

# **Farming and Respiratory Disease: the Role of Respirators in Prevention**



# Three Categories of Respiratory Hazards

- Particulate contaminants
  - Dusts, fumes, mist
- Gases and vapors
  - Pesticides & nitric oxide
- Oxygen-deficient atmospheres
  - Sealed silos or storage for fruits / vegetables
  - Pits (manure gases)
  - Tanks (decomposition gases)

# Breathing Can Be Dangerous to your Health

- Asthma: respiratory disease that can begin or worsen due to exposure
- Characterized by episodic narrowing of the respiratory tract
- You may have non-work related asthma but have your symptoms could be exacerbated by exposure to non-specific irritants (eg grain dust).

# Two Types of Asthma

- Allergic
  - caused by exposure to allergens such as pollen, mold, pet dander, and so on. These allergy triggers—pollen, for example—may not be present at all times, so asthmatic symptoms vary depending on the season and the environment.
  - Exposure activates the body's immune system. When the body comes into contact with a foreign substance, it releases antibodies to react with or destroy the substance. However, sometimes the antibody release involves the overproduction of an antibody called immunoglobulin E, causing a release of chemical mediators such as leukotriene, prostaglandin, and histamine, which can result in the contractions of airway muscles that characterize an asthma attack.

# Two Types of Asthma

- Non-Allergic
  - triggered by nonallergenic substances such as wood smoke, grain dust, tobacco smoke, fresh paint, cleaners, perfumes, and so on. Symptoms are similar to those of allergic asthma. Repeated exposure to these nonallergenic substances causes the release of chemical mediators (described above) that can cause airway constriction.

# Asthma Prevention

- Store grain at recommended moisture-content levels to reduce mold growth.
- Properly ventilate animal-housing areas to reduce the accumulation of ammonia and other gases.
- Frequently remove animal waste to reduce the buildup of ammonia and decrease your exposure to urine and fecal allergens.
- Identify dust hazards at your farm or ranch and reduce exposure by cleaning these areas. Limit your time in dusty areas.
- When cleaning a barn or stable, wet down areas to avoid dust from becoming airborne.
- Wash your work clothes in hot water at least once per week
- Provide/Use appropriate personal protective equipment (PPE)
- Wear appropriate respiratory protection if medically approved to do so. Be fit tested to ensure proper fit and seal to your face.

# Breathing Can Be Dangerous for your Health

- Farmer's lung: hypersensitivity pneumonitis induced by the inhalation of *biologic dusts*
  - Hay/straw dust, mold spores or other ag products
  - Lung inflammation
    - Delayed allergic reaction
    - Microorganisms attach to dust
  - Affect 5-8% of those exposed

# Farmer's Lung

- Symptoms
  - Presents 4-12 hours after exposure
  - Cough
  - Chills
  - Labored breathing
  - Muscle pain
  - Subsides in 3-5 days

# Farmer's Lung Prevention

- Take steps to avoid crop spoilage and production of bacterial or mold spores
  - Inhibit mold growth (eg wet hay, grain or other crops should be dried as thoroughly as possible prior to storing)
  - If possible, hay with a high risk of spoilage should be stored in silage instead of bales
  - Properly ventilate buildings with large amounts of dusty material
  - Handle dusty materials mechanically
  - During cleaning of barns or stables, dust from moldy crops should be wetted down before being swept to prevent it from becoming airborne.
  - Wear a respirator

# Breathing Can Be Dangerous for your Health

- Silo Fillers Disease (toxic hemorrhagic pulmonary edema): inhalation of *oxides of nitrogen* ( $\text{NO}_2$ ) gas from fermentation of fresh silage
  - $\text{NO}_2$  combines with water in your lungs to form highly corrosive nitric acid.
  - Severe, permanent lung damage
  - Fermentation can start within 2 hours of filling silo
  - Reaches maximum in 2-3 days
  - Disease progression: bronchiolitis obliterans

# Silo Filler's Disease Symptoms

- Coughing, burning, shortness of breath, chills, fever, headaches, nausea, or vomiting.
- May not immediately experience the symptoms from a mild exposure, in 3-30 hours there is a slow, progressive inflammation of the lungs that results in fluid buildup in the lungs.
- Unique characteristic: may be a relapse in two to six weeks after the original episode, which may be milder or more severe than the first episode

# Silo Fillers Disease Prevention-Upright Silos

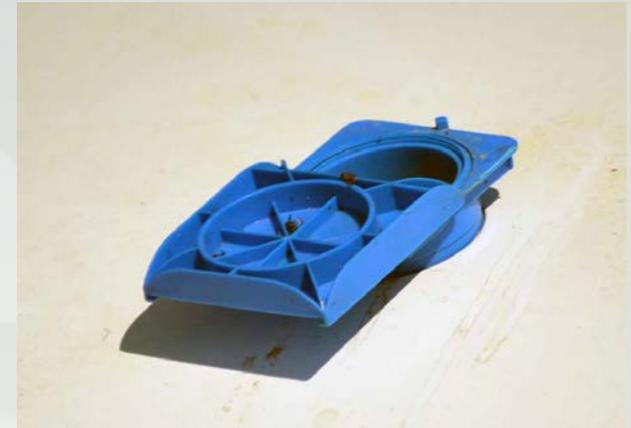
- **Stay out of an upright silo for at least three weeks after filling.**
- Be alert for bleach-like odors and/or yellowish-reddish brown gases
- Entering the silo, e.g., to set up a silo unloader, do so immediately after the last load is in. Ventilate by running a forage blower at least 15-20 minutes before entering and keep it running while inside.
- Use a multi-gas monitor to check for O<sub>2</sub> deficiency – use NO<sub>2</sub> sensor

# Silo Fillers Disease Prevention-Upright Silos

- Use a self-contained breathing apparatus (SCBA) if entering
- When opening a chute door for the first time after filling, if possible, go a door above the silage level. Have someone keep in contact with you from the outside the silo chute.
- Ventilate the silo room adequately for three weeks after filling, keeping windows and doors open.
- Keep the door between the silo room and the barn closed to prevent silo gas from killing livestock.

# Silo Fillers Disease Prevention – Silage bags & horizontal silos (bunkers/piles)

- NO<sub>2</sub> heavier than air – consider drift (may collect in other buildings or low areas)
- Cover immediately when done harvesting.
- Observe for any signs of gas when repairing plastic or working around the area.
- Do not puncture bubbles in plastic that may release the gas directly into a worker's face.
- Use caution when opening the plastic during the first three weeks after covering or sealing a horizontal silo or silage bag.



# Silo Filler's Disease

- **NEVER ENTER A NEWLY FILLED SILO FOR AT LEAST 3 WEEKS**



# Breathing Can Be Dangerous for Your Health

- Other respiratory conditions:
  - irritation of the upper respiratory tract
- organic dust toxic syndrome (ODTS)
  - Lung inflammation
  - Concentrated exposure to moldy hay, straw, grain
- chronic bronchitis
- neuromuscular respiratory failure

<https://www.ncbi.nlm.nih.gov/pubmed/1511556>

# Chronic Bronchitis

- Chronic phlegm producing cough
- End result of a variety of exposures
- Last or recurs over years
- Can lead to:
  - Shortness of breath
  - Reduced endurance
  - Permanent lung damage

# Exposures Causing Respiratory Illness

- Grain dust (all types of grain), Grain mites
- Dander (Cow, pig, poultry), Urine (Cow and Pig)
- Fungi (Alternaria, Aspergillus, Cladosporium)
- Mycotoxins (eg aflatoxin, zearalenone, vomitoxin)
- Bacteria/biochemical components & excretions (endotoxins)
- Antibiotics (spiramycin, amprolium)
- Chemical exposures (eg formaldehyde, glutaraldehyde, ammonia, disinfectants, pesticides)
- Welding fumes
- Inorganic dust (eg dust from soil during prep or harvest)

# What Can I do to prevent Respiratory Illness?

- Ventilation
  - Eg ventilation of animal accommodation
  - Local exhaust
- Work Practices
  - Improvements in animal rearing techniques
  - Careful drying and storage of animal feed-stuffs, crops and other products
- Use of respirator (if medically approved to do so)

# When Should I Wear A Respirator?

Anytime you may be exposed to environmental hazards that may cause respiratory illness

# Parts of a Respirator

- Facepiece/Headpiece
- Chemical Cartridge
  - Removes gases and vapors
- Particulate Filter/Pre-filter
  - Traps dusts, mists, fumes

# Choosing a Respirator

- Depends upon:
  - Type and concentration of contaminant
  - Need for eye, face protection
  - Need for supplemental air/oxygen
  - Presence of facial hair

## Respiratory Hazard

## Required Protection

Pesticide dusts, mists, vapors, and gasses	A NIOSH-approved chemical cartridge respirator or gas mask with added pre-filter. For extremely high gases concentrations, where the oxygen level may be low, wear a supplied-air respirator. Refer to pesticide container label for additional requirements.
Mold dust, grain dust, manure dust, dust from poultry operations, road or field dust, and untreated sawdust	A NIOSH-approved mechanical filter respirator or dust/mist mask approved for use with toxic dusts.
Ammonia	A NIOSH-approved chemical cartridge respirator or gas mask approved for use with ammonia.
Hydrogen sulfide (manure gas)	Supplied-air respirator approved by NIOSH.
Nitrogen dioxide (silo gas)	Supplied-air respirator approved by NIOSH.
Welding fumes	A NIOSH-approved mechanical filter respirator approved for use with fumes.
Spray paint mists	A NIOSH-approved mechanical filter respirator approved for use with spray paints or organic vapor cartridge with paint prefilter on chemical cartridge respirator.
Carbon monoxide (gas-powered vehicle or machinery exhaust)	A NIOSH-approved gas mask or supplied-air respirator.
Fumigants	CAUTION: Fumigants are highly penetrating and some can penetrate the rubber and plastic parts on respirators. In addition, some are colorless and odorless and give no warning of exposure. Many respirators approved for pesticides are NOT approved for protection against fumigants. For the best protection, completely avoid fumigants and treated areas yourself and leave entry into treated areas to trained professionals.

# NIOSH Approval System for Particulate Filters

- **N95/R95/P95** masks filter out 95% of dust particles  
N=Not resistant to oil, R=Somewhat resistant to oil, P=Strongly resistant to oil
- **N99/R99/P99** masks filter out 99% of dust particles
- **N100/R100/P100** masks filter out 99.97% of dust particles



[https://www.cdc.gov/niosh/npptl/topics/respirators/disp\\_part/resresource1quest2.html](https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/resresource1quest2.html)



<http://www.gemplers.com/images/items/8293-lrg.jpg>

# Air Purifying (Neg)

- Removes contaminants from air you are breathing
- Tight Fitting:
  - Medical Evaluation
  - Fit Test
  - User Seal Check
- Loose Fitting:
  - Medical Evaluation

## Major Types of Respirators

*Air-purifying respirators*, which remove contaminants from the air.

Tight Fitting



**Half mask/Dust mask**  
APF=10  
*Needs to be fit tested*



**Half mask (Elastomeric)**  
APF=10  
*Needs to be fit tested*



**Full facepiece (Elastomeric)**  
APF=50  
*Needs to be fit tested*



**Loose-Fitting Powered  
Air-Purifying Respirator (PAPR)**  
APF= 25



**Hood Powered Air-Purifying  
Respirator (PAPR)**  
APF= 25

Loose Fitting

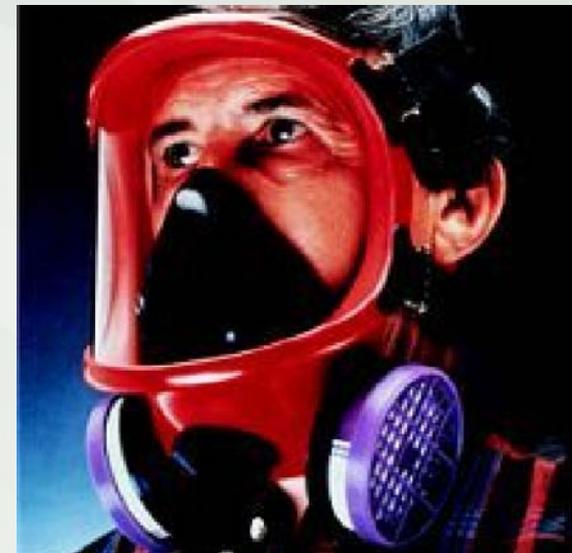
# Dust Masks

- Dust masks capture airborne particles (dust, mist, fumes) but not gases or vapors (unless equipped with charcoal layer)
- Specific WPS rules for filter replacement
  - Family farm owner exempt



# Half Mask/Full Face

- Gas & Vapor cartridge
  - Chemical cartridges trap different types of chemicals, but not dusts, mists or fumes
- Particulate cartridge
  - Trap particulates only
- Combination cartridge
  - Will trap both gas/vapor + particulate



# Powered Air Purifying Respirators

- Has battery-powered fan that draws air through cartridges and blows it into the facepiece
- Can provide better protection than other cartridge respirators
  - Special filter: Only HE (High Efficiency) filters used: Filters at least 99.97% of airborne particles.



# Air Supplied

- Air supplied from another source
  - Medical evaluation
  - Fit Test

*Atmosphere-supplying respirators, which provide clean air from an uncontaminated source.*



**Full Facepiece Supplied-Air Respirator (SAR)  
with an auxiliary Escape Bottle**  
APF=1,000  
APF = 10,000 (if used in "escape" mode)  
*Needs to be fit tested*



**Full Facepiece Abrasive Blasting  
Continuous Flow**  
APF=1,000  
*Needs to be fit tested*



**Full Facepiece Self-Contained  
Breathing Apparatus (SCBA)**  
Pressure demand mode is APF=10,000  
*Needs to be fit tested*

# Medical Evaluation and Fit Test



# Respirators and Physical Fitness – Medical Evaluations

- WPS: Medical evaluations are **required for anyone required to wear a respirator**
- Breathing through a respirator is work for the body
- Respirators can be hazardous to people with heart or lung problems



# Medical Evaluation

- First step of a medical evaluation: confidential medical questionnaire
- Health care provider decides if you need a medical exam
- Employers do not see the questionnaire or the results of the medical exam.
- Employers receive notice on whether the individual is medically fit to wear a respirator

# OSHA INFOSHEET

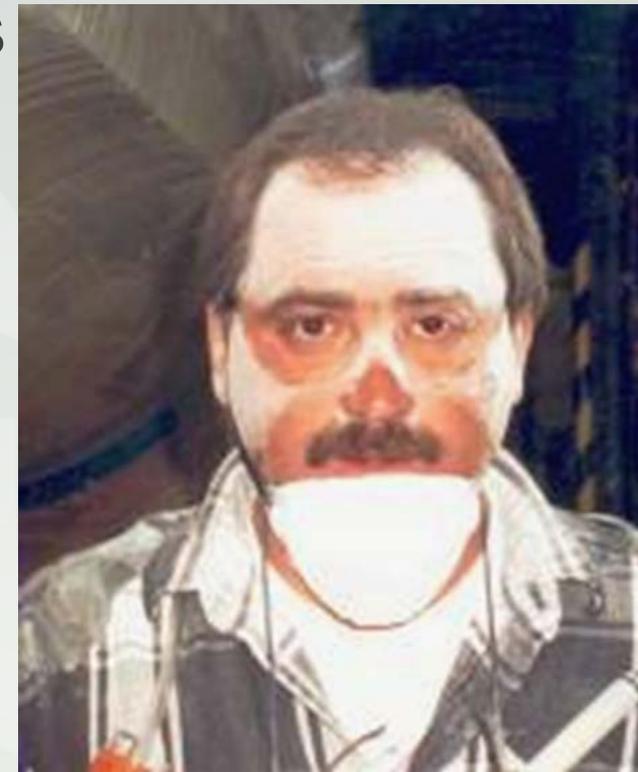
**Part A Section 1. (Mandatory)** The following information must be provided by every employee who has been selected to use any type of respirator (please print)

**Part A. Section 2. (Mandatory)** Questions 1 through 9 below must be answered by every employee who has been selected to use any type of respirator (please circle "yes" or "no").

	YES	NO
1. Do you <i>currently</i> smoke tobacco, or have you smoked tobacco in the last month?	<input type="checkbox"/>	<input type="checkbox"/>
2. Have you <i>ever had</i> any of the following conditions?	<input type="checkbox"/>	<input type="checkbox"/>
a. Seizures	<input type="checkbox"/>	<input type="checkbox"/>
b. Diabetes (sugar disease)	<input type="checkbox"/>	<input type="checkbox"/>
c. Allergic reactions that interfere with your breathing	<input type="checkbox"/>	<input type="checkbox"/>
d. Claustrophobia (fear of closed-in places)	<input type="checkbox"/>	<input type="checkbox"/>
e. Trouble smelling odors	<input type="checkbox"/>	<input type="checkbox"/>
3. Have you <i>ever had</i> any of the following pulmonary or lung problems?	<input type="checkbox"/>	<input type="checkbox"/>
a. Asbestosis	<input type="checkbox"/>	<input type="checkbox"/>
b. Asthma	<input type="checkbox"/>	<input type="checkbox"/>

# Why Fit Test?

- NIOSH research: 10% of subjects failed a fit test after 1 year using the same make, model, and size respirator.
- $\pm$  20lbs? Research indicates you should get fit tested again.
  - Other facial changes requiring fit testing: extensive dental work, scarring, or cosmetic surgery.



# Qualitative Fit Test

- Determines whether the mask provides an acceptable fit to a wearer.
- Relies on a subjective sensation (taste, irritation, smell) of the respirator wearer to a particular test agent
  - Before a qualitative test is conducted, the user has to undergo a sensitivity test to see if s(he) can smell, taste or react to the substance/test agent.

# Qualitative Fit Test

- A gas, vapor, or aerosol test agent is introduced into an area surrounding the user's head.
- Can the wearer sense the presence of the test agent by means of taste, odor, or nasal irritation?
  - YES = respirator does not fit properly
  - NO = fits properly



# User Seal Check v Fit Test



# Any MIOSHA Standards I Should Know About RE Respiratory Protection?

- Yes, Occupational Health Standard Part 700-Agriculture
- See Rule 325.2442 (Rule 42) Respiratory protective equipment; selection and use
  - Rule 42(a) Respiratory protective equipment; maintenance
  - Rule 42(b) Respiratory protective equipment; types for certain hazards
  - Rule 42(c) Respiratory protective equipment; supplies and components