

PPE SELECTION GUIDELINES AND QUICK REFERENCE GUIDE

PURPOSE

This supplement has been developed to assist in the appropriate selection of Personal Protective Equipment (PPE) for protection from those hazards determined from conducting a PPE Hazard Assessment of a work area or process. The protective device should be selected to fit the job, and the employee should become acquainted with the limitations of the device.

EYE PROTECTION

GENERAL

Suitable safety eyewear shall be provided and used where machinery, equipment, or operations present the hazards of flying objects, impact, liquids, chemicals, injurious energies (laser, glare, radiation, etc.), intense heat/cold, or a combination of these hazards. Care should be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Certain operations require face protection in addition to eye protection and unless specifically designed for such uses, face shields are not to be worn in lieu of safety eyewear. The selection, use, and maintenance of safety eyewear shall be in accordance with ANSI Z87.1-2003 *Occupational and Educational Personal Eye and Face Protection Devices*, or equivalent.

It is essential that eye and face protectors be kept clean. They shall be cleaned and inspected daily. Pitted or scratched lenses or face shields reduce vision and seriously reduce protection. Accordingly, lenses and face shields shall be replaced when they are pitted or scratched to such a degree that vision is obscured.

- ***Safety Glasses***

Safety glasses shall meet the impact requirements of ANSI Z87.1 or equivalent. Lenses and frames shall be marked with the manufacturer's symbol to indicate compliance with ANSI Z87.1. The use of approved lenses in unapproved frames is not acceptable. Tinted lenses in safety glasses for minimizing solar glare are permissible only when used outdoors during daylight hours. Prescription safety glasses can be worn by personnel whose vision requires the use of corrective lenses.

- ***Side Shields***

Side shields are required on safety glasses worn in eye-hazard areas and operations, unless it has been specifically determined for a particular operation that it is not possible for injurious objects or energies to enter the wearer's eyes from the side or that the reduced peripheral vision would pose a greater hazard to the employee. Side shields shall not be easily

detachable from the frames; snap-on or slip-on types of side shields are not acceptable unless secure.

- ***Goggles***

Goggles or eyecups shall be worn to protect against dust particles, liquids, splashes, mists, spray, and injurious radiation. They shall be designed to protect the eye sockets and the facial area around the eyes, thus protecting the wearer from side exposure. They can be worn over corrective eye glasses if they do not disturb the adjustment of the glasses, or corrective lenses can be incorporated into the goggle by mounting behind the protective lens.

- ***Laser Protection***

Eye protection for laser operations must be in compliance with ANSI Z136.1-2007 *Safe Use of Lasers*, or equivalent. For details on laser eye protection see the Duke Policy on Laser Safety at http://www.safety.duke.edu/sites/default/files/laser_policy.pdf.

- ***Welding Shades***

Shades in the form of spectacles, goggles, hand-held shields, or helmets are necessary when you are welding, brazing or torch-cutting, or when such work is being performed near you. Hazard assessment for the operation will determine the appropriate shade value. Filter lenses must meet the requirements for shade designations in OSHA 1910.133(a) (5) and be identified as such. Additional information on welding shades, their selection, and additional PPE can be found at <https://www.safety.duke.edu/occupational-hygiene-safety/personal-protective-equipment>.

HEAD, NECK, AND FACE PROTECTION

GENERAL

Head, neck and face protection must be worn when employees are exposed to working environments where they might be struck on the head, strike their head against an overhead hazard, entangle their hair or be exposed to flying debris (e.g., chips, particles, sand, molten metal, etc.), or to chemical splashing, high voltage, electric shock or a combination of these hazards.

- ***Face Shields***

Face shields shall be worn to protect the face and front of the neck from flying particles and sprays or splashes of hazardous liquids.

- ***Hard Hats***

Hard hats shall be constructed, selected, used, and maintained in accordance with ANSI/ISEA Z89.1-2009 *Industrial Head Protection*. Be certain that hard hats provided are not bump caps, make the selection based on the ANSI descriptions of Protective Helmets, and ensure that the helmet is marked with certification (manufacturer's name, the legend "ANSI Z89.1" and the class designation of G, E, or C).

Class G (General) Helmets are designed to decrease the impact of falling objects and to lessen the risk of being exposed to low-voltage electrical conductors. Helmets are tested at 2200 volts of electrical charge in order to be certified.

Class E (Electrical) Helmets are also intended to decrease the impact of falling objects, but these helmets reduce the risk of coming into contact with High-voltage electrical conductors. They are tested at 20,000 volts of electrical charge in order to receive certification.

Class C (Conductive) Helmets also reduce the force of impact of falling objects, but do not protect against electrical contact.

- ***Hair Protection***

Long hair, including long facial hair, which is susceptible to becoming entangled in moving machinery or drawn into such machinery by the generation of static electricity, shall be controlled by caps or hair nets.

- ***Welding Helmets***

Welding helmets are designed to protect the welder from particles of hot metal and their eyes from arc radiation. Hand held shields are available for those standing nearby and observing. When selecting a helmet, be sure the helmet packaging and product advertises either “ANSI Z87.1-2003” or “Z87+.”

FOOT PROTECTION

GENERAL

Unless otherwise noted, the term shoe as used herein includes boots. Protective footwear should be worn in areas where there is a danger of foot injuries due to falling, rolling, or puncture from objects; slips, trips and falls from slippery or wet surfaces; and exposure to electrical or chemical hazards. Protective footwear (other than slip-resistant footwear and overshoes) must comply with ASTM F2413-05 *Standard Specification for Performance Requirements for Foot Protection*. Protective footwear must first meet the requirements for impact and compression resistance before being ASTM certified. Requirements for additional protection can then be met and would fall under the following categories:

PROTECTIVE FOOTWEAR

- ***Metatarsal (Mt)***

The purpose of metatarsal footwear is to prevent or reduce the severity of injury to the metatarsal and toe areas. Metatarsal protection should be an integral and permanent part of the footwear that covers the instep. Add-on devices are acceptable as long as they provide protection equivalent to ASTM performance standards.

- ***Dielectric Insulation (DI)***
DI footwear provides additional insulation if accidental contact is made with energized electrical conductors, apparatus or circuits and must meet the minimum insulation performance requirements of ASTM F1117-03 (2008) *Standard Specification for Dielectric Footwear* and tested with the ASTM F1116-03 (2008) *Standard Test Method for Determining Dielectric Strength of Dielectric Footwear*.
- ***Electrical Shock Resistant (EH)***
Footwear designed to reduce the hazards due to the contact of the sole with electrically energized parts and to provide secondary electrical hazard protection on substantially insulated surfaces. The soles of electrical hazard footwear are non-conductive and must be capable of withstanding the application of 14,000 volts at 60 hertz for one minute with no current flow or leakage current in excess of 3.0 milliamperes, under dry conditions.
- ***Conductive Footwear (Cd)***
Footwear designed to discharge static electricity from your body through your shoes into grounded floors. Floors must be grounded so that a charge can be dissipated. Conductive footwear is designed and manufactured to minimize static electricity and to reduce the possibility of ignition of volatile chemicals, explosives, or explosive dusts. The electrical resistance must range between zero and 500,000 ohms.
Warning – Conductive footwear may NOT be worn near open electrical circuits or highly charged objects of any kind that require Electrical Hazard (NON-conductive) footwear.
- ***Static Dissipative (SD)***
This type of footwear is designed to reduce the accumulation of excess static electricity by conducting body charge to ground, while maintaining a high enough level of electrical resistance to reduce the possibility of electric shock. The footwear must have electrical resistance between 10^6 ohms and 10^8 ohms.
- ***Chain Saw Cut Resistant (CS)***
This footwear is designed to protect the foot area between the toe and lower leg when operating a chain saw and must meet the ASTM F1818-04 *Standard Specification for Foot Protection for Chainsaw Users*.
- ***Puncture Resistant (PR)***
A puncture resistant device located in the shoe sole reduces the possibility of puncture wounds to the soles of the feet by objects that could penetrate the outsoles of the footwear.

ADDITIONAL SAFETY FOOTWEAR

- ***Slip Resistant***
Shoes with tread composition and tread pattern designed to give better traction than standard shoes on slippery surfaces shall be worn to prevent slips and falls in wet environments.

- ***Overshoes***

Rubber or neoprene overshoes are designed to protect against splashing liquids or chemicals.

HAND PROTECTION

GENERAL

Suitable hand and lower arm protection shall be provided and used where machinery, equipment or operations present the hazards of mechanical injury, extreme heat or cold exposure, chemical exposure, blood and body fluids (BBF), hazardous drugs, radiation, electrical shock, vibration, or a combination of these hazards. Online glove selection guides can be accessed at:

<https://www.safety.duke.edu/occupational-hygiene-safety/personal-protective-equipment>.

GLOVES

- ***Thermal Gloves***

A variety of gloves are designed to protect workers' hands and arms from the extremes of hot or cold when working with autoclaves, cryogenics, kitchen equipment, food, welding, or laboratory equipment. Gloves should be chosen based on the extreme of temperatures expected along with conditions of wet, dry, and abrasive.

- ***Disposable Gloves***

Disposable gloves are used most commonly in food processing or assembly, laboratories, industrial, and healthcare applications. They are available in latex rubber, nitrile, polyethylene, PVC, neoprene, vinyl and other synthetic materials. Latex is being replaced by other suitable alternatives because of the latex allergy concern.

- ***Chemotherapy Gloves***

These are disposable gloves that are designed for use when handling chemotherapy drugs or any hazardous drug that is being compounded, prepared or administered. They should be tested according to the ASTM D6978-05 *Standard Practice for Assessment of Resistance of Medical Gloves to Permeation by Chemotherapy Drugs* (after 2005) or F739-07 *Standard Test Method for Permeation of Liquids and Gases through Protective Clothing Materials under Conditions of Continuous Contact* (before 2005), and approved by the FDA for use with chemotherapy drugs.

- ***Cut-Resistant Gloves***

Kevlar or Dyneema fiber knit gloves, gloves containing metal fibers, or metal mesh gloves are used when workers are at risk of being cut by equipment or the products they are handling.

- ***Chemical Resistant Gloves***

These gloves can be disposable or re-useable and generally do not protect against all chemical hazards. The appropriate glove material must be selected that provides resistance to the specific chemical hazard that will be encountered, such as acids,

alcohols, oils, corrosives, and solvents. See the selection guides found on the OESO website: <https://www.safety.duke.edu/occupational-hygiene-safety/personal-protective-equipment/gloves-chemical-applications>

- ***Electrical Gloves***
Rubber and leather insulating gloves, mittens, and sleeves are designed to protect the worker from electrical hazards such as fire ignition, electric shock, arc flash and blast. The proper gloves shall be chosen in accordance with the NFPA 70E (2009) *Standard for Electrical Safety in the Workplace* and tested to appropriate voltage meeting ASTM D120-09 *Standard Specification for Rubber Insulating Gloves*.
- ***Anti-Vibration Gloves***
Padded gloves are used to prevent hand-arm vibration syndrome (HAVS) that often occurs from repeat exposure to vibration. Highly specialized tasks such as operating chain saws, grinders, nail guns, sanders and any machinery that produces high levels of vibration would put employees at risk for HAVS.
- ***General Purpose Gloves***
These gloves are available in jersey, canvas or string knits, leather, or as leather palm work gloves. They protect against abrasion and can be unlined or lined for cold weather.
- ***Finger Cots***
Made of latex, nitrile rubber, vinyl, cotton, or leather, these individual finger covers can be used in the healthcare industry, food processing and when handling rough, sharp, and hot surfaces.

PROTECTIVE CLOTHING

GENERAL

Protective clothing includes coveralls, aprons, sleeves, leggings, and garments that cover the body. These items are intended to protect the wearer against heat, cold, moisture, toxic chemicals, acids, corrosives, electricity, biological and physical hazards such as sharp objects, flying objects, excessive dust, grease, etc.

When specific items of personal attire are judged to be hazardous to an operation or work environment, their use shall be prohibited. Some examples: The wearing of long sleeves, jewelry, and loose-fitting or dangling clothing shall not be permitted around rotating machinery; silk, wool, rayon, nylon, and other synthetic fiber garments shall not be worn in any operation in which the generation of static electricity would create a hazard.

Suitable attire, including appropriate shoes, normally worn by prudent individuals to avoid unnecessary risk, is the responsibility of the employee and is considered a condition of employment.

SPECIAL CLOTHING

Where employees are required to wear special protective clothing that necessitates changing from street clothes, a designated location for changing clothes and suitable clothing lockers will be provided.

Special protective clothing worn on the job shall not be worn or taken away from the premises by employees, since this may expose other persons to unnecessary risk caused by contaminated clothing. The Department will be responsible for cleaning and drying special clothing contaminated with or exposed to hazardous materials or for proper disposal in the event contaminated clothing needs to be discarded.

Special clothing for biological hazards is covered under Section VI of the Duke University Safety Manual.

- ***Paperlike Fiber***
Disposable suits made of this material provide protection against dusts.
- ***Tyvek®***
Garments of differing formulations provide a variety of protection ranging from non-hazardous dusts to dry particulate hazards such as lead dust, mold, asbestos, and other aerosol hazards.
- ***Tychem®***
These garments protect against a wide range of chemical hazards ranging from light to moderate liquid splash to higher levels of protection for hazmat applications.
- ***Kevlar®***
Kevlar is a synthetic fiber which is highly resistant to cuts and punctures.
- ***Treated Wool and Cotton***
Protective clothing made from treated wool and cotton adapts well to changing workplace temperatures and is comfortable as well as fire resistant. Treated cotton and wool clothing protects against dust, abrasions, and rough and irritating surfaces.
- ***Duck***
Duck is a closely woven cotton fabric which protects against cuts and bruises during the handling of heavy, sharp, or rough materials.
- ***Leather***
Leather gloves protect against dry heat, flame, cuts, and abrasion.
- ***Rubber, Rubberized Fabrics, Neoprene and Plastics***
Protective clothing made from these materials protects against certain acids and other chemicals.

Clothing for protection from electrical hazards shall conform to the NFPA 70E Table 130.7(C) (8), *Standards on Protective Equipment*.

- **Protera™**
Protera garments meet the NFPA 70E Category 2 requirements for protection from electric arc hazards.
- **Nomex®**
This is a flame resistant synthetic fiber that will not melt, drip or support combustion and is combined with high break strength, tear resistance and abrasion resistance properties.

HIGH-VISIBILITY CLOTHING

When employees are performing work in the road or in the right-of-way, they shall wear high-visibility clothing that conforms to ANSI/ISEA 107-2004 *High-Visibility Safety Apparel and Headwear*, Class 2 requirements at a minimum.

Fall Protection

Personnel may be exposed to fall hazards when performing work on a surface with an unprotected side or edge that is 4 feet or more above a lower level, or 10 feet or more on scaffolds. Fall protection may also be required when using vehicle man lifts, elevated platforms, tree trimming, performing work on poles, roofs, or fixed ladders. Workers must use fall protection where required. A personal fall arrest system consists of a full-body harness, lanyard, lifeline and snaphooks, and must be in compliance with OSHA 29 CFR 1926, Subpart M, *Fall Protection for Construction* and OSHA 29 CFR 1910, Subpart D, *Walking Working Surfaces*, as well as OSHA 29 CFR 1910.140 (*Personal Fall Protection Systems*), for General Industry.

HEARING PROTECTION

Hearing protection is required for employees working in areas where they are exposed to noise at or above 85 dBA, or while working with equipment that generates noise at or above 85 dBA. For details see the Duke Policy on Occupational Noise Exposure at http://www.safety.duke.edu/sites/default/files/II_3Noise.pdf and <http://www.safety.duke.edu/occupational-hygiene-safety/personal-protective-equipment/hearing-conservation>.

RESPIRATORY PROTECTION

Employees may be exposed to respiratory hazards that require the use of respirators, such as during emergency response, handling animals, working with hazardous chemicals, disturbing asbestos, welding, painting, etc. Employees needing respiratory protection will be placed on the Respiratory Protection Program prior to respirator use. For details on protection against inhalation hazards see the Duke Policy on Respiratory Protection at https://www.safety.duke.edu/sites/default/files/II_2RespiratoryProtection.pdf and the OHS

Respiratory Protection page at <https://www.safety.duke.edu/occupational-hygiene-safety/personal-protective-equipment/respiratory-protection>.

PPE Examples

Source of Hazard	Affected Body Part	Recommended PPE
Chemical and Splashing Liquid (e.g., acid and chemical handling, hazardous drug preparation and administration, biological substances, food processing, painting, cleaning products, pesticide and herbicide use, etc.)	Eyes	Goggles, safety glasses with side shields (not for chemical protection)
	Head, Neck, Face	Chem-resistant Tyvek hood, face shield, chemical/liquid resistant hoods/caps, fluid-resistant surgical masks or surgical mask/face shield combinations (generally not for chemical protection)
	Feet and Toes	Slip-resistant shoes, chemical/liquid resistant overshoes
	Hands	Chosen based on specific hazard: Nitrile, butyl rubber, neoprene, Silver Shield, or other chemical resistant gloves or mittens, chemotherapy gloves
	Body: torso, arms, legs	Chemical/liquid resistant clothing
High Heat (dry) (e.g., Burns from hot surfaces, sparks, Bunsen burners, welding, kitchen equipment, furnace operations, etc.)	Eyes	Goggles, safety glasses with side shields, insulated helmets
	Head, Neck, Face	Face shield, flame retardant/insulated helmet, cap or hood
	Feet and Toes	Leather shoes, foundry shoes
	Hands	Hand protection made from insulated or flame resistant materials such as Nomex, Kevlar, leather, terry, cotton, etc.
	Body: torso, arms, legs	Clothing made from flame resistant or insulated material such as Nomex or leather
High Heat (liquid) (e.g., Burns from hot liquids, molten metal, steam, food	Eyes	Goggles, Safety glasses w/ side shields
	Head, Neck, Face	Face shields, protective

preparation, etc.)		hoods/helmets
	Feet and Toes	Leather shoes, foundry shoes
	Hands	Insulated gloves with added liquid resistant properties when necessary
	Body: torso, arms, legs	Clothing made from treated wool or cotton, leather or specialty fabrics such as Nomex
Cryogenics/Extreme Cold (e.g., cryo-burns, frostbite, permanent eye damage from liquid nitrogen, CO ₂ , non-insulated equipment, etc.)	Eyes	Goggles
	Head, Neck, Face	Face shield
	Feet and Toes	Appropriate safety shoes
	Hands	Cryo-gloves
	Body: torso, arms, legs	Lab coat, long pants, aprons, insulated cotton or synthetic fabrics
Dust/Flying Debris (e.g., Chipping, grinding, sanding, chiseling, woodworking, grounds keeping, coal handling, buffing, general dusty conditions, etc.)	Eyes	Goggles, safety glasses w/ side protection
	Head, Neck, Face	Face shield, hard hat, helmet, hood
	Feet and Toes	Safety shoes if appropriate
	Hands	Appropriate protective gloves
	Body: torso, arms, legs	Protective clothing made from synthetic or natural fabrics such as Kevlar or treated cotton/wool, or cotton duck.
Impact/Compression (e.g., Crushing or penetration from machinery, rotating equipment, materials handling, carpentry, construction, etc.)	Eyes	Safety glasses w/ side shields
	Head, Neck, Face	Class G, E, or C helmets
	Feet and Toes	Safety toes and metatarsal guards
	Hands	Leather, Kevlar or other specialty material
	Body: torso, arms, legs	Leather, Kevlar or cotton duck clothing
UV/IR Radiation (e.g., Optical radiation from welding, cutting, torch brazing or soldering, glare, laser, working outdoors, etc.)	Eyes	Spectacles, welding face shield, goggles, or helmets with appropriate shaded or special purpose lenses.
	Head, Neck, Face	Same as above
	Feet and Toes	Closed-toe shoes
	Hands	Sunscreen
	Body: torso, arms, legs	Sunscreen; clothing with SPF rating
Electrical Hazards (e.g., Open circuits, energized electrical equipment or utilities,	Eyes	Safety glasses
	Head, Neck, Face	Hard hat, Class E
	Feet and Toes	Electrical hazard footwear

electrical arcs, etc.)	Hands	Rubber gloves and insulating sleeves, Class 00-4 based on max. voltage exposure
	Body: torso, arms, legs	Garments made from Protera synthetic material, flame retardant clothing
Puncture/Cuts/Abrasions (e.g., Sharp edges from tools and machines, food preparation, surgical equipment, syringes, etc.)	Eyes	Safety glasses w/ side shields
	Head, Neck, Face	Face shield
	Feet and Toes	Safety toed and puncture resistant soles
	Hands	Material depends on specific hazard and severity, but can include leather, rubber, cotton, Kevlar, metal mesh, etc.
	Body: torso, arms, legs	Clothing made from Kevlar, treated wool or cotton, duck or leather.
Slippery/Wet Surfaces (e.g., Oil, water, soaps, wax, chemicals, food handling areas, etc.)	Feet and Toes	Slip resistant safety shoes
Fall Hazards (e.g., Unprotected elevated working surfaces)	Body	Personal fall arrest system
Noise (e.g., Mechanical rooms, machining, grinding, sanding, cage washing, dish washing, pneumatic equip., grounds equipment, generators, chillers, motors, saws, jackhammers, etc.)	Head, Neck, Face	Ear plugs, ear muffs, or canal caps
Respiratory (e.g., Emergency response, hazardous chemicals, powders, mists, vapors, smoke or gases, painting, welding, cutting, brazing, disturbing asbestos, lead, silica, or other particulate hazards, working with animals, entering fume hood plenums, grounds equipment, etc.)	Respiratory	Appropriate respirator can be a filtering facepiece (such as an N-95), PAPR, half-mask air-purifying, full-face air-purifying, or supplied air (including SCBA) depending on the hazard; must be approved by OESO

Visit <https://www.safety.duke.edu/occupational-hygiene-safety/personal-protective-equipment> for additional information and links to PPE selection guides and safety guidelines.

References

Code of Federal Regulations, Title 29 (OSHA)

1910.132, *Personal Protective Equipment*

1910.135, *Occupational Head Protection*

1910.137, *Electrical Protective Devices*

1910.140, *Personal Fall Protection Systems*

1910.145, *Specifications for accident prevention signs and tags*

1910.1030, *Bloodborne Pathogens*

1910.1200, *Hazard Communication*

1910, Subpart D, *Walking Working Surfaces*

1926, Subpart E, *Personal Protective and Life Saving Equipment*

1926, Subpart M, *Fall Protection*

ASTM F2413-05 *Standard Specification for Performance Requirements for Foot Protection*

ASTM D6978-05 *Standard Practice for Assessment of Resistance of Medical Gloves to Permeation by Chemotherapy Drugs*

ASTM F739-07 *Standard Test Method for Permeation of Liquids and Gases through Protective Clothing Materials under Conditions of Continuous Contact*

ASTM D120-09 *Standard Specification for Rubber Insulating Gloves*

ASTM F1117-03 (2008) *Standard Specification for Dielectric Footwear*

ASTM F1116-03 (2008) *Standard Test Method for Determining Dielectric Strength of Dielectric Footwear*

ASTM F1818-04 *Standard Specification for Foot Protection for Chain Saw Users*

American National Standards Institute (ANSI) Z87.1-2003 *Occupational and Educational Personal Eye and Face Protection Devices*

American National Standards Institute (ANSI/ISEA) Z89.1-2009 *Industrial Head Protection*

American National Standards Institute (ANSI) Z136.1-2007 *Safe Use of Lasers*

American National Standards Institute (ANSI/ISEA) Z107-2004 *High-Visibility Safety Apparel and Headwear*

National Fire Protection Association (NFPA) 70E (2009), *Standard for Electrical Safety in the Workplace*

American National Standards Institute (ANSI/ASSE Z359.2-2017, *Minimum Requirements for a Comprehensive Managed Fall Protection Program*