PPE Refresher—Checking out factors in glove selection

To protect against a chemical hazard, gloves must be impervious to the chemical, at least for some period of time. Resources are available to match gloves with a specific hazard and determine the appropriateness of use. In this exercise these resources will be used for an exposure scenario you may experience at work.

Objectives

When you have completed this exercise, you will be better able to:

- Use resources to identify appropriate level of protection by gloves

Overview

Hand protection is covered in OSHA standard 29CFR1910.138 Hand protection.

(a) General requirements. Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes.
(b) Selection. Employers shall base the selection of the appropriate hand protection 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.

Disposable gloves
Latex (l), latex free (r)

Nitrile gloves
photo from https://tools.niehs.nih.gov

Factors Considered in Selection

A hazard assessment including the factors shown in 1910.138(b) is conducted prior to the selection. Discussions with various vendors and use of electronic resources are used to identify the glove that will be protective for each situation, called an exposure scenario.

Many factors are considered in selection, including the following:

Chemical resistance: Different materials are resistant to different chemicals. The glove material is selected to provide protection against the chemicals likely to be encountered. Three terms are very important:

Penetration - When the chemical goes through imperfections in the material.

Degradation - When contact with chemical changes the physical properties of the glove.

Permeation - When the chemical goes into or through the glove material on a molecular level. The rate of permeation is dependent on six major factors:

- Contact time
- Material thickness
- Concentration
- Temperature
- Size of the contaminant molecules and pore space
- Physical state of chemicals

Permeation time will decrease if the material becomes abraded (scraped or worn away) during work.

Physical integrity: Every glove should be inspected prior to use to assure that there are no observable defects such as tears, holes, discoloration or cracks.

Resistance to temperature extremes: Heat and cold can adversely affect glove material. Cold temperatures could crack the material, so that it provides no protection. Heat may destroy the chemical resistance of clothing or even melt it.

Ability to be cleaned: If the intent is to reuse gloves, a program must be in place for cleaning, decontamination, inspection and storage.

Cost: Initial and ongoing costs of purchasing PPE can be important considerations for management. However, buying less expensive, inferior products which do not adequately protect employees for a single use can be more expensive in the long run due need to use multiple pairs of gloves during the task.

Flexibility: Materials need to be flexible enough for the wearer to work safely. Gloves which are too rigid may create gripping problems that may lead to other hazards.

Size: Gloves must be available in a variety of sizes to accommodate the hand sizes of the workers. Gloves that are too small will tear easily and provide no protection; gloves that are too large will make working difficult and can become caught in moving parts leading to injury.

Design: Gloves should be selected to accommodate all other PPE used at the same time, such as protective suits.

Example of a glove chart (https://www.osha.gov/Publications/osha3151.pdf)

Chemical - and Liquid - Resistant Gloves

Chemical-resistant gloves are made with different kinds of rubber: natural, butyl, neoprene, nitrile and fluorocarbon (viton); or various kinds of plastic: polyvinyl chloride (PVC), polyvinyl alcohol and polyethylene. These materials can be blended or laminated for 24better performance. As a general rule, the thicker the glove material, the greater the chemical resistance but thick gloves may impair grip and dexterity, having a negative impact on safety.

Some examples of chemical-resistant gloves include:

Butyl gloves are made of a synthetic rubber and protect against a wide variety of chemicals, such as peroxide, rocket fuels, highly corrosive acids (nitric acid, sulfuric acid, hydrofluoric acid and red-fuming nitric acid), strong bases, alcohols, aldehydes, ketones, esters and nitrocompounds. 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 and halogenated solvents.

Natural (latex) rubber gloves are comfortable to wear, which makes 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 workers' hands from most water solutions of acids, alkalis, salts and ketones. Latex gloves have caused allergic reactions in some individuals and may not be appropriate for all employees. Hypoallergenic gloves, glove liners and powderless gloves are possible alternatives for workers who are allergic to latex gloves.

Neoprene gloves are made of synthetic rubber and offer good pliability, finger dexterity, high density and tear resistance. They protect 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 gloves are made of a copolymer and provide protection from chlorinated solvents such as trichloroethylene and perchloroethylene. Although intended for jobs requiring dexterity and sensitivity, nitrile gloves stand up to 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.

The following table from the U.S. Department of Energy (Occupational Safety and Health Technical Reference Manual) rates various gloves as being protective against specific chemicals and will help you select the most appropriate gloves to protect your employees. The ratings are abbreviated as follows: VG: Very Good; G: Good; F: Fair; P: Poor (not recommended). Chemicals marked with an asterisk (*) are for limited service.

Table 4
Chemical Resistance Selection Chart for Protective Gloves

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
Amy 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

Exercise– Glove Protection

Working in groups, use resources to identify the protection of gloves for exposure scenarios provided or that you do at work. Complete the Worksheet provided by the Facilitator.

Closing

For the scenario you considered, did you:

- Use resources to identify protection of gloves for specific hazard(s)?

Based on this exercise, what takeaways do you have as you go back to work?

Please ask any remaining questions.