Selecting a Glove for Protection against Chemicals: Step 3 evaluating your job task needs

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If you have done your homework and you have identified two to three possible glove types, then the likely next step is to select the best choice for your specific job task or workplace application. Almost every workplace application is different and numerous factors must be taken into consideration before an appropriate selection can be made. Some of the factors that should be considered include:

- Glove integrity and barrier protection
- Chemical hazard
- Dexterity
- Puncture resistance
- Hand fatigue
- Comfort
- Allergy
- Manufacturing environment
- Cost

Glove integrity and barrier protection

Glove integrity is essentially a measure of holes that can pass fluids, such as blood or infectious agents. Holes can also pass chemicals, but the tests for glove integrity are primarily designed to test immediate penetration of water (or water containing a surrogate virus) through the glove material. All the same, liquid chemicals will more readily pass through holes in a material. If skin contact with the chemical is likely to result in immediate harm, then it will be critical to select a glove that provides a reliable barrier against penetration. There are several standardized tests that give an indication of freedom from holes.

Some of the common standardized tests for glove integrity are:

- ASTM D5151 Standard Test Method for Detection of Holes in Medical Gloves (http://www.astm.org/Standards/D5151.htm)
- U.S. FDA Patient examination gloves and surgeons' gloves; sample plans and test method for leakage defects; adulteration in Title 21 of the Code of Federal Regulations, Section 800.20 (http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=800.20)

- ASTM F1670 Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Synthetic Blood (http://www.astm.org/Standards/F1670.htm)
- ASTM F1671 Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration as a Test System (http://www.astm.org/Standards/F1671.htm)

With some of these standards an acceptable quality level (AQL) is used and/or reported, which can further aid in the selection process. For example, an AQL of 2.5 means that less than 2.5% of the gloves tested had holes that leaked water. In some cases, manufacturers will report more stringent AQLs around 1.5, which indicates a higher level of overall barrier protection. The lower the AQL the lower percentage of holes detected.

Therefore, if one needs an adequate barrier against chemical penetration, then selecting a glove that meets one or more of these above standards can be critical. Look for these standard test results on the manufacturer's brochure or technical data sheet. Sometimes the information is provided right on the box/bag.

Lastly, sometimes workers are exposed to both chemical and biological agents (e.g., blood). If this is the case then suitable barrier protection is a must. Here are some jobs that often require added glove integrity:

- Custodians in medical settings
- Dentists and dental assistants
- Emergency medical personnel
- Law enforcement and corrections officers
- Medical lab technicians
- Tattoo artists

Chemical hazard

We have already established the importance of chemical hazard as a major deciding factor; however, it is still important to evaluate the severity of the hazard against other factors associated with the workplace task or application. For example, use of a heavy duty glove for protection against mild irritation can have several drawbacks. The gloves will often be thicker and stiffer, which can affect dexterity and cause undue hand fatigue. A softer (more elastic) and thinner glove may suffice, especially if there is no real hand contact with the chemical. In contrast, protection against a corrosive chemical will likely require a more durable glove. In some cases, a much thicker chemical resistant glove (non-disposable) may be required.

It is best to look at the severity of the chemical hazard and make a determination as to how important chemical resistance and protection are in comparison to the other factors.

Dexterity

Many tasks require manual dexterity, which involves the ability to feel and manipulate small devices or tools. Some tasks require more dexterity than others. For example, a mechanic using a wrench to loosen an oil pan drain plug does not require as much dexterity as a nurse using a syringe to deliver a medication to a patient. Both are exposed to a chemical hazard, but the nurse will not be able to perform his/her task with a glove that interferes with dexterity.

Glove thickness and type can affect dexterity. Unfortunately, researchers are still evaluating which glove types provide optimal dexterity. Therefore, this is something that should be evaluated by the users. Going with a thinner glove will help, but it will be best to get some samples of the different glove types and test them out on the job to determine which ones perform the best. Just be cautious and make sure hazardous chemicals are not involved as part of the evaluation, as any interference with dexterity could result in an inadvertent spill or accident. Mock evaluations are always recommended.

Here are some jobs that often require manual dexterity:

- Dentists and dental assistants
- Emergency medical personnel
- Jewelers
- Lab technicians
- Law enforcement and corrections officers
- Manicurists and hair dressers
- Medical lab technicians and phlebotomists
- Medical personnel
- Pharmacists
- Tattoo artists

Puncture resistance

If there are hazards that can cause severe injury to the hands, then disposable gloves are not the best option. However, added puncture resistance may be desirable if the hazard is small or use of truly cut-

resistant or puncture-resistant gloves are just not feasible. Use of disposable gloves in these cases is often a compromise for the sake of practicality and manual dexterity.

Occupations where dexterity and puncture resistance are equally important include:

- Automotive mechanics
- Dentists and dental assistants
- Emergency medical personnel
- Lab technicians
- Law enforcement and corrections officers
- Maintenance personnel
- Manicurists and hair dressers
- Tattoo artists

Keep in mind that disposable gloves are not going to provide a lot of puncture or cut resistance. One common standardized test method that manufacturers may use to evaluate puncture resistance is ANSI/ISEA 105 (http://www.safetyequipment.org/c/std105-2011.cfm). The standard provides levels of performance that aid in the selection process. There are also tests for abrasion resistance and cut protection, but these may not be readily available for disposable gloves.

The more commonly marketed gloves providing added puncture resistance are thicker, heavy-duty or industrial nitrile gloves. They are often 8-mils in thickness compared to the common 3 to 5 mils with general duty nitrile gloves. Nitrile often provides more puncture resistance than latex.

Hand fatigue

Any time a person puts on a fitted elastic or plastic glove there will be some added resistance to hand movement that could lead to hand fatigue. Hand fatigue is more likely to occur when the user is required to manipulate small tools or devices, such as dental tools or syringes. The smaller the diameter the more force will be required to hold it. Now imagine how much extra force may be required when we put on a glove that restricts such movements.

If users complain of discomfort or hand pain, then hand fatigue is an obvious issue that should be addressed. But, we can also anticipate these types of issues if we know users are required to manipulate small tools or devices and if they are doing it for prolonged periods of time. The solution is often turning to a softer (more elastic) and thinner glove. The trade-offs on protection should be obvious, but workers in pain will either not wear the necessary hand protection or will not be very

productive. If hand fatigue is an issue, then be sure to get a variety of glove samples and have the users evaluate which ones reduce the discomfort and/or fatigue.

Here are some jobs that involve prolonged use of small devices or tools:

- Dentists and dental assistants
- Emergency medical personnel
- Jewelers
- Lab technicians
- Manicurists
- Medical lab technicians and phlebotomists

Comfort

If gloves are not comfortable and do not fit properly, then workers are less likely to use them. The thicker and stiffer the gloves are the more likely workers will find them uncomfortable. The longer a worker is required to wear gloves, the more likely they will experience discomfort. So, if the chemical hazard is minimal and puncture resistance is not a key issue, then going with a thinner, more elastic or softer glove may be the best option.

There may be other issues that affect user comfort, such as breathability and occlusion (trapping of sweat). Thicker and tighter fitting gloves are more likely to trap heat and sweat. In contrast, thinner, loose fitting gloves may feel more comfortable but may also affect dexterity, puncture resistance and chemical resistance. There is an obvious trade-off between comfort and level of protection we must be aware of.

The unfortunate reality is that any glove can cause comfort issues and workers may resent the choice you make on their behalf. Everyone likes to have some control over things that affect his/her comfort. This includes the thermostat setting, radio station playing in the background, and even the type of protective clothing they wear. Therefore, when it comes to comfort let the users test several options over a few weeks and make the final decision. Having some choice and control is better than none at all.

Allergy

Some people are allergic to proteins in natural rubber latex (referred to here as simply latex), while others may develop sensitivity to latex. The allergies range from mild dermatitis to a life threatening response.

With latex gloves, it has been found that the cornstarch powder (used to aid in donning gloves and to control moisture) can facilitate exposures to latex proteins. The skin can become exposed to the proteins, which would otherwise be trapped inside the polymer. Also, users can inhale the powder when it becomes airborne putting the gloves on. Thus, steps have been taken to reduce the removable protein amounts in latex glove products. One standard test for this used with gloves is:

> ASTM D5712 Standard Test Method for Analysis of Aqueous Extractable Protein in Natural Rubber and Its Products Using the Modified Lowry Method (http://www.astm.org/Standards/D5712.htm)

There is also a standardized test for powder-free gloves that is often used with latex gloves.

> ASTM D6124 Standard Test Method for Residual Powder on Medical Gloves (http://www.astm.org/Standards/D6124.htm)

The other option is to select a latex-free glove that will provide equivalent chemical protection. This may be necessary if an employee, client or patient has a latex allergy. Depending on the chemical hazard, the possible options include neoprene, nitrile or vinyl. If latex allergy is an issue and the decision is to go with a latex-free option, then it will be important to make sure the product states that it is in fact latex-free and contains no natural rubber latex. Gloves do not come packaged with ingredient lists and it is not safe to assume it is not in there because it is not mentioned.

Manufacturing environment

If gloves are being used mainly to protect a product against contamination, then use of a controlled environment or "cleanroom" glove will be the best option. These gloves are manufactured, cleaned, and packaged in a manner that will help ensure significant amounts of residues and oils will not be released from the glove surface during use. The major drawbacks are that they will be more expensive and the lack of oils, plasticizers or other softening agents can make them less elastic and more uncomfortable to wear. There are ways to manufacturer a more elastic glove by changing the properties of the polymer, but once again there will be a trade-off, as this will also change the chemical resistance properties of the polymer. It will be best to evaluate comfort separately after the critical protection issues are addressed.

Cost

Whether we like it or not, cost is almost always an issue and consideration. If it is not, then you are probably not working in a sustainable environment. Unlimited budgets and reckless spending are not sustainable practices. However, if cost is the only consideration when selecting a glove for worker protection then it is likely the workers will not be adequately protected. They may also suffer from additional issues such as hand fatigue or allergic reactions.

So what is the real goal when considering cost? Essentially, we want to select a glove that will meet our specific needs and not break the bank. If a comfortable, light-duty glove that will protect against mild irritants is all that is needed, then why pay two or three times more for a heavy-duty glove designed for emergency medical personnel. But, if puncture resistance, barrier protection and chemical resistance are all critical, then expect to pay a little more.

Ultimately, cost comes into consideration when we have choices, such as one brand over another. Once you have decided which type of glove works best for your application, then make an attempt to find two or more brands to choose from that meet your needs. In addition, many times the cost issue will be a matter of where you get the gloves from and how they are packaged. For example, buying a case of 2,000 gloves from a distributer will often cost less per glove than buying individual packages of 10, 50 or 100 gloves from a local hardware store. The shelf-life of many gloves, if properly stored, can be several years so buying gloves for the year should not be ruled out.

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