Chemical Protective Clothing – Glove Selection Fact Sheets

WHAT SHOULD I KNOW FIRST ABOUT CHEMICAL PROTECTIVE CLOTHING?

Chemical protective clothing should not be considered as a replacement for engineering control methods. However, there are often few alternatives available, or an emergency (e.g., a spill) requires their use. Since the clothing is the last line of defense for protecting the skin, care must be taken to ensure it provides the level of protection expected.

The phrase commonly found on the Safety Data Sheet (SDS) "Wear impervious (or impermeable) gloves" has very limited value. It is technically inaccurate. **No** glove material will remain impervious to a specific chemical forever. **No** one glove material is resistant to all chemicals. Some chemicals will travel through or permeate the glove in a few seconds, while other chemicals may take days or weeks.

Information specifying the best type of chemical protective material is what should be on the SDS (e.g., neoprene, butyl rubber). If this information is missing, contact the supplier or manufacturer of the product. Manufacturers of chemical protective gloves and clothing may also assist their customers in making the appropriate choices.

What is meant by permeation rate, breakthrough time, and degradation?

Permeation rate is the rate at which the chemical will move through the material. It is measured in a laboratory and is expressed in units like milligrams per square meter per second (or some other [weight of chemical] per [unit area of material] per [unit of time]). The higher the permeation rate, the faster the chemical will move through the material.

Permeation is different from penetration. Penetration occurs when the chemical leaks through seams, pinholes and other imperfections in the material: permeation occurs when the chemical diffuses or travels through intact material.

Breakthrough time is time it takes a chemical to permeate completely through the material. It is determined by applying the chemical on the glove exterior and measuring the time it takes to detect the chemical on the inside surface. The sensitivity of the analytical instruments used in these measurements influence when a chemical is first detected. The breakthrough time gives some indication of how long a glove can be used before the chemical will permeate through the material.

Degradation is a measurement of the physical deterioration of the material due to contact with a chemical. The material may get harder, stiffer, more brittle, softer, weaker, or may swell. The worst example is that the material may actually dissolve in the chemical.

How do I choose the right material for the job?

Based on the above information, it becomes apparent that you must carefully choose the appropriate material for each job. Before deciding about which kind of glove or other chemical protective clothing to use, you should gather and analyze information on a number of factors. Be sure to:

1. Complete an accurate description of the task.
2. Identify all hazards that may require hand protection. This identification should include a list of the chemicals involved as well as physical hazards such as abrasion, tearing, puncture, fire/flames, temperature, and/or biological hazards. The kind of hazards present will also affect the decision to use other chemical protective clothing in addition to gloves. Check the Safety Data Sheet and other sources for information.
3. Determine the flexibility and touch sensitivity needed for the task. This need may significantly limit the thickness of glove material that can be used. The requirement for textured or non-slip surfaces to improve grip must also be considered.
4. Know the type of potential contact (e.g., occasional contact or splash protection or continuous immersion of hands). This contact will also help in choosing the appropriate length of the glove.
5. Determine the contact period. How long the worker could be in contact with the chemical (and which chemicals) may also influence the selection of type and thickness of the glove material and the choice of lined or unlined gloves.
6. Determine the potential effects of skin exposure. The immediate irritation or corrosion of the skin must be considered in addition to the potential health effects to the entire body from absorbing the chemical through the skin.
7. Consider what hazards may be presented by the use of the protective clothing itself. For example, protective clothing can contribute to heat stress; reduced dexterity; rip or tactile functions; poor comfort; or may contribute to skin conditions.
8. Consider the decontamination procedures. Consider whether the gloves should be disposed of or cleaned after use. If they are cleaned, consider the cleaning method, how often they can be cleaned, and any special procedures required for disposing of the “decontamination wash waste”?
9. Provide the necessary education and training required which includes:

- what are the hazards of skin contact with the chemical/material,
- what are limitations of the gloves,
- what could happen and what to do if the gloves fail, and
- when to dispose of or to decontaminate gloves.

Suggested materials should be selected based on quantitative information such as permeation rate, breakthrough time, penetration and degradation, and the other considerations mentioned above. Various factors like the thickness of the material, manufacturing methods, and product quality control can have a significant effect on these properties.

For a few specific situations when it is impossible to predict the variety of hazards, multilaminate gloves made of layers of several different materials are available.

WHAT IS AN EXAMPLE OF A GUIDE TO THE SELECTION OF SKIN PROTECTION?

Guide to the Selection of Skin Protection		
Hazard	**Degree of Hazard**	**Protective Material**
Abrasion	**Severe**	**Reinforced heavy rubber, staple-reinforced heavy leather**
	Less Severe	**Rubber, plastic, leather, polyester, nylon, cotton**
Sharp Edges	**Severe**	**Metal mesh, staple-reinforced heavy leather, Kevlar®**
	Less Severe	**Leather, terry cloth (aramid fiber)**
	Mild with delicate work	**Lightweight leather, polyester, nylon, cotton**
Chemicals and fluids	**Risk varies according to the chemical, its concentration, and time of contact among other factors. Refer to the manufacturer, or product SDS.**	**Dependant on chemical. Examples include: Natural rubber, neoprene, nitrile rubber, butyl rubber, polyvinyl chloride, polyvinyl alcohol, Saranex™, Tychem®, Trellchem®**
Cold		**Leather, insulated plastic or rubber, wool, cotton**

Heat	**High temperatures (over 350 deg C)**	**Asbestos**
	Medium high (up to 350 deg C)	**Nomex®, Kevlar®, neoprene-coated asbestos, heat-resistant leather with linings**
	Warm (up to 200 deg C)	**Nomex®, Kevlar®, heat-resistant leather, terry cloth (aramid fiber)**
	Less warm (up to 100 deg C)	**Chrome-tanned leather, terry cloth**
General Duty		**Cotton, terry cloth, leather**
Product Contamination		**Thin-film plastic, lightweight leather, cotton, polyester, nylon**
Radiation		**Lead-lined rubber, plastic or leather**

Note: The mention of trade name products in the above table is not intended as a recommendation or endorsement of any product.

What are some other points to remember about skin and hand protection?

Since there are many hazards, hand protection can be provided in a variety of ways: finger guards, cots and thimbles, hand pads, mitts, and gloves.

- Choose hand protection that adequately protects from the hazard(s) of a specific job and adequately meets the specific tasks involved in the job (such as flexibility or dexterity).
- Follow the manufacturer’s instructions for care, decontamination, and maintenance of gloves.
- Be aware that some materials may cause reactions in some workers such as allergies to latex. Offer alternatives where possible.
- Make sure the gloves fit properly.
- Make sure all exposed skin is covered by gloves. Gloves should be long enough so that there is no gap between the glove and sleeve.
- Do not wear gloves with metal parts near electrical equipment.
- Do not use worn or torn gloves.
- Clean gloves as instructed by the supplier.
- Inspect and test gloves for defects before using.
- Test all rubber or synthetic gloves for pin holes or leaks by inflating them (see figures below).

- Know how to remove, and either clean or dispose of used gloves, as appropriate.

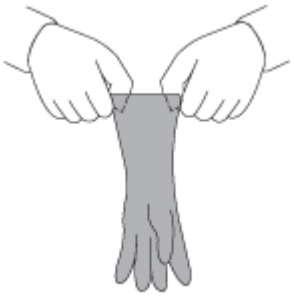

Figure 1

Hold cuff as illustrated, with thumbs inside, stretch cuff slightly.

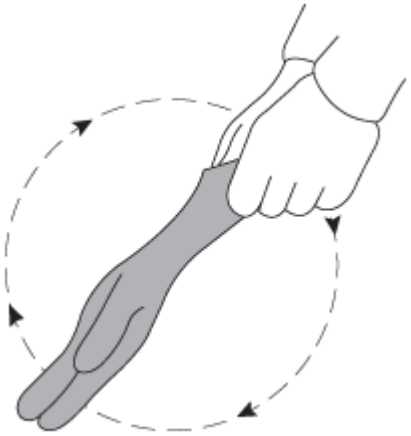

Figure 2

Swing glove outward and over towards the face,

two or three times, trapping air inside.

Figure 3

Squeeze inflated portion of glove with left hand,

causing rubber to expand and magnify any defect.

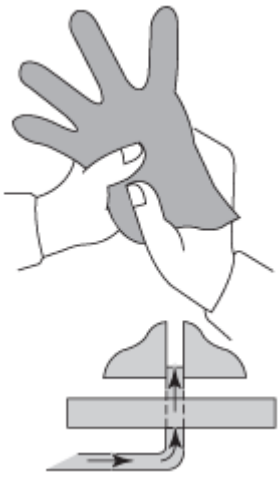

Figure 4

If large numbers need testing use a compressed air jig.

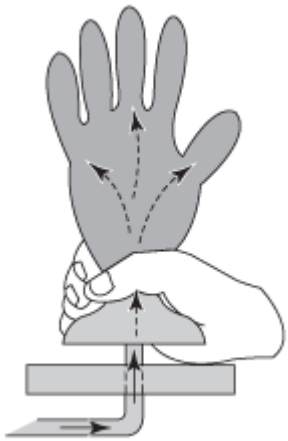

Figure 5

Double roll cuff over and grip with right hand.

What is meant by a workplace evaluation?

The selected glove should be carefully tested in the actual job conditions. In some situations it may be desirable to do laboratory tests on the gloves using American Society for Testing and Materials (ASTM) methods. This is especially important if you do not have information of the permeation time of a particular chemical you are using or if you are using mixtures of solvents or chemicals. Some glove manufacturers may undertake these tests for their customers.

Does the use of chemical protective clothing require a PPE program?

The employer must put a process in place to ensure a competent person reviews the selection and use of chemical protective clothing. If chemical protective gloves and clothing are required, there should be a complete PPE program in place that includes

- the training of workers in the proper use and care of protective gear and
- the selection, fitting, maintenance and inspection of the protective clothing and gloves.

A successful program will ensure that any changes in chemicals being used are accounted for, will regularly check for any issues, and will result in necessary

changes or improvements.

Unfortunately, chemical protective clothing is often considered as a fast and easy method of providing skin protection. The long-term costs of setting up and maintaining a chemical protective clothing program may be higher than the costs for implementing proper engineering controls. In addition, even with the use of gloves, the risk of contact with the chemical still remains. However, in many situations, when the engineering controls for enclosing hazardous chemicals are not practicable, a chemical protective clothing program becomes essential for the protection of workers.

Since personal protective equipment such as gloves are the last line of defense, considerable effort should be expended to ensure that adequate protection is actually being provided.

What are some sources of information for chemical protective clothing material selection?

Many manufacturers of chemical protective clothing provide charts and computer software to help in selecting the appropriate gloves when working with a chemical or a specific mixture. In addition, there are various glove-material compatibility charts and other glove selection aids available from independent sources. However care must be taken in interpreting generic information, since the properties, thicknesses, and quality assurance of glove materials may vary between manufacturers.

For solvent mixtures, however, tests may have to be carried out if data are not available of the specific mixture. The reason for this is that the properties of the mixture, especially permeation time, cannot be predicted by using data from the individual components of the mixture.

Protective clothing has been recommended for some materials on our web site.