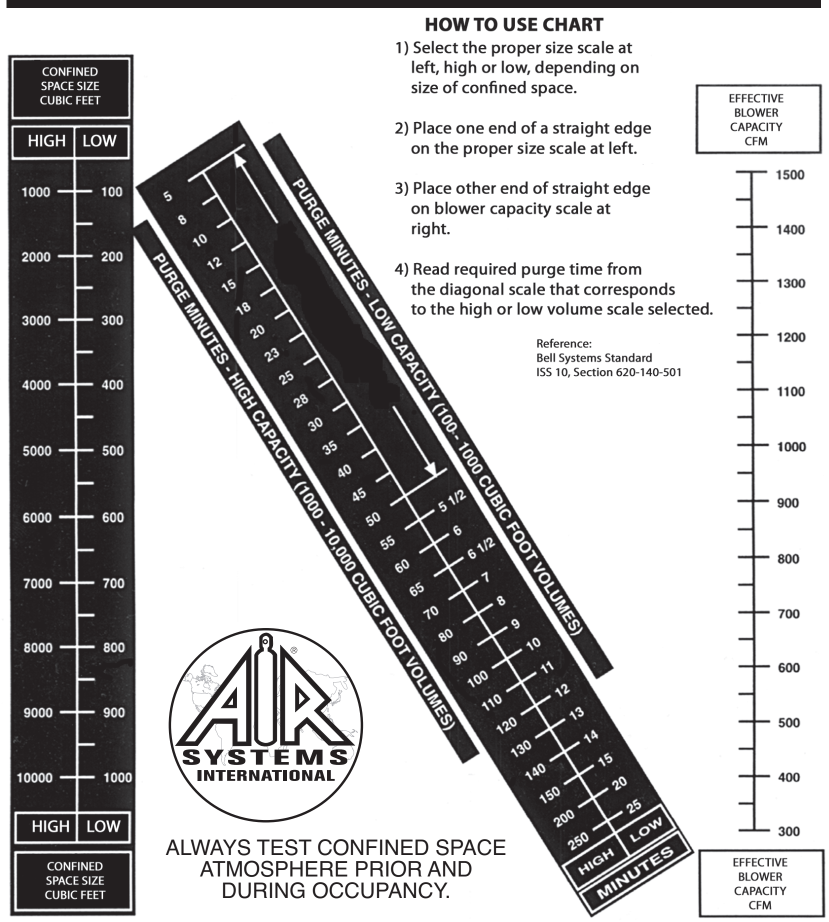
Confined Space Ventilation Safety Tips

1) Proper ventilation procedures should be followed in accordance with all Federal, State, and Local laws. For work in hazardous locations, follow ANSI/API 2015 and 2016 procedures.
2) Always test the confined space for hazardous gases and sufficient oxygen with a calibrated multi-gas monitor prior to ventilating the space. After ventilating for a sufficient amount of time, re-test the confined space before entering the space. Ventilation must remain in operation while the confined space is occupied.
3) Use a purge time chart, provided on Air Systems' blowers, and below, to calculate purge times prior to entering a confined space. Each 90º bend in a section of 8" duct will reduce flow approximately 10-15%.
4) If toxic or combustible gases or low oxygen levels are encountered, increase ventilation purge times by 50% and retest the air quality.
5) When ventilating a manhole or tank, always set the blower back from the opening a minimum of five (5) feet. This should prevent any hazardous gases that may be purged from the confined space from being drawn back into the intake of the blower and forced back into the confined space.
6) Never block or restrict entry and egress to or from a confined space opening. Always use Air Systems' Conductive Saddle Vent® System placed in the opening of the manhole or tank to allow continuous ventilation without restricting entry and egress to the opening.
7) With gases heavier than air, ventilation duct should be placed at the bottom of the confined space allowing the blower's air to push the gases out the top of the confined space.
8) Always use non-sparking tools in and around a hazardous work site.
9) When using a Venturi style pneumatic air horn (also called an eductor) on a steel tank, make sure the aluminum base is not dragged along the surface of the steel tank; this may cause a spark where rust is forming. Always make certain that the Venturi blower has been properly bonded to the tank prior to ventilating and assure the tank is properly grounded.
10) Always have proper respiratory equipment for the ventilated work space and for emergency rescue.
11) The build-up of static electricity is more prevalent during cool dry conditions, typically below 50% relative humidity. Depending on the work environment, anti-static clothing and special static removal devices may be necessary to prevent ignition from static electrical discharge.

The Conductive Saddle Vent® Ventilation System

Confined Space Entry - Do it Right the First Time!

ESTIMATING APPROXIMATE PURGE TIMES



1) Proper ventilation procedures should be followed in accordance with all Federal, State and Local Laws.
2) Air quality of the confined space should be tested prior to ventilation.
3) Ventilate confined space for the minimum times recommended above and retest air quality prior to entry.
4) If toxic and/or combustible gases or low oxygen is encountered, increase purge times by 50%
5) If 2 blowers are used, add the two capacities and proceed with the "**HOW TO USE CHART**" directions above.
6) Effective blower capacity is measured with one or two 90º bends in 8" diameter, 25 foot blower hose.
7) Maintain continuous ventilation while confined space is occupied.

Hazardous Location Identification
Selecting Proper Equipment

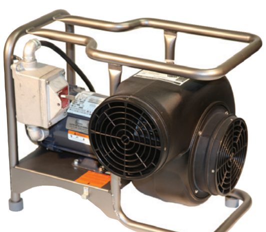
Confined spaces are some of the most dangerous and potentially life-threatening work environments in industry, making ventilation, respiratory, and PPE equipment an integral component of a total safety program. US OSHA states "electical equipment must be approved by a Nationally Recognized Testing Laboratory (NRTL) " **. . . and stated in 29 CFR 1910.303(a). In addition, NRTL's must approve this equipment using U.S. recognized test standards, 29 CFR 1910.7."** Proper selection and training with approved hazardous location safety equipment can reduce the potential cause of accidents and even loss of life. In order to select the proper equipment, the worker must first determine whether the location is considered a "Hazardous" or "Non-Hazardous" location.

Ventilation Equipment for Hazardous Locations

When a location is determined to be a hazardous location or there is the potential for a hazardous work location, it is necessary to take every precaution to guard against ignition of the hazardous atmosphere. The traditional "Combustion Triangle" is made up of three elements: 1) fuel 2) oxygen and 3) an ignition source. All three must be considered when developing a plan to ventilate hazardous or potentially hazardous environments.

Hazardous location electrical equipment, approved by a Nationally Recognized Testing Laboratory (NRTL) such as UL or CSA, is designed and constructed to eliminate the potential for ignition of the work environment.

The following is a list of equipment criteria to consider for all hazardous locations:



Explosion-Proof Electric Blower SVB-E8EXP

Explosion-Proof Electric Products - Units should have a hazard label stating Class, Group, and Division approvals listed from the approving agency, e.g. CSA or UL. Blowers should have a grounding lug to ground the unit and safely remove the build-up of static electricity to a safe grounded source. These types of electric blowers should have a metal frame and housing or a conductive plastic housing to assure a good ground to the electrical source and an aluminum non-sparking blower wheel to prevent metal sparking.

Explosion-Proof Electric Axial Fan CVF-8EXP

Intrinsically Safe Equipment - Intrinsically safe fans use a non-sparking, air powered motor. Static charges may develop during ventilation; proper fan grounding and conductive ducting should be used to remove static charges. Proper ventilation procedures should be followed in accordance with all Federal, State, and Local laws. For work in hazardous locations, follow ANSI/API 2015 and 2016 procedures.

For Use In Hazardous Locations

Pneumatic Air Powered Blower SVB-A8

Conductive Duct SVH-CND815

Conductive Ducting - Choose ventilation duct that has fabric made of conductive material. This type of duct will reduce the potential build-up of static electricity on both the interior and exterior surfaces of the duct that can result from the movement of air and small dust particles during ventilation. Air Systems adds a grounding wire to the conductive duct's interior wire helix; it attaches to the blower so that any static charges can be removed to either the blower's ground lug or to Air Systems' Conductive Saddle Vent® Ventilation System.

Air Systems International, Inc.
Email: sales@airsystems.com
Catalog Request: catalog@airsystems.com
www.airsystems.com

Blower & Fan Selection Guide

VIDEO ONLINE

www.airsystems.com