

Basics of Personal Protective Equipments

By B. P. Parmar - Ret. Senior Inspector of Factories, Gujarat State

- PPE is a second line of defense for protection of employee's protection. The first line of defense is to eliminate accident-causing situations at the work place by effective engineering measures.
- PPE does not and cannot eliminate hazards at work. As a barrier between the hazard and the worker, PPE can help to eliminate an injury or reduces severity.
- PPE should be resorted to only, if absolute removal of hazard in the work environment is impossible or impracticable.
- PPE relevant to hazard should be selected and used.
- PPE should be conforming to applicable National Standards or codes of practice and good engineering practices.

PPE' principal requirements are:

- To safeguard the workers from identified hazard to which he is exposed.
- To afford reasonable comfort.
- To permit essential movements of limbs required for efficient job performance.
- To be amenable to easy cleaning and maintenance.

HEAD PROTECTION

The head is for absorbing knowledge- not-the blows. It house command center of our central nervous system that controls all movements, senses and basic body functions. An injury to the head can pose a serious threat to the brain. The complex mechanism of the brain is delicately balanced and extremely susceptible (*easily influenced*); the slightest disturbance in its functioning can have great consequences for the body, since the brain is housed in the head, it is utmost important to protect it against all

injuries and accidents. One single head injury can turn the victim in to veritable (*a word used to make description more forceful*) vegetable and even rob him from the life.

The safety helmet must be worn at all times in the process area and when performing mechanical work. To ensure proper protection, the cradle must be adjusted so that there is a minimum clearance of 2.5 centimeters between the head and the shell of the helmet. Helmets of non-conductive material shall be worn.

EYE PROTECTION

Eyes are our windows to the world, the best means of direct and instant communication that the body has with the environment. If eye sight is lost, a curtain of darkness descends between us and the world, isolating us physically, psychologically and emotionally. Eyes are precious, vital parts of the body; we cannot neglect them. Indifference to their care, in many cases, causes irreversible damage.

a) Safety goggles

Safety goggles are used to protect the eyes against injuries from flying objects, splashing liquids and harmful rays that can always be controlled at the source. Safety goggles are used against acids, alkalis, and dusts, mists, chipping and welding.

If goggles get sprayed with acid or alkali (caustic), the person must get under a shower as soon as possible. If it is necessary to remove the goggles to be able to the way to shower, special care must be taken to keep acid or caustic out of the eyes. The following procedure may be followed:

- (1). Bend over until looking directly at the ground.
- (2). Pull goggles down and away from the face (by stretching head band) and then slipping them over the top of the head.
- (3). Place the hand across the forehead and then straighten up and proceed to shower.

Goggles should not be removed before getting under the shower. The above method is to be used only when the vision is obscured by the splashed material. For maximum protection and comfort, goggles must be properly adjusted to fit the face.

(b) Face shield

Certain operations present a hazard to the face as well as to the eyes. In such cases face shields provide suitable protection. A transparent plastic shield is a suitable protection. A transparent plastic shield in a suitable frame is recommended for such jobs as metal shaving, working with chemicals at laboratory benches, buffing, sanding, light grinding or furnace burner lighting. When a lot of vapour is present in the area, safety goggles must be worn first with the face shield on top. Face shield must be used while looking through peep hole in to the fire box of a furnace or boilers. Blue face shields will give better protection from hot rays, ultra violet rays, etc.

The headband is the only adjustable feature on the face shield. It should be adjusted so as to hold the shield in the place.

HAND PROTECTION

Hands are the two busiest, most important, indispensable (*too important to be without*), invaluable, and at same time vulnerable (*easily hurt in body or in mind*) tools the human body has at its disposal. The versatility (*having many different uses*) of their use sets humans apart from other living creatures. We use them constantly for so many diverse (*very different*) jobs that we tend to take them for granted. Our hands and fingers are a set of amazingly (*surprising and causing pleasure*) dexterous (*clever and skillful with your hands*) tools with the strength to grasp, grip, lift, push, pull, squeeze, twist and hold the things. They are sensitive to touch, respond to pressure, temperature and pain and have the flexibility and co-ordination to perform highly complicated and intricate (*the quality of containing many small detailed parts and often being difficult*) jobs.

Various types of gloves are worn during any operation where there is probability of contact with harmful chemicals, solvents, hot oils; hot objects, sharp edges etc. electrically tested high voltage gloves must be worn by employees when working on high voltage electrical equipments or lines. Gloves must be inspected before use every time.

LEG PROTECTION

Our leg keeps us mobile. Apart from assisting in our domestic activities, these pair of slender (*attractively thin and graceful*) limbs helps us to go out to earn our lively hood. In the processes, they are exposed to various hazards and unfortunately, are often injured. Leg accidents account for a large proportion of occupational accidents and many go unrecorded.

Shoes worn by the employees on duty must completely cover the feet. Sandals/open-toe shoes are considered unsafe. Almost all jobs in the field require the use of safety shoes. Gumboots are used to protect against chemical splashes and where it is necessary to work in water or bottom sediment.

EAR PROTECTION

Hearing is of life's most precious gifts. It through the process of hearing that a new born baby learns about world and to speak. A child with defective hearing may have severe difficulty in learning to speak. Too much noise can damage hearing temporarily or even permanently, create stress that can and does some times affects one's physical and mental well being and cause accidents in work place, when people can't hear instructions and warning signals. Hearing conservation is protecting your ear (hearing) from potentially damaging levels of sound. Impaired hearing prevent us from leading a full, happy participative life in the community surely. It is a rare gift worth protecting in all seriousness.

On the job or the area having high noise levels, the excessive noise may cause fatigue and distraction which would result in accidental injury. In such cases, ear plugs are to be used. Ear plug will reduces sound level and provide relief.

RESPIRATORY PROTECTION

The respiratory system, consisting of some vital organs of the body, is the very core of the human being. If it collapses, life itself will extinguish. One naturally, must give the best protection against the hazards of the work place that threatens it.

The air we breathe is some times contaminated with dusts, vapours, toxic fumes or gases. Various types of respiratory protective equipments are provided which enable us to breathe uncontaminated air even in presence of contaminants. It should be remembered that all gases, other than air, are harmful to human beings if inhaled in sufficient concentration.

The action of those gases are classified as either asphyxiating or irritating. Asphyxiating gases may cause death by reacting with the oxygen carrier in blood. Irritating gases may cause injury or death not only by this methods but also by burns, both internal and external.

In general to sustain life, oxygen concentration of oxygen of any atmosphere must be between 16 and 18 per cent by volume.

Each type of equipment has a definite but its limitations must be kept in mind. One limitation is common to all. They will not provide protection in an atmosphere contaminated by a substance which may be absorbed through the skin. Care should be taken that exhausted equipment is not used.

A. Gas masks

Gas masks are used for respiratory protection against gases, vapours and particulate matter which otherwise are harmful to life or health. Gas masks are air-purifying devices, design solely to remove specific contaminants from the air. It is essential to restrict their use in atmosphere which contains sufficient oxygen to support life (at least

16% - 18% by volume) and which contains not more than 0.5 – 2.0 percent concentration s of toxic gases and vapours by volume. In areas having less than 16 % 0xygen concentration by volume, compressed air breathing apparatus or on line air respirators should be use.

Please remember that:

“IF THE SPECIFIC EXPOSURE CONCENTRATIONS ARE SUSPECTED TO BE EXCEEDING SPECIFIC LIMITATIONS ONLY A SELF CONTAINED BREATHING APPARATUS SHOULD BE USE.”

“DO NOT USE MASKS FOR FIRE FIGHTING”.

1. Chin type gas mask canister:

Chin type canisters, because of their small size, should be used in concentration not in excess of 0.5 percent.

2. Industrial size gas mask canisters:

It is approved for use in area where the total toxic gas concentration does not exceed 0.5-0.2 percent by volume.

3. Service life of canisters:

This depends upon various factors like the design, amount of chemical fill, packing uniformity and its density, variable exposure conditions etc. How ever, duration of service life based on actual man test performed is given below for guidance

Protection against	Service life
Acid gases/ HCl / HCN	15 minutes
Organic vapours	25 minutes
Ammonia	25 minutes
Carbon monoxide	30 minutes
Chlorine	15 minutes

Basis-Average breathing rate of 25 liters / minutes. The canister should be preferably renewed in every six months/one year or after 100 hours of

use which ever is earlier. The canister gas mask should not be use in any closed area i.e. closed vessel etc. unless gas tests indicate that the quantity of gas present is less than 5% of lower explosive limit in case of hydrocarbons or 2% by volume in case of other gases.

Gas mask is a protective system consisting of a face piece, breathing tube and chemical absorbent canister specially labeled to indicate the type of protection. Chin type gas masks also give face and respiration protection. The small oval/round shaped canister and face piece are designed to permit downward head movement.

Operation

- a. Select proper type of canister for a specific application.
- b. Remove the seal from the bottom of the canister.
- c. Adjust the head strap until the mask fits snugly around the chin to avoid leakage. Check for leakage by blocking the airport of the canister.
- d. Keep a record of the time for which the canister has been used. Also note down the date when its seal was opened.

B: Air line respirator with full-face gas mask and kink proof tube for compressed air constant flow.

1. Application and description:

A constant flow airline respirator is for use in atmosphere not immediately danger to life or health. It requires sufficient length of air tube and positive air supply instrument air. The mask and tube is equipped with pressure regulator, which regulates the quantity of air as per the requirements. The air tube is rolled in a hose reel which can be wall/stand mounted. This holds 50-100 ft. tube and does not allow the tube to sag.

2. operation:

Clean the face piece and check for proper air supply. Wear the mask and pull the straps and ensure that the mask has a tight fit on the face. The face piece has round thread union for use with filters, compressed air

breathing apparatus and hose masks. It also has exhalation valve for breathing. The tube should be carried over the shoulder and tied with at the waist belt to avoid interference in use. Ensure that air flows across the inner surface of face piece to minimize fogging. Clean the face piece after use and roll back tube in the hose reel.

C: Self contained compressed air breathing apparatus with full-face mask, air tube and cylinder.

1. Application:

This is a complete independent breathing protection and can be use in an atmosphere when a source of compressed air is not available or compressed air is likely to be contaminated with toxic gas, vapours. Contrary to conventional demand type apparatus, this one is designed to maintained positive pressure in side the face piece, regard less of exhalation and inhalation condition.

2. Description:

It consists of a cylinder mounted on a back on a back plate secure by a cylinder straps and supported on the wearer's back by a harness and belt. Rubber facemask is secured over the face by a rubber head harness. The high-pressure air in the cylinder is supplied to the demand regulator and to a pressure gauge by two flexible hoses. Cylinder valve should be operated before using the set. An alarm warning device is fitted to the back plate.

3. Testing:

Inspection

- a) Make sure that the air cylinder is firmly installed on the back plat.
- b) Make sure that the pressure reducer and pressure indicator are firmly installed and the indicator line is not twisted.
- c) Check the demand valve for correct assembly by removing exhalation valve cover.
- d) Maker sure that the pointer of pressure indicator is showing "zero".

Functional testing:

- a) First, close the by-pass valve, turn selector knob to off position.
- b) Slowly opened the cylinder valve and confirmed the cylinder pressure by observing the Pressure Indicator (P.I.). less pressure will shorten the duration of use. The minimum pressure should be 100 kg/cm²

Immediately after opening the cylinder valve, a small volume of the air will be vented through the demand valve. This will be stopped by a further opening of the valve.

- c) After confirming the cylinder air pressure, switch the lock knob in sequence of “off-on-off”. After that, fully close the cylinder valve. If the compressed air is discharged from the face piece when the lock knob is set to “on” the positive pressure function is normal. In order to save the compressed air, the lock knob operation should be done quickly.
- d) Now slowly open the bypass valve to lower the pressure and make sure that the alarm sounds at approximately 30 kg/cm² pressure.

4. Operation:

- (a) Put on the apparatus on the back, adjust the straps, correct the waist and chest bands and adjust them for comfortable fitting.
- (b) Confirmed that the bypass valve is closed and the selector knob is in “off” position. Slowly and completely open the cylinder valve.
- (c) Put on the face piece and fasten the straps to ensure a tight fitting. The wearer should be clean shaved in order to ensure air tightness.
- (d) Set the lock knob to “on” position, create a gap between cheeks and face piece. If hissing sound of air is heard, it is confirmed that positive pressure is available.
- (e) Perform air tightness test by fully closing the cylinder valve. Stop respiring and make sure that P.I. is showing downward value. Open the cylinder valve when P.I. scale shows “80” and take a deep breath. If the pressure decreasing time from 100 to 80 takes 5 seconds or

more the tightness of the face piece is okay. If the pressure decreases at the faster rate, readjust the face piece to make it leak proof.

- (f) Never breathe while the cylinder valve is being closed. Open cylinder valve fully to avoid difficulty in breathing. When the conditions from (a) to (e) above are met with, the apparatus is ready to use.
- (g) Always keep the eyepiece clean. Never use organic solvents for cleaning the eyepiece.

5. Precautions during use:

- (a) Make sure of the air pressure in the cylinder. Service duration varies with the air pressure in the cylinder.
- (b) Alarm function at cylinder pressure of 30 kg/cm².
- (c) Do not use bypass valve except in the case of demand valve failure
- (d) Leave the work place reserving sufficient amount of air in the cylinder for enabling safe return to fresh open-air zone.

After use:

- (a) Take off the apparatus, set the lock knob in off position, close the cylinder valve, open the bypass valve and release the compressed air pressure.
- (b) Clean the facemask from inside and out side and keep in the apparatus box. Always keep face mask away from the sunlight.
- (c) Change the cylinder if air is exhausted and inform the safety department through your departmental head/ supervisor.

1. specifications of Kawasaki life gem pressure demand type air breathing apparatus:

Cylinder volume	8 liters
Air volume in side the cylinder	1200 liters
Maximum charging pressure	150 kg/cm ²
Hydrostatic test pressure	250 kg/cm ²
Gross weight (kg) including face piece	14.1 kgs
Cylinder (empty) wt.	8.1 kgs.
Duration of use (minutes)	21 approximately

7. Specifications of Dragger make set:

Cylinder volume	9.0 liters
Air volume in side the cylinder	1200 liters
Maximum charging pressure	137 kg/cm ²
Hydrostatic test pressure	235 kg/cm ²
Gross weight (kg) including face piece	10.7 Kgs
Cylinder (empty) wt.	7.7 Kgs.
Duration of use (minutes)	20 approximately

D. Air blower hose mask with hand operated blower:

This is design to provide fresh air to the wearer from outside gaseous area. This can be safely used when it is possible to keep blower suction in fresh air.

The use is restricted for a maximum of two hose lines, each originating from blower and not exceeding 150 feet in length.

- a) The face piece should be adjusted and tested before use.
- b) The blower must always be kept in fresh air.

The blower should be driven continuously from the time a man puts on the mask until he returns and removes it.

- c) A line must be secured to the user.

E. Dust mask:

The dust mask covers the nose and mouth of the wearer and protects him from breathing dusty air while working in an atmosphere contaminated with solid particles. After using it for some time, filter elements get choked and breathing becomes difficult. Change the filter in such a case.

SKIN PROTECTION

The skin is the body's first line of defense; its role is that of a foot soldier in military strategy. Like the infantry, it usually faces and absorbs the burnt of the enemy attack a good general does not send his soldiers in to battle without planning to safe guard their survival. In hazardous work environment, the skin is the most vulnerable to accident and infection from exposure. So far, your own body is well being protected your skin against all hazards, both at home and at work.

BODY PROTECTION

Safety gadgets are required for body protection while working with acid, alkali, certain equipment or while handling chemicals as there are chances of spray, spillage etc.

CARE

All personal protective equipment after its inspection, cleaning and necessary repairs, it should be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture or damaging chemical to retain its or original effectiveness.

In case of any problem, which is not understood, it is better to contact manufacturer. All personal protective equipments shall be cleaned and examined after every use. Respirator should be cleaned daily or regular basis. Filter and chemical cartridge shall be replaced when needed.

LEGAL REQUIREMENT:

In the Factories Act 1948, there are specific provisions for providing the personal protective equipment to workers who are exposed to unsafe and unhealthy environment. The provisions of the law relating to use of the personal protective equipment in different operations and processes are framed in such a spirit that the workers working on the operations and in the processes are protected against possible hazards.

It is also the intention of the law that theses personal protective equipments shall be of such type and made of such materials that they

withstand to such specific hazards for which they are actually being used.

Quality of personal protective equipment shall be as per the provision in Rule 68-B of Gujarat Factories Rules 1963 under the Factories Act 1948.

Sr. no.	Personal protection	Type of safety appliances to be used	Hazards and protection	Inspection, maintenance and storage
1	HEAD PROTECTION	Safety Helmet	<ol style="list-style-type: none"> 1. Protection against falling objects and impact hazards. 2. Protection against electric hazards (The non-metallic construction offers electrical resistance.) 	<ol style="list-style-type: none"> (1) Inner adjustable harness for impact absorption. (2) Chin strap for tight fit. (3) Clean, wash with water and soap. (4) Store upright, away from heavy sharp object. (5) Change inner harness if damage.

Sr. no.	Personal protection	Type of safety appliances to be used	Hazards and protection	Inspection, maintenance and storage

2	EYE PROTECTION	Safety Goggles	1. While handling corrosive, toxic organic liquids or vapors.	(1) Inspect before use, check for proper fitting. (2) Clean, wash with soap periodically.
		Welder's goggles	2. While handling hot liquids. 3. Protection against flying particles.	(3) Discard/replace if lens bends and head band buckle, elastic head is damage.
		Chipper's Goggles	1. During electric welding by the welders and their helpers. 2. During gas cutting, protection against spark, radiations and intense glare.	(4) to avoid distortion, do not store goggles near heat and do not apply pressure on them.
			Protection against grinding, chipping.	

Sr. no.	Personal protection	Type of safety appliances to be used	Hazards and protection	Inspection, maintenance and storage
3	FACE PROTECTION	<p>Face shield</p> <p>Welder's Goggles/Face shields</p> <p>Acid and alkali Proof Hood</p>	<p>1. Protection of the complete face against chemical splash, hot liquids or vapours of chemicals.</p> <p>2. Protection against flying particles /sparks.</p> <p>1. Protection while welding against spark and intense glare, sparks and flying particles.</p> <p>2. Protection of Face / Neck while handling corrosive, organic, inorganic, hot liquids</p>	<p>1. Check for proper fitting.</p> <p>2. Check visor and replace if found damaged.</p> <p>3. Clean and wash before and after use.</p> <p>4. Keep in enclosure and away from sun light and heat source.</p> <p>5. Clean with soap and</p>

			and vapours and splashing of chemicals. 3. Protection against their fumes and vapours.	water and dry.
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Sr. no.	Personal protection	Type of safety appliances to be used	Hazards and protection	Inspection, maintenance and storage
4	HEARING PROTECTION	Ear plug	Working in area where high noise level exists due to machines and equipment.	1. Check for any defect. 2. Wash with soap or water

Sr. no.	Personal protection	Type of safety appliances to be used	Hazards and protection	Inspection, maintenance and storage
5	HANDS AND FINGERS	1. Canvas hand gloves 2. Canvas leather hand gloves.	1. To protect against abrasion/chaffing . Handling of empty drums and while working in the plant for general. 1. To protect against sharp, rough objects 2. To protect against the	1. Check for defect / damage. 2. Wash after use and dry. 3. Check for any damage. 4. Wash with water and dry. 5. Keep away from sun light & source of heat.

		<p>3. Asbestos hand gloves</p> <p>4. Rubber, PVC, Surgical Hand Gloves.</p>	<p>welder's flame, spark and operations of steam valves</p> <p>1. To protect while handling hot materials for a long time and where exposure to excessive heat is involved.</p> <p>2. For protection against handling hot equipment, on steam services or when there are steam leaks.</p> <p>3. For protection while lighting the furnace. Heaters etc.</p> <p>1. For protection against corrosive liquids like acids, alkalis, while working in the operating area.</p>	
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Sr. no.	Personal protection	Type of safety appliances	Hazards and protection	Inspection, maintenance and storage
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		to be used		
5	FOOT AND LEG PROTECTION	Safety Shoes Gum Boots	1. Protection against falling of heavy materials on the foot. 2. Protection against electrocution from the foot 1. Protection against contact with corrosive, hot inorganic or organic chemical. 2. Protection against direct contact with skin.	

Sr. no.	Personal protection	Type of safety appliances to be used	Hazards and protection	Inspection, maintenance and storage
6	BODY PROTECTION	Cotton Aprons and Boiler Suit	1. For protection against cyanide dust falling on clothes and body. 2. Protection against splashing of chemicals.	1. Wash with soap water & dry 2. Neutralize Cyanide dust with sodium thiosulphate solution before washing
		PVC Aprons	Protection against splashing of chemicals & corrosive liquids.	1. Wash with water & dry 2. Store away from source of heat

		Pressurized Neck to toe Overall	Protection of complete body against highly toxic chemicals in case of emergency (high concentration of toxic gas)	<ol style="list-style-type: none"> 1. Keep it dry & hang it vertically, away from sun light and source of heat. 2. If hydro cyanide acid is splashed, neutralized & wash immediately
		PVS Neck to toe overall	Protection against acid & alkali and splashing of chemicals while carrying out operation/maintenance of jobs.	<ol style="list-style-type: none"> 1. Keep dry & away from sun light and source of heat. 2. If cyanide acid is splashed, neutralized & wash immediately. If acid is splashed, washed it immediately.
		Asbestos Suit	Protection against hot surfaces	

Sr. no.	Personal protection	Type of safety appliances to be used	Hazards and protection	Inspection, maintenance and storage
7	RESPIRATORY PROTE	Full gas mask with Canister	Emergency protection in the atmosphere of	1) Check the inhalation and exhalation valves.

	<p>CAUTION</p> <p>(For HCN, Chlorine, Acid gases and Ammonia)</p>	<p>Half face mask with filter</p> <p>On line Air respiratory Protection with full face Gas Mask and kink proof Tube for compressed air.</p>	<p>toxic gas.</p> <ol style="list-style-type: none"> 1. Emergency protection against atmosphere of toxic gas for escape. 2. Protections against gases, vapours and particles. <p>1 Protection against toxic gases when oxygen concentration is not sufficient and for long time use for planned maintenance work.</p>	<ol style="list-style-type: none"> 2) Check the date of expiry of the canister. 3) Check tightness of the mask. 4) Keep the seal of the canister in tact. Do not leave it open. 5) Replace the canister if exhausted 6) Record, the duration and date of use, of canister. 7) Store properly to avoid contact with moisture and dust. 8) Concentration of harmful gases should not exceed 0.1 % when using cartridge filter. Fit the respirator with head strap assembly and ensure that it is tight fit. Change the filter when an increase in breathing resistance is noted. When replacing filters care must be taken that they are positioned properly. Clean the half mask after every use, blow away the absorbed dust with compressed air.
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		<p>Self Contained Breathing Apparatus with full face mask, Air tube and Air cylinder</p> <p>Air Blower Hose Mask Respirator with hand operated Blower. Dust Mask</p>	<p>Emergency protection against toxic gases, when compressed air is not available, or air compressor area is also contaminated with toxic gas.</p> <p>Emergency protection against toxic gases when on line air respirator with compressed air is not available, or cannot be used.</p> <p>Respiratory protection against dusts and mists.</p>	<p>Replace the filter if breathing resistance still persists.</p> <p>9) Check if all connections are tight.</p> <p>10) Check inhalation and exhalation valves before use.</p> <p>11) Check if the air regulator is properly working and sufficient air is available. Clean filter of the regulator if found choked.</p> <p>12) Check if the air tube is in good condition and properly wrapped on hose reel.</p> <p>13) Be careful of entanglement of the hosepipe.</p> <p>14) Keep mask and tube clean and store properly.</p> <p>15) Check for the pressure in air cylinder.</p> <p>16) Check for air tightness after wearing.</p> <p>17) Check if sufficient air is available and that the air hose in</p>
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				<p>good condition.</p> <p>18) Check the damage of filter inhalation valve, the elastic straps and change them if required.</p> <p>19) Store away from moisture and sunlight.</p> <p>20) Clean it before use.</p>
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Sr. no	Personal protection	Type of safety appliances to be used	Hazards and protection	Inspection, maintenance and storage
8	PROTECTION FROM FALLING	Safety Belts	Protection from falling while working at high elevation area, entering tanks, sewers or other closed vessels.	<p>1. Inspect before use and check for defect.</p> <p>2. Check for rope hooks and stitches.</p> <p>3. Check the securing line, belt and the anchor before use.</p>