Understanding Static Electricity in Confined Space Entry Ventilation

General industry needs a clear, well-defined "how-to" standard on the proper procedures for controlling and safely removing electrostatic charges.

PHOTOS: AIR SYSTEMS INTERNATIONAL

by David F. Angelico

Some of the most dangerous and potentially lethal occupations involve working in tanks, manholes and underground vaults. 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 phone, chemical, pharmaceutical and oil storage companies 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 in providing general industry with the 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 a minimum for general industry to follow. The one process needed in the OSHA standard is a specific work practice on the safe removal of static electricity during confined space ventilation.

Figure 1. A metal grounding lug connects the ducting and its wire helix to the blower to form an electrical bond.

Meeting Industry Demands

As a manufacturer, we have to be responsive to the wants and needs of our customers. Since the development and

Figure 2. The system shown above establishes continuous ventilation in the confined space without obstructing the entry or egress of the workers.

marketing of the first Saddle Vent confined space entry ventilation system in the early 1990s, we have constantly been asked by companies, contractors, military and consultants, "How do you properly handle the potential problem of static electricity build-up when you are ventilating a tank or manhole?"

The art and science of ventilation has many books and articles to help in the quest for understanding the different techniques of ventilation used in industry. However, the one area that is very sketchy involves ventilation and the potential disastrous problems of electrostatic charges. Many of the corporate and government procedures reference that static charges should be removed, 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. These two documents provide requirements and actual procedures for safe entry and work in tanks. More specifically, they address the issues with regard to controlling static electricity. The one ingredient missing in these standards is how to set up and test a good ventilation system.

Static Electricity - The Basics

At some time in our lives, we have all felt the effect of static electricity build-up. By simply walking across the living room carpet and touching a metal doorknob or refrigerator, we can feel and see the spark of discharged static electricity. I recently was filling my car with gasoline and 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, I should 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. This really caught my attention and illustrated the need for more specific treatment of the problem of static electricity in ventilation.

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? This 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 very low. Even though all matter contains free electrons, these electrons are unable to move freely through materials with high electrical resistance. These materials are called dielectric.

Our basic Industrial Saddle Vent device is made of standard non-conductive polyethylene and even if it is properly grounded, the displaced electrons become trapped on the surface of the device. 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 states that a low relative humidity, below 50 percent, 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 and provide the charge necessary to cause an intense explosion of the dusty space.

Figure 3. This ventilation system made of conductive material forms a complete electrical circuit from the end of the duct all the way back to the grounded ventilation blower.

Proper Ventilation System

Both OSHA and API standards state that good work practices in a confined space necessitate continuous ventilation before and during the work performed in a confined space. The objective of a good ventilation system is to first remove gas from the confined space and then to stabilize the space by providing continuous fresh air to the workers.

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 ducting and its wire helix to the blower to form an electrical bond (see Figure 1). Ducting should be supplied with fabric manufactured with a conductive coating material and a 12-inch grounding wire attached to the metal helix inside the duct and installed at each end of the duct. The bonding process is simply where metal components in the blower system are connected to form a conductive path that ensures electrical continuity and the flow of static electricity back to a safe grounded source. In performing tank work, the entire blower system is bonded to the tank that is connected to a proper earth ground. API standards 2015 and 2016 detail how the use of a venturi-type eductor along with an electric blower, can be used to accomplish a preferred push/pull method of confined space ventilation. The one aspect of this set-up that is missing is how to test the system. What levels of resistance are sufficient to remove static charges?

Upgraded 2003 Confined Space Entry Technique

A good confined space entry program includes meeting key objectives listed in the OSHA 1910.146 and API standards; one is the aspect of self-rescue. The use of a device such as the Saddle Vent air conduit (see Figure 2) allows the worker to establish continuous ventilation in the confined space without obstructing the entry or egress of the workers. This device meets the objective of self-rescue for the workers who may encounter hazardous work environments.

The second key objective is to provide a ventilation system that eliminates the build-up of static electricity and provides for a safer work environment. The original Saddle Vent device is now available in conductive plastic material. This Conductive Saddle Vent connects to the conductive ducting and when properly assembled (see Figure 3), forms a complete electrical circuit from the 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 ventilation system can now be safely removed through the ventilation system.

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. The use of work-specific devices like the Conductive Saddle Vent System will eliminate one more potential hazard from the confined space worker's list of worries.

This article is only a beginning in an effort to bring to light the need for more help in the area of worker safety with regard to confined space entry. Industry professionals from many disciplines must work together to develop safe working procedures for general industry with regard to controlling static electricity in the work environment. A detailed step-by-step method must be developed to set-up and properly test the conductive ventilation system. The use of a volt/ohm meter can be invaluable to the supervisor setting up the system and answering questions such as what is the recommended maximum level of resistance (ohms) that needs to be achieved in order to remove the static charges. OH

David F. Angelico, B.S., M.B.A, is president of Air Systems International Inc, incorporated in 1986. First products developed consisted of small portable breathing air compressors designed with a unique fully automatic reserve air system, used in the nuclear industry. He developed the patented Saddle Vent air conduit used to provide continuous fresh air in confined spaces without having to remove the ventilation ducting. He testified and provided recommendations at the federal OSHA hearings on the confined space entry standard.