



SSU 2007-10

## SUPERVISORS' GUIDE TO AIRBORNE CONTAMINANTS & RESPIRATORS

By SeaBright Insurance Loss Control

**T**here are many things in life that humans can do without—for a while at least. Breathable air is not one of them. Airborne contaminants can be extremely hazardous to one's health if inhaled through the mouth or nose into the respiratory system. Many different types of exposures are possible when hazardous chemicals are part of work operations. The three basic types of airborne contaminants are *particulates*, *gases*, and *vapors*. This article will explain the basic properties of, and some of the differences between, these three different states of matter. It will also briefly cover key elements in a respiratory protection program. These are matters all supervisors should understand when these invisible, but possibly deadly, hazards exist in the workplace.

### Identify and Control

Once the potential existence of an airborne contaminant is identified, the first step is to safely measure the exposure concentration. If a harmful level is found during the evaluation or measurement process, some form of protection for workers is required. The most preferred methods of protection are engineering controls such as:

1. Confine or enclose the operation from workers;
2. Install an exhaust ventilation system;
3. Replace the toxic material source with a non-toxic substitute material.

If none of these preferred methods are feasible, then a complete respiratory protection program is necessary. This includes developing written policies and procedures, and providing all exposed workers with appropriate respiratory equipment for each specific exposure.

### Types of Airborne Contaminants

A. **Particulates** are airborne contaminants in the form of solid or liquid particles.

**Dusts** are probably the most common of the solid particles. Dusts are airborne solids that are usually created by some form of mechanical action. Operations such as sanding of wood surfaces, using a grinding wheel on metal objects, and crushing rocks create dust. The process of opening a bag of dry concrete mix and dumping it into a mixer also creates dust. The smaller particles remain airborne for longer periods of time, which increases the chance that they will be inhaled by unprotected workers. Some highly concentrated dust is more a nuisance than anything else. Some may be toxic.

**Fumes** are probably the most difficult solid particulate matter to understand and are often confused with vapors or gases. Fumes are fine, solid particles that form when material from a volatilized solid condenses with air. For example, the process of arc welding causes vapors from molten metals to evaporate and then condense to produce fumes. Toxic fumes are created when welding on metal that has been galvanized or finished with lead-based paint.

**Mists** are fine airborne liquid particles that are most commonly created during the process of dispersing liquids. For example, a paint spraying operation creates paint spray mist.

**Smokes** are very fine particles created by incomplete combustion and generally contain both solid and liquid particulate matter.

**B. Gases** are distinguished from particulates because of their formless state. They diffuse readily throughout a space or area because they are not restricted by any cohesive forces. Gases may expand or contract when subjected to changes in pressure and temperature. Acetylene, nitrogen, carbon monoxide, methane, and hydrogen sulfide are examples of potentially hazardous gases.

**C. Vapors** are very similar to gases. They are best defined as the gaseous state of a substance that is in a liquid or solid state when it is at room temperature and normal pressure. The process of changing a liquid into a vapor is known as the evaporation process. Solvents, paint thinners, paint, and gasoline are examples of liquids that produce vapors quickly when exposed to open air.

## Evaluating/Measuring the Concentration

A *threshold limit value* (TLV) of an airborne contaminate is that concentration, by volume in air, *under* which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effects. A list of TLV's is published yearly by the American Conference of Governmental Industrial Hygienists. Another measurement, the *permissible exposure level* (PEL), for most known airborne contaminants is published as law in the OSHA standards. Most of the OSHA levels were adopted initially from the TLV list but are not updated annually.

Exposure limits for particulates are usually expressed in milligrams per cubic meter of air (mg/m<sup>3</sup>). Limits for gases and vapors are usually expressed in parts per million of air (ppm). Exposure limits for each airborne contaminant, plus necessary measures that provide protection, are outlined in the Material Safety Data Sheet (MSDS) for that chemical or material. Air sampling with special sampling instruments and equipment may be necessary to accurately measure the concentration of each contaminant.

## Filtered Air or Fresh Air?

When harmful concentrations of airborne contaminants exist, and preferred engineering control measures are not feasible, appropriate respirators must be selected and used by all workers in the exposure area. The two basic types of respirators are air purifying and air supplying.

**Air-Purifying respirators** come in several types, but the most common types are disposable masks, half masks, and full-face masks. One type, which is appropriate for particulates only, uses replaceable filters that trap particulates before they can be inhaled by the wearer. Please refer to Supervisors' Safety Update No. 2007-05 for definitions of NIOSH criteria for particulate respirators and recommendations for meeting them.

Air-purifying respirators can also provide protection from specific types or classes of gases and vapors. A replaceable color-coded cartridge or canister traps the vapors or gases. Some of these respirators combine a pre-filter for particulates plus a cartridge or canister for vapors or gases.

Powered air-purifying respirators utilize a motor and blower system, which brings a constant flow of purified air to the respirator wearer. These provide enhanced comfort under some working conditions, but can only be used when adequate oxygen is present. Air purifying respirators are **never** sufficient in oxygen deficient atmospheres. Typically, most firms prohibit any entry into an oxygen deficient atmosphere unless it is absolutely necessary.

**Air-Supplying respirators** provide fresh air from an uncontaminated source. Two basic types are used: The first is a self-contained breathing apparatus (SCBA) in which the wearer usually carries a tank of compressed air on his or her back. The second type supplies air to the face piece through an air hose that is connected to a remote source. A small auxiliary SCBA air supply may be included with some supplied air respirator systems as an emergency backup system.

Air-supplying respirators are necessary for survival in oxygen deficient atmospheres and in atmospheres containing harmful levels of airborne contaminants that are immediately dangerous to life or health (IDLH). An example would be a confined space such as a tank that previously contained benzene.

If you are certain about the type and source of contaminants, your local safety supply distributor can help you select the proper respirator. If you are not sure, a consulting industrial hygienist can survey the workplace, advise you how to best protect those who are exposed, and assure that you meet safety codes and regulations.

## Respiratory Protection Requirements

The OSHA regulations for selection and use of respirators are contained in 29 CFR Part 1910.134 for general industry and 29 CFR Part 1926.103 for construction. There are also specialized OSHA standards for specific airborne contaminants such as asbestos, cadmium, chromium, formaldehyde, and lead. Some key highlights of the current program requirements are as follows:

Written standard operating procedures governing the selection and use of respirators shall be established. All the elements of your company's respiratory protection program must be outlined in written form. Program must designate a qualified administrator to oversee program.

Respirators, training, and medical evaluations must be provided at no cost to the employee. Employees must complete a questionnaire, and a medical evaluation by physician or other licensed health care professional must medically clear users prior to fit testing and use.

Respirators selected must be certified by the National Institute for Occupational Safety and Health (NIOSH) and must be used with the conditions of its certification.

The user shall be instructed and trained in the proper use of respirators and their limitations. A qualitative or quantitative respirator fit test by a qualified respirator specialist is required before the equipment is used, to ensure an effective fit. The wearer should also perform a positive pressure and negative pressure fit check with each use of the respirator.

The positive pressure fit test: Wearers should place their hand over the exhalation valve, exhale to push the face piece outward, and hold their breath for about 10 seconds. If the face piece deflates then the seal is not adequate or the respirator is leaking in some other area.

The negative pressure fit check: Wearers should place their palms over the cartridge or intake openings, inhale so that the face piece collapses to their face, hold their breath for about 10 seconds, and if the face piece does not remain collapsed then the seal is not adequate or the respirator is leaking in some other area.

Fit testing is required prior to initial use, whenever a different face piece is used, and at least annually.

Respirators must not be worn when conditions prevent a good face seal. In many cases, facial hair does not permit a good seal.

The manufacturer's instructions should be followed for fit check procedures on disposable particulate respirators.

Respirators shall be regularly cleaned and disinfected. Those used by more than one worker shall be thoroughly cleaned and disinfected after each use. Respirators shall be stored in a convenient, clean, and sanitary location. Stored respirators must be protected from dust, sunlight, heat, extreme cold, excessive moisture, and damaging chemicals. Storage in a sealed plastic bag is preferred.

Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency use such as self-contained devices shall be thoroughly inspected at least once a month and after each use. Routine inspections before and after each use include a check of all connections, the face piece, headbands, valves, connecting tubes, and canisters as applicable. Cartridges, canisters, or the entire respirator should be replaced as necessary according to the manufacturer's suggestions.

### **Take Care and Breathe Easy**

Exposure to airborne contaminants may cause serious health problems for you and your workers unless adequate protection is provided. But if hazards are properly evaluated and adequate respirators are used, you and your workers can continue to breathe safely. The work it takes to develop a complete respiratory protection program\* will be worth it, not only to meet legal requirements—but most of all to save lives!

*\*Your SeaBright Loss Control Consultant can provide you with a sample written Respiratory Protection Program on request.*