The Chemical Safety Mechanism
University of Wisconsin-Madison
Office of Chemical Safety

Glove Use Considerations

One of the first lines of defense against laboratory hazards is protective gloves, so it pays to choose your gloves wisely and seek advice if necessary. In a lab setting our hands are the closest thing to a potentially harmful situation. They are the only part of our body that goes inside of a fume hood and they routinely hover just inches above a chemical reaction. The gloves have to meet certain requirements such as protection against specific hazards as well as fit and comfort. Kimberly-Clark took a survey at the 2006 National Safety Council (NSC) Congress and found that 57% of Personal Protective Equipment noncompliance was due to poor fit or discomfort (Kimberly-Clark Professional, 2007).

With so many factors to consider and such a vast array of glove choices, choosing the correct glove can be a daunting task. After reading this article you should feel both more confident in identifying your Personal Protection Equipment (PPE) needs and well equipped with some helpful resources. Remember, it is the responsibility of the supervisor or PI to supply the appropriate PPE, education and training to their staff.

Steps for Choosing the Right Glove

All gloves are not created equal. Each type of glove (and even each brand) has certain benefits and drawbacks. It is important that you choose the right glove that is best suited for your needs. Following the steps listed below will help with your process.

1. **Identify your hazard.**
   Identify the type of hazards you'll be exposed to and the materials you will work with. This information can then be used to select the glove type and material you will need.

   The main hazards to be considered include:

   - Exposure to chemicals and toxic substance
   - Cuts and abrasions
   - Infectious potential
   - Temperature

   There are specific gloves made for each one of these hazards or for several of them combined. While there are gloves that are specifically designed to protect against cuts and abrasions this article will concentrate on chemical hazards and how they affect glove choices. *It is extremely important to remember that some gloves provide better protection from certain chemicals than others.* Check the Material Safety Data Sheet (MSDS) for the chemicals you are working with. You can also check the safety standard of a glove on the manufacturer's website. Some additional information and links to websites is provided later in this article.

2. **Determine how much contact you will have with the hazardous materials.**
   Choosing the correct glove involves more than just ensuring chemical compatibility. It will also depend on how the hazardous materials are used. Consider whether you are likely to have:

- **Incidental Contact -** Situations where you will have minimal contact with the hazardous material and just need a barrier between you and the agent to prevent incidental contact.
- **Extended Contact -** In these situations you would be immersing your hands in a chemical, working with sharps or extreme temperatures.

3. Identify the type of glove for your exposure.

From a chemical safety point of view glove choice will be dependent on the above two factors – what chemicals you are using and how you plan to use the chemicals.

Disposable or reusable

For incidental contact disposable gloves are usually a good choice. Disposable gloves are the most commonly used gloves in the workplace. They are acceptable when working with small quantities of chemicals and for protection from incidental contact. Disposable nitrile gloves are the most widely used on campus. These are preferred over latex gloves because latex can cause allergies while nitrile gloves have higher chemical resistance and tears can be seen easier. If you are working with concentrated solutions or under prolonged, direct exposure to chemicals a reusable glove should be used. These are normally made of thicker material. Some dexterity may be lost but the protection provided is generally greater.

Chemical Compatibility

Determining the chemical compatibility of a glove is a key element in glove selection. While disposable nitrile gloves are usually a great choice they are often used inappropriately. Chemicals like acetaldehyde and tetrahydrofuran readily penetrate these gloves. The table below provides a general guideline for glove selection.

GLOVE MATERIAL	APPLICATIONS	DISADVANTAGES
Butyl	Highest resistance to gas and water vapors. Especially useful for working with esters and ketones.	Does not protect against chlorinated solvents or hydrocarbons.
Latex	Good protection against water-based materials and biological materials.	Can cause allergic reactions, limited protection from organic solvents, punctures not easily identified.
Neoprene	Excellent tensile strength and heat resistance. Compatible with some acids and caustics. Some abrasion resistance.	Very little tear resistance, poor protection against tetrahydrofuran and styrene.
Nitrile	Chemical and abrasion resistance. Good for general duties. Protects against oil, petroleum and some acids and caustics.	Poor protection from many ketones, benzene, trichloroethylene (TCE) or methylene chloride.

Norfoil®	Great protection against most hazardous substances.	Dexterity will be compromised due to loose fit.
PVC	Resists most acids, fats and petroleum hydrocarbons and abrasions.	Usually imported so the quality may be poor.
Viton®	Excellent resistance to chlorinated and aromatic solvents. Little resistance to cuts and abrasions.	Tears easily, expensive, poor protection from some ketones, esters and amines.

Gloves vary from company to company as various formulations are used in production so it is best to view the data directly from the manufacturer. Below are a few useful links that make checking glove compatibility easy.

http://www.coleparmer.com/SafetyChemGuide?CID=8&SrtBy=3

http://www.chemrest.com/

http://www.newpig.com/wcsstore/NewPigUSCatalogAssetStore/Attachment/documents/ccg/NORTH_NITRILE.pdf

The manufacturers' will use a number of terms that you should understand:

- **Breakthrough time**: The time it takes for the chemical to travel through the glove material. This tells you how long you can wear the glove.
- **Permeation Rate**: The amount of the chemical that passes through the glove once breakthrough has occurred. You'll want to choose the lowest rate because this means that less of the chemical will pass through.
- **Degradation rating**: This is the physical change that will happen to the glove once it is affected by a chemical. This usually means that by this time the glove has become damaged or compromised.

Other Considerations

While the above discussion focused on chemical compatibility other factors often need to be taken into account when considering gloves. Is the glove resistant to abrasions, punctures, or variable temperatures? Again, the glove manufacturers often provide this information.

Some Tips and General Considerations on Using Gloves

General Considerations

Once you're gloved and ready to work you may think that you are completely safe but there are still steps you need to take to ensure that the gloves you choose are used correctly. Here are a few things to consider about the overall protection given by your gloves:

- Although your hands are protected, you should also avoid contamination of your gloves as much as possible.
- No glove provides 100% protection. All gloves begin to degrade and become more permeable with time.
- Check for tears, holes or discoloration BEFORE and DURING use.

- The resistance a glove has to a chemical will vary with the gloves thickness and material type.
- The concentration and temperature of a chemical will affect the rate of permeability.
- When using disposable gloves:
    - Replace gloves regularly and never wear them outside the lab.
    - Discard the gloves right away should they become contaminated. Attempting to remove the contamination with water or a paper towel is not effective.
    - Never submerge your disposable glove into a hazardous substance. Always use tongs or tweezers when removing stir rods, test tubes etc. from a solution.
- When using reusable gloves:
    - Check for signs of degradation and replace when necessary.
    - Decontaminate the gloves after using. This will help reduce degradation in many cases. However, in some instances the chemicals should not be washed down the drain as this can lead to environmental contamination.
- Although contaminated gloves should never be worn outside the laboratory, It is recommended that you bring gloves along (along with spill materials and other appropriate PPE) if there is the possibility of a hazardous spill during transportation.

Double Gloving

There are situations where double gloving is beneficial and there are methods for doing this. You could use two pairs of the same glove. If the first protective layer becomes compromised there is still a second layer of protection. When working with various chemicals or chemical mixtures you may want the first and second layer of gloves to offer a different hazard protection. This technique gives the wearer protection from multiple hazards where each glove on its own may not provide a full range of protection. Norfoil® gloves for example, are good for most hazardous chemicals but they often fit poorly and are very slippery. By double gloving with a nitrile glove on top of the Norfoil®, you retain the chemical protection while maintaining your fine motor ability. Situations like this reap many benefits from double gloving.

Glove Sizing and Length

You'll want to make sure your gloves fit properly. This ensures that your work can be done comfortably and without any delays. If the hand protection is too tight it may cause the wearer to overuse their hand muscles, making it difficult to continue working. When a glove is too large it can get caught on things which can be dangerous when working around machinery. In both instances there will be some loss in dexterity.

In most laboratory settings gloves that cover up to the wrist are used. Longer gloves are needed when more of your arm is likely to come in contact with something hazardous. An example of this might be when working with large volumes of chemicals which may involve immersion. There are many other situations that require longer arm protection. Always consider the hazards involved when choosing the appropriate PPE.

Glove Removal

- With both hands gloved, pinch the top of one glove and pull it off from top to bottom and hold it in the gloved hand.

- With the exposed hand, grab the second glove from the inside and pull it off, tucking the first glove inside the second.
- Throw the gloves away. It is never O.K. to reuse disposable gloves.
- Never touch the outside of the glove with bare skin; this will expose you to contamination.
- After removing the gloves wash your hands as soon as possible.

A Little about Glove Allergies

It is estimated that anywhere from 10%-19% of health care workers have developed an allergy to latex. Laboratory workers are just as susceptible to these allergies. The cause of the allergic reaction is not necessarily the latex but the combination of materials used in its production. Chemical accelerators are used to speed up the process that transforms latex to a firm rubbery consistency. These accelerators are known allergens. After production, latex gloves are often powdered with cornstarch. This ensures that the glove will slide on quickly while resisting tears. Cornstarch binds to the accelerator proteins in the glove bringing them in contact with the skin. It also absorbs the oils on our hands which is a natural barrier. As our hands become dry and cracked the allergens make their way into our bodies.

If you suffer from latex allergy there are many steps you can take to protect yourself. **Remember, latex itself is often not the direct cause of an allergic reaction.**

- Nitrile gloves are considered an alternative for those with latex allergy.
- Try gloves from various companies. Some companies use more accelerators than others and some companies wash their gloves more thoroughly to remove excess chemicals.
- Try latex gloves that are not powdered. This will help eliminate the drying effect that allows the entry of allergens.
- Avoid using harsh or alcohol containing soaps that dry and strip your hands of oils. Soaps that are marketed as antibacterial or antimicrobial are usually very drying.
- If your supervisor or PI is unable to provide an alternative to latex gloves, try a cotton glove liner. This will give you a barrier of protection from the gloves.

http://www.glovenation.com/index.html offers free glove samples and has a variety of light powder, powder free and nitrile gloves.

Final Thoughts

Glove selection and usage are an integral part of an effective laboratory safety program since gloves, along with safety eyewear, are the most commonly used PPE. Choose wisely, use properly, and get help from the manufacturer or the Chemical Safety Office if you have any questions.

August 2012

For More Information Contact:

Environment, Health and Safety Department
30 East Campus Mall, Madison, WI 53715-1227
Phone (608) 265-5000 · **Fax** (608) 262-6767;
The Chemical Safety Office