

California Institute of Technology

PERSONAL PROTECTIVE EQUIPMENT GUIDE



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SCOPE

This guide addresses the California Occupational Safety and Health Administration (Cal/OSHA) head, eye, face, body, foot, and hand protection requirements of 8 CCR §3380 – 3385, and sanitation of PPE requirement of 8 CCR §3387.

PURPOSE

The purpose of this guide is to protect employees from the risk of injury by creating a barrier against workplace hazards by using the appropriate personal protective equipment (PPE).

PPE shall be used when engineering and/or administrative controls cannot be implemented to control the hazards of a process or the environment that may cause injury or impairment to employees.

This recommendation defines the requirements for the selection, training, application, and use of PPE. The PPE covered in this document includes eye and face protection, head protection, hearing protection, respiratory protection, foot protection, hand protection, protective clothing, and protective shields and barriers.

These requirements apply to all Caltech personnel working in Facilities, Laboratories, and in work locations where PPE is applicable. For additional and specific information about laboratory PPE, consult other [Caltech Safety Programs](#).

Respiratory protection, hearing protection, and fall protection have more rigorous requirements but are still covered under these guidelines. EH&S will assist in hazard assessments and training as needed.

RESPONSIBILITIES

MANAGERS/SUPERVISORS

Managers/Supervisors have the primary responsibility for implementation of the PPE Guide in their work areas, including:

- Hazard assessments are conducted and documented.
 - Update the hazard assessment if conditions in the workplace change.
- Providing appropriate PPE and making it available to employees.
- Ensuring employees are trained on the proper use, care, and cleaning of PPE.
- Maintaining records on PPE assignment.
- Supervising staff to ensure that the PPE program elements are followed and that employees properly use and care for PPE.
- Ensuring that defective or damaged equipment is immediately replaced.

EMPLOYEES

All Caltech employees are responsible for adhering to the following:

- Properly wear and maintain PPE as instructed.
- Attend required training sessions and comply with all applicable safety requirements.
- Inform their manager/supervisor of the need to repair or replace PPE.
- Never use PPE that is defective or damaged.
- Inform their manager/supervisor when there is a concern about an unknown or hazardous situation.

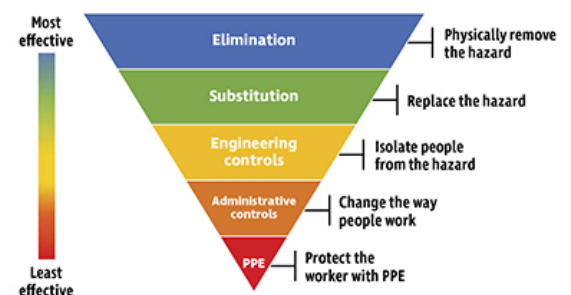
ENVIRONMENTAL HEALTH & SAFETY (EH&S)

- Conducting periodic review of this guide.
- Conducting workplace hazard assessments to identify appropriate PPE for designated jobs.
- Develop and administer PPE training whenever necessary.
- Maintaining records of hazard assessments.

DEFINITIONS

- **Administrative Controls:** Measures aimed at reducing employee exposure to hazards. These measures include procedures and training, and exercise breaks and rotation of workers. These types of controls are normally used in conjunction with other controls that more directly prevent or control exposure to the hazard.
- **Engineering Controls:** Intended to control the hazard at its source. It is the preferred way of controlling hazards. The work environment and the job itself should be designed to eliminate hazards or reduce exposure to hazards. Engineering controls are based on the following principles:
 - If feasible, design the facility, equipment, or process to remove the hazard or substitute something that is not hazardous.
 - If removal is not feasible, enclose the hazard to prevent exposure in normal operations.
 - Where complete enclosure is not feasible, establish barriers or local ventilation to reduce exposure to the hazard in normal operations.
- **Hazard Assessment:** An evaluation of a workplace, work situation or task, as to the potential for hazards that an employee may encounter while performing the job. The evaluation should be used to set standard operating procedures (SOP) for personnel including the appropriate PPE required to mitigate risks, and then train employees on the protective features and limitations of the PPE, and on its proper use and maintenance.
- **Personal Protective Equipment (PPE):** Using PPE

NIOSH HIERARCHY OF CONTROLS



requires hazard awareness and training on the part of the user.

- Appropriate PPE must match the task hazards, and equipment is prescribed when hazards cannot be eliminated by administrative or engineering controls.
- Employees must be aware that the equipment does not eliminate the hazard. If the equipment fails, exposure will occur. To reduce the possibility of failure, equipment must be properly fitted and maintained in a clean and serviceable condition.

EQUIPMENT SPECIFICATIONS

Protective clothing and equipment must conform to National Institute of Occupational Safety and Health (NIOSH) specifications, American National Standards Institute (ANSI) standards, and American Society for Testing and Materials (ASTM), which have been incorporated into the Cal/OSHA regulations.

- **Head Protection:** ANSI Z89.1-2019. Refer to [8 CCR §3381](#).
- **Eye and Face Protection:** ANSI Z87.1-2020. Refer to [8 CCR §3382](#).
- **Foot Protection:** ASTM F-2412-18, ASTM F-2413-18, ANSI Z41.1-2018. [8 CCR §3385](#).
- **Hand Protection:** ANSI 105-2023. Selection must be based on the performance characteristics of the glove in relation to the tasks to be completed. Refer to [8 CCR §3384](#).
- **Body Protection:** ANSI 101-2014, ANSI Z9.10-2014. Selection must be based on the exposed body parts, not otherwise protected, to hazardous or flying substances or objects. Refer to [8 CCR §3383](#).
- **Respiratory Protection:** ANSI Z88. Respirators, cartridges, filters, and other components shall be NIOSH certified. Refer to [8 CCR §5144](#).
- **Hearing Protection:** ANSI S3.19-2013. Shall have information for the Noise Reduction Rating (NRR). [8 CCR §5097](#).

PPE shall be of such design, fit and durability as to provide adequate protection against the hazards for which they are designed. They shall be reasonably comfortable and shall not unduly encumber the employee's movements necessary to perform his or her work.

HEAD PROTECTION

Protective Helmets

Employees exposed to flying or falling objects and/or electric shock and burns shall be safeguarded by means of approved head protection. The shell of the protective hat shall be hard enough to resist a blow and the headband and crown straps shall keep the shell away from the wearer's skull. Bump caps/skull guards can be issued and worn for protection against scalp lacerations from contact with sharp objects. However, bump caps shall not be worn as substitutes for safety hats because they do not afford protection from high impact forces or penetration by falling objects.

Head protection will be furnished to, and used by, all employees engaged in construction and other miscellaneous work. Head protection must also be worn by engineers, inspectors, and visitors at sites where hazards from falling or fixed objects or electrical shock are present. The following are impact types and electrical classes of protective helmets.

ANSI Impact Type of Hard Hats

Type I: Reduce the force of impact resulting from a blow only to the top of the head.

Type II: Reduce the force of impact resulting from a blow to the top or sides of the head.

ANSI Electrical Class of Hard Hats

Class G (General): Provide impact and penetration resistance along with limited voltage protection from electrical hazards (up to 2,200 volts).

Class E (Electrical): Provide impact and penetration resistance along with the highest level of voltage protection against electrical hazards (up to 20,000 volts).

Class C (Conductive): Provide impact and penetration resistance *only*. Class C hard hats are usually made of aluminum, which is an electrical conductor, and therefore should not be used in situations involving electrical hazards.

Hair Enclosures - Face and Head

Where there is a risk of injury from hair entanglement in moving parts of machinery, combustibles, or toxic contaminants, employees shall confine their hair to eliminate the hazard by using a hat, cap, or net (e.g., hairnet, beard cover, etc.).

EYE AND FACE PROTECTION

Prevention of eye injuries requires that all persons who enter eye hazard areas wear protective eye wear. This includes employees, visitors, researchers, contractors or others passing through an identified eye hazard area. Managers/Supervisors shall stock a sufficient quantity of safety goggles and glasses to provide eye protection for visitors. Eye hazard areas should be posted with signs. Persons who wear prescription glasses must be provided eye protection that fits over their glasses without disturbing the proper position of the prescription lenses or the protective lenses. It is especially important for wearers of contact lenses to use eye and face protection devices in a hazardous environment.

Appropriate eye and face protection shall be used when employees are exposed to hazards from flying particles, molten metal, acids or caustic liquids, chemical liquids, gases, or vapors, bioaerosols, or potentially injurious light radiation. The following are descriptions of the most common types of eye and face protection and the types of hazards they can guard against.

Safety Glasses: Protective eyeglasses are made with safety frames, tempered glass or plastic lenses. Covered temples provide eye protection from moderate impact and flying particles. Safety glasses shall have either wrap-around frames or permanent side shields that are non-removable.

Prescription Safety Glasses: Prescription safety glasses shall conform to all requirements of non-prescription safety glasses. For more information on how to order prescription safety glasses, please see the [Prescription Safety Glasses Request Form](#).

Goggles: Vinyl framed goggles are available with directly, indirectly or non-vented frames. Indirectly vented goggles should be used when there is a hazard from chemical splash. Non-vented frames should be used to protect from hazardous gases and vapors. Goggles may be worn in combination with corrective lenses to insure protection along with proper vision.

Face Shields: Face shields are available in various sizes, tensile strength, impact and heat resistance and light ray filtering capacity. Face shields should be used in operations when the entire face needs protection and should be worn to protect the skin, mouth and nose. Face shields cannot be used as a substitute for safety glasses or goggles.

Welders/Chippers Goggles: Welders goggles provide protection from sparking, scaling or splashing metals and harmful light rays. Lenses are impact resistant and are available in graduated shades of filtration. Chippers/Grinders goggles provide eye protection from flying particles. Refer to [8 CCR §3382, Table EP-1](#) for guidance in selecting protection against radiant energy.

Welding Face Shields: Use welding face shields to protect workers' eyes and face from infrared or radiant light burns, flying sparks, metal spatter and slag chips encountered during welding, brazing, soldering, resistance welding, bare or shielded electric arc welding and oxyacetylene welding and cutting operations.

Laser Safety Goggles: Laser safety goggles must be specific to the wavelength of the laser and be of optical density adequate for the energy involved. All protective goggles shall be labeled with the wavelength and optical density for intended use and the visible light transmission. Refer to [8 CCR §3382, Table EP-2](#) for laser safety glass selection guidelines.

FOOT AND LEG PROTECTION

Appropriate foot protection shall be required for employees who are exposed to: electrical hazards; hot, corrosive, poisonous substances; falling objects; crushing or penetrating actions; or, abnormally wet environments. Safety shoes have an impact resistant toe and insoles to protect against puncture wounds. Safety boots offer more protection when splash hazards (chemicals, molten materials) are present. When working with corrosives, caustics, cutting oils, or petroleum products, neoprene or nitrile boots are often required to prevent penetration. Do not tuck pant legs into boots when working with chemicals or hot liquids, because it can funnel hazardous liquids into the boot. Nonskid shoes will be worn where floors are wet or greasy.

Electrical hazard safety shoes are not designed to be a replacement for electrically rated matting in high voltage situations. Electrical safety shoes are to be used when working on low voltage circuits and as a secondary means of protection.

Footwear that meets established safety standards will have an ANSI label inside each shoe. There are many types and styles of protective footwear, and it is possible that a particular job may require special protection. Footwear which is inappropriate to the extent that its ordinary use

creates the possibility of foot injuries shall not be worn. The following are descriptions of the most common types of foot, toe, and leg protection and the types of hazards they can guard against.

Safety Shoes: Have impact-resistant toes and heat-resistant soles that protect the feet against hot work surfaces common in roofing, paving, and hot metal industries. The metal insoles of some safety shoes protect against puncture sounds. Safety shoes may also be designed to be electrically conductive to prevent buildup of static electricity or non-conductive to protect workers from workplace electrical hazards.

All protective footwear must comply with the following standards:

- ASTM F-2412-2005, “Standard Test Methods for Foot Protection”.
- ASTM F-2413-2005, “Standard Specification for Performance Requirements for Foot Protection”.

Leggings: Protect the lower legs and feet from heat hazards such as molten metal or welding sparks.

Metatarsal Guards: Protect the instep from impact and compression.

Toe guards: Fit over the toes of regular shoes to protect the toes from impact and compression hazards.

Combination Foot and Shin Guards: Protect the lower legs and feet and may be used in combination with toe guards when greater protection is needed.

Safety Shoe Reimbursement: If safety shoes are required by a shop/laboratory, a set monetary amount will be reimbursed to the employee. Please see the [safety shoe reimbursement form](#) for more information.

BODY PROTECTION

Body protection, such as aprons or chaps, may be required for employees whose work exposes parts of their body to hazardous substances, equipment, or flying objects.

Clothing appropriate for the work being done must be worn. Loose sleeves, shirt tails, ties, lapels, cuffs, other loose clothing or unrestrained hair which can be entangled in moving machinery or materials should not be worn.

HEARING PROTECTION

Hearing protection, including plugs and muffs, is recommended to be worn in noisy environments. EH&S conducted a noise survey and found that exposures over an 8-hour time weighted average of 85 A-weight decibels (dBA) were not existent.

Hearing protection must be worn by employees if:

- They are in a designated “Hearing Protection Required” area.
- They are in an area where the noise exposure is determined to be excessive, even if the area has not been officially designated as a “Hearing Protection Required” area (e.g.,

- portable equipment or tools which temporarily create a noise hazard), or
- They have experienced a standard threshold shift or are exposed to noise levels at or above the action level.

HAND PROTECTION

Hand protection shall be used when work involves unusual and excessive exposure to cuts; burns; harmful physical, chemical or biological materials; or extreme temperatures. Glove selection shall be based on performance characteristics of the gloves, conditions, duration of use and hazards present. One type of glove will NOT work in all situations.

Always read instructions and warnings on chemical container labels and safety data sheets before handling any chemical. Recommended glove types are often listed in the section for personal protective equipment. All glove materials are eventually permeated by chemicals. Gloves must be replaced periodically, depending on frequency of use and permeability to the substance(s) handled.

Power tools and machinery must have guards installed or incorporated into their design that prevent the hands from contacting the point of operation, power train, or other moving parts. Do not wear gloves around moving machinery, such as drill presses, mills, lathes, and grinders.

The following are descriptions of the most common types of hand protection and the types of hazards they can guard against.

Leather, Canvas, or Metal Mesh Gloves

Sturdy gloves made from metal mesh, leather, or canvas provide protection against cuts and burns. Leather or canvas gloves also protect against sustained heat.

Leather Gloves: Protect against sparks, moderate heat, blows, chips and rough objects.

Aluminized Gloves: Provide reflective and insulating protection against heat and require an insert made of synthetic materials to protect against heat and cold.

Aramid Fiber Gloves: Protect against heat and cold, are cut- and abrasive-resistant and wear well.

Synthetic Gloves (various materials): Offer protection against heat and cold, are cut and abrasive-resistant and may withstand some diluted acids. These materials do not stand up against alkalis and solvents.

Fabric and Coated Fabric Gloves

Fabric and coated fabric gloves are made of cotton or other fabric to provide varying degrees of protection.

Fabric Gloves: Protect against dirt, chafing and abrasions. They do not provide sufficient protection for use with rough, sharp or heavy materials. Adding a plastic coating will strengthen some fabric gloves.

Coated Fabric Gloves: Normally made from cotton flannel. These gloves are used for tasks ranging from handling bricks and wire to chemical laboratory containers. When selecting gloves to protect against chemical exposure hazards, always check with the manufacturer or review the manufacturer's product literature to determine the gloves' effectiveness against specific workplace chemicals and conditions.

Chemical- and Liquid-Resistant Gloves

Chemical-resistant gloves are made with different kinds of rubber: natural, butyl, neoprene, nitrile and fluorocarbon (viton); or various kinds of plastic: polyvinyl chloride (PVC), polyvinyl alcohol and polyethylene. These materials can be blended or laminated for better performance. As a general rule, the thicker the glove material, the greater the chemical resistance, but thick gloves may impair grip and dexterity, having a negative impact on safety. Some examples of chemical-resistant gloves include:

Butyl Gloves: Made of a synthetic rubber and protect against a wide variety of chemicals, such as peroxide, rocket fuels, highly corrosive acids (nitric acid, sulfuric acid, hydrofluoric acid and red-fuming nitric acid), strong bases, alcohols, aldehydes, ketones, esters and nitro-compounds. Butyl gloves also resist oxidation, ozone corrosion and abrasion, and remain flexible at low temperatures. Butyl rubber does not perform well with aliphatic and aromatic hydrocarbons and halogenated solvents.

Natural (latex) Rubber Gloves: Comfortable to wear, which makes them a popular general-purpose glove. They feature outstanding tensile strength, elasticity, and temperature resistance. In addition to resisting abrasions caused by grinding and polishing, these gloves protect employees' hands from most water solutions of acids, alkalis, salts, and ketones. Latex gloves have caused allergic reactions in some individuals and may not be appropriate for all employees. Hypoallergenic gloves, glove liners and powderless gloves are possible alternatives for employees who are allergic to latex gloves.

Neoprene Gloves: Made of synthetic rubber and offer good pliability, finger dexterity, high density and tear resistance. They protect against hydraulic fluids, gasoline, alcohols, organic acids and alkalis. They generally have chemical and wear resistance properties superior to those made of natural rubber.

Nitrile Gloves: Made of a copolymer and provide protection from chlorinated solvents such as trichloroethylene and perchloroethylene. Although intended for jobs requiring dexterity and sensitivity, nitrile gloves stand up to heavy use even after prolonged exposure to substances that cause other gloves to deteriorate. They offer protection when working with oils, greases, acids, caustics, and alcohols but are generally not recommended for use with strong oxidizing agents, aromatic solvents, ketones and acetates.

For further information, please see the [Caltech Glove Selection Guide](#).

RESPIRATORY PROTECTION

Disposable dust/fume/particle mask: For the control of nuisance dusts in the presence of adequate breathing air.

Half-mask air purifying respirator: For the control of air contaminants at concentrations of up to 10 times the Cal-OSHA Permissible Exposure Limit (PEL) in the presence of adequate breathing air.

Full-face air purifying respirator: For the control of air contaminants at concentrations up to 50 times Cal-OSHA PEL in the presence of adequate breathing air.

Supplied air (airline) respirator: For the control of air contaminants at concentrations of up to 1000 times the Cal-OSHA PEL.

For further information, please see Caltech's [Respiratory Protection Program](#).

PPE MAINTENANCE

All PPE must be kept clean and properly maintained. Cleaning is particularly important for eye and face protection because dirty or fogged lenses can impair vision. PPE should be inspected, cleaned and maintained at regular intervals so that the equipment continues to provide protection. Personal protective equipment shall not be shared between employees until it has been properly cleaned and sanitized. PPE will be distributed for individual use whenever possible. Contaminated PPE must be disposed of in a manner that protects employees from exposure to hazards and complies with hazardous waste regulations. Contact [EH&S](#) for assistance with disposal.

TRAINING

Any worker required to wear PPE shall receive training in the proper use and care of the equipment issued. Refresher training shall be offered as needed to employees. The training shall include, but not necessarily be limited to, the following subjects:

- When PPE is necessary;
- What PPE is necessary;
- How to properly don, doff, adjust and wear PPE;
- The limitations of the PPE; and
- The proper care, maintenance, useful life and disposal of the PPE.

RE-TRAINING

Circumstances in which retraining is required include:

- Changes in the workplace render previous training obsolete; or
- Changes in the types of PPE to be used render previous training obsolete; or
- Inadequacies in an affected employee's knowledge or use of assigned PPE indicate that the employee has not retained the requisite understanding or skill.