Chemical Resistance Guide for Gloves – Quick Tips

The Occupational Safety and Health Administration (OSHA) addresses the need for hand protection in 29 Code of Federal Regulations (CFR) 1910.138:

- 1910.138(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.”
- 1910.138(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.”

Employers must match the right glove with each application or task. The selection of proper gloves begins with a hazard assessment. The hazard assessment process helps identify the chemicals or combination of chemicals and their properties a task or job requires. This information is critical when selecting chemical resistant gloves.

Factors that influence chemical resistant glove selection include:

- Chemical(s) being handled
- Concentration of the chemical(s)
- Temperature of the chemical(s)
- Frequency and duration of contact with the chemical(s)
- Nature of contact – total immersion or splash only
- Length to be protected – hand, forearm, arm
- Dexterity required
- Grip requirements
- Size and comfort requirements

The key factor for determining what glove material is best suited for a given application is the chemical being used. A Safety Data Sheet (SDS) is the first and usually best place to find a suggestion for which glove material is appropriate. If that information is not on the SDS, then refer to the glove manufacturers' chemical resistance guides and select the glove with the best rating for the anticipated exposure.

The glove manufacturers' test data is generally from a laboratory environment and with one specific chemical. Glove manufacturers generally do not test chemical mixtures and don't consider other variables, such as hot or cold temperatures and cut hazards.

On these chemical resistance guides, you will find references to gloves made from many different materials. Different glove materials react differently to individual chemicals and the chemical compatibility of a given material can and does vary from glove manufacturer to glove manufacturer. Glove selection must be based on the given manufacturer's test data.

Gloves are generally tested and rated in three categories for chemical compatibility: **degradation, breakthrough time** and **permeation rate**. All three should be considered when selecting a glove.

Degradation is a change in physical properties of the glove material. Common effects include swelling, wrinkling, stiffness, change in color or other physical deterioration. The degradation ratings indicate how well a glove will hold up when working with a specific chemical. Degradation tests vary by manufacturer. There is no standardized test that is used by everyone in the industry. However, the glove material usually has constant exposure to the test chemical and the percent weight change is then determined at time intervals. Degradation is usually the first test conducted. Most manufacturers do not test permeation or breakthrough time if the chemical causes significant degradation to the glove material. Degradation alone can be enough to disqualify a glove for use with a chemical.

Breakthrough time is the elapsed time between initial contact of the chemical on one side of the glove material and the analytical detection of the chemical on the other side of the glove material. This test is conducted per the ASTM F739 Standard Test Method for Permeation of Liquids and Gases through Protective Clothing Materials under Conditions of Continuous Contact. The higher the result, the longer it takes for the chemical to pass through the glove material. The actual time reported on the chemical is usually listed on the resistance charts. If breakthrough did not occur, the data reported is typically None Detected (ND) or greater than (>) the indicated test period. The times generally reflect how long a glove can be expected to provide resistance when totally submerged in the test chemical.

Permeation rate is a measurement that describes the rate of the chemical passing through the glove material at the molecular level. This process is similar to how a balloon loses air after enough time passes even though it is still tied and has no visible holes. The thickness of the glove can greatly affect the permeation rate. Manufacturers report permeation rate in different ways. Some report in micrograms of chemical per square centimeter of glove material per minute ($\mu g/cm^2/min$). The higher the result, the more chemical passing through. Other manufacturers rate the permeation similar to that done for degradation: excellent (E), good (G), fair (F), poor (P) and not recommended (NR). If chemical breakthrough does not occur, permeation is not measured. This is reported as ND or not tested (NT) depending upon the manufacturer. This test is also conducted per ASTM F739.

See Quick Tips #191: Chemical-Resistant Gloves Guide for more information on selecting a chemical-resistant glove.

See Quick Tips #306: Safety Glove Size Chart for assistance with glove sizing.

Frequently Asked Questions

Q: If a glove is compatible with 50% Nitric Acid, can I assume it will work for 10% Nitric Acid?

A: No. You should never assume that different concentrations will have the same effect. In fact, Nitric Acid is more corrosive at 10% than it is at 50%. You should always check the SDS for chemical information and glove suggestions. It is also suggested that you perform your own tests before you use the glove in your application.

Q: Can I use test data from another glove manufacturer's selection chart if the manufacturer of a similar glove we use was not tested against the chemical in question?

A: No. It is not prudent to assume the test data from one glove manufacturer will correlate to another manufacturer's glove. Variables such as thickness, material properties and quality assurance of glove materials can affect the performance of the glove. Selecting another brand of gloves with the appropriate test data, checking the SDS or conducting your own controlled environment test, if test data is not available, are possible options to help identify a viable glove option.

Sources

MAPA® Professional
North® by Honeywell
Ansell Protective Products Inc.
SHOWA USA

Source: Grainger Know How – https://www.grainger.com/know-how