



Safe Operating Procedure

(Revised 10/25)

PERSONAL PROTECTIVE EQUIPMENT (PPE) - HAND PROTECTION

Introduction

This SOP provides information on the selection and use of protective gloves to protect the hands from injury. Special purpose gloves (e.g., firefighter gloves, welding gloves, arc flash protection) are beyond the scope of this SOP.

Hand Hazards

Hand protection is necessary when there is risk of:

- Contact with or absorption of harmful chemicals, microorganisms (such as bacteria, viruses, fungi, etc.) and/or their toxins, and radioactive materials.
- Contact with sharp objects or surfaces that could result in severe cuts or lacerations (e.g., knives, saws, barbed wired, etc.).
- Contact with rough surfaces or materials that can cause severe abrasions (scrapes), such as sand, concrete blocks, rocks, ropes, etc.
- Penetration by sharp objects, such as nails, splinters, needles/sharps, or even puncture wounds inflicted by animal bites.
- Exposure to temperature extremes, which could be associated with outdoor winter conditions, heated surfaces (pots, pans, etc.), or cooled surfaces (lab specimens stored at -80 degrees C., etc.).
- Exposure to temperature extremes associated with processes or products, for example, cryogenic materials (like dry ice, liquid nitrogen, etc.), and torching or welding operations.
- Exposure to severe and prolonged/repeated vibration, such as using a jackhammer, sander, chainsaw, compactor, etc.
- Potential contact with live electrical systems operating at greater than 50 Volts AC

(alternating current).

Numerous consensus standards by various organizations relate to protective gloves, including but not limited to those published by the National Fire Protection Association (NFPA), American National Standards Institute (ANSI), American Society for Testing Materials (ASTM), and International Standards Organization (ISO). Unlike eye/face, head, and foot protective devices, OSHA does not reference any particular standard for glove performance. This SOP highlights provisions of ANSI 105, Hand and Arm Protection Classification; however, the standard does not address all hand hazards.

Chemical Contact

Manufacturers of chemical-resistant gloves will typically provide data to describe a glove's chemical resistance in terms of degradation, breakthrough time, and permeation rate, as well as an overall indication of whether a particular glove is recommended for a particular chemical in consideration of the test data. This information is often based on tests conducted in accordance with ASTM Methods F739 and D471 and ANSI/ISEA 105. Glove manufacturers may choose to use European Standards.

- **Degradation** tests measure the reduction in one or more physical properties of a glove material due to contact with a chemical. Glove materials may become hard, stiff, brittle, or they may grow softer, weaker, and swell to several times their original size. If a chemical has a significant impact on the physical properties of a glove material, its permeation resistance is quickly impaired.
- **Permeation** measures passage of a chemical through the glove material on a molecular level (e.g., not through pin holes, seams, defects, etc.). Permeation is expressed in both breakthrough time and permeation rate. Breakthrough time, expressed in minutes, reflects the amount of time that it took for a chemical to pass completely through the glove material during testing. Permeation rate is an expression of how quickly the chemical passes through the glove material (e.g., does it trickle or pour through).

ANSI 105, Hand and Arm Protection Classification, provides the following classification schemes for chemical permeation and degradation.

Classification for Chemical Permeation	Classification for Degradation Resistance
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Level	Standard breakthrough time (minutes)	Level	Percentage change (%)
0	<10	0	> 80
1	>= 10	1	</= 80
2	>= 30	2	</= 60
3	>= 60	3	</= 40
4	>= 120	4	</= 20
5	>= 240		
6	>= 480		

When selecting a chemical-resistant glove, consult the Safety Data Sheet for the chemical of concern and review the chemical resistance data provided by the glove manufacturer. Consider the toxicity of the chemical and the circumstances of potential contact (e.g., incidental contact or extensive contact).

Also consider the tasks at hand and whether the glove should also be resistant to abrasion, tears, punctures, etc. These considerations will assist in determining the desired material(s) of construction (e.g., nitrile, butyl rubber, neoprene) and glove thickness. Thin exam-like gloves provide a low protection barrier but a high level of dexterity, while thicker gloves provide greater chemical resistance but less dexterity. For highly toxic materials that are absorbed through the skin, specialized gloves may be necessary even for protection against incidental contact only.

Cut, Puncture and Abrasion Resistance

ANSI/ISEA 105 establishes classification criteria for cut resistance, puncture resistance, and abrasion resistance, and standardized marking to communicate these classifications. An example of an ANSI/ISEA 105 marking is depicted in the image shown immediately below:

ANSI/ISEA 105



The top value is for cut resistance (A5 in the example shown); the value on the right (2 in this example) is for puncture resistance (except for hypodermic needle resistance); the value on the left is for abrasion resistance (3 in this example). If an “X” appears in any position, that means that the manufacturer is not making a claim for that particular performance attribute.

The tables below summarize classification criteria in ANSI/ISEA 105.

Cut Resistance		
Cut resistance testing measures how the material will resist cutting by a sharp edge		
Classification	Protect against	Example Applications
A1	Protect against scrapes	Material handling, small parts assembly (sharp edges), packaging, warehouse, general purpose, construction, pulp and paper, automotive assembly
A2		
A3		
A4	Protect against cuts for which stitches would be required	Appliance manufacturing, bottle and light glass handling, canning, drywall work, electrical, carpet installation, HVAC, pulp and paper, automotive assembly, metal fabrication and handling, packaging, warehouse, food/prep processing
A5		
A6	Protect against cuts for which stitched would be required	Metal stamping, metal recycling, automotive assembly, metal fabrication, glass manufacturing, HVAC, food prep/processing, meat processing
A7		
A8		
A9		
	Protect against brutal or extreme injuries	

Puncture Resistance (non-hypodermic needle)	
Puncture resistance testing measures how the material will resist puncture by a pointed object (other than a hypodermic needle, which has its own classification criteria)	
Classification	Example Applications
0	Paper/cardboard cuts, light material handling
1	Light construction, material handling, parts assembly
2	
3	Construction, light glass handling
4	Construction, glass handling, recycling, injection molding
5	Heavy construction, demolition, manufacturing

Abrasion Resistance	
Abrasion resistance testing measures how well the material will resist loss from rubbing on rough surfaces	
Classification	Relative Description
0	Minimal or no protection
1	Light
2	Light-medium
3	Medium
4	Medium-heavy
5	Heavy
6	Extra heavy

Heat and Flame Resistance

ANSI/ISEA 105 provides classification schemes for ignition resistance and burning behavior, heat degradation resistance, and conductive heat resistance.

- Ignition resistance and burning behavior testing measure how easily a material will ignite and if ignited how readily it will continue to burn once the flame is removed. The scale ranges from 0 to 4. A rating of “0” indicates that the material ignited within 3 seconds of exposure and continued to burn for more than 2 seconds after the flame was removed. A rating of “4” indicates that a material did not ignite when exposed to a flame

for at least 12 seconds.

- Heat degradation testing determines the exposure temperature at which a material is thermally stable. The scale ranges from 0 to 4. A rating of “0” indicates the material did not char, ignite, melt, etc. at temperatures of less than 100 C (212 F). A rating of 4 indicates the material did not char, ignite, melt, etc. at a temperature of 340 C (644 F).
- Conductive heat resistance testing measures the insulation provided when in contact with a hot surface. The scale ranges from 0 to 5. The scale is based on the temperature at which a second-degree burn could be sustained and considers time to pain. A rating of “0” indicates a test temperature of less than 80 C (176 F). A rating of “5” indicates a test temperature of up to 370 C (698 F).

Cold

Cryogen protective gloves are needed when working with liquefied gases. Most manufacturers use a European standard which incorporates a numerical rating scale that reflects the glove’s resistance to convective cold (on a scale of 1 to 4), followed by resistance to contact cold (on a scale of 1 to 4), and lastly permeability to water (where 0 means permeable to water; 1 means impermeable to water). The end result is a three-digit performance rating. Gloves with higher numerical ratings provide greater insulating capacity. Gloves for extreme weather conditions are not tested to any particular standard.

Anti-Vibration

Anti-vibration gloves, as their name states, are used for highly specialized tasks such as operating chainsaws, grinders, nail guns, sanders and other tools/machinery that produce high levels of vibration. These gloves provide extra padding to help prevent hand-arm vibration syndrome (HAVS) that occurs from repeated exposure to vibration. Anti-vibration gloves are rated with a pass/fail criteria, usually in accordance with applicable ANSI or similar international consensus standards.

Electric Shock

Electric hazard gloves are classified based on voltage. Class 00 rubber gloves are rated for a maximum voltage of 500V AC. Class 4 gloves are rated for a maximum of 36,000V AC. Tags on electric hazard gloves are color coded to facilitate identification. Tags on class 00 gloves are beige in color. In addition to “class” rating, electrical gloves are also divided into two types. Type I gloves are **not** resistant to ozone and UV light; Type II gloves are resistant to ozone and UV light. Electric shock gloves often must be supplemented with leather protectors rated as the appropriate arc flash rating.

General Purpose

Typically, general-purpose gloves are not tested to any standard. Examples of general-purpose gloves are gardening gloves, leather work gloves, driving gloves, mechanic's gloves, etc.

General Guidance on Proper Use

Regardless of the type of protective glove used:

- It is essential to select gloves suitable for potential hazards. In some cases, there may be more than one hazard. For example, it may be necessary to select a chemical resistant glove that also provides enhanced cut-resistance. In some cases, it may be necessary to layer different combinations of gloves to achieve the needed protection.
- Select gloves of an appropriate style (length, cuff/no cuff, etc.).
- A good fit is necessary to provide the most protection, dexterity, and comfort. Don't wear gloves that are too big or too small.
- Review and adhere to the manufacturer's use and maintenance instructions.
- Check the integrity of the glove prior to each use. Discard gloves that have degraded (such as cracking, brittle, swollen, delaminated, discolored, and so on), or become compromised through rips, tears, excessive abrasion, etc.
- Store gloves in a clean, well-ventilated area with low light intensity and free from exposure to ozone, high relative humidity, and/or contaminants that may degrade the gloves over time.
- Be aware that some people are prone to allergic reactions to latex gloves. Specially made low-allergen latex gloves or gloves of a substitute material, such as nitrile, are recommended.
- Almost all manufacturers of cut-resistant gloves **DO NOT** recommend their use when operating powered devices to avoid the risk of "pulling" a person into a point of operation of a machine. Gloves are typically tested for use with non-powered blades and sharps only

If Using Chemical Protective Gloves

- If the glove is intended to provide splash protection only and not intended to be a barrier

to significant contact with a chemical hazard, remove and replace when contaminated and before touching anything in or entering “clean” areas such as office, hall, elevator, etc.

- Do not re-use disposable gloves.
- Wash hands after removing gloves and particularly before eating and drinking.
- Review the Safety Data Sheet (SDS) of the chemical(s) of concern. Consider whether the chemical of concern is relatively toxic or non-toxic and whether it is efficiently or poorly absorbed through the skin. Know the signs and symptoms of exposure. These factors will all impact selection of the proper glove.
- Review the glove manufacturer’s data concerning degradation, penetration, and permeability with respect to the specific chemical(s) of concern. Recognize that degradation, penetration, and permeation data for individual compounds are likely not accurate for mixtures of compounds. This is of great concern when one component is particularly toxic or presents other serious health hazards. Layering two different types of gloves may help.
- Verify that the gloves you intend to use are appropriate to the exposure situation (e.g., vapor, splash, liquid splash, intermittent liquid contact, continuous liquid contact, relative toxicity, etc.), and functional requirements of the task (e.g., dexterity, mechanical durability, etc.).
- Ensure that hands are clean before donning gloves. If the hands are contaminated before gloves are put on, absorption of the chemical through the skin will be enhanced while the gloves are on. For this reason, wash hands after removing contaminated gloves and before donning clean gloves.