Attachment 3

CHEMICAL PROTECTIVE GLOVES AND CLOTHING SELECTION GUIDE

Gloves, lab coats, aprons, and other chemical protective clothing (CPC) are to be worn to protect the skin and prevent contamination on clothing, when exposed to hazards such as:

- Absorption of harmful chemicals,
- Chemical or thermal burns,
- Lacerations, abrasions, punctures,
- Harmful temperature extremes.

The degree of chemical protection afforded by a certain material is a function of:

- Chemical type you need protection against,
- The task length, and
- The level of activity.

Plus, the barrier effectiveness of CPC against a particular chemical is rated (and advertised) in terms of each chemical's:

- Permeation rate: the rate at which a known amount of chemical diffuses through a given area of clothing per unit time and can be detected on the inside surface.

- Breakthrough time: the time it takes for a given chemical to pass through a material from the start of contact on one side, to the detection of chemical on the other side. Units of breakthrough time are usually expressed in minutes or hours and a typical test takes up to 8 hours. If no measurable breakthrough is detected after 8 hours, the result might be reported as a breakthrough time of ">8 hours".

- Degradation (and loss of elasticity) potential of the material: rated in terms of a change in one or more physical properties after contact with the chemical: includes cracking, swelling, shrinking, stretching, and dissolving. It is a more subjective observation but factors into the recommendations of both manufacturers and independent raters. Note that a good degradation value does not mean the chemical will not permeate.

Compare the chemicals in use against published selection charts, such as:

- CPC manufacturers (check web sites) and suppliers (such as Fisher Scientific or Lab Safety Supply),
- *"Quick Selection Guide to Chemical Protective Clothing",* Forsberg & Mansdorf, available at the MSC/SIL, OSHEM, or through your safety coordinator
- NIOSH Recommendations for Chemical Protective Clothing: A Companion to the NIOSH Pocket Guide to Chemical Hazards

Consider all of the following factors in making your decision.

1. **Toxicity of the chemical**: For a highly toxic material, particularly one with high skin absorption rates, gloves may not even be an appropriate final control. Review the MSDS and other literature with your LSO and consult OSEM for guidance.

2. **Physical Requirements of the Work**: Remember, the most perfect glove is useless if easily cut, torn, or damaged. For highly physical work, double gloving is an alternative, or using dipped (multi-compound) or multilayered gloves. Consider the following:

   - Will tasks lead to puncture, abrasion, or tearing of the glove? (i.e., will palms or fingers need to be lined with abrasion-resistant material).
   - Will tactile sensitivity or extra grip be needed?
   - Will the weight of heavy gloves impair work or lead to fatigue and other related safety hazards? (may need to alter the task or institute more frequent breaks).
   - Will there be extreme temperature or humidity conditions ? (if so, check with manufacturer on what effect this may have such as brittling or faster breakthrough; permeation & breakthrough tests are done at a specified temperature).
   - Will the glove be used extensively outdoors? Will sunlight, ozone, UV degrade the product more quickly?
   - Is the glove material flammable? Or, flame resistant?

3. **Research published rating charts.** Scan safety catalogues for a wide variety of CPC manufacturers, then review each manufacturer's charts for your specific chemicals. Do not rely on charts that indicate the protective ability of a certain material against an entire class of chemicals, such as "acids". Reputable manufacturers will list at least permeation data. Call the manufacturer with questions and be comfortable that the product was tested under similar work and environmental conditions. Forsberg & Mansdorf recommends starting with a material that has at least a 4 hour breakthrough time, then looking at permeation rates.

4. **Chemical Mixtures.** Remember that no one clothing material will be a barrier to all chemicals; it may be more efficient to purchase different gloves for distinct purposes than to search for a "wonder" glove. In fact, the OSHA Standard recommends that for mixtures of chemicals, a glove should be selected on the basis of the chemical component with the shortest breakthrough time.

5. **Manufacturer Variability.** The chemical resistance of a certain material may vary widely from manufacturer to manufacturer, depending on construction methods, (and even from lot to lot for a given source). So check with a specific manufacturer on the match (i.e, not everyone's nitrile glove protects equally). Also, check with the manufacturer on specific storage or shelf-life requirements of its products.

6. **Material Thickness/Immersion Time.** Usually, the thicker the glove, the slower the permeation rate for a given chemical. Likewise, your potential exposure to a chemical increases if you are immersing your entire hand in a chemical as opposed to just handling a contaminated surface with fingertips. Once again, know your task.

   Thin, surgical-type gloves (latex, vinyl, nitrile are most common) are somewhat protective against incidental contact with certain chemicals and allow dexterity but may not be protective against full immersion or prolonged contact.

7. **"Persistent Permeation".** Note, also, that once a chemical has begun to diffuse into a plastic/rubber material, it will continue to diffuse toward the interior (a phenomenon known as "persistent permeation") even after the surface has been wiped clean with soap and water. The next workday, some absorbed chemical may reach the inside of the glove. This amount should be insignificant through a glove of highly resistant material. However, it may be a critical factor if purchasing gloves for highly toxic or carcinogenic materials (of which any amount inside a glove is undesirable) or highly viscous materials (which are difficult to remove).

8. **Consider quality construction of the CPC.** Clothing (lab coats, aprons, etc) are rated in same manner, with same standards. However, the swatch of material does not include seams. Seams are either stitched (which can leave holes) or welded with a welding/cementing tape over the stitching. The latter seam type is more expensive but offers the best splash protection. Quality gloves will have stitched seams overlaid with tape or sealed with a coating. For clothing, multiple layers of fabric overlap should be present to avoid penetration of chemical.

9. **A special note on latex gloves.** If using surgical-type barrier gloves for handling objects, they should be vinyl material, not latex. Latex gloves, particularly when powdered, can cause a mild-to-severe allergic reaction in sensitive individuals. The use of vinyl barrier gloves (disposed after use) is highly recommended when handling objects potentially contaminated with residual particulate preservatives and pesticides. If cotton gloves are desired for tactile reasons, they should be worn in addition to vinyl gloves for full dermal protection (cotton alone will act as a contaminant "wick" to the skin, especially if moistened by perspiration).