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Safety First

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Gloves - Selection And Use

Choosing the appropriate hand protection can be a challenge in a laboratory setting. Considering the fact that dermatitis or inflammation of the skin accounts for 40-45% of all work-related diseases, selecting the right glove for the job is important.

Not only can many chemicals cause skin irritation or burns, but absorption through the skin can be a significant route of exposure to certain chemicals. Dimethyl sulfoxide (DMSO), nitrobenzene, and many solvents are examples of chemicals that can be readily absorbed through the skin into the bloodstream, where the chemical may cause harmful effects.

When Should Gloves Be Worn

Protective gloves should be worn when handling hazardous materials, chemicals of unknown toxicity, corrosive materials, rough or sharp-edged objects, and very hot or very cold materials. When handling chemicals in a laboratory, disposable latex, vinyl or nitrile examination gloves are usually appropriate for most circumstances. These gloves will offer protection from incidental splashes or contact.

When working with chemicals with high acute toxicity, working with corrosives in high concentrations, handling chemicals for extended periods of time or immersing all or part of a hand into a chemical, the appropriate glove material should be selected, based on chemical compatibility.

Selecting the Appropriate Glove Material

When selecting the appropriate glove, the following characteristics should be considered:

- degradation rating
- breakthrough time
- permeation rate

Degradation is the change in one or more of the physical properties of a glove caused by contact with a chemical. Degradation typically appears as hardening, stiffening, swelling, shrinking or cracking of the glove. Degradation ratings indicate how well a glove will hold up when exposed to a chemical. When looking at a chemical compatibility chart, degradation is usually reported as E (excellent), G (good), F (fair), P (poor), NR (not recommended) or NT (not tested).

Breakthrough time is the elapsed time between the initial contact of the test chemical on the surface of the glove and the analytical detection of the chemical on the inside of the glove.

Permeation rate is the rate at which the test chemical passes through the glove material once breakthrough has occurred and equilibrium is reached. Permeation involves absorption of the chemical on the surface of the glove, diffusion through the glove, and desorption of the chemical on the inside of the glove. Permeation rate is usually reported as E (excellent), G (good), F (fair), P (poor) or NR (not recommended). If chemical breakthrough does not occur, then permeation rate is not measured and is reported ND (none detected).

Manufacturers stress that permeation and degradation tests are done under laboratory test conditions, which can vary significantly from actual end-use conditions. Users may opt to conduct their own tests, particularly when working with highly toxic materials.

For mixtures, it is recommended that the glove material be selected based on the shortest breakthrough time.

The following table includes major glove types and their general uses. This list is not exhaustive.

Glove Material	General Uses
Butyl	Offers the highest resistance to permeation by most gases and water vapor. Especially suitable for use with esters and ketones.
Neoprene	Provides moderate abrasion resistance but good tensile strength and heat resistance. Compatible with many acids, caustics and oils.
Nitrile	Excellent general duty glove. Provides protection from a wide variety of solvents, oils, petroleum products and some corrosives. Excellent resistance to cuts, snags, punctures and abrasions.
PVC	Provides excellent abrasion resistance and protection from most fats, acids, and petroleum hydrocarbons.
PVA	Highly impermeable to gases. Excellent protection from aromatic and chlorinated solvents. Cannot be used in water or water-based solutions.

Viton	Exceptional resistance to chlorinated and aromatic solvents. Good resistance to cuts and abrasions.
Silver Shield	Resists a wide variety of toxic and hazardous chemicals. Provides the highest level of overall chemical resistance.
Natural rubber	Provides flexibility and resistance to a wide variety of acids, caustics, salts, detergents and alcohols.

Where to Find Compatibility Information

Most glove manufacturers have chemical compatibility charts available for their gloves. These charts may be found in laboratory safety supply catalogs such as Fisher Scientific and Lab Safety Supply. Best Gloves offers copies of their glove compatibility charts upon request. To obtain a copy, call them directly at 800-241-0323. Best Gloves also has a great deal of information available on their web site, including a downloadable glove selection program. Their homepage is located at: http://www.bestglove.com

Most material safety data sheets (MSDS) recommend the most protective glove material in their Protective Equipment section. There are MSDSs for many laboratory chemicals available on the web.

Other Considerations

There are several factors besides glove material to consider when selecting the appropriate glove. The amount of dexterity needed to perform a particular manipulation must be weighed against the glove material recommended for maximum chemical resistance. In some cases, particularly when working with delicate objects where fine dexterity is crucial, a bulky glove may actually be more of a hazard.

Where fine dexterity is needed, consider double gloving with a less compatible material, immediately removing and replacing the outer glove if there are any signs of contamination. In some cases, such as when wearing Silver Shield gloves, it may be possible to wear a tight-fitting glove over the loose glove to increase the amount of dexterity allowed.

Glove thickness, usually measured in mils or gauge, is another consideration. A 10-gauge glove is equivalent to 10 mils or 0.01 inches. Thinner, lighter gloves offer better touch sensitivity and flexibility, but may provide shorter breakthrough times. Generally, doubling the thickness of the glove quadruples the breakthrough time.

Glove length should be chosen based on the depth to which the arm will be immersed or where chemical splash is likely. Gloves longer than 14 inches provide extra protection against splash or immersion.

Glove size may also be important. One size does not fit all. Gloves which are too tight tend to cause fatigue, while gloves which are too loose will have loose finger ends which make work more difficult. The circumference of the hand, measured in inches, is roughly equivalent to the reported glove size. Glove color, cuff design, and lining should also be considered for some tasks.

Glove Inspection, Use and Care

All gloves should be inspected for signs of degradation or puncture before use. Test for pinholes by blowing or trapping air inside and rolling them out. Do not fill them with water, as this makes the gloves uncomfortable and may make it more difficult to detect a leak when wearing the glove.

Disposable gloves should be changed when there is any sign of contamination. Reusable gloves should be washed frequently if used for an extended period of time.

While wearing gloves, be careful not to handle anything but the materials involved in the procedure. Touching equipment, phones, wastebaskets or other surfaces may cause contamination. Be aware of touching the face, hair, and clothing as well.

Before removing them, wash the outside of the glove. To avoid accidental skin exposure, remove the first glove by grasping the cuff and peeling the glove off the hand so that the glove is inside out. Repeat this process with the second hand, touching the inside of the glove cuff, rather than the outside. Wash hands immediately with soap and water.

Follow the manufacturer’s instructions for washing and caring for reusable gloves.

Latex Gloves and Related Allergies

Allergic reactions to natural rubber latex have been increasing since 1987, when the Center for Disease Control recommended the use of universal precautions to protect against potentially infectious materials, bloodborne pathogens and HIV. Increased glove demand also resulted in higher levels of allergens due to changes in the manufacturing process. In addition to skin contact with the latex allergens, inhalation is another potential route of exposure. Latex proteins may be released into the air along with the powders used to lubricate the interior of the glove.

In June, 1997, the National Institute of Occupational Safety and Health (NIOSH) issued an alert Preventing Allergic Reactions to Latex in the Workplace publication number DHHS (NIOSH) 97-135). The full text of this publication is available at the NIOSH web site: http://www.cdc.gov/niosh/homepage.html

NIOSH studies indicate that 8-12% of healthcare workers regularly exposed to latex are sensitized, compared to 1-6% of the general population. Latex exposure symptoms include skin rash and inflammation, respiratory irritation, asthma and shock. The amount of exposure needed to sensitize an individual to natural rubber latex is not known, but when exposures are reduced, sensitization decreases.

NIOSH recommends the following actions to reduce exposure to latex:

If latex gloves must be used, choose reduced-protein, powder-free latex gloves.

Whenever possible, substitute another glove material.

Wash hands with mild soap and water after removing latex gloves.

Questions Every Laboratory Worker Should Be Able To Answer

Who is your Chemical Hygiene Officer?

Where is your Chemical Hygiene Plan?

To what chemicals are you exposed?

Where can copies of the Material Safety Data Sheets (MSDS) for those chemicals be obtained?

What are hazards associated with these chemicals?

How do you protect yourself from these hazards?

SPECIAL POINTS OF INTEREST:

- *Weekly chemical waste pickup for Walters Life Science Building: Wednesdays, from 1:00-2:00 pm. The waste room is located on the second floor, outside the hallway where compressed gas cylinders are stored.*
- *Weekly chemical waste pickup for Science and Engineering Research Facility: Wednesdays, from 2:00– 3:00 pm. Room # 207-B (on the loading dock)*
- *To schedule a safety seminar for your department or lab, call EH&S at 4-5084*

If you need a lab checkout, please schedule it several days in advance.

Prudent Practices for Laboratory Safety

The new culture of laboratory safety implements the priority of ``safety first" through a greatly increased emphasis on experiment planning, including habitual attention to risk assessment and consideration of hazards for oneself, one's fellow workers, and the public.

The key word ``prudence'' provides a middle pathway between the extremes of stultifying over regulation and a reckless rush to ``get the job done'' in the laboratory. A prudent attitude toward dealing with hazards in the laboratory is characterized by a determination to make every effort to be informed about risks and reduce them to a minimum while recognizing that the notion of ``zero risk'' in laboratory operations (or any other workplace) is an impossible ideal. However, an accident-free workplace can be approached by setting a goal of zero incidents and zero excuses. Continuous basic respect and care for the health and safety of laboratory workers and the greater society constitute the starting point.

Assume that all chemicals encountered in the laboratory are potentially toxic to some degree. Because the risk posed by a toxic chemical depends on the extent of exposure and the chemical's inherent toxicity, minimize exposure by avoiding skin contact and inhalation exposure through proper clothing and ventilation as habitual safe practice.

Treat any mixture of chemicals as potentially more toxic than its most toxic component. Treat all new compounds, or those of unknown toxicity, as though they could be acutely toxic in the short run and chronically toxic in the long run. Because typical reactions produce a variety of by-products that are often unidentified or unknown, reaction products should be assumed to be toxic during work-up. Even though the likelihood is small that any given unknown chemical is very toxic, and the potential dose is usually low, laboratory researchers and workers may be exposed to thousands of chemicals during a professional lifetime, and there is a reasonable probability of eventual dangerous accidental exposure to a toxic substance. A habit of minimizing exposure should be cultivated.

The flammability, corrosiveness, and explosibility of chemicals and their combinations must also be considered along with toxicity in evaluating hazards and planning how to deal with them. In addition, wise risk management requires taking into account the amount of material to be used in an experiment.

The American Chemical Society booklet ``Less Is Better'' (1993) emphasizes the safety and financial reasons for buying chemicals in small packages: reduced risk of breakage, reduced risk of exposure following an accident, reduced storage cost, reduced waste from decomposition during prolonged storage in partially empty bottles, and reduced disposal cost for small containers of unused material.

Some Chemicals That Are Not Compatible With Latex Gloves

This list is not exhaustive. Acetaldehyde, Acetic anhydride, Acetone, Acetonitrile, Acetophenone, Acetyl chloride, Acrolein, Acrylamide, Acrylic acid, Acrylonitrile, Allyamine, Allyl acrylate, Allyl alcohol, Allyl bromide, Allyl chloride, Ammonium hydroxide 30-70%, Aniline, Benlate, Benzaldehyde, Benzene, Benzonitile, Benzoyl chloride, Benzyl acetate, Benzyl alcohol, Benzyl chloride, Bisphenol A diglycidyl ether, Bromine, Bromoacetonitrile, Bromobenzene, Bromodichloromethane, 2-Bromoethanol, 1-Bromo-2-propanol, 3-Bromo-1-propanol, 1,3-Butadiene, *n*-Butanol, 2-Butanone peroxide, *n*-Butyl acetate, Butyl acrylate, *n*-Butylamine, *sec*-Butylamine, *tert*-Butylamine, *n*-Butyl chloride, Butyl glycol, Butyl glycol acetate, *tert*-Butyl methyl ether, *p*-*tert*-Butyltoluene, Butyraldehyde, Butyric acid, *beta*-Butyrol-actone, Caprylic acid, Carbon disulfide, Carbon tetrachloride, Carmustin, Chloroacetonitile, Chlorobenzene, 4-Chlorobenzotrifluoride, Chloroform, 3-Chloro-2-

methylpropene, 1-Chloronaphthalene, 2-Chloro-2-nitropropane, Chloroprene, 1-Chloro-2-propanol, 3-Chloro-1-propanol, *o*-Chlorotoluene, *p*-Chloro-toluene, Chlorotrimethylsilane, Chromic acid, Chromic acid 30-70%, Coal tar extract, *m*-Cresol, Cresols (isomeric mixtures), Crotonaldehyde, Cumene, Cumene hydroperoxide, Cyclohexamide, Cyclohexane, Cyclohexanol, Cyclohexanone, Cyclopentane, Diallyamine, Di-*n*-amylamine, Dibromochloromethane, Di-*n*-butylamine, Di-*n*-butyl phthalate, Dichloroacetyl chloride, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,2-Dichlorobenzene, 1,4-Dichloroethane, *cis*-1,2-Dichloroethylene, *trans*-1,2-Dichloroethylene, *cis*, *trans*-1,2-Dichloroethylene, 1,2-Dichloropropane, 2,3-Dichloro-1-propene, 1,3-Dichloropropene, Diesel fuel, Diethylamine, 2-(Diethylamino)ethanol, Diethyl benzene, Diethyl carbonate, Diethyldichlorosilane, Diethylenetriamine, Diisobutylamine, Diisobutyl ketone, Diisooctylphthalate, Diisopropylamine, Dimethoxane, Dimethylacetamide, Dimethylamine, 2-(Di-methyl-amino)ethanol, 3-(Dimethylamino)propylamine, 1,3-Dimethylbutylamine, Dimethyl ether, Dimethylformamide, 1,1-Di-methylhydrazine, 2,6-Dimethylmorpholine, Dimethyl sulfoxide, Dimethylvinyl chloride, 2,4-Dinitrotoluene, 1,3-Dioxane, 1,4-Dioxane, Di-*n*-propylamine, Divinyl benzene, Epibromohydrin, Epichlorohydrin, 1,2-Epoxybutane, Epoxytrichloropropane, Ethanol, Ethion 4,1-Ethoxy-2-propanol, Ethyl acetate, Ethyl acrylate, Ethylamine, Ethyl benzene, Ethyl bromide, Ethyl-*n*-butylamine, Ethylenediamine, Ethylene dibromide, Ethylene dichloride, Ethylene oxide, Ethyl ether, Ethyl glycol, Ethyl glycol acetate, 2-Ethyl-1-hexanol, Ethyl methacrylate, Ethyl parathion 30-70%, Formaldehyde, Freon 113 or TF, Freon TMC, Furan, Furfural, Fusilade 250EC, Gasoline 40-55% aromatics, Gasoline (unleaded), Halothane, Heptane, *n*-Hexane, Hexachlorocyclopentadiene, 1,1,1,3,3,3-Hexamethyldisiazane, 1,6-Hexanediamine, 1,6-Hexanediol diacrylate, Hydrogen fluoride, 4-Hydroxy-4-methyl-2-pentanone, 3,3'-Iminobis(propylamine), *beta*-Ionone, Isobutanol, Isobutyl acrylate, Isobutylamine, Isobutyraldehyde, Isooctane, Isopentyl acetate, Isopentylnitrite, Isophorone, Isoprene, Isopropanol, Isopropylamine, Isopropyl ether, Isopropyl methacrylate, Jet fuel <30% aromatics, Kerosene, *d,l*-Limonene, Mercaptoacetic acid, Methacrylic acid, Methacrylonitile, Methanol, 4-Methoxy-4-methyl-2-pentanone, Methyl acrylate, Methylamine (30-70%), Methyl chloride, Methylene bromide, Methylene chloride, N-Methyethanolamine, Methyl acetate, 3-Methylaminopropylamine, Methyl ethyl ketone, Methyl eugenol, Methyl glycol, Methyl glycol acetate, Methyl iodide, Methyl isobutyl ketone, Methyl isocyanate, Methyl methacrylate, Methyl parathion 30-70%, *alpha*-Methylstyrene, Morpholine, Naptha <3% aromatics, Naptha 15-20% aromatics, Naptha VMP <30% aromatics, Naphthalene, Nitric acid (red fuming), Nitric acid 30-70%, Nitrobenzene, Nitroethane, Nitrogen tetroxide, Nitromethane, 1-Nitropropane, 2-Nitropropane, N-Nitrosodimethylamine, 2-Nitrotoluene, *n*-Octane, *n*-Octanol, Oleic acid, Palmitic acid, Pentachlorophenol, *n*-Pentane, n-Pentanol, *n*-Pentyl acetate, *n*-Pentylamine, Perchloroethylene, Peroxyacetic acid, Petroleum ethers <1% aromatics, Phenol >70%, Phosphine, Phosphorus trichloride, Picric acid, *beta*-Picoline, Piperidine, Piperazine, Polychlorinated biphenyls, 1,3-Propanediamine, *n*-Propanol, *beta*-Propio-lactone, Propionaldehyde, Propionitile, Propyl acetate, 1,2-Propylene oxide, Propyl methacrylate, Pyridine, Shale oil, Silicon etch, Styrene, Sulfuric acid >70%, 1,1,1,2-Tetra-chloroethane, 1,1,2,2-Tetrachloroethane, Tetrahydrofuran, N,N,N',N'-Tetramethylethylene-diamine, Thiophene, Titanium tetrachloride, Toluene, Toluene-2,4-diisocyanate, Treflan EC, Triallyamine, Tribromomethane, Trichloroacetaldehyde, Trichloroacetonitrile, 1,2,4-Trichloro-benzene, 1,1,1-Trichloro-ethane, 1,1,2-Tri-chloroethane, Trichloroethylene, Tricresyl phosphate, Triethylamine, Triethylentetra-amine, Tri-*n*-propylamine, Turpentine, Valeronitrile, Vinyl acetate, Vinyl chloride, Vinylidene chloride, Vinylidene fluoride, Water, Witch hazel, Xylene

EMERGENCY NUMBERS

Environmental Health & Safety - 974-5084
UTIA Safety Officer - 974-1153
UT Police - 974-3114
Knox County Emergency - 911
Poison Control Center - 1-800-288-9999
Health Department / East Tennessee Regional Office - 546-9221
Food & Drug Administration - 545-4601
American Red Cross - 1-800-564-1234

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If a job or project cannot be done safely, it should not be done