STANDARDS RELATED TO

SAFETY AND HAZARDS IN PROCESS INDUSTRIES

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INTRODUCTION

- **HAZARDS** include sources with the potential to cause harm and hazardous situations, or circumstances with the potential threat to life, health, property or environment.

- **INDUSTRIAL HAZARD** may be defined as any condition produced by the industries that may cause injury or death to the personnel or loss of product and property.

- **SAFETY** in simple terms means freedom from occurrence of risk or injury or loss.

- **INDUSTRIAL SAFETY** refers to the management of all operations and events within an **industry** in order to protect its employees and assets by minimizing hazards, risks, accidents, and near misses.

What are different types of Hazards in Process Industries ?

Physical Hazards

noise, radiation exposure and, temperature,vibrations, heat, cold, pressure, radiation,fibre.

Chemical Hazards

flammable/explosive material, toxic and sensitizing material

Biological Hazards

dust and pathogens

Physical Hazards

Physical hazards are substances or activities that threaten physical safety. They are the most common and are present in most workplaces at one time or another. These include unsafe conditions that can cause injury, illness and death.

NOISE

- Noise exposure can cause damage to the ear and lead to lifelong hearing loss.
- Short term exposure to continuous loud noises can cause ringing in the ears—tinnitus—that can persist for hours after the exposure. But long term exposure to such noise can lead to long-lasting damage.
- Worldwide, 16% of the disabling hearing loss in adults is attributed to occupational noise[1].

RADIATIONS

- Radiation exposure includes exposures from uranium or other nuclear powering substances as well as microwave and radiofrequency radiation from exposure to magnetic and electrical fields.
- Radiation exposure can cause harm to the body, usually without overt symptoms in the short term but deadly in the long term.

TEMPERATURE EXTREMES

- Working in unheated, non-air-conditioned facilities or outdoors can expose employees to temperature extremes. Working in heat and cold stress both can the body's thermoregulation systems.
- Effect of heat Stress include exhaustion and heat stroke. Exhaustion happens when the body tries to cool itself by sweating, which causes a loss of water and salts.
- Cold-related illnesses and injuries include hypothermia, frostbite and trench foot.

CHEMICAL HAZARDS

- **Chemical Hazards** refers to the risk on exposure to hazardous chemical.
- The hazard associated with a chemical depends on specific chemical, chemicals with which it is mixed and their relative propotions.

Types of Chemical Hazards in the Workplace

There different types of chemical hazards in the workplace are:

1. Asphyxiants, a substance or mixture that displaces oxygen in the ambient atmosphere, and can thus cause oxygen deprivation in those who are exposed, leading to unconsciousness and death. Example Carbon monoxide and cyanide.

2. Corrosives, Chemicals which readily tend to attack materials in contact.Corrosives are materials that can attack and chemically destroy exposed body tissues. However, corrosive chemicals also have the potential to produce systemic chemical exposure away from the point of contact when mixed with other substances.

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3. Irritants, are material that can cause cause harm to the eyes, skin, or respiratory tract of a person. On exposure may lead to redness, rashes, inflammation, coughing, or hemorrhaging. Irritants are mostly short-term severe illnesses but can also have long-lasting side effects in some people. Irritant Causing Chemical Examples: nickel chloride and chromic acid.

4. Sensitizers, a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical. Overexposure to these chemical can lead to as asthma and contact dermatitis

Continued…

5. Carcinogens, are cancer-causing chemical substances, and exposure to small amount of such a chemical can have severe impact on human health. The impact of these chemical substances will appear many years after the exposure. Chemical Carcinogen Examples: Benzene, cadmium, formaldehyde, and vinyl chloride.

6. Mutagens, is a physical or chemical agent that permanently changes genetic material, usually DNA, in an organism and thus increases the frequency of mutations above the natural background level. As many mutations can cause cancer, such mutagens are therefore carcinogens. Examples: Benzene, ionizing radiation, and hydrogen peroxide

Continued…

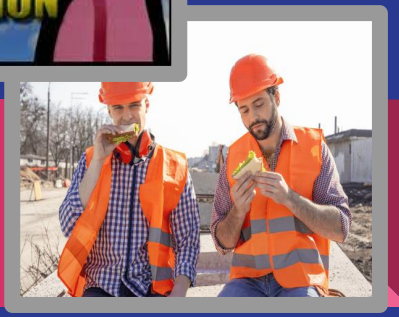
7. Teratogens, are the substances that on exposure can disrupt the physical and functional development of a human embryo causing birth defects and even the unhealthy advancement of pregnancy. Chemical Teratogen Examples: Thalidomide, ionizing radiation, and organic mercury compounds.

8. Reactive, are the chemical substances which when combined with other chemical or substances such as air, water can cause explosion.Reactive Chemical Examples: Nitric acid, benzoyl peroxide, and silane.

9. Flammable, chemical substances which burn or ignite when exposed to oxygen.Flammable Chemical Examples: Methanol, acetone, propane, and butane.

Routes of Entry

- The ways by which the chemicals are able to enter the body are called “routes of entry.”
- To prevent the exposure of hazardous chemical better understanding of these routes is necessary.
- The three main “Routes of Entry” are:
  - ➢ Absorption
  - ➢ Inhalation
  - ➢ Ingestion

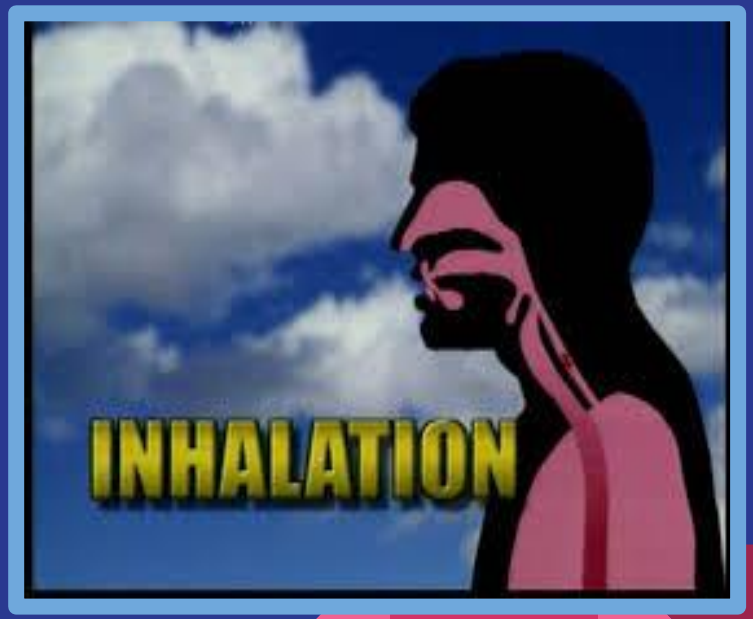


Absorption

- Occurs when the hazardous chemicals come in contact of exposed parts and get absorbed in the body.
- To prevent absorption, wear proper protective equipment:
    - ➢ Chemical gloves
    - ➢ Aprons
    - ➢ Coveralls

Inhalation

- Inhalation of toxic vapors, mists, gases, or dusts can produce poisoning by absorption through the mucous membrane of the mouth, throat, and lungs and can seriously damage these tissues by local action.
- In order to prevent inhaling hazardous chemicals proper respiratory protection should be used.



Ingestion

- Ingestion of hazardous chemical occur directly when hazardous chemicals are eaten or swallowed and indirectly if while handling of chemicals proper precautions are not taken.
- To avoid ingesting hazardous chemicals never:
  - ➔ eat
  - ➔ drink
  - ➔ apply make-up
- Always wash hands after handling chemicals .

How Can A Chemical Hazard Affect Your Health?

Skin Absorption

- Itching
- Redness
- Burns
- Blisters
- Rash/Hives

Ingestion

- Abdominal Pain
- Nausea
- Vomiting
- Diarrhea
- A warm sensation in the stomach (halogenated hydrocarbons)
- Dark-colored (black water) urine (arsenic)
- Dehydration

Inhalation

- Drowsiness
- Dizziness/Vertigo
- Headache
- Confusion/Lethary
- Clear drainage from nose
- Cough/Dry/Scratching/Burning Throat
- Blurred vision
- Shortness of breath
- Rapid breathing (tachypnea)
- Rapid heart rate (tachycardia)

Eye Contact

- Redness of the eyes
- Burning sensation in eyes
- Constant tear production
- Mucous discharge from tear ducts
- Blurred vision / blindness (partial or complete)

Accidents in Chemical Industries

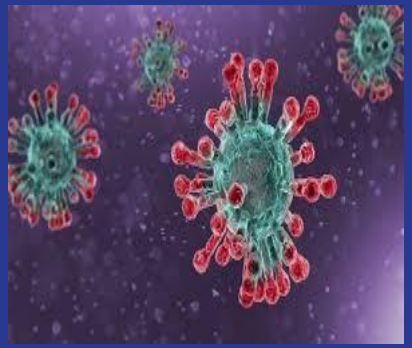
Recent accidents in Chemical Industries

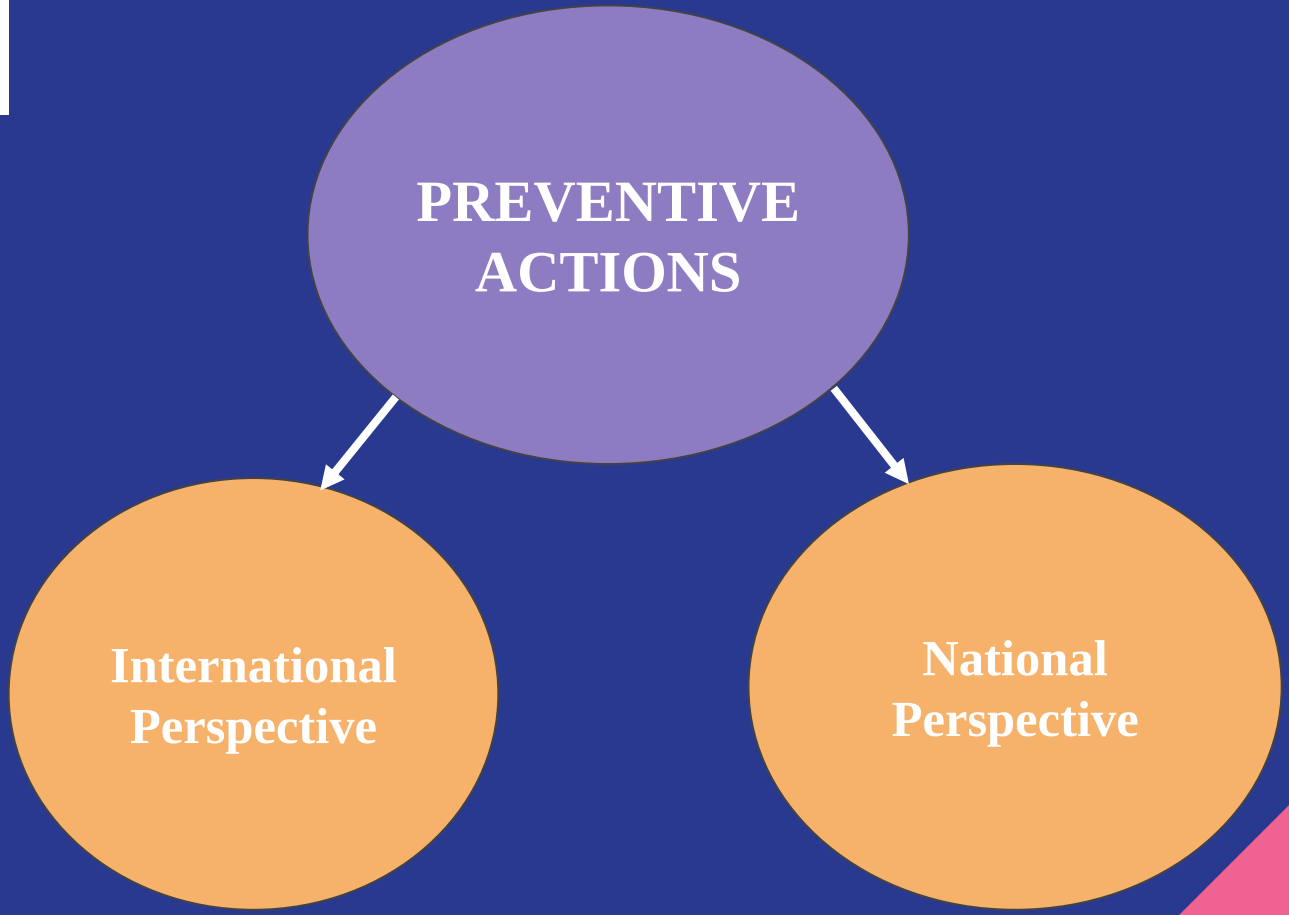
S No.	Date	Industry	Accident Details	Effects
1.	16.12.2021	Gujarat Fluoro Chemicals	Explosion	Around 15 workers were injured in the explosion and the subsequent fire. 3 died
2.	08.062021	SVS Aqua Technologies	Fire during packaging	18 dead in fire
3.	13.04.201	Speciality Chemicals, Tarapur MIDC	Explosion	2 workers were killed and 3 other injured during explosion
4.	07.05.2020	Polymer Manufacturing unit , Vizag	Styrene Gas leak	Styrene vapor got released from the styrene storage tank causing 12 deaths, around 1000 hospitalized,and nearly 12000 evacuated. An estimated 800 tons gas leaked into atmosphere

Biological Hazards

Biological hazards include dust and pathogens such as bacteria, viruses, fungi, and other living organisms that can cause acute and chronic infections by entering the body either directly or through breaks in the skin.

Covid -19 Pandemic




PREVENTIVE ACTIONS
International Perspective
National Perspective

OVERVIEW OF INTERNATIONAL STANDARDIZATION ACTIVITY IN THE FIELD OF SAFETY AND HAZARDS IN PROCESS INDUSTRIES

International Standardization in the field of Personal Safety

- There is one technical committee under ISO dedicated to Personal Safety i.e. ISO/ TC 94 Personal Safety - Personal Protective Equipment.
- It deals with the standardization of the performance of personal protective equipment designed to safeguard wearers against all known possible hazards.
- Total 192 standards have been published under this TC and its various subcommittees.

Subcommittees under ISO/TC 94

SUBCOMMITTEE	SUBCOMMITTEE TITLE	PUBLISHED STANDARDS	STANDARDS UNDER DEVELOPMENT
ISO/TC 94/SC 3	Foot protection	17	0
ISO/TC 94/SC 4	Personal equipment for protection against falls	12	0
ISO/TC 94/SC 6	Eye and face protection	20	4
ISO/TC 94/SC 13	Protective clothing	71	24
ISO/TC 94/SC 14	Firefighters' personal equipment	34	3
ISO/TC 94/SC 15	Respiratory protective devices	37	9

ISO/TC 283 Occupational Health and Safety Management

- Standardization in the field of occupational health and safety management to enable an organization to control its OH&S risks and improve its OH&S performance.
- There are 3 published standards and 3 are under development.
- The important standards under this committee are:
    1. ISO 45001:2018 Occupational health and safety management systems — Requirements with guidance for use; and
    2. ISO/PAS 45005:2020 Occupational health and safety management — General guidelines for safe working during the COVID-19 pandemic

ISO 45001:2018 Occupational health and safety management systems — Requirements with guidance for use

- ISO 45001:2018 specifies requirements for an occupational health and safety (OH&S) management system, and gives guidance for its use, to enable organizations to provide safe and healthy workplaces by preventing work-related injury and ill health, as well as by proactively improving its OH&S performance.

- ISO 45001:2018 is applicable to any organization that wishes to establish, implement and maintain an OH&S management system to improve occupational health and safety, eliminate hazards and minimize OH&S risks (including system deficiencies), take advantage of OH&S opportunities, and address OH&S management system nonconformities associated with its activities.

Continued….

- ISO 45001:2018 helps an organization to achieve the intended outcomes of its OH&S management system. Consistent with the organization's OH&S policy, the intended outcomes of an OH&S management system include:

  a) continual improvement of OH&S performance;

  b) fulfilment of legal requirements and other requirements;

  c) achievement of OH&S objectives.

ISO/DIS 45002

Occupational health and safety management systems — General guidelines for the implementation of ISO 45001:2018

ISO/PAS 45005:2020 Occupational health and safety management — General guidelines for safe working during the COVID-19 pandemic

- This document gives guidelines for organizations on how to manage the risks arising from COVID-19 to protect work-related health, safety and well-being.
- This document is applicable to organizations of all sizes and sectors, including those that:

  a) have been operating throughout the pandemic;

  b) are resuming or planning to resume operations following full or partial closure;

  c) are re-occupying workplaces that have been fully or partially closed;

  d) are new and planning to operate for the first time.

OVERVIEW OF BIS STANDARDIZATION ACTIVITY IN THE FIELD OF SAFETY IN PROCESS INDUSTRIES

CHD 7 CHEMICAL HAZARDS

Chairman: Shri K S Ram Prasad,Ex-Head (MD & KMS),Resource and Documentation Division,AERB

Members: Industry, Academia, Government

Scope:

To formulate Indian Standard for

i)Terminology, methods of sampling and test codes of practices and guidelines relating to chemical hazards and Occupational Health and Safety related to chemicals,
ii) Classifications of hazardous chemicals and chemical hazards ,
iii) Code of safety for operational hazards in chemical industries and chemical laboratories etc iv)Safety data sheets and cards for hazardous chemicals

Continued….

Total Published Standard -75

Aspect wise report

Aspect	No of Standards
Code of Practice	72
Method of Test	2
Terminology	1

Important Published Standards

1) IS 4906: 2017 Radiochemical Laboratories- Code of Safety

- Radiation science is a very specialized field. Radioisotopes are increasingly employed in medicines, agriculture, industry and in research laboratories.
- The characteristic radiotoxicity and difficulties of detection of these radioisotopes may have hazardous impact on life.
- For prevention of chemical accidents, in radiochemical laboratories Indian Code of Safety for Radiochemical Laboratories IS 4906:2017 may be consulted.

Continued….

Standard IS 4906: 2017 lays emphasis and provides guidance on:

- Important characteristics of radioactive material and their storage and hazardous impacts.
- Precautions to be taken in the design and layout of radiochemical laboratories.
- Prescribes the precautions to be taken while handling, storage and disposal of radioactive material.
- Includes training and safety supervisions.
- Protective measures to be taken while working includes- equipments, protective clothings, and respirators.

Continued….

2) IS 4209: 2013 CHEMICAL LABORATORIES — CODE OF SAFETY (Second Revision)

- Chemical laboratories are places equipped for conducting scientific experiments in field of test methods and manufacture of chemicals etc. and also include labs for teaching practical sciences.
- The code of safety for chemical laboratories are needed because of following:

  i) Due to hazards inherent in the nature and handling of chemicals;

  ii) Due to hazards from inadequacy or handling of instrumental facilities necessary in chemical laboratories, such as electricity, glassware, machinery equipment, gas, steam, water, apparatus for high/low temperature and pressure. Innumerable chemicals used as reagents and solvents are flammable/toxic/corrosive/poisonous, etc, and are harmful/irritants to body tissues.

- For prevention of chemical accidents, in chemical laboratories Indian Standard Code of Safety for Chemical Laboratories IS 4909: 2013 may be consulted.

Continued….

Standard IS 4906: 2017 lays emphasis and provides guidance on:

- Factors involving safety.
- Functional design, incompatible material, disposal and safety equipments to be available in the chemical laboratories.
- General laboratory techniques.
- Measure to be taken in case of accidents, labelling of hazardous chemicals.

Continued….

3) IS 15656:2006 (Hazard identification and risk analysis - Code of practice)

- Prevention of human and property losses is integral to the operation and management of chemical process plants. This may be achieved through the selection of a technology that is inherently safe. Alternatively safety of plant design and/ or operation can be audited by the application of hazard identification and risk analysis techniques, and adopting measures suggested by the analysis. The latter approach constitutes Quantitative Risk Analysis (QRA).

- This Code of practice is intended for safety professionals and engineers in the areas of chemical plant safety to upgrade safety performance of the plants and covers the methods of identifying, assessing and reducing hazards including evaluation and selection of methods for particular applications

Continued….

4) IS 1446: 2002 Classification of Dangerous Goods(Second Revision).

- The handling of dangerous goods during transportation is regulated in order to prevent such goods from causing either accidents to persons or damage to the means of transport employed or to other goods. Keeping these objectives in view, this standard lists dangerous substances and classifies them according to risk involved so that appropriate precautions can be taken by the concerned agencies.
- This standard classifies chemicals and dangerous goods by the type of risk involved and lists the corresponding UN number to facilitate national and international transport.

Important Standards under Revision

1) Revision of Code of Safety for chemicals.

The revision of Code of safety for chemicals is taken up by BIS to incorporate the technological development, requirements of stakeholders, safety, economical & environmental issues in the following aspects:

a) Properties;
b) Health hazards and toxic informations;
c) Personal protective equipments;
d) Storage handling , labelling and transport;
e) Spillage, leakage and waste disposal;
f) Fire prevention and fire fighting;
g) Training; and
h) Health management, First aid and medical treatment.

Important Subject under Development

1) **Material Safety Data Sheet.**

- Material Safety Data Sheet (MSDS) or simply SDS (Safety Data Sheet) is the means of communicating information about the hazardous properties of a material to the users, plant workers, people handling material in transit, the government agencies involved and general public. This is an essential component of hazard communication.
- This standard provides requirements for the format for Material Safety Data Sheet (MSDS). The possible contents that should be given under each of the 16 sections of the format are outlined. Guidelines for compilation and completion of an MSDS also have been provided.
- The 16 sections of the format are:
  - ❖ SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION
  - ❖ SECTION 2 - HAZARDS IDENTIFICATION
  - ❖ SECTION 3 - COMPOSITION/INFORMATION ON INGREDIENTS

Continued….

- SECTION 4 - FIRST-AID MEASURES
- SECTION 5 - FIRE-FIGHTING MEASURES
- SECTION 6 - ACCIDENTAL RELEASE MEASURES
- SECTION 7 - HANDLING AND STORAGE
- SECTION 8 - EXPOSURE CONTROLS AND PERSONAL PROTECTION
- SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES
- SECTION 10 - STABILITY AND REACTIVITY
- SECTION 11 - TOXICOLOGICAL INFORMATION
- SECTION 12 - ECOLOGICAL INFORMATION
- SECTION 13 - DISPOSAL CONSIDERATIONS
- SECTION 14 - TRANSPORT INFORMATION
- SECTION 15 - REGULATORY INFORMATION
- SECTION 16 - OTHER INFORMATION

CHD 8 ‘Occupational Safety and Hazards Sectional Committee’

Chairperson: Shri Lalit R. Gabhane, Director General, National Safety Council

Members: Industry, Academia, Government

Scope:

To formulate Indian Standard for

i) Terminology relating to Occupational Health and Safety

ii) Specifications and code of practice for testing of safety equipment

iii) Code of safety for operational hazards in industries other than chemical industries

iv) Occupational health and safety management system, procedure and practices.

Continued….

Total Published Standard -76

Aspect wise report

Aspect	No of Standards
Product	35
Code of Practice	11
Methods of Test	21
Terminology	1
System Standard	2
Safety Standard	1
Others	5

Important Published Standards

1) **IS 5983 : 1980 Specification for Eye - Protectors**

- Eye protectors are very important as it is widely used in industrial operations.

- This standard covers requirements for eye- protectors in order to provide protection against small particles flying at high velocity, molten metal, chemical splashes, harmful dust, gases, optical radiation which pose hazards that can damage the eye.

- This standard is currently under revision and is being harmonized with international standard ISO 16321-1 : 2021 Eye and Face Protection for occupational use- Part 1 General Requirements.

Important Published Standards

2) **IS 8521 (Part 1 & 2) : 1977 Specification for industrial safety face shields Part 1 with plastics visor & Part 2 with wire - Mesh visor**

- The industrial safety face shields with plastics visor can be used in the working operations against chips and sawdust; in metal machining operations against flying particles; in buffing, polishing and grinding operations where particles may strike the face; in spot welding; and in the handling of corrosive materials. They are not acceptable for protection against heavy welding and gas cutting operations.
- The industrial safety face shields with wire mesh visor may be used to protect face against heat and glare from the furnaces and wherever heated material is handled.

Important Published Standards

3) IS 9473 : 2002 Respiratory protective devices - Filtering half masks to protect against particles – Specification *(First Revision)*

- These devices are designed to protect against solid and water-based aerosols only or against both solid and liquid aerosols.
- Air enters the filtering half mask and passes directly to the nose and mouth area of the facepiece or, via an inhalation valve, if fitted. The exhaled air flows through the filter material and/or an exhalation valve (if fitted) directly to the ambient atmosphere.
- This standard prescribes requirements and method of sampling and tests for filtering half masks as respiratory protective devices against particles except for escape purposes.

Important Published Standards

4) IS 14166 : 1994 Respiratory protective devices full - Face masks – Specification

- This standard covers to full face masks for respiratory protective devices, except escape apparatus and diving apparatus. It specifies requirements for full face masks for use as part of respiratory protective devices.
- Air enters the full face mask through the facepiece connector(s) and passes either directly through the nose and mouth area or via the eye (visor) area of the full face mask.
- The exhaled air flows back either through the facepiece connector into the breathing apparatus (closed-circuit breathing apparatus, pendulum breathing) or directly to the ambient atmosphere. Via the exhalation valve(s) (open-circuit breathing apparatus), or by other appropriate means in other types of respiratory protective devices.

Important Published Standards

5) **IS 14746 : 1999 Respiratory protective devices - Half masks and quarter masks - Specification**

- Half masks and quarter masks are widely used in the environment where there is contamination of toxic or hazardous gases in the air. Depending on concentration and nature of the contamination, the half masks or quarter masks are used.
- This standard prescribes requirements for half masks and quarter masks for use as part of respiratory protective devices, except escape apparatus and diving apparatus.

Important Published Standards

6) IS 15803 : 2008 Respiratory protective devices – Self contained closed circuit breathing apparatus chemical oxygen (KO2) type, self generating, self rescuers – Specification

- Chemical oxygen (K02) type self generating, self rescuers are used for escape by miners/persons from irrespirable atmosphere after an explosion/similar situation, to a safe place within a reasonable time . These are self contained closed circuit breathing apparatus for escape.
- In these apparatus, breathing gas exhaled by the wearer of apparatus enters into a circuit via, facepiece or mouthpiece containing a cartridge with chemical(s) that absorbs both exhaled carbon dioxide and humidity and releases oxygen into the breathing bag where it is available for rebreathing.

Important Published Standards

7) IS 3521 (Part 1 to 9) : 2021 Personal Fall Arrest System series of standards

- **Part 1 Full Body Harness (Fourth Revision)**- Full body harnesses are required to protect persons from injury by arresting the fall in the event of the user losing his/her balance or support and falling from the place of working either at an elevation or in closed locations or containers. Some examples of work where a danger of fall exists are given below:

  a) Industrial duty in plant and maintenance work while working at higher elevations;

  b) Construction, erection, installation and such other jobs;

  c) Working of electrical servicemen and linemen on general duty or high tension installation poles; installation and overhead maintenance and also for service to outdoor transformers and other similar jobs;

Important Published Standards

d) Workers working inside ship holds, tankers, silos, chimneys, manholes, sewers or similar other enclosed spaces;

e) Maintenance of buildings, structures or similar jobs, such as paintings, window cleaning, chimney cleaning, etc.; and

f) Working in potentially explosive environment.

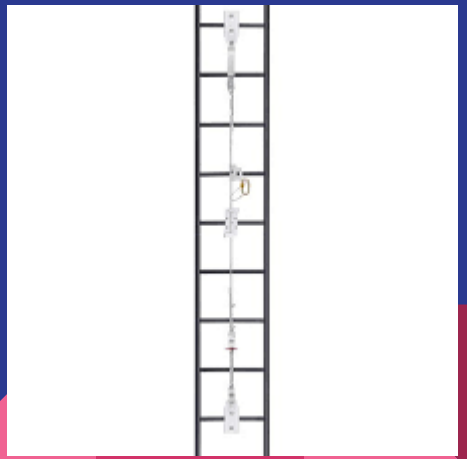
- **Part 2 Lanyards and Energy Absorbers-** Lanyards and energy absorbers are used together as a connecting subsystem in personal fall-arrest systems (PFAS).

  PFAS complying with this part of IS 3521 should satisfy ergonomic requirements and should only be used if the work allows means of connection to a suitable anchor device of demonstrated strength and if it can be implemented without compromising the safety of the user. Personnel should be trained and instructed in the safe use of the equipment and be observant of such training and instruction.

Important Published Standards

- **Part 3 Self-retracting Lifelines** - Self-retracting lifelines are used as a connecting sub-system in personal fall-arrest systems (PFAS).

- **Part 4 Vertical Rails and Vertical Lifelines Incorporating a Sliding-type Fall Arrester- Vertical rails and vertical lifelines** incorporate a sliding-type fall arrester and constitute a personal fall-arrest system (PFAS) when connected to a full-body harness.



- **Part 5 Connectors with Self-closing and Self-locking Gates-** Connectors are used in personal fall-arrest systems (PFAS), such that, if an arrest takes place, the arresting force will not exceed 6kN .

Important Published Standards

- Part 7 Single Point Anchor Devices - This International Standard specifies requirements, test methods, and marking, labelling and packaging, as appropriate, of both permanent and temporary single-point anchor devices exclusively for the attachment of personal protective equipment (PPE) for protection against falls from a height for fall arrest, work positioning and travel restriction (work restraint).

- **Part 8 Flexible Horizontal Lifeline Systems-** This Standard specifies design and performance requirements, test methods, user instructions, marking and labelling as appropriate, of flexible horizontal lifeline systems for use at any one time by up to three persons, exclusively for the attachment of personal protective equipment for protection against falls from a height. It does not stipulate designs for flexible horizontal lifelines, except for design limitations that are necessary for safe and durable service.

Important Published Standards

- **Part 9 Descending Devices-** Descending devices are intended to be used in conjunction with an appropriate descent line and other equipment, for example, an appropriate harness or rescue loop and a reliable anchor, to enable a person to descend from one position to another, either on their own or assisted by another person.

  Typical uses are emergency egress and work positioning. In addition to their primary function of allowing access to a lower point, descending devices and descent lines have a fall protection function.


Do you have
any questions?


Thank
you