SKM4353 Safety in Petroleum Engineering
Chapter 5: Hazard Abatement

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Hazard Control/ Abatement Philosophy

SOURCE

- Elimination
- Substitution
- Isolation
- Engineering control

PATH

- Guarding
- Barricade
- Shield
- Engineering control

WORKER

- Training and Competency
- PTW
- PPE

Hierarchy of control measures

Elimination
- Changing the process/machinery

Substitution
- Using less hazardous material/process

Isolation
- Noisy equipment from workers work area

Engineering control
- Modification/retrofit

Administrative control
- procedure, PTW, number exposed

Personal Protective Equipment

Control measures at the source

- Elimination
  - completely removing hazard or risk of exposure
  - the ideal control solution
  - example;
    - ✓ban use of hazardous chemicals e.g. Benzene, asbestos
    - ✓Removal of hazardous substances(chemicals) from the floor

Control measures at the source

- Substitution
  - replacing the hazard with less hazardous alternatives
  - example;
    - ✓Using rock wool instead of asbestos for insulation
    - ✓Using chemical in pellet or paste form instead of dust powder
- Isolation
  - locating source of hazard away from people
  - example
    - ✓Isolating a compressor from workers to reduce noise

Engineering control

- The next preferred measure if a hazard cannot be eliminated or substituted
- Examples include;
  - enclosing the hazard e.g. noisy, hot, rotating equipment
  - installing machinery guarding
  - installing exhaust ventilation

Administrative control

- Including work practices which reduce risks and limits the exposure
- Examples;
  - reduce the number of employees exposed to hazard
  - reduce the period of exposure
  - rotating the workers
  - procedures
    - ✓SOP
    - ✓PTW
    - ✓HAZOP
    - ✓Lock Out Tag Out

Safe Operating Procedure (SOP)

- A form of administrative control to guide workers to work safely and appropriately
- Identifies the hazards and imposes the precautions and control measures
- Also refers to as Working Instruction(WI) Manual

Example of SOP

High Pressure Hoses

- Check hose fittings for proper connections
- Operator should never leave machine while pumping is in process
- Make sure all hoses and nozzles are in good shape
- Do not stand over hoses
- Use proper lifting procedures
- Do not allow heavy equipment to run over hoses

Lock Out & Tag Out

- They are designed to prevent accidents & injuries caused by the accidental release of energy
- These procedures prevent workers from being accidentally exposed to injuries and even life threatening situations with energized equipment
- OSHA regulates lockout/tagout through the Control of Hazardous Energy standard

Importance of LOTO

Before the standard went into effect in 1984, OSHA estimated the failure to control hazardous energy sources caused:

- 10 percent of serious industrial accidents
- 33,000 lost workdays each year
- Loss of about 140 lives each year

Scope and Application

- General Industry employees covering the servicing and maintenance of machines and equipment in which the unexpected start-up or the release of stored energy could cause injury to employees. (If employees are performing service or maintenance tasks that do not expose them to the unexpected release of hazardous energy, the standard does not apply.)

The standard does not apply in the following situations:

- While servicing or maintaining **cord** and **plug** connected electrical equipment.

  (The hazards must be controlled by unplugging the equipment from the energy source; the plug must be under the exclusive control of the employee performing the service and/or maintenance.)

Normal Production Operations

The lockout/tagout rule may apply during normal operations in some instances.

If a servicing activity - such as lubricating, cleaning, or un-jamming the production equipment - takes place during production, employees performing the servicing are covered by lockout/tagout when any of the following conditions occurs:

- The employee must either remove or bypass machine guards or other safety devices
- The employee is required to place any part of his or her body in contact with the point of operation of the operational machine or piece of equipment; or
- The employee is required to place any part of his or her body into a danger zone associated with a machines' operating cycle.

In the above situations, the equipment must be de-energized and locks or tags must be applied to the energy-Isolation devices.

What is Lockout?

- The process of preventing the flow of energy from a power source to a piece of equipment, and keeping it from operating.

- Is accomplished by installing the lockout device at the power source so that equipment powered by the source cannot be operated.

What is Tagout?

- **The placement of a tag on the power source. It acts as a warning, not to restore energy**

It is not a physical restraint. Tags must clearly state: DO NOT OPERATE or the like, and must be applied by hand.

Energy-Isolating Device

- Mechanical device that physically prevents the transmission or release of energy. Such as manually-operated electrical circuit breakers, disconnect switches, line valves, and blocks.
- Guards against accidental machine or equipment start-up or the unexpected re-energizing of equipment during servicing or maintenance
- These include things such as, manually operated electrical circuit breakers, disconnect switches, line valves, and blocks

Energy-Isolating Devices (cont'd)

- When the energy-isolating device cannot be locked out, the employer must use tagout or modify or replace the device to make it capable of being locked.

- When using tagout, employers must train their employees in the limitations of tags.

Energy-Isolating Devices (cont'd)

- Whenever major replacement, repair, renovation or modification of machines or equipment is performed and whenever new machines or equipment are installed or purchased, the energy-isolating devices for such machines or equipment must be lockable.

Authorized Employees

- Authorized employees physically lock or tag out equipment for servicing or maintenance. Note that these individuals are not necessarily the people who normally operate the equipment.

Affected Employees

- Are those workers whose job requires them to operate equipment subject to lockout/tagout, or those employees who work in areas where lockout/tagout is used. Your employer will inform you if you are an affected employee.

- An affected employee becomes an “authorized” employee whenever he or she performs servicing or maintenance functions on machines or equipment that must be locked or tagged.

Some **of the energy sources that require Lockout/Tagout**

- Electrical
- Mechanical
- Pneumatic(involving gases, especially air)
- Hydraulic(involving fluids, especially water)
- Chemical
- Thermal
- Water Under Pressure (or steam)
- Gravity
- Potential

Employee Training

- The employer must provide effective initial training and retraining as necessary and must certify that such training has been given to all employees covered by the standard. The certification must contain each employee's name and dates of training.

- Retraining must be provided, as required, whenever there is a change in job assignments, a change in machines, equipment or processes that present a new hazard, or a change in energy control procedures.

- Additional retraining must be conducted whenever a periodic inspection reveals, or whenever the employer has reason to believe, that there are deviations from or inadequacies in the employee's knowledge or use of the energy control procedure.

Other Concerns

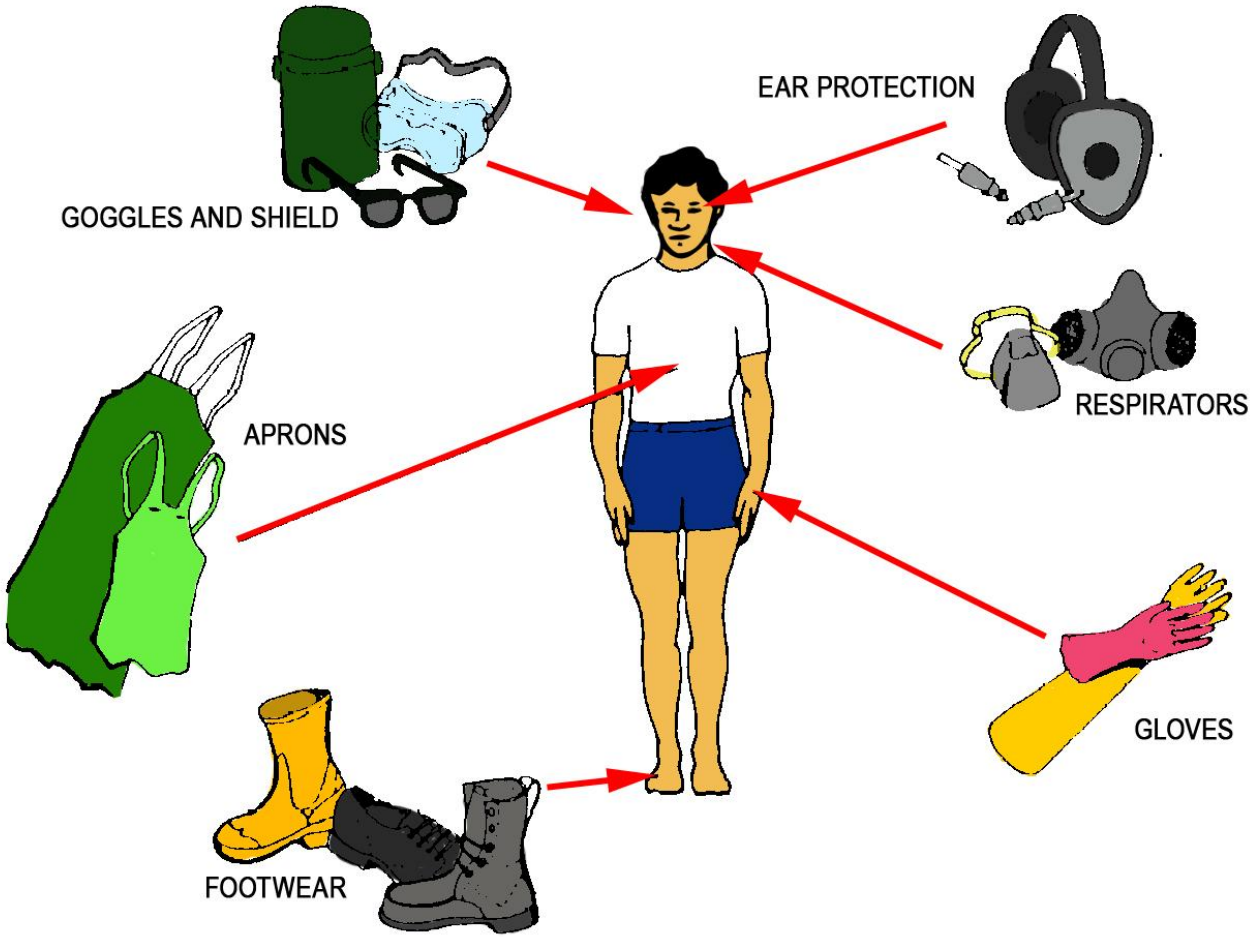
- Outside Contractors - They must be informed of your lockout/tagout procedure in full detail so that their employees understand the meaning of locks or tags that they may come across during the course of their work. In addition, if the contractor will be using locks or tags, they should inform your employer so that everyone affected may be notified.

Other Concerns (cont'd)

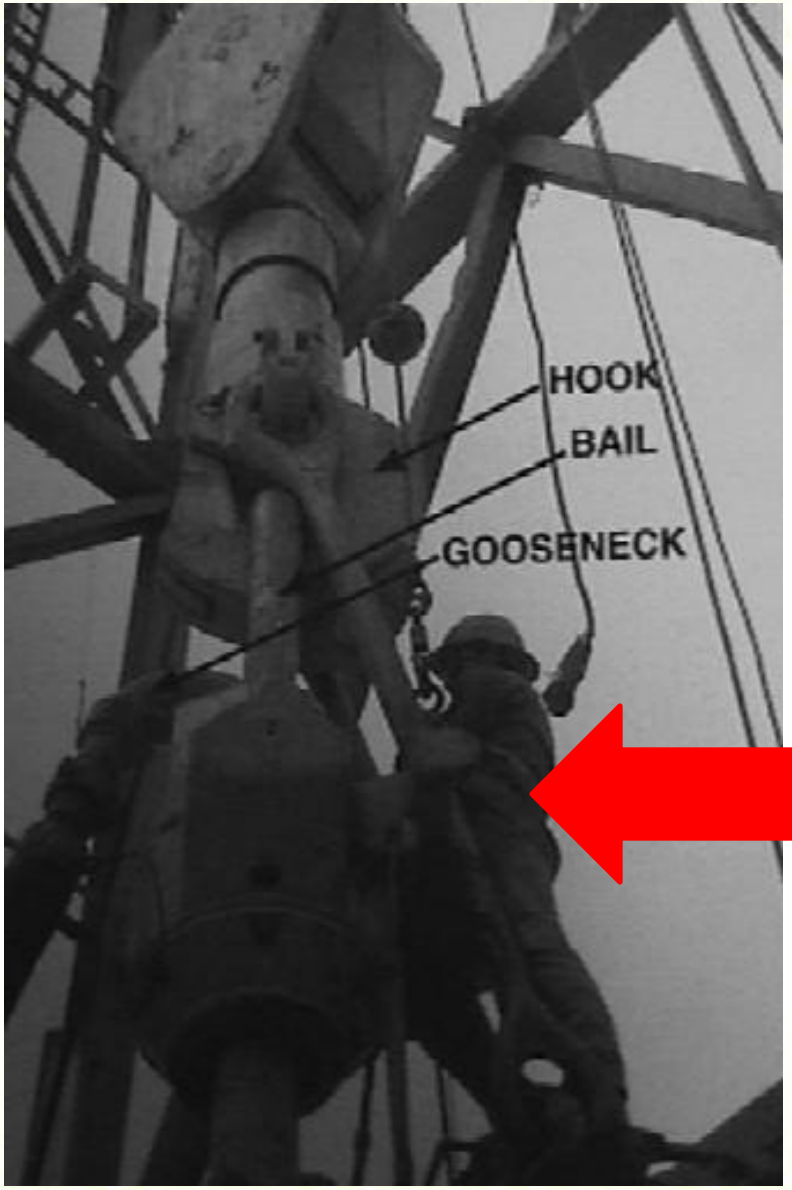
- **Shift and Personnel Changes - In general, if a piece of equipment is locked out at shift change, the person on the next shift must apply his/her lock before the employee who is leaving can remove his/her lock.**

Other Concerns (cont'd)

- **Group Lockout/Tagout - Procedures used must be as effective as that provided by utilizing a personal lockout/tagout device. Your employer can assign one person primary responsibility for the group servicing or maintenance operation. This person will verify shutdown and isolation, application of member lockout/tagout devices, completion of group member job assignments prior to removal of lockout/tagout devices, etc...**



PERSONAL PROTECTIVE EQUIPMENT (PPE)



Is he tied off?

What do you think would happen if he falls??

OSHA requires certain PPE based on the hazards employees are exposed to.

OSHA also requires training for employees in the proper selection, use, and maintenance of PPE.

PPE

Personal protective equipment should not be used as a substitute for engineering, work practice, and/or administrative controls.

Personal protective equipment should be used in conjunction with these controls to provide for employee safety and health in the workplace.

Personal protective equipment
includes all clothing and other work accessories designed to create a barrier against workplace hazards.

Selection of the proper personal protective equipment for a job is important.

Employers and employees must understand the equipment's purpose and its limitations. The equipment must not be altered or removed even though an employee may find it uncomfortable.

(Sometimes equipment may be uncomfortable simply because it does not fit properly.)

The basic element of any management program for personal protective equipment should be an in-depth evaluation of the equipment needed to protect against the hazards at the workplace.

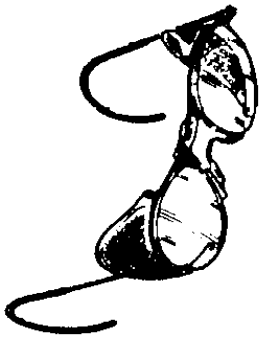
Management dedicated to the safety and health of employees should use that evaluation to set a standard operating procedure for personnel, then train employees on the protective limitations of personal protective equipment, and on its proper use and maintenance.

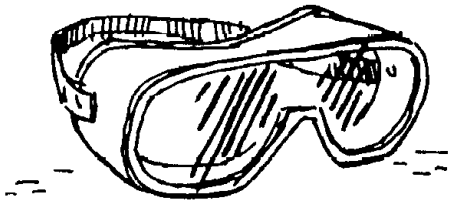
Using personal protective equipment requires hazard awareness and training on the part of the user.

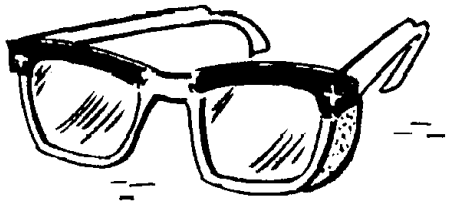
To reduce the possibility of failure, equipment must be properly fitted and maintained in a clean and serviceable condition.

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

EYE PROTECTION

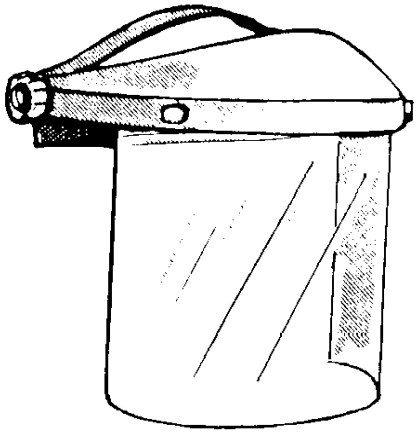






Eye protection comes in different types. Goggles are designed for solid or liquid hazards that are airborne and in a quantity that there is a greater likelihood of contact with or near the eye. Safety eyeglasses with protective side shields are designed for eye protection when the hazard is more casual by nature and the hazard(s) is of low quantity and likelihood.

EYE / FACE PROTECTION



For more severe hazards, full face protection is needed. Examples of this are heavy grinding and heavy spraying or splashing. The full face shield not only protects the eyes, but the entire facial area as well. The face shield affords extra protection against hazards involving temperature extremes or hazardous chemicals. Due to the wide opening on the sides and bottom of the face shield, protective eyewear must be worn along with the face shield.

COMMON EYE / FACE HAZARDS

IMPACT

Chipping, grinding machining, woodworking, sawing, drilling, chiseling, powered fastening, riveting, and sanding.

HEAT

Furnace operations, pouring, casting, hot dipping, welding, chemicals

LIGHT AND/OR RADIATION

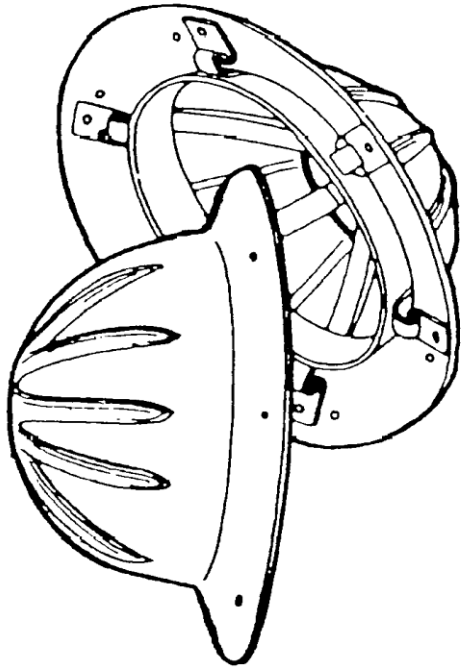
Electric welding, gas welding, gas cutting, and soldering.

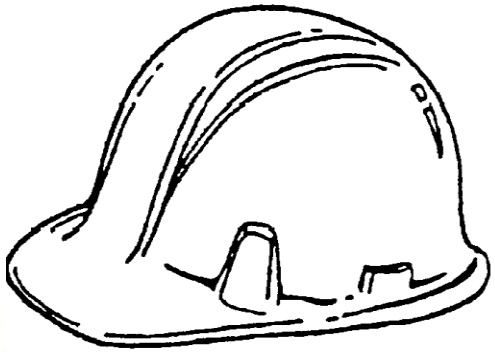
NUISANCE

Irritating mists, dusts.

HEAD PROTECTION

Hard hats are necessary to protect workers against hazards that include falling objects and overhead hazards in general. There are different types of hard hats. Some hats are designed to protect only against bumps (low overhead hazards), while others afford protection against falling objects. Metal hard hats should not be worn when there is a potential for contact with anything electrical. Hard hats must conform with the requirements of ANSI Z89.1-1986. Check the label on the hat for compliance with this standard.





TYPES OF HEAD PROTECTION

CLASS "A" HELMETS

For impact, penetration, and electrical protection from low-voltage conductors (tested to 2,200 volts).

CLASS "B" HELMETS

For impact, penetration, and electrical protection from high-voltage conductors (tested to 20,000 volts).

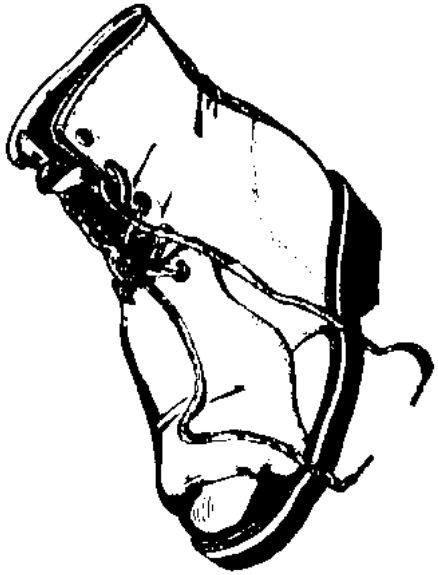
CLASS "C" HELMETS

For impact and penetration hazards hazards only. Usually made of aluminum, which conducts electricity, and should not be worn around electrical hazards.

FOOT PROTECTION

Proper footwear can afford a level of protection for the feet and toes. Steel-toed boots or shoes protect toes against the crushing hazard of falling objects, such involved with pipe moving or heavy material handling. Rubber boots protect the feet against chemical hazards. For chemical hazards, check with your MSDS'.

Footwear should also be selected based on protection from the walking/working surface. Construction sites with nails, or rough terrain including sharp rocks will require shoes or boots with sturdy, puncture-resistant soles.



HAZARDOUS CONDITIONS REQUIRING FOOT PROTECTION

IMPACT

Carrying or handling materials such as packages, objects, parts or heavy tools which could be dropped.

COMPRESSION

Work activities involving skid trucks (manual material handling carts, around bulk rolls, around heavy pipes.

PUNCTURE

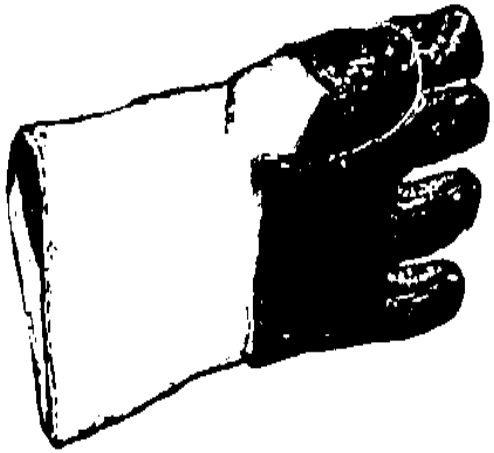
Sharp object hazards such as nails, wire, tacks, screws, large staples, scrap metal, etc.

CHEMICAL

Check with MSDS for proper protection.

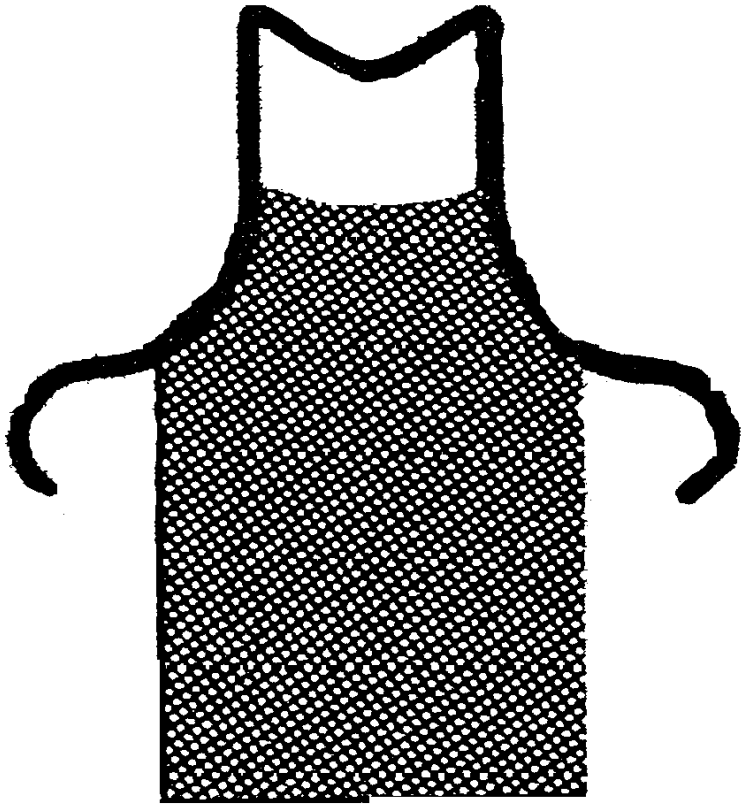
HAND PROTECTION

Gloves should be selected according to the hazard. Handling hot materials usually requires leather gloves. Heavy cotton glove usually afford ample protection against scratch and abrasive hazards. Rubber gloves are usually necessary for electrical and chemical hazards. There are gloves designed to protect against cut hazards, as in the meat industry. Check with your MSDS' and/or your glove supplier for more information.



OTHER PROTECTION

Other PPE may be required to protect against chemicals, cuts, abrasions, heat, etc.



Hearing protection

Ear muff

Ear plug

Breathing Protective equipments

- **Self-Contained Breathing Apparatus (30 min sets)**

  - suitable for search and rescue work and emergency operations.

- **Canister Masks**
  - not satisfactory for rescue and maintenance work.

Fall protection

- To be used when working at heights (>1.8m)
- May be dangerous if used incorrectly
- Safety harness minimize injuries by distributing forces evenly.