



Ames Procedural Requirements

APR 1700.1

Last Revised: 10/17/2008

COMPLIANCE IS MANDATORY

Ames Health and Safety Manual

Chapter 33 - Personal Protective Equipment (PPE) Hazard Assessment and Selection

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33.1 Purpose

The purpose of this chapter is to provide guidance to employees and supervisors on the selection of appropriate for Personal Protective Equipment (PPE) to prevent them from injury or illness from hazards that can not be controlled using engineering or procedural controls.

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33.2 Applicability

This manual is applicable to: (1) all Ames Employees; and (2) all persons and entities who agree in writing to comply with this manual.

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33.3 Responsibilities

33.3.1 Safety, Health and Medical Services

1. Maintain oversight of hazard assessment and personal protective equipment (PPE) selection and training programs.
2. Be a resource to employees and supervisors for review of hazards and hazard assessments and the selection of appropriate PPE.
3. Provide up-to-date and appropriate PPE training to employees and supervisors. This training will be reviewed at least annually and updated as necessary.
4. Maintain records for general PPE training provided.
5. Review this Chapter as necessary to ensure that material is correct, up-to-date, and appropriate for the NASA Ames workforce.

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33.3.2 Ames Health Unit

1. Provide medical consultation and examinations government employees when referred by their supervisors for PPE medical authorizations or job related problems.
2. Provide prescription safety glasses to qualified Government employees.

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33.3.3 Managers and Supervisors

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33.3.4 Contracting Officer's Technical Representatives (COTR)

Monitor and evaluate the contractor compliance with this chapter and with 29 CFR 1910.132. (See Contractor Evaluation Checklist for Hazard Assessment and PPE Selection, in Appendix B, section 33.13.4). Contractor policies and procedures described in the corporate Injury and Illness Prevention Program should be, at a minimum, equivalent to the provisions of this chapter.

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33.3.5 Employees

1. Before performing work that necessitates PPE:
 - Attend and pass applicable PPE training;
 - Receive any applicable medical clearance;
 - Demonstrate understanding of PPE requirements and the ability to use, store, and properly decontaminate PPE;
 - Obtain the proper PPE in the proper size and fit for the work
2. Always wear designated, appropriate PPE for hazardous work.
3. Do not use personally owned PPE at ARC without the supervisor's approval. Personally owned safety shoes, prescription safety glasses, etc. must meet applicable OSHA requirements and American National Standards Institute (ANSI) standards. The employer is required by law to provide required PPE to employees at no cost to the employee.
4. Never use defective or damaged PPE.
5. Bag and label PPE contaminated with hazardous materials destined for disposal as hazardous waste.
6. Stop working in the hazardous area and notify the area manager or supervisor if there is any problem with issued PPE or concerns with the quality, appropriateness, effectiveness, or use of provided PPE.

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33.4 PPE Hazard Assessment Process

The Occupational Safety and Health Administration (OSHA) and NASA require written workplace hazard assessments to identify potential hazards for which PPE is needed and for which engineering design or administrative controls cannot feasibly be used to eliminate the hazard. PPE is not considered the first line of protection against workplace hazards. Engineering design and administrative controls must be the first priority of defense against occupational hazards.

Supervisors at NASA Ames Research Center are required to conduct a walkthrough safety survey of their area of responsibility to ensure all hazards are identified and all necessary hazards assessments are complete and accurate. The steps for this survey begin with defining the workplace, reviewing the facility layout and observing/evaluating the tasks. Then the supervisors need to identify where personnel are located, assess all of the potential hazards, determine affected body areas, and estimate the probability and severity of these hazards. Some examples of hazards found in the workplace are listed below.

General Hazard Categories	Examples of Specific Hazards
Biological hazards	Body fluids (bloodborne pathogens), animal bites, insect bites, toxins, allergens, pathogenic microbes, bird excrement, rodents
Chemical hazards	Flammability, corrosiveness, reactivity, toxicity, irritation, harmful dust, gases and vapors
Electrical hazards	Electric shock, electrical burns, electric arc blast, static electricity
Environmental hazards	Noise, bright light, darkness, cold or hot weather, high humidity, wet weather, high winds
Person-equipment hazards	Moving machinery or vehicles, sources of

	motion/moving parts, hazards from wearing incorrect or poor-fitting PPE, reduce mobility, impaired vision, poor communication
Person-position hazards	Falls from heights, engulfment (water, dirt, sand, etc.) low worker visibility, bumps into stationary objects/structures
Physical hazards	Flying debris, projectiles, falling objects, rough or abrasive surfaces, excessive vibration, high pressure (explosive potential)
Radiation hazards	Ionizing radiation (alpha, beta, gamma, x-ray) or Non-ionizing radiation (radar, microwave, radio frequency, laser, UV light, IR light, arc welding)
Thermal hazards	Flame, high heat, sparks, hot surfaces, hot liquids or gases, molten metal

The assessment of all potential workplace hazards and the selection of appropriate PPE for the employees who perform the hazardous tasks must be documented in the form of the PPE Hazard Assessments or other comparable documents such as SOPs (standard operating procedures), Laboratory Safety Plans, or a Job Hazard Analysis. Whenever conditions, materials, or processes change, supervisors are responsible to ensure any new hazards or changes in hazards are assessed, documented, and communicated to personnel exposed to these hazards. The Ames, Safety, Health and Medical Services will be in the hazard assessment if needed.

The PPE Hazard Assessment (or comparable document) will serve as a written certification that the specific hazards have been evaluated and the proper PPE has been selected. This document must also identify the specific workplace and task, the person (s) performing the evaluation, the supervisor's signature, and the date of the evaluation.

Forms to assist in the PPE Hazard Assessment are found in Appendix A (PPE Hazard Assessment Survey Form) or the Job Hazard Analysis Form which is available on line (see References). The Ames Occupational Safety, Health & Medical Services Division can furnish templates of a Lab Safety Plan or advise the supervisor on the method for hazard assessments. Page 4 of the PPE Hazard Assessment Survey Form can serve as a specific record of which PPE is selected for the hazardous tasks.

Hazard assessments in the workplace should also include a review of injury and accident reports (including near misses) and employee reports of unsafe or unhealthy working conditions.

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33.5 Selection and Use of Personal Protective Equipment

Employers must provide their employees with appropriate PPE for eyes, ears, respiratory system, face, head, torso, and extremities. PPE must be maintained in a sanitary and reliable condition. PPE must be used whenever hazards may cause injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact. Supervisors must ensure that each item of PPE is appropriately selected for each employee, with consideration of regulatory requirements, and manufacturer's technical data and use recommendations. Forms provided in Appendix A provide for documentation of this process. General guidelines for selecting PPE are listed below.

- PPE items must meet (at a minimum) all applicable standards such as ANSI and NIOSH.
- Poor fit or incorrect sizes may reduce PPE effectiveness.
- Consider PPE expected service life versus actual use life.
- Wherever visitors may be exposed to workplace hazards, they must be provided with appropriate PPE.
- The Safety, Health and Medical Services Division is a resource to be used whenever there are questions regarding proper PPE selection or use.

This chapter covers general PPE selection and use. In certain cases specific PPE is covered in a different Chapter (e.g. respiratory protection-Chapter 28, Laser eye wear-Chapter 8, ect..). To prevent redundancy or differing instruction due to different revisions date, the selection and use of these specific types of PPE will only be covered in their associated Chapters.

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33.5.1 Eye and Face Protection

Each employee shall use appropriate eye or face protection and a face shield, if necessary, when exposed to eye or face hazards from flying particles, sparks, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, radiant heat, electrical hazard, or potentially injurious light radiation.

When selecting eye and face protection, supervisors should consult the manufacturer's description or technical data in order to ensure that the selected items provide identified splash, impact, heat, electrical, and/or special light protection. Eye and face protective devices shall meet, at a minimum, ANSI Z87.1-2003.

Face shields are only supplementary protective devices worn to shield the face from certain hazards. They must always be worn with safety glasses or goggles. Splash goggles and face shield are essential when there is a possibility of liquid splash; this is especially important for work with highly corrosive liquids or cryogenics. Safety glasses with side shields and full-face shields with throat protection should be worn when working in areas with flying objects or with explosive or highly hazardous materials.

ANSI-approved safety glasses must be provided for visitors in any area that is posted with a sign requiring eye protection because of machine tools, optical radiation, etc.

OSHA stipulates the following general requirements and provisions for safety glasses and goggles:

- Side Protection: Safety glasses shall include side protection when there is a hazard from flying objects. Detachable side protectors (e.g., clip-on or slide-on side shields) that meet the pertinent OSHA requirements are acceptable.
- Prescription Lenses: Each affected employee who wears prescription lenses while engaged in operations that involve eye hazards shall wear eye protection that incorporates the prescription in its design. Alternatively, the employee can use eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses. Contact lenses may be worn with appropriate eye protection except where specifically prohibited.
- Manufacturer Identification: Eye and face PPE shall be distinctly marked to facilitate identification of the manufacturer, and such markings shall not be removed or defaced.
- Filter Lenses: Filter lenses for protection against radiant energy during welding, cutting, brazing and soldering shall be selected in accordance with OSHA criteria provided in Appendix C (section 33.13.5).
- For laser eye protection, see information in Section 33.6.3.

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33.5.2 Head Protection

A protective helmet (hard hat) is required for work in areas where there is a potential for injury to the head from falling or flying objects or bumps against fixed objects. A protective helmet designed to reduce electrical shock hazard is required for work near exposed electrical conductors that could contact the head.

Protective helmets, or hard hats, must resist penetration by objects, absorb shock of a blow, be water resistant and slow burning, and have an easily adjustable headband and suspension. A chin-strap is required when working at elevated heights. Protective helmets must comply with ANSI Z89.1-2003. American National Standard for Personnel Protection - Protective Headwear for Industrial Workers.

Hard hat classifications are described below:

Class E (electrical) are tested to with stand 20,000 volts	General service; limited voltage protection
Class G (general) helmets are tested at 2200 volts;and	Utility service, high voltage protection
Class C (conductive) provide no electrical protection	General service; no voltage protection

Hard hats must be inspected regularly and replaced when signs of wear, damage, or deterioration appear in the shell or the suspension. Hard hats do not have an indefinite useful life, nor are they resistant to all physical and chemical exposures. Most manufacturers recommend replacing hard hats that are used regularly every five years regardless of outward appearance. If work conditions include temperature extremes, sunlight or chemical, the hard hat should be replaced sooner. A replacement is required whenever there is a strike from an object or the hard hat has fallen from a significant distance.

Bump caps are permissible where there is no hazard of falling or flying objects or low-voltage electrical contact to the head.

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33.5.3 Foot Protection

Protective footwear is required for work in areas where there is a danger of foot injuries due to falling and rolling objects, electrical hazards, hot or slippery surfaces, molten metal, or objects piercing the sole. Foot protection should be considered for occupations such as metal work, shipping, receiving and warehouse operations, construction, and facility maintenance.

Safety shoes or boots must comply with Z41-1991, American National Standard for Personal Protection - Protective Footwear. This standard provides both impact and compression protection. The ANSI Z41 Committee has recently been dissolved and its functions assumed by ASTM International. They new standard ASTM WK11588-New Standard Guide for Protective Footwear is currently in draft form, but will be the standard for safety shoes and boot selection for this Chapter once it is fully implemented.

Where necessary, footwear that provides metatarsal protection, puncture protection, chemical resistance, electrical insulation, or electrical conduction should be selected. Additionally, leggings, external toe or metatarsal guards (worn over the shoe), and shin guards can also be used for protection against foot and lower leg injuries.

Damaged or worn safety shoes need to be replaced to ensure protection against foot injuries.

Employees must be trained to identify when safety shoes need to be replaced, for example:

- Torn or cracked uppers
- Separation between soles and uppers
- Holes or cracks in heel or soles
- Metal embedded in heels or soles in electrical safety shoes

Damaged or worn safety shoes need to be replaced to ensure protection against foot injuries. Ames replacement policy allows one pair of shoes or boots per year, if needed.

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33.5.4 Hand Protection

PPE for hand protection must be used whenever the potential exists for exposure to hazards, including skin absorption of harmful substances, severe cuts or lacerations; severe abrasions; punctures; chemical burns;

thermal burns; and harmful temperature extremes. The first line of defense against hand injuries shall be machine guarding, barriers, and work procedures. If such measures fail to eliminate the hazards, then protective gloves shall be used to protect employees' hands. When risk of injury includes the arm, protective sleeves are appropriate.

33.5.4.1 Selection

The tasks to be performed, conditions present, duration of use, and the hazards and potential hazards that have been identified during the hazard evaluation process direct the selection of protective gloves. 29 CFR 1910.132 states: "OSHA is unaware of any gloves that provide protection against all potential hand hazards, and commonly available glove materials provide only limited protection against many chemicals." Therefore, the following should be reviewed and considered during the selection process:

- Manufacturer's performance data for penetration, permeation, breakthrough times, thermal protection specific to the materials used.
- Duration, frequency, and degree of exposure of the hazard (for example, immersion or splash protection).
- The degree of dexterity required and the physical stresses that will be applied.
- Material Safety Data Sheet (MSDS) data for toxicity, dermal effects, skin absorption, and recommended PPE for work with hazardous chemicals.

The Safety Division has the expertise to recommend gloves upon request. Extensive glove selection information from several manufacturers can be reviewed at <http://q.arc.nasa.gov/qh/safety/gloves/>

33.5.4.2 Records

Glove selections (manufacturer, trade name, size, and cuff length if not standard) must be documented for each employee. The documentation must include the chemical or trade names of materials for which the glove is specified, and any special requirements such as double-gloving. This information may be recorded on PPE Ensemble Record, page 4 of the PPE Hazard Assessment Survey Form in Appendix A.

33.5.4.3 General Rules for Protective Glove Use and Maintenance

1. Always wear gloves designated for protection against the specific hazards encountered; be aware of limitations, chemical compatibilities, and incompatibilities.
2. Inspect gloves for discoloration, punctures, cracks, and tears before use.
3. Immediately replace and discard defective, damaged, and contaminated gloves.
4. Establish a replacement schedule for reusable gloves, depending on frequency and type of use, even if they do not appear to be contaminated or damaged.
5. Do not reuse disposable gloves that have been exposed to hazardous materials.
6. Wash reusable gloves that have been exposed to hazardous materials before removing from hands.
7. Use cryogenic gloves for work at low temperatures. Select cryogenic gloves that are loose-fitting, insulated, and impermeable for work with cryogenic fluids to avoid gloves freezing to hand.
8. Wear gloves of appropriate cuff length, or gauntlets to protect wrists and arms.
9. Use cotton or hypoallergenic Nitrile gloves as liners to avoid contact with latex gloves in case of latex sensitivity when latex gloves are designated.
10. Do not use barrier creams or lotions as a substitute for gloves when working with hazardous materials; use only to supplement PPE or reduce skin contact to gloves.
11. Use leather gloves only where protection from chemicals is not needed.
12. Avoid wearing gloves with loose cuffs around moving machinery. Select Kevlar, steel mesh, or other appropriate gloves for mechanical hazards.
13. Rubber insulating gloves for electrical or telecommunications work are subject to special requirements. Refer to sections 33.6.1 and 33.6.2.

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33.5.5 Apparel

33.5.5.1 Personal Clothing

Clothing appropriate for the work must be worn. For example, loose sleeves, ties, lapels, cuffs, or other loose clothing and jewelry that can become entangled in moving machinery must not be worn when working with machine tools or with hazardous materials. Polyester clothing should not be worn for work with torches or other sources of ignition. Leather clothing or accessories should not be worn in situations where chemicals could be absorbed in the leather and held close to the skin.

Footwear must also be appropriate for the workplace and operations. For example, shoes with closed toe and heel must be worn where chemical or mechanical hazards may exist. Clogs, perforated shoes, sandals, and cloth shoes do not provide protection against most spilled chemicals, and must not be used in areas with chemical spill hazards.

Personal clothing that has become contaminated with irritating or hazardous agents must be removed. The clothing must then be disposed of as hazardous waste unless the agents can be safely removed in the workplace. Alternatively, a laundry service can be used, but they must be advised of the contamination. Contaminated clothing must be bagged and labeled to identify the hazard.

33.5.5.2 Protective Apparel

Garments such as cotton laboratory coats and tyvek coveralls should be worn if there is a possibility that personal clothing could become contaminated with a hazardous material. Apparel that is contaminated with hazardous materials must be removed and may not be worn outside the work area.

Protective apparel must be selected with consideration of all the hazards involved. For example, cotton coats do not burn readily but they react rapidly with acids. Impervious aprons are essential when chemical splash is possible. However, plastic aprons can accumulate static electricity, and so they should not be used around flammable solvents or materials that can be ignited by static discharge. Some disposable garments provide only limited protection from vapor or gas penetration. Polyester coats are not suitable for work with flame, hot objects, or flammable materials. Additional items, such as gauntlets for arm protection, may be advisable for some operations with hazardous liquids. Equipment selected must function effectively in an environment of combined hazards.

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33.5.6 Safety Shields

Shields, such as the sash of a chemical fume hood, should be used for protection against possible splash hazards. Safety shields should be selected by engineering review with evaluation of factors including tensile strength, impact strength and shatter resistance, resistance to bending loads, chemical resistance, transparency, and burning rate, and used in accordance with the manufacturer's recommendations.

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33.5.7 Respiratory Protection

Respirators with appropriate chemical and/or filters cartridges are required for work in atmospheres with air contaminants above the OSHA Permissible Exposure Limit (PEL) or other specific standards. Respirators are available for other processes where there is a potential for odor or particulate exposures. Choosing the appropriate respiratory protection can be an effective method of protecting the respiratory tract when engineering design and administrative controls can not reduce the exposure levels to an acceptable limit. When there is a potential for decreased oxygen, high concentrations of a chemical (e.g., >50 times the PEL or IDLH levels), or poor warning properties, air supply respirators are required. The use of a respirator requires training, a medical evaluation, an industrial hygiene evaluation, and fit testing of an appropriate selected respirator. Respirator requirements are described in APG 1700.1, Chapter 28, Respiratory

Protection. Respirators and their use must also comply with all applicable OSHA regulations, NIOSH approvals, and ANSI standards.

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33.5.8 Hearing Protection

Ear plugs and ear muffs are the primary PPE to reduce occupational noise levels at Ames. The basic approach for selecting hearing protection devices includes evaluating the noise hazard, understanding the Ames and OSHA requirements, and selecting the proper PPE to reduce the occupational noise to an acceptable level. Selection includes comfort, noise attenuation, design features, materials, disposable versus re-use, etc. The Hearing Conservation Program, Chapter 29 in APG 1700.1, describes the Ames and OSHA requirements for all aspects of noise PPE.

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33.6 Operation-Specific PPE

Persons to whom the following sections apply should consult the applicable standards for the complete OSHA requirements.

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33.6.1 Electrical Protective Devices

29 CFR 1910.137	Electrical protective equipment
29 CFR 1910.333(c)(2)	Electrical Safety, Use of PPE
29 CFR 1910.335(a)	Electrical Safety, Use of PPE

Electricity can create three possible types of hazards:

- Exposure to electrical shock
- Exposure to electrical arc
- Exposure to static electricity

When energy hazards exist that cannot be eliminated, then engineering practices, administrative practices, safe work practices, PPE and proper training will be implemented. The workplace and specific jobs shall be evaluated to determine the appropriate PPE to reduce the electrical hazards. PPE is not the same for the three types of electrical hazards. Body areas that can be affected include entire body, head, face, eyes, arms, hands, and feet. Safety shoes, hard hats and insulated nonmetallic framed safety glasses worn by electrical workers shall meet the requirements of ANSI Z41, ANSI Z89.1, and ANSI Z87.1 specifications respectively.

Design requirements and in-service care and use requirements are specified by OSHA for electrical protective equipment, including insulating blankets, matting, covers, line hose, gloves, and sleeves made of rubber. All electrical protective equipment shall be certified by the manufacturer to meet all applicable American Society for Testing Materials, (ASTM) standards. Equipment that meets these standards complies with the specifications for manufacture and marking, current proof testing, workmanship, and finish.

Acceptable electrical protective equipment is clearly marked with a Class designation (0,1,2,3 or 4) and Type I (for non-ozone-resistant equipment other than matting) or Type II (ozone-resistant equipment other than matting.) Rubber Insulating Equipment Voltage Requirements, from 29 CFR 1910.137, Table I-5, are reproduced in Appendix D.

The following specific use requirements apply to insulating blankets, covers, line hose, gloves, and sleeve

made of rubber:

1. Maximum use voltages shall conform to those listed in Appendix D.
2. Insulating equipment shall be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves shall be given an air test, along with the visual inspection.
3. Insulating equipment with any defect that damages the insulating properties may not be used. Defects include: a hole, tear, puncture or cut; ozone cutting or checking; an embedded foreign object; texture changes such as swelling, softening, hardening, or becoming sticky or inelastic.
4. Insulating equipment found to have other defects that might affect its insulating properties shall be removed from service and returned for testing or replaced.
5. Insulating equipment shall be cleaned, per manufacturer's instructions, as needed to remove foreign substances.
6. Insulating equipment shall be stored in such a location and in such a manner as to protect it from injurious substances and conditions such as light, temperature extremes (>90°F), excessive humidity, and ozone. The equipment shall be stored flat, undistorted, right side out, unfolded and in protective containers. Blankets may be rolled provided the inner diameter is at least 2 inches.
7. Protector gloves shall be worn over insulating gloves, except that they need not be used with Class 0 gloves, under limited-use conditions, or where small equipment and parts manipulation necessitate unusually high finger dexterity. A glove one class higher than that required for the voltage involved may be used for similar work without protector gloves if the possibility of physical damage to the gloves is small. Insulating gloves that have been used without protector gloves may not be used at a higher voltage until they have been tested according to the applicable national consensus standards.
8. Electrical protective equipment shall be subjective to periodic electrical tests. OSHA Tables I-5 and I-6, indicating test voltages and the maximum intervals between tests, are reproduced in Appendix D. Each glove shall be conspicuously marked with the last test date.
9. Insulating PPE that fails to pass inspections or electrical tests should be destroyed, disposed of, and replaced.
10. Special guidelines for work near exposed energized conductors or circuit parts include the use of insulated tools or handling equipment, nonconductive ropes, handlines, and the use of shields, barriers and insulating materials. Conductive articles of jewelry and clothing may not be worn. Consult the Ames Electrical Safety Chapter (APG 1700.1, Chapter 11) for additional information on reducing electrical hazards.

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33.6.2 Protective Equipment for Telecommunications and Insulating Equipment

29 CFR 1910.268(f) Telecommunications, Insulating Equipment All PPE must be inspected by a competent person before each day's use to ensure that they are in good condition. Rubber gloves must be air tested.

33.6.2.1 Rubber Insulating Equipment

Rubber insulating equipment must meet ANSI standards J6.6-1971 and J6.4-1971; non-rubber equipment is acceptable if it provides equivalent electrical and mechanical protection. All insulating equipment must be periodically retested (visual, electrical, and mechanical testing) at intervals listed in Appendix D.

Gloves and blankets must be marked to indicate compliance with the retest schedule. Defective gloves must be destroyed by cutting them open from the finger to the gauntlet.

Insulating gloves and blankets must be stored away from direct sunlight, steam pipes, and other sources of excessive heat; gloves must be stored in glove bags or in their original containers, and blankets in a canister or other protective device. Gloves and blankets may not be folded while in storage (blankets may be rolled)

33.6.2.2 Personal Fall Protection Equipment

In the workplace, fall protection measures must be implemented whenever personnel are exposed to a fall four or more feet to the lower level or the ground (six feet for construction related activity). Such measures may include a body harness system with appropriate connectors, anchorages, lanyards, and shock absorbers, that shall meet the design and testing requirements of ANSI Z359.1, "Safety Requirements for Personal Fall-arrest Systems, Subsystems, and Components" and OSHA 29 CFR 1910.66, Appendix C. Safety belts are not allowed for fall arrest at Ames.

A safety harness should be worn snug, not tight. The chest strap should be located at the sternum. The back ring is placed between the shoulder blades, and the lower strap is placed under the posterior. When the harness is worn properly, it distributes the body weight evenly. When not worn properly and a person falls, the chest strap can choke one to death while the leg straps can cut off circulation in the legs and increase body pressure, resulting in heart failure. No employee at Ames is allowed to wear a harness fall arrest system without appropriate training.

Personal fall arrest systems shall be inspected prior to each use for mildew, wear, damage or other deterioration. Any defective equipment shall be immediately tagged out and removed from service.

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33.6.3 Protective Equipment for Laser Operations

Protective eyewear must be provided for use wherever personnel could be exposed to levels of laser radiation above Maximum Permissible Exposures (MPE) as established by the American National Standard Institute (ANSI Z136.1). All laser eyewear must be clearly labeled with the optical density values and the useful wavelengths, and must be periodically inspected to ensure serviceability. A Laser Eye Examination is required for all persons (Government and contractor employees, students and associates) who do work that requires laser safety eyewear at Ames. The Ames program for laser safety is contained in NHB 1700.1 chapter 7, Nonionizing Radiation Safety.

33.6.3.1 Protective Equipment for Hazardous Waste Operations and Hazardous Materials Emergency Response

29 CFR 1910.120(g)	Hazardous Waste Operations
29 CFR 1910.120, Appendix B	General Description and Discussion of the Levels of Protection and Protective Gear

Hazardous waste operations have long been required to have a written PPE program. For hazardous waste sites and emergency response, PPE selection follows the initial evaluation and hazard identification. Ensembles for four levels of protection (A, B, C, and D) are described in the regulation, along with test standards, selection, care, and use requirements. Persons involved in these operations must be trained in all applicable elements of the regulations.

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33.6.4 Protective Equipment for Welding Operations

29 CFR 1910.252(b)	Welding
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A welder can encounter such hazards as fire or excessive heat, sparks, electrical shock, dangerous fumes, molten metal, burns, UV or Infra red radiation, intense visible light, and/or excessive noise. PPE alone cannot eliminate all the potential hazards during welding, but using the correct PPE appropriately can reduce risk and prevent injury and incidents. Welders must routinely wear safety gloves, fire-resistant clothing, safety shoes, and eye/face protection to ensure their safety. All welding PPE material shall be made to insulate against heat and electricity and be noncombustible.

Eye/face Protection: Goggles or safety glasses with side shields are worn with helmets or hand shields in welding or cutting processes to protect the eyes and face because one form of eye protection is not enough.

These items should conform to ANSI Z87.1-1989, "American National Practice for Occupational and Educational Eye and Face Protection", and ANSI Z89.1-1986, "Protective Head-ware for Industrial Workers". Goggles must have ventilation to prevent fogging. All filter lenses and plates shall meet the test for transmission of radiant energy prescribed in the ANSI Standard. Lenses must be permanently marked to identify the source and shade. Filter plates must be easily removed. Appendix C of this Chapter describes the required lens shades for various welding operations.

Helmets shall be designed to protect the face, neck, and ears from direct radiant energy.

Protective clothing: Flame/fire resistant fabric or leather protective clothing is required to control heat and spark hazards. When a UV or an infra red hazard is present, all skin must be covered with preferably dark woolen material. Synthetic blend fabrics should never be worn during welding operations. If cotton is used it should be thick and chemically treated to resist flammability. Sleeves and collars should be buttoned and outer clothing free from oil and grease. Open front pockets and cuffs ought to be avoided.

Respiratory Protection: Respiratory protective equipment is required when:

- Gas, dust or fumes cannot be kept below the permissible threshold limits (PEL)
- There is a potential for oxygen deficiency
- Performing inert-gas-shielded arc welding
- Other PPE required depending on the work conditions are:
 - Skull cap to protect head, ears, and hair from sparks or burns (especially when working overhead)
 - Safety boots with high tops
 - Hard hats if exposed to sharp or falling objects
 - Hearing protection in noisy work areas
 - Leather aprons, sleeves, and/or leggings

Welders must inspect their PPE before each job, making sure lenses and filters are not scratched or pitted, goggle straps are not stretched or damaged, helmets are not cracked or damaged, or clothing not torn or worn. After each use, the PPE should be wiped clean of dust and dirt.

Nearby employees to the welding operations may need PPE protection. As an alternative, flameproof shielding or screens may be used as a protective barrier.

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33.6.5 Protective Equipment for Bloodborne Pathogens

29 CFR 1910.1030 (c, d),	Bloodborne Pathogens
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Appropriate PPE, such as gloves, gowns, laboratory coats, face shields, eye protection, mouthpieces, resuscitation bags, pocket masks, or other ventilation devices must be provided when there is occupational exposure, or reasonable anticipation of exposure to bloodborne pathogens. All available and feasible engineering controls must be implemented for BBP protection. Appropriate PPE will not permit potentially infectious materials to reach the employee's clothes, skin, eyes, mouth, etc. under normal conditions of use. Employees with a potential for a bloodborne pathogen exposure, including emergency responders, must be trained in the standard and the use of applicable PPE. See the Ames Health and Safety Manual APG 1700.1, Chapter 32, Bloodborne Pathogens Protection Plan for further information.

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33.6.6 Permit-Required Confined Spaces

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The permit process for confined space entry includes hazard evaluation with atmospheric testing and selection of appropriate PPE. The program and training requirements are described in APG 1700.1 chapter 26, Confined-Space Entry Program.

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33.6.7 Substance-Specific Standards

In addition to the general requirements, substance-specific standards establish the air concentrations above which employees must wear respiratory protection, as well as requirements such as medical monitoring. Supervisors are responsible for determining where these standards apply and meeting the special requirements. The Safety Division provides air monitoring on request. The following is a partial list of commonly encountered contaminants that have specific standards:

Asbestos	29 CFR 1910.1001
Lead	29 CFR 1910.1025
Ethylene Oxide	29 CFR 1910.1047
Formaldehyde	29 CFR 1910.1048
Benzene	29 CFR 1910.1028
Cadmium	29 CFR 1910.1027
Methylene chloride	29 CFR 1910.1052

A complete list of OSHA-regulated substances with specific standards is available from the Safety Division.

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33.6.8 Construction

29 CFR 1926

Construction contractors are responsible for knowing and complying with all applicable elements of the OSHA construction standard. Notable OSHA regulations related to the construction work include standards for asbestos, 29 CFR 1926.1101, and Lead, 29 CFR 1926.62. Construction unique requirements are addressed in the contractor's project safety plan and their Code of Safe Practices. Construction project review and oversight are provided by the Safety Division.

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33.6.9 Other

The general PPE requirements apply to all hazardous tasks and worksites. Additional operations-specific PPE requirements are included throughout OSHA regulations. Each person must know and follow the requirements for his/her assigned tasks.

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33.7 Sources of Personal Protective Equipment

33.7.1 Equipment Available From Ames Stores Stock

Commonly used safety supplies are readily available through Ames Stores Stock. These include:

- Safety glasses, goggles, and face shields
- Bump caps and hard hats
- Chemical and thermal protective gloves
- Ear plugs and muffs
- Respiratory protection equipment for personnel currently enrolled in the respiratory protection program.
- Chemical protective aprons

PPE and general safety supplies in Ames Stores Stock is maintained on the Safety Office Web site (<http://arcapps.arc.nasa.gov?App/Bus/App/BSGindex.taf>).

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33.7.2 Prescription Safety Glasses

Prescription or fitted safety glasses are provided to government employees by the Ames Health Unit (one pair per year is typically allowed; cost restrictions may apply). The Ames Health Unit will schedule a screening appointment upon receipt of ARC Form 169, Authorization for Safety Protective Equipment, when properly completed and signed by the employee's manager/supervisor and by the Safety Division.

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33.7.3 Safety Boots and Shoes

Safety shoes may be purchased for government employees, with branch management approval, by government bank card or purchase order.

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33.7.4 Other Protective Equipment

Reusable protective clothing, such as lab or shop coats and coveralls, is typically provided by means of laundry contracts funded by the user's organization. Adequate supplies of items not available through Stores Stock should be acquired from commercial sources and maintained by the supervisor. Vendor catalogs, Web sites, and manufacturer's data in the Safety Division are resources that may be used for product and source selection.

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33.8 Disposal of Contaminated PPE

Contaminated PPE should be bagged or otherwise accumulated in appropriate containers, for disposal as hazardous waste and identified on the waste label as PPE contaminated with the named hazardous materials and the date. Complete a Form A (http://q.arc.nasa.gov/qe/forms/chem_pickup_Form-A.pdf) and fax or call the Hazardous Waste organization for a waste pick-up.

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33.9 Training

Each employee who is required to use PPE must be trained to know at least the following:

- When PPE is necessary

- What PPE is necessary
- How to properly don, doff, adjust and wear PPE
- Limitations of the PPE
- Proper care, maintenance, useful life, and disposal of the PPE

The Safety Division offers initial, basic PPE training. It is the supervisor's responsibility to ensure that employees are provided with task-specific training. This includes providing instruction in the use and care of specialized PPE equipment, and retraining employees when workplace changes occur that affect the types of PPE. The PPE Hazard Assessment (see Section 33.4) is a useful tool for training and documentation.

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33.10 Records

The PPE Hazard Assessment and selection documentation is retained at the worksite as an attachment to the area safety plan or written operating procedure. It can also be posted in the workplace for easy reference. The Safety Division maintains records of PPE training that is provided by the Safety Division. Supervisors shall maintain documentation of task-specific training that they provide, including the dates and subjects, for each employee.

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33.11 Authority

- 29 CFR 1910.120 General Description and Discussion of the Levels of Protection and Protective Gear
- 29 CFR 1910.120 Hazardous Waste Operations
- 29 CFR 1910.132 General Requirements for PPE
- 29 CFR 1910.133 Eye and Face Protection
- 29 CFR 1910.134 Respiratory Protection
- 29 CFR 1910.135 Head Protection
- 29 CFR 1910.136 Occupational Foot Protection
- 29 CFR 1910.137 Electrical Protective Equipment
- 29 CFR 1910.138 Hand Protection
- 29 CFR 1910.146 Permit-Required Confined Spaces
- 29 CFR 1910.252 Welding
- 29 CFR 1910.268 Telecommunications, Insulating Equipment
- 29 CFR 1910.333 Electrical Safety - Selection and Use of Work Practices
- 29 CFR 1910.335 Electrical Safety - Safeguards for Personnel Protection
- 29 CFR 1910.502 Fall Protection Equipment
- 29 CFR 1910.1001 Asbestos Exposure Clothing
- 29 CFR 1910.1030 Bloodborne Pathogens
- 29 CFR 1926 Construction
- 42 CFR 84 Subpart J Particulate Respirators

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33.12 Definitions

ANSI: The American National Standards Institute is a voluntary membership organization (with private funding) that develops consensus standards nationally for a wide variety of devices and procedures.

IDLH: A concentration of a material that is immediately dangerous to life and health.

Job Hazard Analysis: The JHA is similar to the PPE Hazard Assessment, although it describes a specific job step by step, listing each hazard and control factors as it progresses through the operation. All controls are listed including the recommended PPE. Some organizations use JHA's in place of PPE Hazard Assessments. Generic JHA's and a template can be found a <http://q.arc.nasa.gov/gh/jha/>.

NIOSH: The National Institute for Occupational Safety and Health is a U.S. research and advisory agency to OSHA (Occupational Safety and Health Administration).

PEL: the permissible exposure limit is the legal standard exposure limit that is published and enforced by OSHA.

Personal Protective Equipment (PPE): Devices and clothing designed to be worn or used for the protection or safety of an individual while in potentially hazardous areas or performing potentially hazardous operations.

PPE Hazard Assessment: A written certification documenting the evaluation of the hazards in the workplace and the prescribed PPE to be used to control those hazards. The Supervisor signs and dates the assessment and ensures all affected employees read it. A sample form is located in Appendix A.

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33.13 References

Ames Health and Safety Manual: <http://q/safetymanual/index.php>

Ames reference on glove selection: <http://q.arc.nasa.gov/qh/safety/gloves/>

Job Hazard Analysis Form: <http://q.arc.nasa.gov/qh/jha>

NIOSH Recommended Chemical Clothing: <http://www.cdc.gov/noish/ncpc1.html>

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33.14.1 Appendix A

Personal Protective Equipment (PPE) Hazard Assessment Survey

Code: _____ Bldg: _____ Location: _____ Supervisor: _____ Date: _____

Job Classification: _____ Task: _____

The hazards associated with this task and the appropriate PPE are identified below with .

Part of Body	Hazard	Required PPE	Note #**
Body 	<input type="checkbox"/> Chemical(s) splash or contact (liquids, solids, gases)	<input type="checkbox"/> Chemical-resistant coveralls <input type="checkbox"/> Chemical-resistant apron <input type="checkbox"/> Lab coat or apron/sleeves	
	<input type="checkbox"/> Dust – heavy metals or hazardous fibers	<input type="checkbox"/> Tyvek® coveralls	
	<input type="checkbox"/> Electrical arc blast	<input type="checkbox"/> Flash suit (jacket, pants & hood with integral face shield)	
	<input type="checkbox"/> Electric Shock	<input type="checkbox"/> Rubber insulating mats	
	<input type="checkbox"/> Falls to a different level or into hazardous equipment	<input type="checkbox"/> Body harness and lanyard (minimum, additional equipment may be required)	
	<input type="checkbox"/> Hot metal, molten metal or sparks	<input type="checkbox"/> Flame-resistant cotton jacket/pants <input type="checkbox"/> Leather welding clothing <input type="checkbox"/> Nomex® coveralls	
	<input type="checkbox"/> Impact-flying objects	<input type="checkbox"/> Long sleeves/ apron/ lab coat	
	<input type="checkbox"/> UV light	<input type="checkbox"/> Coveralls <input type="checkbox"/> Long sleeve shirt and long pants	
	<input type="checkbox"/> Radiant Heat	<input type="checkbox"/> Aluminized apron	
	<input type="checkbox"/> Other	<input type="checkbox"/> Other	
Ears 	<input type="checkbox"/> Exposure to noise levels (85-110 dBA TWA)	<input type="checkbox"/> Ear muffs OR plugs with a NRR of ≥ 27	
	<input type="checkbox"/> Exposure to very high noise levels (110 dBA TWA and above)	<input type="checkbox"/> Ear muffs AND plugs with a NRR of ≥ 29 each	
	<input type="checkbox"/> Impact noise (140 dB and above)	<input type="checkbox"/> Ear muffs OR plugs with a NRR of >27	
	<input type="checkbox"/> Exposure to sparks	<input type="checkbox"/> Leather welding hood	
	<input type="checkbox"/> Other	<input type="checkbox"/> Other	
Eyes and Face	<input type="checkbox"/> Chemical – splashing	<input type="checkbox"/> Chemical splash goggles AND	
Part of Body	Hazard	Required PPE	Note #**
	corrosive liquid	face shield	
	<input type="checkbox"/> Chemical-irritating mists or splash	<input type="checkbox"/> Chemical splash goggles	
	<input type="checkbox"/> Chemical-potential splashing liquid (non-corrosive and non-irritating)	<input type="checkbox"/> Safety glasses with side shields <input type="checkbox"/> Chemical splash goggles	
	<input type="checkbox"/> Electrical arc blast	<input type="checkbox"/> Flash suit hood with integral face shield	
	<input type="checkbox"/> Glare, high intensity lights, sunlight	<input type="checkbox"/> Shaded safety glasses	
	<input type="checkbox"/> Hot sparks-grinding	<input type="checkbox"/> Safety glasses OR goggles AND face shield	

33.14.2 Appendix B: Contractor Evaluation Checklist for Hazard Assessment and PPE Selection

From (Contractor): _____
 Contract No: _____
 Contract Title: _____

To (COTR): _____
 Org Code: _____

Date: _____ Report Period: _____ to _____.

Location: _____

Bldg: _____

Laboratory (29 CFR 1910.1450 applies): _____

Other (29 CFR 1910.120 applies): _____

Brief Description of Operation: _____

1	Hazard Assessment		
1.a	Hazard Assessment was performed during the Report Period. Hazard Assessments are attached for the following worksites (attach list):	Yes <input type="checkbox"/>	No <input type="checkbox"/>
1.b	Changes in the workplace or operations necessitated reassessment (attach list).	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	PPE Selection and Provision		
2.a	Appropriate PPE has been selected and provided to employees.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Training		
3.a	All employees required to use PPE have been trained in accordance with 29 CFR 1910.132 .	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3.b	Training was conducted during the report period List dates and number of employees trained (attach list)	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3.c	Written certification of training is maintained.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Issues and Actions		
4.a	Explanation and Action Plan for each "NO" answer (attach list).	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4.b	Request conference with NASA Safety regarding issues that involve hazard assessment and/or PPE (explain).	Yes <input type="checkbox"/>	No <input type="checkbox"/>

Submitted by:
 Printed Name: _____
 Signature: _____
 Date: _____

33.14.3 Appendix C: Filter Lenses for Protection against Radiant Energy

Welding Operations	Electrode Size (inches)	Arc Current (amps)	Minimum* Protective Shade
Shielded metal arc	<3/32	<60	7
	3/32 to 5/32	60 to 160	8
	4/32 to 1/4	160 to 250	10
	>1/4	250 to 550	11
Gas metal arc and flux cored arc welding		<60	7
		60 to 160	10
		160 to 250	10
		250 to 550	10
Gas Tungsten arc welding		<50	8
		50 to 150	8
		150 to 500	10
Air carbon arc cutting	(light)	<500	10
	(heavy)	500 to 1000	11
Plasma arc welding		<20	6
		20 to 100	8
		100 to 400	10
		400 to 800	11
Plasma arc cutting	(light)	<300	
	(medium)	300 to 400	
	(heavy)	400 to 800	
Torch brazing			3
Torch soldering			2
Carbon arc welding			14
Welding Operations	Plate Thickness (inches)	Plate Thickness (mm)	Minimum* Protective Shade
Gas welding (light)	< 1/8	< 3.2	4
Gas welding (medium)	1/8 to 1/2	3.2 to 12.7	5
Gas welding (heavy)	> 1/2	>12.7	6
Oxygen cutting (light)	<1	> 25	3
Oxygen cutting (medium)	1 to 6	25 to 150	4
Oxygen cutting (heavy)	> 6	> 150	5

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

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33.14.4 Appendix D: Test Requirements for PPE Insulating Equipment

Rubber Insulating Equipment Voltage Requirements

Class Of Equipment	Maximum Use Voltage(1) AC-RMS	Retest Voltage (2) AC-RMS	Retest Voltage(2) DC average
0	1 000	5 000	20 000
1	7 500	10 000	40 000
2	17 000	20 000	50 000
3	26 500	30 000	60 000
4	36 000	40 000	70 000

Footnotes:

- The maximum use voltage is the AC voltage (rms) classification of the protective equipment that designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to the phase-to-phase voltage on multiphase circuits. However, the phase-to-ground potential is considered to be the nominal design voltage:
 - If there is no multiphase exposure in a system area and if the voltage exposure is limited to the phase-to-ground potential or
 - If the electrical equipment and devices are insulated or isolated or both so that the multiphase exposure on a grounded the circuit is removed.
- The proof-test voltage shall be applied continuously for at least one minute, but no more than three minutes.

Rubber Insulating Equipment Test Intervals

TYPE OF EQUIPMENT	WHEN TO TEST
Rubber insulating line hose	Upon indication that insulating value is suspect
Rubber insulating covers	Upon indication that insulating value is suspect
Rubber insulating blankets	Before first issue and every 12 months thereafter*
Rubber insulating gloves	Before first issue and every 6 months thereafter
Rubber insulating sleeves	Before first issue and every 12 months thereafter*

- * If the insulating equipment has been electrically tested but not issued for service, it may not be placed into service unless it has been electrically tested within the previous 12 months.

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