

# How to Protect Yourself From Respiratory Hazards<sup>1</sup>

---

David E. Baker, Brooke Ballenger and Rusty Lee<sup>2</sup>

Many farming situations present respiratory health hazards to farm workers. In fact, high percentages of farm workers may risk this type of health problem. For example, exposure to various respiratory hazards has been linked to coughs and the presence of sputum (with or without airflow obstructions) in 20 to 90 percent of farm workers and families, depending on the type of exposure. Symptoms of chronic bronchitis have been observed in as many as 50 percent of swine confinement workers and grain handlers.

Yet with a few precautions and an understanding of respiratory dangers, these hazards can be minimized or even eliminated. This publication discusses some respiratory hazards common to farming and the equipment that can reduce the threat to farm workers.

## SOME COMMON HAZARDS

**FARMER'S LUNG.** Farmer's Lung is an allergic reaction caused by inhaling dust from moldy hay, straw and grain. Dairy and grain farmers are the most common victims. Working outdoors with these materials poses minimal danger because the dust is quickly dispersed. The months when moldy crops are handled indoors are the most dangerous.

Because the dust is so fine, it gets past defense systems in the nose and throat. When the dust reaches the inner parts of the lungs, the lung's internal defense system usually takes over and removes it without damage. But a few people will develop an allergy. The first exposure creates the allergy in sensitive individuals,

and subsequent exposures trigger an allergic reaction. Symptoms may resemble anything from a cold to pneumonia. Scar tissue forms in the lungs. The cold-like symptoms may clear up, but the scarring is permanent.

Lung damage may be too slight to notice during the early stages of Farmer's Lung. Repeated exposure increases tissue damage, causing victims to begin experiencing shortness of breath. This makes strenuous work more difficult, and victims eventually may find it a struggle to even get out of a chair.

**TOXIC ORGANIC DUST SYNDROME.** Dust from moldy hay, grain and silage also can cause Toxic Organic Dust Syndrome (TODS), which has symptoms resembling Farmer's Lung. However, TODS does not produce long-term illness or cause permanent lung damage. Even if TODS occurs several times in the same person, it will behave similarly each time, with severity depending on the individual and the dose of inhaled dusts. Farmers will not contract TODS unless they inhale large amounts of moldy dust.

**NUISANCE DUSTS.** Suspended dust particles encountered during farm operations that do not contain spores from moldy organic matter are considered "nuisance dusts." While inhaling them usually will not cause an allergic reaction, repeated

---

1. This document is GO1935, published by the University Extension, the University of Columbia-Missouri, Columbia, MO 65211. Publication date: October 1993.

2. David E. Baker, Brooke Ballenger and Rusty Lee, Department of Agricultural Engineering, University Extension, the University of Missouri-Columbia, Columbia, MO 65211 .

**Table 1.** Comparison of air-purifying respirators. None of these should be used in oxygen-limiting environments.

<b>Disposable mechanical filter respirators</b>
Uses: Dusts. Not recommended for gases. Fit: Good fit hard to obtain. Adjustable and two-strap models available. Amount of maintenance: low Breathing resistance: High (unless has exhalation valve) Remarks: Easy to see over. Lightweight. Clog with moisture from wearer's breath in humid air. Cause glasses to fog in cold weather.
<b>Mechanical filter respirators</b>
Uses: Dusts. Not recommended for gases Fit: Moderately good for half-mask models. Amount of maintenance: Moderate (unless disposable) Breathing resistance: moderate Remarks: Reusable mask with replaceable dust filter
<b>Chemical cartridge respirators</b>
Uses: Dusts, gases. Fit: Good Amount of maintenance: Moderate Breathing resistance: Moderate Remarks: Some "disposables" available that are discarded when cartridge is spent. Selecting the correct type of particulate or gas cartridge is mandatory. Particulate prefilters available.
<b>Gas masks</b>
Uses: Dusts, gases Fit: Good Amount of maintenance: Moderate Breathing resistance: Moderate Remarks: Larger capacity canisters rather than cartridges. Correct type of canister must be selected.
<b>Powered air purifiers</b>
Uses: Dusts, gases Fit: Good Amount of maintenance: Moderate to high Breathing resistance: Low Remarks: Add noticeable weight. Not recommended for protection against gases unless specified. Will be expensive to repair. Possible lengthy repair period.

exposure can turn portions of the lung into hardened, non-functioning tissue. As a result, the lung's capacity to take in oxygen will be reduced, and the victim will become more vulnerable to respiratory diseases like pneumonia, tuberculosis and bronchitis.

**GASES.** A variety of worker-disabling gases, including nitrogen dioxide (NO<sub>2</sub>), hydrogen sulfide (H<sub>2</sub>S), ammonia (NH<sub>3</sub>), carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>), are produced during many routine farm operations. These gases are commonly produced in areas such as silos and manure pits. Exposure to low levels of these gases will produce lung and eye irritations, dizziness, drowsiness and headaches. High levels will quickly render a worker unconscious, and death will follow (see MU publication G01931, Animal Handling Safety Considerations).

**FARM CHEMICALS.** Pesticides (herbicides, insecticides and fungicides), fertilizers (ammonium nitrate), sanitizers (calcium hypochlorite) and battery acid are common farm chemicals which produce harmful fumes. Always follow label directions when handling

these chemicals. Labels will list potential hazards to workers and identify the personal protective equipment necessary during handling (see MU publication G01917, Personal Protective Equipment for Working With Pesticides).

## PROTECTIVE EQUIPMENT

Selection of specific types of protective equipment depends on the hazards present and the amount of filtering necessary (see Table 1 and Table 2). Regardless of the type that is chosen, however, all respiratory protection must be approved by NIOSH.

**AIR-PURIFYING RESPIRATORS.** Air-purifying respirators remove contaminants from the air but can be used only in an environment that has enough oxygen to sustain life. Do not use air purifiers to provide protection from the dangers of oxygen-limited environments. Respirators are effective only up to their specified concentration limits.

The composition of a respirator's filter depends on the contaminant to be filtered. Various chemicals are used to remove gases and vapors. The useful life of the respirator is determined by the contaminant concentration, breathing volume of the wearer and capacity of the air purifying medium.

There are several styles of air-purifying respirators, but only two general types: the mechanical filter and the chemical cartridge.

**MECHANICAL FILTERS** provide protection against particulates such as dusts, mists or metal fumes. A fibrous material in the filter traps the particles.

A mechanical filter respirator with toxic dust approval should be used to protect against grain dusts and mold spores. It should seal tightly around the nose and mouth. A fume-approved respirator of this type also should be worn when welding. Do not use a mechanical filter for protection from chemicals or toxic gases.

As the filtering capacity is exhausted, the filter will become plugged with the trapped particles. This becomes apparent when more effort is required to draw air. At this point, the filter should be replaced.

**CHEMICAL CARTRIDGES** protect against certain gases and all but the most toxic organic vapors. The filtering medium is activated carbon, which retains the contaminant. Its primary function is to remove organic vapors, but filters also can be added for protection from a variety of specific gases. The correct cartridge for the material to be filtered must be in place. Do not use chemical cartridge filters when working with gases or vapors that cannot be effectively filtered out by the cartridge, regardless of concentration.

Cartridges should be replaced regularly with heavy use, or the carbon's capacity will be exhausted and contaminants will pass through the filter and be inhaled.

For protection during spray painting or pesticide application, chemical cartridges that work in conjunction with a specific mechanical filter should be used.

**POWERED AIR PURIFIERS.** The powered air purifier can be a mechanical filter, a chemical cartridge respirator, or a combination of both. These devices have a motor blower assembly that forces air through the filter and into the breathing zone of the wearer. Breathing is much easier because no effort is required to draw air through the filter.

Powered air purifiers may be preferred for excessively high concentrations of dusts or pesticides, but **they cannot be used in oxygen-limited environments.**

Common headgear for powered air purifiers consists of a hard helmet and a rigid visor. Non-rigid head and face covers also are available.

Powered air purifiers are powered by a battery pack strapped onto the user's waist or back. The batteries may be of the rechargeable or disposable type. Another option is an adapter that allows the unit to be powered by the 12V or 24V DC available from a vehicle battery, such as that in a tractor or skid-steer loader.

Since most powered air purifiers provide constant positive pressure, they do not require a tight face seal, so beards, sideburns and different sized faces or heads do not hinder a good fit.

**GAS MASKS.** Gas masks are more effective than chemical cartridge respirators against high concentrations of toxic gases. The chemical filter in the gas mask removes toxic vapors and particles from the air, such as fumigants for buildings. Like all air-purifying devices, gas masks also should not be used in oxygen-limited environments.

Gas masks have replaceable canisters that are larger than the cartridges used in chemical cartridge respirators and are more effective than chemical cartridges against high concentrations of toxic gases and vapors. The canisters also contain a larger volume of chemical sorbent and may be used for longer periods of time than the chemical cartridges before breakthrough occurs.

For canisters and cartridges, the fit of the mask to the individual is equally important to the degree of protection as is the volume of chemical sorbent. Gas masks usually have a full face piece with an attached hose leading to a canister mounted on the wearer's belt. Chin-type canisters also are available, but they have somewhat smaller capacities.

**SUPPLIED-AIR RESPIRATORS.** Because none of the air-purifying respirators or powered air

**Table 2.** Respirator types that should be used against common agricultural airborne contaminants.

Respiratory hazard	Required type of respiratory protection
Pesticides	Chemical cartridge approved <sup>1</sup> pesticide respirator; gas mask or self-contained breathing apparatus, depending on concentration, oxygen level and type of application (refer to Precaution note on product label).
Fumigants (for buildings)	Gas mask, supplied-air or self-contained breathing apparatus, depending on type of application.
Fumigants (for soil)	Chemical cartridge, full-face organic vapor respirator.
Carbon monoxide	Self-contained breathing apparatus.
Nitrogen dioxide (silage gas)	Self-contained breathing apparatus.
Hydrogen sulfide	Supplied-air respirator with full face piece, helmet or hood, or self-contained breathing apparatus.
Ammonia	Chemical cartridge respirator approved for ammonia and methylamines.
Chemical additives (powder or solids)	An approved toxic dust respirator.
Grain dust	An approved toxic dust respirator.
Paint	An approved spray paint respirator.
Welding	An approved fume respirator.
Fungal spores	An approved toxic dust respirator.

<sup>1</sup> *Approved refers to respirators with NIOSH/MSHA approval. This will be clearly designated on the package, and an approval number will appear on the respirator. The approval ensures that the equipment has been tested and meets a minimum standard of performance.*

purifiers supply oxygen, they should never be used in oxygen-deficient areas. Instead, a supplied-air respirator that brings in uncontaminated air from an outside source should be used.

Two types of supplied-air respirators are approved for use in oxygen-deficient areas, such as manure pits, silos containing silo gas, airtight silos, or bins containing high-moisture grain. They are the hose mask with blower and emergency air supply (not to be confused with powered air purifiers) and the self-contained breathing apparatus (SCBA). When using a SCBA, the wearer carries a portable supply of air that is independent of the environment.

This equipment is expensive to buy and maintain. Its high cost often makes it impractical to have on the farm. Take precautions entering oxygen-deficient environments, especially if you do not have a SCBA. If you must enter these settings, all panels and doors should be open and all ventilation systems should be on for at least 30 minutes before entry.

Always secure a lifeline to yourself when entering areas that may be deficient in oxygen. Without a SCBA, this lifeline is the only means others have to rescue you if you become unconscious.

## FITTING

Regardless of the type of equipment selected, it must fit properly to ensure complete protection. OSHA requires fit testing for all respiratory protection used by employees.

A device must have a tight seal around the nose and mouth or contaminated air will leak through the seal. Facial hair can prevent a good seal, even if it is only one day's stubble.

For best results, have equipment fitted to the wearer by qualified personnel and follow the manufacturer's instructions. An easy way to check the seal is to conduct a positive or negative fit check. For a positive check, cover the exhalation valve with the palm of the hand and exhale so that air builds up inside the respirator. If there is a leak, you will feel it against the skin of your face. For a negative fit check, cover the cartridge(s) with your hands and inhale. If there is no leakage, the mask will be drawn tightly to your face.

## MAINTENANCE

Respiratory protective equipment should be stored in a clean, dry place away from work and chemical storage areas.

Regular cleaning, repairing and changing of cartridges is required when using respirators more than

once. The prefilter should be changed after each day of spraying, and the pesticide cartridge should be changed as soon as the wearer detects the odor of the pesticide. It is important to always have a spare set of cartridges available.

Dust filters should be replaced when they become difficult to breath through. For respirators with rubber face pieces, make sure the valves are intact. The face piece may be washed with warm water and mild soap.

The most convenient, maintenance-free device is the disposable air-purifying respirator. When the filter is used up, it may be replaced with a new one.

*Partial funding for this guide was provided by the University of Missouri-Columbia/National Institute for Occupational Safety and Health Cooperative Agricultural Promotions Agreement.*