Personal Protective Equipment (PPE)

By Christine Kleen and Thomas Langill, Ph.D.

The use of PPE in a galvanizing facility is necessary for the protection of workers. Hard hats, gloves, steel-toe boots, and protective clothing by the kettle are some of the PPE that is used. Proper training and understanding of PPE is necessary for the safety of personnel in the plant. This Health, Safety & Environment Note focuses on the types of PPE necessary at a galvanizing facility.
Introduction

The use of personal protective equipment (PPE) is essential for the protection of workers in a galvanizing facility. The type of PPE used depends on the work environment. PPE commonly used at a galvanizing facility include a hard hat, safety glasses, face shields, hearing protection, gloves, coveralls, and safety footwear.

Background Information and PPE Regulation

In OSHA’s regulation, 29 CFR 1910.132, “PPE is to be provided, used, and maintained in a sanitary and reliable condition whenever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact.”

Preventative measures should be implemented before PPE is selected. Engineering controls, housekeeping and hygiene are three preventative measures. PPE should be used in conjunction with these controls to provide for employee safety and health in the workplace.

PPE includes all work accessories and clothing designed to create a barrier against workplace hazards. Selection of the correct PPE for a job is important. Employers and employees must both understand the equipment’s purpose and its limitations.

Assessment of the Regulation

Employers are required to evaluate the workplace to determine if hazards are present or likely to be present that require the use of head, eye, face, hand, or feet protection. If hazards or the likelihood of hazards are found, employers must select and have affected employees use properly fitted PPE suitable for protection from these hazards. In 29 CFR 1910.132, “employers must certify in writing that a workplace hazard assessment has been performed, the date(s) of the hazard assessment, and identifies the document as a certification of hazard assessment.”

OSHA’s non-mandatory appendix in 29 CFR 1910.132 outlines general compliance guidelines for identifying, organizing, and analyzing sources of hazards and selection criteria for protective gear. According to Appendix B, a hazard assessment must consist of a walkthrough survey of the facility. Observations on the likelihood of injury or illness should be noted. Some areas that should be observed are:

- Sources of motion – such as machinery or processes
- Sources of high temperature
- Types of chemical exposures
- Sources of harmful dust that can accumulate or become airborne
- Sources of light radiation
- Sources of falling objects or the potential for dropping objects
- Sources of sharp objects
- Sources of rolling or pinching objects
- Layout of workplace and location of co-workers
- Any electrical hazards

Employer Payment of PPE

OSHA has placed a proposed rule on employer payment of PPE on their long-term agenda. OSHA published the proposed rule in the Federal Register on March 31, 1999 and plans to revise the PPE rule to clarify employers’ requirements to pay for PPE and under what circumstances.
Many OSHA standards already require employers to provide employees with PPE. These requirements address PPE of many kinds: hard hats, gloves, goggles, safety shoes, safety glasses, welding helmets and goggles, face shields, chemical protective equipment, and so forth. The provisions in OSHA standards that require PPE generally state that the employer is to provide such PPE; however, some of these provisions do not specify that the employer is to provide such PPE at no cost to the employee.

OSHA has proposed regulatory language to clarify that with only a few exceptions for specific types of PPE, the employer must pay for the PPE provided. The specific types of PPE OSHA has exempted in certain circumstances are safety-toe protective footwear, prescription safety eyewear, and logging boots. Currently, OSHA has delayed any decision on the proposed rule and the next step has not been determined.1

**PPE for Galvanizing Areas**

A galvanizing facility uses many overhead cranes that are constantly moving heavy steel pieces. A hard hat can minimize the chance of a serious accident caused by falling objects. Safety glasses, goggles, face shields, visors, and masks protect eyes against heat and chemical splashes and flying debris. Splashes from the galvanizing process tanks and particles from the finishing and repair area can be hazardous to the eyes.

Gloves are probably the most widely used item of PPE. Gloves are traditionally made of leather, but can be made of different types of material to protect against specific hazards, such as handling sharp pieces of steel and wire. Some areas of a galvanizing plant may require additional body coverings. Employees may wear protective garments such as overalls, jump suits or aprons to protect against chemical spills and molten zinc splashes.

Industrial safety footwear with steel-toes is designed to prevent injuries to feet caused by falling objects and to provide good traction on slippery surfaces. Impact resistant shoes are designed to protect against falling or cutting objects. Both types of footwear are appropriate throughout the galvanizing facility. Rubber boots should be worn in the chemical processing area. Chemical resistant rubber or neoprene boots are designed to protect the feet from chemical hazards. These boots combined with impact resistant footwear are appropriate for the cleaning and pickling areas of the plant.

In the galvanizing process, there are several areas where PPE is used.

- **Caustic and other Degreasing Cleaners** – hard hats, gloves, rubber safety footwear, eye protection and face shields
- **Pickling** – rubber gloves and aprons, eye protection, hard hats, and rubber or neoprene safety-toe foot wear
- **Fluxing** – safety goggles or face shield, rubber gloves and apron, neoprene or rubber footwear, hard hats
- **Galvanizing Kettle** – safety footwear, hard hats, face shields, eye protection, flame-retardant coveralls and gloves
- **Post-treatment Solutions** – safety goggles, rubber gloves, a rubber apron and rubber safety footwear, hard hats
- **Inspection/Cleanup** – gloves, safety glasses, face shields, hearing protection, respirator protection, hard hats
  - **Welding** – non-flammable clothing, hand and eye protection
Eye and Face Protection

Employers are required to provide suitable eye protection to each affected employee where there is a potential for injury to the eyes or face. Some of the potential hazards that might cause eye or face injuries include the following:

- Dust and other flying particles, such as metal shavings
- Molten metal that might splash
- Acids and other caustic liquid chemicals that might splash
- Intense light, such as that created by welding arcs and lasers

There are several types of eye protection that can be used.

- Safety glasses
- Goggles
- Face shields – used in conjunction with goggles or safety glasses around operations that expose employees to molten metal, chemical splashes, or flying particles. The face shield must be 6 inches high and 0.04 inches thick.
- Welding helmet – uses special absorptive lenses that filter the intense light and radiant energy that is produced during welding operations; safety glasses or goggles should also be worn

When there is a hazard from flying objects, eye protection shall have side protection. Detachable side protectors (e.g. clip-on or slide-on side shields) meeting the pertinent requirements of 29 CFR 1910.133 are acceptable. For employees that use prescriptive lenses, employers shall provide eye protection that incorporates the prescription in its design or provide eye protection that can be worn over the prescriptive lenses.

Employees that weld or are in contact with injurious light radiation shall use equipment with filter lenses that have a shade number appropriate for the work being performed. The appropriate shade index for the filter lenses is located in 29 CFR 1910.133.

Eye and face protection should meet the following minimum requirements:

- Provide adequate protection against the particular hazards for which they are designed
- Be reasonably comfortable when worn under the designated conditions
- Fit snugly without interfering with the movements or vision of the wearer
- Be durable
- Be capable of being disinfected
- Be easy to clean
- Be kept clean and in good repair

There are also protective measures that can be used in combination with appropriate eye and face protectors.

- Machine guards – always make sure that guards, shields, and screens are in place and in good working order before using these types of machines
- Work area barriers – set up to separate workers and bystanders from hazardous operations
- Ventilation – can significantly reduce the amount of airborne particles that could be hazardous to eyes
- Lighting – good lighting reduces eye strain and glare and also promotes both safety and improved productivity
- Signs and warnings – obstructions and protruding objects should be identified and marked
- Eyewash stations – located within 100 feet of the work area

In caring for eye and face protection, equipment shall be cleaned using mild soap and water after every use. Eye and face protection shall also be kept in good working
order and stored in cool dry areas away from moisture.5

**Hearing Protection**

Exposure to high noise levels can cause hearing loss or impairment. There is no cure for noise-induced hearing loss. Prevention is the only way to avoid hearing damage. Employees should wear a hearing protection device whenever exposed to noise that is 85 decibels or greater for an 8-hour period of time.

There are several different hearing protection devices. Foam earplugs, PVC earplugs, and earmuffs are the most popular hearing protection devices. The type of hearing protection to use depends on the level of noise encountered. Occupational noise exposure is covered in 29 CFR 1910.95.

When using hearing protection devices, there are advantages and disadvantages, depending on the type of hearing protection device selected.5

<table>
<thead>
<tr>
<th>Advantages of Earplugs</th>
<th>Disadvantages of Earplugs</th>
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<tbody>
<tr>
<td>Small and lightweight</td>
<td>May work loose and require occasional refitting</td>
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<tr>
<td>Comfortable in hot environments</td>
<td>Require specific fitting instructions</td>
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<tr>
<td>Easily used with other safety equipment</td>
<td>Are frequently soiled</td>
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<table>
<thead>
<tr>
<th>Advantages of Earmuffs</th>
<th>Disadvantages of Earmuffs</th>
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</thead>
<tbody>
<tr>
<td>Easy for employer to supervise the wearing of this device</td>
<td>May fit tight on the head</td>
</tr>
<tr>
<td>One size fits all</td>
<td>Uncomfortable in warm environments</td>
</tr>
<tr>
<td>Fits better for longer periods of time</td>
<td>Problems occur when used with other equipment</td>
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Hearing protective devices should be stored in a clean, cool, dry place. If foam earplugs become soiled, torn, or stiff, the earplugs should be discarded and a new pair used. PVC earplugs can be cleaned in a mild solution of soap and water and dried with a soft towel. PVC earplugs should be discarded when they become torn or brittle. Earmuffs should be inspected for cracks around the foam cups. If the earmuffs are damaged, they should be repaired immediately or a new pair issued.5

Employers shall administer a continuing, effective hearing conservation program whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels. The employer shall also develop and implement a monitoring program. Monitoring shall be repeated whenever there is a change in production, process, equipment or controls that increase noise exposures to the extent that additional employees may be exposed at or above the action level. If the attenuation provided by hearing protectors being used by employees may be rendered inadequate, monitoring shall also be repeated.

The key elements of a hearing conservation program include monitoring workplace noise levels, annual employee training, and annual audiometric testing. Annual audiometric testing serves as a measure of the overall effectiveness of the hearing conservation program.6

**Respiratory Protection**

The primary objective of preventing atmospheric contamination is to control occupational diseases and hazards caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors. This should be accomplished, when feasible, by accepted
engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible or while they are being instituted, appropriate respirators shall be used.

Employers may provide respirators at the request of employees or allow employees to use their own respirators if the employer determines that such respirator use will not in itself create a hazard. If voluntary respirator use is permissible, the employer shall provide respirator users with information from Appendix D of 29 CFR 1910.134, “Information for employees using respirators when not required under the standard.”

In order to use respirators at a facility, a respirator program needs to be in effect. A respiratory protection program is designed to provide information and protection against airborne inhalation hazards and to ensure respirators are properly selected, used, and maintained by personnel. Employers are required to develop and implement a written respiratory protection program with required worksite specific procedures and elements. The program shall be updated as necessary to reflect changes in workplace conditions that affect respirator use. Employers are not required to include in a written respiratory protection program employees whose only use of respirators involves the voluntary use of filtering face pieces (dust masks). Respirators and the requirements of the written respiratory protection program are addressed in 29 CFR 1910.134.

Employers shall provide respirators, training, and medical evaluations to the employee at no cost. Before the employee is fit-tested or required to use the respirator in the workplace, a medical evaluation is performed to determine the employee’s ability to use a respirator.

There are two major categories of respirators, air purifying and supplied air. The selection of an appropriate respirator shall be based on the respiratory hazard(s) to which the worker is exposed. In the selection of a respirator, the employer needs to do the following:

- Determine the level of hazard that is posed by the environment and where the work is being done
- Determine the type, form, toxicity, concentration, and time exposed to the contaminant
- Assess individual sensitivity to the contaminant
- Assess individual requirements – does employee have glasses/facial hair/dentures/wears other PPE (all can affect the fit of the respirator)\(^5\)
- Select a NOISH-certified respirator – shall be used in compliance with the conditions of its certification
- Select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user

Respirators need to be cleaned, stored, and maintained so that they do not present a health hazard to the users. Respirators used in routine situations shall be inspected before each use and during cleaning. When inspecting respirators look for:

- Cracks or chips in the faceplate
- Cracks or holes in the breathing tube or airlines
- Worn or frayed straps
- Worn or damaged fittings
- Bent or corroded buckles
- Dirty or improperly seated valves

Respirators should also be monitored to be sure they are working properly. A respirator is not working when:

\(^5\)
• The user can smell or taste the contaminant
• Breathing becomes difficult
• The user becomes dizzy or nauseous
• Manufacturer’s recommended service life of the filters or cartridges expire
• Respirator is damaged

Respirators that fail an inspection or are found to be defective should be removed from service and either discarded or repaired. Repairs or adjustments to respirators are to be made only people appropriately trained and shall be done according to the manufacturer’s recommendations and specifications for the type and extent of repairs to be performed.

Respirators should be stored when not in use. To store the respirator, place in a sealable plastic bag. The respirator should be stored somewhere that is convenient, but away from dust, sunlight, heat, extreme cold, moisture, and damaging chemicals. Respirators should also be packed or stored to prevent deformation of the face piece and exhalation valve.

**Head Protection**

Employers shall ensure that an employee wears a protective helmet when working in areas where there is a potential for injury to the head from falling objects and bumping heads against fixed objects, such as exposed pipes or beams. When employees are exposed near electrical conductors that would contact the head, employers shall ensure that a protective helmet designed to reduce electrical shock is worn. Protective helmets purchased after July 5, 1994 shall comply with ANSI Z89.1-1986, “American National Standard for Personnel Protection – Protective Headwear for Industrial Workers – Requirements.” Head protection is covered in 29 CFR 1910.135.

There are several types of hard hats available for head protection.
• Class A – protects from falling objects and electric shocks up to 2,200 volts
• Class B – protects from falling objects and electrical shocks up to 20,000 volts
• Class C – protects from falling objects but does not protect from electrical shocks and corrosive substances
• Bump caps – designed to protect from bumping head on protruding objects but does not protect from falling objects or electrical shocks

When inspecting head protection equipment, look for cracks, nicks, dents, gouges, and any damage caused by impact, penetration, abrasions, or rough treatment. If a hard hat is made of thermoplastic (polyethylene, polycarbonate) materials, inspect the shell for the following: stiffness, brittleness, fading, dullness of color, or a chalky appearance. If the shell exhibits any of these conditions or if the shell is obviously otherwise damaged, the hard hat should be removed from service and replaced immediately.

Maintenance should also be performed on hard hats.
• Clean hard hat at least once a month (or as needed) to remove oil, grease, chemicals and sweat that can collect in and around the hat.
• Clean by soaking in a solution of mild soap and hot water for 5-10 minutes. Rinse with clean water, wipe and let air dry or follow the manufacturer’s recommendation.
• Sunlight and heat can damage the suspension of the hard hat. Store hard hat in a clean, dry and cool location.
**Foot Protection**


Some potential hazards for feet are:
- Heavy objects, such as barrels or tools that might roll onto or fall on feet
- Sharp objects, such as nails or spikes that might pierce the soles or uppers of ordinary shoes
- Molten metal that might splash on feet or legs
- Hot or wet surfaces
- Exposure to electrical hazards
- Slippery surfaces

When wearing and using safety footwear, the correct selection of footwear for the type of activity encountered should be taken into consideration.
- Select and use the right kind of footwear for the job.
- Avoid footwear made of leather or cloth if work is around acids or caustics. These chemicals quickly eat through the leather or cloth and can injure feet.
- Select footwear that fits

There are several different types of safety shoes and boots.
- Steel toe – protects toes from being crushed by falling objects
- Metatarsal – special guards that run from the ankle to toes and protect entire foot
- Reinforced sole – metal reinforcement that protects foot from punctures
- Latex/rubber – resists chemicals and provides extra traction on slippery surfaces
- PVC – protects against moisture and improves traction
- Butyl – protects against most ketones, aldehydes, alcohols, acids, salts, and alkalies
- Vinyl – resists solvents, acids, alkalis, salts, water, grease, and blood
- Nitrile – resists animal fats, oils, and chemicals
- Electrostatic dissipating – conducts static electricity to floors that are grounded
- Electrical hazard – insulated with tough rubber to prevent shocks and burns from electricity
- Disposable – shower slippers, clear polyethylene and non-woven booties used in dust free work areas

Maintenance and inspection of the footwear should be implemented to be sure that the footwear is still appropriate for use.
- Inspect footwear before use. Look for holes and cracks that might allow fluids to leak into the footwear
- Replace footwear that are worn or torn
- After working with chemicals, hose footwear with water to rinse away any chemicals or dirt before removing footwear
- Avoid borrowing footwear
- Store footwear in a clean, cool, dry, ventilated area

**Hand Protection**

Hand protection is covered under 29 CFR 1910.138. There are several types of gloves to use when exposed to chemicals and molten metal, everyday handling and finishing of steel parts, and high temperature. Employers shall base the selection of appropriate hand protection on the task to be performed,
conditions present, duration of use, and the hazards and potential hazards identified.

- Metal mesh – resists sharp edges and prevent cuts
- Leather – shields hands from rough surfaces
- Vinyl and neoprene – protects against harmful chemicals
- Rubber – protects when working around electricity
- Padded cloth – protects hands from sharp edges, slivers, dirt and vibration
- Heat resistant – protects from heat and flames
- Latex disposable – protects from germs and bacteria
- Lead-lined – protects from radiation sources

When wearing and using gloves, the maintenance and inspection of the gloves are important to the effectiveness of the PPE.

- Select and use the right kind of glove for the job
- Select gloves that fit
- For gloves that have a life expectancy, discard the gloves after the recommended time has expired
- Remove any rings, watches, or bracelets that might cut or tear gloves
- Wash hands before and after wearing gloves
- Inspect gloves before use. Look for holes and cracks
- Replace gloves that are worn or torn
- After working with chemicals, hold gloved hands under running water to rinse away any chemicals or dirt before removing the gloves
- Wash cotton gloves as needed
- Avoid borrowing gloves
- Store gloves right side out in a clean, cool, dry, ventilated area
- Never wear gloves around powered rotating equipment, such as drills, lathes, etc.

**Protective Clothing**

Protective clothing is designed to give the worker limited protection from exposure to hazards such as fire, extreme heat, molten metal, corrosive chemicals, body impact, cuts, and cold temperature. Protective apparel includes jackets, coats, aprons, trousers, sleeves, leggings, and coveralls. The particular clothing material and style should be selected based on the hazards involved.

The following information on protective clothing was taken from studies done by two companies. Their investigation suggested certain types of clothing that are suitable for around the galvanizing kettle. After an accident at a galvanizing facility that used the recommended type of protective clothing and the accident victims were burned through the recommended PPE, a study was conducted by this company to investigate different protective clothing products.

Two companies, Witt Galvanizing and Noranda, investigated different protective clothing that could be used near molten metal. The isolated study conducted by Witt Galvanizing was internally performed and rated clothing material that successfully provided protection against exposure to molten zinc.

The test conducted was based on ASTM specification F 955-96, “Evaluating Heat Transfer through Materials for Protective Clothing upon Contact with Molten Substances.” Materials for the zinc test were also exposed to sulfuric and caustic solutions and allowed to dry. This test simulated splashing of surface cleaning solutions in the galvanizing process.
During the test, zinc ran off and scorched the color out of the material. The materials smoked a little and did not heat the clothing attached to the wood splashboard. In order of ranking, the following clothing material was accepted for use near the kettle.

1. Nomex® 950, Green
2. Kevlar® 29, Yellow
3. Nomex® 650, Blue
4. Indura® Cotton, Blue – did develop a small 1/32” hole in the zinc exposure area but zinc was also wicked away by the fabric

For the caustic and sulfuric acid test, the liquid solution rolled off the material and caused no apparent degradation of material. The following materials were found to be suitable.

- Nomex® 950, Green
- Kevlar® 29, Yellow
- Nomex® 650, Blue

The Indura® fabric was also an effective material; however, there was some deterioration in the liquid exposure area. The materials used in this test were ranked based on the condition of the material in the area of the liquid solution exposure after 25 washings. air

The fabrics tested were Vinex®, cotton and wool serge. Vinex® is a flame resistant fabric that is a blend of 85% inherently flame resistant Vinal (polyvinyl alcohol) fiber and 15% polynosic rayon. Wool serge is a type of twilled woolen fabric. Of the fabrics tested, wool serge offered the best flame and magnesium splash resistance. The molten metal did not stick to the fabric and the fabric can provide an extended protection against severe burns.

After an accident where the employees were outfitted in Nomex® material around the kettle area and still became burned through the Nomex®, Valmont Industries, Inc. underwent an internal investigation of seven different materials. The seven materials were Proban® FR-7A, Nomex®, Genesis®, Indura®, Vinex®, Banox®, Oasis®, and PR-97®. Material was cut into rough 14 x 14 inch squares and placed on a frame that held the material in place for testing. A frame was constructed of angle iron and set at 70 degrees. The test samples were held onto the frame using small spring clamps. A ladle that held seven fluid ounces of zinc was used to pour over the different materials.

Results from Valmont’s investigation showed that Nomex® is not suitable for areas that are exposed to molten zinc. This differs from the Witt study’s recommendations. The main difference between the two studies is the quantity of zinc that was exposed to the testing material. Valmont poured significantly more zinc on their materials when conducting their test. Valmont’s study also had the same results as Noranda in their testing of Vinex®. Vinex® is also not suitable
around the kettle area. The results of the other materials tested are:

- **Proban® FR-7A** – no sticking of zinc on the material, slight char on the fabric, material burned but did not ignite.
- **Nomex® and Genesis®** (Nomex® material under a different trade name) – severe sticking of zinc to the material, some shrinkage, zinc did not burn through the fabric
- **Vinex®** – severe sticking of zinc, some small holes burned through the fabric, moderate shrinkage
- **Indura®** – moderate to heavy sticking of zinc, charring and a few small holes where there was heavy adhesion, Indura® style 315 showed light sticking of zinc and a few small charred spots
- **Banox®** – very little sticking of zinc, adhesion of zinc was minimal, no holes burned through the material
- **Oasis®** – moderate to heavy zinc sticking, no signs of shrinkage but severe charring on the backside of samples, zinc did burn or melt through the material in a couple of small spots
- **PR-97®** – moderate to heavy sticking of the zinc with good adhesion, charring and discoloration on the backside of test sample, couple small areas where the zinc had burned through the material

After reviewing the information on the seven materials, Valmont decided to use the Banox® material since it performed the best with the least zinc adhesion and little charring. Besides using the Banox®, Valmont also uses the following PPE around the galvanizing kettle.

- Leather steel toed boots with metatarsal guards
- Spats to cover the boots
- Banox® chaps to cover the legs
- Kevlar® sleeves that cover wrist and forearms
- Green Proban® jacket
- Heavier more heat resistant gloves with longer cuff
- Safety glasses
- Hard hat with face shield attachment
- Proban® shroud to cover the back of the neck

In an informal survey of galvanizers, other types of protective clothing used were aluminized fabric and cotton. Cotton will still burn but can give employees some level of protection in the event of a molten zinc splash. The cotton material is usually treated with a flame retardant. Some galvanizers have noted that workers using special flame retardant fabrics have complained that the fabric was too hot to work in while near the kettle. Nylon material or nylon synthetic fabric is not recommended for use since the material will quickly melt on contact with the molten zinc.

**PPE Training**

Employers are to provide training to each employee who is required to use PPE. Each employee should 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
- The limitations of the PPE
- The proper care, maintenance, useful life and disposal of the PPE

Employers are required to certify in writing that training has been carried out and that employees have an understanding of the
material. Each written certification shall contain the name of each employee trained, the date(s) of training, and identify the subject of certification.

Employees must also be aware that PPE does not eliminate the hazard. If the PPE fails, exposure will occur. To reduce the possibility of failure, equipment must be properly fitted and maintained in a clean and serviceable condition. Employers and employees must understand the PPE purpose and its limitations.

Employees should periodically inspect PPE for:
- Evidence of chemical attack, such as discoloration, swelling, stiffening, and softening (Note: chemical permeation can occur without any visible effects)
- Failure to close
- Tears
- Punctures
- Ripped seams

**Summary**

PPE is essential in maintaining the safety of workers. In the galvanizing industry, a variety of PPE is used to protect employees. Employers determine the selection of appropriate PPE based on legal requirements and previous plant accident experience. Proper choice of equipment is important to ensure the safety of personnel.

**Bibliography**