
UNIT 3 PERSONAL PROTECTIVE EQUIPMENT

Structure

3.1 Introduction

Objectives

3.2 Important Factors in the Use of PPE

3.2.1 The Requirement for PPE

3.2.2 The Assessment of Possible hazards

3.2.3 Selection of PPE

3.2.4 Providing Training to the Employees for Proper Utilization of PPE

3.3 Types and Usages of PPE

3.3.1 Eye and Face Protecting Equipments

3.3.2 Head Protecting Equipments

3.3.3 Foot and Leg Protecting Equipments

3.3.4 Hand and Arm Protecting Equipments

3.3.5 Body Protecting Equipments

3.3.6 Hearing Protecting Equipments

3.3.7 Respiratory Protective Equipments

3.4 Let Us Sum Up

3.5 Key Words

3.6 Answers to SAQs

3.7 References and Future Studies

3.1 INTRODUCTION

In previous units the importance of safety has been discussed in detail as accident incidents are unacceptable. It is also desirable that in case if any incident of accident maximum efforts should be adopted so as to reduce the loss of life and property. Use of Personal Protective Equipment is taken into limelight in this unit as main motive is to minimize the loss of life, and for reducing the chances of injuries to the labour. PPE are those equipments that protect the users against associated risks and possible dangers at work place. There are multiple equipments for different type of nature of work. These generally include safety helmets, high visibility clothing or vests, protective hand gloves, goggles for eye protection, dusk masks, protective footwear, hearing protection, face shield, breathing apparatus, safety harness, and respirators etc.

These equipments are capable of protecting the labours against hazards at work station like heat generated, physical harm, chemical exposure, electric shocks, biohazards and toxic gases released due to any reaction. These equipments are worn by employers for protecting themselves against job-

related occupational safety and health purposes in an Industry. Clothing's are covered under category name as "Protective clothing" whereas dedicated masks, guards, shields, pads and others are enlisted under category of "Protective gear". These equipments are said to be safest approach when it comes to protect employers against any type hazard or danger. These protective equipments come into play and helps in protecting employers by reducing the exposure to hazards in case when all engineering controls and administrative controls are not able to prevent the risks. Whenever a hazard is associated with the type of work, there comes the need for PPE. These equipments are not hundred percent saviors as they may also fail sometime resulting in workers being exposed to the hazard.

In this unit, you will be introduced to Personal Protective Equipment(PPE), which is used to build a barrier between the user and the working ambience in case of hazard posing job. PPE plays it role by preventing wearers' exposure with that of the danger or hazardous event that might take place during working hours. Various types of PPE and their significance are explained in this chapter.

Objectives

After going through this unit you will be able to:

- define personal protective equipments;
- identify the important factors required in the use of PPE;
- classify personal protective equipments; and
- define the purpose and use of personal protective equipments.

3.2 IMPORTANT FACTORS IN THE USE OF PPE

It is employers' duty to provide a safe and healthy workplace to their workers for performing their dedicated job safely. Management team needs to promote and encourage their employees to adopt safe work culture by wearing personal protective equipments during delivering their duties. Hazards are everywhere in various forms like chemicals, falling objects, sharp edges, flying sparks etc. Prevention can be done from these dangerous situations by making proper utilization of protective equipments. These equipments protect employees from the hazards that are associated with the work place. One of the best ways to protect workers is by controlling the hazard at its origin point itself. Hazards can be eliminated or controlled to a great extent by using proper engineering and work practices at workplaces.

In case when engineering, work practices as well as administrative controls lacks in controlling the resulting danger, then employers of the organization must provide personal protective equipments to their workers and they should also ensure its proper use. Variety of hazards could be avoided by wearing personal protective equipments. PPE can be classified into different types; example covers equipments like helmets, hand gloves, safety boots, goggles

for eye protection, hard hats, protective hearing devices, safety belts, full body suits and respirators, some of these are shown in Figure 3.1. PPE should not be remembered as an accident prevention measure, it is generally for ensuring the injury is minimized to some extent.

The occupational safety and health administration (OSHA) has provided a safety booklet which is written in public domain and it has been authorized to reproduce fully or partially without permission. This safety guide is helpful to all the employers and their workers to achieve following objectives;

- Helpful in recognizing the types of personal protective equipments.
- Provides the basic knowledge of performing a hazard assessment of the workstation.
- Choosing correct personal protective equipments for different circumstances.
- Recognizing the type of training required for making employers gain knowledge about proper use and care of personal protective equipments.

The information provided by this guide booklet is general in nature and also it does not give information regarding workplace related hazards or the PPE requirements.

3.2.1 The Requirement for PPE

There are varieties of hazards that are associated with the work place. There is huge need for joint efforts from both the employers and the workers in this regard for preventing hazards and protecting employees against those hazards. Cooperation of administrative team, employers and employees all together can aid in ensuring the greatest possible protection at workplace which substantially establishes and maintains a safe and healthy work place. Following are the responsibilities of employers that they must look into consideration;

- Conducting workplace related hazard assessment in order to recognize and regulate physical and health hazards.
- Determining and giving apt PPE to the employees.
- Provision for providing training to the employees regarding the appropriate and efficient use of PPE.
- Providing knowledge to the employees regarding maintenance of PPE that needs to replace worn out or damaged PPE.
- Employer must undertake the responsibility of reviewing periodically, updating and estimating the productiveness and efficacy of the PPE program.
- Whereas employees must deliver their duties by fulfilling following objectives;

- He should wear PPE properly for his own safety purpose.
- Must attend training sessions which are related to the proper utilization of PPE.
- It's employees' duty to take care, clean and maintain the PPE equipments.
- Employees should inform their supervisors in case of damaged or replacement of PPE.



Figure 3.1: Different Safety Equipments

3.2.2 The Assessment of Possible Hazards

The first most steps in designing and developing safety and health program is to assess the possible hazard associated with the work site. This process of identifying and finding out possible hazards is called as hazard assessment. Understanding of possible hazards and risk at shop floor is very crucial step in industrial safety. The potential hazards that are covered under heading of physical hazards are high intensity lighting, movable objects, inconstant temperature, sharp pointed edges, electrical connections etc. Whereas hazards that are covered under the heading of health hazards are chemical exposure, radiations, overexposure to toxic dust or gas or fume etc.

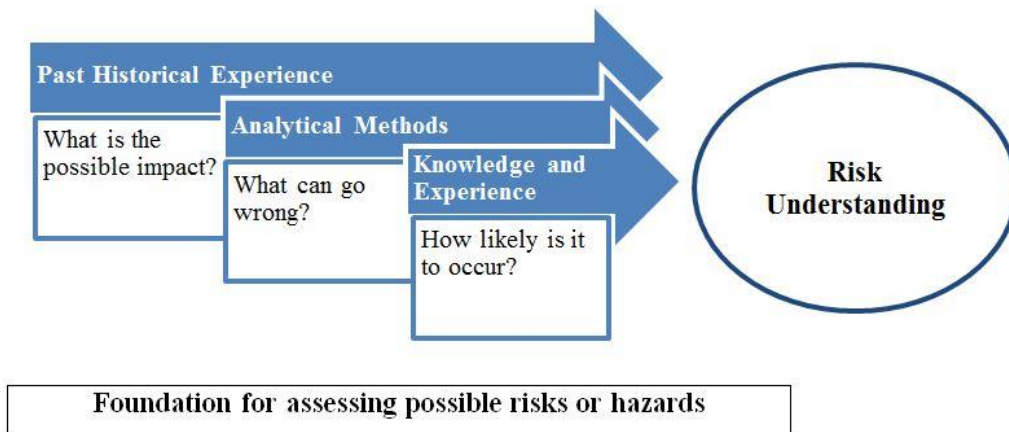


Figure 3.2: Assessment of Possible Risks or Hazards

By conducting a walkthrough survey of the workshop and developing a list of potential hazards under labels or groups namely impact, chemical, penetration, cold/heat, light radiation, biological, etc. In addition to these there are some other parameters also that need to be kept in mind while reviewing shop floor survey. Those parameters are as following:

- Electricity sources in plant.
- Machine motion or processes related sources that may result into an impact amongst equipment and workers.
- High temperature related sources which might lead to skin burns, injury to eyes or fire.
- Types of chemicals that are being used in the work space.
- Harmful dusts sources.
- Light radiation sources which includes brazing, heat treatment, welding, cutting, high intensity lights.
- Sources of falling or dropping objects.
- Sources of sharp pointed objects that may cut, poke, puncture or stab accidentally the worker.
- Sources of biologic hazards that may include blood or other sources of potentially infected materials in the work place.

Once this walkthrough survey is finished, it is employer's responsibility for organizing and analyzing the acquired data regarding the sources of hazards and equips the worker with the type of PPE required. It is imperative for the employer to have full-fledged knowledge about the types of PPE available and their level of protection imparted. Selecting PPE that will provide maximum level of protection to the employees is important to protect them against possible hazards at work site. Periodic re-assessment should also be carried out in order to check for the changes in working behaviour of machines, equipments, or changes in operating procedural conditions that might affect occupational hazards. Re-assessment carried out periodically must also inculcate the review of total number of injuries and illness to detect

the trend or concerned areas and ultimately undertaking appropriate corrective actions. Re-assessment should also incorporate the suitability of already existing PPE in terms of their usage, age and condition.

Following information must be documented in the form of written certification regarding hazard assessment:

- Recognition of the work site that has been evaluated;
- Personal information who has conducted the assessment;
- Mention the date of assessment conduction;
- Recognition of the records or documents those are desirable for the certification of the hazard assessment practice.

3.2.3 Selection of PPE

All the desirable clothing and equipments that are covered under PPE must be manufactured to provide maximum safety and should be constructed in such a way that it is able to maintain the designed PPE in a clean and reliable manner. While working at work site the employers must take into consideration of proper fit and size of the PPE. This will ensure and encourage employees to make proper utilization of PPE if they feel comfortable and it fits well to their personality. Each employee has different sizes and personality, so they must select their desired PPE according to their health and size so that they can deliver their duties properly. Almost all the protective devices are available in multiple sizes and care must be taken while selecting proper size for individual worker. A condition of safely covered or dangerously exposed comes into role when an employee is wearing unfit PPE. If an employee has to wear different types of PPE at the same time, then he must ensure their compatibility.

3.2.4 Providing Training to the Employees for Proper Utilization of PPE

It is employers' responsibility to train their recruited employees about the proper use of PPE which they will be going to use during their course of action. Before doing this, the employer himself must be trained to know following things:

- When PPE is required
- What PPE is required
- Information related to how to put on, wear, adjust and take off the PPE
- Limitations of the PPE
- Protection, proper care, maintenance, useful life and discarding of PPE.

It is solely employers' duty to re-assure that each worker has attained a full understanding of the PPE training as well as he has gained full knowledge of

using and wearing equipments properly before allowing them to deliver their duties at the workshop that are prone to danger. Employer must make provision for re-training the workers those who are not demonstrating the appropriate understanding and skill levels while using PPE. There are few other cases also that require additional training of the workers like when a worker is shifted or transferred from one work site to another site, other case may be when new PPE of advanced features arrive and provided training becomes obsolete.

The employer must record each worker's details like his name, age, training dates, who have attended the workshop regarding PPE usage. He must also provide some sort of certification to the attendees who have acquired training regarding wear or usage of PPE.

3.3 TYPES AND USAGES OF PPE

While working in any industry, wearing the right PPE is crucial for every employee so as to eliminate or reduce the chances of exposure to possible hazards or risks at work place. Various types of PPE are available in today's market that must be adopted for workers safety. These may be categorized as follows:

3.3.1 Eye and Face Protecting Equipments

There are multiple tasks on shop floor that possess a large number of hazards that may cause or harm workers eyes and face in many ways. These possible hazards may be floating particles or debris in air, molten metal splashes, splashes from chemicals in liquid form, caustic or acidic liquids, vapors or gases originating from chemicals, laser radiations, etc.

Many employees suffer from eyes and face injuries during delivering their duties at work place which may be contributed the fact that they might not be wearing any eye and face protective equipment while others result from wearing those protective equipments improperly. It is employers duty to make sure that his worker is wearing eye and face protection equipment properly, plus the equipment which he is wearing is in good condition and is properly fitting him and protecting him against the hazard.

Protection of Prescription Lenses

Utilizing prescription corrective lenses on daily basis will not adequately protect employee against the possible occupational hazards related to eye or face. So it is employers' duty to ensure that his employee wearing corrective lenses is also wearing some eye protection equipment which either includes those prescription into that design itself or he must wear some additional eye protecting equipment to protect his prescription lenses. It is also critical to ensure that the protective equipment worn by the employee does not hinder the vision of the employee in any way. While working in hazardous condition it should be made compulsion for the employees wearing prescription lenses

to wear protective equipment as well to protect them against possible hazards at work place. Eye protection equipments need to be worn by almost all the employees who are working as electricians, plumbers and pipefitters, carpenters, assemblers, welders, grinding machine operators and chemical process labours, etc. In case of other job categories it is purely employers' job to forecast through hazard assessment whether there is need for any eye and face PPE.

There are various types of eye or face injuries that might occur at work place like, chemical splashes from hazardous substances, hot liquids or other type of solvents, dirt, dust, wood or metal debris floating in air that may enter into the eyes from operations like grinding, chipping, hammering, sawing, objects that swing near eyes or face like tools, ropes, chains or limbs, harmful radiations originating from operations like welding, laser related operation.

Various types of eye protection:

Following aspects must be undertaken while selecting proper protective equipment for eye or face safety or an employee:

- Its ability to protect the user against the possible workplace hazards.
- Opted equipment is able to fit properly and is comfortable to wear during the course of work.
- Opted equipment should not hinder the vision of the user.
- Opted equipment must be clean, stiff, strong and durable.
- Opted equipment must allow usage of other PPE also if it is required by the user for conducting his job.

Following are the common types of eye and face protective equipments:

- **Safety glasses and goggles:** Eyes play the most important part of the body so it is very important to protect them against possible occupational hazards. Injuries related to eyes could be prevented by wearing spectacles made of metal or plastic frames and impact resistant lenses. Some goggles models also incorporate side shields for maximum safety of eyes from all sides. These tight fitting glasses protect employees from dirt, debris in air, chemical splashes, hot liquid splashes and many more such activities and protect eyes from possible impact. It also recommended wearing eye glasses under the face shield safety equipment.
- **Welding shields:** these shields made up of vulcanized fiber or sometimes fiberglass and are capable of providing full face protection during welding operation. Welding shields are composed of filtered lenses that protect eyes and face against the possible burns which may be caused due to intense radiant light. These shields are also capable of protecting the employee against flying sparks, slag chips, and metal splatter that are generally produced during the operations of soldering,

welding, cutting and brazing. In order to protect employees' eyes and face against possible eye and face related hazards, it is important to give the shade number to the filter lenses so that employees do not get confused while opting for any specific operation.

- **Laser safety glasses:** As it is clear from its name, these are capable of protecting the eyes against the intense concentrations of light that are produced via laser related operations. The selection of this type of glasses is totally based upon the laser wavelength and the power it is capable of producing. This is not only limited to protecting eyes against the resultant laser radiations but also capable of filtering all types of lights that are entering the eyes directly.
- **Chemical splash glasses:** These types of glasses are recommended to wear whenever there are chances of occurrence of splashes from chemicals, hot liquid solvents or other infectious substances while conducting operations. These glasses sometimes also act as impact glasses by protecting eyes against flying debris in air.
- **Face shields:** These shields are long plastic covering starting from the forehead ending to chin of the user. These shields are capable of protecting the entire face of the user against the possible occupational hazards that may be flying objects, high speed dust particles or debris, sparks, chemical splashes, or any type of infectious materials. But these shields are ineffective in protecting against impact hazards. It is advised to the employees to wear safety goggles also underneath these shields so as to ensure maximum safety of their eyes as well as face against possible impact hazard.

All these eyewear safety equipments are designed to worn in case of specific type of hazards. So it is critical that each employee has full knowledge of possible hazards which might occur at his work place. This can be done by conducting different hazard assessment tests for that specific work place which has been discussed in previous section.

3.3.2 Head Protecting Equipments

These protective equipments are capable of protecting employees head against potential injuries occurring during performing tasks. As it is well known fact that head injuries might result in loss of life or lifetime impairment. Preventing employees against such fatal incidents of head injuries is possible by making them wearing hard hat or safety helmet during their job hours. These hard hats or safety helmets are efficient enough in protecting employees against the incidents of burns, electrical shock hazards as well as against impact and penetration hazards also.

It is imperative that employers of the industry make a note of possible following concerns and make their employees wear helmets during their job functioning time:

- If there are chances of falling objects from certain height and strike the worker on the head from above;
- If there are chances of bumping their head against fixed objects (fixed beams or pipes);
- If there are chances of potential head injury accidentally due to presence of some sort of electrical hazards.

Some of the occupations that require an employee to wear these hard hats or helmets generally include constructional workers, linemen, welders, electricians, carpenters, among many others. Also in case whenever a worker is working under some tools or conveyor belts whose possibility of falling on head is there, in these cases also employer must wear these safety helmets to ensure safety of him head against possible injury. Protective helmets must be able to fulfill following objectives:

- Should be able to defend against falling objects.
- Should be shock resistant.
- Should be water resistant and slow burning.
- Opted cap or helmet must have harder outer shell and must incorporate shock absorber lining into it.

There are other considerations also that need to be considered while using these safety head protection equipments. Some of these concerns are size and care considerations, like suppose even if the opted head equipment meets all the other criteria but it unfit size is making user uncomfortable then all its purpose goes in vain. The selected head equipment is inappropriate if it is either too small or too large and is not fitting into head of the employee. These head safety equipments should be provided in variety of sizes with adjustable headbands to safeguard its proper fit. By proper fit here it means that adequate clearance must be provided between the shell and the suspension system in order to provide sufficient ventilation and efficient disposal of the confronted impact. The material of the helmet should be such that it does not irritate the users' skin; it does not bind, slip or fall off during the time of operation.

There are various other accessories also that are allowable with these head safety equipments like safety goggles, provision for earmuffs, face safety shields and mounted lights on helmets. Additional protection against sun and rain water could be ensured if a helmet is equipped with brims or side edges that help in diverging the rainwater. All these additional protective accessories must not inhibit the actual role of safety elements of that particular equipment.

The useful life of any protective equipment could be extended by maintaining frequent cleaning and its proper survey. It is very important to check the shortcomings of the helmet on daily basis that might occur due to cracks, wear, tear or rough usage, that might hinder in the proper functioning of the hat. Use of paint and paint thinners must be eliminated completely as they

may deteriorate the actual functioning of the helmet by weakening its shell. The integrity of the protection is affected by drilling holes or by applying paint on the helmet which is totally undesirable. By storing these helmets direct under sun light may also damage the integrity of the helmet. Helmets with defects like perforation, indication of exposure to UV light or other types of radiation, heat, cracking or any sort of deformity must be removed from service or replaced with the new one.

3.3.3 Foot and Leg Protecting Equipments

Employees who encounter foot or leg injuries due to rolling or falling objects or from crushing objects must adopt usage of foot and leg protecting equipments during their working hours. The body parts like foot or leg must be covered with safety equipments in case where an employee is exposed to poisonous, corrosive or hot substances. Non-conductive footwear must be worn by the employees who all are prone to expose to electrical hazards or static electricity at the work place. There are various situations that may arise at the shop floor where it becomes necessary for the worker or labour to wear these safety boots for protecting his leg or foot against hazards.

Following are few of the situations that necessitate the usage of safety boots:

- Possibility of rolling or falling of heavy objects onto the employee's feet.
- While working with sharp objects that may pierce the soles of ordinary shoes.
- While working with molten metals or liquid solvents or chemicals which might splash onto the employer's lower body.
- While carrying out job nearby wet or slippery surfaces.
- While working in the presence of electrical hazards.

There are different types of footwear for different situations. It is important to check for product's labeling and accordingly required safety shoes must be adopted as per the situation. When it comes to protecting, there are various choices available, like leggings which are capable of protecting legs and feet against heat hazards generating from welding sparks or molten liquid (metals, chemicals, etc.). Metatarsal guards that are strapped outside of the shoes which may be made of steel, fiber, aluminium or plastic which guards and protects the instep area against impact and compression situation. Toe guards are generally made of plastic, aluminium or steel which are capable of protecting ordinary shoes against impact and compression related hazards. When need for greater protection is encountered combination foot and shin guards with toe guards may be used in those situations. There are other types of shoes also which incorporates heat resistant soles and impact resistant toes that are capable of protecting feet against hot work surface areas. These safety shoes may be of electrically conductive type or non-conductive type depending upon the situation at work place.

There are special purposes shoes also which are further sub-classed into different types:

- **Electrically conductive shoes** that are capable of providing protection against the hazard produced due to static electricity. In order to reduce the risks related to working in explosive and hazardous environment which is associated with the manufacturing of explosives, employees are advised to wear these types of shoes reduce the static electricity risk. This static electricity buildup on the body could become a leading reason for producing a spark and ultimately leading to an explosion or fire in the factory. Workers working with electrical hazards must not wear these conductive shoes. Reminder must be kept in mind to remove these shoes after the completion of job hours. Also these shoes should not be worn with nylon, silk or wool socks as they promote static electricity.
- **Electrically non-conductive shoes**, safety-toe shoes generally come under non-conductive type and they are capable of preventing the user against electrical hazards. These boots are capable of sustaining open circuit of up to 600 volts in dry conditions. By utilizing other insulating equipments in these shoes, this can aid in eliminating the risk of electrical hazard at work sites. The safety issues related to these shoes are compromised in the state of wet conditions, shoe soles are worn out, the sole or heel is accommodating some metallic particles in it.
- **Foundry shoes**, their main aim is to provide insulation to the feet of the user wearing it against extreme heat of molten metal. Foundry shoes also prevent the lodging of hot metal inside the shoes through eyelets, tongues or other shoe parts. These shoes are generally made up of leather or leather-substitute boots that incorporates built-in safety toes.

Over the period of time, these shoes also needs protective care periodically in order to check for their smooth functioning. This can be done by inspecting these safety shoes for wear and tear prior to their actual use. These inspection practices generally involves identifying cracks, holes, broken laces or buckles, separation of soles. Every safety shoe manufacturer provides their basic recommendation which includes information related to cleaning and maintenance of safety shoes.

3.3.4 Hand and Arm Protecting Equipments

After conducting hazard assessment activities if possibility of hand or arms related injury is observed which is unavoidable even after using engineering and work practice controls in such cases there comes the need for advising employees to wear hand and arm protective equipments for protecting themselves against possible hazards. In such cases it is employers responsibility as well to check whether their employees are following safety guidelines or not, they are wearing safety equipments or not while performing their jobs on shop floor. Possible hazards that can harm ones hands or arms includes cuts from sharp objects, abrasions, chemical exposure,

dangers related to electrical hazards, bruises, absorption of harmful substances by skin, thermal burns, fractures etc. Hand or arm safety equipments generally includes hand gloves which may be of rubber or other protective material according to desired applications, finger guards, elbow length long hand gloves or arm coverings.

There are various types of protective gloves that are available in today's market which are capable of preventing employee against a variety of hazards. The selection of type of gloves is solely dependent upon the type of operation to be performed by the employee and nature of the hazard associated with that operation. It becomes easier to select the right pair of gloves by determining the type of hand related hazards at that particular work place. So employee should strictly make use of safety hand gloves that are designed specifically for the tasks that possess some danger. Different gloves need to be utilized for different functions, different operations or different tasks. It is not advised to use one hand gloves for all the operations.

There are various factors that need to be kept in mind while selecting protective gloves for a work station, like the chemical type that needs to be handled, nature of contact, contact duration, area requiring protection, thermal protection, grip requirement, size and comfort, abrasion or resistance requirements.

Different workplace requires different types of hand gloves, also these gloves are manufactured using different materials depending upon the purpose type or workplace related hazards. There are variety of gloves available like fabric and coated fabric gloves, gloves made of leathers, metal mesh or canvas, gloves for chemical or liquid resistance, and sometime they are made of insulating rubber also which are required in case of electrical hazards.

Gloves made of leather or canvases are capable of providing protection against cases of burns or cuts, sustained heat. Leather gloves specifically insure against nearby rough objects, chips, moderate heat or sparks.

Aluminized gloves are capable of providing resistance against heat and cold. Aramid fiber gloves are another type of gloves that are again capable of providing protection against cuts or abrasion, heat and cold. Lastly there are gloves made of synthetic fibers also those are able to withstand against cuts, abrasions, cold, heat and some diluted acids as well.

It is desirable to check these gloves for flaws on regular basis. Inspection should be done for puncture, holes, torn out cases. If any default is observed during inspection then those gloves must be replaced by new one. Sometimes it is difficult to detect pinhole size holes, so these are check by filling water in gloves and examining for pinhole leaks. Gloves used in chemical handling get degraded and starts showing their inability by discoloring and becoming stiff. Chemical resistant gloves could be checked for their quality by testing their absorptive abilities, toxicity of the chemicals to be handled, duration of exposure etc.

3.3.5 Body Protecting Equipments

Protecting body against possible occupational hazards is also very important. Employees who all are working in industries and there are chances of confronting possible body injuries during their course of work must wear protective equipments which are capable of protecting their bodies against possible hazards. The need for wearing body protecting hazards comes into role when other control fails (administrative, engineering and work practice) to run or control the hazards. The body injuries at work station could be caused due to following possible reasons:

- Exposure to hazardous chemicals.
- Exposure to extreme temperature conditions.
- Exposure to hot liquids and possibility of splashes from molten metals.
- Possibility of tools related, materials related and machinery related impacts to the body.

Various types of clothes are available in different sizes for the employees to ensure protection of their body against possible occupational impacts or exposures. Again it is employer's job to check and make sure that his each employee is wearing body protective equipment while conducting his work on shop floor in order to protect him against possible hazards. There are varieties of body protecting equipments available in today's market that depends upon the job type that decides what type of body suit need to be worn on body. Few examples include full body suits, jackets, laboratory overcoats, vests, aprons, coveralls and surgical gowns. By assessing the job for possible hazards one can find out the potential threats to body. If the assessment report point outs the need for body protecting equipments then the user should first check for its proper size, its proper functioning and also he must inspect full equipment before wearing it. Full body protecting equipment is capable of providing protection against almost all types of toxic chemicals or acidic substances.

These body protecting equipments are made up of wide variety of available materials like paper like fiber, leather based, plastics, rubberized fabrics, rubber, treated wool and cotton etc. Body suit made of paper like fiber are resistant to dust and splashes. Treated wool and cotton based suits are capable of protecting the user against dust, fire, changing temperatures, and are comfortable to wear. In case of dry heat and direct flames protective suits made of leather could be used. Whereas chemical and physical hazards related harms could be prevented by wearing body suits made of rubber, neoprene and plastics.

3.3.6 Hearing Protecting Equipments

The need for wearing hearing protective equipments comes into need when administrative, engineering and work practice controls are unable to protect

the worker against the noises generating at the workplace. Hearing protectors are able to reduce the noise which is called as attenuation going through the user's ears. This attenuation controlled totally depends upon the type of equipment used and how well this equipment fits to the user who is wearing it. The task of providing hearing equipment to an employee can be challenging as the amount of noise reaching the ears of labour and the exposure time must be known before providing the equipment type.

There are certain factors upon which the excessive noise exposure to employee depends and by determining following factors the type of hearing protector could be allotted to the employee working in those conditions:

- Evaluating the noise loudness in decibels (dB).
- Estimating the employee's duration of exposure to the noise.
- Analyzing if any employee needs to travel in between work areas which possess distinguished noise levels.
- Identifying noise generating sources (single or multiple).

All the above mentioned factors could be identified by conducting worksite assessment in prior to actual work being done in those areas. Hearing protectors are required in case of high noise levels generating from distinguished sources as exposure to these noises for longer duration could lead to hear impairment for life time.

There are different types of hearing protective equipments available in market like single use ear plugs, earmuffs and molded ear plugs. After using these ear plugs it is user's responsibility to clean equipment which he has used. User should ensure for perfect seal around the ears while wearing these ear protective devices and should also avoid facial movements (talking or chewing) as these may hinder in proper functioning of these devices during the actual operation.

3.3.7 Respiratory Protecting Equipments

It is desirable to maintain good respiration while working at work sites. There are a lot of chances of coming in contact with the surrounding harmful gases, dust, chemical reaction fumes, powder, smoke or vapors while performing any dedicated job. There are variety of respiratory equipments available in today's market that are capable of protecting the user against these harmful dusts or gases like dust masks, full face masks, etc. These masks are assisted with elastic band or belt which makes the mask to fit properly onto the face of the user. These masks are also capable of preventing user in coming contact with the droplets of hazardous substances. These masks could also be used in a case where one employee is sick and prevents in transmitting his germs in the surrounding air and prevents other employees working nearby from that infected person. Powered respirators, monitors, filter respirators, light weight respirators are few types of protective equipments.

It is employer's job to get a thorough knowledge of potential respiratory hazards that might be encountered in the worksite. By assessing this he will be able to advise his team to wear protective masks in order to prevent themselves against those respiratory hazards. Then proper training must be given to the employees regarding what type of and when these protective masks need to be utilized. It is solely employees' duty to check for any fault in the masks and replace it with the new one or dispose it totally.

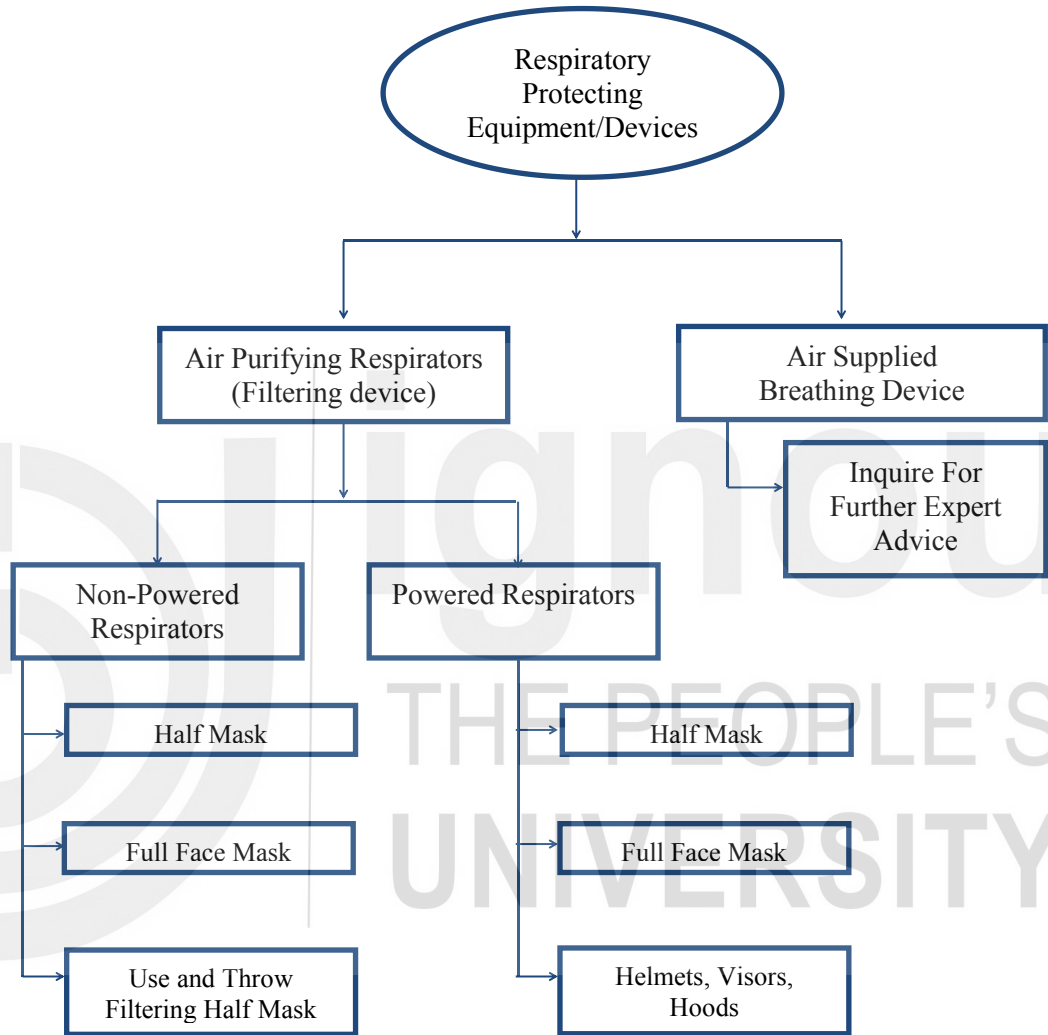


Figure 3.3: Types of Respiratory Protecting Equipments

SAQ 1

a) State True or False

- i) Safety equipments are hundred percent saviors.
- ii) PPE are used to build a barrier between the user and the working ambience in case of hazard posing job.
- iii) Workplace related hazard assessment is not so important.
- iv) Employee wearing corrective lenses should not necessarily wear any eye protection equipment.
- v) Gloves made of leather or canvases are capable of Providing protection against chemicals like dilute acids.

T/F

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- b) What is PPE? Why these PPEs are required in industrial safety?
- c) What is hazard assessment? Name potential hazards that may occur in a plant?
- d) PPE is selected on what basis? Explain importance of training employees regarding proper usage of PPE.
- e) Name various types of PPEs used in industries. Explain any four of these PPEs.

3.4 LET US SUM UP

Each company or industry must take responsibility of providing work station that is free of life threatening hazards for its employees. It is important to take measures for eliminating hazards in the work environment, on the other hand it might be impossible or infeasible to eradicate all the hazards completely through engineering design, guarding or administrative controls. In such cases PPE (Personal protective equipment) might be adopted for safety purpose of employees. The personal protective equipment type required during any tragedy or circumstances will solely depends upon the particular hazard that might occur, the exposure duration and will ultimately depend upon exposure intensity. In order to safeguard employees against identified hazards, it is important to make employees use of PPE. In order to be effective, the opted PPE should be readily available, should be of correct size and should be designed properly for the use intended. PPE use ensures and increases employees' safety against damaged or defective equipment. PPE program must be arranged for training employees about the benefits of PPE and is considered as an important part of it. Each supervisor or team leader should be able to assess the hazards and should be able to manage their employees, and then only those supervisors will be titled as effective coach. Supervisor should communicate their employees the need for wearing PPE devices while working in their respective sites via in formal training sessions, in informal one on one conversation.

3.5 KEY WORDS

Dangerous goods – Also referred to as hazardous materials. Any solid, liquid, or gas that can harm people, other living organisms, property, or the environment.

Fire precautions: The measures taken and the fire protection features provided in a building (e.g. design, systems, equipment and procedures) to minimise the risk to the occupants from the outbreak of fire.

Fire prevention: The concept of preventing outbreaks of fire, of reducing the risk of fire spreading and of avoiding danger to persons and property from fire.

First aid: The skilled application of accepted principles of treatment on the occurrence of an accident or in the case of sudden illness, using facilities or materials available at the time.

OSHA Occupational Safety and Health Administration – A government agency in the department of Labor to maintain a safe and health work environment.

Safety Manager – Provides cost savings and staffing flexibility while ensuring you're in compliance with safety regulations.

Safety Strategy – The act of being safe, understand how strategy affects structure and how the choice of structure affects efficiency and effectiveness.

Active System - A system that uses mechanical means to satisfy load demand as opposed to passive systems.

Risk -When we refer to risk in relation to occupational safety and health the most commonly used definition is 'risk is the likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard.

Explosion -An **explosion** is the result, not the cause, of a rapid expansion of gases. It may occur from physical or mechanical change.

Toxic- It is a chemical that has a median lethal concentration (LC₅₀) in air of more than 200 parts per million (ppm) but not more than 2,000 parts per million by volume of gas or vapor, or more than 2 milligrams per liter but not more than 20 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for 1 hour.

PPE- Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

3.6 ANSWERS TO SAQs

SAQ 1

- a) i) False
ii) False
iii) True
iiii) False
ivi) False
vi) False
- b) PPE are those equipments that protect the users against associated risks and possible dangers at work place. There are multiple equipments for different type of nature of work. These generally include safety helmets, high visibility clothing or vests, protective hand gloves, goggles for eye

protection, dusk masks, protective footwear, hearing protection, face shield, breathing apparatus, safety harness, and respirators etc. These equipments are worn by employers for protecting themselves against job-related occupational safety and health purposes in an Industry.

These PPEs are required in industrial safety due to following reasons:

- Hazards are everywhere in various forms like chemicals, falling objects, sharp edges, flying sparks etc.
 - Prevention can be done from these dangerous situations by making proper utilization of protective equipments.
 - These equipments protect employees from the hazards that are associated with the work place.
 - These equipments are capable of protecting the labours against hazards at work station like heat generated, physical harm, chemical exposure, electric shocks, biohazards and toxic gases released due to any reaction.
 - One of the best ways to protect workers is by controlling the hazard at its origin point itself. Hazards can be eliminated or controlled to a great extent by using proper engineering and work practices at workplaces.
- c) The first most steps in designing and developing safety and health program is to assess the possible hazard associated with the work site. This process of identifying and finding out possible hazards is called as hazard assessment. Understanding of possible hazards and risk at shop floor is very crucial step in industrial safety. Hazards occurring in industries are covered under two headings namely physical hazards and health hazards:
- The potential hazards that are covered under heading of physical hazards are high intensity lighting, movable objects, inconstant temperature, sharp pointed edges, electrical connections etc.
 - Whereas hazards that are covered under the heading of health hazards are chemical exposure, radiations, overexposure to toxic dust or gas or fume etc.
- d) PPE is selected on the basis of following factors:
- All the desirable clothing and equipments that are covered under PPE must be manufactured to provide maximum safety and should be constructed in such a way that it is able to maintain the designed PPE in a clean and reliable manner.
 - While working at work site the employers must take into consideration of proper fit and size of the PPE. This will ensure and encourage employees to make proper utilization of PPE if they feel comfortable and it fits well to their personality.
 - Each employee has different sizes and personality, so they must select their desired PPE according to their health and size so that they can deliver their duties properly.

- If an employee has to wear different types of PPE at the same time, then he must ensure their compatibility.

Training of employees regarding proper usage of PPE plays very crucial role in following proper safety concerns while performing actual operation on shop floor. It is employers' responsibility to train their recruited employees about the proper use of PPE which they will be going to use during their course of action. It is solely employers' duty to re-assure that each worker has attained a full understanding of the PPE training as well as he has gained full knowledge of using and wearing equipments properly before allowing them to deliver their duties at the workshop that are prone to danger. Employer must make provision for re-training the workers those who are not demonstrating the appropriate understanding and skill levels while using PPE. There are few other cases also that require additional training of the workers like when a worker is shifted or transferred from one work site to another site, other case may be when new PPE of advanced features arrive and provided training becomes obsolete.

- e) There are following types of protective equipments depending upon the type of operation to be performed by the user;
- i) Eye and Face Protecting Equipments
 - ii) Head Protecting Equipments
 - iii) Foot and Leg Protecting Equipments
 - iv) Hand and Arm Protecting Equipments
 - v) Body Protecting Equipments
 - vi) Hearing Protecting Equipments
 - vii) Respiratory Protecting Equipments

i. Eye and Face Protecting Equipments

There are multiple tasks on shop floor that possess a large number of hazards that may cause or harm workers eyes and face in many ways. These possible hazards may be floating particles or debris in air, molten metal splashes, splashes from chemicals in liquid form, caustic or acidic liquids, vapors or gases originating from chemicals, laser radiations, etc. Many employees suffer from eyes and face injuries during delivering their duties at work place which may be contributed the fact that they might not be wearing any eye and face protective equipments while others result from wearing those protective equipments improperly. It is employers duty to make sure that his worker is wearing eye and face protection equipment properly,

plus the equipment which he is wearing is in good condition and is properly fitting him and protecting him against the hazard.

ii. Head Protecting Equipments

These protective equipments are capable of protecting employees head against potential injuries occurring during performing tasks. As it is well known fact that head injuries might result in loss of life or lifetime impairment. Preventing employees against such fatal incidents of head injuries is possible by making them wearing hard hat or safety helmet during their job hours. These hard hats or safety helmets are efficient enough in protecting employees against the incidents of burns, electrical shock hazards as well as against impact and penetration hazards also.

It is imperative that employers of the industry make a note of possible following concerns and make their employees wear helmets during their job functioning time:

- If there are chances of falling objects from certain height and strike the worker on the head from above;
- If there are chances of bumping their head against fixed objects (fixed beams or pipes);
- If there are chances of potential head injury accidentally due to presence of some sort of electrical hazards.

iii. Foot and Leg Protecting Equipments

Employees who encounter foot or leg injuries due to rolling or falling objects or from crushing objects must adopt usage of foot and leg protecting equipments during their working hours. The body parts like foot or leg must be covered with safety equipments in case where an employee is exposed to poisonous, corrosive or hot substances. Non-conductive footwear must be worn by the employees who all are prone to expose to electrical hazards or static electricity at the work place. There are various situations that may arise at the shop floor where it becomes necessary for the worker or labour to wear these safety boots for protecting his leg or foot against hazards.

Following are few of the situations that necessitate the usage of safety boots:

- Possibility of rolling or falling of heavy objects onto the employee's feet.
- While working with sharp objects that may pierce the soles of ordinary shoes.
- While working with molten metals or liquid solvents or chemicals which might splash onto the employer's lower body.

- While carrying out job nearby wet or slippery surfaces.
- While working in the presence of electrical hazards.

iv. **Respiratory Protective Equipment**

It is desirable to maintain good respiration while working at work sites. There are a lot of chances of coming in contact with the surrounding harmful gases, dust, chemical reaction fumes, powder, smoke or vapors while performing any dedicated job. There are variety of respiratory equipments available in today's market that are capable of protecting the user against these harmful dusts or gases like dust masks, full face masks, etc. These masks are assisted with elastic band or belt which makes the mask to fit properly onto the face of the user. These masks are also capable of preventing user in coming contact with the droplets of hazardous substances. These masks could also be used in a case where one employee is sick and prevents in transmitting his germs in the surrounding air and prevents other employees working nearby from that infected person. Powered respirators, monitors, filter respirators, light weight respirators are few types of protective equipments.

It is employer's job to get a thorough knowledge of potential respiratory hazards that might be encountered in the worksite. By assessing this he will be able to advise his team to wear protective masks in order to prevent themselves against those respiratory hazards. Then proper training must be given to the employees regarding what type of and when these protective masks need to be utilized. It is solely employees' duty to check for any fault in the masks and replace it with the new one or dispose it totally.

3.7 REFERENCES AND FURTHER STUDIES

Web links

- <https://www.osha.gov/SLTC/personalprotectiveequipment/>
- <https://www.ppe.org/types-of-personal-protective-equipment-ppe/>
- <https://study.com/academy/lesson/types-of-personal-protective-equipment.html>
- <https://www.tvh.com/en-in/blog/7-types-of-personal-protective-equipment-ppe-to-guarantee-your-safety>
- <http://www.safety.uwa.edu.au/topics/physical/protective-equipment>
- <https://ehs.ucmerced.edu/researchers-labs/ppe/selection>