Personal Protective Equipment

1. PURPOSE
   1. The purpose of this Standard Operating Procedure (SOP) is to ensure the safe and proper use of personal protective equipment (PPE) by all members of the University Rocket Club during rocket building, testing, and launch activities.
2. SCOPE
   1. This SOP applies to all members, participants, and visitors involved in rocket club activities, including but not limited to building, testing, and launching rockets
3. RESPONSIBILITIES
   1. **Executive Responsible for Enforcement:** Oskar Garcia, President.
   2. Personnel involved in rocket club activities shall be responsible for:
      1. Familiarizing themselves with this SOP and following its guidelines
      2. Attending PPE training sessions
      3. Reporting any concerns or issues related to PPE to the club leadership.
4. Types of Personal Protective Equipment

4.1 This section addresses general PPE requirements, including eye and face, head, foot and leg, hand and arm and body (torso) protection. Separate programs exist for respiratory protection and hearing protection as the need for participation in these programs is established.

4.2 Eye and Face Protection: Employees and students shall wear the appropriate eye and face protection when involved in activities where there is the potential for eye and face injury from:handling of hot solids, liquids, or molten metals;flying particles from chiseling, drilling, sawing, cutting, etc.;intense non-ionizing radiation from gas or electric arc welding, torch brazing, oxygen cutting, laser use, etc.

4.4 Most common types of eye protection used in the workplace:

4.4.1 Eye Protection:

4.4.1.1 Safety Glasses: Ordinary prescription glasses do not provide adequate protection. Eye protection must conform to the American National Standards Institute (ANSI), Standard Z87.1-1989 or latest edition. Look for this stamp on the inside of the safety glass frame. Prescription safety glasses are recommended for employees who must routinely wear safety glasses in lieu of fitting safety glasses over their personal glasses. All safety glasses must have side shields. Whenever protection against splashing is a concern, “Chemical Splash Goggles” must be worn. For more guidance on safety glasses selection, please contact EHS.

4.4.1.2 Goggles: Goggles are intended for use when protection is needed against chemicals or particles. Impact protection goggles, which contain perforations on the side of goggle, are not to be used for chemical splash protection. Splash goggles, which contain shielded vents at the top of the goggle, are appropriate for chemical splash protection, and also provide limited eye impact protection.

4.4.1.3 Face Shields: Face shields must not be used as the sole source of protection for eye hazards. Full-face shields provide the face and throat with partial protection from flying particles and liquid splash. For maximum protection against chemical splash, a full-face shield should be used in combination with chemical splash goggles. Face shields are appropriate as secondary protection when implosion (e.g. vacuum applications) or explosion hazards are present. Face shields, which are contoured to protect the sides of the neck as well as frontal protection, are preferred.

4.4.2 Eye Protection for Non-ionizing Radiation: The radiation produced by welding covers a broad range of the spectrum of light. Exposure to ultraviolet light (UV- B) from welding operations can cause “welders flash”, a painful inflammable of the outer layer of the cornea. Arc welding or arc cutting operations, including submerged arc welding, require the use of welding helmets with an appropriate filter lens. Goggles with filter plates or tinted glass are available for operations where intense light sources are encountered, including but not limited to, gas welding or oxygen cutting operations. Spectacles with suitable filter lenses may be appropriate for light gas welding operations, torch brazing, or inspection.

4.5 Hand Protection: Employees shall use hand protection when exposed to hazards including:

i. Skin absorption of harmful substances

ii. Lacerations

iii. Severe cuts

iv. Severe abrasions

v. Chemical burns

vi. Thermal burns

vii. Harmful temperature extremes

4.5.1 Gloves made from a wide variety of materials are designed for many types of workplace hazards. In general, gloves fall into four groups:

1. Gloves made of leather, canvas or metal mesh

2. Fabric and coated fabric gloves

3. Chemical and liquid resistant gloves

4. Insulating rubber gloves (See 29 CFR 1910.137)

4.5.1.1 Leather, Canvas or Metal Mesh Gloves

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

2. Leather gloves protect against sparks, moderate heat, blows, chips and rough objects.

3. Aluminized gloves provide reflective and insulating protection against heat and require an insert made of synthetic materials to protect against heat and cold.

4. Aramid fiber gloves protect against heat and cold, are cut- and abrasive- resistant, and wear well.

5.Synthetic gloves of various materials offer protection against heat and cold, are cut- and abrasive-resistant and may withstand some diluted acids. These materials do not stand up against alkalis and solvents.

6. Fabric and Coated Fabric Gloves

6.1. Fabric and coated fabric gloves are made of cotton or other fabric to provide varying degrees of protection. Fabric gloves protect against dirt, slivers, chafing and abrasions. They do not provide sufficient protection for use with rough, sharp or heavy materials. Adding a plastic coating will strengthen some fabric gloves.

7. Coated fabric gloves are normally made from cotton flannel with napping on one side. By coating the unnapped side with plastic, fabric gloves are transformed into general-purpose hand protection offering slip-resistant qualities. These gloves are used for tasks ranging from handling bricks and wire to chemical laboratory containers. When selecting gloves to protect against chemical exposure hazards, always check with the manufacturer or review the manufacturer’s product

4.5.2. literature to determine the gloves’ effectiveness against specific workplace chemicals and conditions.

4.5.2.1. Chemical and Liquid Resistant Gloves

1. Chemical-resistant gloves are made with different kinds of rubber: natural, butyl, neoprene, nitrile and fluorocarbon (viton); or various kinds of plastic: polyvinyl chloride (PVC), polyvinyl alcohol and polyethylene. These materials can be blended or laminated for better performance. As a general rule, the thicker the glove material, the greater the chemical resistance but thick gloves may impair grip and dexterity, having a negative impact on safety. Appendix E lists types of chemical and liquid gloves, as well as their advantages and disadvantages. Appendix F lists several chemicals and recommends the type of chemical resistant glove that should be used when handling that specific chemical. Some examples of chemical-resistant gloves include:

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

4.5.2.3 Natural (latex) rubber gloves are comfortable to wear, which makes them a popular general-purpose glove. They feature outstanding tensile strength, elasticity and temperature resistance. In addition to resisting abrasions caused by grinding and polishing, these gloves protect workers’ hands from most water solutions of acids, alkalis, salts and ketones. Latex gloves may cause allergic reactions in some individuals and may not be appropriate for all . Hypoallergenic gloves, glove liners and powder less gloves are possible alternatives for those who are allergic to latex gloves.

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

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

4.5.3. There are no ANSI standards for gloves. However, selection must be based on the performance characteristics of the glove in relation to the tasks to be performed. Wear proper hand protection whenever the potential for contact with chemicals, sharp objects, or very hot or cold materials exists. Select gloves bases on the properties of the materials in use, the degree of protection needed, and the nature of the work (direct contact necessary, dexterity needed, etc.). Leather gloves may be used for protection against sharp edged objects, such as when picking up broken glassware or inserting glass tubes into stoppers. When working at temperature extremes, use insulated gloves. When considering chemical gloves, note that chemicals will permeate glove materials. The permeation rate varies depending on the chemical, glove material, and thickness. Double gloving is recommended when handling highly toxic or carcinogenic materials. Before each use, inspect the gloves for discoloration, punctures and tears. Before removal, wash gloves if the glove material is impermeable to water. Observe any changes in glove color and texture, including hardening or softening, which may be indications of glove degradation. For more information on glove selection, visit the Ansell web-site or contact EHS for guidance.

4.6 Body Protection:

Any one working around hazardous materials or machinery shall not wear loose clothing (e.g. saris, dangling neckties, necklaces) or unrestrained long hair. Loose clothing, jewelry, and unrestrained long hair can become ensnared in moving parts of machinery or contact chemicals. Finger rings can damage gloves, trap chemicals against the skin and be an infection control issue.

4.6.1 Cotton lab coats (preferable to rayon or polyester coats) should be worn to protect clothing from becoming soiled and to provide limited protection against minor splashes of chemicals, biological materials, and radioactive materials. Lab coats with button closure are preferred over zipper closer, since these are easier to remove in case of an emergency. Assure that hazardous chemicals, radioactive materials, or toxic dusts are not carried home by using lab coats, disposable protective clothing, or work clothes which remain at the workplace. Tyvek coveralls can be used over street clothes for protection against particles and low hazard liquids. However, this will not resist liquid penetrations, and if splashed with chemicals, should be removed immediately. Vinyl or rubber

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

4.6.3 Employees should know the appropriate techniques for removing protective apparel, especially any that has become contaminated. Special procedures may need to be followed for cleaning and/or discarding contaminated apparel. Chemicals spills on leather clothing accessories (watchbands, shoes, belts, and such) can be especially hazardous because many chemicals can be absorbed in the leather and then held close to the skin for long periods. Such items must be removed promptly and typically be discarded to prevent the possibility of chemical burns. Note that flame resistance should be considered when selecting whole body protection. Source of ignition could include open flames, arcs, sparks, chemicals, radiation energy and more.

4.7. Protective clothing comes in a variety of materials, each effective against particular hazards, such as:

4.7.1 Paper-like fiber used for disposable suits provide protection against dust and splashes.

4.7.2 Treated wool and cotton adapts well to changing temperatures, is comfortable and fire-resistant and protects against dust, abrasions and rough and irritating surfaces.

4.7.3 Duck is a closely woven cotton fabric that protects against cuts and bruises when handling heavy, sharp or rough materials.

4.7.4 Leather is often used to protect against dry heat and flames.

4.7.5 Rubber, rubberized fabrics, neoprene and plastics protect against certain chemicals and physical hazards. When chemical or physical hazards are present, check with the clothing manufacturer to ensure that the material selected will provide protection against the specific hazard.

4.8 Occupational Foot Protection: Safety footwear shall conform to the requirements and specifications of ANSI Z41.1-1991 or latest edition, “Men’s Safety-Toe Footwear.” Wear proper shoes, not sandals or open toed shoes, in work areas where chemicals are used or stored. Perforated shoes, sandals or cloth sneakers should not be worn in areas where mechanical work is being done. Safety shoes are required for protection against injury from heavy falling objects (handling of objects weighing more than fifteen pounds which, if dropped, would likely result in a foot injury), against crushing by rolling objects (warehouse, loading docks, etc.), and against laceration or penetration by sharp objects. Pullovers, worn over regular shoes, are available for protection against certain chemicals. These boots are made of a stretchable rubber compound and are well suited for cleaning up chemical spills.

4.8.1. Foot and leg protection choices include the following:

4.8.1.1 Leggings protect the lower legs and feet from heat hazards such as molten metal or welding sparks. Safety snaps allow leggings to be removed quickly.

4.8.1.2 Metatarsal guards protect the instep area from impact and compression. Made of aluminum, steel, fiber or plastic, these guards may be strapped to the outside of shoes.

4.8.1.3 Toe guards fit over the toes of regular shoes to protect the toes from impact and compression hazards. They may be made of steel, aluminum or plastic.

4.9 Occupational Head Protection: supervisors must ensure that their employees head protection when any of the following apply:

1. Objects (such as tools) that might fall from above and strike them on the head,
2. Fixed objects, such as exposed pipes and beams,
3. Accidental head contact with electrical hazards.

4.9.1 In general, protective helmets or hard hats should do the following:

1. Resist penetration by objects.

2. Absorb the shock of a blow.

3. Be water-resistant and slow burning.

4. Have clear instructions explaining proper adjustment and replacement of the suspension and headband.

4.9.2 Hard hats are divided into three industrial classes:

1. Class A hard hats provide impact and penetration resistance along with limited voltage protection (up to 2,200 volts).

2. Class B hard hats provide the highest level of protection against electrical hazards, with high-voltage shock and burn protection (up to 20,000 volts). They also provide protection from impact and penetration hazards by flying/falling objects.

3. Class C hard hats provide lightweight comfort and impact protection but offer no protection from electrical hazards.

4. Another class of protective headgear on the market is called a “bump hat,” designed for use in areas with low head clearance. They are recommended for areas where protection is needed from head bumps and lacerations. These are not designed to protect against falling or flying objects and are not ANSI approved. It is essential to check the type of hard hat employees are using to ensure that the equipment provides appropriate protection. Each hat should bear a label inside the shell that lists the manufacturer, the ANSI designation and the class of the hat.

4.9.3 Hard hats must have a hard outer shell and a shock-absorbing lining that incorporates a headband and straps that suspend the shell from 1 to 1 1/4 inches (2.54 cm to 3.18 cm) away from the head. This type of design provides shock absorption during an impact and ventilation during normal wear.

4.9.4 Helmets designed to protect the head from impact and penetration from falling/flying objects and from limited electric shock and burn shall meet the requirements and specifications established in ANSI Z89.1- 1986 or latest edition, “Requirements for Industrial Head Protection”.

4.9.5 Upon inspecting the equipment, if the member finds the following signs of deterioration, then the hard hat should be taken out of service.

4.9.5.1 Suspension system (head band and straps) no longer holds the shell from 1 inch to 1 ¼ inches away from the employee’s head.

4.9.5.2 Cracking, tearing or graying of the lining (head band and straps)

4.9.5.3 The brim or the shell show signs of chalking, flaking, or loss of surface gloss

4.9.6 Employees working in higher elevations, such as aerial lifts, need chin straps for their helmets.

4.9.7 Use of stickers should be limited for use on hard hats, since they hide deterioration and other defects. Paints, paint thinners and cleaning agents can weaken the shell of a hard hat and may eliminate electrical resistance. Ultraviolet light and extreme heat can reduce the strength of the hard hats. Therefore, employees should not store or transport hard hats in direct sunlight. Manufacturer’s specifications must be followed with respect to cleaning.

4.10 Electrical Protection: Specific design, performance, use, and care requirements apply to protective equipment used for isolation against electrical hazards. Persons responsible for the purchase, maintenance, and use of such equipment (insulating blankets, matting, covers, line hose, gloves, and sleeves made of rubber) must be familiar with these requirements (refer to 29 CFR 1910.137).

4.11 Hearing Protection: See the TTU Hearing Conservation Program SOP.

4.12 Respiratory Protection: See the TTU Respiratory Protection Program SOP.

1. PROCEDURE
   1. Fire Retardant Gloves
      1. When handling flammable materials, working with open flames, or potential exposure to heat or fire, individuals shall wear fire retardant gloves.
      2. Gloves shall be inspected for damage or wear before each use and replaced if necessary.
      3. Gloves should be stored in a clean and dry location, away from heat and chemicals.
   2. Lab Coats
      1. Lab coats shall be worn when working with chemicals, biological materials, or activities that may result in splashes or spills.
      2. Select lab coats made of fire-retardant or chemical-resistant fabric, depending on the specific hazards involved.
      3. Lab coats should be buttoned up to protect the torso and prevent exposed skin.
   3. Face Shields or Goggles
      1. Face shields or goggles shall be worn to protect the eyes and face from chemical splashes, flying debris, or potential hazards.
      2. Select appropriate face shields or goggles based on the nature of the hazards and ensure they comply with safety standards.
      3. Adjust the fit for a secure and comfortable fit, providing clear vision and complete coverage.
2. Cleaning and Maintenance of PPE

6.1 It is important that all PPE be kept clean and properly maintained. Cleaning is particularly important for eye and face protection where dirty or fogged lenses could impair vision. Employees must inspect, clean, and maintain their PPE according to the manufacturers’ instructions before and after each use (see attached). Supervisors are responsible for ensuring that users properly maintain their PPE in good condition.

5.2 Personal protective equipment must not be shared between members until it has been properly cleaned and sanitized. PPE will be distributed for individual use whenever possible. If employees provide their own PPE, make sure that it is adequate for the work place hazards, and that it is maintained in a clean and reliable condition. Defective or damaged PPE will not be used and will be immediately discarded and replaced.

It is also important to ensure that contaminated PPE which cannot be decontaminated is disposed of in a manner that protects from exposure to hazards.

6.0 SAFETY

* 1. Possible safety considerations include:
     1. Properly maintaining and inspecting PPE before each use.
     2. Following manufacturer instructions for the correct usage and care of PPE.
     3. Being aware of the limitations and capabilities of the selected PPE. 5.1.4 Reporting any damaged or malfunctioning PPE to the club leadership.
  2. Hazards can be prevented by:
     1. Conducting regular risk assessments for each activity.
     2. Ensuring all individuals are trained in the proper use of PPE.
     3. Providing clear communication of PPE requirements and procedures.
  3. Hazards can be mitigated by:
     1. Regularly reviewing and updating this SOP based on identified risks or changes in regulations. 5.3.2 Seeking feedback from members and participants to improve PPE protocols.
     2. Seeking feedback from members and participants to improve PPE protocols.
     3. Addressing any non-compliance or deviations from PPE requirements promptly.
  4. In the event of an incident, the proper response shall be:
     1. Following emergency procedures outlined in this SOP.
     2. Reporting the incident to club leadership and taking appropriate action as necessary.

1. REFERENCES AND RESOURCES
   1. Author, “Title,” Web URL
2. REVIEW AND APPROVAL

|  |  |  |
| --- | --- | --- |
| **Step** | **Date** | **Done/Approved By** |
| Drafted | JUNE 15, 2023 | Oskar K. Garcia (President) |
| Approved by Safety Officer |  |  |
| Approved by President/Committee |  |  |
| Effective |  |  |
| Revised |  |  |

1. REVISION HISTORY

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| --- | --- | --- |
| **Version** | **Effective Date** | **Notes** |
| 1.0.0 | JUNE 1, 2023 | Original version |

10. The methods for assembling Guided Missile propulsion system:

10.1 A full-scale guided missile has four main parts, the frame, the payload system, propulsion system and the guidance system. 10.2 The propulsion system of a rocket includes parts such as the tanks pumps, propellants, power head, and rocket nozzle. The key task of the propulsion system of a rocket is to produce thrust.

10.2.1 Step 1: Design

In this step, the design of the propulsion system of the missile should be prepared before the manufacturing starts. Through computer simulations, missile designers will prepare the correct design. This simulation will assist the designers to select the proper designs for parts of the propulsion unit.

10.2.2 Step 2: Propulsion parts manufacturing.

In this step, all the parts of the propulsion unit will be manufactured separately and will be brought together to assemble it. Parts like, tank pumps, propellant, power head and many more. will be manufactured separately.

10.2.3 Step 3 Assembling

In this step, the already manufactured parts of the propulsion unit will be brought together to assemble it. Great care should be taken at this point as a small mistake can lead to a catastrophic accident. So, the assembling of the parts should be done the supervision of the experts.

10.2.4 Step 4: Testing

Each part of the propulsion unit gets tested rigorously before sending for final assembling process. Completed guided missiles are also get tested either from aircraft or from helicopters for practice targets