UNIVERSITY OF NEBRASKA MEDICAL CENTER℠
ENVIRONMENTAL HEALTH AND SAFETY

SAFETY GUIDELINE
Hand Protection

Policy

The University of Nebraska Medical Center (UNMC) aims to minimize the risk of hand injuries to personnel. To accomplish this, appropriate hand protection must be worn whenever there is a risk of injury to the hand from severe cuts or lacerations, severe abrasions, punctures, chemical burns, thermal burns, exposure to extreme temperatures, or skin absorption of harmful substances.

Principal Investigators (PIs), department managers and supervisors are responsible for ensuring that each affected employee wears hand protection, and the selection of appropriate hand protection should be based on an evaluation of the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards and potential hazards identified.

Hazards to Consider

The proper use of hand protection can protect employees from chemical and physical hazards. Hand protection must be worn whenever potential hazards exist, including:

<u>Chemicals, Biologicals, Bloodborne Pathogens, and Radioactive Materials:</u> Exposure to these hazardous materials can pose adverse health effects. Proper hand protection must be worn when working with any of these materials. Some chemicals can penetrate gloves that offer adequate protection from other chemicals.

<u>Skin Absorption of Hazardous Substances:</u> Hazardous materials have the potential to enter the body through broken and intact skin. Numerous solvents can be absorbed through the skin, resulting in dry hands, itching, rashes, and swelling. Solvents that penetrate the skin and enter the bloodstream can cause damage to internal organs. Exposure to harmful dust, pesticides, insecticides, and fertilizers can cause skin irritation, dermatitis, and rashes.

Amputations: Hand amputation hazards in the workplace may include operating unguarded machinery, using damaged tools, improper use of hand tools, entanglement in moving parts, exposure to sharp edges on equipment, working with chemicals that can cause severe burns, and using improper hand protection when handling hazardous materials, among others.

Cuts and Lacerations: Several cut and laceration hazards exist in the workplace. These include hydraulic or hand-operated equipment, power saws and tools with rotating blades, box knives, hand saws, straps, and wires used to package boxes and bales, string trimmers and lawn mowing equipment, snow removal equipment, scalpel blades, dissection tools, and other similar items.

Abrasions: Several pieces of equipment used in the workplace can cause scrapes, skin tearing, and skin removal. This includes sanders, grinders, equipment with rotating belts and wheels, conveyor belts, belt and chain drives, cams, flywheels, spindles, rotating shafts, scrap metal, and broken glass, among other materials.

Punctures: Many tools and equipment can cause punctures in the workplace. This includes drill presses, nail guns, hand tools such as screwdrivers, needles, and other sharp objects used in clinical or laboratory settings, as well as slivers from metal and wood.

Pinches and Crushes: Many tools and equipment can cause pinches and crushes in the workplace. Machinery with unguarded moving parts (conveyors, belts, rollers, presses, etc.), power tools with pinch points, manual material handling, etc., can lead to severe injuries in the workplace, including broken bones, lacerations, and amputations.

Vibration, Grip, and Impact: Operating tools such as jackhammers, chainsaws, grinders, sanders, and other vibrating tools and equipment can pose hazards related to vibration, grip, and impact in the workplace. Repeated exposure to vibrations from tools and equipment can cause symptoms including numbness, tingling, pain, decreased grip strength, damage to nerves and blood vessels in the hands and fingers, and reduced dexterity and work capacity. It can ultimately lead to the development of Hand-Arm Vibration Syndrome.

Electrical Shock and Burns: Direct contact with live wires, exposed electrical components on damaged equipment, working in wet conditions, improper grounding, overloaded circuits, and the lack of appropriate insulated gloves can all lead to electrical shock or burns to the hands when touching energized parts.

Thermal Burns and Extreme Temperatures: Several workplace operations can present thermal burn hazards. This includes welding, cutting, brazing, and other hot work operations, as well as steam and boiler room operations, working around hot tanks and pipes, ovens, and food service operations, among others.

Cold, Frostbite, and Extreme Temperatures: Several workplace operations and environments pose cold and frostbite hazards. This includes outdoor work during frigid conditions, snow removal operations, working in refrigerated rooms and walk-in freezers, handling cold chemicals, liquid gases, and cryogenic materials such as dry ice and liquid nitrogen, as well as shipping, receiving, and warehouse operations under cold conditions.

Hand Protection Types

Disposable Gloves: Typically, very thin, they provide improved sensitivity and dexterity, making them ideal for single-use situations. These gloves tear and puncture easily and do not offer the same level of protection as chemical-resistant gloves. They are typically sufficient for incidental chemical contact but should not be used for direct chemical contact processes. They must be replaced in the event of contamination or if visible damage occurs.

Disposable gloves are available in various materials, including latex, nitrile, polyethylene, PVC, neoprene, vinyl, and others. The use of powdered latex gloves is prohibited at UNMC. Employees shall use powder-free non-latex gloves whenever possible. Powder-free, non-latex gloves must be provided to all employees who are sensitized or allergic to latex. Please reference the UNMC Prevention and Management of Latex Sensitivity Policy for additional information.

Coated Gloves: Gloves coated with nitrile and natural rubber. Often used as a substitute for leather gloves when dexterity is essential, such as working in wet environments. These gloves offer minimal protection from cuts, abrasions, and punctures.

Chemical Resistant Gloves: Gloves that protect against specific chemicals and liquids. These gloves are typically thicker than standard disposable gloves, providing minimal protection against abrasions, cuts, punctures, and snags. The appropriate glove material must be selected to protect against specific chemical hazards. The chemical Safety Data Sheet (SDS) should be reviewed to determine appropriate glove material. Refer to the glove manufacturer's chemical resistance guide if the SDS does not provide the necessary information.

Double Gloving: This practice is recommended when handling highly toxic or carcinogenic chemicals.

Reusable Gloves: Gloves designed for reuse in various situations, including general-purpose gloves, leather gloves, cut-resistant gloves, puncture-resistant gloves, and electrical gloves. These gloves are not typically suitable for chemical use as they eventually permeate the composition materials; however, they can be used safely for a limited time if specific use and glove characteristics are known.

General-Purpose Gloves: Gloves that protect against abrasions, cuts, punctures, and snags.

Leather Gloves: A versatile glove that offers comfort, durability, and dexterity. These gloves offer abrasion resistance and mild heat resistance.

Cut-Resistant Gloves: These gloves are available in various materials, including Kevlar, metal mesh, aluminized, and other cut-resistant materials, and are rated according to the level of force required to cut through them. When working with knives, glass, and other sharp tools and equipment, these gloves protect from cuts, scrapes, and scratches. This is extremely important, as broken skin is more susceptible to exposure to chemicals and hazardous materials. When chemical protection is required, in addition to cut protection, employees should wear cut-resistant gloves over their chemical-resistant gloves.

Puncture-Resistant Gloves: These gloves are available in various materials and are rated according to the force required to puncture them. They protect against punctures from glass, metal, needle sticks, and other sharp objects.

Anti-Vibration and Impact Gloves: These gloves are designed to protect against vibration and impact from tools and equipment. These gloves help prevent hand, finger, and arm fatigue.

Temperature-Resistant Gloves: These gloves are available in various materials, including leather, Kevlar, cotton, terrycloth, cryogenic gloves, welding gloves, rubber, Nomex, Zetex, and Flextra, and protect against extreme hot and cold temperatures. Some of these gloves may protect against hot or cold objects but not against hot or cold gases and liquids. They must be selected based on the type of heat or cold exposure source.

Insulated Gloves: These gloves should be used when working with extremely cold or hot temperatures. Various synthetic materials can be used briefly up to 1,000 degrees Fahrenheit. Insulated gloves constructed with asbestos should not be used.

Electrical Gloves: Rubber and leather insulating gloves, mittens, and sleeves are designed to protect from electrical hazards, including electrical shock, fire ignition, arc flash, and blast.

Selection of Hand Protection

OSHA is unaware of any gloves that protect against all potential hazards, and commonly available glove materials offer only limited protection against many chemicals. It is essential to select the most suitable glove for a particular application, determine its wear time, and assess whether it can be reused.

It is also essential to understand the performance characteristics of gloves and the specific hazards they may encounter, such as chemical, cut, or flame hazards. These performance characteristics should be assessed by using standard test procedures. Before purchasing gloves, request documentation from the manufacturer to confirm that the gloves meet the relevant test standards for the anticipated hazards.

Factors to consider for general glove selection include:

- If the performance characteristics are acceptable, in certain circumstances, it may be more cost-effective to use cheaper gloves and replace them regularly than to reuse more expensive types.
- The work activities of the employee should be assessed to determine the degree of dexterity and grip required, the duration, frequency, and degree of exposure to the hazard, the physical stresses that will be applied, the length of protection needed (hand, arm, forearm), and size and comfort requirements.

Additional factors to consider for electrical glove selection include:

- Electrical gloves shall be selected in accordance with the NFPA 70E Standard for Electrical Safety in the Workplace.
- They must be tested to the appropriate voltage, meeting the ASTM D120 Standard Specification for Rubber Insulating Gloves.

Additional factors to consider for chemical-resistant glove selection include:

- Chemical being handled.
- Concentration of the chemical.
- Temperature of chemical.
- Immersion or splash contact.
- The toxic properties of chemicals must be determined, in particular, the ability of the chemical to cause local effects on the skin and/or to penetrate the skin and cause systemic effects.
- The ability of the chemical to penetrate through the glove must be determined.
- <u>Breakthrough Time:</u> The time it takes for the chemical to pass to the inside of the glove.
- <u>Permeation:</u> If a chemical will pass through a glove material
- <u>Degradation:</u> The chemical's effect on the physical properties of the glove material upon contact, which can lead to permeation or breakthrough within the glove.
    - <u>Butyl:</u> Made of synthetic rubber, it protects against a wide variety of chemicals, including peroxides, rocket fuels, highly corrosive acids (such as nitric acid, sulfuric acid, hydrofluoric acid, and red-fuming nitric acid), strong bases, alcohols, aldehydes, ketones, esters, and nitro compounds. Butyl gloves also resist oxidation, ozone corrosion, and abrasion and remain flexible at low temperatures. Butyl rubber does not perform well with aliphatic and aromatic hydrocarbons or halogenated solvents.
    - <u>Latex and Natural Rubber:</u> Comfortable to wear, making them a popular, general-purpose glove. They feature outstanding tensile strength, elasticity, and temperature resistance. In addition to resisting abrasions caused by grinding and polishing, these gloves protect employees' hands from most water solutions of

acids, alkalis, salts, and ketones. The use of powdered latex gloves is prohibited at UNMC. Employees shall use powder-free non-latex gloves whenever possible. Powder-free, non-latex gloves shall be provided to all employees who are sensitive to or allergic to latex.
    - Neoprene: Made of synthetic rubber, it offers a range of protection against hydraulic fluids, gasoline, alcohols, organic acids, and alkalis. They generally have chemical and wear resistance properties superior to those made of natural rubber.
    - Nitrile: Made of a copolymer, it provides protection from chlorinated solvents such as trichloroethylene and perchloroethylene. Although intended for jobs requiring dexterity and sensitivity, nitrile gloves withstand heavy use even after prolonged exposure to substances that cause other gloves to deteriorate. They offer protection when working with oils, greases, acids, caustics, and alcohols but are generally not recommended for use with strong oxidizing agents, aromatic solvents, ketones, and acetates.
- For mixtures and formulated materials (unless specific test data is available), a glove should be selected based on the chemical component with the shortest breakthrough time since solvents can carry active ingredients through polymeric materials.
- Generally, chemical-resistant gloves are suitable for handling dry powders.
- Employees must be able to remove hand protection in a manner that prevents skin contamination. Please refer to the 'Removing Contaminated Gloves' section for additional guidance.

The chemical Safety Data Sheet (SDS) should be reviewed to determine appropriate glove material. If the information is not provided in the SDS, the glove manufacturer's chemical resistance guide should be referenced. Ansell Guardian Chemical provides databases which include:

- Advanced Chemical Product Selector
- Permeation and Degradation Database

The following table, provided by the U.S. Department of Energy's Occupational Safety and Health Technical Reference Manual, rates various glove protective qualities against specific chemicals. This table will help you select the appropriate hand protection when working with chemicals. Chemicals marked with an asterisk (*) are for limited service. The rating abbreviations are as follows:

- VG: Very Good
- G: Good
- F: Fair
- P: Poor (not recommended)

Chemical	Neoprene	Latex/Rubber	Butyl	Nitrile
Acetaldehyde*	VG	G	VG	G
Acetic acid	VG	VG	VG	VG
Acetone*	G	VG	VG	P

Ammonium hydroxide	VG	VG	VG	VG
Amyl acetate*	F	P	F	P
Aniline	G	F	F	P
Benzaldehyde*	F	F	G	G
Benzene*	P	P	P	F
Butyl acetate	G	F	F	P
Butyl alcohol	VG	VG	VG	VG
Carbon disulfide	F	F	F	F
Carbon tetrachloride*	F	P	P	G
Castor oil	F	P	F	VG
Chlorobenzene*	F	P	F	P
Chloroform*	G	P	P	F
Chloronaphthalene	F	P	F	F
Chromic acid (50%)	F	P	F	F
Citric acid (10%)	VG	VG	VG	VG
Cyclohexanol	G	F	G	VG
Dibutyl phthalate*	G	P	G	G
Diesel fuel	G	P	P	VG
Diisobutyl ketone	P	F	G	P
Dimethylformamide	F	F	G	G
Dioctyl phthalate	G	P	F	VG
Dioxane	VG	G	G	G
Epoxy resins, dry	VG	VG	VG	VG
Ethyl acetate*	G	F	G	F
Ethyl alcohol	VG	VG	VG	VG
Ethyl ether*	VG	G	VG	G
Ethylene dichloride*	F	P	F	P
Ethylene glycol	VG	VG	VG	VG
Formaldehyde	VG	VG	VG	VG
Formic acid	VG	VG	VG	VG
Freon 11	G	P	F	G
Freon 12	G	P	F	G
Freon 21	G	P	F	G
Freon 22	G	P	F	G
Furfural*	G	G	G	G
Gasoline, leaded	G	P	F	VG

Gasoline, unleaded	G	P	F	VG
Glycerin	VG	VG	VG	VG
Hexane	F	P	P	G
Hydrazine (65%)	F	G	G	G
Hydrochloric acid	VG	G	G	G
Hydrofluoric acid (48%)	VG	G	G	G
Hydrogen peroxide (30%)	G	G	G	G
Hydroquinone	G	G	G	F
Isooctane	F	P	P	VG
Kerosene	VG	F	F	VG
Ketones	G	VG	VG	P
Lacquer thinners	G	F	F	P
Lactic acid (85%)	VG	VG	VG	VG
Lauric acid (36%)	VG	F	VG	VG
Lineolic acid	VG	P	F	G
Linseed oil	VG	P	F	VG
Maleic acid	VG	VG	VG	VG
Methyl alcohol	VG	VG	VG	VG
Methylamine	F	F	G	G
Methyl bromide	G	F	G	F
Methyl chloride*	P	P	P	P
Methyl ethyl ketone*	G	G	VG	P
Methyl isobutyl ketone*	F	F	VG	P
Methyl methacrylate	G	G	VG	F
Monoethanolamine	VG	G	VG	VG
Morpholine	VG	VG	VG	G
Naphthalene	G	F	F	G
Napthas, aliphatic	VG	F	F	VG
Napthas, aromatic	G	P	P	G
Nitric acid*	G	F	F	F
Nitric acid, red and white fuming	P	P	P	P
Nitromethane (95.5%) *	F	P	F	F

Nitropropane (95.5%)	F	P	F	F
Octyl alcohol	VG	VG	VG	VG
Oleic acid	VG	F	G	VG
Oxalic acid	VG	VG	VG	VG
Palmitic acid	VG	VG	VG	VG
Perchloric acid (60%)	VG	F	G	G
Perchloroethylene	F	P	P	G
Petroleum distillates (naphtha)	G	P	P	VG
Phenol	VG	F	G	F
Phosphoric acid	VG	G	VG	VG
Potassium hydroxide	VG	VG	VG	VG
Propyl acetate	G	F	G	F
Propyl alcohol	VG	VG	VG	VG
Propyl alcohol (iso)	VG	VG	VG	VG
Sodium hydroxide	VG	VG	VG	VG
Styrene	P	P	P	F
Styrene (100%)	P	P	P	F
Sulfuric acid	G	G	G	G
Tannic acid (65)	VG	VG	VG	VG
Toluene*	F	P	P	F
Toluene diisocyanate (TDI)	F	G	G	F
Trichloroethylene*	F	F	P	G
Triethanolamine (85%)	VG	G	G	VG
Tung oil	VG	P	F	VG
Turpentine	G	F	F	VG
Xylene*	P	P	P	F

Removing Contaminated Hand Protection

Employees should avoid touching their face and exposed skin when wearing gloves or other hand protection. Hand protection must not be worn outside of the work area. Contaminated gloves should be removed immediately to avoid cross-contamination. Contaminated gloves can easily cross-contaminate surfaces such as door handles, phones, computers, light switches, and controls, exposing other employees to the hazard.

[Proper Removal of Contaminated Gloves Poster]

Comfort, Fit, Maintenance, and Storage

Always follow the manufacturer's instructions regarding use, cleaning, storage, and care of hand protection.

- Ensure the gloves selected fit the hands properly. Gloves that are too small will limit hand mobility and are prone to tearing. Gloves that are too big will limit dexterity.
- Ensure the selected gloves are the proper length required.
- Hands should be cleaned before putting on gloves to remove any dirt, grease, or other contaminants that could cause potential skin irritation while wearing the gloves.
- Inspect hand protection before use. Look for cuts, tears, punctures, abnormal stiffness, discoloration, and other signs of damage.
- Discard any defective or damaged hand protection.
- Reusable gloves should be stored in a dry and clean area.
- Reusable gloves saturated with moisture should be hung to dry.
- Reuseable gloves should be cleaned according to the manufacturer’s instructions.
- Reuseable gloves that are shared between employees must be cleaned or sanitized between use. If they cannot be cleaned or sanitized, disposal gloves will need to be worn as a liner under the reusable gloves.

Additional requirements for electrical gloves:

- It is essential to inspect electrical gloves for any signs of wear or damage, such as holes or tears.
- Electrically insulated gloves must be tested every 6 months to check the integrity of the gloves. If a pair of electrically insulated gloves has not been tested within the past 12 months, they should not be used and must be discarded.

Training and Issuance

Principal Investigators (PIs), department managers and supervisors are responsible for determining and providing the appropriate personal protective equipment (PPE) and training on the PPE required for processes being conducted. Employees are responsible for inspecting their protective equipment (PPE) before and after use, reporting any defects or damage to their supervisor, wearing PPE as instructed, and maintaining and storing it appropriately.

PPE training should be documented, and a copy of the training record should be available upon request. Please review the Personal Protective Equipment (PPE) Training & Issuance Record for additional information.

Additional Resources

OSHA 29 CFR 1910.138
OSHA 29 CFR 1910 Subpart I Appendix B
OSHA Personal Protective Equipment 3151-02R 2023