

Seminar Titled  
**SAFETY MEASURES IN PROPULSION  
SYSTEMS**

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Carried out at  
**Propulsion Division  
National Aerospace Laboratories  
Bangalore – 37**

The project titled  
**SAFETY MEASURES IN PROPULSION  
SYSTEMS**

Submitted in partial fulfillment of the requirement  
for the award of Diploma of  
**Diploma in Industrial Safety**

Submitted by  
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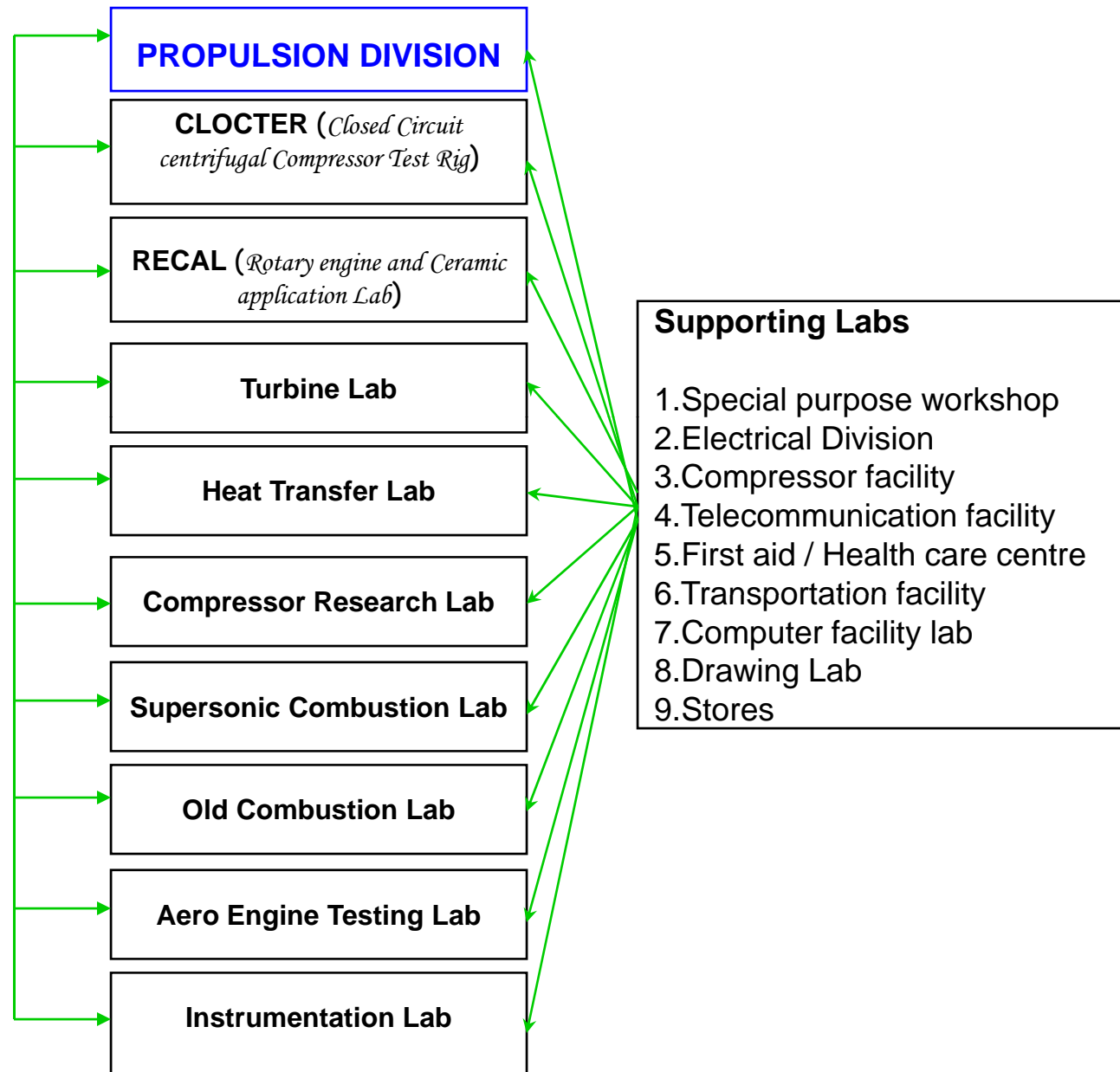
## **Aim of the project**

**This project will be aimed to reduce hazardous nature in propulsion system and maintain enhanced safety procedures as well as suggest methods for safety in various facilities in propulsion division and personal productive equipment.**

## **Objectives**

- **To maintain safety rules and standards.**
- **To reduce hazardous nature in propulsion systems by improving safety method.**
- **Enhanced reduction of fire, noise, mechanical failure, electrical hazard to human being by using proper personal productive equipments.**
- **Enhanced reduction of emission form propulsion system by improving design factor in engine technology.**
- **To enhance productivity by improving safety method.**

# Propulsion Division Infrastructures / Testing Facilities



**What is hazard?**

**Hazard is a word which can cause accident or disastrous to human beings and machineries by unsafe action**

**Hazard – Unsafe Action**

**What is safety?**

**safety is the word which can hold the accident, prevent the hazard by safe action to human beings and machineries.**

**Safety – safe action**

## Why safety standardization required in propulsion systems?

Which is the enhanced method to avoid hazard nature by maintaining and evaluating high level standard in propulsion system to improve R&D activities. The following international organization gives safety standard for propulsion systems

- ❖ EPA (US Environmental Protection Agency)
- ❖ ASSE (American Society of Safety Engineers)
- ❖ CSB (Chemical Safety and Hazard Investigation Board)
- ❖ NSC (US National Safety Council)
- ❖ OSHA (Occupational Safety and Health Administration)
- ❖ DGFASLI (The Directorate General, Factory Advice Service & Labour Institutes)
- ❖ NFPA (National Fire Protection Association)
- ❖ ILO (International Labour Organization)
- ❖ NTSB ( US National Transportation Safety Board)

# Tariff Advisory Committee hazard classification

- **Light Hazard Occupancies**  
Educational and Research Institution
- **Ordinary Hazard Occupancies**  
Manufacturing and machinery occupancies
- **High Hazard Occupancies**  
Propulsion system facilities / Aircraft hangers

# Types of basic hazard in propulsion systems / Facility

## Types of hazard

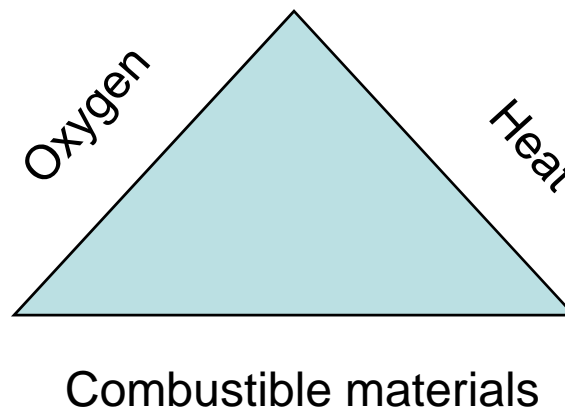
## Sources

- Fire Combustion process / operation
- Electrical Electrical systems / operation
- Mechanical failure Machineries / operation
- Heat radiation Combustion process / operation
- Noise Higher rpm rotating rig
- Vibration Higher rpm rotating rig
- Emission Combustion process / operation



## Fire hazard in propulsion systems and their productive equipments

Fire is chemical reaction in which a combustible material combines with oxygen in the atmosphere to give out heat and flame.



FIRE = Combustible material + Oxygen + Heat (Equal combination)

## General Recommendations for fire hazard

- Good housekeeping to be maintained both inside as well as outside the building.
- Fire License to be obtained wherever required under the West Bengal Fire Service Act, 1950.
- Floor Numbers as well as directional signs of escape routes to be prominently displayed.
- Fire Notice for evacuation and fire fighting to be prepared to display at all vulnerable places in the building.
- The occupants, employees and security staff to be made well-conversant about the installed fire safety and protection measures for their use in exigencies.
- Arrangements to be made for the regular maintenance and checking of the installed fire protection measures to impart cent percent confidence regarding their perfect working in times of need.
- Trained Firemen and Fire Officers in the form of prescribed crew to be maintained for round the clock safety of the establishment.
- Mock practice and fire evacuation drills to be organized for the regular periodical performance in accordance to the National Building Code - Part IV.
- The No Objection Certificate issued by the Director general, West Bengal Fire Services to be reviewed and renewed annually.

# Fire Fighting Systems

The most common types of fire protection systems which are commonly used in industry are as follows:

1. Hydrant System
2. Sprinkler System
3. Fire Alarm System
4. CO<sub>2</sub> System
5. Extinguishers
6. Foam System
7. Halon System
8. Water Spray System
9. Dry Chemical Powder System

# Class of fires and suitable fighting equipments

## **Class A (Solid)**

Fires involving combustible materials of organic nature, such as wood, paper, rubber and many plastics etc., where the cooling effect of water is essential for extinction of fires.

## **Class B (liquid)**

Fires involving flammable liquids, petroleum products etc.,

## **Class C (gas)**

Fires involving flammable gases under pressure including liquefied gases, where it is necessary to inhibit the burning gas at fast rate with an inert gas, powder or vaporizing liquid for extinguishment.

## **Class D (material)**

Fires involving combustible metals, such as magnesium, aluminium, zinc, sodium, potassium, when the burning metals are reactive to water and water containing agents, and in certain cases carbon dioxide, halogenated hydrocarbons and ordinary dry powders. These fire required special media and techniques to extinguish.

# Suitability of Portable Fire Extinguishers

## **Class A Fires**

Water expelling type extinguishers.

## **Class B Fires**

Foam, dry powder, carbon dioxide extinguishers.

## **Class C Fires**

Dry powder and carbon dioxide extinguishers.

## **Class D Fires**

Extinguishers designed for expelling special dry chemical powder.

## Suitability of Different Types of Fire Extinguishers for Different Class of Fires

Type of Extinguisher	Type of Fires			
	A	B	C	D
Fire extinguisher, soda acid, IS:934-1976	S	NS	NS	NS
Fire extinguisher water type, gas cartridge, IS:940-1976	S	NS	NS	NS
Water type bucket pump, IS:1924-1975	S	NS	NS	NS
Water type stored pressure, IS:6234-1971	S	NS	NS	NS
Fire extinguisher chemical foam, IS:933-1976	S	S	NS	NS
Fire extinguisher dry powder, IS:2171-1976	NS	S	S	@NS
Fire extinguisher carbon dioxide type, IS:2878-1976	NS	S	S	NS

S For suitable

NS For not suitable

@ Suitable if special dry powder for burning metal is used

## Placing Extinguisher at Appropriate Location.

- Each new extinguisher should be charged with the ' refill ' provided with it in accordance with the instruction given on the refill container. This however does not apply to the carbon dioxide extinguishers which are available fully charged.
- All refills should conform to relevant Indian Standards.
- All bucket pump type extinguishers should be filled with clean water before being placed in position.
- All new extinguishers should be wiped clean from the outside and the brass parts should be polished with metal polish. Care should be taken to ensure that the nozzle outlet or the vent holes provided in the screwed portion of the cap or shifter valve or vent holes, if provided, do not get clogged.
- Where applicable, hose and nozzle connections should be checked to ensure tightness of joints.
- Each first aid fire extinguishers should be allotted a special number by which it shall be referred to in the records. The following details should be painted with white paint on the body of each fire extinguisher :
  - Serial number,
  - Date of last refilling, and
  - Date of last inspection.
- The details should be repainted each time the extinguisher is refilled or inspected.

## In Open Area:

- Fire extinguishers should be placed on masonry platforms or in wooden or metal cabinets in such a way that their bottom is 750 mm above the ground level.
- Where cabinets or sheds are used to house the extinguishers in the open, these should be so designed that removal of these extinguishers are not hampered in an emergency.

## Inside a building and under cover

- Fire extinguishers whether hung on brackets or kept on shelves should have their bottom 750-mm above the floor level.
- In no case a fire extinguisher should be placed in a position where it is likely to gain heat from the surrounding equipment or the process.

**IMPORTANT: Recharge all extinguishers immediately after use regardless of how much they were used.**



## Fire extinguisher use & safety tips

- Use a portable fire extinguisher when the fire is confined to a small area, such as a wastebasket, and is not growing; everyone has exited the building; the fire department has been called or is being called; and the room is not filled with smoke.

To operate a fire extinguisher, remember the word **PASS**:

- **P**ull the pin. Hold the extinguisher with the nozzle pointing away from you, and release the locking mechanism.
- **A**im low. Point the extinguisher at the base of the fire.
- **S**queeze the lever slowly and evenly.
- **S**weep the nozzle from side-to-side.
- For the home, select a multi-purpose extinguisher (can be used on all types of home fires) that is large enough to put out a small fire, but not so heavy as to be difficult to handle.
- Choose a fire extinguisher that carries the label of an independent testing laboratory.
- Read the instructions that come with the fire extinguisher and become familiar with its parts and operation before a fire breaks out. Local fire departments or fire equipment distributors often offer hands-on fire extinguisher trainings.
- Install fire extinguishers close to an exit and keep your back to a clear exit when you use the device so you can make an easy escape if the fire cannot be controlled. If the room fills with smoke, leave immediately. Know when to go. Fire extinguishers are one element of a fire response plan, but the primary element is safe escape. Every household should have a home fire escape plan and working
- If a fire breaks out, your first step is to call the fire department and get everyone out of the house. If the fire is not spreading and is confined to a small area, use the appropriate type extinguisher for the fire. Know both your limits and the fire extinguisher's limits.
- Periodically inspect your extinguishers to determine if they need to be recharged or replaced. Extinguishers need to be recharged or replaced after each use -- even if you haven't used the entire extinguishing agent.
- When using a portable extinguisher, keep your back to an unobstructed exit that is free from fire.
- Check the manufacturer's instructions for operating guidelines, including proper distance between the extinguisher and fire. Always aim at the base of the fire.

## Some precautions to avoid electrical accidents

- Use always ISI stamped equipments and accessories.
- Replace faulty switches, plugs-pins as and when it was notices.
- Always use 3 way pin & plugs for that wiring should be done suitably to install 3 way sockets for all electrical equipments.
- Engage authorized / licensed persons to carry out wiring or repair works.
- Very old wiring has to be rewired with new switches and fixtures.
- Don't handle electrical apparatus equipments and installations with wet body.
- Provide rubber mats / wooden platform in front of permanent equipments and main switches.
- Switch off and remove fuses before taking up any repair works on any equipments given by electricity.
- Don't move or remove the electrical appliances without switching off the power supply.

## First aid for electrical hazard

- Ensure that the victim of electrical shock is released from the electrical contact.
- Electrical shock often stops breathing – give artificial respiration.
- Treat the victim for shock by placing his head lower than his feet and keeping him warm. Don't give fluids if the victim is unconscious.
- If the victim is burned, cut away loose clothing and immerse the burned area in cold water.
- Get medical aid for any electrical accident.

## Noise Control method

- Every noise problem break down to three component parts.
  - A radiating sound energy
  - A path along which the sound energy travels.
  - A receiver such as human ear, control could be achieved by monitoring any of the above mentioned factors. Usually the following are adopted to check the noise in industries.
- Control of noise by absorption
- The application of sound absorption materials to walls could reduce noise exposure in the room. However this method has limited application in industries as the absorbing material has no effect upon the direct noise from the source.
  - Substitution of less-noisy machines. This includes squeeze type equipment in the place of drop hammers, welding in place of riveting and chemical cleaning of metal instead of high speed polishing and grinding.
  - Reduction of exposure noise
  - Personal protection against noise. This fact is used in personal protection, which can be in the form of either ear muff or ear plug. Ear muffs are used for protection against high frequency, noise while ear plugs for low frequency. If there is going to be a lot of physical exertion the use of muff is recommended. When the work is light the plugs can be used.
- These devices are found to provide reduction of 25 to 40 db if properly worn.

## Control of heat exposures

- Besides providing good general ventilation, it would be necessary in any industrial / laboratory to adopt other additional means for giving relief from heat to the workers.
- Control at source by segregation or by placing equipment out of doors.
- Insulation of heat producing equipment will not only reduce the amount of heat exposure but also result in the savings in fuel consumption etc.,
- Control of radiant heat – by radiation shielding : A shield is simply a sheet of material, opaque to the infra-red waves placed between a hot objects and work surroundings. Materials best suited for radiant heat shields are those with surface that have high reflxivities for radiant heat and low emissivities under plant conditions. As sheet aluminium has these properties, it is the most common materials used for radiation shielding.
- Insulating the roof
- Provision of false roof
- White washing and glazing the exterior surface of the roof.
- Spraying of water intermittently over the roof and cool it by evaporation.
- Openings and glazing in the walls and roof through which suns rays could directly penetrate in summer.

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## During welding

- There should be an observer.
- Use portable screens, booths or partitions to minimize the spread of sparks.
- Trained persons should be employed.
- Do not leave material lying around on the floor.
- In case of electric welding check the connections, cables and earthing in particular.
- Ensure that the welder uses appropriate personal protective equipment like goggles, gloves, boots and if any necessary respirator.
- Don't leave electric circuits on or blow torches burning when the welder has to take break or has to be away for any reason.

## After welding

- Inspect the area for sparks or aflame materials. If you find any remove and extinguish them.
- If any portable extinguisher has been used, replenish it.
- Gas cylinders, blow torches etc., should be returned to the stores or kept at the authorized place.

## Hydrogen fuels and safety

1. Sufficient ventilation to ensure that workers are not unduly exposed to gasoline fumes and other toxic vapors.
2. Fume covers and exhaust systems in laboratory areas.
3. Fuel storage should be away from the combustion area and flame.
4. Necessary safety equipment, such as fire blankets, fire extinguisher, eyewash stations, etc.
5. Automatic fire extinguishing system for laboratory areas. The extinguishing system's design should include considerations regarding the susceptibility of laboratory instruments to damage when exposed to water or dry chemicals.
6. An adequate heating, ventilation, and air conditioning (HVAC) system to handle excess heat generated by surroundings.
7. A properly designed and sized electrical system.
8. Automatic hydrocarbon monitors to warn of critical accumulation of explosive vapours.



## **Ignition hazard control from LPG/Petrol/Kerosene fuels**

1. Electrical wiring and equipment for light, heat, or power purposes shall be installed in observance with the requirements .
2. Internal combustion engine powered equipment shall be so located that the exhausts are well away from combustible materials. When the exhausts are piped to outside the building under construction, a clearance of at least 6 inches shall be maintained between such piping and combustible material.
3. Smoking shall be prohibited at or in the vicinity of operations which constitute a fire hazard, and shall be conspicuously posted: "No Smoking or Open Flame."
4. Portable battery powered lighting equipment, used in connection with the storage, handling, or use of flammable gases or liquids, shall be of the type approved for the hazardous locations.
5. The nozzle of air, inert gas, and steam lines or hoses, when used in the cleaning or ventilation of tanks and vessels that contain hazardous concentrations of flammable gases or vapors, shall be bonded to the tank or vessel shell. Bonding devices shall not be attached or detached in hazardous concentrations of flammable gases or vapors

# **SPECIAL TYPE GAS USAGE AND SAFETY**

## **Precaution**

1. Since Freon 11 is practically odorless and nontoxic, it is not necessary to wear a gas mask when servicing equipment that contains it. However, it is essential that proper protection be afforded the eyes by the use of goggles or large-lensed spectacles to eliminate the possibility of liquid Freon 11 coming in contact with the eyes and causing injury by freezing the tissues of the eyes. This protection is necessary and should be taken whenever loosening a connection on a system in which Freon 11 is confined.
2. Leakage should be monitor in the rig.
3. Proper maintenance should be done.

## **Remedies**

1. If liquid Freon 11 should come in contact with the eyes, the person suffering the injury should be taken at once to an eye specialist. Avoid rubbing or irritating the eyes and give the following first-aid treatment immediately:
2. Irrigate the eyes with drops of sterile mineral oil.
3. If irritation continues, wash the eyes with weak boric acid solution or sterile salt solution not exceeding 2 percent sodium chloride (common table salt).

## Radiation hazard and their prevention method/standards

1. The American Conference of Governmental Industrial Hygienists (ACGIH) has published the Threshold Limit Values (TLV) for occupational exposures to UV, Visible and IR radiation incident upon eye. The TLV may be taken as a guide in providing the eye protection filter glasses to the workers to prevent the hazards of retinal, thermal and photo-chemical injury.
2. German standards — DIN 4646 and 4647 specifies the spectral transmission of eye protection filters required by the welder during gas and/or arc welding under various variants of work like size of electrodes, thickness of the work sample, and for hot welding etc. Depending upon the type of welding operations, the filter may have spectral transmission of 10% or less between UV wavelength region (320nm to 365 nm), 40% or less between Visible region (400nm to 700nm) and less than 30% for IR radiations (800nm-2000nm). These filter glasses are commercially available.

**Safety is required by all whether a man is big or same**

**Over confidence is an invention to accidents**

**Invest on safety – Earn on productivity**

**Work safely all the while – Go home with a smile**

**Alert today – Alive tomorrow**

**Accident for one – suffering for many**

**Always maintain safety – Both in life and work**

**One milligram safety – Can give million tones of happiness**

**A chance taker is an accident maker**

**THANK YOU**