

MU Guide

Personal Protective Equipment for Working With Pesticides

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Pesticides can enter the body in four main ways: by mouth, by inhalation, or by contact with the skin or eyes. In most pesticide handling situations, the skin is the part of the body most likely to receive exposure. About 97 percent of human exposure to pesticides during spraying occurs through contact with the skin. To prevent exposure to pesticides, applicators should wear protective clothing and personal protective equipment (PPE).

Every pesticide product label contains specific information about necessary clothing and equipment to be worn while mixing, loading and applying that product. This information may be found in the "Precautionary Statements" section of the label. Remember, the label is the law. Read it and wear the appropriate equipment. For more detailed information about chemical and physical hazards associated with a specific pesticide, read the Material Safety Data Sheet (MSDS) for that product. The MSDS is available from the pesticide dealer.

Pesticide applicators need to choose the proper personal protective equipment for the job at hand. Because there are many pesticides with varied toxicity levels and formulations, each with specific PPE requirements, proper selection of protective equipment can be difficult. This publication offers general guidance on selection of personal protective equipment.

Gloves

Pesticide labels frequently specify use of either waterproof or chemical-resistant gloves. Keep in mind that waterproof materials are not necessarily chemical-resistant. Always wear unlined gloves and never wear cotton, leather or canvas gloves when applying pesticides. Investing in a pair of chemical-resistant gloves can go a long way toward preventing dermal exposure.

Polymers used for chemical-resistant gloves include barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, natural rubber, polyethylene plastics, polyvinyl chloride and viton (Table 1). These materials are used either individually or in various combinations in commercially available gloves. Refer to Table 1 when the PPE section of the pesticide label specifies chemical-resistance categories A through H. The table refers you to several PPE materials from which to choose for each



Working with pesticides is inherently hazardous. Using the appropriate personal protective equipment as specified on the pesticide label can help minimize the danger of accidental exposure.

category. It also tells how long you can expect the material to be resistant to the pesticide you are using. For example, the label may state: "If you want more options, follow the instructions for category G on an EPA chemical resistance category selections chart." This means you should select protective equipment made from barrier laminate or viton because they are highly resistant to that pesticide.

Chemical-resistant gloves are fabricated in two

Table 1. Environmental Protection Agency chemical resistance categories for selected personal protective materials

Selection category listed on pesticide label	Type of personal protective material							
	Barrier laminate	Butyl rubber ≥14 mils	Nitrile rubber ≥14 mils	Neoprene rubber* ≥14 mils	Natural rubber ≥14 mils	Polyethylene	Polyvinyl chloride (PVC) ≥14 mils	Viton ≥14 mils
A (dry and water-based)	High	High	High	High	High	High	High	High
B	High	High	Slight	Slight	None	Slight	Slight	Slight
C	High	High	High	High	Moderate	Moderate	High	High
D	High	High	Moderate	Moderate	None	None	None	Slight
E	High	Slight	High	High	Slight	None	Moderate	High
F	High	High	High	Moderate	Slight	None	Slight	High
G	High	Slight	Slight	Slight	None	None	None	High
H	High	Slight	Slight	Slight	None	None	None	High

*Includes natural rubber blends and laminates.

Key:

High: Highly chemical resistant. Clean or replace PPE at end of each day's work period. Rinse off pesticides at rest breaks.
 Moderate: Moderately chemical resistant. Clean or replace PPE within an hour or two of contact.
 Slight: Slightly chemical resistant. Clean or replace PPE within 10 minutes of contact.
 None: Not chemical resistant. Do not wear this type of material as PPE when contact is possible.

forms. One is that of the hand silhouette. This glove is made by die cutting a two-dimensional outline of a hand from a plastic film. Two of these flat hand forms are welded around the edges to form a glove. Most gloves made of polyethylene are constructed in this manner. The hand silhouette gloves may be undesirable because of poor fit, loss of dexterity, and difficulty in keeping the gloves on the hand. The second and more common type of chemical-resistant glove is made by dip molding, that is, by dipping a hand mold into a polymer-containing liquid. Dipped gloves are right- and left-handed and are sized. These gloves provide both a better fit and improved dexterity. Some of the dipped gloves come with curved fingers, which provide additional comfort.

Glove thickness is described in units of mils (1 mil = 0.001 inch). In general, barrier effectiveness and resistance to tear and puncture increase with thickness. Commercially available gloves range in thickness from 1 to 60 mils. The most commonly used chemical-resistant gloves range from 12 to 22 mils in thickness.

Gloves are sized either numerically or qualitatively. A numerical scale ranges from men's sizes 7 to 12. The size designation refers to the circumference of the hand, in inches, measured around the palm and below the knuckles. Gloves sized qualitatively may carry labels such as "large," "men's size," or "one size fits all." Gloves are manufactured in a variety of lengths, measured from the tip of the middle finger to the edge of the cuff. Longer gloves that extend to the upper arm area are available.

Footwear

Some pesticide labels state that the only footwear required for applying certain pesticides is "shoes plus socks." Other labels may direct the applicator to wear "chemical-resistant footwear plus socks."

Chemical-resistant boots are made principally of natural rubber, which may be coated with polyurethane,

polyvinyl chloride or blends of these materials. An important consideration when selecting boots is their height, which can range from 6 inches for ankle boots to 16 inches or more for over-the-knee models. Regardless of how high the boots are, pant legs should not be tucked into them but should be worn outside so that pesticides cannot be funneled down into the boot. Boots may have steel toes and anti-skid soles. Like gloves, they may be sized either numerically or qualitatively.

Shoe covers are designed to be worn over footwear that is not chemically resistant, including shoes and boots made of leather or fabric. Some covers are disposable while others are designed to be reused. They are generally less expensive than boots.

Eye and face protection

Although pesticide contact on the face typically occurs less frequently than, say, contact on the hands, the health consequences of facial contact are potentially more serious, especially for contact with the eyes. Selecting eye protection equipment depends largely on exposure conditions and pesticide formulation. In some situations, applicators may be in close proximity to pesticides that present the danger of splash, irritating mists or nuisance dusts. Common sense should determine which type of protective eyewear is appropriate. Excluding the full-face respirator, there are three basic types of protective eyewear: chemical splash goggles, face shields and shielded safety glasses. Eyewear should meet or exceed the current impact-resistance specification of the American National Standards Institute (ANSI Z87.1). Use Table 2 to determine the appropriate protective eyewear based on the pesticide label requirement.

There are several types of safety glasses. *The user should keep in mind that safety glasses are generally recommended for use with the least toxic pesticides and provide only minimal protection.* Safety glasses are designed

Table 2. Selection guide for eye and face protection

Label requirement	Acceptable eye protection
Protective eyewear	Safety glasses with brow, front and temple protection, or face shield, or goggles, or full-face respirator
Goggles	Goggles or full-face respirator
Full-face respirator	Full-face respirator

primarily to protect the wearer from direct impact and heat. Safety glasses with the full sideshields provide the greatest protection from flying objects but only minimal protection from chemical dust or splash. Even though some pesticide labels permit use of safety glasses, better protection will be provided by chemical splash goggles.

Goggles are available in two styles — cup goggles, which cover the eye sockets completely, and cover goggles, which may be worn over prescription eyeglasses. Although cup goggles are appropriate for working with pesticides, they are not as widely available as cover goggles, which are available in many styles and are more commonly used. When choosing goggles, consider what type of ventilation they offer. Directly ventilated goggles create the possibility of a liquid or aerosol entering through the perforations. Indirectly ventilated goggles are considered splash resistant, and they minimize fogging and exclude the direct passage of dusts, liquids, or particles. Consider also the lens material. Polycarbonate is the material of choice; it is lightweight and provides good chemical splash resistance and strong impact resistance. Other optional features with goggles include UV protection, anti-fogging coating, tinting and scratch resistance.

Face shields should not be worn without safety glasses or goggles. Generally, these are worn when it is highly likely that splashing of pesticides will occur. When selecting a face shield, consider models that allow replacement of windows, are light in weight, provide protection beneath the chin, and have UV protection and anti-fog, scratch-resistant coatings. Headbands should be made of a nonabsorbent material.

Head protection

Situations that call for overhead pesticide application require the use of chemical-resistant headgear. There are two basic choices: hats and hoods.

Chemical-resistant hats are typically designed and sold as sou'wester or nor'easter styles. They have wide brims and some have chin straps. Typically, they are constructed of materials such as chloroprene or polyvinyl chloride. For overhead protection as well as chemical resistance, many hard hat designs are acceptable.

Hoods are available in a variety of styles; differences are primarily in the extent of head and upper body coverage. Some hoods are sold in combination with a jacket or coverall to which they can be attached. Some hoods cover the head and neck, while others will also cover the shoulders. With pesticide applications, select

hoods that are coated on both sides with a chemical-resistant substance, such as polyvinyl chloride.

Body protection

When only frontal protection is necessary, the pesticide label will state that a chemical-resistant apron should be worn when mixing, loading or cleaning equipment. With some products, an apron is required in addition to other protective clothing to protect against spills. Styles of aprons include bib-type, waist-type, split-leg and sleeved. They are constructed of many of the chemical-resistant PPE materials listed in Table 1 as well as others. Regardless of material, they should be coated on both sides and the edges should be sealed to guard against pesticide wicking and absorption.

Woven cotton and cotton/polyester reusable coveralls are commonly used by pesticide applicators who are applying low-toxicity pesticides (CAUTION on the label). Woven coveralls vary in type of weave, weight, finish, style, type and location of closures, and location of pockets. Because trace amounts of pesticide residues can't be removed from cotton fabrics, they should be replaced at least annually. For additional information on laundering pesticide-contaminated clothing, see MU publication G1914, *Laundering Pesticide-Contaminated Clothing*.

Reusable coveralls and two-piece suits made of nonwoven fabrics are commercially available. These may be coated with any of the PPE materials listed in Table 1. Pesticide labels will provide information on proper selection.

Limited-use or disposable coveralls and other garments have become increasingly popular because of their low cost, availability and ease of use. The fabrics used in these garments vary in breathability, weight, thickness, flexibility, strength, durability, abrasion resistance and chemical resistance. The garments should be discarded at the end of each workday; never attempt to launder nonwoven fabrics because doing so can reduce their repellency and move contaminants to the inside of the garment. Use Table 3 for help in selecting the appropriate body protection, depending on requirements specified on a pesticide label.

Respiratory protection

Respirators are the most specialized piece of personal protective equipment and proper selection is complicated. Specific information on choosing the appropriate respirator will be supplied by pesticide labels. Use only respirators approved by the National Institute of Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA). Approved respirators will carry a "TC" number prefix, which signifies they have been tested and certified for a specific level of protection. If you plan to purchase a new respirator, a dust/mist respirator that formerly carried a TC-21C NIOSH prefix may carry a

Table 3. Fabric characteristics of some common personal protective materials used in pesticide applications

Material	Particulate protection class*	Liquid proof	Liquid chemical protection	Splash protection class*	Breathable	Relative cost
Tempo®	IV	No	No		Yes	Low
Pro/Shield®2	I	No	Yes	III	Yes	Low
Tyvek®	I	No	No	III	Yes	Low
KLEENGUARD® LP	I	No	No	III	Yes	Low
Tyvek®QC sewn seams	I	No	Yes	II	No	Low
Tyvek®QC sealed seams	I	Yes	Yes	II	No	Moderate
Tychem®SL serged seams	I	No	Yes	I	No	Moderate
Tychem®SL sealed seams	I	Yes	Yes	I	No	High
PVC coverall	I	Yes	Yes	I	No	High
PVC suits	I	Yes	Yes	I	No	Moderate

Note: This table is not a complete list. For information on other materials, consult manufacturers.

*Class is determined by signal words on the pesticide label.

Toxicity Class I materials are highly toxic and contain the signal words "Danger-Poison" or "Danger."

Toxicity Class II materials are moderately toxic and contain the signal word "Warning."

Toxicity Class III materials are slightly toxic and contain the signal word "Caution."

Toxicity Class IV materials are relatively nontoxic and contain the signal word "Caution."

Source: From Gempler's, Belleville, Wisc.

TC-84A prefix. New pesticide labels that specify organic vapor-removing cartridge respirators, once designated only as TC-23C, will also list which filters or pre-filters can be used with the respirator. The filters are identified by codes such as an N, R or P, which indicate the level of oil resistance offered by the filter. "N" filters are excellent for use with dusts and granular formulations. "R" and "P" filters are either oil-resistant (R) or oil-proof (P).

One of the two common types of respirators is the air-purifying respirator. These respirators should be used only where there is sufficient oxygen. Air-purifying respirators remove airborne contaminants as air enters the respirator through chemical cartridges or mechanical filters. The chemical cartridges are filled with activated carbon, which has a very high absorption capacity for gases and vapors. Mechanical filters provide protection by trapping particulate matter in the fibrous filter material.

Most air-purifying respirators operate under negative pressure; that is, they rely on the power of the wearer's lungs to pull air through the filter elements. These include half-mask dust/mist respirators, half-mask dual-cartridge respirators, full-face dual-cartridge respirators, and canister-type gas masks. Dust/mist respirators and some half-mask dual-cartridge respirators are disposable. The only air-purifying respirator that operates under positive pressure is the powered air-purifying respirator (PAPR). It has a fan that pulls air

through the filters and circulates it over the wearer's face. Air-purifying respirators vary widely in price.

The second basic type of respirator is the atmosphere-supplying respirator. This kind of respirator supplies an independent source of breathable air and is used in conditions where oxygen is deficient or the applicator is exposed to high concentrations of very toxic pesticides in enclosed areas. Breathable air is supplied to the wearer from an independent source through an air line, or the wearer carries oxygen in a tank. These respirators are relatively expensive and should be serviced and inspected by qualified personnel.

An applicator should perform a fit test to determine correct size of a respirator facepiece because a respirator that does not provide a proper seal is of little value. OSHA mandates that a fit test be performed *every time* a person puts on a respirator. Instructions for conducting fit tests generally accompany half-mask and full-face respirators.

Chemical cartridges should be replaced according to the manufacturer's recommendations or the pesticide label or when odor or irritation is noticed. Pre-filters will extend the life of chemical cartridges in dusty conditions. Mechanical filters should be replaced when breathing becomes difficult or the filter is damaged or as specified by the manufacturer or the pesticide label. If no instructions are provided, replace cartridges and filters when the workday is over.



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