

A photograph of an industrial facility, likely a refinery or chemical plant, at sunset. The sky is filled with large, billowing plumes of dark smoke and steam, illuminated from below by the warm orange and yellow hues of the setting sun. The industrial structures, including tall chimneys and complex piping systems, are silhouetted against the bright sky.

INDUSTRIAL SAFETY

Industrial safety is primarily a management activity which is concerned with

- Reducing
- Controlling
- Eliminating hazards from the industries or industrial units

Objectives of Industrial Safety

- To prevent accidents in the plant by reducing the hazard to minimum
- To eliminate accident caused work stoppage and lost production
- To achieve lower workmen's compensation, insurance rates and reduce all other direct and indirect costs of accidents
- To prevent loss of life, permanent disability and the loss of income of worker by eliminating causes of accidents
- To evaluate employee's morale by promoting safe work place and good working condition
- To educate all members of the organization in continuous state of safety mindless and to make supervision competent and intensity safety minded

Measures to ensure industrial Safety

- Safety policy
- Safety committee
- Safety Engineering
 - Guarding of machinery
 - Material handling equipment
 - Safety devices
 - Ergonomics
 - Maintenance
 - General house keeping
- Safety education and training
- Role of Government



Safety Audit

- Safety audit subjects each area of a company's activity to a systematic critical examination with the object of minimizing loss

Safety Survey

- Safety survey is a detailed examination in depth of a narrower field of activity



Safety Inspection

- Routine scheduled inspection of a unit or department, which may be carried out by someone (may be a safety representative) from with the unit.
- Inspection would check the maintenance standards



FIRE



**Fire is a chemical chain reaction between Fuel,
Heat and oxygen**

CLASSIFICATION OF FIRE

	DESCRIPTION	EXAMPLE
A (Solid)	Fire involving ordinary combustible <u>solid</u> materials	Wood, Paper, Textiles
B (Liquid)	Fire involving flammable <u>liquids</u>	Petroleum Products, Paints
C (Gases)	Fire involving gases or liquefied <u>gases</u>	LPG, H ₂ S, H ₂
D (Metal)	Fire that occur in combustible <u>metals</u>	Sodium, Zinc, Potassium, Mg

METHODS OF HEAT TRANSFER

CONDUCTION

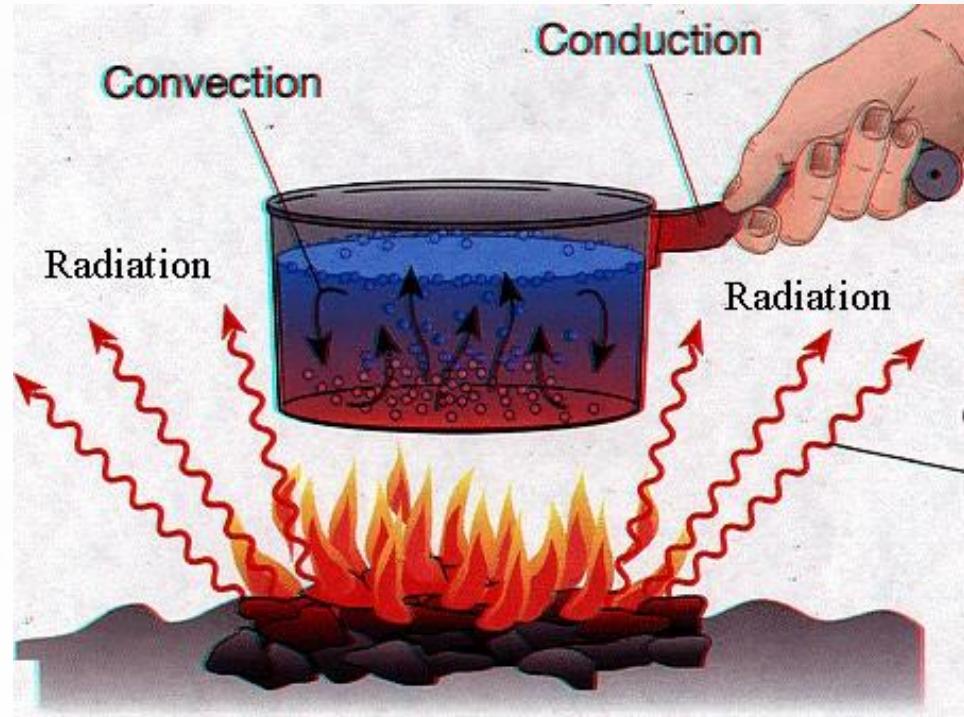
Heat transfer through a medium of solid body

CONVECTION

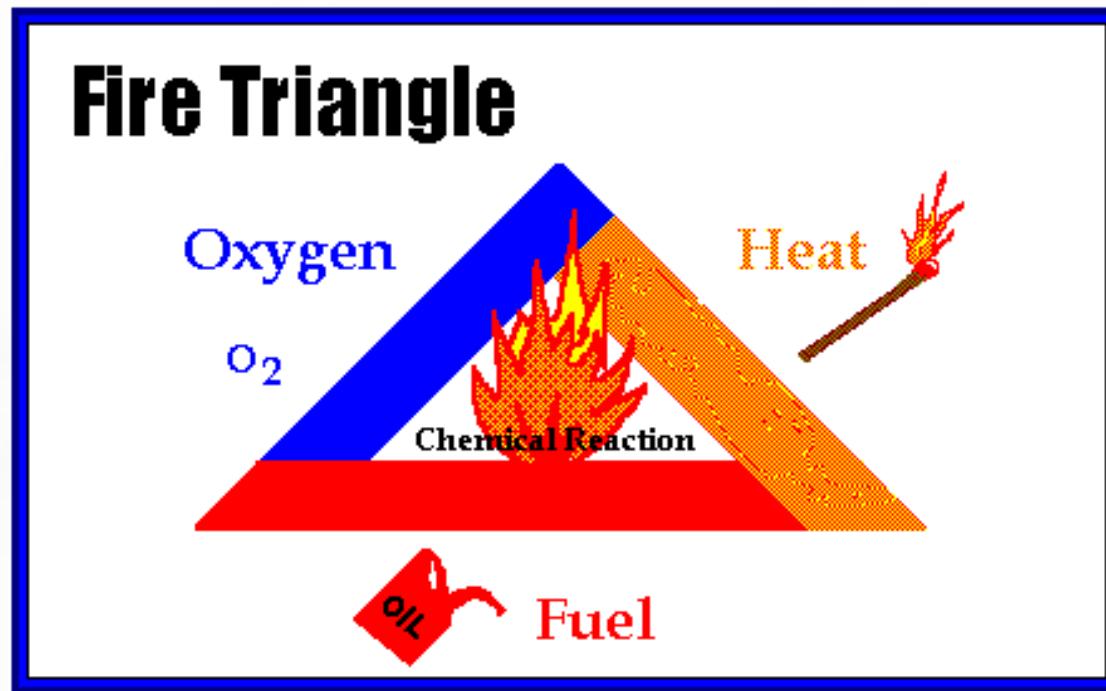
Heat transfer through upward motion of heated matters

RADIATION

Heat transfer through air heat wave



FIRE TRIANGLE



EXTINGUISHING METHODS

- | | | |
|-------------------|---|--------------------------|
| STARVATION | - | REMOVAL OF FUEL |
| SMOTHERING | - | REMOVAL OF OXYGEN |
| COOLING | - | REMOVAL OF HEAT |

EXTINGUISHING MEDIA

- WATER
- FOAM
- DCP (**DRY CHEMICAL POWDER** - NaHCO₃ , NH₄H₂PO₄)
- CO₂
- SAND

Fire Safety

There are **four** essential steps to take if you discover a fire:

R**Rescue**

anyone in immediate danger of the fire.

A**Alarm**

Activate the nearest fire alarm **and** call your fire response telephone number.

C**Contain**

fire by closing all doors in the fire area.

E**Extinguish**

small fires. If the fire cannot be extinguished, leave the area and close the door.

**You
should
know:**

- Locations of nearest fire extinguishers and alarm pull boxes
- The fire location - room number and building
- All fire exits in your work area

How to properly operate a Fire Extinguisher

P**Pull**

the pin, release a lock latch or press a puncture lever.

A**Aim**

the extinguisher at the base of the fire.

S**Squeeze**

the handle of the fire extinguisher.

S**Sweep**

from side-to-side at the base of the flame.

HOW TO USE FIRE EXTINGUISHER

- It is easy to remember how to use a fire extinguisher, you can remember a shot form **PASS** which stands for

Pull

Aim

Squeeze

Sweep

1. Pull the pin



2. Aim the nozzle



3. Squeeze the lever



4. Sweep side to side



CLASSIFICATION OF FIRE EXTINGUISHER

Class of Fire	Type of Fire	Type of Extinguisher
A	Ordinary combustibles: wood, paper, rubber, fabrics, and many plastics	Water, Dry Powder,
B	Flammable Liquids and Gases: gasoline, oils, paint, lacquer, and tar	Carbon Dioxide, Dry Powder Foam
C	Fires involving Live Electrical Equipment	Carbon Dioxide, Dry Powder
D	Combustible Metals or Combustible Metal Alloys	Special Dry Powder

COLOUR OF EXTINGUISHER

WATER

- **RED**



FOAM

- **CREAM**



DCP POWDER

- **BLUE**

CARBON DIOXIDE

- **BLACK**



TYPES OF EXTINGUISHERS

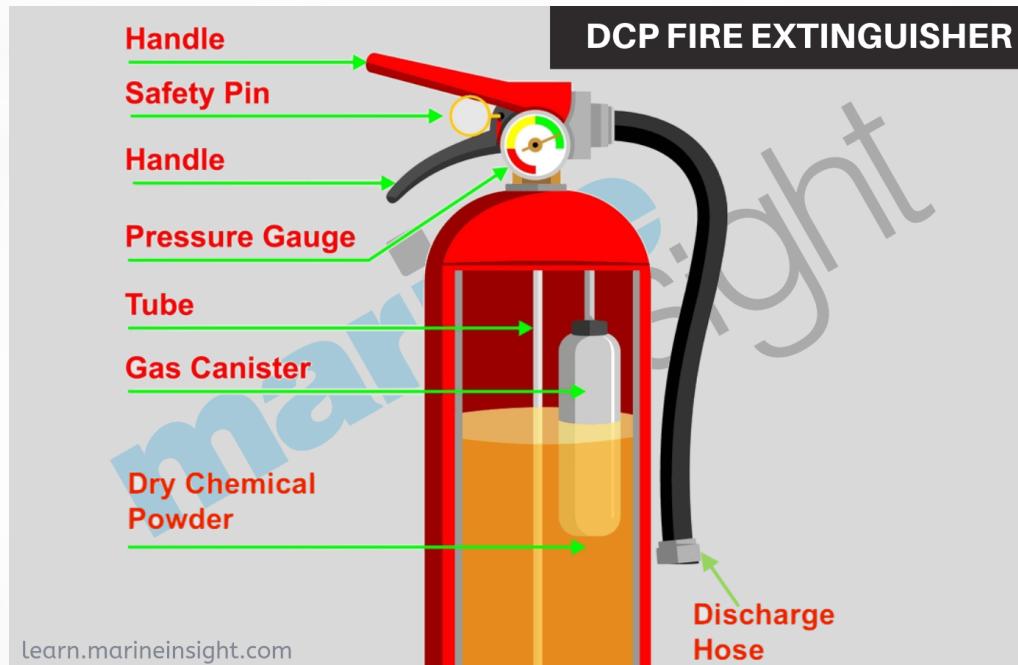
STORED PRESSURE

- Stored pressure fire extinguishers are easily the **most common type**
- In these units, the **expellant (propellant)** is stored in the **same cylinder as the agent itself**
- **Different agents (Water, Foam, DCP Powder)** used in the fire extinguisher may require different propellants (**Nitrogen, Dry Air**)
- Dry Chemical Extinguishers typically use **Nitrogen** or **Dry Air** as propellant
- Water and Foam Extinguishers typically use **Dry Air** as propellant

TYPES OF EXTINGUISHERS

CARTRIDGE TYPE

- In cartridge operated units, the dry chemical is stored in the **non-pressurized cylinder**
- while the propellant; either “**Dry Air**” or **Nitrogen** is stored in a **separate cartridge** located on the side of the unit



ADVANTAGES OF DCP

- Harmless to skin
- Non-conductor of electricity
- Good for blast fire
- Better than CO_2 - on liquid fire
- Non-toxic and non-corrosive

FIRE EXTINGUISHER CHECKLIST

SI.NO	LOCATION	TYPE	PRESSER GUAGE	SAFETY PIN	DUE DATE	OUTER CYLINDER	HOSE NOZLE	REMARK
1	Workshop	ABC	✓	✓	10/22	✓	✓	Nil
2	Office	CO2	✓	✓	10/22	✓	✓	Nil

DEFINITIONS

ACCIDENTS

- Accident is an unplanned event **that cause** personal injury, property damage, equipment damage or environmental pollution

INJURY

- Injury is harmful condition / damage to body as a result of an accident

HAZARD

- Hazard is a potential to cause harm to the body

DEFINITIONS

RISK

- Risk is the combination of Likelihood (chance) of occurrence accident and Consequence (Severity) of the accident

$$\mathbf{R = L \times C}$$

NEARMISS

- Near miss is an unplanned event which does not cause any personal injury, property damage, equipment damage or environmental pollution but it has potential to cause accident. (In feature)

TOOL BOX TALK

- Tool box talk is a pre-job meeting in which supervisor / safety officer will explain about the job to be done and the hazard present in that job

DEFINITIONS

Who is a **COMPETENT PERSON** ?

- One who is capable of identifying and predicting hazards in the work place - Competent Person

STANDARD SAFETY SIGNAGE

MANDATORY- BLUE & WHITE



STANDARD SAFETY SIGNAGE

PROHIBITION - RED & BLACK



STANDARD SAFETY SIGNAGE

WARNING- YELLOW & BLACK



STANDARD SAFETY SIGNAGE

SAFE CONDITION- GREEN & WHITE



STANDARD SAFETY SIGNAGE

FIRE EQUIPMENT



FIRE FIGHTING EQUIPMENTS

- FIRE BLANKETS
- HOSE REELS
- FIRE FIGHTING HOSE
- FIRE MONITOR
- FIRE HYDRANT
- SPRINKLER SYSTEM



COMMON CAUSES OF FIRE

- Spark from electricity
- Smoking
- Hot Work
- Naked Flame
- Hot Surface
- Spark from Vehicles
- Static Electricity
- Lightning

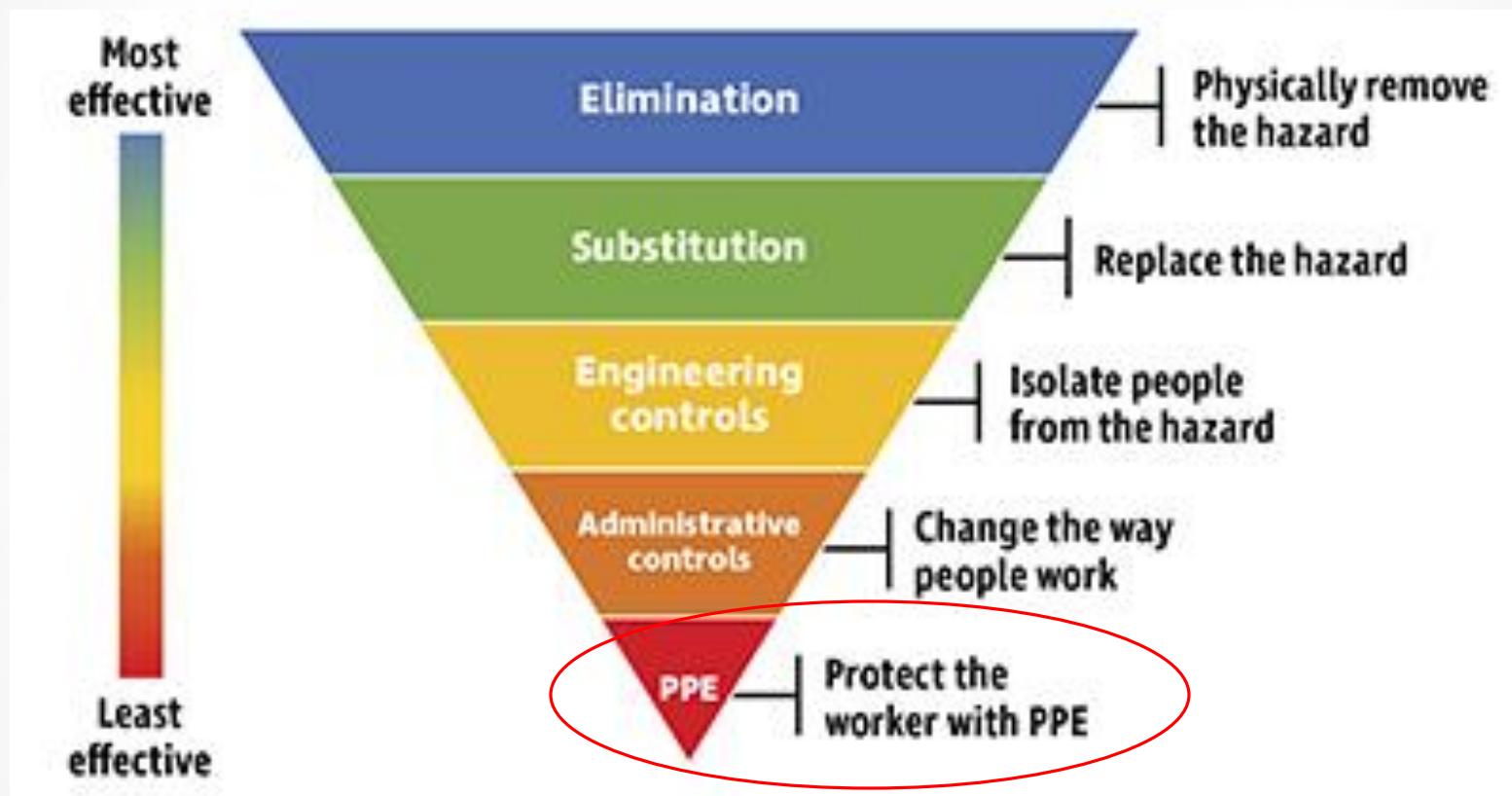
CONSEQUENCE OF FIRE

- People get Injured & Killed
- Damage to equipment/Building
- Environment Damage

PERSONAL PROTECTIVE EQUIPMENT (PPE)



Hierarchy of Risk Control



PPE



Protection Matters

Ear Protection

- use in noisy areas to avoid hearing loss

Respiratory Equipment

- use to protect from inhaling dust and other contaminants

Safety Gloves

- use to protect your hands from injury

You only have one body!



Safety Helmet

- use to protect your head from falling objects

Safety Glasses

- use to protect eyes from flying particles

Reflective Clothing

- use to make sure you are highly visible to other personnel

Safety Shoes

- use to protect your feet from falling or rolling objects

PERSONAL PROTECTIVE EQUIPMENT

PPE is equipment that will protect the user against health or safety risks at work



TYPES OF PPES

□ Respiratory Protective Equipment

e.g. SCBA, Air Respirators etc.



□ Non-Respiratory Protective Equipment

e.g. Hard Hat, Gloves, Goggles, Safety Shoes etc.



NON-RESPIRATORY PROTECTIVE EQUIPMENT

COMMON PPE

- Head Protection
- Eye & Face Protection
- Hand Protection
- Foot Protection



HEAD PROTECTION

- Prevention of head injuries is an important factor in every job
- Head Injuries are caused by **falling, flying object** or by **jumbling** the head against a fixed object



HEAD PROTECTION

HEAD INJURIES



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EYE & FACE PROTECTION

- To protect face from flying particle, splashing liquids, chemicals, chemical gas, vapours, potentially injurious light radiation suitable eye protector equipment to be given



TYPES OF EYE & FACE PROTECTION

- Safety Glasses
- Safety Goggles
- Face Shields
- Welding Goggles
- Laser Safety Glass



EYE & FACE PROTECTION



FOOT PROTECTION

- To protect feet and leg from falling objects, sharp objects, hot surface and wet surface suitable feet / leg protector equipment to be used
 - Safety shoes should be sturdy and acts as a protective covering to toe
 - Some shoes contain metal insole to protect feet from puncture wounds



FOOT PROTECTION



HAND PROTECTION

- Hand protection equipment must be given to protect from hands from burns, abrasion, cuts, punctures, bruise, chemical exposure



HAND PROTECTION



TYPES OF GLOVES

- Leather Gloves
- Cotton Gloves
- Chemical Protection Gloves
- Insulated Rubber Gloves
- Welding Gloves



EAR PROTECTION

- Hearing protection device, also known as a HPD, is an ear protection device worn in or over the ears while exposed to hazardous noise (>85dB, 8hrs) to prevent noise-induced hearing loss
 - Ear Muff
 - Ear Plug



HEARING PROTECTORS

- Ear Plugs - Preferred (20-30 dB)
- Ear Muffs - 2nd Choice (15-30 dB)
- Double Hearing Protectors (plug & muff) used for levels over 115 dB



NOISE LEVELS

- Measured in decibels (dB)
 - * Whisper - 10-20 dB
 - * Speech - 60 dB
 - * Noisy Office - 80 dB
 - * Passing Truck - 100 dB
 - * Jet Engine - 150 dB
- Osha Limit - 85 dB



PERMISSIBLE EXPOSURE LIMIT (PEL)

permissible noise exposure

Duration per day (hours)	Sound Level (dB)
8 HOURS	90 dB
4 HOURS	95 dB
2 HOURS	100 dB
1 HOURS	105 dB
½ HOURS	110 dB
¼ HOURS	115 dB

RESPIRATORY PROTECTIVE EQUIPMENT

- Respiratory protective equipment are life saving equipment**



TYPES OF PROTECTIVE DEVICES

- Air Purifying Devices (APD)
- Air Supplying Devices (ASD)
- Combination of air purifying and air supplying devices



AIR PURIFYING DEVICES

- Air purifying device cleans the contaminated atmosphere

Various types of air purifying device

- * Mechanical Filter Cartridge
- * Chemical Cartridge
- * Gas Mask
- * Powered Air Purifying Devices



AIR PURIFYING DEVICES



Exposure to
silica dust in
construction
work



AIR SUPPLYING DEVICES

- Air supplying devices provide respirable atmosphere to the wearer, independent of the ambient air

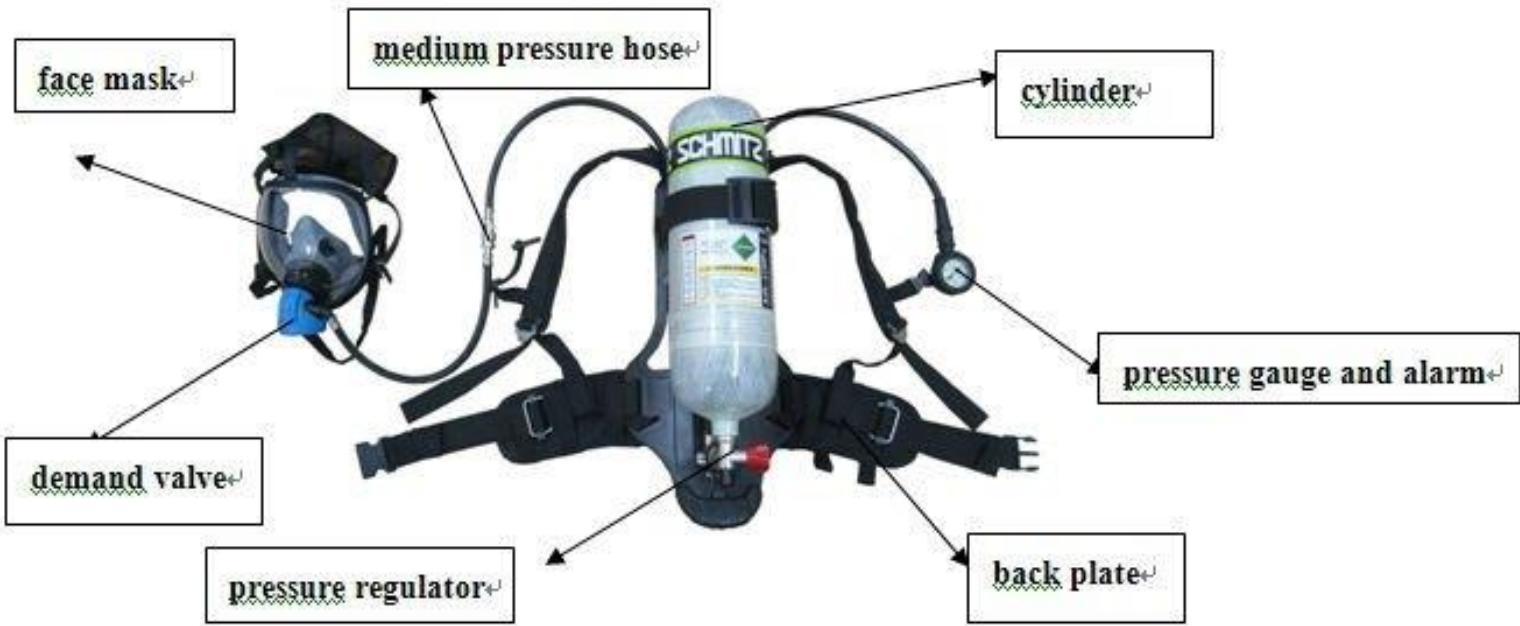
Types of Air Supplying Devices

- Self Contained Breathing Apparatus (SCBA)
- Compressed Air Breathing Apparatus (CABA)
- Emergency Escaping Breathing Apparatus (EEBA)
- Air Line Respirator (ALR)



BREATHING APPARATUS

ANATOMY



CHEMICAL SAFETY



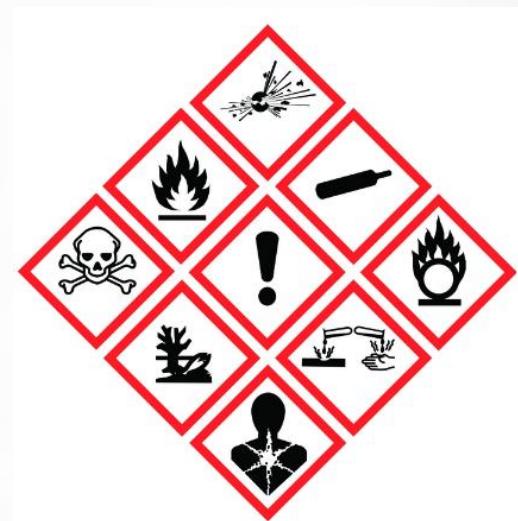
Forms of Chemical Agents

- ❖ Liquids - Harmless to toxic level - we are using in day - to - day life
- ❖ Gases - Volume and State Changed - Combined effect of P & T
- ❖ Vapours - Gaseous form of liquids
- ❖ Mist - Condensed gas form
- ❖ Fumes - Condensed vapour form
- ❖ Dust - Smoke with micro particles - natural or grinding process
- ❖ Fibers - Threads or filaments - Asbestos
- ❖ Aerosol - Solid particles in air



Categories of Danger

- Physio - Chemical Effects
 - Physical or chemical properties of the substance
 - Flammable, oxidizing, explosive
- Health Effect
 - Harmful to living organism
 - Injury, death
- Environmental Effect
 - Potential to damage the environment
 - Air, Soil, Water damage



Classification of Hazardous Substance

- Irritant
- Corrosive
- Harmful
- Very Toxic
- Toxic
- Sensitizing
- Carcinogenic
- Mutagenic
- Teratogenic



Irritant

- Non-corrosive
- Cause inflammation
- May be immediate or prolonged
- Example: Petrol, Detergent, Nuisance dusts



Corrosive

- Contact with living tissue
- Destroy the living tissue by burning
- Example:
 - Acids: HCl , HNO_3 , H_3PO_3
 - Alkalies: $NaOH$, KOH , NH_3
 - Gases and Vapours : Hydrogen Chloride gas - mist like
- Note: Most corrosive liquids expel damaging corrosive vapours - cause burns to the eye or respiratory tract



Harmful



- Damage to the health
- Example: Category 3 Carcinogens, Mutagens, Teratogens

Very Toxic

- Poisonous substance
- Very low quantity cause death
- Acute or chronic damage to health
- Example: H_2S



Acute: produce harmful effect very quickly; within seconds, minutes, hours Example: Cyanide

Chronic: produce harmful effect after very long period of time; month or years Example: Alcohol

Toxic

- Poisonous substance
- Very low quantity cause death
- Acute or chronic damage to health
- Example: *KCN*
 - Insecticide are toxic to insects not harmful to humans



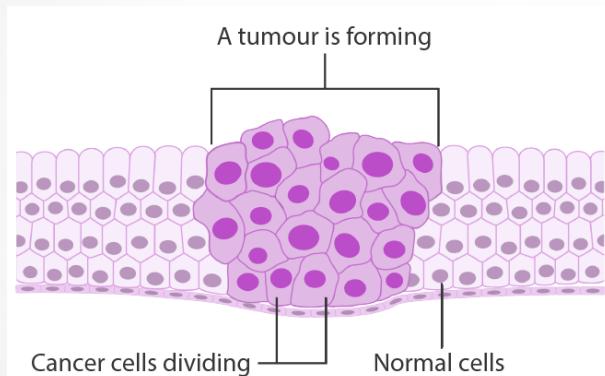
Sensitising

- Allergic reaction
- Example: Metals
 - Nickel
 - Cobalt
 - Resins
 - Plastics



Carcinogenic

- Disorder to cell growth
- Cancer



Mutagenic

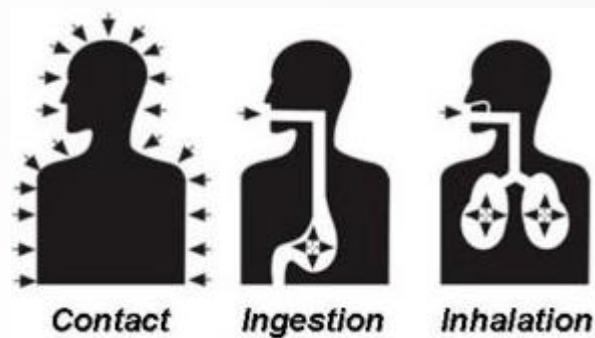
- Induce heritable genetic disorder
- radioactive substances
- x-rays
- ultraviolet radiation

Teratogenic

- Effect Progeny
- Impairment in reproductive functions
- Ethylene oxide

Route of entry

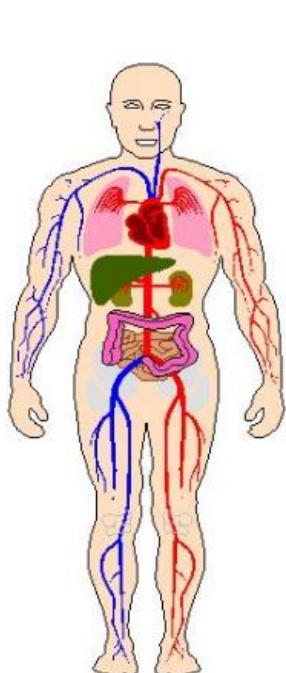
- **INHALATION** - by lungs entry - most common - may be by blood stream
- **INGESTION** - accidental drinking - unlabeled container - poor hygiene
- **ABSORPTION** - skin and across membrane - enters blood stream
- **INJECTION** - liquid or gas under pressure - skin puncture - sharp object
- **DIRECT ENTRY** - by open wound



Target Organs

- Part of the body

- Lungs
- Brain
- Kidneys
- Liver
- Skin



- Target Organ Effects - Chemicals that affect certain organs more than others
 - Hepatotoxins - liver
 - Nephrotoxins - kidney
 - Neurotoxins - nerves
 - Hematopoietic toxins - blood system
 - Pulmonary toxins - lungs
 - Skin toxins - skin

Harmful Agents

- Chemical Agents
 - Dusts, Fumes, Gases, Mists, Vapours and Liquids
- Biological Agents
 - Fungi, Bacteria, Virus

Note: Harmful agent cause local and systemic effects

Local Effect

- When the site of the damage is at the point of contact with the substance
- Example: Corrosive burn on the skin

Systemic Effect

- When the site of damage is at a point other than the point of contact, such as target organ
- Example: Inhaled lead fumes causes effect on the brain

Body Protection Mechanism

- Good Personal Hygiene
- Do not apply cosmetics in the workplace
- No eating or drinking in the workplace
- Proper containers / storage for food and drink
- Provision and use of appropriate PPE
- Taking care when removing contaminated protective clothing

Factors to be consider when Assessing Risk

- Form of substance - Solid, Liquid, Dust, Gas, etc.
- Classification of hazard - Very Toxic, Toxic, Corrosive, etc.
- Quantity and Concentration
- Routs of Entry
- Acute or Chronic or both
- Body Defense
- First signs of damage and illness
- Vulnerability of the people
- Effectiveness of existing control measures

Source of Information

- Product Label
- Worker Exposure Limit
 - ILV, TWA, STEL (chronic, 15 minutes), LTEL (Acute,8hrs), TLV, PEL
- MSDS (Material Safety Data Sheet)
 - 16 sections

Measuring Exposure in Units

- Parts per million (ppm)
- Milligrams per cubic metre of air (mg/m^3)
- Fibres per milliliter of air (*fibers/ml*)

MSDS – 16 sections

- 1. Identification of the substance or preparation and supplier**
- 2. Composition and information on ingredients**
- 3. Hazard identification**
- 4. First aid measure**
- 5. Fire fighting measure**
- 6. Accidental release measures**
- 7. Handling and storage**
- 8. Exposure controls and personal protection**
- 9. Physical and chemical properties**
- 10. Stability and reactivity**
- 11. Toxicological information**
- 12. Ecological information**
- 13. Disposal considerations**
- 14. Transport information**
- 15. Regulatory information**
- 16. Other information**