

# A Study on prevention of hazard in industry by the use of personal protective equipment and implementing smart technology for personal protective equipment.

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**Abstract:** Personal Protective Equipment is used to prevent hazardous effect in all industries. It is useful in preventing the loss of humans. Controlling a hazard at its workplace is the best way to protect the employee's. Depending on the hazard, engineering or work practice control should be used to manage or eliminate hazard to greater extent. Personal protective equipment is used to manage the hazard when it happens. Chemical protective equipment protects the user by providing a barrier between individual and hazardous materials (HAZMAT). It discusses the standards of personal protective equipment. This paper deals about Understanding the types of PPE, Basics of hazard assessment at its workplace, Selection of appropriate PPE for various circumstances, Proper use and take care of PPE, Smart PPE. This paper also covers the various types of smart technology that can be incorporated in clothing for personal protective equipment and applications and examples of smart PPE and it also incorporates future trends of smart PPE.

**Key words:** Hazard, Smart PPE, HAZMAT.

## Introduction:

Hazard exists in every work place in different forms. Falling objects, flying sparks, chemicals, noise. It is mandatory for employers to protect their employees from work place hazards that can cause injury. Controlling a hazard at its workplace is the best way to protect the employee's. Depending on the hazard engineering or work practice control should be used to manage or eliminate hazard to greater extent. Building a barrier between hazard and employees is engineering control, changing the way in which the employees perform their work is work practice control. When engineering and work practice

control are not feasible and do not provide sufficient protection employers must provide PPE to employees and ensure it use. PPE involves item such as foot and hand protection, eye protection, head protection, ear protection and body protection. First step in the effective use of PPE is hazard assessment .the employees have to identify physical and chemical hazards in work place. The lists of potential hazards are impact, penetration, compression, chemical, heat/cold, harmful dust, light (optical radiation) and biologic matters. Documentation of hazard assessment is important in industries. Without the proper use of PPE many people's affected by disabling work related injuries. Nearly 2 million disabling work-related injuries expected this year. More than ¼ will involve head, eyes, hands, and feet. Hard hats were worn by only 16% of those workers who sustained head injuries only 1% of approx. 770 workers suffering face injuries were wearing face protection. Only 23% of the workers with foot injuries wore safety shoes or boots. About 40% of the workers with eye injuries wore eye protection. To avoid these types of accidents PPE should be reliable and smart. Hence according to OSHA regulation PPE should be provided to employees at free of cost.

## Types of PPE for Industrial Workers:

Many industrial sectors such as mining, welding and cutting, construction requires PPE for eye protection, body protection, hearing protection and head protection. Workers in different occupations may encounter different types of threats and thus need different types of PPE for protection. Cooperative efforts of both employees and employers are needed for the greatest possible protection. Employees can be exposed to a large number of hazards that pose danger to their eyes and face. ANSI Z87.1 is used for face and eye protection. Eye protection PPE are Safety glasses: it should be much stronger and more resistant to impact and heat than regular glasses. Equipped with side shields that give you protection from hazards that may not

be directly in front of you Safety glasses should be Z-87 approved to meet OSHA regulations, Goggles: it surround the eye area, they give more protection in situations where the splashing liquids, fumes, vapours, powders, dusts, and mists. It must indicate that they are chemical splash goggles to be worn for that purpose. Face protection PPE are Face shields: it provides full face protection. And it is used around operations where molten metal, chemical splashes, or flying particles. It can be used simultaneously as a hard hat. Welding helmets: it provides both face and eye protection .and absorptive lenses that filter the intense light and radiant energy that is produced during welding operations. Head protection : protecting employees from head hazards is a key element of any safety program ANSI Z89.1 is used for head protection .its classification are Hard hats: Class A: Protects from falling objects and from electrical shocks up to 2,200 volts ,Class B: Protect from electrical shocks up to 20,000 volts ,Class C:Protect you from falling objects ,Bump Caps :Bump caps are made from lightweight plastic and are designed to protect you from bumping your head on protruding objects.

Hand and foot protection: employees who face possible foot or head injuries from falling or rolling objects or from crushing or penetrative material should wear protection. hand and foot protection is regulated by ANSI -Z41-1991 Gloves: Padded cloth gloves: protect hands from sharp edges, slivers, dirt, and vibration, Heat resistant gloves: protect hands from heat and flames, Latex disposable gloves: used to protect hands from germs and bacteria, Lead-lined gloves: used to protect hands from radiation sources, Forearm Cuffs: used to protect forearm ,Thumb Guards and Finger Cots: protect only thumb or fingers ,Mittens: protect hands while working around very cold or hot materials ,Hand Pads: protect hands while working around very hot materials Safety shoes and boots: Steel toe footwear: protects toes from falling objects and from being crushed, Metatarsal footwear: special guards that run from ankle to toes and protect entire foot, Reinforced sole footwear: metal reinforcement that protects foot from punctures, Latex/Rubber footwear: resists chemicals and provides extra traction on slippery surfaces, Insulated Coats and Pants: Fire resistant, Heat resistant Cold resistant. Body protection: Sleeves and Aprons, Coveralls: use for particulate filtering such as asbestos. Noise related hearing loss has been one of the most prevalent occupational health concerns in us for more than 25 years. Bureau of labour statistics (BLS) reported more than 21000 hearing loss due to high workplace noise level. OSHA permissible exposure limit (PEL) is 90dBA for all workers for eight hours on a day. Hearing protection include single use of earplugs waxed cotton, foam, silicon rubber fibre glass wool or molded earplugs

## PPE for Hazmat Workers:

For persons who may near hazardous vapours, chemicals and particles U.S Environmental Protection Agency (EPA) defines four levels of protection with level A required for greatest protection and level D for minimum protection. The EPA levels of protection are widely used by government agencies such as OSHA. American National Standards Institute (ANSI) has been developing safety standards since 1920.OSHA requires the PPE should meet the standards developed by ANSI. For instance, OSHA requirements that PPE for head protection meets ANSI Z41.1-1991 standard (OSHA, 2003).international safety equipment association is the trade association for PPE manufactures. Level A protection is required when the greatest potential for exposure to hazards exists and when greatest level of skin, respiratory and eye protection is required. Level B is for highest level of respiratory protection with lesser level of skin protection. Level B protection is often adequate. Level C is required when the concentration and type of airborne substances. Level D is used when no contaminants are present. Level A and B protection requires the same level of respiratory protection with self-contained breathing apparatus (SCBA).levels A and B protection requires the same inner and outer chemical resistant gloves and boots but different requirements in protective suits. Six focus case studies in US found that level B HAZMAT suits are used hundreds of times a year while. Level A suits are typically used less than 5 times a year.

## Smart Clothing in Personal Protective Equipment:

Smart is the word used to sense and react environmental conditions as stimuli such as those from mechanical, thermal, chemical, electrical or other sources. Smart clothing uses clothing as the platform for microprocessors, electronic devices sensors and communication devices due to miniature size .New sensors are used in any unit of PPE such as suit, gloves head and foot protection and respirator.

A patent is filled on integrated a liquid crystal display together with an electronic circuit in to the eye piece of a welding helmet for optical protection. The helmet requires nothing from welder except that he has to put the helmet. He can merely pick up electrode and this invention protects his eyes solely on the approach of electrode. This way was one of the earliest smart technology applications in PPE.

The technology of active noise reduction (ANR) is also known as active noise control or noise cancellation .it is a technology to reduce unwanted sound by emitting a sound

wave with the same amplitude but with the inverted phase to the noise. Greater distances and penetrate passive barriers such as cement walls which makes it very difficult to attenuate .it uses microphone in the ear cup to capture noise, electronic active noise reduction to 20 dB to provide effective protection against noise. The noise buster ANR earmuff is available in three models over the head, behind the head and hart hat cap mount and can protect employees in many professions such as pipeline workers

### Smart PPE for Fire fight Workers:

The personal alert safety system (PASS) is the device about the size of portable transistor radio worn on fire-fighters. SCBA is mandatory for all fire fighters. PASS uses a motion detector to sense the fire-fighter's movement or lack of movement and will emit a loud pulsating shriek if a fire-fighter collapses or remains motionless for 30 seconds

Smart Nano materials in PPE: Nano materials can be used in PPE. Shape textile may be passive or passive. A smart textile monitors the wearer's physiology or the environment .for example shape memory fabrics can be used for full body protection.

### Conclusion and Future Trends:

The production, use and maintenance of PPE are highly numerous National, multinational and international standards of smart technology are available .the integration of electronics in PPE is termed as smart. The application and environment should not adversely affect the reliability of electronic circuits or devices used in PPE .smart PPE must assure easy use and maintenance. Some PPE users such as HAZMAT workers or fire workers have quickest response time in to an incident. This requires that the electronic devices be seamlessly integrated in to a PPE and smart PPE does not require a complete calibration or turn on procedure. Nano technology such as Nano fibres can be used in smart PPE.

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