STANDARD OPERATING PROCEDURES (SOPS)

(PREVENTION OF INDUSTRIAL ACCIDENTS)

FORMULATED BY -

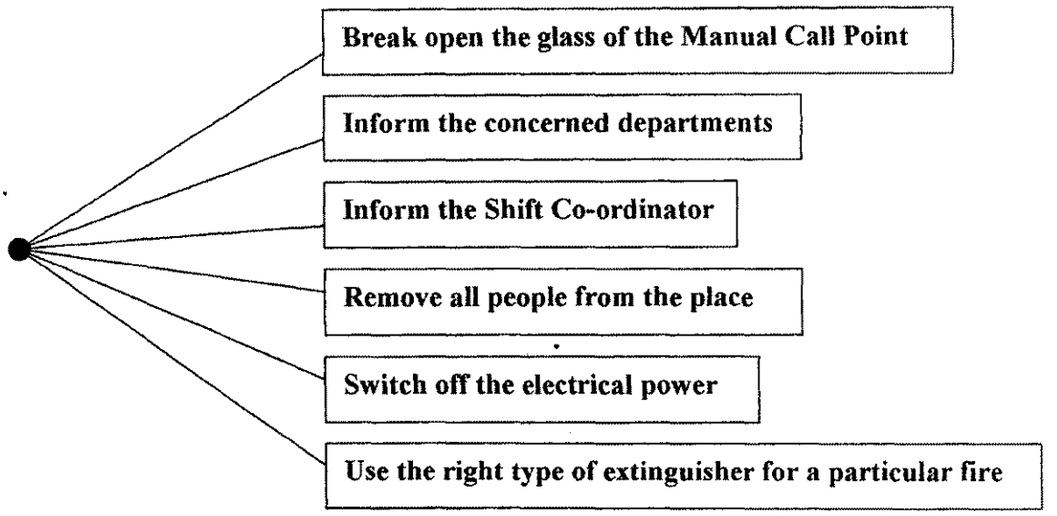
DIRECTORATE OF FACTORIES, LABOUR DEPARTMENT,

GOVERNMENT OF WEST BENGAL

INDEX

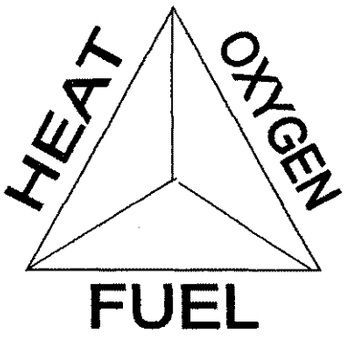
PREVENTION OF FIRE

- *WHAT TO DO INCASE OF A FIRE OR WHEN A FIRE IS DETECTED :-*

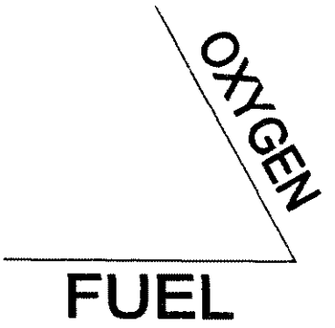


- *THREE THINGS ARE REQUIRED TO IGNITE A FIRE :-*

1) **Heat**
2) **Air or Oxygen**
3) **Fuel**



FIRE TRIANGLE



NO FIRE WITHOUT HEAT

CLASSES OF FIRE :- **FIRE IS OF FIVE TYPES**

1) **'A-Class'** fire or ordinary fire. It is the kind of fire in which 'ASH' is produced. Fire from burning wood , paper , jute , wrapper , etc., are classified as **'A-Class'** fires or ordinary fires.

2) **'B-Class'** fire or fire from flammable liquids. When flammable liquids catch fire then that type of fire is classified as **'B-Class'** fire. For example , fire from oil , petrol , spirit , perfume , etc., are called **'B-Class'** fires.

3) **'C-Class'** fire or fire from combustible gases. When combustible gases catch fire then that kind of fire is called **'C-Class'** fire. For example fire from cooking gas, LPG, acetylene gas, etc., are classified as **'C-Class'** fires.

4) **'D-Class'** fire or metal fire. When chemicals, metals catch fire , they constitute **'D-Class'** fires.

5) **'E-Class'** fire or electric fire. Fire from electrical equipments , for examples, motors , transformers , etc. are called **'E-Class'** fires.

THEORY OF EXTINGUISHING FIRE :-

1) The process of bringing down heat is known as **'Cooling Effect'**.
2) Separation of the fuel is known as **'Starvation'**.
3) The way of separating oxygen is known as **'Smothering Effect'**.

STAGES IN IGNITING A FIRE :-

1) **Incipient Stage** – In this stage no fire or smoke is generated but some fuel / combustible substances form chemical mixtures.
2) **Smouldering Stage** – In this stage the substance starts burning and smoke is produced , but no flames or heat is generated.
3) **Flame Stage** – In this stage the substance starts burning with flames. Amount of smoke reduces and that of generated heat increases.
4) **Heat Stage** – In this stage a lot of heat , flames and poisonous gases are produced and the rate of generation increases at a rapid rate.

FIVE TYPES OF EXTINGUISHERS :-

1) **Water type**
2) **ABC type**
3) **Powder type**
4) **Foam type**
5) **Gas type**

CHOICE OF EXTINGUISHERS

TYPE	EXTINGUISHER	USE IN FIRE OF
A - Class	Water type / ABC	Wood , paper , jute , wrapper , Textile etc.
B - Class	Foam type / ABC	Oil , petrol , spirit , perfume , etc.
C - Class	Foam type / Powder / ABC	Cooking gas , LPG, acetylene gas , etc.
D - Class	Powder type	Chemicals , metals
E - Class	Powder type / Gas type	Electric equipments for example motors , transformers, etc.

SPONTANEOUS IGNITION :-

1) Store all substances that catch fire spontaneously in well ventilated places where there is enough space for free flow of air and where air can't stand for a long time.
2) Store all substances that catch fire spontaneously properly in stacks of smaller heights and separated from each other.
3) Store all substances that catch fire spontaneously atleast 10 metres away from any such building where it is produced or where raw materials needed for their production are stored.

PRECAUTIONS AGAINST FIRE:-

- A minimum gap of 90 cm should be provided between any two machines where there is a chance of fire.
- The layout of all buildings and plants should be such that they do not pose an obstacle in the passage for extinguishing fire.
- Doors and windows should be fitted to external walls of a building in a way such that they can be properly used for extinguishing fire.
- Every path of **EXIT** should be atleast 50 cm wide and the width should increase by 25 cm for every additional half unit. No path of **EXIT** should be less than 25 cm.
- All **EXIT** ways , if it is a staircase , should be meant for only 50 persons ; and if it is a DOOR , should be meant for only 75 persons.
- It is very necessary to know how many workers are working in order to determine the path of **EXIT**.
- For any floor above or below the ground floor , there should be atleast two paths for **EXIT** and one of them should be located inside the building.
- Separate structures should be maintained for storing each item and the paths for **EXIT** should be so located such that workers can very easily go out of the building. There should be atleast two paths for **EXIT** if the number of workers employed is more than 10.
- Every place of storage of individual items should be so connected to staircase or verandah which allows access to open or proper place.
- No **EXIT** doorway shall be less than 100 cm in width and shall not be less than 200 cm in height.
- **EXIT** doorways shall open outwards, that is , away from the room but shall not obstruct the travel along any exit. No door , when opened , shall reduce the required width of stairway or landing to less than 90 cm. Sliding door with up-down movement shall not be installed for this purpose.
- An **EXIT** doorway shall not open immediately upon a flight of stairs. A landing space equal to atleast 1.5 m x 1.5 m shall be provided in the stairway at each doorway. The level of landing shall be the same as that of the floor which it serves.
- The **EXIT** doorways shall be openable from the side which they serve without the use of a key.
- **EXIT** corridors and passageways shall be of a width not less than the aggregate required width for normal built persons.
- Where stairways discharge through corridors and passageways , the height of the corridors and passageways shall not be less than 2.4 metres.
- A staircase shall not be arranged around a lift-shaft unless the latter is totally enclosed by a material having a fire-resistance rating not lower than that of the type of construction of the former.
- Internal stairs shall be constructed of non-combustible materials throughout. Combustible construction shall not be permitted.
- The minimum width of an internal staircase shall be 100 cm.

- Lift, escalators and revolving doors shall not be considered as fire exit.
- The minimum width of treads without nosing shall be 25 cm for an internal staircase. The treads shall be constructed and maintained in a manner to prevent slipping.
- The maximum height of a riser shall be 19 cm.
- Hand rails shall be provided on both sides of a staircase with a minimum height of 100 cm and shall be firmly supported.
- The use of spiral staircase shall be limited to low-occupant load and to a building of height of 9 metres , unless they are connected to platforms such as balconies and terraces to allow escapes to pause. A spiral staircase shall not be less than 300 cm in diameter and have adequate head room.
- The width of a horizontal **EXIT** shall be the same as for the exit doorways.
- The horizontal **EXIT** shall be equipped with atleast one fire door of self-closing type.
- The floor area on the opposite or refuge side of a horizontal **EXIT** shall be sufficient to accommodate occupants of the floor areas served allowing not less than 0.3 square metre per person. The refuge area shall be provided with adequate **EXIT**s and at least one them shall lead directly to the exterior or street.
- Doors in horizontal **EXIT**s shall be openable at all times.

SAFETY PRECAUTIONS FOR STORING COMBUSTIBLE SUBSTANCES :-

STORAGE TANK FARM AREA

1) Use hand-gloves and eye-goggles for measuring level of liquid in a tank.
2) The roof of the tank should be kept clean.
3) Hydrocarbon samples should not be collected in plastic containers.
4) Liquid solvents should not be transferred or transported by means of rubber hoses.
5) The metallic nozzle of a hose should be earthed while using it for spraying high pressure water or vapour / steam meant for cleaning.
6) Stand in the direction of air flow while measuring depths.
7) Provide earthing to the metallic measuring rods.
8) Do not use shoes with iron nails.
9) The tanks should be provided with :
   (a) Roof Catwalk , (b) Level Guage , (c) Dyke Wall,
   (d) A gate restricting entry into that place.
10) Smoking should be strictly prohibited in that place.
11) Cleaning with compressed air should be prohibited in this place.
12) Do not use ordinary 'Hand Lamps'.

13) Check for the amount of oxygen or explosive gases inside before entering a tank for cleaning.
14) Do not use iron instruments for chipping.
15) Do not start any 'Hot Work' without checking for the presence of combustible gases.
16) Take immediate actions in case of leakage.
17) Metallic jumpers should be used for connecting pipe lines at flanges.
18) Every equipment (pump , motor , pipe line , etc.) should be properly earthed.
19) Tankers should be properly earthed while they are unloaded.
20) While installing lighting fittings expert advice should be taken as per IS standards.
21) Permission from Chief Controller of Explosives, Nagpur and State Fire Departments should be obtained before starting usage of tanks.
22) Pipes transporting hydrocarbons and other chemicals should not come in contact with heat.
23) Purge the inside of tanks before entering them or starting 'Hot Work' on them.
24) Water curtain facility should be provided for cooling every storage tank in case such need arises.
25) Install adequate number and of proper type of fire extinguishers nearby.
26) MSDS of the chemicals stored in the tanks should be maintained and displayed nearby.
27) Brass wire net of proper mesh size should be fitted to the openings of Tank Vent Pipes.
28) The storage tanks should be efficiently protected by lightening arresters and they should be checked for earth continuity atleast twice in a year.

PROPERTIES OF LPG AND ASSOCIATED RISKS

LPG is extremely dangerous due to its highly flammable and explosive nature. For its safe usage , knowing LPG's properties and nature is extremely essential

1) LPG is stored and used under pressure. Leaking liquefied LPG rapidly evaporates to form enormous volumes of highly combustible gas thereby posing a risk to security and safety.
2) LPG forms explosive mixtures in air in concentrations between 1.8 % to 9.5 %. volume/volume.
3) 1 litre of LPG forms 250 litres of gas on release.
4) LPG in vapour state is heavier than air and collects at low lying areas. If there is no air movement then LPG dilutes at a very slow rate.
5) LPG is colourless. LPG while evaporating causes intense cooling of the surrounding air , and even condenses water vapour which results in coming out of LPG in larger quantities.

6) Pure **LPG** is an odourless gas. A little amount of a pungent smelling ~~gas~~ liquid 'ethyl mercaptan' having characteristic odour is added to **LPG** to detect its leak.

7) Rapid evaporation of **LPG** causes intense cooling effect and may cause cold burns (frost bites). Personal protective equipment like goggles , hand gloves, protective clothing etc.should be provided to workers working with or handling **LPG**.

8) During undertaking maintenance work on equipments like **LPG** piping, sieves of pumps , vessels , etc. , there is a chance of the presence of pyrophoric iron sulphide. So water hoses and water jets should be used to prevent ignition.

➢ *DRAINING OUT OF WATER FROM LPG VESSELS :-*

1) Two valves should be provided to the drain line.
2) For draining out water :-
   (a) First open the valve adjacent to the vessel and then closed the valve.
   (b) Slowly open the second valve and control the amount of water flowing out of it.
   (c) When the flow of water has ceased close the second valve.
   (d) Next again open the valve adjacent to the vessel and then close the valve.
   (e) Open the second valve and drain out any water inside and again close it and repeat the process until all water has been drained our from LPG vessel.

➢ *PRECAUTIONS FOR CHECKING LEAKAGE AND SPILLAGE :-*

1) Immediately inform the nearest fire station and seal off the place.
2) Shut off the leaks as fast as possible.

MATERIAL SAFETY DATA SHEET

PETROL :- Produced from petroleum and is a mixture of hydrocarbons.

PHYSICAL PROPERTIES :- Volatile liquid ; flammable liquid ;ºcolourless ; before mixing of dye its Specific Gravity ranges from 0.69 to 0.77 ; petrol vapour heavier than air , Flash Point (-) 45^0C (closed cup) ; forms explosive mixtures in air in concentrations from 1.3 % to 7.6 % ;volume/volume auto ignition temperature 257^0C.

HAZARDS :- Fire Hazard – catches fire when comes in contact with heat or flame. Reacts with oxidizing substances.

EXPLOSION :- Can cause explosion in contact with heat or flame.

EXTINGUISHING EQUIPMENTS :- Foam , dry chemical powder , carbon di-oxide type extinguishers.

DIESEL :- Produced from petroleum and is a mixture of hydrocarbons.

PHYSICAL PROPERTIES :- Volatile flammable liquid ; light brown in colour ; has characteristic odour ; solubility in water 30 ppm ; diesel vapour heavier than air ; Flash Point $32^0C - 96^0C$; forms explosive mixtures in air in concentrations from 0.6 % to 7.5 % ; volume/volume auto ignition temperature 256.6^0C.

HAZARDS :- Fire Hazard – catches medium intensity fire when comes in contact with heat or flame. Reacts with oxidizing substances.

EXPLOSION :- Can cause explosion in contact with heat or flame.

KEROSENE :- Produced from petroleum and is a mixture of hydrocarbons.

PHYSICAL PROPERTIES :- Volatile flammable liquid ; almost colourless ; has characteristic odour of aromatic compounds ; solubility in water 0.0002 ppm to 0.0004 ppm ; kerosene vapour heavier than air ; Flash Point $35^0C - 50^0C$; forms explosive mixture with air in concentrations from 0.7 % to 5.0 % ;volume/volume auto ignition temperature 210^0C.

HAZARDS :- Fire Hazard – causes medium intensity fire when comes in contact with heat or flame. Reacts with oxidizing substances.

ARC WELDING

- Use welder suit, welding screen / shield, leather hand gloves, tight shoes.
- Remove combustible materials from the vicinity of welding or cutting operations.
- Keep tight connections of cables to avoid overheating of welding cables.
- Joints between cable sections should be made with properly constructed insulated cable couplings / jointers.
- The welding return should be firmly connected to the metal / job on which welding is taking place by means of well constructed clamp.
- Use suitable screen for out-door jobs.
- Always memorise the location of fire extinguishers.
- Do not use electrode holders with defective jaws.
- Do not attempt to repair welding machine. Always take help of Electric Department.
- Do not use wet hand gloves and shoes while welding.
- Switch off the welding machine before leaving.
- Take care of proper ventilation system.

OXY-ACETYLENE GAS CUTTING & WELDING

OXYGEN ::

- Never use Oxygen near inflammable material specially oil, grease or any other substances likely to cause or accelerate fire. Oxygen itself is not flammable but does support combustion.
- Do not store oxygen and acetylene cylinders together. They should be separately stored.
- Do not permit oil or grease to come in contact with cylinder valve, regulator, hose fittings.
- Open cylinder valves slowly using suitable key. Do not use hammer or wrench to open cylinder valves, if the valves can not be opened by hand notify immediately. Never make attempt to repair oxygen cylinder valve and regulators.
- Never attempt to mix any other gases in oxygen cylinder.
- Oxygen should never be used for ventilation or as a substitute for "compressed air".
- Never use oxygen from cylinders without a suitable pressure reducing regulator attached to the cylinder valve.

ACETYLENE :

- ✶ Acetylene cylinders should be kept in an upright invertical position.
- ✶ Never use acetylene from cylinders without a suitable pressure reducing regulator attached to the cylinder valve.
- ✶ Turn the cylinder so that the valve outlet will point away from the oxygen cylinder.
- ✶ Open cylinder valves slowly using suitable key. Do not use hammer or wrench to open cylinder valves, if the valves can not be opened by hand, notify immediately. Never attampt to repair acetylene cylinder valve and regulators.
- ✶ If a leak occurs in acetylene cylinder valve, take cylinder out in the open air, keeping well away from fires, open lights or source of fires, notify the manufacturer.
- ✶ Acetylene cylinder should never be kept / stored below or nearby of any hot object, steam / corrosive / explosive / substances / hot process jobs.

GENERAL PRECAUTIONS

- ✶ Welding and cutting jobs are to be carried out in areas away from inflammable or combustible substances.
- ✶ Don't carry out any welding jobs in confined spaces without adequate ventilation.
- ✶ Don't pick up hot objects.
- ✶ Don't look at on electric arc with naked eye.
- ✶ Don't use cracked welding shields.
- ✶ Don't attempt to repair equipments.

- Don't do any chipping without suitable goggles.
- Don't drop or abuse cylinders and do not roll.
- Never tamper with cylinder safety devices.
- Always protect hose / welding cable from being trampled on or run over.
- Protect the hose and cylinders from flying sparks, hot slag, hot objects and open flame.
- Don't use match-stick for lighting torch, hand burns may result. Use friction lighters, stationary pilot flame or some other suitable source of ignition.
- When welding or cutting is to be stopped temporarily, release the pressure adjusting screws of the regulators by turning them to the left.
- When the welding or cutting is to be stopped for a long time or taken down, close the cylinder valves and them release all gas pressure from the regulators and hoses.
- Hose pipes of oxygen and acetylene use are to be tested to make sure that the same are free from any leakage. Damaged / leaked hose pipes should never be used.

Safe / standard operating Procedures against electrical hazards (SOP - Electrical)

1. Frequently check the electrical supply / power lines, switches, plug top (dowel pins), plug base, fuse boxes / MCB, D. B. boxes, joint boxes, supply mains, earthing connections, etc.

2. While using any electrical equipment or appliances, if electric shock sensation is felt, immediately stop using that and inform the electrical maintenance supervisor / incharge.

3. While working with any electrical machine or equipment or attending any repair or maintenance work, always use shoes with high insulating rubber sole to avoid electric shock hazard. Never work with wet clothes.

4. Ensure plug top is properly fitted with its base to avoid any possible loose connection likely to cause arcing.

5. Thermal fuses are meant to protect the electrical circuits and electrical insulation but some-times it becomes a source of fire hazard. So, fuses of correct rating and proper fusible alloy metal wire instead of copper conductor wire, shall always be used where MCB is not used.

6. Poor or sub- standard quality supply wires having cheaper quality recycled copper or aluminium conductor with reprocessed non-durable PVC insulation shall not be used, because impurities in the metal leads to a higher resistance developing hot spots which may cause fires or blackouts. Such second quality insulation from old /used plastics / PVC melts faster and deteriorates early. Better use pure copper (electrolytic) wires of I. S. 694 standard or I. S. I. marked aluminium conductor wire always to ensure safety.

7. Supply wires of proper cross - sectional area depending on the load to be carried (e.g. 1.5 sq. mm. cu. wire upto 250 watts, 2.5 sq. mm. cu. for 250 to 1000 w. 4 sq. mm. for 1000 to 3000 watts) must be used to avoid fault - free condition and fire.

8. Overloading thereby overcurrent and overheating, arcing, short-circuit, earth-fault, dampness must be avoided by all possible means to avoid electric shock and fire hazards.

9. Whereever necessary, safe / super trip device, circuit breakers (MCB, ELCB, OCB / VCB / SF 6CB) shall be provided and well maintained by frequent checking for safe working of the electrical machines, furnaces, devices, and other installations (Safety & protective devices - Rule 91 of I. E. Rules, 1956).

10. All electric supply lines and apparatus shall be sufficient in size and power for the work they may be required to do and shall be constructed, situated, protected, worked and maintained in such a manner as to cause no risk of bodily injury to any person, in rightful compliance with the mandatory provisions of Rule 50A of West Bengal Factories Rules, 1958 (Rule 29 of I. E. Rules, 1956 amended).

11. Earth terminal with earth pit and earth electrode shall be provided and maintained in an accessible position at or near the point of commencement of electric power supply within the premises. Laid down standards of Indian Electricity Act, 2003 (Rule 90 of Indian Electricity Rules, 1956) and I. S. : 3043 - 1987 (revised upto date) - code of practice for earthing.

12. An indication of a permanent nature shall be provided and maintained to earthed or earthed neutral conductor (s) which is to be connected there to distinguish from any live conductor. No cut-out link or switch other than a linked switch arranged to operate simultaneously on the earthed or earthed neutral conductor and live conductor shal be inserted.

13. Portable hand lamp must have insulating handle and enclosed plastic coated wire cage and shall be of not more than 24 volts.

14. Every metallic supports, motor, generator, transformer and other electrical appliances, equipments and machines, transformer, plants, any high voltage installation or holdings, etc. shall be properly and reliable earthed.

15. Every medium, high, extra high voltage installations shall affix a notice permanently in understandable (by all) language in conspicuous positions.

16. All electrical equipments like switches, lamps, motor, starters, electric circuit breakers etc. shall be of strictly flame - proof types in the (working) areas where inflammable or explosive or even highly combustible substances are uses. (I. S. : 2148 - 1981 - Revised upto date).

17. Extension chords must not have any taped joints and extension chords must never be used in case of powered bench tools like portable / hand drill. grinder, cutter, etc.

18. Unused power sources and live equipments shall be kept well covered.

19. Powered cords must not be extended with taped joints.

20. Power cords or electric power supply lines must not pass through doors, windows, wall openings, or over any partitions or shall not be hung onmetal pipes, hooks or nails. There shall be no exposed wires on equipment.

21. It should be ensured that all controls function properly, emergency stop / trip devices work properly and indicator lamps operate purposely.

22. Restricted entry and access way to electrical rooms shall be provided and maintained, Easy, free, and unimpeded exit way shall also be maintained.

23. No kind of storage should be allowed in electrical rooms.

24. Never unplug the electrically operated equipment by pulling the cord or plug. First switch off then remove it from the receptacle.

25. Always 3-wire type connection shall be maintained for all portable electric power tools and equipments / appliances. All electrically powered apparatus shall be operated either on the dry floor or on rubber mat or wooden platform.

26. Cover - doors of electrical control panel boxes shall be kept closed.

27. Outlets providing power to portable appiances, shall be equipped with 'ground fault interrupt' (GFI).

28. While removing heavy fuses manually, fuse-puller device should be used, when the circuit is de-energized.

29. In case of carrying out any major electrical repairs, padlocking or tagout procedure must be followed.

30. Large motors must be provided with protective relays to stand against unwanted hazards of over-current, earth leakage, insulation failure, over-heating due to closing of ventilation windows, phase failure etc.

31. In case of electric are welding machine, welding cable should be of hard wear type. Welding return cable conductor should have crosssectional area sufficient to carry the full welding current load. Both welding earth and welding return loads must be well connected to the work / job to maintain reliable electrical connection all along.

32. While climbing any pole, full body harness attached with a safety laneyard shall be provided, if possible together with a rope grab type fall arrestor. The strength of the pole must be tested before climbing. Before climbing any, pole, the line person must first note - (a) Type and position of the circuits, (b) the location of the power source if lines are energized; (c) the particular work to be done : (d) the method of work is to be used ; (e) the clearance is required to protect the working position.

33. In case of E. O. T. crane,

    (a) the main electrical input supply line shall be kept properly insulated as far as possible and should be away from the end- carriage of the travelling crane;

    (b) the 4th wire (i.e. the earth lead) shall be laid as the bottom most one to ensure safety in case of snapping suddenly;