Chapter 15 – Personal Protective Equipment

NOTE: The following boxed paragraph that addresses Hazard Assessments is not a part of the current revision cycle nor is it to be used as a general guide for the performance of Job Hazards Assessments. A new Chapter will be added to the Glenn Safety Manual in the future to address Hazards Assessments; therefore, Chapter 15 will only address Personal Protective Equipment.

The type of personal protective equipment required for any hazardous operation depends upon the nature and severity of the hazards involved. The Area Supervisor shall conduct a Hazard Assessment, with guidance from the Safety Branch (SB) and the Environmental Management Branch (EMB), so that proper PPE can be selected.

The Hazard Assessment shall be documented in writing and shall include, as a minimum:

- Identification of the area(s) assessed.
- The date(s) of the assessment.
- The name of the person(s) conduction the assessment.
- Identification of the hazards present (or likely to be present).
- Identification of the engineering and/or administrative controls that can be instituted to eliminate the hazard.
- The selection of specific PPE when required to be used to mitigate the hazards(s).

See Chapter 1, Appendix A for a generic Hazards List).

The Hazard Assessment shall be approved by the next level supervisor of the person conducting the assessment and maintained on file by the cognizant organization. The Hazard Assessment shall be made readily available to SB or EMB for review upon request. Additional assessments shall be conducted whenever new hazards become present, or are likely to be present, due to changes in work activity. Ultimately, it is the responsibility of the supervisor to ensure a safe work environment, and provide proper personal protection equipment, for their employees.

15.1 Purpose

This chapter establishes minimum program requirements for the Personal Protective Equipment (PPE) Program at the NASA Glenn Research Center (GRC). The program is intended to ensure employees are protected from hazards in the workplace due to:

- Processes
- Environment
- Chemicals
- Radiological material
- Mechanical irritants
- Biological processes

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Or any other hazards that are capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact. PPE is required wherever engineering and administrative controls cannot eliminate or sufficiently reduce the hazard. This program was written to ensure employee awareness in the provision, use, limitations and maintenance of PPE.

15.2 Scope

The PPE program applies to:

- All NASA GRC organizations and employees at both Cleveland and Plum Brook and to all Glenn employees when they travel to other facilities outside of the GRC, including students.
- GRC contractors at Cleveland and Plum Brook, other NASA contractors, non-NASA and non-contractor individuals present at Cleveland and Plum Brook, as expressed in the terms of their contracts or agreements with NASA.
- Center organizational elements, and students, interns, and contractors operating at locations where GRC has operational jurisdiction.
- Other government organizational elements that are tenants at GRC.

15.3 Definitions

Administrative controls – Administrative controls are procedures used to eliminate or reduce the exposure to the hazard. Examples:

- Altering the manner in which employees implement a given procedure or perform a given process/task.
- Limiting the time that an individual performs a task.
- Training employees.
- Rotation of employees.
- Confined space entry and hot work permits.

Breakthrough time – The time it takes for a chemical to permeate through a material.

Control Measures – Methods used to reduce or eliminate exposure to hazards or potential hazard.

Code of Federal Regulations - A codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government. As it pertains to the Personal Protective Equipment Program, the applicable elements of both 29 CFR 1910 (Occupational Safety and Health Standards) and 29 CFR 1926 (Safety and Health Regulations for Construction) apply.

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Degradation – The change in a physical property of a glove material as a result to contact with an incompatible chemical. (Examples of this include: discoloration, brittleness, softness, swelling and weakness).

Dermatitis – Inflammation of the skin. The leading occupational disease in the US.

Dose – The determination of level of risk due to chemical exposure is determined by the dose. Dose is a function of:

- Concentration of the chemical
- Route of exposure
- Duration of exposure

Engineering Controls - Methods of controlling employee exposure by modifying the source or reducing the quantity of contaminants released into the work environment. Examples:

- Machine guards
- Sound absorbing panels
- Local exhaust and ventilation
- Substitution of a less hazardous chemical

Exposure – Contact with a chemical, biological, or physical hazard.

General Duty Clause - The General Duty Clause applies to the OSH Act, Section 5(a)(1) which states that "each employer…shall furnish to each of his employees employment and a place of employment which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees."

Job Hazard Assessment (JHA) - A method used to identify, quantify, and verify hazards related to job tasks. A JHA is more specific in scope than a worksite hazard assessment.

Penetration – Bulk flow of a chemical through a glove material. (i.e. seams and pinholes).

Performance Data – Testing data provided by chemical resistant PPE manufacturers to inform users of each material's capability at protecting against specific chemicals. Performance data typically measures penetration, degradation and permeation of a chemical through a specific material.

Permeation – Movement of a chemical through a material at a molecular level without going through pinholes, pores or other visible openings.

Personal Protective Equipment (PPE) – Clothing, devices and other work accessories designed to create a barrier against workplace hazards. PPE includes items such as:

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- Goggles
- Face shields
- Safety glasses
- Hard hats
- Safety shoes
- Gloves
- Vests
- Earplugs
- Earmuffs
- Respirators
- Hearing protection
- Chemical protective clothing
- Fall protection

Worksite Hazard Assessment – A method used to identify, quantify, and verify hazards related to specific tasks. A worksite hazard assessment is more task specific than a job hazard analysis.

15.4 General Requirements

The most important element of any safety and health program is an in depth evaluation of the hazards present in the workplace called a hazard assessment. This evaluation is used to identify and design engineering and administrative controls to eliminate or reduce the hazards present in the workplace. When engineering and administrative controls do not eliminate or sufficiently reduce the hazards, the hazard assessment is used to select the protective equipment needed. The type of personal protective equipment required for any hazardous operation depends upon the nature and severity of the hazards involved.

The Supervisor shall conduct the hazard assessment with guidance from the Safety Branch (SB) and the Environmental Management Branch (EMB), so that proper controls, and when necessary, the proper PPE can be selected.

PPE is never be used as a substitute for engineering and administrative controls. PPE should only be used as a last resort when engineering and administrative controls do not eliminate or sufficiently reduce the identified hazards. When engineering and administrative controls do not sufficiently reduce hazards, PPE will be used in conjunction with those controls that have been established to provide protection.

PPE is always used in conjunction with other controls and as a last resort because it does not eliminate the presence of hazards. If the PPE fails, exposure will occur. For this reason, GRC provides PPE training to ensure that employees are aware of:

- What PPE is necessary?
- When PPE is necessary.

- How to properly inspect PPE for wear or damage.
- How to properly put on and adjust the fit of PPE.
- How to properly remove PPE.
- The limitations of PPE.
- How to properly care for and store PPE.

Unless stated otherwise in contracts, NASA shall provide PPE to civil servants, which includes NASA employees from other centers, students, interns, and other government visitors.

Contractors must refer to their individual contracts to determine if they are capable of obtaining PPE from the GRC stockroom. If a contract does not permit a company to obtain PPE from the GRC stockroom, they are responsible for providing PPE to their employees in compliance with this chapter.

15.5 Responsibilities

15.5.1 Chief, Safety Branch

- Overall management, coordination, and documentation of the Personal Protective Equipment Program.
- Assigning a Program Lead to be responsible for the implementation of the PPE Program.

15.5.2 PPE Program Lead

- Updating the PPE program as necessary to ensure that the program reflects the latest information available from OSHA, NIOSH, other national consensus standards, and Federal Regulations
- Working with the Logistics and Technical Information Division (LTID) to ensure proper protective equipment is supplied through the stockroom
- Developing, maintaining, and managing the GRC PPE Training Program
- Assisting employees with selecting the appropriate controls and PPE
- Assisting Supervisors with the performance of JHA's

15.5.3 Industrial Hygiene PPE Lead

- Supporting the development and update of the PPE training program
- Assisting the PPE Program Lead in developing and maintaining a training program
- Working with the Logistics and Technical Information Division (LTID) to ensure proper protective equipment is supplied through the stockroom
- Providing guidance on industrial hygiene related protective equipment.
- Assisting employees with selecting the appropriate controls and PPE

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15.5.4 Supervisors

- Being knowledgeable of the PPE Program.
- Complying with the PPE Program.
- Attending the PPE training if personally exposed to hazards in the workplace or if responsible for employees that are exposed to hazards.
- Being knowledgeable of the hazards in the workplace.
- Ensuring proper engineering and administrative controls are implemented and used.
- Ensuring employees are properly trained in the use of PPE and understand the protective capabilities and limitations of selected PPE.
- Ensuring their employees are properly using the appropriate PPE protection against hazards identified in the job hazard assessment.
- Ensuring employees wear their PPE properly.
- Providing financial resources for the obtaining PPE.

15.5.5 Employees

- Being knowledgeable of the PPE Program.
- Complying with the PPE Program.
- Attending the PPE training if exposed to hazards in the workplace.
- Knowing how to appropriately select PPE for the hazards identified in the workplace.
- Wearing the appropriate PPE when required.
- Wearing PPE properly.
- Replacing damaged PPE.

15.5.6 Building Managers

- Ensuring that areas within the building requiring special protective equipment be adequately marked.
- Working with the Safety Branch and Industrial Hygiene Team to ensure proper signs reused.

15.5.7 Organization Development and Training Office

- Coordinating the date, time and location for PPE training sessions with the PPE Program Lead.
- Posting PPE training sessions on "Toady at Glenn" and the Organization Development and Training Office website.
- Providing attendance sheets and survey forms for training session attendees
- Maintaining training attendance records for Civil Servants. (NOTE: Support Service Contractors are responsible for maintaining their own training records in accordance with their individual contracts with NASA.)

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15.5.8 Logistics and Technical Information Division (LTID)

- Stocking personal protective items that meet or exceed OSHA requirements.
- Notifying the SB and EMB Industrial Hygiene Team before changes to stock items is made.

15.6 Specific PPE Elements

- Eye and Face Protection (29CFR1910.133 and 29CFR1926.102).
- Respiratory Protection (29CFR1910.134 and 29CFR1926.103).
- Head Protection (29CFR1910.135 and 29CFR1926.100).
- Foot Protection (29CFR1910.136).
- Electrical Protective Equipment (29CFR1910.137 and 29CFR1910, Subpart S).
- Hand Protection (29CFR1910.138).
- 7 Fall Protection.

NOTE: An on-line catalog displaying all PPE that is currently available through NASA GRC's Stock Room is available at http://osat.grc.nasa.gov/emo/. Click on "Complete Protective Clothing Catalog". This catalog provides a user-friendly tool to assess the PPE that is available at GRC, the sizes and corresponding catalog numbers for desired PPE, and supplemental information regarding PPE usage and limitations.

15.6.1 Eye and Face Protection

A. Eye and Face Protection Requirements

The requirements of 29 CFR 1910.133 and 29 CFR 1926.102 applies to any equipment used to protect the eye and face.

Eye and face protection must be worn when employees are exposed to eye or face hazards from:

- Flying particles
- Molten metal
- Liquid chemicals (acids, caustics, hot, etc.)
- Hazardous gases or vapors
- Potentially injurious light radiation

Eye and face protection worn at GRC must meet the requirements established by the American National Standards Institute for eye and face protection, ANSI Z87. 1, "Occupational and Educational Eye and Face Protection Practice."

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B. Eye and Face Protection Classifications

There are various types of eye and face protection available depending upon the specific hazard. Some types of eye and face protection include:

- Eyeglasses, with side shields
- Eye goggles (chemical and industrial)
- Face shields
- Welding helmets
- Phototropic lenses

C. Eye and Face Protection Usage

Admittance to areas requiring eye or face protection shall be prohibited to individuals not wearing the proper eye protection, except in the case of an emergency.

Table 1 of this chapter can be used to assist in selecting the appropriate eye and face protection.

If a greater degree of face protection is required than just wearing eye protection, then face shields can be worn in conjunction with the appropriate eye protection for the hazard present; however, faceshields can never be worn without safety glasses or goggles.

Side eye protection is required where there is a hazard from flying particles. Prescription safety glasses must be worn with proper fitting, ANSI approved sideshields.

When the possibility of multiple and simultaneous exposures exist to a variety of hazards, protection against the highest level of each hazard shall be provided. Protective devices do not provide unlimited protection.

Caution should be used when wearing metal frame protective devices in electrical hazard areas.

Safety glasses must be worn close to the face. When glasses are worn low on the nose, they are not able to protect the eyes from flying particles.

Atmospheric conditions and the restricted ventilation of goggles can cause lenses to fog. For this reason, goggles with indirect ventilation must be used when working in areas where chemicals are used.

Contact lenses may trap chemical vapors and other foreign matter, thereby causing eye injury. When the work environment entails exposure to chemical fumes, vapors or splashes, intense heat, molten metals, or a highly particulate atmosphere, contact lens use shall be prohibited.

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Phototropic or photo-chromatic lenses shall **not** be used for indoor industrial applications. They may be used outdoors only, providing the operations do not involve hazardous ultraviolet or infrared radiation.

Welding helmets must be worn by employees performing any welding operations. SB can be consulted to ensure the proper shade is selected for the specific welding operation. The minimum shade required by OSHA must be met at all times. Table 2 of this Chapter describes the filter shades required during specific welding operations.

Welding filters that are designed to change color once an arc is struck are **not** permitted to be used at NASA. OSHA does not have sufficient data to ensure they provide the level of protection necessary to prevent eye injuries; therefore, these helmets are not approved for use.

D. Eye and Face Protection Inspection/Maintenance

Eye protection is a personal item and should be used exclusively by the individual to whom it is issued. All eye and face protection shall be maintained in a clean and reliable condition. Continuous use of dirty or scratched lenses can contribute to eye fatigue and result in accidents. Eye protectors shall be cleaned as needed in a solution of mild soap and water.

Pitted or scratched lenses must be replaced before the safety eyewear may be used again. Supervisors shall ensure compliance.

Prescription safety glasses may be procured through Medical Services.

Table 1 - Eye and Face Selection Chart

Source (and some examples)	Assessment of Hazard	Protection Required
Impact (chipping, grinding, machining, masonry work, wood working, sawing, drilling, chiseling, powdered fastening, riveting and sanding)	Flying fragments, objects, large chips, particles, sand, dirt, etc.	Glasses with side protection Goggles Faceshields
Heat (furnace operations, pouring, casting, hot dipping, and welding)	Hot sparks	Glasses with side protection Goggles Faceshields
	Splashes from molten metals	Faceshields worn over goggles
	High temperature exposure	Screen faceshields, Reflective faceshields
Chemicals (Acid and chemical handling, degreasing, and plating)	Splash	Goggles (eyecup or cover type) Faceshields
	Irritating mists	Special purpose goggles
Dust (woodworking, buffing, general dust conditions)	Nuisance dust	Goggles (eye cup or cover type)

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Electric Arc Welding	Optical radiation	Welding helmet Welding shield Typical shades 10-14
Gas Welding	Optical radiation	Welding goggles Welding face shield Typical shades: Gas welding 4-8 Cutting 3-6 Brazing 3-4
Cutting **Torch Brazing** **Torch Soldering**	Optical radiation	Spectacles Welding face shield Typical shades 1.5-3
Glare (working outside)	Poor vision	Glasses with shaded or special purpose lenses

Table 2 - Eye and Face Selection Chart for Radiant Energy

Operations	**Electrode Size 1/32 in.**	**Arc Current (Amperes)**	**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
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 Arc Welding		Less than 500	10
		500-1000	11
Plasma Arc Welding		Less than 20	6
		20-100	8
		100-400	10
		400-800	11
Plasma Arc Cutting		Less than 300	8
		300-400	9
		400-800	10
Torch Brazing			3
Torch Soldering			2
Carbon Arc Welding			14

15.6.2 Respiratory Protection Program

Reference Chapter 12 of the Glenn Environmental Programs Manual
http://osat.grc.nasa.gov/epm/epm-2/epm12.pdf

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15.6.3 Head Protection

A. Hard Hat Requirements

The requirements of 29 CFR 1910.135 and 29 CFR 1926.100 applies to any equipment used to protect the head from impact and electrical hazards. Hard hats are required when there is a potential for injury to the head from falling objects, side impact or bump hazards. Hard hats able to reduce electrical shock hazard must be worn when an employee is near exposed electrical conductors that could contact the head.

Protective helmets and hard hats worn at GRC must meet the requirements established by the American National Standards Institute for industrial head protection (ANSI Z89.1).

B. Hard Hat Classifications

Hard Hats are classified by ANSI as follows:

- Class G (was Class A) - provides impact and penetration resistance as well as electrical protection up to 2,200 volts.
- Class E (was Class B) - provides impact and penetration resistance as well as electrical protection up to 20,000 volts.
- Class C – provides only impact and penetration resistance. They are made of aluminum and will conduct electricity. They should not be worn around electrical hazards.

There are two styles of hard hats approved for use:

- Type I – offers protection from overhead impacts and penetration and limited side impact.
- Type II - offers protection from overhead and side impacts and penetration (much like a batting helmet).

Only Class G (A) and Class E (B) hard hats are allowed to be used at GRC. Hard hats ordered through the stockroom are rated Class E (B), Type I. Type II are permitted to be used but are not currently offered through the stock room.

C. Hard Hat Usage

All head protection utilized by employees shall offer protection from impact and penetration by falling and flying objectives and from limited electrical shock and burn; therefore, bump caps shall not be used for protection from head hazards since they do not meet the ANSI requirements, which establish specific protective performance characteristics.

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All safety hats will be fitted so that there is at least 1-1/2 inches of airspace between the top of the wearer's head and the inside shell of the hat. This permits the suspension to provide adequate cushioning. Hard hats must be worn such that the suspension system fits securely on the individuals head and the hat adjustment is at the back. Any other manner in which the hard hat is worn will seriously comprised its protective capabilities. Chin-straps are recommended where there is a reasonable probability that safety hats could be knocked or blown off.

Winter liners can be worn in cold weather conditions.

Protecting the head may also require covering or confining long hair when there is a potential for it to become entangled in moving machinery.

D. Hard Hat Inspection/Maintenance

Employees are responsible for inspecting their hard hat before each use. Hard hats should be cleaned of debris prior to inspections to ensure all fractures and defects can be seen. Hard hats should be cleaned in warm water with a mild detergent. Solvents and other harsh chemicals should not be used to clean a hard hat. Stickers should not be used on hard hats since they can cover a small fracture in the shell.

All components including the shell, suspension, headbands, and accessories shall be visually inspected for dents, cracks, punctures, and any damage due to impact, rough treatment, or wear that may reduce the structural integrity of the hard hat below design criteria.

Damaged hard hats cannot be repaired. They shall be discarded and replaced. Other defective parts (suspension, chin strap, and other attachments) must be replaced with OEM (Original Equipment Manufacturer) parts.

15.6.4 Foot Protection

15.6.4.1 Foot Protection Requirements

Per 29 CFR 1910.136, protective footwear with approved metatarsal or toe guards, or both, shall be worn by all personnel who are working in areas where there is a danger of foot injuries due to:

- Falling objects
- Rolling objects
- Piercing the sole of the foot
- Electrical hazards at ground level

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All safety-toe footwear must meet the requirements and specifications of ANSI Z41.1 and must be maintained in reliable condition in order to ensure its protective capabilities.

Foot Protection Classifications

Foot protection is classified by ANSI utilizing the following tests:

Compression Test

Classification	Pounds	Clearance Remaining in Toe (inches)
30	1,000	0.5
50	1,750	0.5
75	2,500	0.5

Impact Test

Classification	Foot Pounds	Clearance Remaining in Toe (inches)
30	30	0.5
50	50	0.5
75	75	0.5

Metatarsal Protection Test

Classification	Pounds	Clearance Remaining in Foot (inches)
30	30	0.5
50	50	0.5
75	75	0.5

15.6.4.2 Foot Protection Usage

All footwear must be properly laced and fit snugly. The toe cap should cover the entire toe area of the foot. If the toe cap does not cover the entire toe area, or extends past the toe area, the footwear is not providing the proper fit and will not provide adequate protection and will also be uncomfortable to wear.

There are several options available when selecting foot protection. Some options are as follows:

Toe Protection

Toe Armor	Developed by Wolverine, this non-metallic composite toe cap totally encapsulates the toes. It weighs less than steel and transmits less cold.

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Steel Toe	A steel cap that can be heavy and can increase risk of frostbite in cold weather. Extends from the sole of the shoe over the toes.
Composite Toe	A nonmetallic toe that weighs less than steel and transmits less cold. Extends from the sole of the shoe over the toes.

Soles

Durashock Soles	A long wearing, lightweight outsole with "bounce technology" for incredible shock absorbing comfort and durability (only offered in Wolverine brand of shoes).
Vibram soles	Tough, long wearing and only found on the best shoes.

Shoe Material

Kevlar Stitching	An organic fiber manufactured by DuPont that possesses unique characteristics when compared to other man-made or natural fibers. It has high strength, thermal, puncture, and cut resistance while maintaining resistance to many chemicals and solvents.
Prosafe 2000 Super Leather	A waterproof material that exceeds U.S. military specifications and is extremely durable and resistant to chemicals, alkalines, dilute acids, automotive fluids and salts. It also exceeds NFPA heat and flame resistance requirements for firefighter footwear. This leather remains soft, supple and durable even in the harshest environments.
Gore-Tex Fabric	A waterproof membrane that keeps liquids out while allowing air to penetrate allowing the foot to breath for cooler, dryer, more comfortable feet.
Sympatex Waterproof Material	A waterproof material that keeps your feet dry while allowing the foot to breathe.
Thinsulate	3M Thinsulate is the finest shoe insulation made today. It is lightweight, not bulky, and keeps your feet warm.
Insulated	Shoes carry an insulating material in the lining to keep feet warm and comfortable in cold environments.

Special Hazards

Electrical Hazard	This shoe is designed to protect the wearer from open circuits of 600 volts or less under dry conditions
SD1 (ESD)	This shoe is constructed to reduce the accumulation of static electricity by conducting the body charge to the properly grounded

	flooring system. SD Type footwear will fall within 10^6 - 10^8 ohms of resistance generally considered to be acceptable for semi conductor applications.
Puncture Resistant Sole	This shoe contains a stainless steel midsole, which is designed to reduce the hazards of puncture wounds caused by sharp objects that could penetrate the sole.
Metatarsal Protection	This shoe contains a composite or steel plate that entirely covers the top of foot beyond the toes for additional protection.

15.6.4.3 Foot Protection Inspection/Maintenance

Footwear is a personal item and should be used exclusively by the individual to whom it is issued. Footwear shall be maintained in a clean and reliable condition.

Footwear should be inspected before each use for:

- Tears in the upper part of the safety shoe
- Worn or torn laces
- Protrusions through the sole
- Dents in the toe cap or metatarsal protection

If any of the above conditions occur, the footwear must be replaced immediately.

15.6.5 Electrical Protective Devices

15.6.5.1 Electrical Protective Device Requirements

Electrical protective devices include insulating blankets, matting, covers, line hose, gloves, and sleeves made of rubber all of which are designed to minimize or eliminated personal exposure to electrical energy sources.

15.6.5.2 Electrical Protective Device Classifications

There are no specific classifications for electrical protective devices.

15.6.5.3 Electrical Protective Device Usage

The use of GFCI's (Ground-Fault Circuit Interrupters) is required at GRC for the following:

- All 120 volt, single-phase 15- and 20-ampere receptacle outlets on construction sites which are not part of the permanent wiring of the building or structure which are in use by employees

- For any other situations, an Assured Equipment Grounding Conductor Program (AEGCP) must be established. (See 29 CFR 1926.404, "Wiring Design and Protection").

15.6.5.4 Electrical Protective Device Inspection/Maintenance

OSHA requires that any electrical protective devices that are used to provide personal protection be subjected to certain A-C (Alternating Current) proof tests, and workmanship and finish test to ensure that the materials used in electrical applications are acceptable for use. See SB for assistance in complying with OSHA requirements when conducting A-C proof tests.

15.6.6 Hand Protection

15.6.6.1 Hand Protection Requirements

The requirements of 29 CFR 1910.138 applies to applications where protective gloves are required. Hand protection is required when employees' hands or arms are exposed to:

- Severe cuts and lacerations
- Abrasions
- Punctures
- Skin absorption of harmful substances
- Chemical burns
- Thermal burns
- Harmful temperature extremes

There are no ANSI standards for gloves. Work gloves, in general, comply with industry/manufacturer standards. Chemical resistant gloves are performance tested by each manufacturer against several chemicals to determine their ability to resist chemical breakdown from a specific chemical; therefore, chemical resistant gloves must be selected based on the manufacturer's performance data.

15.6.6.2 Hand Protection Classifications

There are two general categories for gloves:

- Work Gloves
- Chemical Resistant Gloves

Work gloves are designed to protect employees from physical hazards such as cuts, abrasions, and burns. Chemical resistant gloves are designed to protect employees from chemical exposures.

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Work Glove Usage

Work gloves must be used in accordance with the manufacturer's recommendations.

Loose fitting work gloves cannot be used when an employee is working on or near open moving parts such as drills and grinders. When an employee is working with moving parts, the gloves must be form fitting; they cannot be loose or have torn fragments hanging from them. There are several styles of tight-fitting work gloves available through stock.

Oils and grease are common causes of occupational dermatitis. Oil and grease protective work gloves should be worn when working around oily and greasy parts. The stock room currently carries several nitrile coated work gloves that will offer protection from oils and grease.

Thermal protective gloves provide insulative protection, **not** protection from spilled cryogenic liquids. They are designed to fit loosely so they can quickly be shaken off in case of a spill.

Chemical Resistant Glove Usage

There is no single glove material that can provide protection from all hazards. Even chemical resistant glove materials provide limited protection against many chemicals. Therefore, it is important to select the most appropriate glove for a particular application and to determine how long it can be worn, and whether it can be reused. Gloves will be selected based upon performance characteristics of the gloves relative to:

- Task(s) being performed
- Conditions present
- Duration of use
- Frequency of use
- Degree of exposure to the hazard
- Hazards and potential hazards identified
- Severity of the hazard
- 'Employee sensitivities to glove materials
- Glove performance data

The same glove materials manufactured by different companies will offer various levels of protection against the same chemical; therefore, information on performance characteristics of a glove is based on information provided by the manufacturer of the glove to be used. If the glove has not been tested against a specific chemical to be used, the MSDS will be consulted for further information. If the MSDS does not provide specific glove material, the manufacturer can be contacted by the Industrial Hygiene Team (IHT) to determine what glove material would be appropriate for use.

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In some circumstances, it may be more cost effective to regularly dispose of cheaper gloves than to reuse types that are more expensive. When disposable gloves are used, it is important to ensure that the glove material is able to protect against the hazard for the duration of time potential exposure can occur.

Generally, any chemical resistant glove can be used for dry powders.

Vinyl gloves are a controlled item at GRC because it is often misused as a chemical resistant glove. Vinyl latex gloves offer no chemical protection and can only be worn to protect hands from general dirt and debris.

Employees must be able to remove chemical resistant gloves in such a manner as to prevent skin contamination. There are several methods to safely remove chemical resistant gloves. One method is to pinch the glove near the cuff on the inside of the wrist and pull both gloves off simultaneously. This will result in both gloves being turned inside out, where the chemical contamination will remain inside the gloves.

Non-disposable chemical resistant gloves should be cleaned after every use to ensure that chemical contamination does not remain on the glove.

It may be necessary to wear two pairs of gloves at the same time. For example, a thin chemical resistant glove may need a tougher outer glove to prevent punctures; however, it is never allowable to wear two types of chemical resistant gloves to protect against a mixture of chemicals. For example: if glove material A protects against acetone but not hydrochloric acid, and glove material B protects against hydrochloric acid but not acetone, a combination of gloves A and B cannot be used to protect against a mixture of hydrochloric acid and acetone. The reason is glove B will be permeated by the acetone allowing hydrochloric acid to penetrate glove A. When working with a chemical mixture, a glove that offers protection against all chemicals in the mixture **must** be selected.

15.6.6.3 Hand Protection Inspection/Maintenance

All arm and hand protection equipment shall be maintained in good, clean condition in accordance with the manufacturer's recommendations. Gloves should be checked for signs of deterioration before every use.

15.6.7 Fall Protection

15.6.7.1 Fall Protection Requirements

The requirements of 29 CFR 1910, Subpart F, Section 66, Appendix C, and 29 CFR 1926, Subpart E, Sections 104, 105, and 106 apply to applications where fall protection devices apply.

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Fall protection must be worn when working 6 ft or higher above the next lower working surface. Body positioning belts are not permitted to be used as a means of fall protection. They are very dangerous and can sever the spinal column and cause damage to internal organs.

15.6.7.2 Fall Protection Classifications

The above OSHA requirements address the use of safety jackets, lifelines, lanyards, safety nets, working over or near water, and personal fall arrest systems. Each has specific uses depending on the work situation and the work environment.

15.6.7.3 Fall Protection Usage

Fall protection such as lifelines, safety harnesses, and associated equipment must be used in a work environment where the hazards of falling cannot be eliminated by railings, floors, or other means. Supervisors must contact the Safety branch to determine the most appropriate type of fall protection equipment to be used.

Unless otherwise specified, most fall protection is designed to provide protection for a mass limit of 310 pounds. Individuals weighing over 310 pounds should not use fall protection or be placed in a situation where fall protection is required. Individuals who weigh less than 310 pounds must ensure that the combined weight of their tools, equipment and body weight does not equal or exceed 310 pounds.

Workers must have a co-worker in the area when using fall protection. The co- worker must help rescue any worker who has fallen. Any equipment used in a fall cannot be reused. It is impossible to determine the damage the restraint system may have incurred which could limit its effectiveness.

It is best to keep pant and shirt pockets empty when wearing fall protection. If a fall does occur, any items in pockets will be thrust into your flesh at a force much greater than your own body weight.

Each harness is different so the manufacturer's instructions must be reviewed whenever a new piece of fall protection is purchased. In general, the dee ring must be positioned in the middle of the back between the shoulder blades. Straps should not be twisted. The loose end of the webbing used for adjusting must remain on the outside and away from the user. Fall protection should fit rather snugly but not so tight, that circulation is cut off. The harness should be snug so it does not shift or change positions if a fall does occur.

Fall protection connecting devices must be attached to the back dee-ring of a full body harness. Never attach non locking snaps to a dee-ring. Side, front, and chest dee-rings should be used for positioning only. Shoulder dee-rings are for retrieval only.

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Free fall distance should be kept at a minimum. Free falls greater than 6 feet are not permitted. To help assure this, the tie-off attachment point should be located at or above back dee-ring. In other words, the dee-ring on the harness cannot be above the tie off point. Therefore, the tie off point cannot be the work surface. The free fall distance is the distance in the elongation of the shock absorbing lanyard plus the length of the un-elongated lanyard.

Connecting Devices

- Only lanyards with locking snap hooks and shock absorbers will be used.
- Tie off in a manner that limits free fall to the shortest possible distance (the maximum free fall distance allowed is 6 feet).
- Make sure objects below you will not be struck if you fall.
- When using a shock absorbing lanyard, take into consideration the elongation distance of the lanyard.
- Do not tie knots in the lanyard.
- Do not disable locking latches or alter the connecting device in any way.
- Do not attach multiple lanyards together or attach a lanyard back onto itself.
- Do not wrap lanyards around sharp or rough edges.
- A webbed cross arm strap can be used to wrap around a surface and connect to a lanyard's snap hook.
- Do not allow lanyards to come in contact with high temperature surfaces, welding or other heat sources.
- Natural materials such as cotton cannot be used as part of the fall protection system.
- Polyester harnesses should be used in certain chemical or acidic environments.

Anchor Points

- The anchor point (point where system is tied off to) must be able to withstand 5,000 pounds per worker. If two workers are tied off to the same structure, it must be able to withstand 10,000 pounds etc.
- Work should always be done directly underneath the anchoring point to avoid a swinging injury.
- The anchor point must be able to limit free fall distance to less than 6 feet.
- The anchor point must be at or above the connection to the back dee-ring.

Proper anchoring and tie-off techniques

A knot cannot be used to tie off. A knot will reduce the lifeline or lanyard strength by 50 percent or more. Using a rope lanyard or lifeline around an "H" or "I" beam can reduce its strength by as much as 70 percent due to the cutting action of the beam edges. Webbed cross arm straps should be used around "H" and "I" beams. Each employee must have a separate lifeline. The following connections may not be used:

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- Two or more snap hooks connected to one dee-ring.
- Two snap hooks connected to each other.
- A snap hook connected back on its integral lanyard.
- A snap hook connected to a webbing loop or webbing lanyard.
- Connections that do not allow the snap to completely close and be locked.

15.6.7.4 Fall Protection Inspection/Maintenance

Personal lifelines, retrieval lines, body supports, belts, harnesses, and associated equipment shall be used, cared for, and inspected in accordance with the manufacturer's recommendations. Supervisors shall ensure compliance.

Fall protection must be inspected before each use for mildew, wear, damage and other deterioration. Defective components must be removed from service. Fall protection must not be altered in any way. If a piece of fall protection was used in a fall, it cannot be used again.

To clean fall protection, wipe off all surface dirt with a sponge dampened in plain water. Squeeze the sponge dry. Dip the sponge in a mild solution of water and commercial soap or detergent. Work up a thick lather, with a vigorous back and forth motion. Then wipe the harness dry with a clean cloth. Hang freely to dry but away from excessive heat, steam, or prolonged periods of sunlight.

Proper storage and maintenance after use are as important as cleaning the equipment of dirt, corrosives or contaminants. Storage areas should be clean, dry and free of direct sunlight, high heat, and exposure to fumes and corrosive elements.

<u>Body Harness Inspection</u>

For all harness straps, begin at one end of the strap, holding the body side of the strap towards you; grasp the strap with your hands about 6 - 8 inches apart. Bend the belt to form the letter "n". This permits you to see more easily and damaged fibers or cuts on the outside of the belt. Perform this procedure for the entire strap and for all straps.

Check dee-rings for distortion, cracks, breaks and rough or sharp edges. Dee-rings should be able to pivot freely. Buckle and dee-ring attachments should be checked for any unusual wear, frayed or cut fibers, or distortion of the buckle or dee-rings.
Check belts and straps for distorted or broken grommets. The tongue of belt buckles should be free of distortion in shape (including sharp edges) and in motion. They should overlap the buckle frame and move freely back and forth in their socket. Rollers should move freely on the frame.

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Lanyard Inspection

When inspecting lanyards, begin at one end and work to the opposite end. Slowly rotate the lanyard so that the entire circumference is checked. Inspections should be performed using the following procedures:

- Inspect snaps closely for hook and eye distortions, cracks, corrosion or pitted surfaces. The latch should sit into the nose without binding and should not be distorted or obstructed. The latch spring should exert enough force to firmly close the latch. Latch locks must be able to keep the latch from opening when it is closed.
- Thimbles should be firmly seated in the eye of the splice and the splice should have no loose or cut strands. The edges of the thimble must be free of sharp edges, distortion or cracks.
- When inspecting a steel lanyard, watch for cuts, frayed areas, or unusual wearing patterns on the wire. Broken strands will separate from the body of the lanyard.
- When inspecting a webbed lanyard, the lanyard should be bent over a pipe or mandrel and each side observed for cuts, breaks, swelling, discoloration, cracks, and charring. Observe closely for breaks in the stitching.
- When inspecting a rope lanyard, rotate the lanyard while inspecting from end to end to find any fuzzy, worn, broken or cut fibers. Pay attention to rope diameter; changes in rope diameter reflect weakened areas.

Visual Indications of Damage to Webbing and Lanyards

Type of Webbing	Heat	Chemical	Molten Metal or flame	Paint and Solvents
Nylon and Codura	In excessive heat, nylon becomes brittle and has a shriveled brownish appearance. Fibers will break when flexed. Do not use above 200 degrees F	Change in color usually appearing as a brownish smear or smudge. Transverse cracks when belt is bent over a mandrel. Loss of elasticity in belt.	Webbing strands fuse together. Hard shiny spots. Hard and brittle feel. Will not support combustion	Paint, which penetrates and dries, restricts movement of fibers. Drying agents and solvents in some paints will appear as chemical damage.
Polyester (Dacron)	Same as nylon except do not use above 180 degrees F	Same as Nylon	Same as nylon except will support combustion	Same as nylon

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15.7 Supplemental PPE Elements

- Respiratory Protection Program (29CFR1910.134) - Reference Chapter 12 of the Glenn Environmental Programs Manual http://osat.grc.nasa.gov/epm/epm-2/epm12.pdf.
- Hearing Conservation Program (29CFR1910.95) - Reference Chapter 11 of the Glenn Environmental Programs Manual http://osat.grc.nasa.gov/epm/epm-2/epm11.pdf.
- Laser Radiation Protection Program - Reference Chapters 30 of the Glenn Environmental Programs Manual. http://osat.grc.nasa.gov/emo/Laser%20Manual/laser-manual1-98.htm

15.8 Training Requirements

Training must be provided to employees before they are required to wear any personal protective equipment.

Refresher training is required when:

- A new piece of protective equipment is required to be worn.
- There is a change in the type of PPE being used.
- The employee does not show the ability to properly use the PPE.
- A worker's job scope has changed/been altered.

15.9 Records

Training records will be maintained by the Organization Development and Training Office for Civil Servants. Copies of classroom attendance sheets will be made available to support organizations (support service contractors, construction contractors, maintenance contractors, etc.) upon request.

15.10 Summary

In summary, proper personal protective equipment shall be worn whenever a situation requires its use. If there is any doubt about whether the use of personal protective equipment is required, SB and/or EMB shall be contacted to make that determination. When respiratory protection is required because of an existing or potential hazard, EMB must approve such use. All personnel using PPE should have received training regarding the proper use of that equipment prior to use.

All personal protective equipment shall be maintained in a reliable condition. Regular inspection of the equipment is required to ensure its adequacy. Area Supervisors shall be responsible for ensuring proper use and maintenance of their employees' personal protective equipment.

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15.11 Bibliography

- Accident Prevention. Manual for Industrial Operations. 1988. National Safety Council, Washington, D.C. ANSI Z41.1. American National Standards Institute. 1999, "ANSI Standard for Personal Protection-Protective Footwear".
- ANSI Z87.1. American National Standards Institute. 1989. ANSI Practice for Occupational and Educational Eye and Face Protection".
- ANSI Z89.1. American National Standards Institute. 1997. ANSI Standard for Industrial Head Protection".
- Title 29, Code of Federal Regulations, Part 1910 – Occupational Safety and Health Standards Subpart I – Personal Protective Equipment & Part 1926 – Safety and Health Regulations for Construction Subpart E – Personal Protective and Life Saving Equipment.