## *Web sites to visit*

Many Web sites offer additional information about chemical-resistant gloves. The EPA site for the Chemical Resistance Category Chart shown is at **www.epa.gov/oppfead1/safety/workers/equip.htm**.

Commercial sites that offer information about personal protective equipment (PPE) are:

**www.safetyonline.com/BuyersGuide**
**www.northsafety.com**
**www.bestglove.com**
**www.ansellpro.com**

## *Additional references*


Guo, C., J. Stone, H. M. Stahr, and M. Shelley. (2002). Cleanup of gloves contaminated with granular terbufos and tefluthrin. *Arch. Environ. Contamin. & Toxicol.* 42:383–388.

Stone, J., C. Coffman, P. M. Imerman, K. Song, and M. Shelley II. (2005). Cotton liners to mediate comfort for greenhouse applicators, *Arch. Environ. Contamin. & Toxicol.* 48:1–9.



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No endorsement of products or firms is intended, nor is criticism implied of those not mentioned. Suggestions in this publication are intended to alert pesticide users to safety concerns; however, following these procedures cannot guarantee total protection from pesticides.


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# *Protect your hands with gloves*

IOWA STATE UNIVERSITY
University Extension


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# Protect your hands with gloves

The best way to prevent hand contamination when you need to apply pesticides around the home, farm, or business is by wearing protective gloves. With each pesticide, the label states if gloves are needed and suggests which of many available types are acceptable.

## *What type of glove material is required?*

Glove materials differ in their resistance to pesticides and their solvents. No chemical-resistant glove material is an effective barrier to all pesticides for an unlimited time. If protective gloves are required, the pesticide label may show a letter (A–H) that corresponds to glove materials in the EPA Chemical Resistance Category Chart shown. For example, if you are using a Category B pesticide, barrier laminate (Silvershield® or 4H®) or butyl rubber offer high chemical resistance, but other types would not offer sufficient protection.

The interpretation of the rating system (high, moderate, slight, none) is shown in the footnote of the chart. For example, "High" resistance means that chemical-resistant gloves should be cleaned or replaced at the end of the work day—generally one 8-hour application period. If used less time, they can be reused after cleaning. For information about cleanup, see the section "How can I manage gloves effectively?"

Cotton, canvas, or leather gloves alone are not enough protection when using pesticides because they readily absorb liquids and are not a complete barrier for dust and granules.

However, exceptions exist for double-gloving (wearing one glove type over another) or when gloves are worn with separate liners. For example, leather gloves can be worn over chemical-resistant glove liners to protect from thorns.

## EPA Chemical Resistance Category Chart

For use when PPE section on the pesticide label lists a chemical resistance category. The Worker Protection Standard requires that labels of pesticides used on farms, and in forests, nurseries, and greenhouses list the type of personal protective equipment (PPE) that must be worn with each product. Labels will refer to chemical resistance categories (A–H) for PPE. Items in these categories are made of materials that the pesticide cannot pass through during the times indicated below the chart. Choose the category of resistance that best matches the handling task duration. The categories are based on the solvents used in the pesticides, NOT the pesticides themselves. Therefore, there will be instances where the same pesticide with two different formulations (wettable powder-WP and emulsifiable concentrate-EC, for example) will require PPE from two different chemical resistance categories.

| Selection Category Listed on Pesticide Label | Types 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 (a dry and water-based formulation) | 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 |

**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:** No chemical resistance. Do not wear this type of material as PPE when contact is possible.

## *What about glove linings?*

The EPA recently amended the Worker Protection Standard (WPS) to allow wear of separate disposable liners under chemical-resistant gloves to improve comfort. Many applicators complained that the required unlined gloves made their hands sweat and were uncomfortable. Research at Iowa State University and Cornell University in New York found that greenhouse applicators believed that cotton liners increased their comfort and did not interfere with their work routine. Most of the liners worn beneath the chemical-resistant gloves showed very little contamination afterward.

The EPA recently ruled that separate disposable glove liners may be worn beneath chemical-resistant gloves for comfort. Researchers believe this may encourage more consistent use of chemical-resistant gloves, which are known to reduce hand contamination.

Separate disposable glove liners may be cotton knits or other wickable fiber-knit fabrics for optimal stretch, a close fit, and moisture control. They are available both with and without fingers from several sources at minimal cost.

If you decide to wear liners, you may need a larger chemical-resistant glove size to fit over them. Liners cannot be longer than the chemical-resistant gloves.

Although many chemical-resistant gloves are designed and available with unitary flocked or knit linings, these are not in compliance with the WPS because they can trap and hold pesticides close to the skin, cannot be cleaned adequately after wearing, and if worn again, may be a source of increased pesticide exposure.

## *How thick should gloves be?*

Glove thickness affects their protective qualities. It takes longer for chemicals to penetrate or permeate thick materials than thinner ones. Thus, the thicker the glove, the more protection provided. The Chemical Resistance Category Chart states that most materials should be at least 14 mils thick. The thickness needed varies with the material, the task, and the length of time protection is needed.

Thicker chemical-resistant gloves resist punctures and tears. However, thicker gloves also may be stiffer and reduce manual dexterity and grasping ability. If a glove fits well, you may be able to wear it longer with less awkwardness. Single-use disposables should only be worn for tasks of very short duration.

Glove thickness is generally noted in mils (1 mil = 0.001 inch), which should be on glove labels or in advertising. A 15-mil glove is thinner than a 22-mil glove and, therefore, less protective. Typical thicknesses for various types of gloves are shown in the table below.

| Glove Type | Mils Thickness |
|---|---|
| Butyl | 13–32 |
| Natural rubber latex | 11–50 |
| Nitrile | 7–22 |
| Neoprene | 28–35 |
| **Single-use** | |
| Barrier laminate | 4 |
| Nitrile | 4–8 |

## *How can I find comfortable gloves?*

Start by identifying your correct glove size. Gloves that fit correctly will be more comfortable to wear. Your best size can be found by using a measuring tape to measure around your palm. If your hand measures 10 inches, try a large or extra-large size.

Glove sizes (for both men and women) are as follows:

| Glove Size | | Hand Measurement in Inches |
|---|---|---|
| Extra small | = | 5–7 |
| Small | = | 7–8 |
| Medium | = | 8–9 |
| Large | = | 9–10 |
| Extra large | = | 10–12 |

Glove length should be selected according to the work requirements. Gloves should be at least 12 inches in length to cover your wrists, but you can get gloves in various lengths, including ones long enough to reach over your elbows.

Finding the correct size and length are the first steps in getting a comfortable fit. Different glove types often do not have the same finger length, palm width, or thumb position even if they are marked as the same size. Glove manufacturers may use various "model" hands to create their sizing and within one manufacturer's line of gloves, different sizing specifications may be used for the various types offered.

If possible, try on a pair of sample gloves before buying a quantity to check out how they feel on your hands. Some suppliers provide free sample gloves or let you open glove packages to check the fit. If you can't try on a sample, buy only one or two pairs at first to see how the gloves work out before investing in a season's supply.

Suppliers may offer only the large or extra-large size because even a small hand can fit into a large glove, whereas a large hand cannot fit into a small glove. An optimum fit may not be available for everyone, but don't be satisfied with gloves that are too big. Remember, if gloves are too large, they may be clumsy, awkward to use, and get caught in equipment. If they are too small, the material can stretch, making it thinner and less protective. Also, tight gloves can make your hands tire quickly, and they are hard to get on and off.

## *How can I manage gloves effectively?*

Chemical-resistant gloves cannot help if they are not available when you need them; have a backup pair available if the ones you are wearing tear or start to leak. It is good to have several pairs of clean gloves in zip-close bags or unopened packages, so you have a fresh pair ready to finish your work.

Use common sense when wearing chemical-resistant gloves over or under sleeve cuffs. Wear gloves over cuffs unless you are working in a drenching spray from above. If so, put gloves under your sleeves so the chemical doesn't run down your sleeve and arm into the gloves.

After wearing gloves for pesticide application, they are generally contaminated. Before you take off your gloves, rinse off and wash your gloves on the outside with soapy water, if possible. Wash the gloves while they are still on your hands.

To take off gloves, peel one glove off by grasping the cuff, then hold it wrong-side out in your bare hands as you peel off the other glove. Thus, both gloves are wrong-side out, with contamination on the inside. Never pull off gloves with your teeth!

Put the pesticide-soiled gloves into a large zip-close bag when you take them off. Be sure chemical-resistant gloves are either discarded or stored properly so that other items do not get contaminated.

Never throw contaminated gloves on the seat or floor of a vehicle or leave them around the garage, house, or anywhere that children or other family members might be tempted to try them on.

Research has shown that washing chemical-resistant gloves on the outside can reduce contamination from granular pesticides (terbufos and tefluthrin), but residues remain within the glove material itself, whether nitrile, neoprene, or barrier laminate. After washing test specimens with detergent in the laboratory, the level of terbufos contamination (DANGER label) was significantly reduced for nitrile gloves but not for neoprene. The health hazard of reusing such contaminated gloves is unknown. But, barrier laminate gloves are single-use disposables, so they must be discarded after use.

Never put contaminated gloves in the washing machine to clean them because submerging them may transfer contamination to the inside. Also, heavy contamination may be transferred to the washing machine or other textiles in the washer.

Never put contaminated gloves in the dryer because they shrink, melt, and may make a mess.

## *Glove disposal*

When you dispose of any chemical-resistant gloves, use the same procedures as for empty pesticide containers, but first cut off the fingers, so they can't be removed from the garbage and worn again. Keep a pair of scissors for this purpose in your cleanup area. Do not use the family sewing, kitchen, or haircutting scissors to avoid contaminating them.

## *When do I need new gloves?*

Pesticides can permeate glove materials, leaving no visible signs of damage to the glove. You may not be able to see the pesticides, but tests with fluorescent dyes have shown that gloves are contaminated easily during pesticide handling, mixing, and application.

All gloves should be replaced after 10 hours of continuous chemical exposure or a full day's work. Sooner replacement will be needed if/when gloves

- leak;
- show stains or color changes;
- soften, swell, or bubble;
- start to dissolve or become jellylike; or
- stiffen or crack.