



Institution of Safety Engineers (India)

"Aim to prevent Accident, Protect Environment & Minimise Losses during disaster"

www.iseindia.in



ISE (India)

This manual is Property of **Institution of Safety Engineers (India)**. No any organisation or body is allowed to copy of this manual without permission of Institution of Safety Engineers (India).

This manual Provide basis knowledge about Industrial Safety.

1. Safety Management

A Safety Management System (SMS) is a systematic positive approach to managing safety including the necessary organizational structures, accountabilities, policies and procedures. Safety Management system help to create safe healthy work environment to prevent accident & protect environment. It help to improve safety performance in industries.

Yearly several Lakh people are killed or injured in industries due to mechanical, electrical, chemical, Physical, Environmental and radiation hazard or occupational diseases. Occupational diseases are notified in Schedule III of The Factories Act 1948.

2. Need of Safety

2.1 Social Need

The accident causes social loss in great magnitude in form of suffering, loss of earning capacity and cost due to disturbance to economic efficiency. The economic costs are more tangible.

2.1 Management Need

Management bear huge loss due to accident. Cost of accident is two Types Direct & Indirect cost. Indirect cost is several times more than Direct Cost. Direct cost include medical expenses, compensation to the injured or their families.

2.3 Legal Need

As per The Building & other construction Act 1996, Factories Act 1948 and several other related Acts & rules the general duty of the employer is to ensure Health & Safety of his employee & protect the Environment.

2.4 Humatarian Need

The Humanitarian reason for prevention of accidents is based on notion that it is duty of every person to ensure safety of his fellow men

3. Terminology

Safety: Control over hazards or Freedom from unacceptable risk of harm.

Accident: Undesirable Event that arises to injury, fatality, ill health, property damage or combination of these.

Hazard: Source, Situation, or Act with a potential for harm in terms of human injury or ill health or property damage or a combination of these all.

Reportable injury: If a person sustained injury & unable to resume his duty within 48 hours.

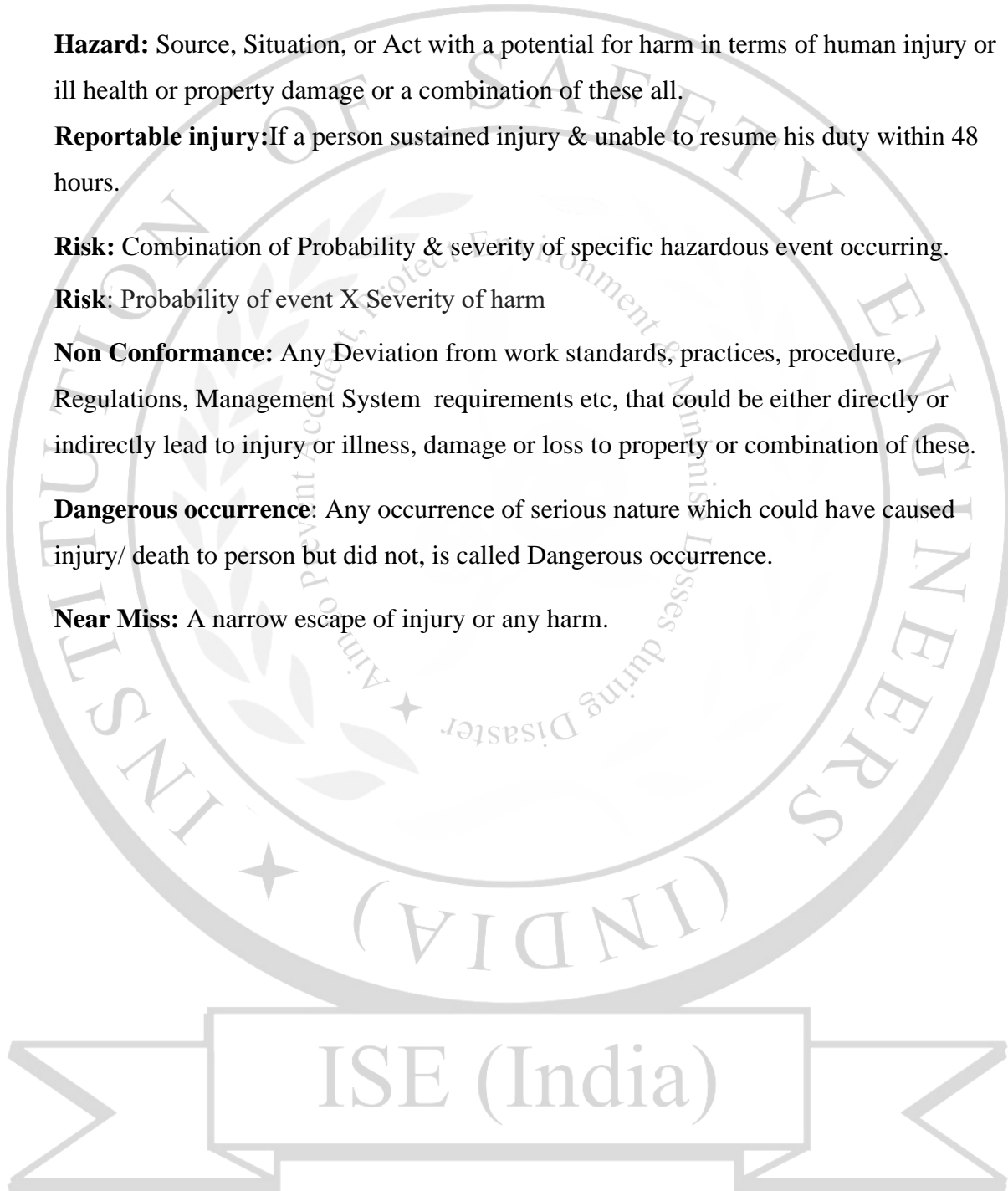
Risk: Combination of Probability & severity of specific hazardous event occurring.

Risk: Probability of event X Severity of harm

Non Conformance: Any Deviation from work standards, practices, procedure, Regulations, Management System requirements etc, that could be either directly or indirectly lead to injury or illness, damage or loss to property or combination of these.

Dangerous occurrence: Any occurrence of serious nature which could have caused injury/ death to person but did not, is called Dangerous occurrence.

Near Miss: A narrow escape of injury or any harm.



Method To Calculation Accident Rate, Frequency Rate & Severity Rate (as per IS3786)

$$\text{Accident Rate: } \frac{\text{Total Numbers of Lost Time injury}}{\text{Average Numbers of employees}} \times 1000$$

$$\text{Frequency Rate: } \frac{\text{Total Numbers of Lost Time injury}}{\text{Man-hours worked}} \times 1000000$$

$$\text{Severity rate: } \frac{\text{Total Man Days Lost}}{\text{Man-hours worked}} \times 1000000$$

Example

Employees: 200 (Average) Working hours (W.H): 8 hours Per Day

Numbers of Days in a Month: 26 Lost Time Injury (L.T.I): 02

Total Man-hours: Average No. of Employees per day X No. of Day in Month X W.H

Total Man-hours: $200 \times 8 \times 26 = 41600$ hours

$$\text{Accident rate: } \frac{02}{200} \times 1000 = 10 \text{ Per Thousand}$$

Note: Here accident Rate is calculated on lost time injury.

4. Causes of Accident

Unsafe Act & unsafe Condition are basic cause of any Accident. When both conjugate at one point then accident happened.

In other words, Human and mechanical failure are causes of accident.

5.1 Unsafe Act

Committing mistake by person or Any act that may lead to accident is known as unsafe act. Following are example of unsafe act:

- Working without wearing safety helmet & safety Shoes
- Working at height without wearing full body harness.
- Taking Rest in working Areas
- working or Taking rest below Hanging Load
- Over speeding
- Operating equipment without qualification or authorization.
- Lack of/or improper use of PPE
- Operating equipment at unsafe speeds
- Failure to warn
- Bypass or removal of safety devices
- Using defective equipment

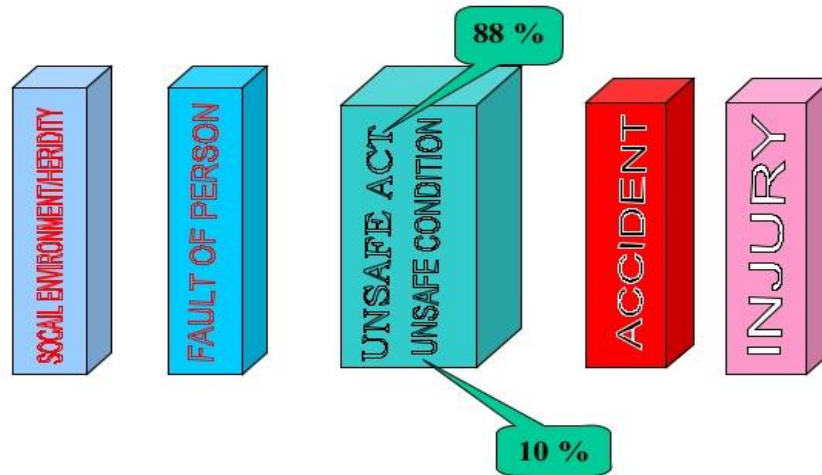
5.2 Unsafe condition

Any sources or situation or condition that have potential to create accident is known as unsafe condition. Following are example of unsafe Condition:

- Damage welding Cable
- Mechanical guard not Provided on rotating parts
- Defective sling or lifting equipment.
- Defective work platform
- Floor or platform Opening, Pits
- Poor housekeeping
- Defective tools, equipment or supplies
- Inadequate supports or guards
- Congestion in the workplace
- Inadequate warning systems
- Hazardous atmospheric conditions etc.

5.3 Domino Theory

88% Accident occurred due to unsafe act, 10% due to Unsafe Condition & 2% due to natural calamity



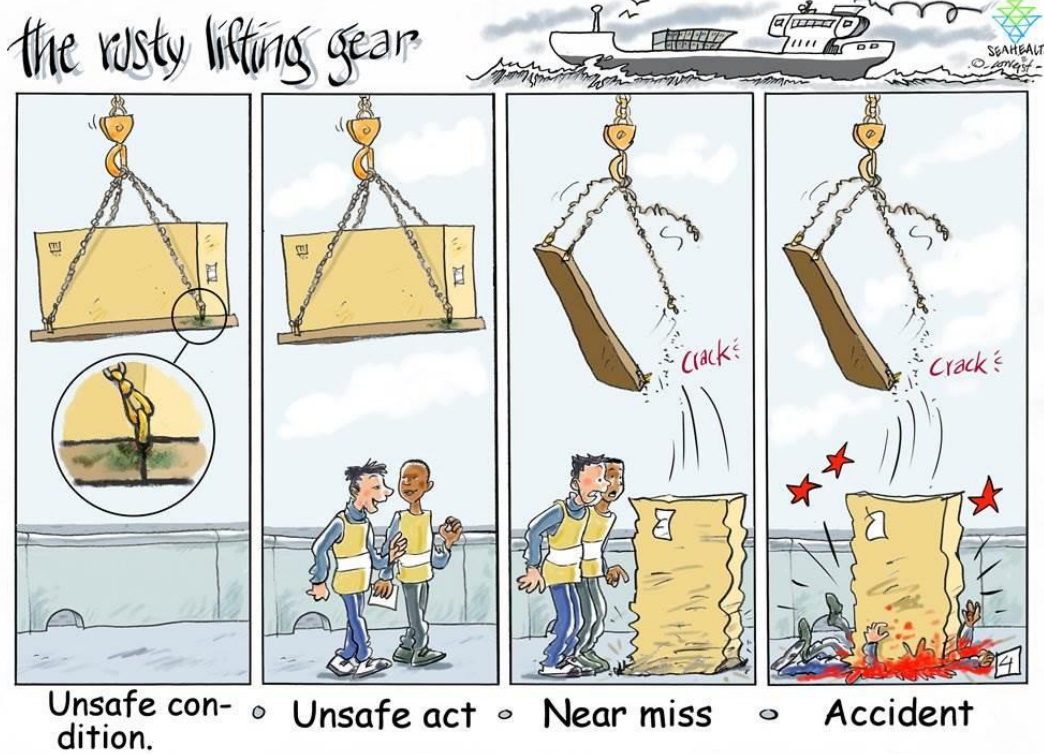
5.4 HENRICH THEORY OF ACCIDENT CAUSATION

This theory says that 30000 unsafe acts and unsafe condition create 3000 Near miss, 300 Minor accident, 30 major accident and 1 fatal accident

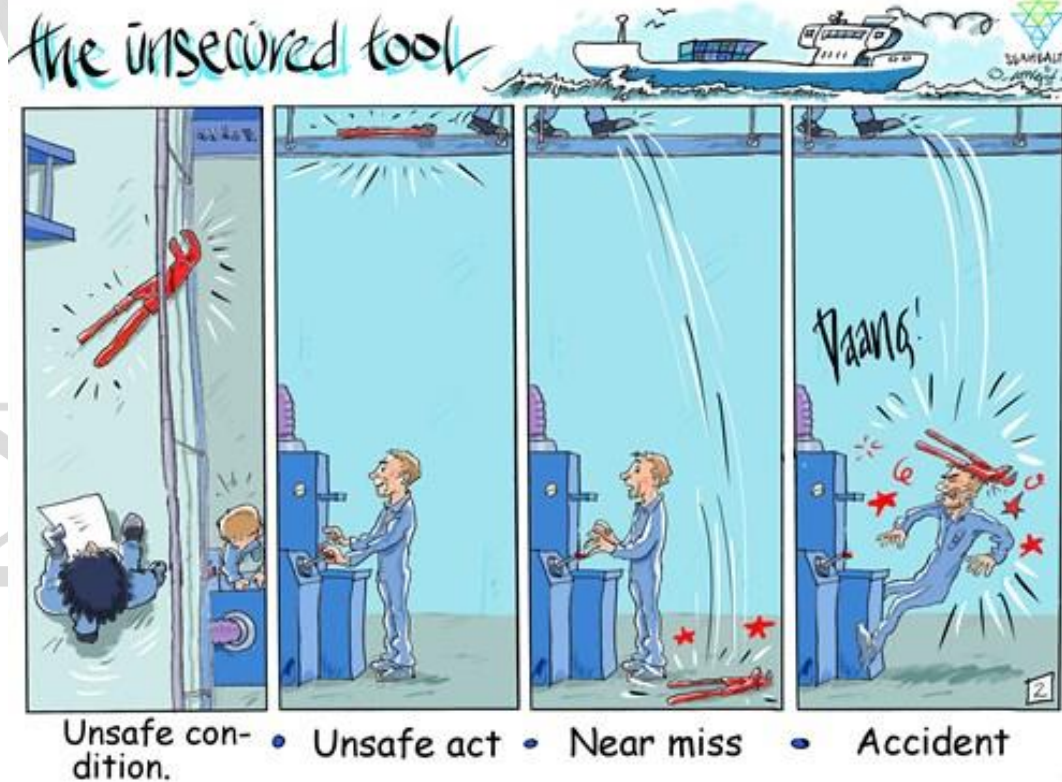


Example of Non-conformance

Example (I)



Example (II)



5. Accident prevention strategies

Accident can be prevented to

- I) Eliminate hazard or II) Prevent unsafe practices

6.1 HIERARCHY OF HAZARD CONTROL

- I) Eliminate the hazard
- II) Isolate to hazard
- III) Engineering control
- IV) Administrative control
- V) Personnel Protective Equipments

More effective

Hazard can be controlled at work place as per hazard control method.

6. Housekeeping

Good housekeeping always increases productivity. It prevents injury such as fall, Trip, Slip, fire etc. Poor Housekeeping is source of Accident.

Good housekeeping means materials have stacked properly & kept separately. All walkways are free from any obstruction.

Example of poor housekeeping



7.1 Benefits of Good Housekeeping

- I) Eliminates accident and fire hazards.
- II) Maintains safe, healthy work conditions.
- III) Saves time, money, materials, space, and effort.
- IV) Improves productivity and quality.
- V) Employees Boosts Employees morale.
- VI) Reflects a well-run organization.

Example of good housekeeping



8. Hazard in a Industries

Different Types of hazard found in an industries as per their Nature. Following are

Types of Hazard:

- Fall of person due to poor workmanship, loss of balance, uneven surface, floor opening, poor work platform, working at height without using full body harness, Defective ladder or stair, slippery floor, Loose material in assess etc.
- Fall of material due to failure of lifting appliances, Tools & tackles, Loose material Keeping at edge on height or near floor opening, Poor method of Material lifting & shifting etc.
- Mechanical hazard (entanglement, contact with sharp edge, Ejection like spark and small particle emitting during grinding job.)
- Electrical hazard Like Fire, Electrocution, Burn injury, Fall due to electrical shock.
- Fire Hazard due to hot job near flammable material, Inadequate storage of Flammable material metal storage tank, Smoking,
- Physical Hazard like heat, Poor illumination, Cold stress,
- Environmental hazard like dust, fumes, Gases, NO_x, SO_x, Noise
- Ergonomical hazard includes repetitive movement, manual handling, workplace/job/task design, uncomfortable workstation and poor body positioning
- Chemical hazard like dust, fumes, gases create central nervous system problem & respiratory problem due to inhalation and create skin problem when come in its contact.
- Vehicle movement may cause of hit to person, Hit to object or Collision or topples

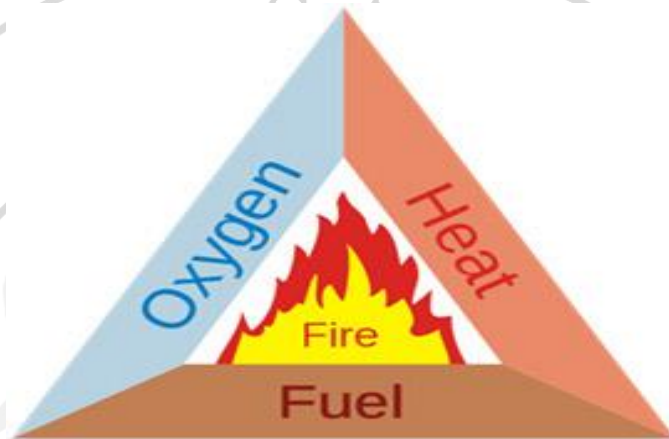
Long term exposure of Noise create Hearing loss & Known as Noise induced hearing Loss (NIHL). Vibration create vibration induced white finger.

ISE (India)

9. Fire

Fire is a chemical reaction in which combustible material combines with oxygen when external source of heat is applied

9.1 Fire Triangle



9.2 Causes of Fire

- Hot Job near flammable material.
- Flammable material storage near heat source area or live power cable or direct sun light.
- Loose Electrical Connection.
- Over load- electrical equipment.
- Smoking.
- Poor Bonding of flammable material
- Poor earthing with flammable material storage tank.
- Static electricity.
- Poor Housekeeping.



9.3 THREE PRINCIPLE OF FIRE EXTINCTION





COOLING: To use water

SMOTHERING: Reduce Level of Oxygen

STARVATION: To Reduce Amount of fuel

9.4 Types of Fire Extinguisher & Its use

Fire Extinguisher Chart

Extinguisher		Type of Fire				
Colour	Type	Solids (wood, paper, cloth, etc)	Flammable Liquids	Flammable Gasses	Electrical Equipment	Cooking Oils & Fats
	Water	✓ Yes	✗ No	✗ No	✗ No	✗ No
	Foam	✓ Yes	✓ Yes	✗ No	✗ No	✓ Yes
	Dry Powder	✓ Yes	✓ Yes	✓ Yes	✓ Yes	✗ No
	Carbon Dioxide (CO2)	✗ No	✓ Yes	✗ No	✓ Yes	✓ Yes

ISE (India)

10 Personal protective equipment (PPE)

Personal protective equipment (PPE) refers to Safety helmets, safety shoes, gloves, high-visibility clothing, goggles, or equipment designed to protect personnel from injury or exposure. PPE does not eliminate to hazard, it minimises the severity of hazardous event and protect to personnel from exposure of hazard.

10.1 Types of personal protective equipment

PPE can be classified in the following categories, based on the type of protection:

- Head protection – for example, Safety helmets, hard hats
- Foot protection – for example, Safety shoes/boots
- Respiratory protection - for example, disposable, cartridge, air line, half or full face
- Eye protection – for example, goggles/ spectacles, shields, visors
- Hearing protection – for example, plugs & ear muffs.
- Hand protection – for example, gloves and barrier creams
- Working from heights - for example, harness and fall arrest devices
- Skin protection – for example, Full body suit, Heat resistant suit
- Other personal protective equipment: This may include PPE for specific job such disposable clothing for working with chemicals, radiation hazards, painting, welding, Gas cutting. Examples include lead aprons for X-Ray protection; sleeve protectors, aprons, coveralls when using chemicals; leather jackets, trousers and spats for welding; thermal and cold protective clothing for work near furnaces and cool rooms.

ISE (India)

Example of PPE's



Safety Helmet



Safety Shoes



Ear plug



Ear muff



Safety helmet attached with Shield



Shield



Nitrile gloves



Cotton gloves



Lather/ welding gloves



Safety Harness



Apron



Safety Mask



Goggle



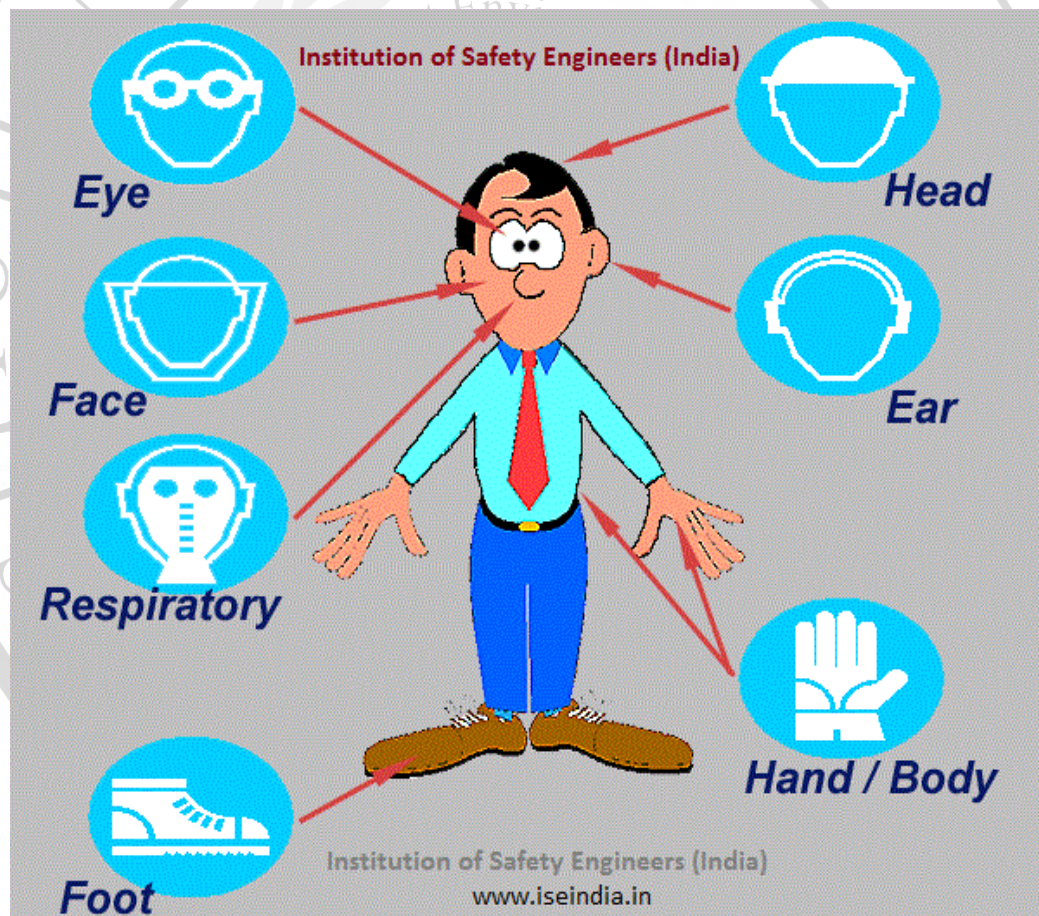
Heat resistance suit



Self-contained breathing apparatus

10.2 Selection & use of Personnel Protective Equipment (PPE)

Select to PPE as per specific Job. PPE must be Standard quality and ensure its all parameter through Indian standard or European Nation (EN) and it should be reliable during using. Standard quality PPE help to protect to person. PPE's not eliminate to hazard, it minimise the severity of injury of hazardous event. Use PPE in proper manner as per manufacturer recommendation. Need to deliver training among all employees regarding Proper use & handling of PPE. Never use defective PPE.



ISE (India)

11 Hazard identification Techniques

Hazard in a Engineering Industries is identified by following Method.

- Safety Inspection
- Hazard identification & Risk assessment Techniques
- Job safety Analysis
- Safety Audit
- Safety Survey
- Accident/ Incident investigation
- Hazard operability (HAZOP) study
- Fault Tree Analysis
- Environmental monitoring



12 Safety Management in industries

Identify Hazard, evaluate risk and control risk As low as reasonable practicable (ALARP). Conduct Safety Training on Regular basis. Display Safety signage & warning notice where are required. Assign responsibility of safety to section in charge. Conduct safety committee meeting & organised Motivational program to create safety awareness among employees. Adequate Fire Extinguisher to be provided at workplace. Always use suitable personnel Protective equipment. Never choose short cut route for any job. Before starting work, Planned properly to control hazard at work place. Report all accident include near miss, investigate it & Take corrective preventive action to prevent similar Future Accident. Always adopt safe Practices for work.

