Personal Protective Equipment Selection Guide

THE UNIVERSITY OF UTAH
OCCUPATIONAL AND ENVIRONMENTAL HEALTH AND SAFETY

Selecting Personal Protective Equipment (PPE)

Note: PPE alone should not be relied on to provide protection against hazards, but should be used in conjunction with engineering controls (machine guards, noise dampening systems, etc.) and appropriate work practices (proper training, written standard operating procedures, etc.).

1. Familiarize yourself with the potential hazards in the area and the types of PPE that are available

2. Consider the hazards associated with the environment (impact velocities, masses, projectile shape, radiation intensities).

3. Select PPE that ensures a greater level of protection than the minimum required to protect workers from the hazards.

4. Fit the worker with the PPE and give instructions on its use and care. It is very important that workers be made aware of all warning labels for and limitations of their PPE.

Please note: This guide is not intended to provide an exhaustive and all-inclusive guide for the selection of personal protective equipment. Rather, it is intended to provide a basic guide to assist with basic PPE selection in your area. If you have questions that are not addressed or questions about the material in this guide please contact Occupational and Environmental Health and Safety by calling 801-581-6590.

Occupational Head Protection

Helmets designed to protect the head from impact and penetration from falling/flying objects and from limited electric shock and burn shall meet the requirements and specifications established in ANSI *Z89.1- 1986*, "Requirements for Industrial Head Protection". For more information contact OEHS.

Eye and Face Protection

Faculty, staff, students, contractors, and visitors shall wear the appropriate eye and face protection when involved in activities where there is the potential for eye and face injury from:

- Handling of hot solids, liquids, or molten metals
- Flying particles from chiseling, milling, sawing, turning, shaping, cutting, etc.
- Heat treatment, tempering, or kiln firing of any metal or other materials
- Intense light radiation from gas or electric arc welding, glassblowing, torch brazing, oxygen cutting, laser use, etc.
- Repair or servicing of any vehicle
- Handling of chemicals and gases

Eye protection choices include the following:

Safety Glasses

Ordinary prescription glasses do not provide adequate protection. Eye protection must conform to the American National Standards Institute (ANSI), Standard Z87.1-1989. Look for this stamp on the inside of the safety glass frame. Prescription safety glasses are recommended for employees who must routinely wear safety glasses in lieu of fitting safety glasses over their personal glasses. All safety glasses should have side shields. Whenever protection against splashing is a concern, "Chemical Splash Goggles" must be worn. See the Eye and Face Protection Selection Guide for further information.

Goggles

Use - Goggles are intended for use when protection is needed against chemicals or particles. Impact protection goggles which contain perforations on the sides of goggle are not to be used for chemical splash protection, therefore are not recommended. Splash goggles which contain shielded vents at the top of the goggle are appropriate for chemical splash protection, and also provide limited eye impact protection. Goggles only protect the eyes, offering no protection for the face and neck. See the Eye and Face Protection Selection Guide for further information.

Face Shields

Full-face shields provide the face and throat and partial protection from flying particles and liquid splash. For maximum protection against chemical splash, a full-face shield should be used in combination with chemical splash goggles. Face shields are appropriate as secondary protection when implosion (e.g vacuum applications) or explosion hazards are present. Face

shields which are contoured to protect the sides of the neck as well as frontal protection are preferred.

See the Eye and Face Protection Selection Guide below for further information.

Protective Device Descriptions

1. Spectacles
   *with sideshields
2. Goggles, non-vented
3. Goggles, indirect vented
4. Goggles, direct vented
5. Goggles, welding
6. Goggles, chipping
   *eyecup type, clear safety lenses
7. Faceshield
   *plastic or mesh, clear or reflective lens
8. Helmet, welding
   *stationary window or life-front window

APPLICATIONS				
	Source	**Assessment of Hazard**	**Protection**	**Protection Device Description #**
Impact	Chipping, grinding, machining, masonry work, woodworking, sawing, drilling, chiseling, powered fastening, riveting, and sanding	Flying fragments, objects, large chips, sand particles, dirt, etc.	Spectacles with side protection, goggles. For severe exposure use faceshield	1, 2, 3, 4, 6, 7
Heat	Furnace Operations, pouring, casting, hot dipping, and welding	Hot sparks	Faceshield goggles, spectacles with side protection. For severe exposure, use faceshield	1, 2, 3, 6, 7
		Splash from molten metals	Faceshieled worn over goggles	3, 7 for severe exposure
		High temperature exposure	Screen faceshield, reflective faceshield	7 for screen/ reflective shields
Chemical	Handling of acids and chemicals, degreasing plating	Splash	Goggles, eyecup, and cover types. For severe exposure use faceshield	2, 3, 7 for severe exposure
		Irritating mists	special-purpose goggles	2
Dust	Woodworking, buffing, general dusty conditions	Nuisance dust	Goggles, eyecup and cover types	2, 3, 6

APPLICATIONS				
	Source	**Assessment of Hazard**	**Protection**	**Protection Device Description #**
Light &/or Radiation	Welding: Electric arc	Optical radiation	Welding helmet or welding shield. Typical shades: 10-14	8
	Welding: Gas	Optical Radiation	Welding goggles or welding faceshield. Typical shades: gas welding, 4-8; cutting 3-6, brazing 3-4	5, 8
	Cutting, torch brazing, torch soldering	Optical radiation	Spectacles or welding faceshield. Typical shades:1, 5-3	1(filter lenses advisable), 5, 8
	Glare	Poor vision	Spectacles with shaded or special purpose lenses, as suitable	1

Eye Protection for Intense Light Sources

(Welding, glassblowing, gas welding, oxygen cutting, torch brazing, laser use, etc.)

The radiation produced by welding covers a broad range of the spectrum of light. Exposure to ultraviolet light (UV-B) from welding operations can cause "welders flash", a painful inflammation of the outer layer of the cornea. Arc welding or arc cutting operations, including submerged arc welding, require the use of welding helmets with an appropriate filter lens. Goggles with filter plates or tinted glass are available for glassblowing and other operations where intense light sources are encountered, including but not limited to, gas welding or oxygen cutting operations. Spectacles with suitable filter lenses may be appropriate for light gas welding operations, torch brazing, or inspection. See Filter Lenses chart for assistance in selecting appropriate shade selection. Users and visitors to Laser use areas (the laser nominal hazard zone) must be protected with suitable laser protection eye wear.

Filter Lenses for Protection against Radiant Energy

Operations	**Electrode Size 1/32 in.**	**Arc Current**	**Minimum* Protective Shade**
Shielded metal arc welding	Less than 3	Less than 60	7
	3-5	60-160	8
	5-8	160-250	10
	More than 8	250-550	11

Operations	Electrode Size 1/32 in.	Arc Current	Minimum* Protective Shade
Gas metal arc welding and flux cored arc welding		Less than 60	7
		60-160	10
		160-250	10
		250-500	10
Gas Tungsten arc welding		Less than 50	8
		50-150	8
		150-500	10
Air carbon	(light)	Less than 500	10
Arc cutting	(heavy)	500-1000	11
Plasma arc welding		Less than 20	6
		20-100	8
		100-400	10
		400-800	11
Plasma arc cutting	(light)**	Less than 300	8
	(medium)**	300-400	9
	(heavy)**	400-800	10
Torch brazing			3
Torch Soldering			2
Carbon arc welding			14

Filter Lenses for Protection against Radiant Energy

Operations	Plate thickness- in.	Plate thickness- mm	Minimum* Protective Shade
Gas Welding:			
Light	Under 1/8	Under 3.2	4
Medium	1/8 to 1/2	3.2 to 12.7	5
Heavy	Over 1/2	Over 12.7	6
Oxygen Cutting:			
Light	Under 1	Under 25	3
Medium	1 to 6	25 to 150	4
Heavy	Over 6	Over 150	5

* As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum. In oxyfuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.

** These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the workplace.

Hand Protection

Employees shall use hand protection when exposed to hazards including:

Skin absorption of harmful substances
Laceration
Abrasion
Puncture
Chemical burn
Thermal burn
Harmful temperature extremes

Wear proper hand protection whenever the potential for contact with chemicals, sharp objects, or very hot or cold materials exists. Select gloves based on the properties of the material in use, the degree of protection needed, and the nature of the work (direct contact necessary, dexterity needed, etc). Check the Hand Protection Reference Guide below to assist you in selecting proper gloves for your task.

Leather gloves may be used for protection against sharp edged objects, such as when picking up broken glassware or inserting glass tubes into stoppers.

When working at temperature extremes, use insulated gloves. Materials such as Nomex and Kevlar may be used briefly up to 1000 F. Do not use gloves containing asbestos.

When working with pyrophoric materials use flame resistant pilots gloves under a chemically protective glove appropriate for use with the chemical in question.

When considering chemical gloves, note that glove materials will be permeated (pass through) by chemicals. The permeation rate varies depending on the chemical, glove material, and thickness. Double gloving is recommended when handling highly toxic or carcinogenic materials. Before each use, inspect the gloves for discoloration, punctures and tears. Before removal, wash gloves if the glove material is impermeable to water. Observe any changes in glove color and texture, including hardening or softening, which may be indications of glove degradation**.**

Disclaimer

The material in this section is intended to provide an overview of the chemical protective glove categories. When selecting a glove, the user must consider that the chemical resistance of a

given glove material can vary from one manufacturer to another based on the material thickness. Glove material must be selected based on the manufacturer's chemical resistance data (glove selection/compatibility chart).

HAZARD	TYPE OF GLOVE
Light Duty	Cotton, Leather or Kevlar (moving boxes etc)
Medium Duty	Leather or Kevlar (wood, small pieces of roughed glass, etc)
Heavy Duty	Kevlar (exposure to sharp or jagged metal, glass, box cutters, etc)
High Temperature	Insulating Gloves
Low Temperature	Insulating Gloves
Cryogenics	Cryogenic Gloves (must extend above wrist and not have elastic)
Electrical	Use appropriate PPE for high voltage maintenance prescribed through your electrical safety training. See Electrical Protection.
Chemical	Choose the appropriate number from the matrix below for your hazard/frequency condition. The corresponding recommendations to the matrix numbers are listed below the chart. Then, consult the Chemical Protective Glove Selection Guide below.

Chemical Hazard Class	Frequency of Use		
	No Use	Periodic Use	Routine Use
Low hazard chemicals	1	1	1
Moderate hazard chemicals	2	2	3
High hazard chemicals	3	3	4

1. Use glove which provides dexterity (choice of material is not important)
2. Use glove which provides dexterity needed (consider permeation and degradation rating of glove against chemical). Gloves rated "r" are minimally acceptable
3. Use glove effectiveness against chemical as primary consideration. Gloves which are rated as R for 8 hours are minimally acceptable.
4. Use glove effectiveness against chemical as primary consideration. Gloves which are rated as RR for 8 hours are minimally acceptable. Seek methods to reduce chemical contact time with glove. ***Never immerse gloves in chemical baths - Gloves should be used to provide splash protection only, to the greatest extent possible. See chemical Protective Glove Selection Guide below.***

CHEMICAL PROTECTIVE GLOVE SELECTION GUIDE
RECOMMENDATION KEY

Letters R & N
The letter R represents good chemical resistance, while the letter N represents poor chemical resistance.

Letter Case
Upper case letters indicate consensus and a relatively large amount of information and lower case denote a relatively small amount of information or inconsistencies.

Number of Letters
Double characters indicate test data in support of the recommendation. Single letters show no test data in support of the recommendation.

	PROTECTIVE MATERIAL										
CHEMICAL HAZARD	**Butyl**	**CPE**	**Viton/ Neo-prene**	**Natural Rubber**	**Neo-prene**	**Neo-prene + PVC**	**Nitrile**	**PE**	**PVC**	**Viton**	**Butyl/ Neo-prene**
Acetaldehyde	RR	NN		NN	NN	NN	NN	NN	NN	NN	
Acetic Acid	R	RR		nn	RR	nn	RR	nn	NN	RR	
Acetic Anhydride	RR	RR		NN	nn				NN	n	
Acetone	RR	NN		NN	NN	nn	NN	NN	NN	NN	
Acetonitrile	RR	RR	nn	NN	NN		NN	NN	NN	RR	RR
Acrylic Acid	r								n		
Acrylonitrile	n	nn		N	r	n	n	NN	N	n	
Ammonium Hydroxide	R	r		RR	RR	NN	RR	NN	NN	r	
Amyl Alcohol	RR		r	NN	RR	NN	nn	nn	NN	RR	r
Aniline/Benzamine	RR	r	RR	NN	NN	NN	nn	NN	NN	NN	RR
Benzaldehyde	RR	n	n	nn	nn	n	nn	NN	N	RR	r
Benzene	NN	nn	RR	NN	NN	NN	NN	NN	NN	nn	RR
Benzoyl Chloride	RR	n	r		nn				NN	nn	n
Butanol/Butyl Alcohol	R	r		nn	RR	nn	RR	RR	nn	r	

	PROTECTIVE MATERIAL										
CHEMICAL HAZARD	**Butyl**	**CPE**	**Viton/ Neo-prene**	**Natural Rubber**	**Neo-prene**	**Neo-prene + PVC**	**Nitrile**	**PE**	**PVC**	**Viton**	**Butyl/ Neo-prene**
Butoxyethanol (EGBE)			r				NN		RR		n
Butyraldehyde	nn		n	R	nn	r	r		R	nn	r
Carbon Disulfide	NN	NN		N	N	n	NN	NN	N	RR	
Carbon Tetrachloride	N	nn	r	NN	NN	NN	N	NN	NN	RR	n
Chloroacetone	r		n	n	R	n			N		r
Chloroform	N	NN	r	NN	NN	n	NN	NN	NN	RR	n
Chromic Acid	n	r		NN	N	RR	N	RR	RR	r	
Cumene		RR	r								n
Cyclohexane	RR	n	n				nn		n	nn	n
Cyclohexanol	n	r	r	NN	NN	nn	RR	RR	RR	RR	r
Cyclohexanone	RR	n	n				nn		n	nn	n
Dibenzyl Ether	r		n	N	R	r	r		R		r
Dichlorobenzene	n	nn							n		
Diethanolamine	RR			n	RR	n	nn		r	RR	
Diethylamine	Silver Shield Glove = RR										
Dimethyl Formamide (DMF)	RR			nn	NN	n	NN	nn	N	NN	
Dimethyl Sulfoxide (DMSO)		RR		RR	RR	RR	nn	RR	NN		
Dioctyl Phthalate (DOP)				n	r	nn		NN	nn		
Dioxane	RR	r		NN	NN	n	NN	NN	NN	NN	
Epichlorohydrin	RR	n		NN	nn		nn	NN	NN	nn	nn

	PROTECTIVE MATERIAL										
CHEMICAL HAZARD	**Butyl**	**CPE**	**Viton/ Neo-prene**	**Natural Rubber**	**Neo-prene**	**Neo-prene + PVC**	**Nitrile**	**PE**	**PVC**	**Viton**	**Butyl/ Neo-prene**
Ethanolamine	RR	r	n	RR	RR	RR	RR	RR	RR	n	n
Ethoxyethanol (EGEE)	RR		r	NN	NN		NN		NN		n
Ethyl Acetate	RR	nn	n	NN	NN	nn	NN	NN	nn	n	n
Ethyl Ether	Polyvinyl Alcohol (Cannot be use in processes involving water)										
Ethylene Dichloride	nn	nn	r	NN	NN	n	NN	NN	NN	RR	n
Ethylene Oxide Gas	r	r			n		NN		n	n	
Ethylene Glycol	R	r	r	RR	RR	RR	RR	RR	nn	r	r
Formaldehyde	RR	RR	r	NN	NN	nn	NN	RR	NN	RR	r

Foot Protection

Safety toe footwear shall conform to the requirements and specifications of ANSI Z41.1- 1991, "Men's Safety-Toe Footwear."

Wear proper shoes, not sandals or open toed shoes, in work areas where chemicals are used or stored. Perforated shoes, sandals or cloth sneakers should not be worn in areas where mechanical work is being done.

Safety shoes are required for protection against injury from heavy falling objects (handling of objects weighing more than fifteen pounds which, if dropped, would likely result in a foot injury), against crushing by rolling objects (warehouse, loading docks, etc), and against laceration or penetration by sharp objects.

Pullovers, worn over regular shoes, are available for protection against certain chemicals. These boots are made of a stretchable rubber compound and are well suited for cleaning up chemical spills.

Body Protection

Employees working around hazard materials or machinery shall not wear loose clothing (e.g. saris, dangling neckties, necklaces) or unrestrained long hair. Loose clothing, jewelry, and

unrestrained long hair can become ensnared in moving parts of machinery or contact chemicals. Finger rings can be caught in machinery, damage gloves and trap chemicals against the skin.

Cotton lab coats (preferable to rayon or polyester coats) should be worn to protect your clothing from becoming soiled and to provide limited protection against minor splashes of chemicals and radioactive materials. Assure that hazardous chemicals, radioactive materials, or toxic dusts are not carried home with you on your street clothes by using lab coats, disposable protective clothing, or work clothes which remain at the workplace. Tyvek coveralls can be used over street clothes for protection against particles and low hazard liquids, but do not provide complete protection against liquids. Lab coats will also not resist liquid penetration, and if splashed with chemicals, should be removed immediately.

Vinyl or rubber aprons and sleeves should be used when dispensing corrosive liquids (e.g. hydrofluoric acid, phenol, etc). Where certain metals, organic liquids, or other materials which may self ignite on contact with air are used, Nomex lab coats are recommended, along with face shields. Where contact with hazardous materials with your protective clothing is likely, such as during spill cleanup or pesticide application, polyethylene- coated Tyvek or similar clothing should be used to provide additional protection. The limitations of the protective clothing must always be understood, particularly in situations where contact with the material is likely.

Employees should know the appropriate techniques for removing protective apparel, especially any that has become contaminated. Special procedures may need to be followed for cleaning and/or discarding contaminated apparel. Chemical spills on leather clothing accessories (watchbands, shoes, belts and such) can be especially hazardous because many chemicals can be absorbed in the leather and then held close to the skin for long periods. Such items must be removed promptly and typically be discarded to prevent the possibility of chemical burns.

Respiratory Protection

Respirators may not be used without prior approval from Occupational and Environmental Health and Safety. This assures that respirators are properly selected, users are properly trained, and the appropriate medical exams are conducted according to OSHA regulations. Please contact OEHS at 801-581-6590 if you feel that respiratory protection is needed in your area.

Hearing Protection

Exposure to noise in excess of OSHA regulated levels requires participation in a hearing conservation program. This program includes training and audiometric exams, among other requirements. Please contact OEHS at 801-581-6590 if you feel your noise exposure may be excessive.

Electrical Protection

Specific design and performance, use, and care requirements apply to protective equipment used for isolation against electrical hazards. Persons selecting for purchase, maintaining, and using such equipment (insulating blankets, matting, covers, line hose, gloves, and sleeves made of rubber) must be familiar with these requirements (refer to 29 CFR 1910.137). Please contact OEHS for assistance in selecting appropriate PPE for electrical protection.