SELECTION OF PERSONAL PROTECTIVE EQUIPMENT

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1 Introduction

It is important to follow the principle of “use PPE as a last resort, rather than the preferred option to protect against potential hazards.”
This document provides guidance on a work process for selecting and using Personal Protective Equipment (PPE) at work. Selection tables are included which are general examples of PPE for protecting personnel against hazards that could cause harm.
The information in the selection tables should not be used without giving due consideration to the prevailing work area and environmental conditions by means of specific task based risk assessments.

2 Scope and purpose

The document is intended to provide guidance and examples in selection and use of PPE. It supplements other techniques for assessing and controlling risk.
This document is not intended to replace the need for conducting a task specific risk assessment or to provide details on other administrative or management program elements that can be associated with the proper use of certain types of PPE.
Regulatory bodies may have jurisdiction and influence PPE selection and use.

3 General Requirements

3.1 Responsibilities

In accordance with applicable laws and regulations, each location manager is responsible for determining the PPE needs of its facilities, personnel, contractors, and visitors.
When necessary, the location manager should ask for support from medical or technical experts in order to assess the medical fitness of employees before selecting the appropriate PPE.

3.2 Risk assessments

A risk assessment should be conducted and documented in each work area to assess the risks related to the process, relevant tasks and activities associated with the work area. The risk assessment should be updated when changes are made in a work area that might impact PPE selection. When undertaking the risk assessment the following steps are recommended:

a) Involve the user representatives in the risk assessment process.
b) Assess the risks associated with specific work areas and tasks to determine the need for PPE.
c) Select the PPE that matches the relevant risk. Ensure relevant regulations codes, standards, and PPE specifications are reviewed. (1)

3.3 Maintenance

PPE shall be checked before each use and shall be regularly cleaned, maintained, repaired (unless disposable) and replaced in accordance with the manufacturer’s instructions.
Records of maintenance shall be kept where required.

3.4 Storage

Storage methods shall be in accordance with the manufacturer’s instructions. In some cases, specific storage receptacles for PPE not in use may be required to prevent contamination and keep PPE clean.

3.5 Training

Personnel required to use PPE shall be trained in the following areas:

– The hazards which the selected PPE is being used to protect against.

- It's proper selection (what, when and where to use it);
- It's use (e.g. how to put on, fit, adjust and remove) and limitations; and
- Its proper care, useful service life, disposal, and any required maintenance.

Use of PPE by personnel shall be monitored and any misuse corrected and recorded.

3.6 Personnel

Personnel have a duty to use PPE as instructed and store it appropriately when not in use. Defects or Loss shall be reported and the PPE promptly maintained or replaced.

3.7 Records

Records of PPE maintenance, risk assessments and training shall be kept by the employer. Issue of PPE shall be recorded if required by local regulations.

3.8 Identification of areas where PPE is required

Working areas on site where specific PPE is required shall be clearly identified (e.g. "Hearing Protection Required in This Area" signs).

4 PPE assessments and specifications

When performing a risk assessment, review work areas and tasks for general hazards (e.g., impact, penetration, compression, chemical, heat (or cold), harmful dust, and light (optical) radiation). Also consider specific sources of hazards such as:

- sources of motion; e.g., vehicle movements (fork lift trucks, delivery vehicles), machinery or processes where any movement of tools, machine elements, or particles could exist, or movement of personnel that could result in collision with stationary objects;
- sources of high and low temperatures that could result in burns, eye injury or ignition of protective equipment, etc.;
- types of chemical exposures;
- sources of harmful dust;
- sources of light radiation, e.g., welding, brazing, cutting, furnaces, heat treating, high intensity lights, etc.;
- sources of falling objects or potential for dropping objects;
- sources of sharp objects which might pierce the feet or cut the hands;
- sources of rolling or pinching objects which could crush the feet;
- layout of workplace including working at height
- location of co-workers;
- ambient weather conditions; and
- any electrical hazards.

In addition, injury and accident data, work place inspections and audit findings should be reviewed to help identify other sources of hazard.
The following sections contain general recommendations for the protection requirements for common tasks and the type of PPE to be used. They should be used as a starting point for the selection of the PPE required for any given hazardous situation and an aid to the minimisation of risk. Final selections should be based on a specific review of the work task, the duration of the task, the risk of injury during the task, the consequences of any exposure to an injurious chemical, any related chemical's Material Safety Data Sheet, and any relevant regulatory or national consensus standard exposure limits.

4.1 Hearing protection

All hearing protection shall conform to the requirements of relevant, recognised standards. (2)

The wearing of hearing protection shall be mandatory in areas where noise exceeds the regulatory levels. A sound level survey should be conducted to determine actual noise levels in areas where noise levels are suspected to be above regulatory levels (e.g., compressor buildings and platforms, pump rooms, process areas, turbines, high pressure gas vents, etc.).
The choice of the hearing protection should be determined by taking into consideration both separately and in combination:

- frequency of use
- noise level
- duration of exposure
- ambient noise level
- noise frequency
- additional PPE required for work activity (e.g. gloves, helmet, goggles etc).

4.2 Eye and face protection

All eye and face protection shall conform to the requirements of relevant, recognised standard. (3)
Eye and face protection for all tasks and work areas should be determined based on all hazards identified by the risk assessment.
Standard prescription glasses shall never be considered as eye protection.
Eye and face protection recommendations for various hazard categories are represented in the following table:

Table 1—Eye and face protection selection

Hazard Classification	Hazard	Consequences	Recommended Protection [1)]
Chemical	• Chemical or solvent splashes • Liquid jets • Corrosive or irritating gases and fumes	• Eyes irritation • Eye inflammation • Face burns • Blindness	• Safety glasses with side shields and Face shield [2)] or • Goggles
Cryogenic or heat burn	• Cryogenic liquids and nitrous oxide or carbon dioxide (splashes) • Cryogenic liquid jets • Heat source • Flame	• Face burns • Temporary blindness • Blindness	• Safety glasses with side shields and Face shield [2)] or • Goggles
Radiation	• Glare • Welding arc • Laser radiation • RX radiation	• Eye irritation • Temporary blindness • Eye burns • Blindness	• Safety glasses with side shields or • Tinted safety glasses • Welding mask in case of welding
Mechanical	• High pressure/velocity gas release • Stamp marking of cylinder • Dusts, insulation, catalyst, perlite • Powder washing • Metal chips and drilling • Power brushing, grinding, chipping, sawing (medium-high velocity impact) • Sandblasting • Cutting tools	• Eye irritation • Temporary blindness • Eye perforation • Blindness	• Safety glasses with side shields • Goggles • Face shield

Hazard Classification	Hazard	Consequences	Recommended Protection [1)]
Electrical	• High voltage electricity • Medium voltage electricity • Arc flash	• Face burns • Eye burns • Blindness	• Safety glasses with side shields [4)] • Arc-rated face shield [3)]

1) The recommended protection devices are described generically and should be further classified to fit the appropriate hazard. For example, goggles and safety glasses can be made out of different materials to protect against specific hazards. Safety glasses constructed from polycarbonate materials are a good compromise between weight and performance (resistance to scratches, hot particles, chemicals and UV)

2) Face shields should not be worn when working with gases or chemicals that create hazardous vapours.

3) A face shield with a hood might be required based on risk assessment.

4) Best practice in the US is to use safety glasses for all activities, including all low-voltage electrical work. See NFPA 70E (National Electric Code) for more information.

Face shields should not be considered primary eye protection and should be worn with additional eye protection (safety glasses or goggles)

4.3 Respiratory protection

All respiratory protection shall conform to the requirements of relevant, recognised standards. (4)

Before entering a risk area (e.g., a confined space), the type and concentration of respirable contaminant should have been established by the risk assessment and confined space permit, so the appropriate respirator can be selected. Where the concentration of a contaminant is unknown, the use of supplied breathing air respirators is required.

Specific respiratory protection shall be worn when personnel have the potential to be exposed to hazards above the regulatory limits. Minimum protection recommendations for various respiratory hazards are represented in Table 2.

Table 2—Respiratory protection selection

Exposure/activity	Recommended PPE
Abrasive blasting	Disposable dust mask, filter cartridge respirator or Supplied Breathing Air respirator
Asbestos	Filter cartridge respirator or Supplied Breathing Air respirator
Chlorinated solvents use	Filter cartridge respirator for short term exposure or Supplied Breathing Air respirator
Confined space entry (where safe levels of oxygen or contaminant cannot be guaranteed)	Supplied Breathing Air Respirator
Inert cryogenic liquid fog or carbon dioxide release	Supplied Breathing Air respirator
Dust	Disposable dust mask, filter cartridge respirator or Supplied Breathing Air respirator
Perlite	As for dust but additional protection recommended to provide full face protection
Oxygen deficient atmospheres or unknown atmospheres	Supplied Breathing Air respirator
Petroleum-based products use	Filter cartridge respirator for short term exposure or Supplied Breathing Air respirator

Exposure/activity	Recommended PPE
Toxic gases (Within Europe: of class T e.g. ammonia, carbon monoxide, chlorine, hydrogen chloride, etc.)	Filter cartridge respirator for short term exposure or Supplied Breathing Air respirator
Extremely hazardous and poisonous gases (Within Europe: Toxic gases of class T+ e.g. arsine, phosphine, fluorine, diborane, etc.)	Supplied Breathing Air respirator
Welding/cutting	Filter cartridge respirator or Supplied Breathing Air respirator

1 For filter cartridge respirators, select filter to match material and contamination level where assessments show a risk of exposure above permissible limits. To determine the proper cartridge for air-purifying respirators, either consult a safety professional or the Material Safety Data Sheet of the substance that needs to be filtered. Generally, cartridges are assigned a colour or other coded descriptor designating the type of contaminant they filter.

2 Supplied Breathing Air respirators are available in different types and shall be selected based upon the potential hazard and activity. Some examples are self-contained breathing apparatus (SCBA), airline respirator, airline respirator with escape cylinder, and forced air supplied hoods.

4.4 Head protection

All head protection shall conform to the requirements of relevant, recognised standards. (5)

Typical head protection for various examples of hazards is represented in Table 3.

Table 3—Head protection selection

Exposure/activity	Recommended PPE
Production plant (e.g. ASU, carbon dioxide) and their storage areas	Hard hat (safety helmet)
Construction, demolition, excavation, scaffolding, craneage, overhead hazards	Hard hat (safety helmet)
Electricity/high voltage work (over 440V)	Electrically rated hard hat (safety helmet)
Customer deliveries, where construction, demolition, etc, exists or as required by customer	Hard hat (safety helmet)

4.5 Fall arrest protection

All safety belts, harnesses, lanyards and connecting devices shall meet requirements of local legislation and conform to the requirements of relevant, recognised standards. (6)

Typical fall protection is presented in Table 4.

Table 4 - Fall arrest protection selection

Exposure/activity	Recommended PPE
Risk of falling where no other fall protection (i.e., guard rails, barriers) exist	Full body safety harness, safety line (lanyard) attached to a suitable anchorage point

***WARNING**—Safety belts are used only in positioning system applications. These belts have two side D-rings, and are used only for restraining a worker in position. This type of belt is not used for any vertical free fall protection.*

4.6 Hand protection

All hand protection is made for specific purposes and should be selected on this basis. All hand protection shall conform to the requirements of relevant, recognised standards. (7)

Typical hand protection for various examples of hazards is represented in Table 5.

Table 5—Hand protection selection

Exposure/activity	Recommended PPE
Abrasive blasting	Leather gauntlets
Chemicals	Safety Data Sheet recommended hand protection Note: Materials of construction of gloves for chemical protection vary by chemical, form (liquid or solid), and concentration. Chemical-specific protection should be determined using the safety data sheet or product manufacturer or supplier's recommendation.
Cylinder handling and filling (non-cryogenic)	• Leather wrist gloves • Fabric gloves • Fabric gloves with leather palms
Handling cold equipment, for example: • Loading and unloading • Filling of cryogenic liquids, nitrous oxide or carbon dioxide • Breaking lines or connections on cryogenic liquid systems.	Insulated gauntlets/gloves without linings *Note:* Leather gloves are to protect against cold from cryogenic equipment but do not offer protection against exposure to liquid leaks.
Electricity	Voltage-rated gloves Arc flash-rated gloves NOTE—Match type to electrical potential and specific task.
Materials handling/warehouse	• Leather wrist gloves • Fabric gloves • Fabric gloves with leather palms
Welding/cutting	Leather gauntlets
High temperature	Leather gloves or insulated gloves
Sharp edges, for example when: • Scraping labels • Handling broken glass	Cut-resistant gloves

4.7 Protective footwear

All safety shoes shall conform to the requirements of relevant, recognised standards. (8)

Typical foot protection for various examples of hazards is represented in Table 6.

Table 6—Protective footwear selection – activities

Exposure/activity	Recommended PPE
Production plant, workshops, maintenance activities, installations at customer premises and product transfers	Leather or equivalent material
Cylinder handling and filling	Leather or equivalent material with metatarsal protection
Materials handling/warehouse	Leather or equivalent material
Electrical works	Non-conductive sole
Welding activities	Leather or equivalent material
Welding/cutting	Leather or equivalent material
Chemical handling	SDS-recommended foot protection [1]
Flammable gas and liquid handling	Anti-static sole

1 Materials of construction of shoes for chemical protection vary by chemical, form (liquid or solid), and concentration. Chemical-specific protection shall be determined using the safety data sheet or manufacturer or supplier's recommendation.

2 Minimum specifications for all footwear are:

- Steel or composite safety toe caps
- Where personnel are required to climb ladders, soles should have a defined instep with heel to reduce the risk of slipping off ladder rungs.
- Soles shall be slip resistant and provide appropriate resistance to oil, static electricity, heat, chemical, abrasive etc hazards based on the intended use.

4.8 Protective Clothing

All protective clothing shall conform to the requirements of relevant, recognized standards. (9, 10)

All protective clothing is made for specific purposes and should be selected on the basis of a task-specific risk assessment.

The regular working clothing in the gases industry should be taken into consideration as part of the risk assessment process.

Typical protective clothing for various examples of hazards is represented in Table 7.

Table 7—Protective clothing selection

Exposure/activity	Recommended PPE
Chemical Handling	Materials of construction of clothing for chemical protection vary by chemical, form (liquid or solid), and concentration. Chemical-specific protection shall be determined using the safety data sheet or manufacturer or supplier's recommendation.
Electrical flash fire	FRC** suitably rated for the task's arc flash potential

Exposure/activity	Recommended PPE
Flammable gases, liquids and dusts	FRC** with anti-static properties
Oxygen and nitrous oxide (liquid or gaseous)	FRC** or natural fibre material, e.g. cotton
Other cryogenic liquid gases	Natural fibre material, e.g. Cotton
Areas where there may be vehicular traffic	Bright colours with reflective strips (night time)
Welding/cutting	Leather outer garments, welding jackets and aprons
• ** FRC: Fire Resistant Clothing	

In addition:

– In areas where FRC is mandatory, it is recommended not to wear inner garments or underwear made of synthetic materials because of the risk of melting and sticking to the skin.

5 References

(1) *EU - Council Directive 89/656 Minimum health and safety requirements for the use by workers of personal protective equipment at the workplace and Council Directive 89/686 on the approximation of the laws of the Member States relating to personal protective equipment.*

(2) *EN 352-1:2002 Hearing protectors. Safety requirements and testing, Ear-muffs*

(3) *EN 166:2002 Personal eye protection Specifications; EN 170:2002 Personal eye -protection Ultraviolet filters. Transmittance requirements and recommended use*

(4) *EN 149:2001 Respiratory protective devices. Filtering half masks to protect against particles. Requirements, testing, marking*

(5) *EN 397:1995 Specification for industrial safety helmets*

(6) *EN 361:2002 Personal protective equipment against falls from a height Full body harnesses; EN 358:2000 Personal protective equipment for work positioning and prevention of falls from a height. Belts for work positioning and restraint and work positioning lanyards*

(7) *EN 388:2003 Protective gloves against mechanical risks; EN 374-1:2003 Protective gloves against chemicals and micro-organisms. Terminology and performance requirements*

(8) *EN ISO 20345:2004 Personal Protective Equipment – Safety footwear*

(9) *EN ISO 11611:2007 Protective clothing for use in welding and allied processes. (supersedes EN 470-1:1995 Protective clothing for use in welding and allied processes. General requirements), EN 1149:2006 Protective clothing. Electrostatic properties. Test measurement for surface resistivity*

(10) *EN ISO 11612:2008 Protective Clothing – Clothing to protect against heat and flame (supersedes EN 531:1995 Protective Clothing for workers exposed to heat). CEN/TR 14560:2003 Guidance for selection, use, care and maintenance of protective clothing against heat and flame.*