

Respirators for Handling Pesticides

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This publication examines the types of respirators used during pesticide applications, and how to safely use, maintain, and store them.

Why Use a Respirator?

When working with any pesticide, you must follow all personal protective equipment (PPE) requirements listed on the label. This is for your safety, and also is a legal requirement for using a pesticide. Respirators, a type of PPE, are required when a pesticide can be harmful if inhaled.

A pesticide label may have information about Agricultural Use Requirements, indicating that the product must be used in accordance with its labeling and the Worker Protection Standard (WPS). The purpose of WPS is to reduce risks of illness or injury due to occupational exposures to pesticides. Through WPS, agricultural employers must ensure that their employees will be informed about exposure to pesticides; ensure that they will be protected from exposure to pesticides; and that employers will address pesticide exposures that employees may experience.

Under the 2015 revisions to WPS, agricultural owners/employers, their employees, and family members who use a pesticide that falls under WPS and requires the use of a respirator must follow some Occupational Safety and Health Administration (OSHA) respirator requirements, as well. Although at the time of writing this publication, the implementation date has yet to be determined, we recommend you follow these (future) WPS requirements now. You will be ready when implementation is required. In general, even those to whom WPS does not apply should consider following those requirements of having a medical evaluation, fit test, and training prior to using a respirator. These WPS

requirements address the main reasons that respirators don't provide protection: People don't use them; the respirators leak because they don't fit properly; or filters, cartridges, and canisters aren't replaced when needed. For more information, see <http://www.osha.gov> and search for "respirator."

Types of Respirators

The product label lists the minimum type of respiratory protection required. Among other factors, this is determined by the type and toxicity of the pesticide and the application site. Respirators that provide more protection than the type listed on the label may be used. The label of the respirator will indicate that the National Institute for Occupational Safety and Health (NIOSH) has certified a particular model to meet specific standards.

Two main categories of respirators are air-purifying and atmosphere-supplying. Air-purifying respirators are more commonly used when handling pesticides. They filter the ambient (surrounding) air using filters to protect against particulates, or cartridges and canisters to protect against gases. Atmosphere-supplying respirators provide clean air to the user from a tank or compressor, and are more expensive.

Under WPS, respirators must be approved by NIOSH. This means they have had significant testing, and their safety can be ensured if used and maintained according to directions. Nuisance dust masks, such as the one-strap dust mask, are **not** considered respirators; they are **not** approved by NIOSH. One size fits all, but usually not very well and air can easily leak under the sides of the mask. They may be appropriate for use by someone while sweeping a floor. The nuisance dust mask is not suitable nor is it approved for use with pesticides, even granular or dust formulations.

Air-purifying Respirators

OSHA states these “have filters, cartridges, or canisters that remove contaminants from the air by passing ambient (surrounding) air through the air-purifying element before it reaches the user.” Most have negative pressure; the user pulls air through the filter when he or she inhales. Air-purifying respirators have particulate filters, chemical cartridges, canisters, or a combination of these. The powered air-purifying respirator (PAPR) has positive pressure where air is filtered and supplied via a battery-operated blower. These will be discussed in more detail.

Particulate Filtering Respirator

This type of respirator is approved for protection against dust and mists. Older pesticide labels may refer to the particulate filter mask (Figure 1) as a NIOSH TC-84A respirator.



Figure 1. Two models of NIOSH-approved (TC-84A) particulate filter mask respirators. Both have a metal band at the nose area for adjustment. The mask on the left has straps that are not adjustable; its shape and construction may make it difficult to form the tight seal needed for protection. The mask on the right has adjustable straps and an exhalation valve. 3M photo, © 3M 2016. All rights reserved.

NIOSH has three classes of particulate filters:

- **N**, not resistant to oil;
- **R**, resistant to oil for up to 8 hours; and
- **P**, oil-proof.

As oil is present in some pesticide products, this is an important rating for those in agriculture.

In addition, a particulate filter has an efficiency rating based on how well it protects against particles at least 0.3 microns in diameter. (A human hair has a diameter of about 50 to 70 microns, household dust is 10 microns, and a smoke particle is 2.5 microns, Figure 2.) Protection is needed because particles can be inhaled, and even dust particles can cause long-term (chronic) lung conditions. Filters have minimum efficiencies of 95 percent, 99 percent, and 99.97 per-

cent, listed as 95, 99, and 100 for the respirator (Table 1). For example, an N95 particulate mask is **not** resistant to oil (N), and will filter 95 percent of particulates 0.3 microns or larger (95). In addition to N, R, and P, some filters may be rated HE for high efficiency. This is similar to the 100 efficiency rating. The 95 filters should be appropriate for most pesticides, as most pesticide spray particles are larger than 2 microns. Always refer to the pesticide label for specific requirements.

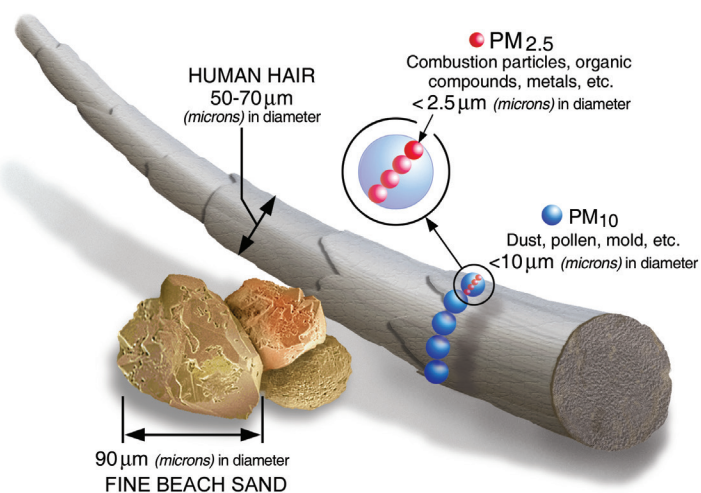


Figure 2. This chart, by the U.S. Environmental Protection Agency, shows the size of various materials in terms of microns.

Table 1. System for naming particulate filters based on resistance to oil and efficiency at removing particulates.

Filter class	Number and minimum efficiency		
N (Not resistant to oil)	95 (Removes 95% of 0.3 microns or larger).	99 (Removes 99% of 0.3 microns or larger)	100 (Removes 99.97% of 0.3 microns or larger)
R (Resistant to oil for up to 8 hours)	95 (Removes 95% . . .)	99 (Removes 99% . . .)	100 (Removes 99.97% . . .)
P (Oil-proof)	95 (Removes 95% . . .)	99 (Removes 99% . . .)	100 (Removes 99.97% . . .)

Several types of respirators that filter particulates are available. Particulate filtering facepiece respirators (masks) usually are made of a cloth-like filter material. An example is the two-strap particulate filter respirator (two examples shown in Figure 1). It can be adjusted for a better fit to protect against dust and other particulates. To increase comfort, some respirators have an exhalation valve that helps minimize the buildup of heat and humidity within the mask.

Particulate filters also are available for half-mask and full-facepiece respirators (Figure 3). These respirators are meant to be reused many times, and have particulate filters



Figure 3. This full-face mask respirator with pink filters provides protection against dusts, as well as eye protection. UNL photo.

Table 2. Some of the color codes for cartridges.

Color*	Offers protection against:
Pink	Dusts, welding fumes
Yellow	Organic vapors, acid gases (chlorine and other disinfectants)
Green	Ammonia (anhydrous, livestock confinement)
Black	Organic vapors (pesticides; not fumigants unless allowed on fumigant label)

*Base choice on text on cartridge label; colors may vary with printer or computer monitor.



Figure 4. This half-mask respirator with replaceable black cartridges offers protection against organic vapors (pesticides). UNL photo.

that snap into place, are sometimes used alone, or are sometimes used with chemical cartridges.

The particulate filter respirator is appropriate to wear when applying fertilizer or lime, working with hay, harvesting, tilling dusty fields, grinding feed, or sweeping. Some granular or dust-formulated pesticides may require the use of a particulate filter respirator during mixing and application. Do **not** use a particulate filter mask when mixing or applying a liquid pesticide; a particulate filter does **not** provide protection against vapors. In addition, the mask may absorb splashes or vapors. While wearing the particulate filter respirator, if breathing becomes difficult or you taste or smell the substance, the filter is no longer effective. Typically, filters for reusable particulate filter masks are meant to be replaced when they have reached the service life listed by the manufacturer or when breathing becomes difficult—whichever comes first. Although the half-mask and full-facepiece masks are reusable, replace them if the mask loses its shape and you cannot adjust it to form a tight seal around your face.

Chemical Cartridge Respirator

This type of respirator can be half-mask or full-face mask. They have replaceable cartridges to remove chemicals from the air; different types of cartridges protect against different materials. Cartridges are color-coded, based on the protection they offer (Table 2). For example, cartridges that protect against organic vapors such as pesticide vapors are black, with “organic vapors” written on the label. (Pesticides are organic compounds; they consist of carbon molecules.) A pink and black cartridge removes pesticide dusts, mists, and fine particles along with organic vapors (such as pesticides).

The half-mask respirator (Figure 4) covers the nose and mouth. If the pesticide label requires eye protection,

you must wear goggles or another type of eye protection in addition to the half-mask respirator. A full-face respirator protects the eyes, nose, and face.

The chemical cartridge respirator is meant to protect against light concentrations of chemicals, such as when mixing pesticides outdoors or applying a pesticide product diluted with water or another carrier. A pink pre-filter cartridge also provides protection from particulate matter. The pesticide label will state if the chemical cartridge respirator is appropriate, and the type of cartridge required. The cartridge respirator should **not** be used if the pesticide product does not have good warning properties, meaning the pesticide cannot be tasted or smelled. This is because one of the warning signs that a cartridge is spent or the respirator is not working correctly is tasting or smelling the chemical while wearing the respirator. **Do not** wear a chemical cartridge respirator in an area considered immediately dangerous to life or health. This is an area where dangerous gases can build up, creating a deadly atmosphere that can kill in seconds. Examples are a manure pit or silo with gases; a chemical cartridge respirator will **not** provide adequate protection in these situations.

Canister Filter Respirator

Also called gas masks, these respirators are more effective for a longer time than cartridge respirators. Only full-face

canister respirators are available (Figure 5). The canister is screwed into the mask or worn on the user's belt, back, or chest. A hose or tube connects the canister to the facepiece. Canister filter respirators are **not** to be used in areas considered immediately dangerous to life or health, such as a manure pit or silo with gases.



Figure 5. Canister filter respirator with an olive cartridge, effective against organic vapors, ammonia, and acid gases. Photo courtesy of HoneywellSafety.com.

Powered Air-purifying Respirator (PAPR)

The PAPR uses a battery-powered fan to pull ambient air through filters or cartridges, and circulates it over the user's face within a full-face mask, protective helmet, or hood (Figure 6). PAPRs may be suitable for particulate dusts and mists, or chemical gases and vapors, depending on the particulate filters or chemical cartridges used. A breathing hose connects the cartridge/filter to the mask, hood, or helmet. While the respirators discussed previously are negative pressure respirators (the user inhales, drawing in air), the PAPR is considered a positive pressure respirator because air is delivered to the wearer. The battery pack to power the fan is strapped to the user's waist or back. Batteries for PAPR range from rechargeable batteries to adapters for using 12V or 24V DC.

With the PAPR, filtered air surrounds the head area within the hood, full-face mask, or helmet. If there is a leak in the respirator, filtered air is forced out through the leak; contaminated air is not drawn in. People with health conditions that prohibit them from wearing a restrictive air mask such as a half- or full-facepiece respirator may be able to use this type. The PAPR is **not** to be worn in areas considered immediately dangerous to life or health.



Figure 6. These PAPRs with a hood (left) and full-face mask (right) have a battery pack worn at the waist. UNL, Honeywell Safety photos.

Atmosphere-supplying Respirators

The air-purifying respirators just discussed are more commonly used when handling pesticides. The other category of respirator, atmosphere-supplying, supplies clean air directly to the user from a tank or compressor. An atmosphere-supplying respirator has positive pressure, because air is delivered to the breather. The tank may be stationary with an air hose to the respirator (supplied-air respirator), or portable and worn on the user's back, called a self-contained breathing apparatus or SCBA (Figure 7). SCBA respirators are appropriate for areas considered immediately dangerous to life or health. They are used when there is very little oxygen, such as in fire-fighting or in high concentrations of a very toxic pesticide in an enclosed area, such as during a fumigation.



Figure 7. Self-contained breathing apparatus with facemask. Photos by HoneywellSafety.com.

Tight-fitting and Loose-fitting Respirators

Another way to classify respirators is by whether they require a seal between the respirator, face, and/or neck to provide protection. Respirators can be classified as tight-fitting or loose-fitting.

Tight-fitting respirators must have a tight seal between the respirator facemask and user's face and/or neck. Examples of tight-fitting respirators are particulate filter masks, full-face masks, and half-masks. If the seal leaks, contaminated air is pulled into the facepiece and inhaled. Facial hair such as a beard or stubble that could interfere with the respirator seal

is not permitted. Piercings, stray hair, and clothing may also interfere with the seal. For WPS, a fit test must be performed for any tight-fitting respirator at least every 12 months to make sure that the facepiece makes a tight seal. Situations such as weight gain, weight loss, or dental work that might affect the seal trigger the need for another fit test.

A loose-fitting respirator, such as a hood or helmet, does not depend on a tight seal with the face to provide protection. These are options for those who have facial hair, or those who cannot find a respirator that provides a tight seal. Loose-fitting respirators do not need to be fit tested.

Selecting the Correct Type of Respirator

Pesticide labels state the types of respirators and cartridges/filters that are required (Figure 8). For your safety, you must use the appropriate respirator and the appropriate filter, cartridge, or canister for the product you will be handling. In some cases, one face mask will work with particulate filters and organic vapor (pesticide) cartridges. Many suppliers have detailed catalogs to help in your selection.

PRECAUTIONARY STATEMENTS
 All mixers, loaders, applicators, and other handlers must wear a NIOSH-approved dust/mist filtering respirator with any R, P, or HE filter or a NIOSH-approved number prefix TC-84A.

Figure 8. This label requires a NIOSH-approved dust/mist filtering respirator with particulate filters (R, P, or HE) to be worn. A NIOSH-approved respirator with any R, P, or HE filter includes the R95 filter mask, which is a TC-84A respirator, or any half-mask or full facepiece respirator with an R, P, or HE particulate filter. The N filter (not resistant to oil) is not suitable.

Using a Respirator

Under the WPS revisions, if WPS applies to you, before using a respirator when handling pesticides you must have a medical evaluation and then a fit test. The medical evaluation is important, because people with some medical conditions may be at risk if they work while wearing a respirator. Your employer or the owner/operator will keep a copy of the medical determination (**not** a copy of the confidential medical evaluation) for two years, stating whether you are medically able to use the respirator. The fit test ensures that the respirator is properly sized and shaped for the wearer to prevent pesticide exposure. It is to be conducted at least annually by someone properly trained. After completing the fit test, you will receive training on:

1. Why a respirator is necessary.
2. How to properly fit, use, and maintain it.
3. Known limitations and capabilities of the respirator.
4. How to use it in emergency situations.
5. How to inspect, put on, remove, check seals, and use.
6. Procedures for maintenance and storage.
7. Medical signs and symptoms that may limit or prevent effective use.

In addition to the medical determination, your employer or the owner/operator will keep records that fit testing and training were conducted annually, as well as fit test results, all for two years. Read all documentation provided with your respirator. It explains how to properly assemble, fit, maintain, and store the respirator. Rubber or plastic parts can break down, so before each use, check the respirator for cracks, abrasions, and deterioration. Check that the facepiece, valves, connecting tubes or hoses, fittings, and filters are in good condition. An inspection checklist may be helpful (Figure 9).

Respirator Inspection Checklist	
Facepiece	<input type="checkbox"/> No cracks, tears, or holes <input type="checkbox"/> No facemask distortion <input type="checkbox"/> No cracked or loose lenses or face shields
Head straps	<input type="checkbox"/> No breaks or tears <input type="checkbox"/> No broken buckles
Valves	<input type="checkbox"/> No residue or dirt, cracks, or tears in valve material
Filters and cartridges	<input type="checkbox"/> NIOSH approved <input type="checkbox"/> Gaskets seat properly <input type="checkbox"/> No cracks or dents in housing <input type="checkbox"/> Proper cartridge for hazards
Air supply systems	<input type="checkbox"/> Breathing-quality air is used <input type="checkbox"/> Supply hoses are in good condition <input type="checkbox"/> Hoses are properly connected <input type="checkbox"/> Settings on regulators and valves are correct

*This checklist represents a general overview of respirator inspection requirements. Always refer to the manufacturer's user manual for more detailed information.

Figure 9. Checklist for inspecting respirators by Oregon Occupational Safety and Health Administration.

Seal Check

Performing a seal check tells if the facepiece is positioned properly to protect you from inhalation exposure. Between removal, cleaning, and storage, the respirator may change shape and not fit the same. A good common practice is to check the seal every time you put on the respirator. Facial hair, for example, interferes with the seal. OSHA states employers “shall not permit respirators with tight-fitting facepieces to be worn by employees who have facial hair that comes between the sealing surface of the facepiece and the face.” This is a good policy to follow, even if WPS and OSHA don't apply, as it helps assure the respirator will provide protection.

Two common ways to check the seal are the positive seal check and the negative seal check. For a half-mask cartridge

respirator, place the respirator on your face, then pull the top (halo-shaped in some models) plastic strap and adjust it over and on top of your head. Next, connect the straps that go behind your neck, and pull the loose ends of the straps to adjust for comfort and fit. When the seal seems tight, perform the seal check.

Positive Seal Check (*Figure 10, left*)

Cover the exhalation valve on the front of the respirator and gently exhale. If you can do this without feeling a rush of air around the faceplate, the seal is good. If you feel air leaking under the facepiece, reposition and repeat the check until the seal is effective.

Negative Seal Check (*Figure 10, right*)

Cover the inlet opening of each of the cartridges with your hands and inhale gently so the facepiece collapses. Hold your breath for about 10 seconds; if the facepiece stays collapsed, the seal is effective. If you can do this without feeling a rush of air around the faceplate, the seal is good. If the facepiece expands or air leaks under the facepiece, reposition and repeat the check until the seal is effective.



Figure 10. Positive (left) and negative (right) seal check. UNL photo.

For a disposable particulate filter mask, put on (don) the mask. Some have a piece of metal along the nose bridge. With both hands, press your fingertips on the metal band at the nosepiece. Press down while moving your fingers along the mask from your nose outward. This will mold the mask to fit your face. To check the seal (*Figure 11*), put both hands over the respirator completely and inhale sharply. You should feel the mask tighten against your face (negative pressure). If air leaks under the mask, adjust the nosepiece or straps. If you can't get a proper seal after repositioning the mask, try another style of respirator.

If the facemask has breaks or damaged portions that would prevent a good seal, replace the respirator. If you cannot get a good seal with any other respirator, use a loose-

fitting respirator or choose an alternative pesticide that does not require a respirator.



Figure 11. Seal check of a disposable particulate filter mask. UNL photo.

Signs that a Respirator Is Not Working

The respirator is not protecting you from exposure if you:

- smell or taste contaminants;
- have eye, nose, or throat irritation;
- have difficulty breathing; or
- are nauseated or dizzy.

If the respirator is not working, get to fresh air **immediately**. Check the faceplate for breaks. You may need to replace the faceplate and/or the cartridges.

Maintaining Your Respirator

A respirator is not meant to be shared with others. After each use, clean and store the respirator properly so it's in good condition for your next use. Follow all directions that came with your respirator regarding cleaning and maintenance. In general, the following directions will apply.

After taking off the respirator, remove the filters, cartridges, or canisters. They generally unthread, bend, or snap out of the faceplate. If the seating is damaged during removal, replace the filter. Set undamaged filters, cartridges, or canisters in the resealable plastic container where the respirator will be stored.

Next, disassemble the facepiece by removing speaking diaphragms, valve assemblies, hoses, or any components recommended by the manufacturer. Replace any defective parts.

Wash components in warm water with a mild detergent or with a cleaner recommended by the manufacturer. Use a stiff bristle (not wire) brush to help remove dirt. Then, rinse the components thoroughly in clean, warm (running) water and allow them to drain. Inspect the cleaned respirator components for any holes, damage, or wear.

When using a cleaner that does not have a disinfecting agent, immerse respirator components for 2 minutes in a solution of 2 tablespoons of laundry bleach to 1 gallon of warm water. Otherwise, you may use a commercial cleanser of equivalent disinfectant quality as directed, if recommended or approved by the manufacturer of the respirator.

After disinfecting, again rinse the components thoroughly in clean, warm, running water and drain. Thorough rinsing is extremely important, as dried detergents or disinfectants on a facepiece may irritate skin. Also, some disinfectant residues may cause rubber to deteriorate or metal parts to corrode.

Hand dry components with a clean lint-free cloth (*Figure 12*) or hang out of direct sunlight to air dry. When dry, reassemble the facepiece, replacing filters, cartridges, or canisters where necessary. Test the respirator to ensure that all components work properly.



Figure 12. Dry with a lint-free cloth.

Store the respirator in a way that preserves its shape and integrity, and protects it from contamination and extreme temperatures. Store filters, cartridges, or canisters and the respirator in the original respirator packaging (*Figure 13*) or a resealable zipper storage bag, away from pesticides. The best type of storage container has an airtight seal, as filters, cartridges, or canisters can absorb pesticides and other organic vapors when exposed to air. Mark the storage container with the purchase date of the filters, cartridges, or canisters and a running tally of the total number of hours used or keep a separate log, discussed later.



Figure 13. Store the respirator in packaging that can be sealed tightly. UNL photo.

Replacing Your Respirator or Its Components

Proper storage helps preserve filters, cartridges, or canisters, but eventually they need to be replaced. They have a limited service life and must be replaced at proper intervals, as listed by the manufacturer. Their service life is greatly affected by:

- temperature,
- humidity,
- work of the user,
- chemical concentration,
- types of chemicals to which they are exposed, and
- extensive exposure to organic vapors over a short time span.

Many respirator manufacturers have online calculators where you can enter this information to determine service life; consult the manufacturer's website. Keep a log of respirator usage to track how long filters, cartridges, or canisters have been used. For more information and a sample log, see the university's Safe Operating Procedure "Respiratory Protection—Air Purifying Respirators Cartridge Change Schedule" at http://ehs.unl.edu/sop/RPP_SOP_Cartridge_Change_Log.pdf

When using a respirator that filters out dusts and mists, change the filter and/or particulate filter mask when breathing becomes difficult, or if the filter is torn, damaged, or wet. In addition, replace chemical cartridges or canisters immediately if you can smell pesticide odors when using the respirator. If no time limitation is given by the manufacturer, replace the filter, cartridge, or canister after it has had 8 hours of use, even if you cannot smell or taste pesticide odors and the

filter seems in good condition. If you are unsure when a filter, cartridge, or canister was last used or if the total hours of use have not been recorded, replace it; **when in doubt, replace.** Begin and maintain a log for the new filters, cartridges, or canisters.

Summary

Always read the pesticide label to see what type of respiratory protection is required for the product you'll be using. Have a medical evaluation to determine if you can safely wear a respirator. Use a respirator approved by the National Institute of Occupational Safety and Health (NIOSH) and have a fit test. Read and follow the manufacturer's instructions for its use and care. Filters, cartridges, and canisters must be designed for the type of contaminant expected. Conduct a seal check and inspect the respirator before every use. Clean the respirator before storing it in a sealed package, away from pesticides and direct sunlight.

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DISCLAIMER

Reference to commercial products or trade names is made with the understanding that no discrimination is intended of those not mentioned and no endorsement by Nebraska Extension is implied for those mentioned.

RESOURCES

3M Centers of Expertise: Worker Health and Safety Respiratory Protection at http://www.3m.com/3M/en_US/safety-centers-of-expertise-us/respiratory-protection/
AgriSafe Network. Information about WPS and respirator use at <http://www.agrisafe.org/epa-worker-protection-standard>
Centers for Disease Control and Prevention (CDC) links to NIOSH publications and other resources at <https://www.cdc.gov/niosh/topics/respirators/>
Occupational Safety and Health Administration (OSHA) training videos, and other resources at <https://www.osha.gov/SLTC/respiratoryprotection/>



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