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# TRAINING ON WORK PLACE SAFETY

13-05-2020

# IMS POLICY

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## QUALITY, ENVIRONMENT, OCCUPATIONAL HEALTH AND SAFETY POLICY

Fuji Electric Consul Neowatt Pvt. Ltd. shall strive to become the Premier Provider of Energy Technology Products, Services and Solutions.

While engaging ourselves in this, considering context of the organization and strategic direction we are committed to-

a) Enhance customer satisfaction

b) Protection of Environment, including prevention of pollution

c) Provide Healthy and safe working conditions for prevention of work related injury and ill health for all our associated personnel

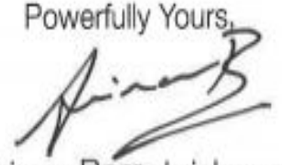
**To achieve these, we are committed to -**

- Satisfy product quality, Delivery, Performance requirements and other requirements related to IMS
- Eliminate Hazards and reduce OH&S Risks
- Eliminate significant environmental aspects and reduce pollution
- Fulfill all companies obligations
- Manufacture Safe, Energy Efficient, Innovative, Reliable, Competitive Energy Technology Products
- Consult Employees and ensure their Participation
- Continual improvement of Quality and EOHS Management Systems

This policy is documented and is available to all employees and interested parties

For, Fuji Electric Consul Neowatt Pvt. Ltd.

Powerfully Yours,



Sriram Ramakrishnan
Managing Director

Date : 15 / 11 / 2019
Rev : 02

# Crossing the Cultural Bridge- DUPONT BRADLEY Curve

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# CATEGORY OF HAZARDS

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## CATEGORY OF HAZARDS

### PHYSICAL

Occupational Hazard that involve Environmental & can cause harm

- Fire
- Explosion
- Heat
- Noise
- Vibration
- Electrical
- Radiation
- Lighting
- Ventilation
- Machinery
- Slippery
- Pressure

### CHEMICAL

Occupational Hazard that caused by exposure of Chemicals in Workplace that can lead to long term detrimental health effects

- Acids
- Fumes
- Flammable Gases
- Flammable Liquids
- Solvent & Sanitizers
- Vapours
- Paints & Lubricants
- Pesticides
- Toners
- Mercury, Lead etc

### BIOLOGICAL

Biological substances that pose a threat to heath of living organism, primarily to humans

- Micro Organisms
- Virus
- Bacteria
- Fungus
- Insect
- Parasites

### ERGONOMIC

Relating to or designed for efficiency and comfort in the Working Environment

- Manual Handling
- Repetitive Movement
- Over Crowding
- Lifting
- Seating Position

### PSYCHOLOGICAL

Hazards that affects the mental well being / health of employees by over whelming individual coping mechanisms and impacting the employee's ability to work in a healthy and safe manner

- Overwork
- Tiredness
- Work Boredom
- Abuse
- Discrimination
- Harassment

# Elements of Safety

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**Let us move onto the Safety Elements which we generally face in our day to day activities**


General Safety
Sources
Causes
Preventions

# SINAGES OF PHYSICAL HAZARD

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## PHYSICAL

**NOISE**

**VIBRATION**

**EXTREME TEMPERATURE**

**RADIATION**

**PRESSURE**

**ELECTRICITY**

# SINAGES OF CHEMICAL HAZARD

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## CHEMICAL

**EXPLOSIVE**

**TOXIC**


**CORROSIVE**

**OXIDIZERS**


**FLAMMABLE LIQUIDS**


**GASES**

# SINAGES OF BIOLOGICAL HAZARD

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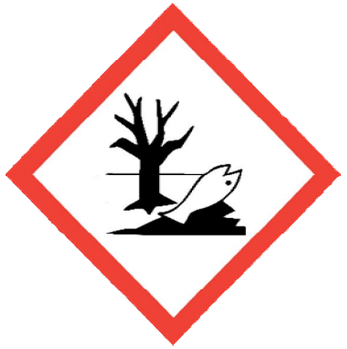
## BIOLOGICAL

| | |
|---|---|
| **BACTERIA**  | **BIOLOGICAL WASTE**   |
| **VIRUS**   | **POISONOUS ANIMAL**  |
| **PARASITE**  | **POISONOUS ANIMAL**  |

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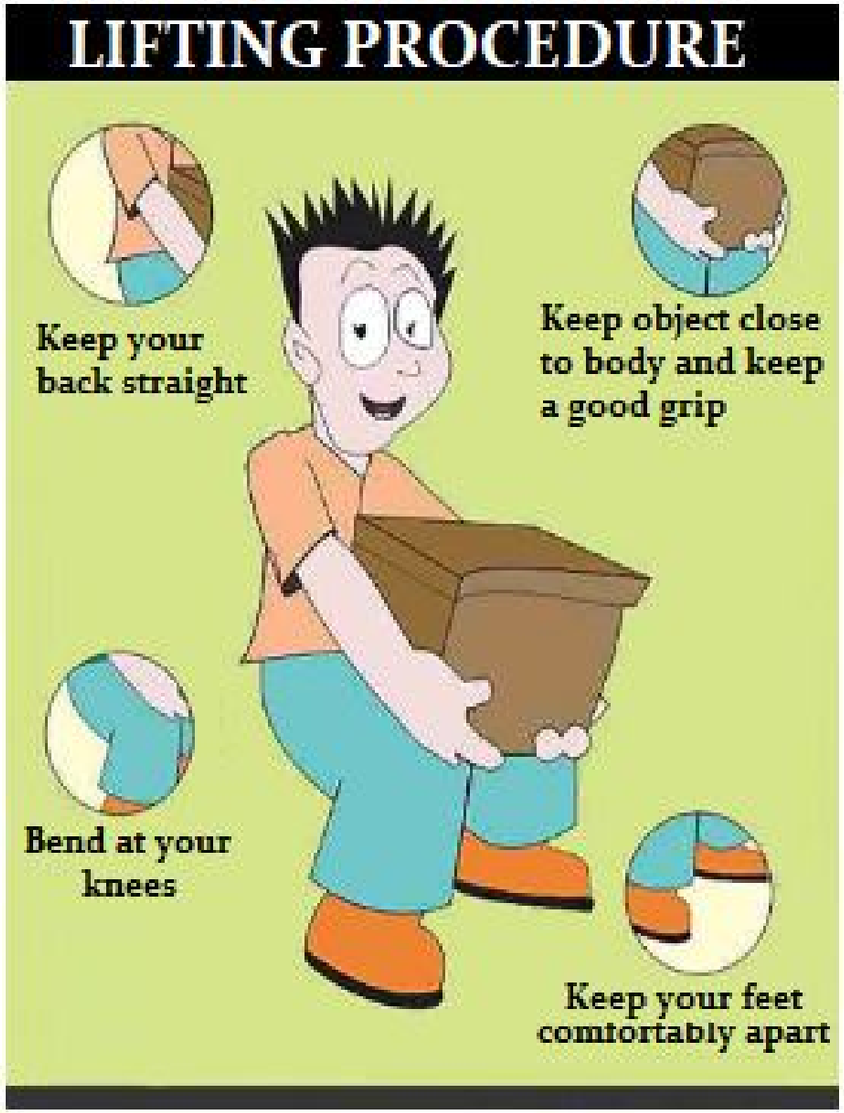
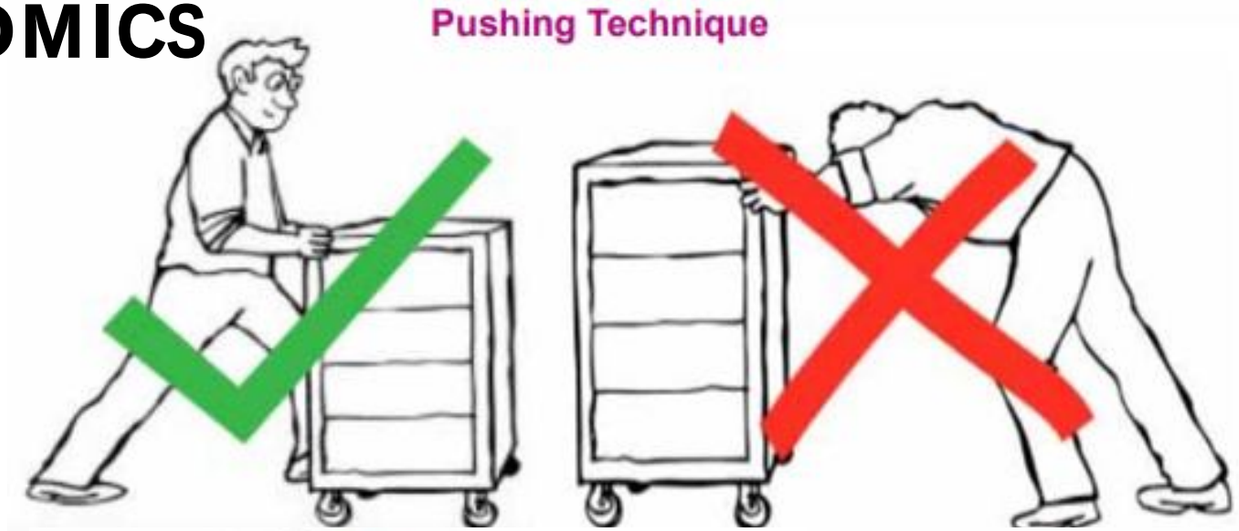
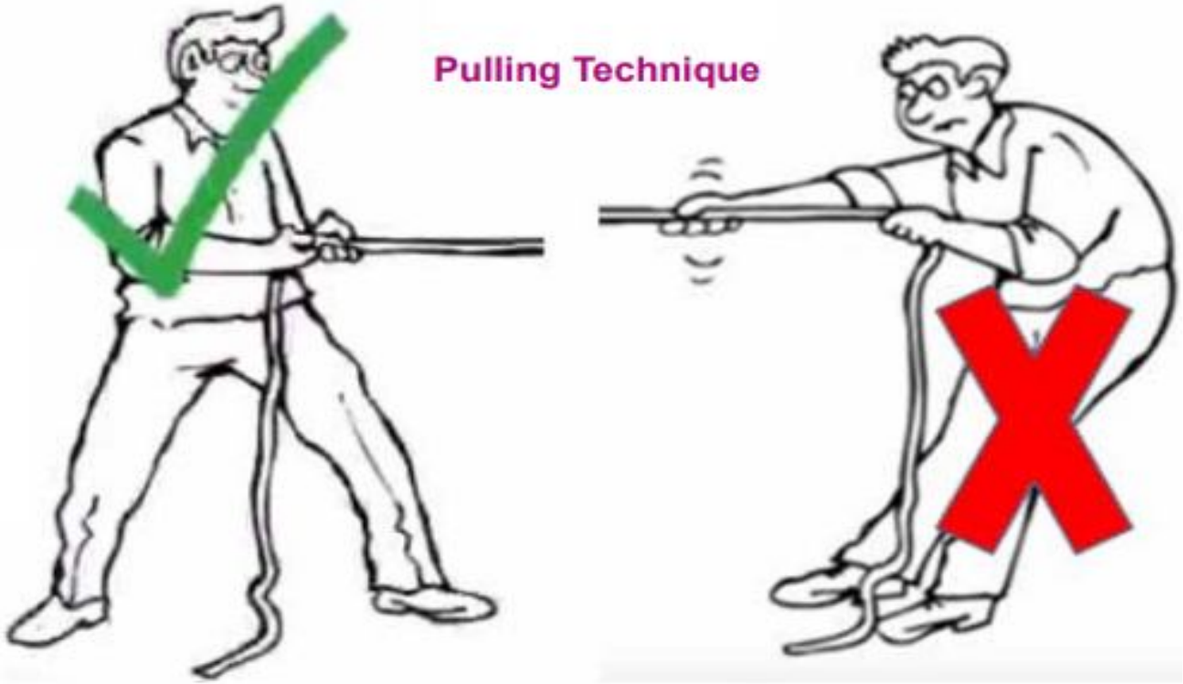
# ERGONOMICS



# HAZARD Vs RISK

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**Hazard** - is something that can cause harm.

**Risk** - is the chance, high or low, that any **hazard** will actually cause somebody harm.

| HAZARD | RISK |
| --- | --- |
|  Water |  Jumping in without knowing how to swim |
|  Gasoline |  Lighting a match |
|  Driving |  Texting |

## HAZARD VERSUS RISK

| | |
| --- | --- |
| Hazard refers to a source of potential harm or danger | Risk refers to the possibility that harm or injury might occur when exposed to a hazard |
| Different elements such as chemicals, excessive noise, fumes, electricity, etc. act as hazards in a workplace | Risk is the possibility of getting harmed after being exposed to chemicals, noise, fumes, etc. |
| May remain the same even if the risk is minimised | It is important to identify the hazard, the potential harm it can cause in order to eliminate risk |

# RISK MATRIX

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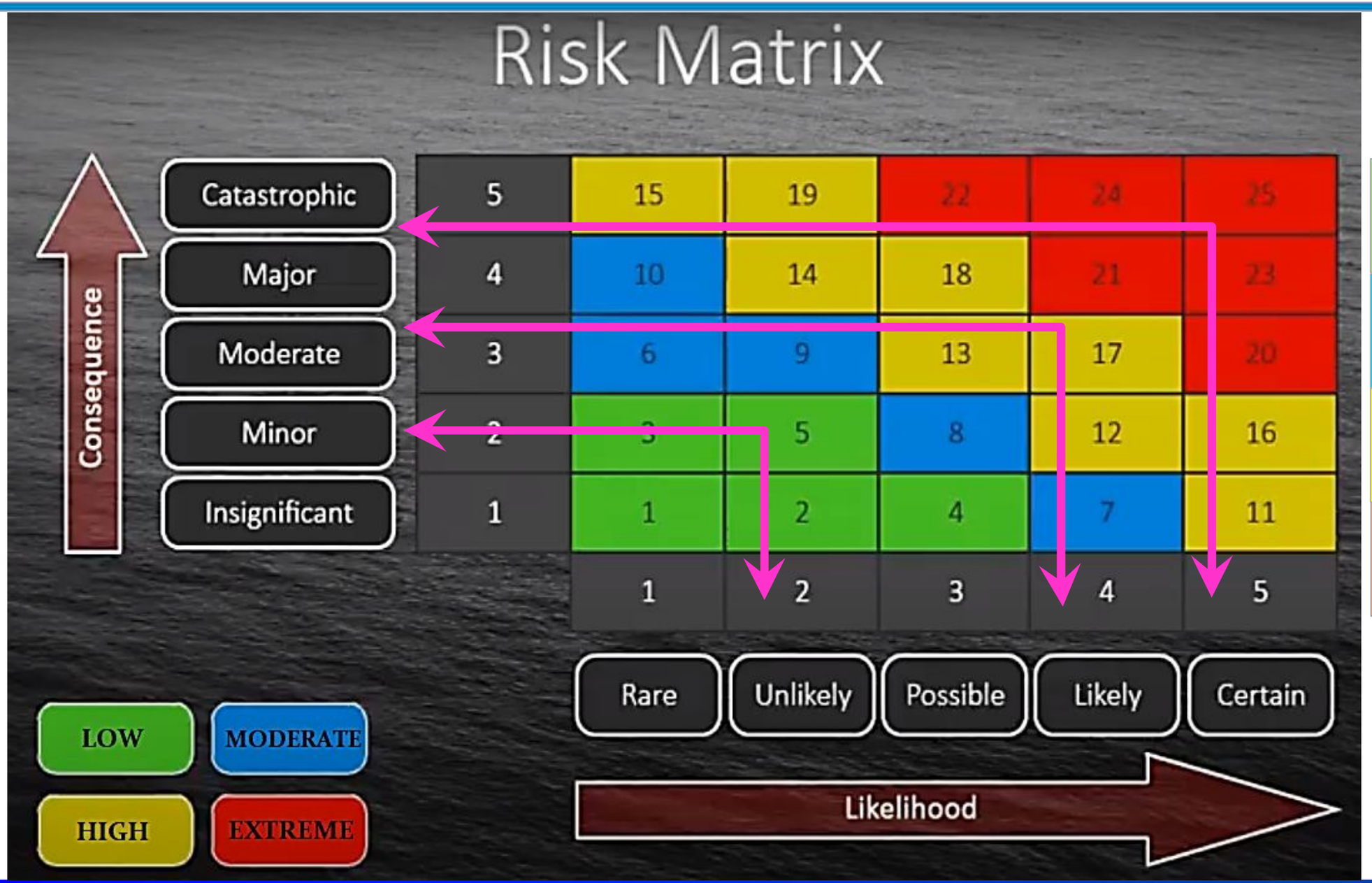


| | |
|---|---|
| LOW | 1 - 5 |
| MODERATE | 6 - 10 |
| HIGH | 11-19 |
| EXTREME | 20 - 25 |

# Basics of Industrial Safety - Definitions

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## • Accident

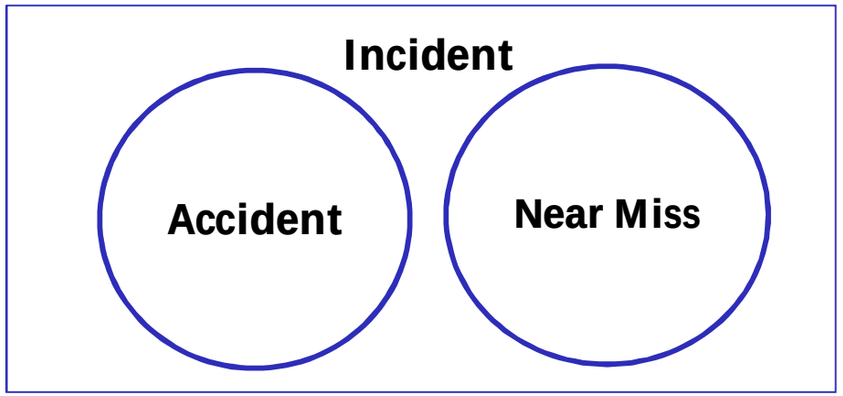
- **Dictionary**
- An unfortunate incident that happens unexpectedly and unintentionally, typically resulting in damage or injury.

- **As per OHSAS18001:1999**
- An incident where injury or ill health occurs is accident.


## • Incident

- **Dictionary**
- An instance of something happening; an event or occurrence.
- A violent event, such as a fracas or assault.

- **As per ISO 45001:2018**
- Occurrence arising out of or in the course of, work that could or does result in injury or ill health.



# Basics of Industrial Safety - Definitions

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## Near Miss

- An incident where **no injury occurred**. Often, the only difference between a Near Miss and a Serious Injury is sheer luck.

## Safety

- The quality or condition of being safe; **freedom from danger**, injury, or damage; security.
- Safety is the condition of being **protected against failure, damage, error**, accidents, or harm.

  Protection involves here both causing and exposure.
- **Freedom from those conditions** which can cause injury or death to personnel, damage to or loss of equipment or property.
- Freedom from **unacceptable risk or harm.**


# Unsafe Act

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The unsafe act is the **behavior or activity** of a person that deviates from normal / correct / accepted procedure.

- Ignoring Safety Rules
- Lack of / Improper use of PPE
- Operating Equipment without Qualification
- Bypass or Removal of safety devices
- Using Defective Equipment
- Usage of Tools other than it's intended purpose
- Playing at work area
- Standing in An Unsafe Position

# Unsafe Condition

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It is the **deviation from normal accepted condition.**

- Defective tools, equipment and machinery
- Congestion in the workplace
- No machine guards or Inadequate guards
- Defective / Improper Electrical Wirings
- Inadequate Safety Device / Warning Systems
- Poor House-Keeping
- Hazardous Atmospheric Condition
- Excessive noise

# Leading a Positive Safety Culture

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**Imagine a place where**

- Hazards are known, controlled & educated
- Employees understand policies & requirements
- Incidents are investigated & CAPA closed in a timely manner
- Health & Safety is a factor in all decision-making
- Employees are engaged and involved
- Risks are assessed and controlled
- Employees experience retribution-free incident reporting
- Job tasks are known & risks/hazards are identified
- Employees are well trained on the hazards of their job tasks
- Contractors are held to the same Health & Safety values

And ……

# Value Vs Priority

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You all think that Safety is a Priority.... **Is it Right?** Answer is **"NO"**

**Safety** is a **Value,** not a **Priority**

**Why Because???**

**Priorities** changes daily, **Values** do not.

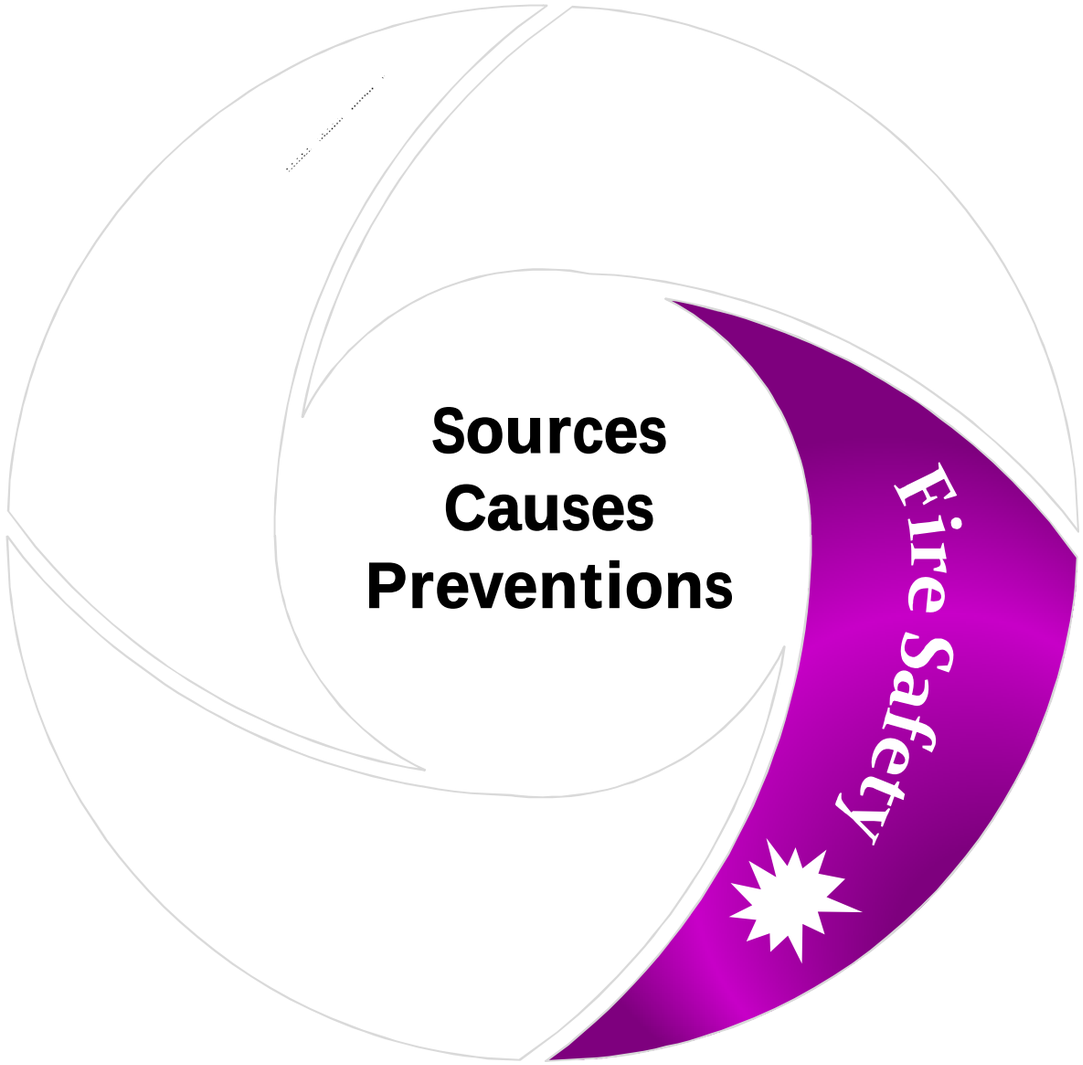
*Attach the value to each priority*: Safe Production, Safe completion of tasks, etc.

For Example: If you are running late for work,

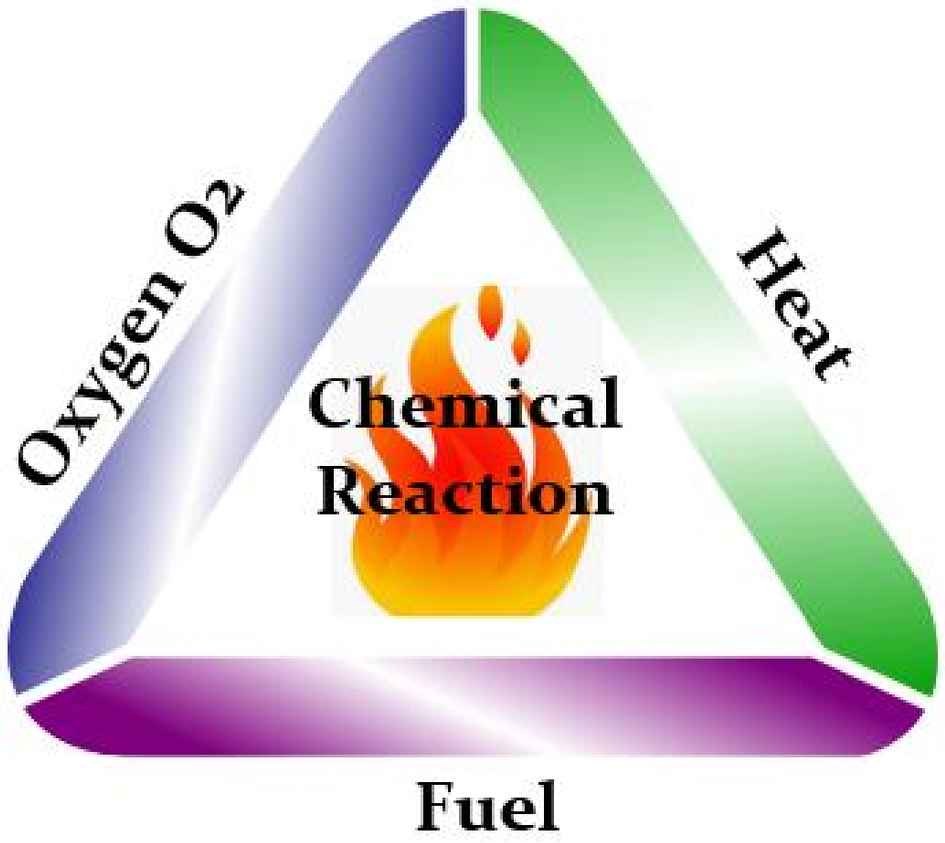
you may skip the cup of coffee....

but you are less likely to skip brushing your teeth, showering, or getting dressed.

**Coffee is a Priority, while good hygiene is a Value.**

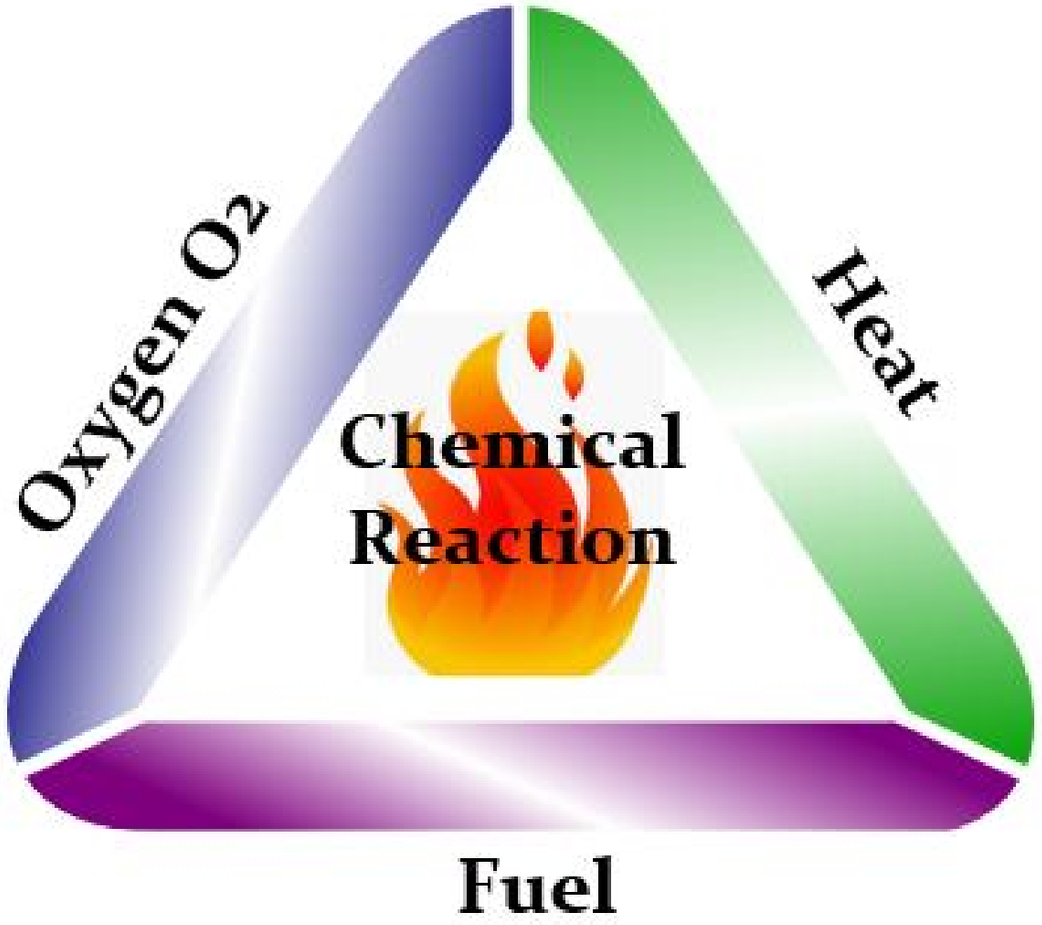

Sources
Causes
Preventions
Fire Safety

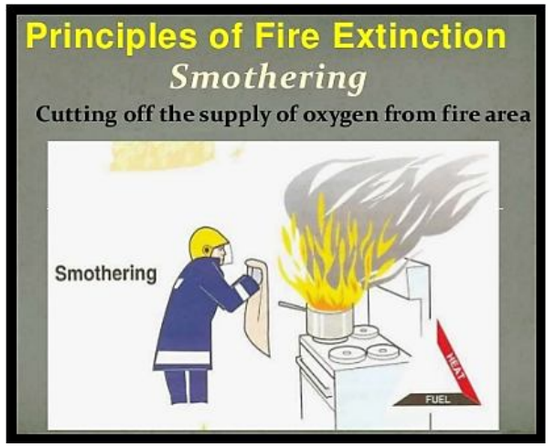
# Fire Triangle



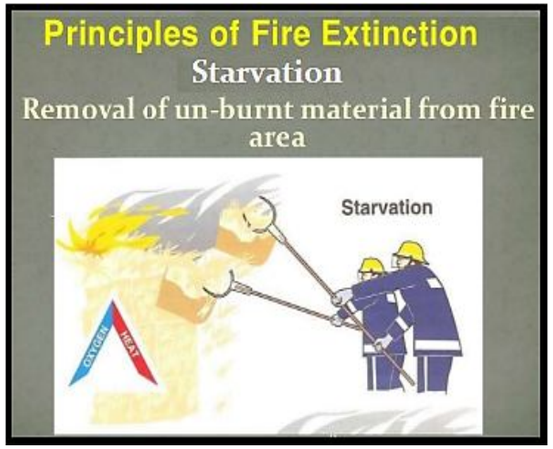

# Stages of Fire

# Principles of Fire Extinction







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# Types of Fire

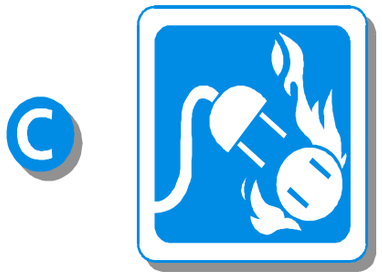
## A Trash Wood Paper


- wood
- paper
- cloth etc.

## B Liquids Grease

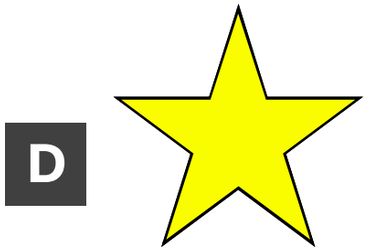

- gasoline
- oil
- grease
- other solvents

## C Electrical Equipment




- computers
- fax machine
- other energized electrical equip.
- Gases

## COMBUSTIBLE METALS




- magnesium
- sodium
- potassium
- titanium
- other flammable metals

## CLASS K FIRES

- Recently recognized by NFPA
- Fires involving combustible oils, lards & fats in commercial cooking.

# KNOWING FIRE EXTINGUISHER

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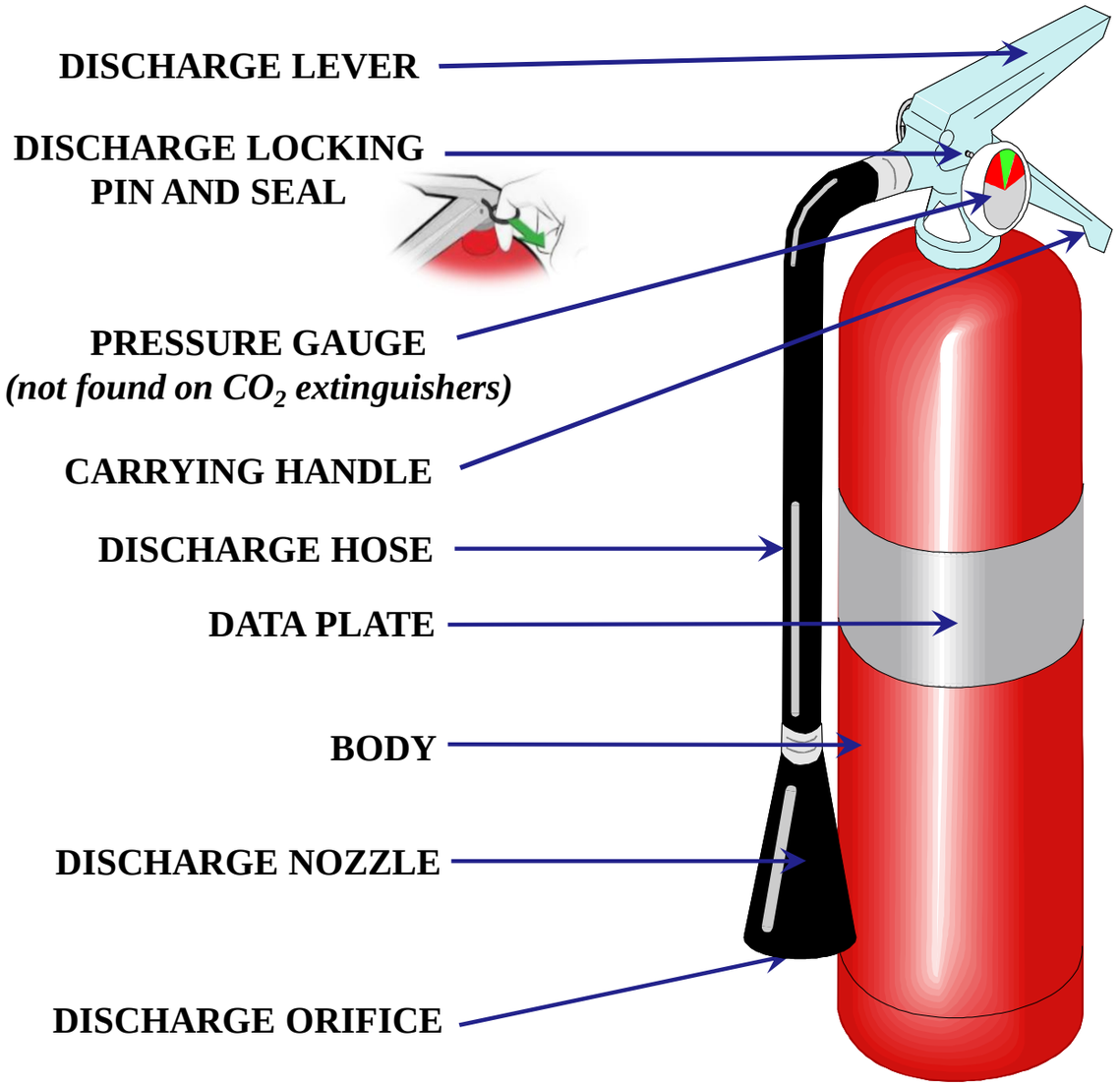


## FIGHTING THE FIRE

**P** — ***Pull the pin***

**A** — ***Aim low at the base of flames***

**S** — ***Squeeze the handle***

**S** — ***Sweep side to side***

# FIRE EXTINGUISHERS

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## Water Extinguisher


- They are used for **Class A fires**
- **Water removes heat** and extinguish the fire.
- Water **must not** be used on fires involving **live electrical equipment** as it can cause electrocution.
- Water **must not** be used on metal fires.

## CO2 Extinguisher


- CO2 extinguishers are mainly used for **Class B and C fires**.
- CO2 extinguish the fire by **displacing oxygen** in the surrounding air.
- CO2 is **not** suitable for fires **involving metals**.
- It's principal advantage is that it **does not leave any residue**.
- Can be used on **electrical/electronic equipment**

# FIRE EXTINGUISHERS

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## Foam Type Extinguisher

- The extinguishing agent is **aqueous film forming concentrate** in water which forms air foams when discharged through an aspirating nozzle.
- It has a **blanketing effect** excluding oxygen from the surface of the fuel as it spreads on the fuel.
- Prevents vapour formation from the surface of the burning liquid.
- Foam extinguishers must not be used on electrical and metal fires.


## Dry Chemical Powder Extinguisher

- The main base chemicals used in DCP extinguishers are **sodium bicarbonate** and **potassium bicarbonate**.
- DCP extinguishers puts out fire by **coating the fuel surface with chemical powder**.
- This separates the **fuel from the oxygen in the air** and prevent vapour formation.
- The powder also **interrupts the chemical chain reaction** of.
- The disadvantage is that it leaves residue particularly making **it difficult to clean up in case of sensitive equipment.**

# FIRE SAFETY

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## FIRE EXTINGUISHER CHART

| Extinguisher Type | | Type of Fire: Solids (Wood, Paper, Cloth, Etc.) | Flammable Liquids | Flammable Gases | Electrical Equipment |
|---|---|---|---|---|---|
|  | Water 'A Type' | ✓ YES | ✗ NO | ✗ NO | ✗ NO |
|  | Foam 'AB Type' | ✓ YES | ✓ YES | ✗ NO | ✗ NO |
|  | Dry Chemical Powder (DCP) 'BC Type' | ✗ NO | ✓ YES | ✓ YES | ✓ YES |
|  | Carbon Dioxide ( $Co_2$ ) 'BC Type' | ✗ NO | ✓ YES | ✓ YES | ✓ YES |

- The extinguisher shall be **easily accessible**.
- The extinguisher shall be in **good working order**.
- The extinguisher must be of **right type for the fire**.
- The fire must be discovered **in its incipient stage** for the effective extinguishment of fire.

## Fire Fighting Arrangements



SINGLE HEADED

# HAZARD CONTROL HIERARCHY

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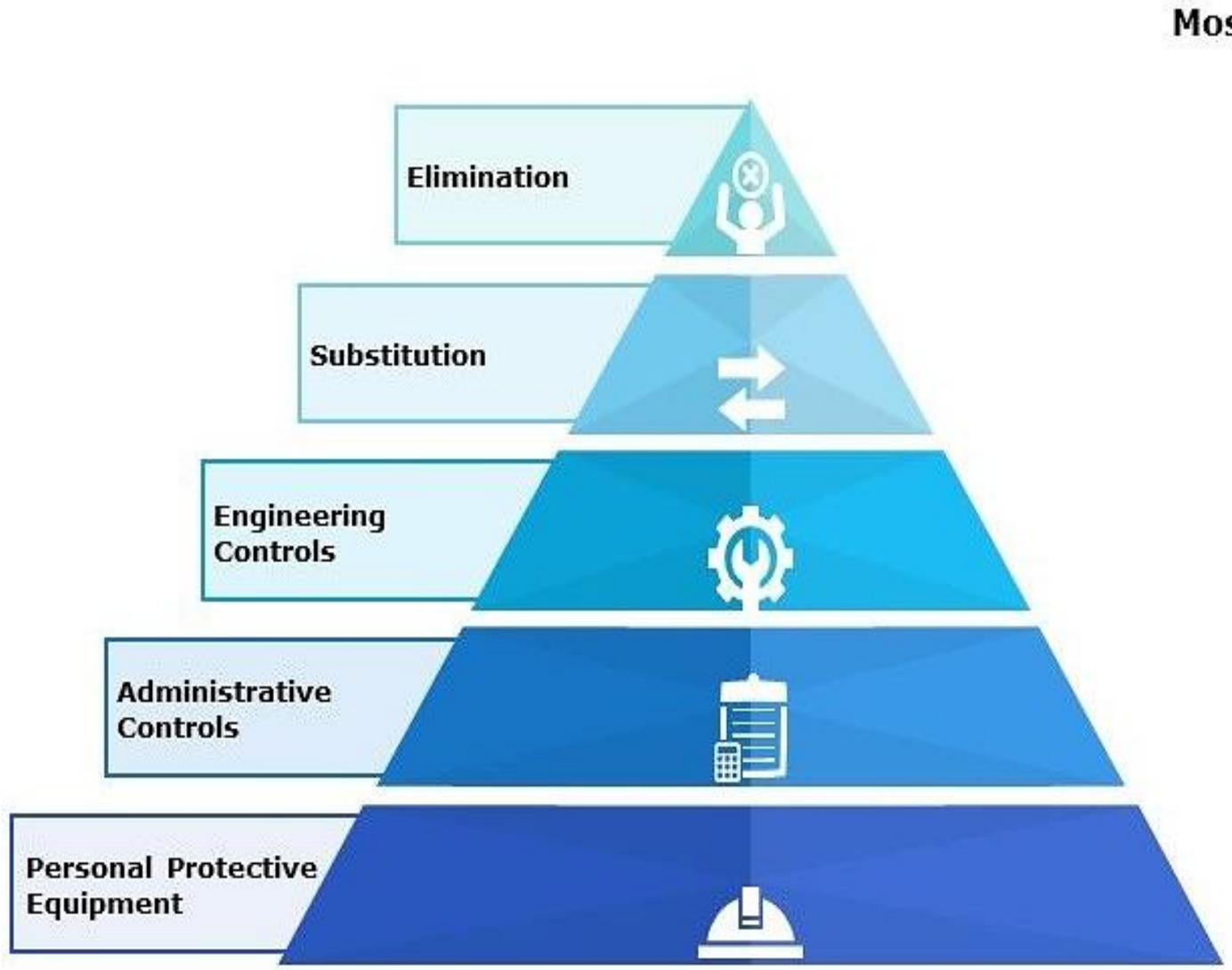



Most Effective

Least Effective

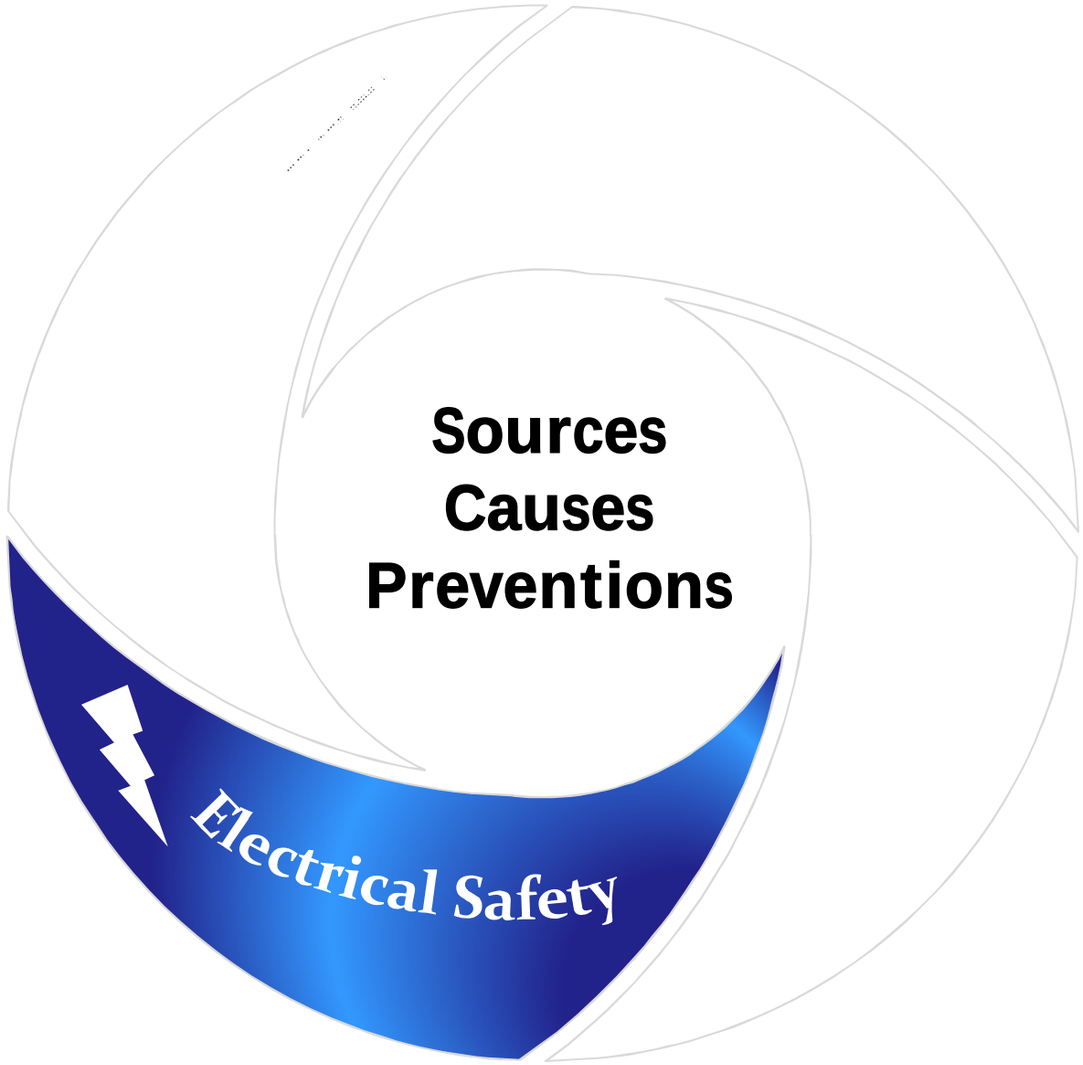
**Elimination**
Remove the hazard from the workplace, whenever possible.

**Substitution**
Substitute hazardous materials or machines with less hazardous ones.

**Engineering Controls**
Design or modify facilities, equipment, systems and processes to reduce the source of exposure.

**Administrative Controls**
Limit exposures by altering the way the work is done.

**Personal Protective Equipment (PPE)**
Use PPE as a last level of protection to reduce exposures to hazards such as chemical contact or noise.


Sources
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Electrical Safety

# ENERGY HAZARDS

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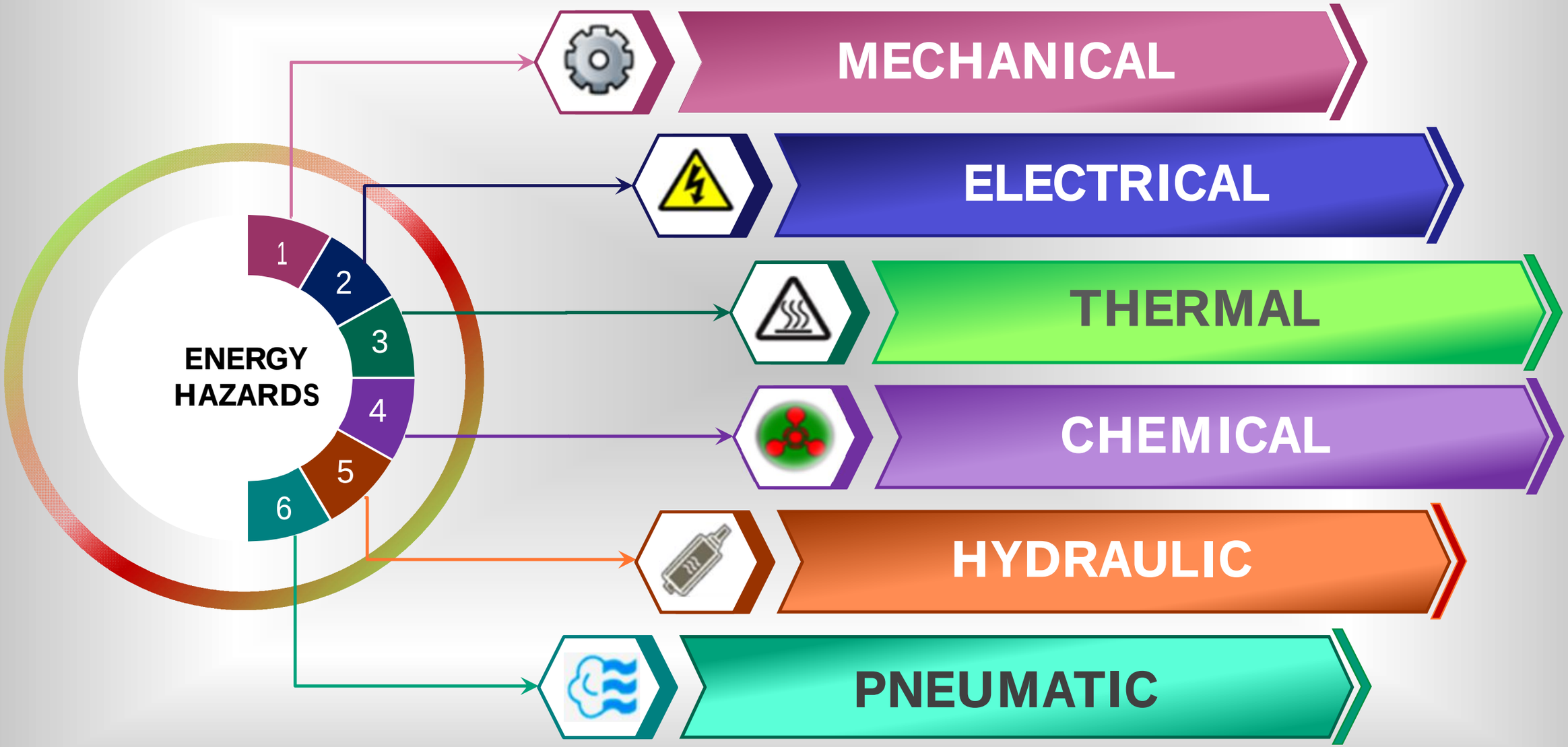
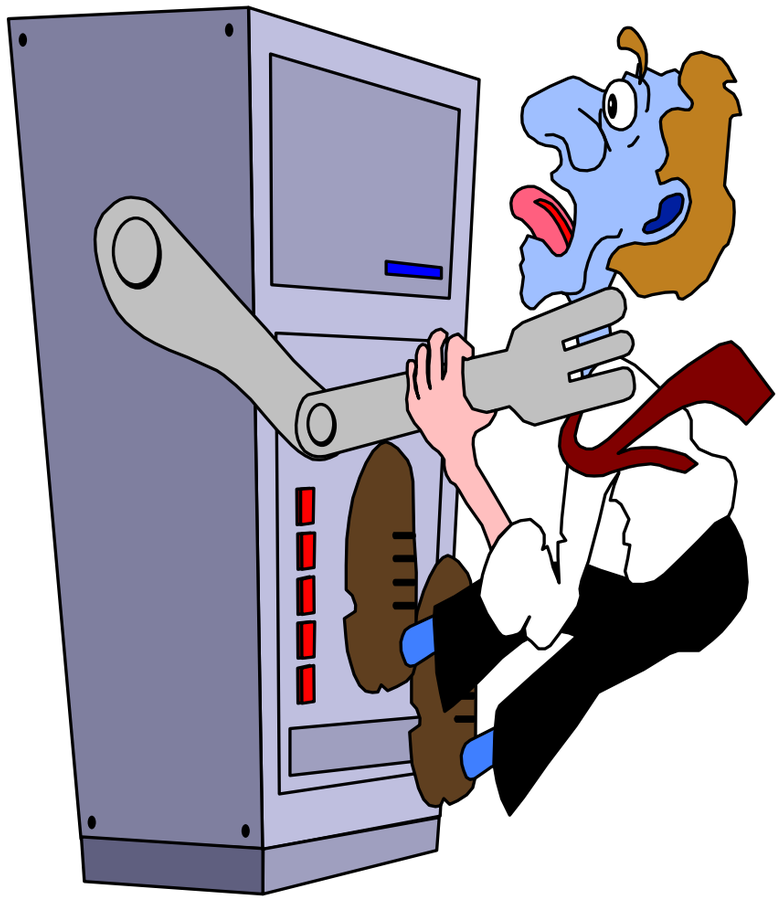
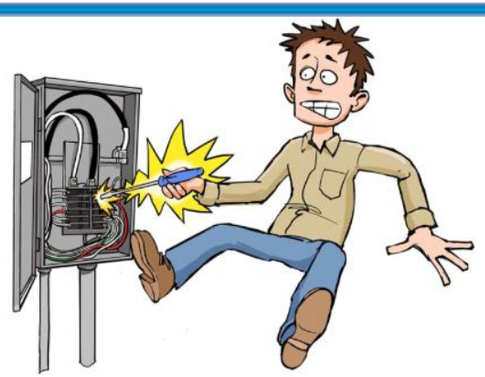


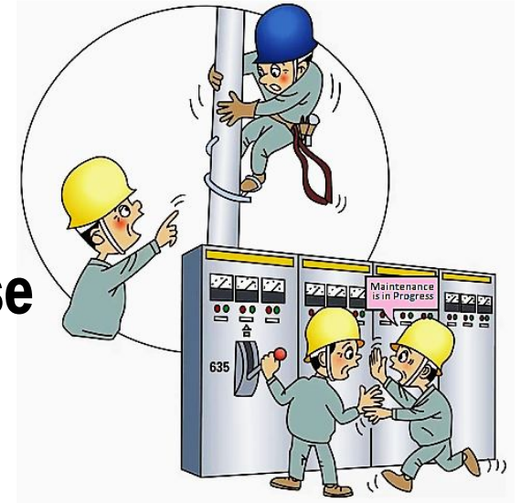
# Injury Statistics

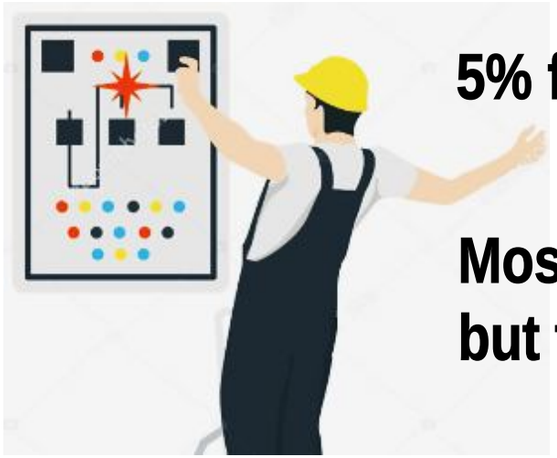




80% failed to turn off equipment

10% equipment activated by someone else



5% failed to control potential energy.

Most of remaining 5% disconnected power but failed to verify effectiveness

# Main Causes for Injuries

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- Failure to **Stop** equipment before servicing
- Failure to **Disconnect** equipment from power source
- Failure to **Dissipate** (bleed, neutralize) residual energy
- Accidental **Restarting** of equipment
- Accidental **Short Circuit** of Equipment and Batteries.
- Failure to **Clear Work Areas** before restarting

# General Energy Control Procedures

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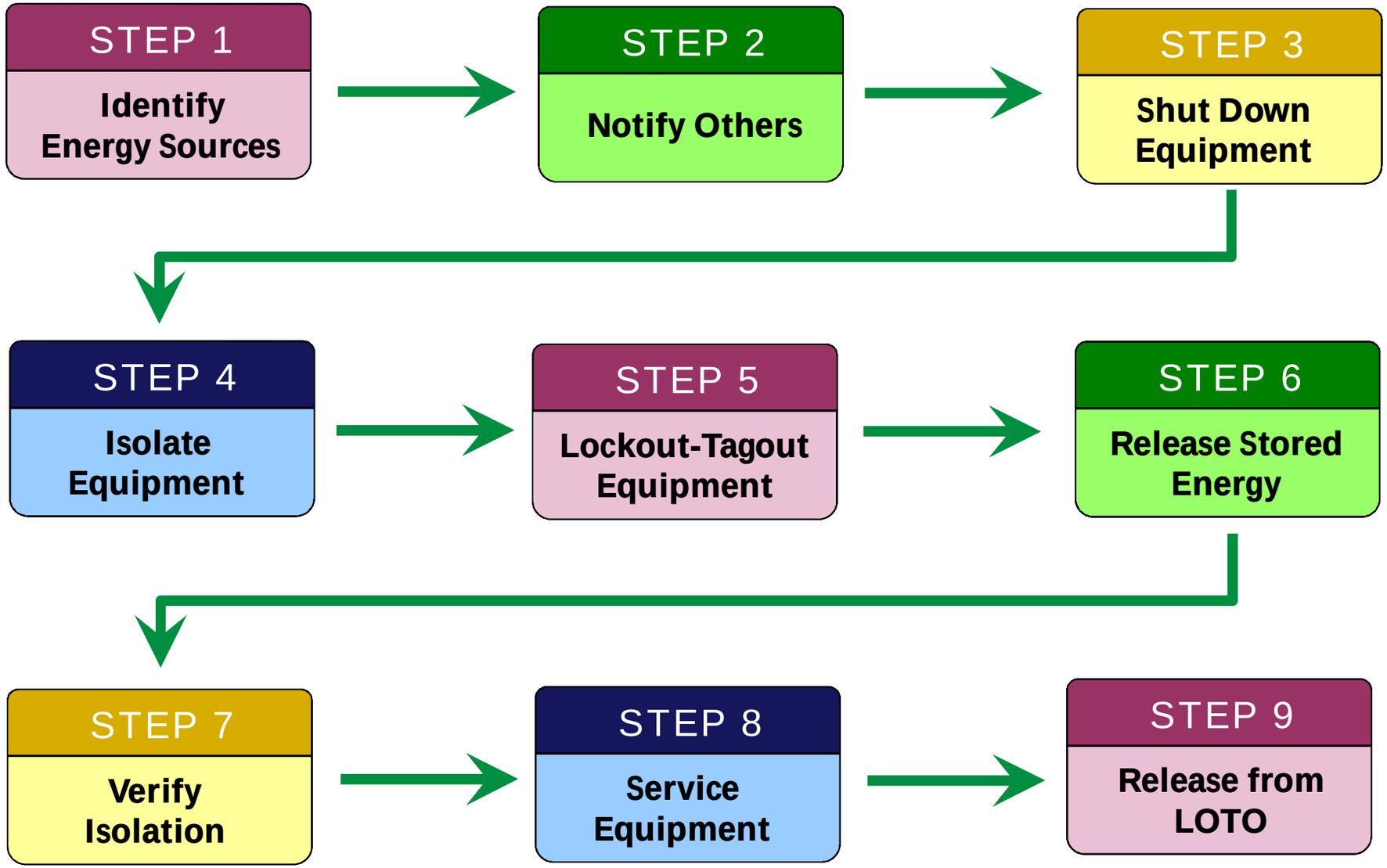

# Types of Electrical Injuries

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- Electricity is invisible – this itself makes it dangerous
- Everyone is exposed to electrical hazards, not just electricians
- Report all electrical shocks and near misses

**Direct** - Electrocution, Electrical shock, Burns

**Indirect** - Falls

## Hand Injuries

## Leg Injuries

## Injuries - Wearing Metals

# Level of Effects on Human Body - Electrical Shocks

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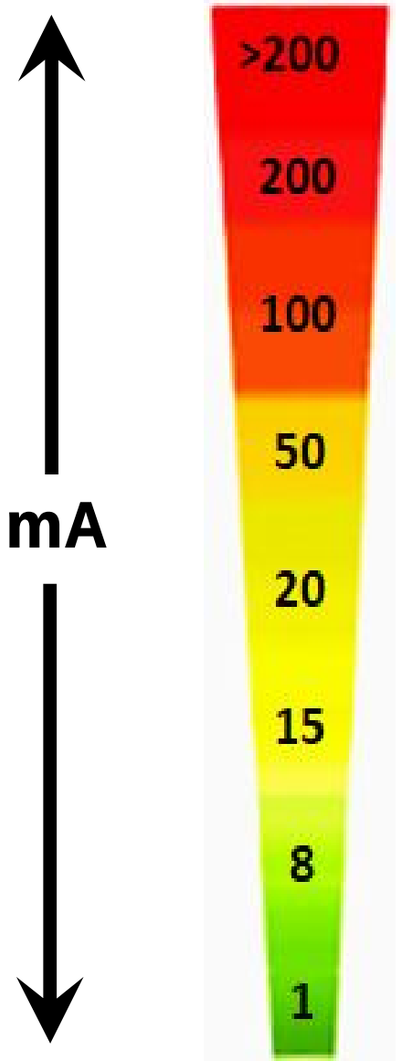


| Hazard Level | Milli-ampere | Effects on Human Body |
|---|---|---|
| SAFE | Less than 1 | No Sensation, Not Felt |
| | 1 - 8 | Shock Sensation; Not Painful |
| UNSAFE | 8 - 15 | Painful Shock |
| | 15 - 20 | Painful Shock; Loss of adjacent muscle control. |
| | 20 - 50 | Painful, severe muscular contractions; difficulty in breathing. Can become paralyzed. |
| | 50 - 100 | Possible Ventricular fibrillation |
| | 100 - 200 | Certain Ventricular fibrillation |
| | More than 200 | Severe burns on organs; severe muscular contractions; chest muscles clamp heart and stop it for the duration of shock. |

# Level of Effects on Human Body - Electrical Shocks

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## Effects of Electricity on the Human Body :

## Electrical Shocks

- The longer the exposure, the increased danger of shock to the victim.
- Low voltage can be extremely dangerous because the degree of injury depends not only on the current, but also on the length of time in contact with the circuit.
  - Example:
    - A current of 100mA applied for 3 seconds is as dangerous as 900mA applied for 0.03 seconds.
- Low Voltage does not mean Low Hazard.
- High Voltages lead to additional injuries such as:
  - Violent muscular contractions
    - Muscle contractions may cause bone fractures from either contractions themselves or from falls.
  - Internal bleeding, destruction of tissues, nerves and muscles.

# Level of Effects on Human Body - Electrical Shocks

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## Effects of Electricity on the Human Body : Burns, Arc Blasts and Electrocution

### Burns

- Electrical burns occur when a person touches electrical wiring or equipment that is used or maintained improperly.
- Typically such burns occur on the hands.
- Clothing may catch on fire and a thermal burn may result for the heat of the fire.

### Arc Blasts

- An arc-blast is a luminous electrical discharge that occurs when high voltages exist across a gap between conductors and current travels through the air.
- Temperature as high as 35,000 F have been reached in arc-blasts.

### Electrocution

- Making contact with Overhead wires.
- Undertaking maintenance on live equipment.
- Working with damaged electrical equipment, such as extension leads, plugs and sockets.
- Using equipment affected by rain or water ingress.

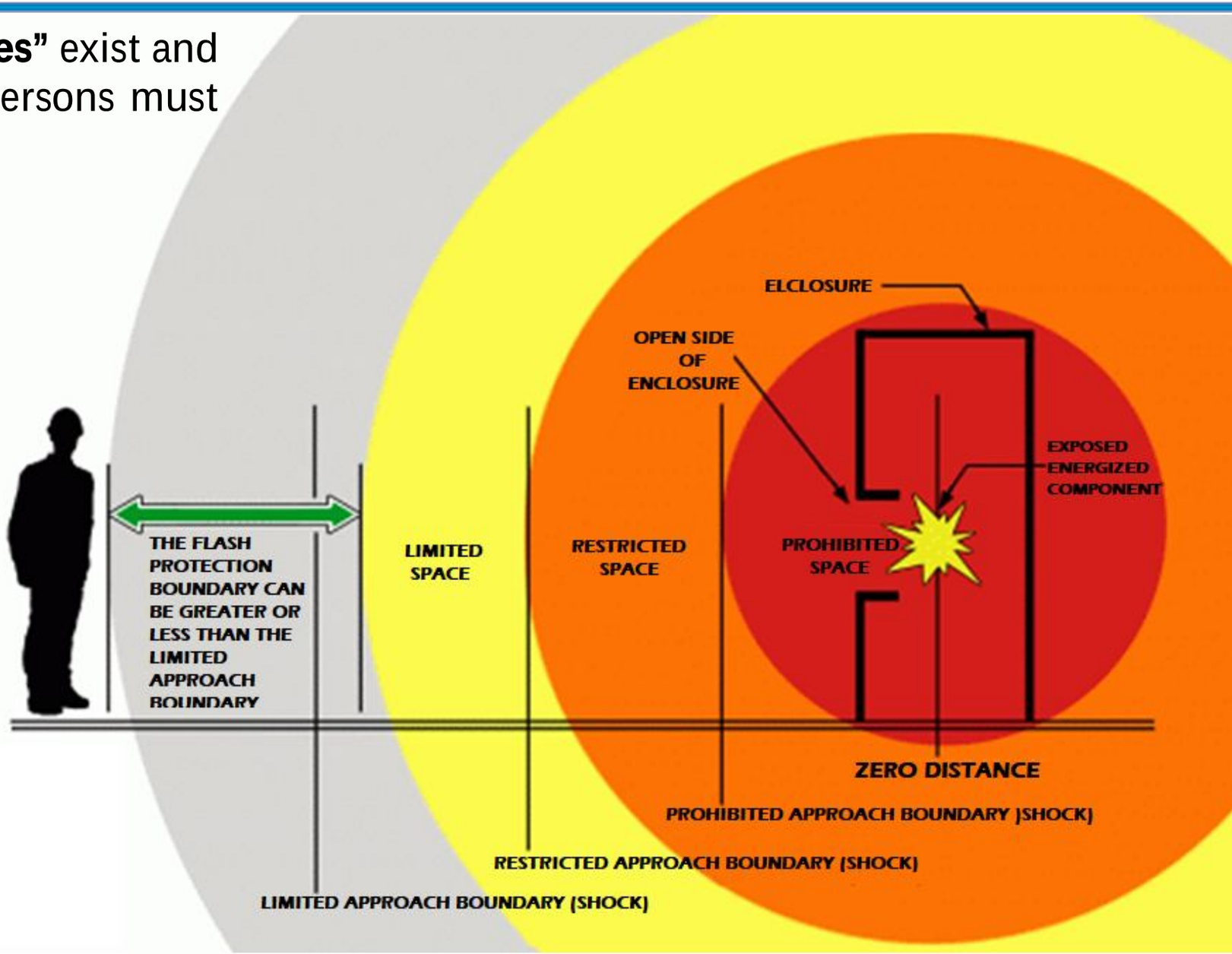
# Electrical Shock Boundaries

- A number of **“approach boundaries”** exist and both qualified and non-qualified persons must understand these definitions.

- **Flash Protection Boundary** (outer boundary):
  The flash boundary is the farthest established boundary from the energy source. If an arc flash occurred, this boundary is where an employee would be exposed to a curable second degree burn (1.2 calories/cm$^2$)

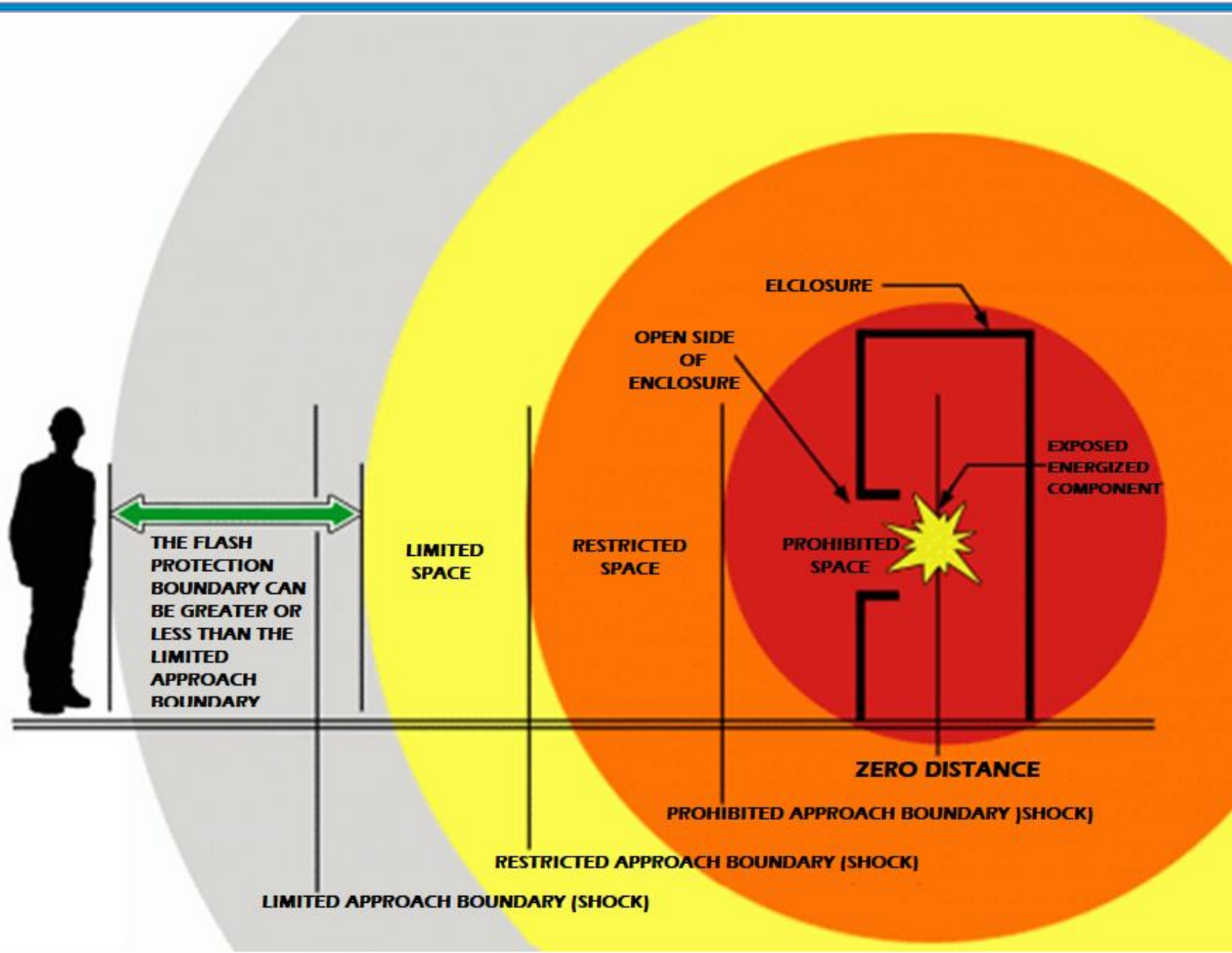
- **Limited Space:**

  An approach limit at a distance from an exposed live part where a shock hazard exists.



# Electrical Shock Boundaries

- **Restricted Space:**
  An approach limit at a distance from an exposed live part which there is an increased risk of shock.
- **Prohibited Space** (inner boundary):
  A distance from an exposed part which is considered the same as making contact with the live part.



# Electrical Hazards Protection

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- *Insulation*
- *Grounding*
- *Guarding*
- *Electrical Protective Devices*
- *Personal Protective Equipments*
- *Safe Work Practices*

# Electrical Hazards Protection

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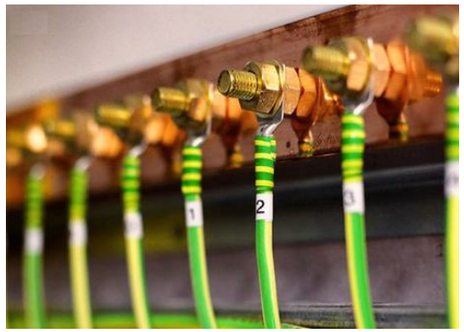
## Insulation

- Plastic or Rubber coverings that does not conduct electricity.
- Insulation prevents live wires from coming in contact with people thus protecting them from electrical shock.

## Grounding



- Grounding is another method of protecting you from electric shock.
- The "ground" refers to a conductive body, usually the earth, and means a conductive connection, whether intentional or accidental, by which an electric circuit or equipment is connected to earth or the ground plane.
- By "grounding" a tool or electrical system, a low-resistance path to the earth is intentionally created.

## Guarding

- A type of isolation that uses various structures to close off live electrical parts.
- These structures include:
  - Boxes
  - Screens
  - Covers
  - Partitions

# Electrical Hazards Protection

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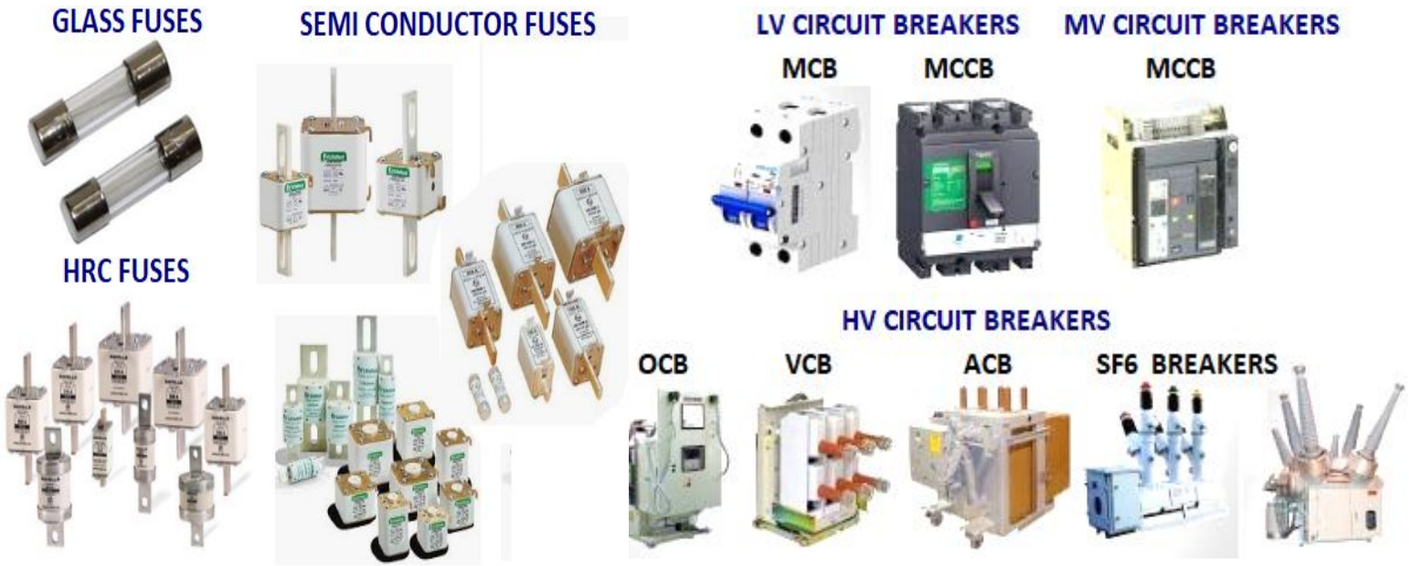
## Ground Fault Circuit Interrupter

- Detects the difference in current between two circuit wires.
- The difference in current could happen when electrical equipment isn't working correctly.
- GFCI are set at about 5mA and are designed to protect workers and not equipments.

## Fuses and Circuit Breakers




- Fuses and Circuit Breakers are intended primarily for the protection of conductors and equipments.
- They prevent over-heating of wires and components which may cause hazards to operators.
- They also open the circuit under certain hazardous ground-fault conditions.

# What is Personal Protective Equipment?

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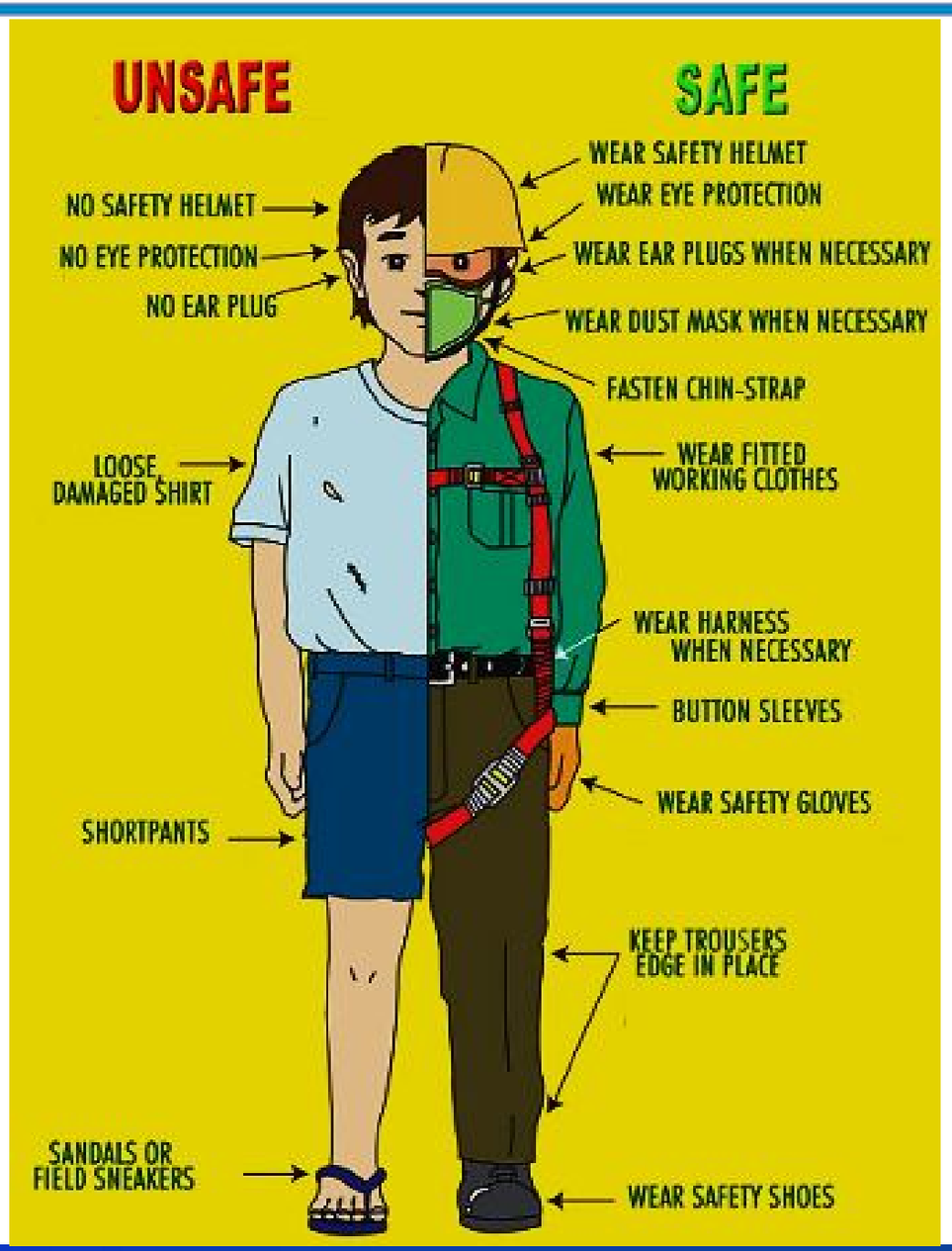
**“Specialized clothing or equipment worn by workers for protection against health and safety hazards”**

- Personal protective equipment, or PPE is designed to protect workers from hazardous workplace resulting from contact with chemical, radiological, physical, electrical, mechanical, or other hazards.

- Electrical PPE with any of the following defects may not be used.
  - If holes, tears, punctures, or cuts are present.
  - Texture changes: Swelling, Softening, Hardening, or becoming sticky or inelastic.
  - An embedded foreign object.
  - Any other defect that damages the insulating properties.



# Personal Protective Equipment?

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01

## HEAD PROTECTION

02

## EYE PROTECTION

03

## EAR PROTECTION

04

## HAND PROTECTION

05

## FOOT PROTECTION

- Apart from above PPEs, Safety Aprons and Respiratory Protection is also must to ensure complete Safety
- Reflective Jackets also necessary when working in a Construction / Industrial Site
- Use Green / Fluorescent Colour Jackets for Engineers and Orange / Saffron for Labours
- Use White Coloured Helmets for Engineers and Blue Colour Helmets for Electricians and Labours

# Electrical Hazards Protection

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## Work Practices

- Employees and others working with electric equipment need to use safe work practices.
  - Analyse and keep ready the appropriate PPEs during planning / starting the work
  - Plan your work by yourself and with others.
    - Allows you to co-ordinate your work and take advantage of what others know about identifying and controlling hazards.
  - Lock out and Tag out circuits and equipment.
    - Shut off the circuit.
    - Lock and Tag out the circuit at the distribution panel.
    - Test the circuit to make sure it's de-energized.
  - Do not work in wet conditions.
  - Avoid overhead power lines.
  - Use proper wiring and connectors.
    - Avoid overloading circuits.
    - Make sure switches and insulation are in good condition.
    - Never use a three prong plug with the third prong broken off.

## ON USAGE

## ON AVOIDANCE

**Protects** — **P** — **Punishes**

**Personnel** — **P** — **Post**

**Effectively** — **E** — **Elimination**

# Electro Static Discharge

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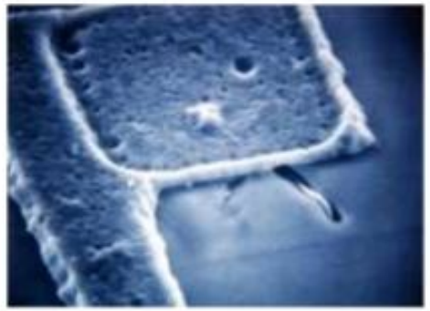
## Electrostatic Discharge



# ESD Basics and Protection

# Electro Static Discharge

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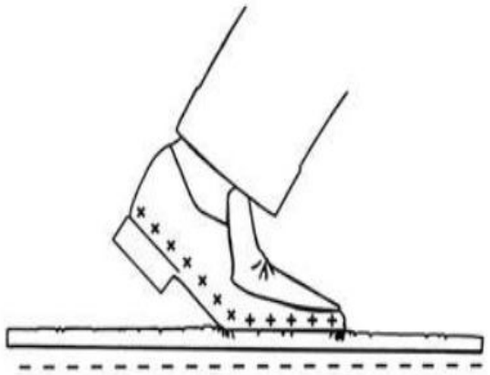
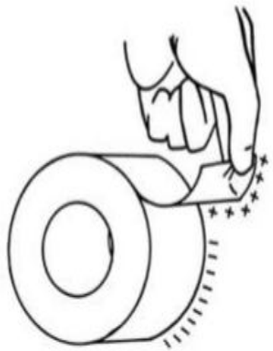
## What is ESD ?

**ESD – Electrostatic Discharge:** The transfer of an electrostatic charge between bodies at different electrical potentials.

- Also referred to as static electricity
- **Electrostatic charge is most commonly created by the contact and separation of two materials which results in Tribocharging**





There are innumerable ESD events occurring all the time that we cannot see or feel.

**People Feel ESD** at **2000 Volts**!!!!

**Component damage** - can occur with as little as **15 – 30 Volts**!!!!

**Examples of Static Generation**
**Typical Voltage Levels**

| Means of Generation | 10-25% RH | 65-90% RH |
|---|---|---|
| Walking across carpet | 35,000V | 1,500V |
| Walking across vinyl tile | 12,000V | 250V |
| Worker at bench | 6,000V | 100V |
| Poly bag picked up from bench | 20,000V | 1,200V |
| Chair with urethane foam | 18,000V | 1,500V |

# Electro Static Discharge

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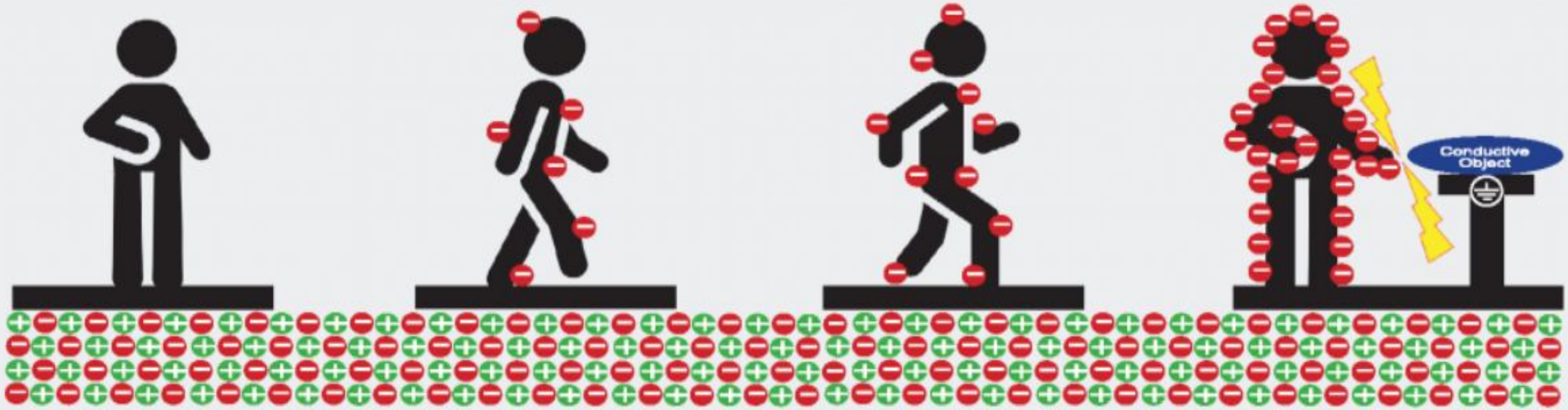
## How A Person Walking Across A Non-ESD Floor Can Cause an ESD "Spark"




With the person at rest, and not currently carrying a charge, the charge is equalized between the person and floor.

With each step taken, the separation of floor and footwear cause negative charges to be taken away or given to the mass of the person, creating an electrical imbalance (charge).

The charge is maintained on the person or will increase as person continues to walk on the non-esd grounded floor.

If the person comes in close proximity of a conductor or grounded object, a Human Body Model (HBM) event may occur.

# Electro Static Discharge

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## Typed of Materials that Charge

### Conductors

- Materials that easily transfer electric charge
- **Can be used to transfer charge to earths ground**
- **Examples**
  - **Metals**
  - **Water**
  - **Carbon**
  - **People**

### Insulators

- Materials that hold an electric charge and can not easily transfer the charge
- **Can not be grounded to earth by common means**
- **Examples**
  - **Plastics**
  - **Glass**
  - **Dry Air**

## Sources of ESD

**The following items are examples of materials that generate and hold electrostatic charge.**

- Vinyl binders
- Equipment covers
- Plastic document holders/sheet protectors
- Post-It™ notes
- Plastic pens
- Bubble wrap
- Plastic housings on equipment
- Paper, schematics, etc.
- Plastic work travelers
- Plastic spray bottles
- Personal items
  - –Purses
  - –Sweaters/jackets
  - –Insulated lunch totes
  - –Combs/brushes
  - –Lotion bottles

# Electro Static Discharge

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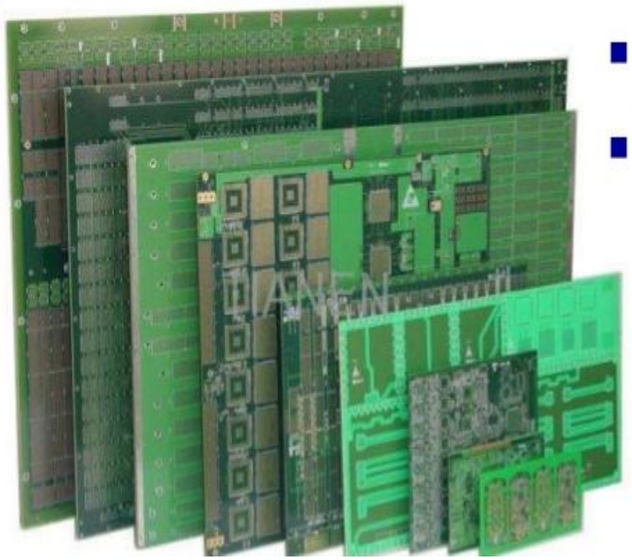
## What type of Materials are ESD Sensitive?

**ESDS – Electrostatic Discharge Sensitive**

Integrated Circuits

- Crystals and oscillators
- Printed Circuit Board Assemblies
- When in doubt, treat it as ESDS!




## Common Causes of ESD

- Opening a common plastic bag
- Removing adhesive tape from a roll or container
- Walking across a floor and grabbing the door knob
- Transporting computer boards or components around in their trays on non- ESD carts
- Sliding circuit boards on a work bench

# Electro Static Discharge

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## Types of ESD Damage

### CATASTROPHIC FAILURE

- A device is exposed to ESD and it no longer works
- The device circuitry is permanently damaged
- Such failures may be caught when tested, before shipment

### LATENT FAILURE

- A device is exposed to ESD and is partially damaged, yet it continues to work
- The product may have a failure after the user places it in service

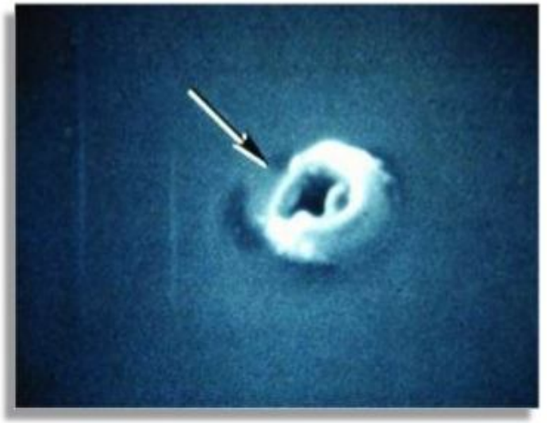
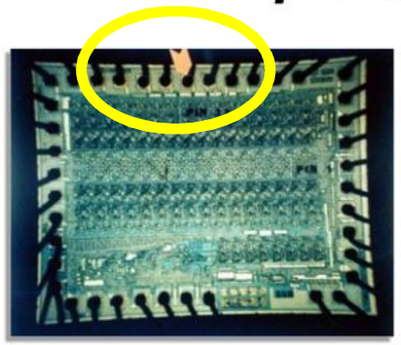
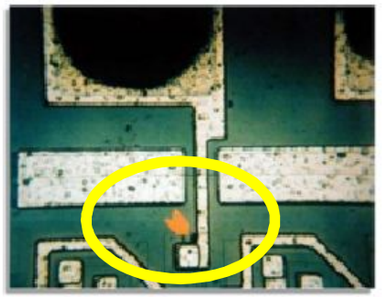


Image of the ESD damage after removal of the capacitor metallization.

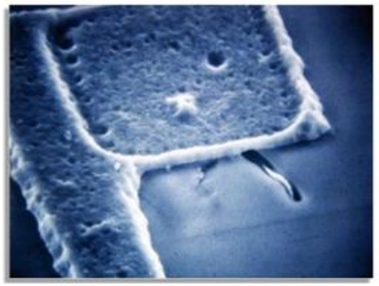
## Example of ESD Damage



- Optical photo of a large Integrated Circuit which has experienced ESD damage to the pin noted by the arrow.



- Higher magnification photo of pin noted by the arrow in the prior slide. This taken at 400 times magnification on a 4" X 5" photo. The damage is noted as the "fuzz" at the end of the arrow.



- Overlying glassivation has been removed & the surface decorated to show the ESD damage at 5,000 times magnification in scanning electron micrograph.

# Electro Static Discharge

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## *Why is ESD Important?*

**Electrostatic Discharge (ESD) can damage sensitive electronic devices, resulting in:**

- Higher manufacturing costs
  - Rework
  - Repair
  - Scrap
- Lower production yields
- Unhappy customers
  - Shorter product life
  - Reduce product reliability

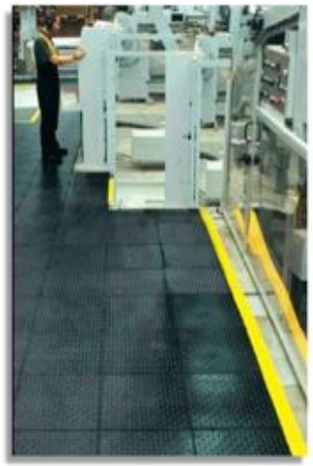
## How to Control ESD ?

***Apart from Training...***

### *Create an ESD Control Area*

- Any area where unprotected ESDS parts and assemblies may be handled
- **ESD areas must be labeled with posted signs and their boundaries marked**

## ESD Control Program Cont.



### All Conductors within the EPA must be grounded

- Personal Grounding: All personnel, including visitors
- Work surfaces and flooring

## Personal Grounding

### Wrist Straps & Coil Cords

- Wrist Straps ground personnel at workstations

### Heel Grounders

- Ground mobile personnel in areas where there are ESD floors

### Smocks

- Smock sleeves should be in contact with the skin, clothing underneath should not show

# Electro Static Discharge

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## Personal Grounding

**All Personal Grounding Equipment Should be Tested or Monitored Daily**

- Wrist Strap and Footwear Testing Stations
- ESD ground monitoring
  - **Constant**
  - **Impedance**

OHM Metrics and Monroe Electronics
Test and Measurement Products

CM Series
ESD Workstation Monitors

## Equipment Grounding

### Work Stations and Tables

- Must have static dissipative surfaces connected to the building ground source.
- Must have wrist strap ground connections (2 recommended), preferably banana jack receptacles, connected in parallel to the bldg ground source
- Should be cleaned daily with an antistatic cleaner

# Electro Static Discharge

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## Equipment Grounding

### Shelving and Cabinets

- Must provide a grounded surface unless parts remain fully enclosed within shielding-type packaging

### Storage Bins

- All parts bins and containers must be static dissipative or antistatic
- Whenever practical, sensitive parts should remain in original container until assembled

## Ionization

Many times, equipment or objects(insulators) are unable to be grounded in which case air ionizers should be used.

### What is Ionization?

Air Ionizers use a process called "neutralization" to remove static charge from insulators that cannot be grounded.

- Ionizers produce positively and negatively charged ions and floods ESD area with Ions.
- Ions are charged particles that are present in the air, and as opposites attract, charges will be neutralized over time.

***Types of Air Ionizers***

Ionizing Nozzles
Air Guns
Bench Top
Overhead Ionizers

# Electro Static Discharge

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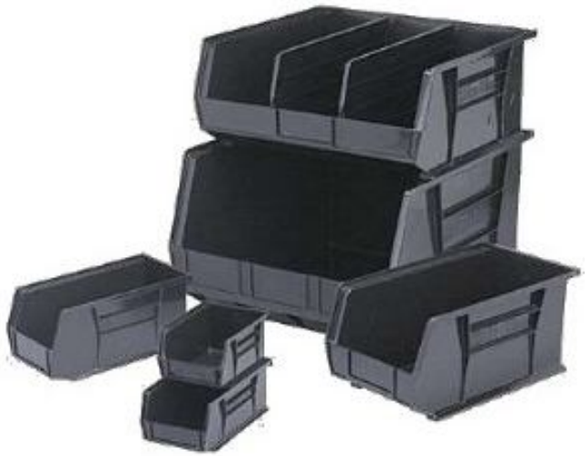
## *ESDS Component Handling and Storage*

**To move ESDS parts or assemblies inside an ESD control area, use one of the following;**

- Static dissipative containers
- Static shielding containers
- Conductive containers or board carriers
- Ground movable racks

Surface Mount Devices
SMD Boxes



# Electro Static Discharge


*ESD Safety*

# HANDLING GAS CYLINDERS

# CHEMIACAL HAZARD - GAS CYLINDERS

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## Introduction

- Certain specific properties of compressed gases make them highly useful in various research activities. These gases, however, can be dangerous if not handled in an appropriate manner. Many of the odourless and colourless gases are highly toxic and flammable and this calls for utmost care while handling them.


## Types of Gases

- Flammable gas burns or explodes if it is mixed with air, oxygen or other oxidant, in the presence of a source of ignition.

  Please note that flammable and inflammable are synonyms & non-inflammable is their antonym.


- Inert gas is resistant to chemical action under normal temperature and pressure conditions.
- Oxidising gas supports combustion.
- Pyrophoric gas spontaneously ignites upon exposure to air.
- Corrosive gas can burn and destroy body tissues on contact. Corrosive gases can also attack and corrode metals.
- Poisonous (Toxic) gas is harmful to humans when it exceeds the maximum allowable concentration in air.

# CHEMIACAL HAZARD - GAS CYLINDERS

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## Frequently Used Gases

- **Inert gases -** Argon, Helium, Neon and Nitrogen
- **Flammable gases -** Hydrogen, Methane, Ethylene, Ethane, Propylene, Acetylene, Isobutylene, LPG and Deuterium
- **Toxic gases -** Carbon monoxide, Sulphur dioxide, Phosgene, Boron trichloride, Germane, Diborane, Chlorine and Ammonia
- **Pyrophoric gases -**Silane and Phosphine
- **Oxidisers -** Oxygen and Nitrous oxide

## Hazards in Gas Cylinder Usage

- Oxygen deficient atmosphere resulting in asphyxiation.
- Formation of flammable gas air mixtures in case of leakage of flammable gas.
- Oxygen enriched atmosphere in case of leakage of oxygen gas.
- Injury caused by fall of gas cylinders during handling.
- Exposure to high concentrations of toxic or corrosive gases in case of leakage.
- Gas cylinders can explode when exposed to high temperatures, e.g., in case of fire.
- If the valve breaks, the sudden release of compressed gas can turn it into a lethal projectile.

# CHEMIACAL HAZARD - GAS CYLINDERS

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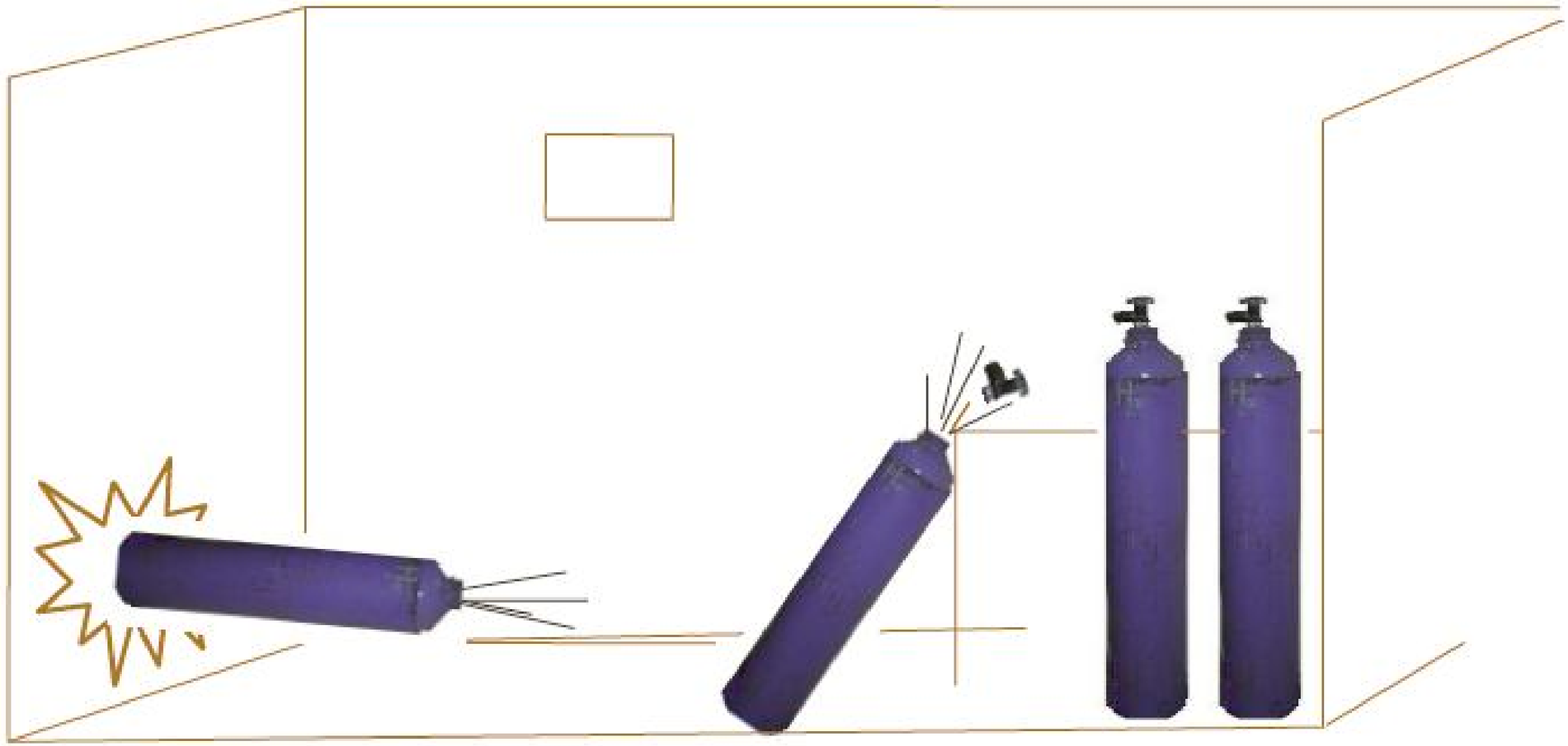
## Breakage of valve can turn the cylinder into a projectile



Gas cylinders should be capped when they are not connected to the system

# CHEMIACAL HAZARD - GAS CYLINDERS

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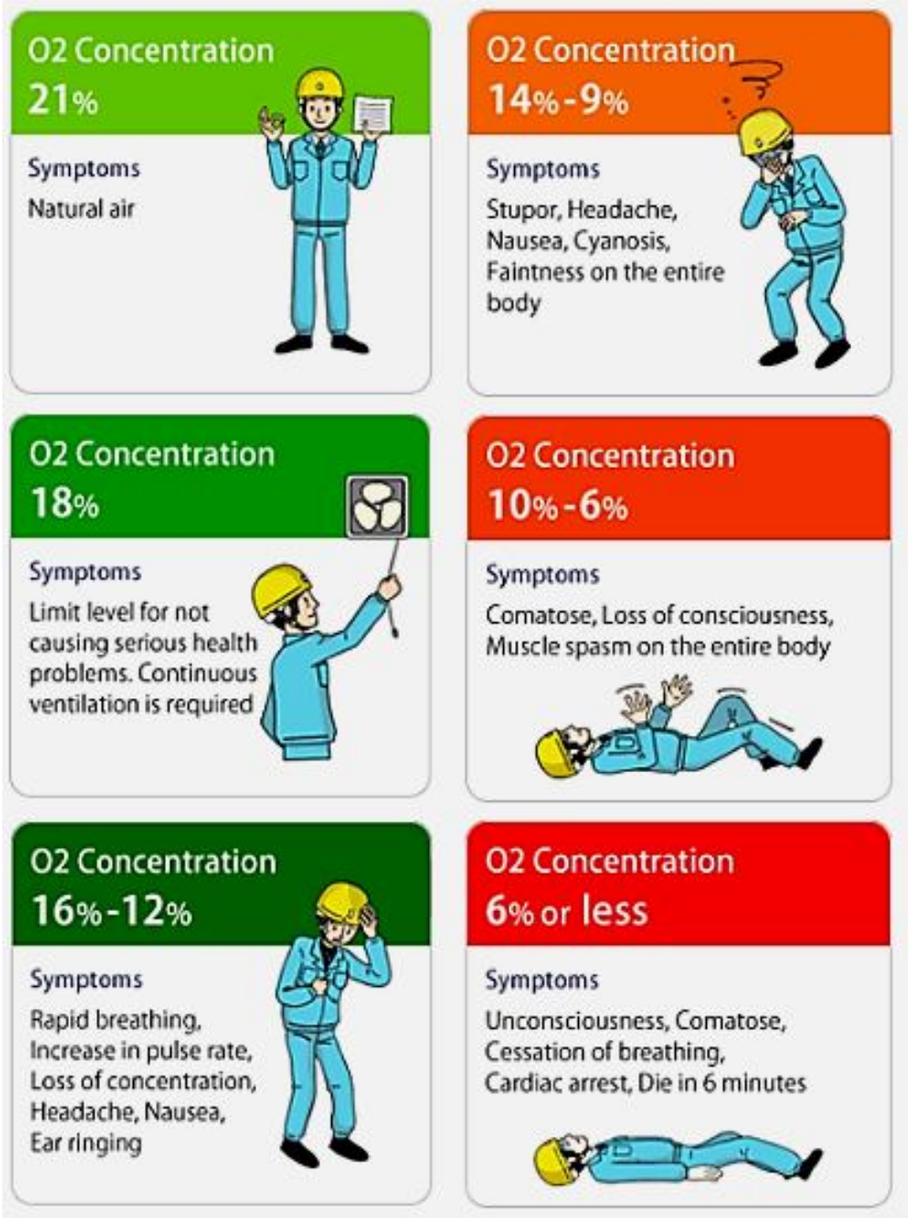
## Oxygen deficiency

Leakage of any gas (except oxygen) inside a confined/enclosed space can cause displacement of oxygen resulting in an oxygen deficient atmosphere.

Entry into a workspace with oxygen level below 19.5% is unsafe and not permitted.



# CHEMIACAL HAZARD - GAS CYLINDERS

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## Oxygen enrichment

- An atmosphere having more than 21% of oxygen is considered as an oxygen enriched atmosphere and is not safe for entry/working.
- A leakage of oxygen gas in an enclosed space can result in an oxygen enriched atmosphere.
- An excess of oxygen in the air can be a fire hazard, as oxygen is a supporter of combustion and it causes materials to burn violently.

# CHEMIACAL HAZARD - GAS CYLINDERS

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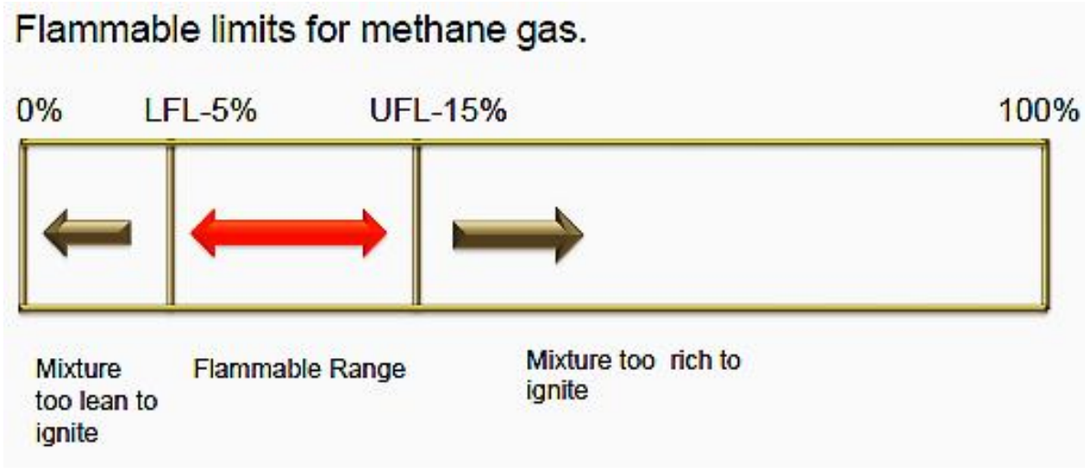
## Flammable vapour air mixtures

- A leakage of a flammable gas would form a flammable vapour air mixture.
- If the vapour air mixture is within the flammable range, it can explode in the presence of an ignition source.

## Flammability Limits

- Vapour air mixtures will only ignite within a well-specified range of composition.
- The lower flammable limit (LFL) is the leanest mixture that can ignite, i.e., the mixture with the smallest fraction of combustible gas.
- The upper flammable limit (UFL) is the richest fraction of combustible gas mixture that can ignite.

## Flammability Limits




| Flammable Gases | LFL | UFL |
|---|---|---|
| **Ethylene** | 2.7 % | 36 % |
| **Propane** | 2.4 % | 9.5 % |
| **Hydrogen** | 4.0 % | 75% |
| **Carbon Monoxide** | 12.5 % | 74 % |

# CHEMIACAL HAZARD - GAS CYLINDERS

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## Toxity

Toxicity is the ability of a substance to produce an unwanted physiological effect when the substance has reached a sufficient concentration at a certain site in the body.

## Toxity Threshold Limit Value (TLV)

Concentration of an airborne substance to which an average person can be repeatedly exposed without adverse effects.

| Toxic gas | TLV |
| --- | --- |
| Carbon monoxide | 29 $mg/m^3$ |
| Phosgene | 0.4 $mg/m^3$ |

# CHEMIACAL HAZARD - GAS CYLINDERS

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## Purchasing & Receiving the Gas Cylinders

Purchase smallest quantities wherever and whenever possible.

When receiving gas cylinders:

- Ensure that they are properly labelled.
- Do not accept cylinders without label of the content.
- The colour of the cylinder alone must not be depended upon.
- Visually inspect for damage.
- Ensure that the gas cylinders are received with valve caps.

# CHEMIACAL HAZARD - GAS CYLINDERS

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## Storage of Gas Cylinders

- Gas cylinders must be stored in a separate storage area outside the building.
- The storage area must be protected from weather.
- Flammable gas cylinders must be separated from oxygen cylinders by a distance of 6m or by a wall of 30 minutes fire resistance.
- Empty cylinders must be marked /tagged and stored separately.



## Storage of Gas Cylinders inside Labs

- Only gas cylinders for immediate use must be stored inside the laboratory.
- Materials must not be stored in front or on top of gas cylinders.
- All cylinders in the laboratories must be clearly labelled.
- Gas cylinders must not be stored near exits and passages. Gas cylinders must be stored away from heat sources.



- Place the valve cap on the cylinder whenever the regulator is removed.
- Cylinders must always be kept chained or supported in a manner to prevent fall.

# CHEMIACAL HAZARD - GAS CYLINDERS

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## Transportation of Gas Cylinders inside Labs

Before moving gas cylinder

- Valve must be closed.
- Regulator must be removed.
- Cylinder must be capped.
- Secure the cylinder in a cylinder cart (with chain).

# CHEMIACAL HAZARD - GAS CYLINDERS

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## Safe Use of Gas Cylinders

- Refer the Material Safety Data Sheet(MSDS) for the gas before usage, to know about the hazards and precautions to be taken.
- Do not tamper with the cylinder valves.
- Always use the correct regulator for the cylinder.
- Inspect the regulator for damage before use.
- Never use damaged regulators, piping, etc.
- After the regulator is attached, the cylinder valve must be opened just enough to indicate pressure on the regulator gauge and all connections must be checked with a compatible solution for leaks.
- Do not stand in front of the regulator gauge or the valve outlet side, while opening the valve.
- Use safety glasses while working with gas cylinders.

# CHEMIACAL HAZARD - GAS CYLINDERS

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## Safe Use of Gas Cylinders

- Before a regulator is removed from a cylinder, the cylinder valve must be closed and the regulator relieved of gas pressure.
- Ensure proper ventilation in the area where gas cylinders are stored.
- Spindle key must always be placed at an easily accessible location, for closing the valve in case of emergency.
- A cylinder must never be emptied to a pressure lower than 25 psi as the residual contents may become contaminated if the valve is left open.
- Close cylinder valve whenever:
  - Work is finished
  - Cylinder is empty
- Store toxic/pyrophoric gases in gas cabinets.
- Gas detectors must be installed for detecting gas leaks.
- The cylinder valve and other fittings used with gas cylinders must be compatible with the type of gas used. Incompatible materials can cause gas leak.
- Greasy and oily materials must never be used on oxygen cylinders or fittings as it can cause explosion.
- Regulators for oxygen service must never be used with flammable gases. Cross contamination of internal parts may result in rapid oxidation and fire.

# CHEMIACAL HAZARD - GAS CYLINDERS

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## Emergency Measures

- If a gas leak occurs from the cylinder inside the gas cabinet it must not be removed from the cabinet.
- No attempt must be made to repair a leak from the base of the valve.
- Personal protective equipment must be used while dealing with toxic/corrosive gas leaks.
- The building must be evacuated immediately if a gas (flammable/ pyrophoric/toxic/corrosive) leak becomes uncontrollable.
- Emergency measures must be undertaken only by trained personnel.
- The gas supplier must be intimated immediately.
- Self Contained Breathing Apparatus(SCBA) must be used while dealing with toxic/corrosive gas leaks or if an oxygen deficient atmosphere exists.


Road Safety
Sources
Causes
Preventions

## Road Accidents Causes

- Lack of awareness about Safety Rules
- Ignoring of wearing the Safety Devices such as Helmets and Safety Belts
- Over Speeding & Rash Driving
- Drunken Drive
- Traffic Violations including jumping signals
- Usage of Mobile Phones and other gadgets during driving
- Improper Road conditions
- Overtaking vehicles at improper places
- Improper maintenance of Vehicle
- Overloading the Vehicle
- Driving despite disqualification
- Careless driving including Rainy and Cloudy conditions
- Other Human Errors

# ROAD SAFETY

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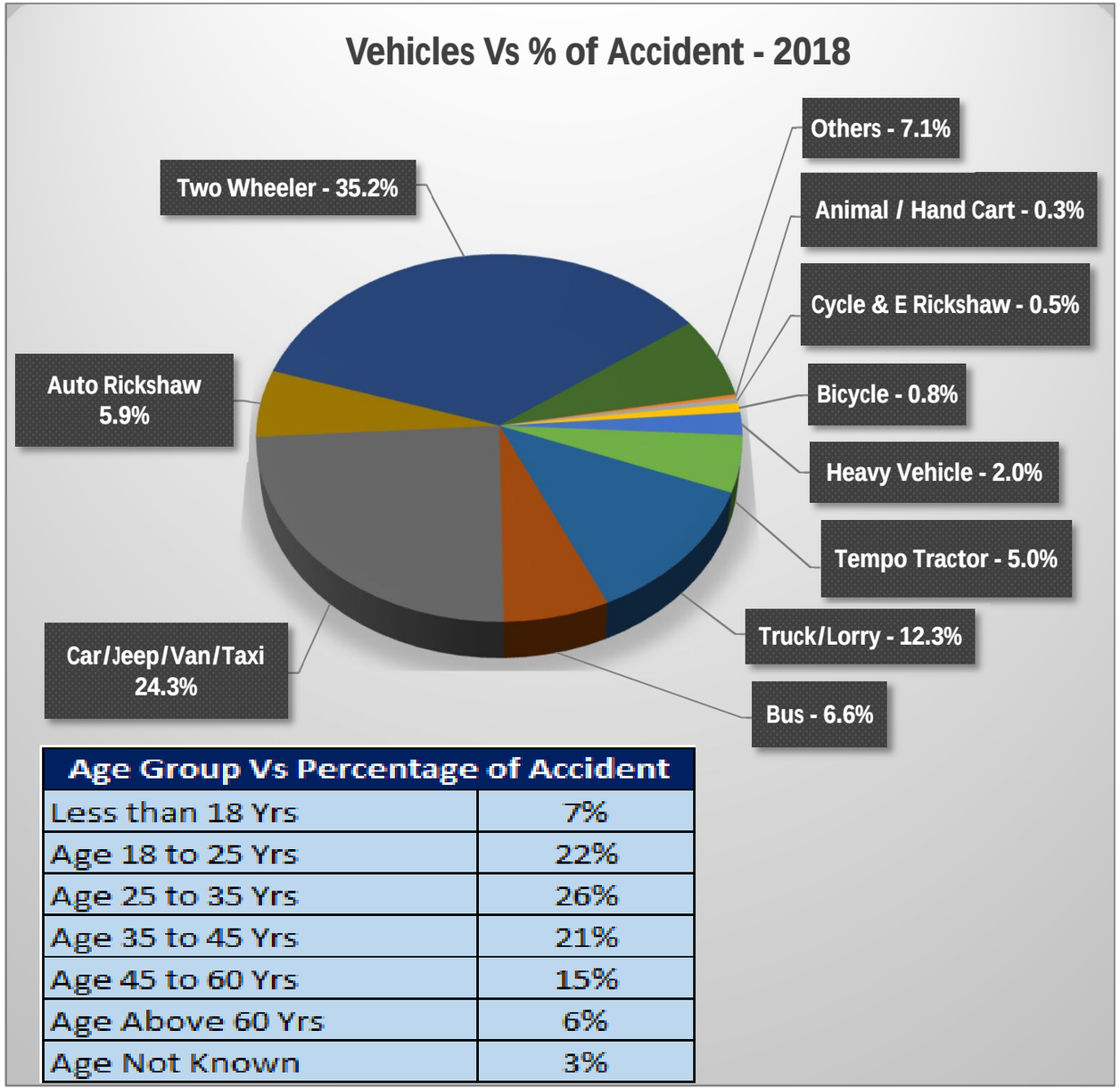


| Age Group Vs Percentage of Accident | |
|---|---|
| Less than 18 Yrs | 7% |
| Age 18 to 25 Yrs | 22% |
| Age 25 to 35 Yrs | 26% |
| Age 35 to 45 Yrs | 21% |
| Age 45 to 60 Yrs | 15% |
| Age Above 60 Yrs | 6% |
| Age Not Known | 3% |

## Accidents Vs Death Rate in 2018

| S.No | States / UTs | No of Road Accidents | % of Increase (Over 2017) | Persons Killed in Accident | % of Increase (Over 2017) | Death Ranking |
|---|---|---|---|---|---|---|
| **1** | **Tamilnadu** | **63,920** | **2.6%** | **12,216** | **32.3** | **3** |
| 2 | Madhya Pradesh | 51,397 | 3.9% | 10,706 | -4.9 | 5 |
| **3** | **Uttar Pradesh** | **42,560** | **-8.9%** | **22,256** | **-9.6** | **1** |
| 4 | Karnataka | 41,707 | 2.0% | 10,990 | -3.5 | 4 |
| 5 | Kerala | 40,181 | -4.3% | 4,303 | 4.2 | 16 |
| **6** | **Maharashtra** | **35,717** | **0.4%** | **13,261** | **-7.5** | **2** |
| 7 | Andhra Pradesh | 24,475 | 5.1% | 7,556 | 6.7 | 8 |
| 8 | Telangana | 22,230 | 1.1% | 6,603 | -0.1 | 10 |
| 9 | Rajasthan | 21,743 | 1.7% | 10,320 | 1.2 | 6 |
| 10 | Gujarat | 18,769 | 1.7% | 7,996 | -8.8 | 7 |
| 11 | Chhattigarh | 13,864 | -2.2% | 4,592 | -9.9 | 15 |
| 12 | West Bengal | 12,705 | -8.5% | 5,711 | 1.0 | 11 |
| 13 | Haryana | 11,262 | 0.0% | 5,118 | - | 13 |
| 14 | Odisha | 11,238 | -3.4% | 5,315 | -9.9 | 12 |
| 15 | Bihar | 9,600 | -7.8% | 6,729 | -17.5 | 9 |
| **Total 15 States** | | **4,21,368** | -0.3% | **1,34,109** | **-1.9** | |
| **Total All India** | | **4,67,044** | | **1,51,417** | | |

# LANGUAGES OF ROAD

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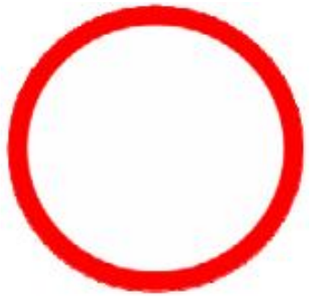
- Road  Safety Signs
- Traffic Signals - Light Signals
- Traffic Police  - Hand Signals
- Road Markings
- Safety Devices

**Mandatory Signs**

Gives Order to follow strictly

**Warning Signs**

Alerts about Hazards / Situations ahead

**Informatory Signs**

Provides information on facilities & Direction

# Mandatory Signs




Stop


Give way

Speed Limt


No Entry


No U- Turn


No Right Turn


Pedestrians Prohibited


Horn Prohibited

Load Limit

Length Limit

Height Limit


No Overtaking


Truck Prohibited


Priority for Oncoming Traffic


No Parking


No Stopping/ Standing


Compulsory Ahead /Right Turn


Compulsory Keep Left


Compulsory Sound Horn

Compulsory Minimum Speed

# Warning / Cautionary Signs

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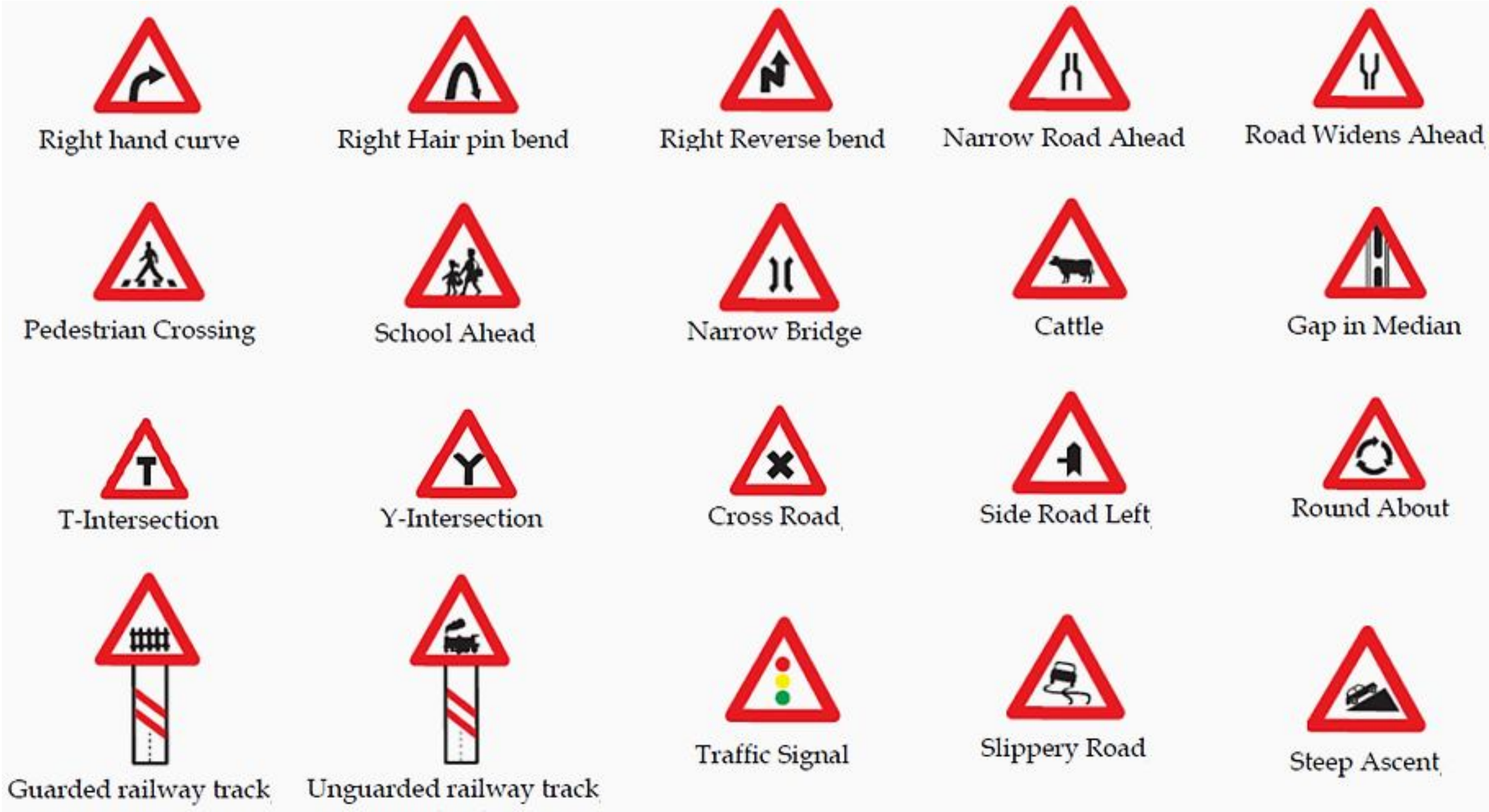
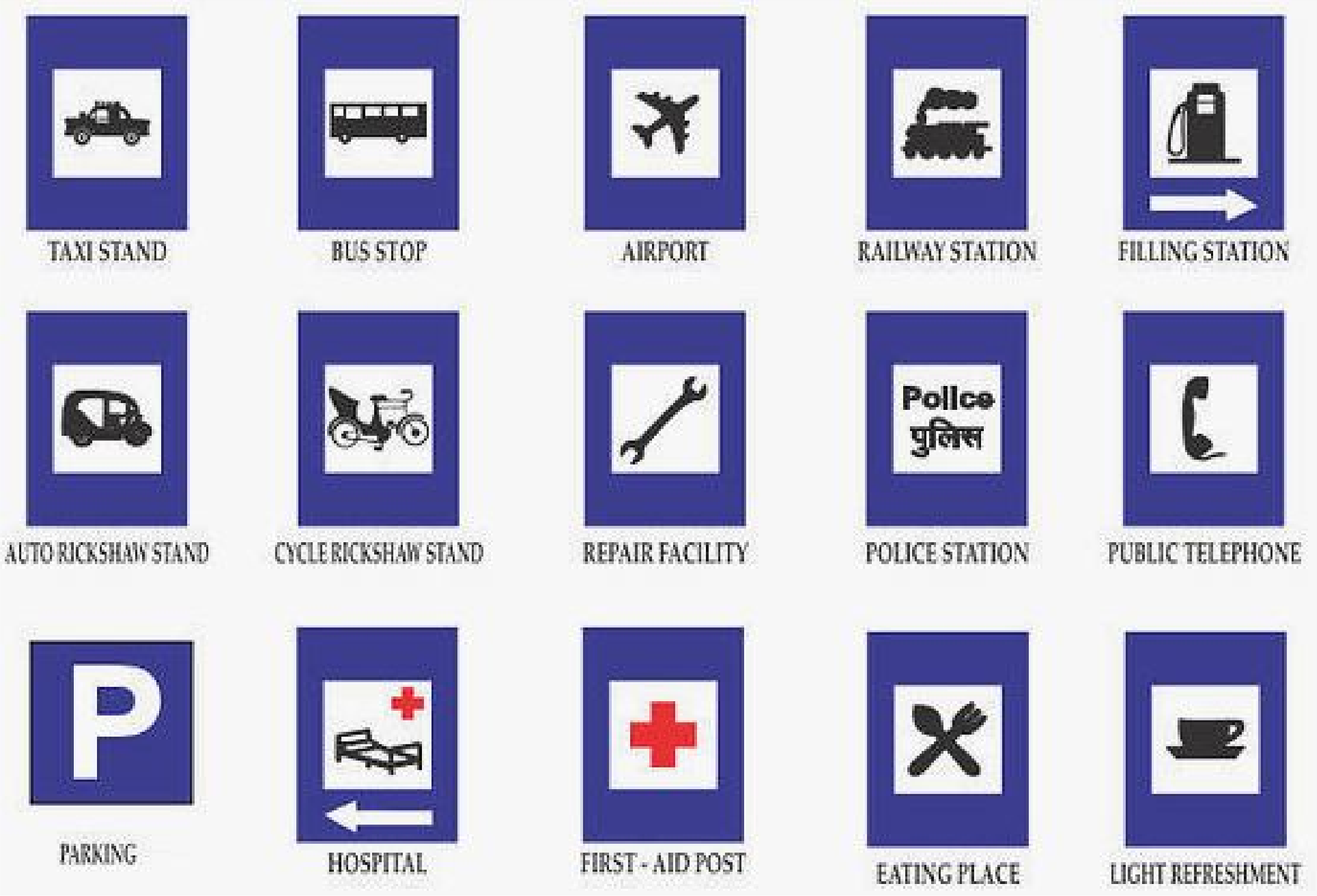


# Informatory Signs



# Informatory Signs

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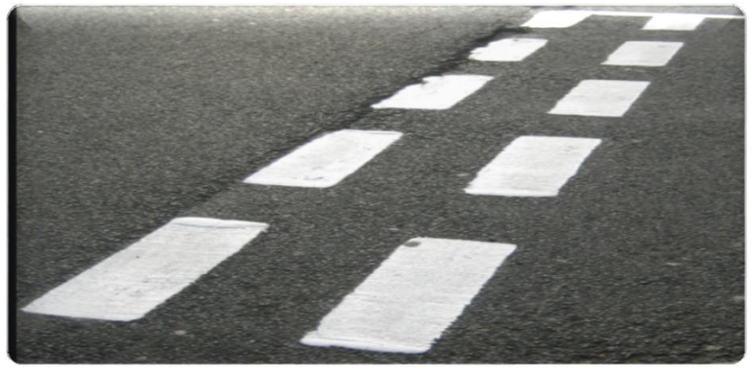
# Road Markings - Dividing Lines

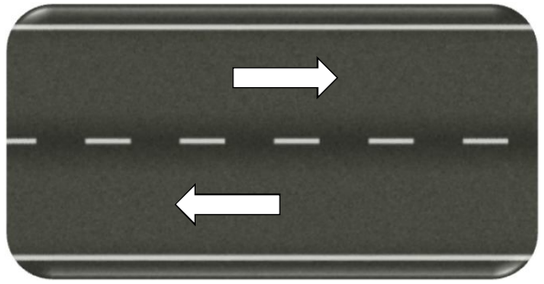


- Indicates **Narrow Road**
- This narrow road would **merge** into a **wide road ahead**
- Drive **carefully**

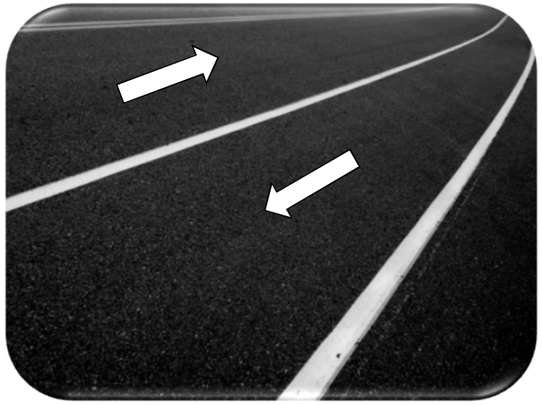
- Indicates **the stopping limit** at the junctions
- While stopping, always stop behind this line

- Indicates **Zebra Crossing**
- These are either straight lines or slanting lines.
- This is the place for **pedestrian crossing**
- Always **stop** the vehicle **behind these lines**
- Always **slow down** when approaching a zebra crossing, look for pedestrians before crossing.

# Road Markings - Dividing Lines



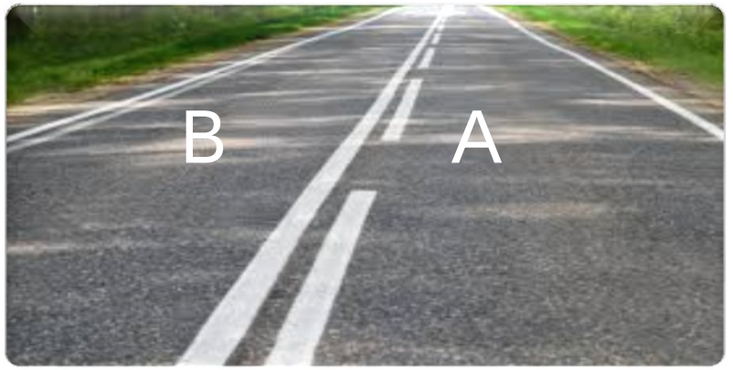
- These broken lines divides the road for traffic in both directions
- **Overtaking is allowed** on these roads



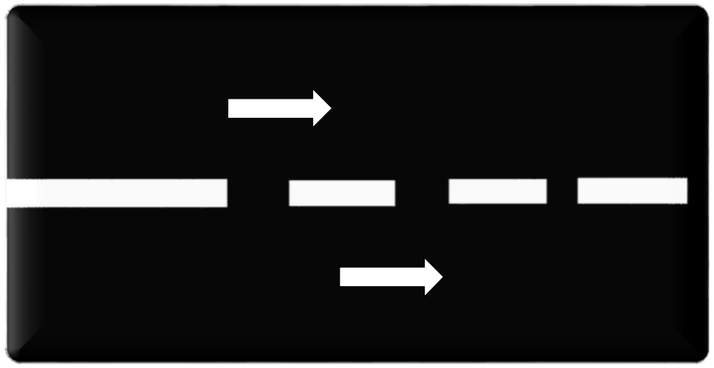
- The firm line divides the road for traffic in both directions
- This line indicate that on this road **no overtaking** is allowed

# Road Markings - Dividing Lines

- Two firm lines running parallel along the road
- **Strictly No overtaking** is allowed at all




- The broken and firm line runs parallel to each other
- It divides the road for traffic in both directions
- There is **no overtaking** allowed for the traffic which runs along the firm line (**B side** of the road)
- **Overtaking is allowed** for traffic which is on the broken line side of the road (**A side** of the road)



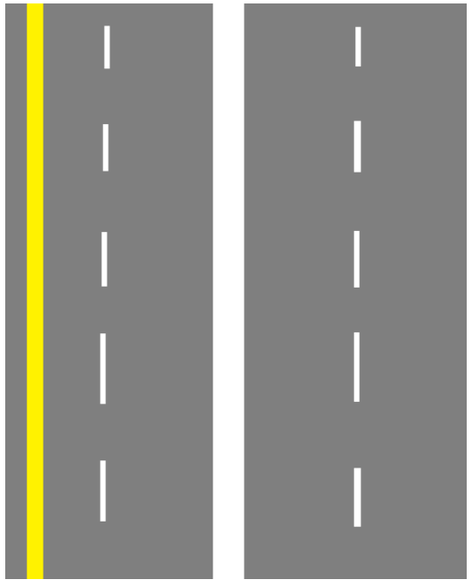
- Broken line gets converted to firm line
- Lane changing allowed only along the broken line
- **No lane changing** allowed along the firm line

# Road Markings - Dividing Lines

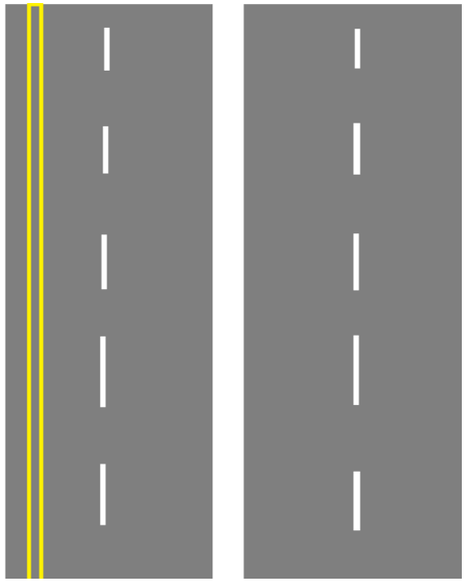
- This is called **BOX JUNCTION**
- **NEVER stop** on a box junction
- Before approaching this junction, check whether the vehicle can **completely cross** this junction. **Only then go ahead**
- **Otherwise stop** before this junction even if the signal is green

- This is called **TRAFFIC CHANNELISER** or painted divider
- **Do not take** the vehicle on to the divider
- This should be **treat**ed like a **firm line** on the road

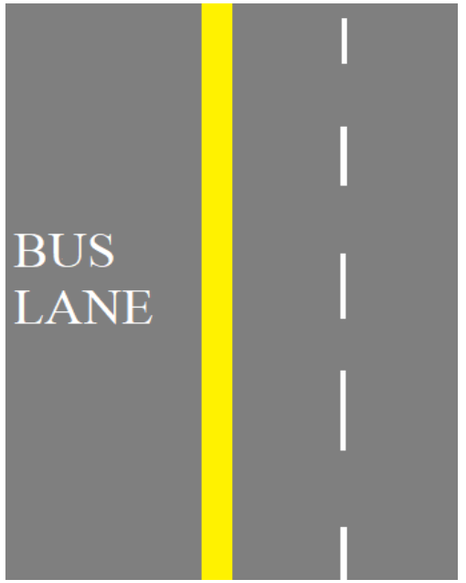
# Road Markings - Dividing Lines



- Yellow line on the extreme left of the road
- Indicates **NO PARKING** is allowed



- Two yellow line at the extreme left of the road
- **STOPPING** of vehicle is **NOT ALLOWED**




- If there is a **lane after the yellow lane**, it is a **special lane**
- Look for road sign to **understand the purpose** of this lane. It could be a bus lane or a heavy vehicle lane
- **Drive** your vehicle **accordingly**

# Road Safety Devices

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## Delineators

## Traffic cone


## Cat Eye

## Traffic barriers

# Stopping Distance

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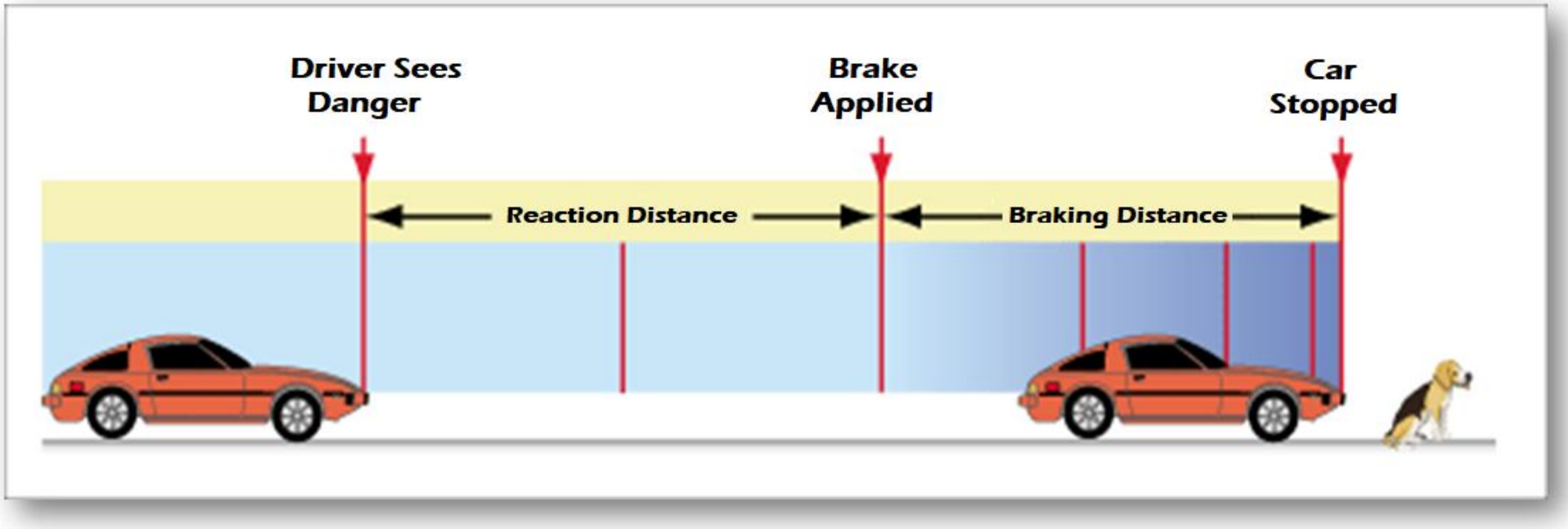
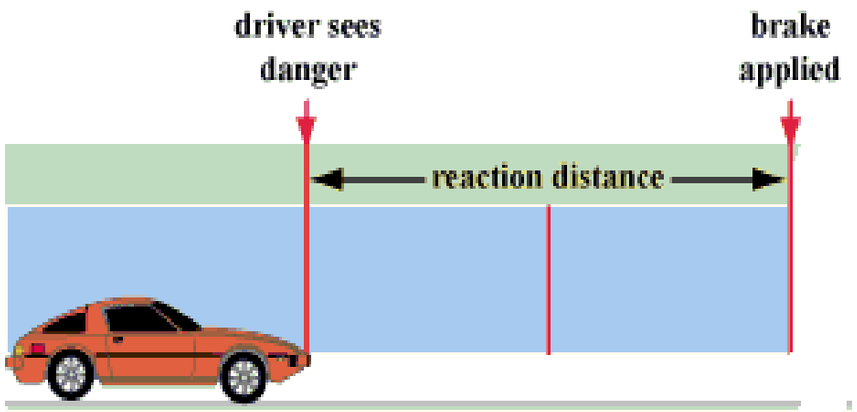
Stopping Distance = Reaction Distance + Braking Distance



# Stopping Distance




- Driving Sees the **Hazard by his eyes**
- Eyes **send signals** to brain
- **Brain decides** to apply the brake
- Brain **sends signal to leg** to apply the brake
- Leg is **lifted from** the **accelerator**
- Leg is **put on brake pedal**

- As per the **law of motion** in physics Thinking Distance A

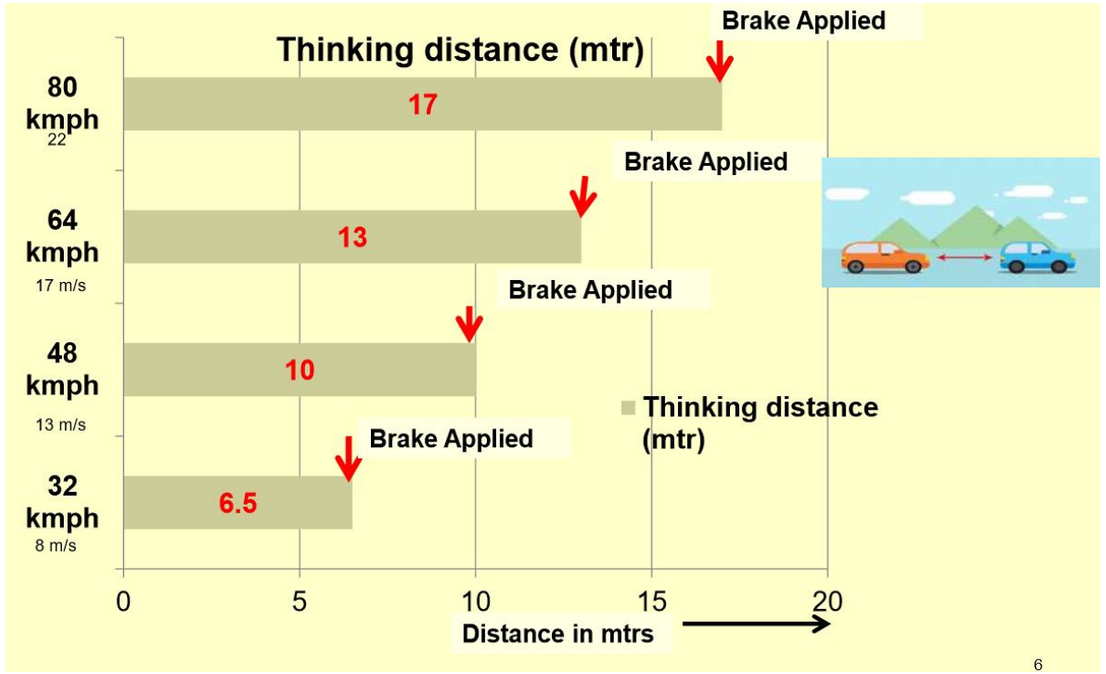
$$A = V * t_R$$

Where

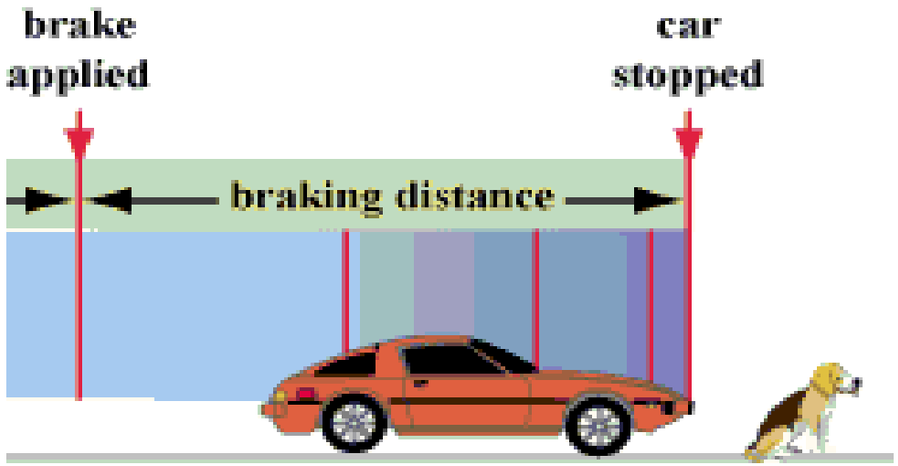
V-Vehicle Speed in m/s

$t_R$- Reaction Time

- Ideal condition $t_R$ is approx. ¾ Secs



# Stopping Distance



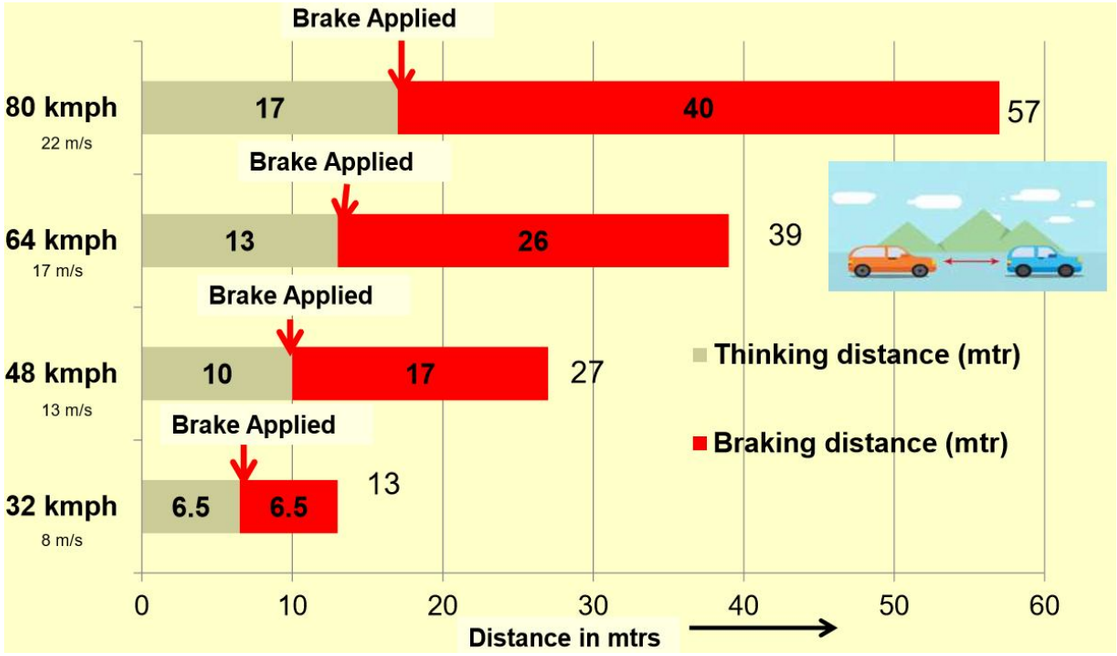

- **If speed of the vehicle V doubles then Braking distance covered will be 4 times**
- If μ reduces then distance will increase

  E.g. Wet, Oily, Snow

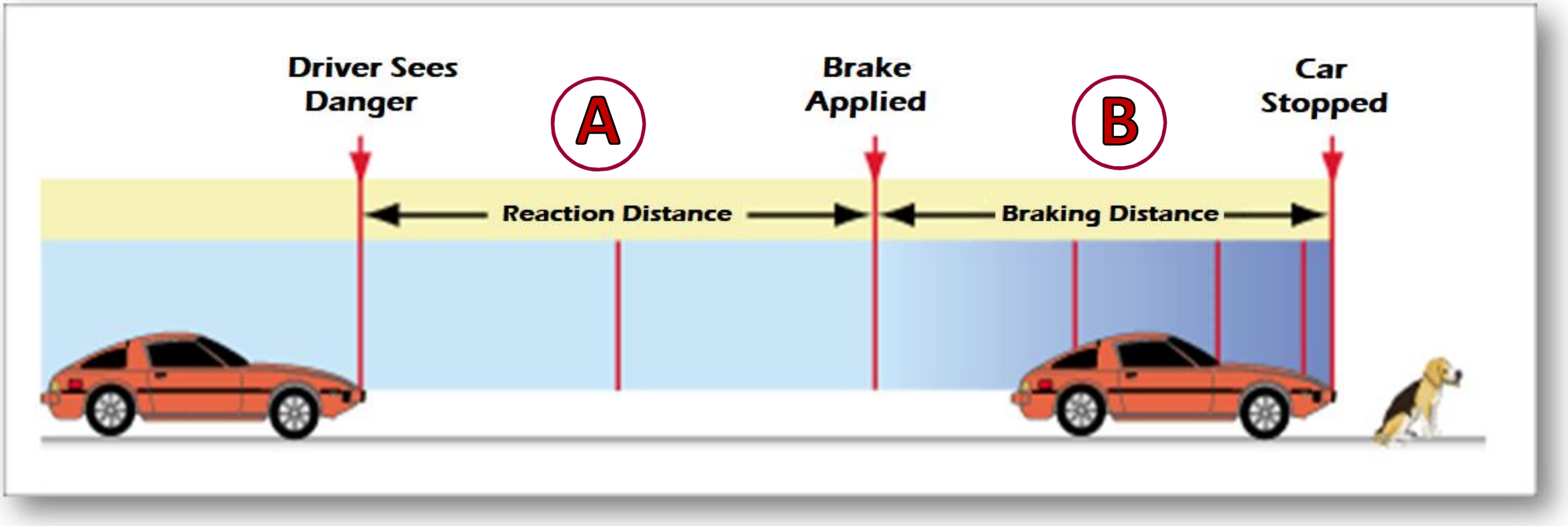
B- Braking Distance: **Distance travelled to stop the vehicle after application of brake**.

$$B=V^2/2\,\mu g$$

V-Vehicle Speed in m/s
μ- co efficient of friction
G –acceleration due to gravity 9.81 $m/s^2$



# Stopping Distance




- Distance required to stop vehicle safely = A + B
- Distance Between the Vehicles / hazard < A + B
- **Severity of accident depends upon:**
- Distance between the vehicles / hazard, speed, road surface

# Stopping Distance

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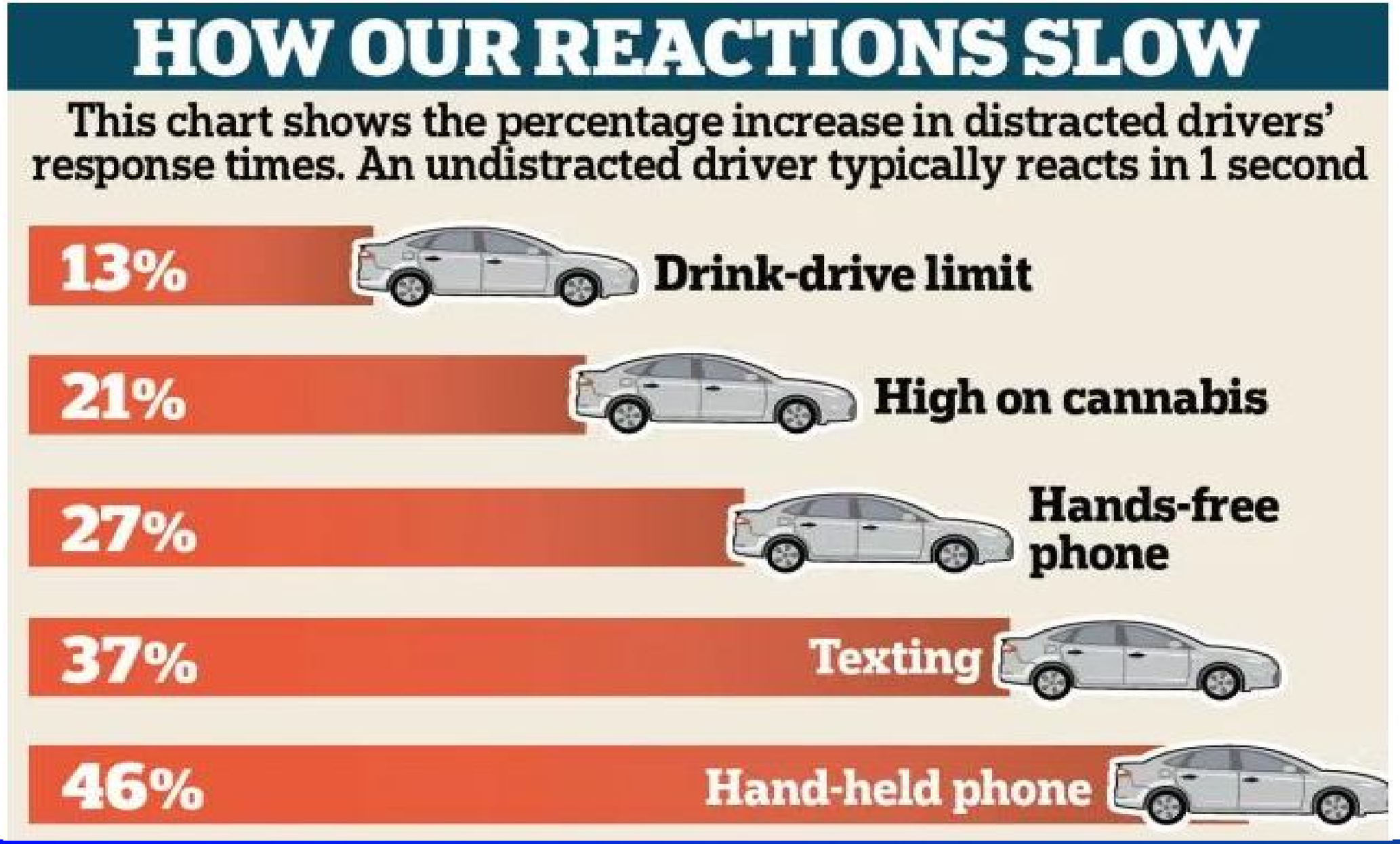

# Anticipations

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- Blind Spot
- Intersections
- Safe distance
- Distraction
- Signal Jump
- Pedestrian Movement
- Animal Movement
- Opening of car door
- Improper Road Conditions
- Turning by other vehicle
- Speed breaker/Safety barricade
- Weather Conditions

# CONCLUSION

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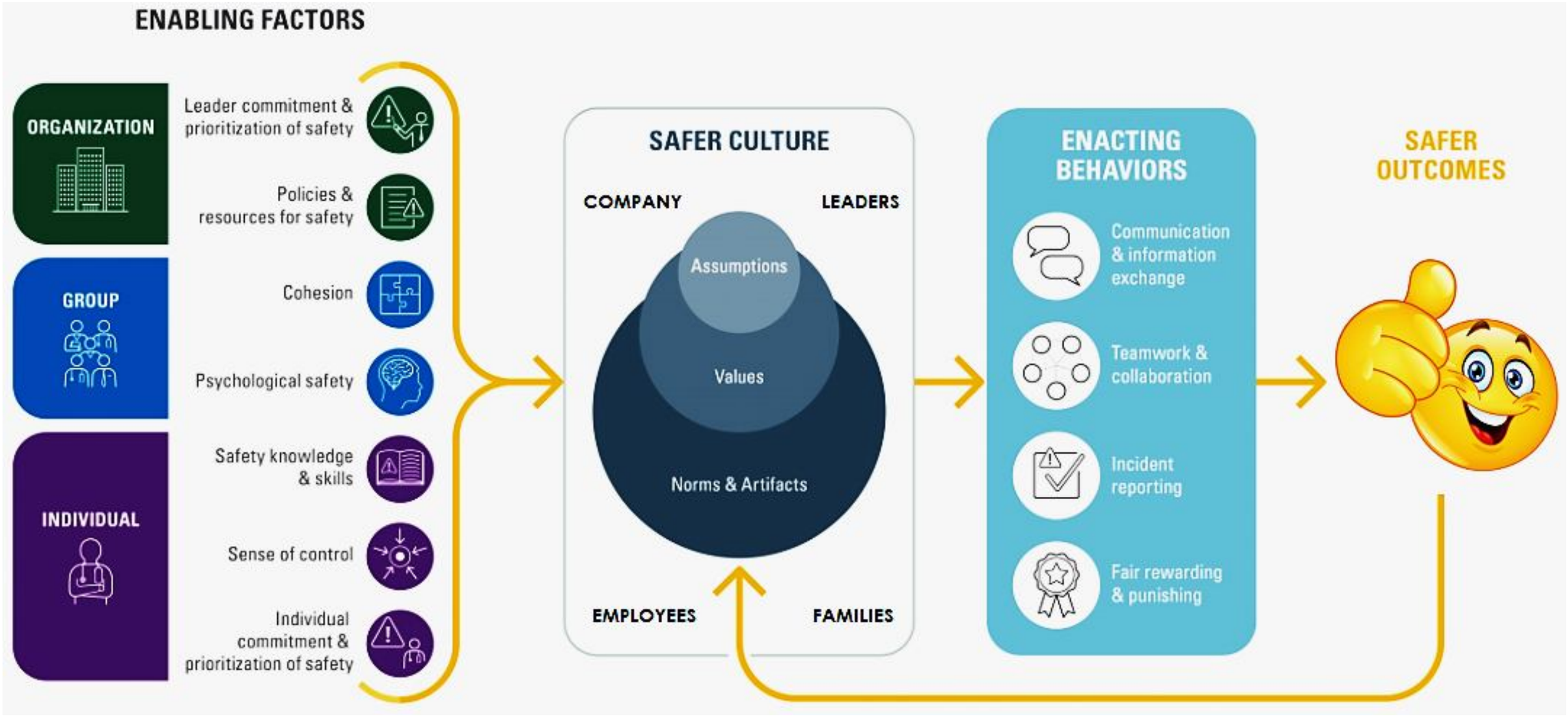


THINK SAFETY
THANK YOU
BE SAFE