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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS



Pamphlet

CLASSIFICATIONS OF FIRES & TYPES OF FIRE EXTINGUISHERS

CAMTECH/E/2022-23/EP-01/ Fire/1.0

JUNE 2022

END USER

GENERAL AWARENESS
TO ALL FIELD STAFF

INDIAN RAILWAYS



EXCELLENCE IN MAINTENANCE

Centre for Advanced Maintenance Technology

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INTRODUCTION

The fire incidences are among the most serious disasters impacting human lives as well as property. Many wrong and misleading information on “Classification of Fires and Fire Extinguishers” are available online which are not as per Indian Standards as details given in table below. This leads to confusion over correct selection of fire extinguishers based on material on fire (fuel), since all available fire extinguishers in India are being manufactured as per Indian Standards. If wrong type of fire extinguisher is used for extinguishing the fire, it might make matters worse.

Material on Fire	Indian standard	UK/ Europe	US	Australian
Solid combustible materials of organic nature	Class A	Class A	Class A	Class A
Flammable liquids	Class B	Class B	Class B	Class B
Flammable gases under pressure	Class C	Class C	Class B	Class C
Combustible metals	Class D	Class D	Class D	Class D
Cooking media (Kitchen Fire)	Class F	Class F	Class K	Class F
Energised electrical conductors/ equipment	No class	No class	Class C	Class E

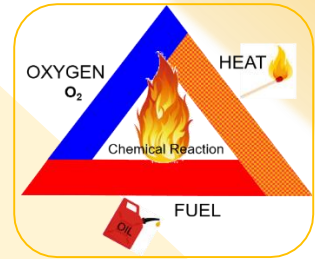
OBJECTIVE OF THIS PAMPHLET

- To create awareness among the field staff to use appropriate fire extinguishers according to the nature of material on fire (fuel).
- To give correct information related to “Classification of Fires and Fire Extinguishers” according to Indian Standards (IS 15683:2018 & IS 2190:2010).
- To give information related to fires involving energized electrical equipment with correct identification of fire extinguishers for mitigation of fire.
- Also to give information related to fire extinguishers appropriate for fires in areas where presence of sensitive electrical and electronic equipment such as control rooms, computers, relay circuits.

CHARACTERISTICS OF FIRE (Fire Triangle)

The fire requires three elements to ignite: heat, fuel, and an oxidizing agent (usually oxygen).

By eliminating any one of the element, fire can be extinguished.



CLASSIFICATION OF FIRE ACCORDING TO

TYPE OF FUEL *(Ref: para 3.1 of IS 15683 : 2018 & para 9 of IS 2190:2010)*

Fires are classified according to the type of fuel that is burning, which is as under:

Class of Fire	Symbol	Definition
Class A		Fires involving solid combustible materials of organic nature such as wood, paper, rubber, plastics, etc. where the cooling effect of water is essential to extinguish the fire.
Class B		Fires involving flammable liquids or liquefiable solids or the like where a blanketing effect is essential to extinguish the fire.
Class C		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		Fires involving combustible metals such as magnesium, aluminium, zinc, sodium, potassium etc., when the burning metals are reactive to water containing agents and in certain cases carbon dioxide, halogenated hydrocarbons and ordinary dry powders. These fire require special media and techniques to extinguish.
Class F		Fires involving cooking media (vegetable or animal oils and fats) in cooking appliances and may be called kitchen fire.
No class		Where fire involves energized electrical equipment.

ELECTRICAL FIRES

(Ref: para 9 of IS 2190 : 2010 and para 10.2.3 of IS 15683 : 2018)

In Indian Standards, Electrical fires (fires involving energised electrical conductors/ equipment) are not given specific class, as they can fall into any of the classifications as per the **material on fire (fuel)**. Electricity may initiate fire but it is not the electricity that is burning but surrounding material that has been set alight. For example, if a computer will burn due to a short circuit, then the computer is on fire and not electricity. In de-energised condition, this is then class A fire.

Therefore, it is important to decide selection and use of extinguisher on live electrical installations. The extinguisher that have passed **electrical conductivity test** should only be used on fires involving energised electrical conductors/equipment and fire extinguishers shall have this symbol marked on it.



Dealing with Electrical Fires

- ☞ Fire extinguishers with **Class C** ratings shall be required **where energized electrical equipment** can be encountered. This requirement includes situations where fire either directly involves or surrounds electrical equipment. Since the fire itself is a Class A or Class B hazard, the fire extinguishers shall be sized and located on the basis of the anticipated Class A or Class B hazard. (Ref: para 5.4.3 of IS 2190 : 2010)
- ☞ Where energized electrical equipment is involved in a fire, **non-conductivity of the extinguishing media** is of utmost importance, and only extinguishers **expelling dry powder, carbon dioxide (without metal horn) or clean agent** should be used. Once the electrical equipment is de-energized, extinguishers suitable for the class of the fire risk involved can be used safely. (Ref: para 10.2 of IS 2190 : 2010).
- ☞ Where **cleanliness and contamination of sensitive electrical equipment** are of importance or where the sensitivity of the control instruments or electronic equipment and systems are likely to be affected, only **Carbon Di-oxide or Clean Agent** type extinguishers should be used. (Ref: para 10.3 of IS 2190 : 2010).

TYPES OF FIRE EXTINGUISHERS (PORTABLE)

(Ref: para 4 of IS 15683 : 2018)

Portable fire extinguishers are not expected to deal with large fires but, these are very valuable if used promptly and efficiently in the early stages of fire. Extinguishers are labelled with either letter-shaped or pictorial symbols that indicate what types of fires the extinguisher is designed to fight.

Fire Extinguishers may be classified by the type of extinguishing medium which they contain. At present, the main types of extinguishers are:

TYPES

Water based

Foam based

Powders based — ABC/BC/D Type

Carbon dioxide

Clean agents and

Water mist type

Water or APW (Air-Pressurized Water) based Fire Extinguishers

★ *Extinguishing Media - Water and Water Mist*

★ *Suitable for - CLASS A (Wood, paper, cloth etc.) fires*

❖ APWs extinguish fire by taking away the **“heat” element** of the Fire Triangle.

Note: Water extinguishers can be very dangerous in the wrong type of situation. Only fight the fire if you're certain as it contains ordinary combustible materials only.



Foam based Fire Extinguishers

★ *Extinguishing Media* - foam (mixed with water)

★ *Suitable for* - class A and class B (flammable liquids)

They spray a type of foam (mixed with water) that expands when it hits the air and blankets the fire.

This blanket prevents the vapours from rising off the liquid to feed the fire, thus starving it of **fuel**. Also, because the foam is mixed with water, it has a **cooling** effect as well.



Dry Chemical Powder (DCP) Based Fire Extinguishers

★ *Extinguishing Media* - Dry Chemical Powder

★ *Suitable for* - suitable for a combination of Class A, B, C fires.

- The greatest portion of this powder is composed of **Mono Ammonium Phosphate (MAP)** and the extinguishers are pressurized with nitrogen.
- Dry chemical extinguishers put out fire by coating the fuel with a thin layer of dust. This separates the **fuel** from the oxygen in the air.
- The powder also works to interrupt the chemical reaction of fire. These extinguishers are very effective at putting out fire.
- DCP fire extinguishers are available in variety of types and are suitable for a combination of Class A, B, C fires.
- It is extremely important to identify which types of dry chemical extinguishers are available at the site.
- DCP (Dry Chemical Powder) extinguishers have an **advantage over CO₂** extinguishers since that leave a non-flammable substance on the extinguished material, **reducing the likelihood of re-ignition**.



Note: Dry powder extinguishers, when used in confined areas may reduce visibility for a few minute, which may temporarily jeopardize escape, rescue or other emergency action. (Ref: 10.5 of IS 2190:2010)

Carbon Dioxide (CO₂) Based Fire Extinguishers

★ *Extinguishing Media* - Carbon Dioxide (CO₂), a non-flammable gas

★ *Suitable for* - suitable for Class B and C fires

- Carbon dioxide is a non-flammable gas that takes away the **oxygen** element of the fire triangle. Without oxygen, there is no fire.
- CO₂ is very cold as it comes out of the extinguisher, so it cools the fuel as well.
- The pressure in this extinguisher is so great that it is not uncommon for bits of dry ice to shoot out the nozzle/horn.
- A CO₂ may be **ineffective in extinguishing a Class A** fire because it may not be able to displace enough oxygen to successfully put the fire out, causing it to re-ignite.
- CO₂ extinguishers have an **advantage** over DCP since they don't leave a harmful residue, therefore it is a **good choice for an electrical fire** on **sensitive electrical equipment**, control instruments or electronic equipment where **cleanliness and contamination** are of importance.



Clean Agents Based Fire Extinguishers (Ref: para 3.13 of IS 15683 : 2018)



- Clean Agents are electrically non-conductive gaseous or vaporizing liquid fire extinguishant that does not leave a residue upon evaporation and are not toxic to level of concentration at which it extinguishes the fire.
- Clean agents are halon substitutes such as HFC, HCFC, HBFC, their blends and fluoro- ketone, etc.
- Name of clean agent shall be marked on the label of the extinguishers.

Wet Chemical extinguisher

- Wet chemical fire extinguisher is specially designed for **CLASS F FIRES**, those involving cooking media such as animal and vegetable fats or oils.
- These extinguishers contain a solution composed of **Potassium** that effectively launches a two-pronged assault on fires:
 - First, the liquid mist, it sprays acts to **cool** the fire.
 - Second, due to the chemical reaction of the solution with the cooking medium, a thick soap-like substance forms, sealing the surface of the liquid to prevent re-ignition.



SPECIAL FIRE EXTINGUISHERS

Fire Suppression Balls

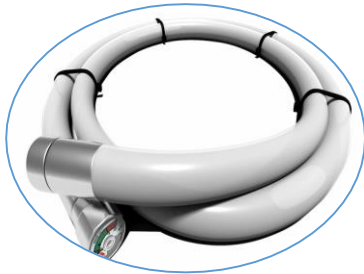
(Ref: Rly. Bd. L. No. 2001/Elect (G)/113/4/Safety dated 07.01.2021)

- These are “**Self activating Fire Extinguishing balls**” and they contain MAP (Mono Ammonium Phosphate) in range of 90 to 95%.
- These fire extinguishing balls are a good low cost source to control spread of fire.
- Whenever these balls come in contact with fire, they burst automatically means even if the place of probable fire is unmanned, after start of fire, these balls will burst without any manual intervention.
- These fire balls may be used in electrical sub-stations, workshops, in coal or metal mines, oil mines etc.



Automatic Cylinder-less Fire Detection & Suppression Tube System

- This system consists of a heat sensitive tube made of special plastic which is closed by a stainless steel fitting on each end.
- The tube has both storage and detection function which means that the extinguishing agent is stored directly in the tube and no additional storage device such as cylinder is needed.
- The system is suitable for protection of small enclosures with greater risk of fire such as electrical panels, server racks, tele-communication cabinets etc.
- It operates automatically without any power supply by detecting higher temperatures. When the temperature in the protected enclosure rises to a critical threshold (between 95°C-120°C temp), the heat sensitive tube melts / ruptures down at the point where the affecting temperature is the highest.
- Melting of the tube creates a hole releasing the entire extinguishing agent stored in the tube directly onto the source of the fire.



MARKING AND COLOUR *(Ref: para 10.1 of IS 15683 : 2018)*

The recommended colour for extinguisher bodies is **RED**. A small band of distinguishing colour of approx. 5 percent/prominent of surface area shall be painted for different type of extinguishers as given below:

Extinguishers	Band Colour
Water based/ Water mist extinguishers	Red
Foam based extinguishers	Yellow
Powder based extinguisher	Blue
Carbon dioxide based extinguishers	Black
Clean agent extinguishers	Green

SUITABILITY OF DIFFERENT TYPES OF FIRE EXTINGUISHERS

(Ref: Table 3 of IS 2190:2010)

S.N.	Type of Extinguisher	Class of Fire			
		A	B	C	D
1.	Water type (gas cartridge or stored pressure)	YES	NO	NO	NO
2.	Mechanical foam type (gas cartridge or stored pressure)	YES	YES	NO	NO
3.	Dry powder type (gas cartridge or stored pressure)	YES	YES	YES	NO
4.	Dry powder type for metal fires	NO	NO	NO	YES
5.	Carbon dioxide type	NO	YES	YES	NO
6.	Clean agent gas type	YES	YES	YES	NO

SUMMARY OF FIRE CLASSES & TYPES OF FIRE EXTINGUISHERS

Fire Class	Material on Fire i.e. Fuel (Ref: para 3.1 of IS 15683: 2018 & para 9 of IS 2190:2010)	Suitable type of Fire Extinguisher (Ref para 10.1 of IS 2190:2010)
Class A	Ordinary combustible solids such as wood, paper, rubber, plastics, furniture, curtains etc.	water, foam, ABC dry chemical powder and halo carbons extinguishers
Class B	Flammable liquids or liquefiable solids such as petrol, diesel oil, acetone, wax etc.	Foam, dry chemical powder, clean Agents and carbon dioxide (CO ₂) extinguishers
Class C	Flammable gases under pressure including liquefied gases such as LPG, natural gas, propane, methane etc.	Dry chemical powder, clean Agents, and carbon dioxide (CO ₂) extinguishers
Class D	Combustible metals such as magnesium, aluminium, zinc, sodium, potassium, etc.	Extinguishers with special dry powder suitable for metal fires
Class F (Kitchen Fire)	Cooking media such vegetable or animal oils and fats etc.	Wet chemical fire extinguisher
	Energised electrical conductors / equipment involved in fire	non-conducting extinguishing media such as dry chemical powder, carbon dioxide (without metal horn) or clean agent.

POINTS TO BE INSPECTED FOR FIRE EXTINGUISHERS

(Ref: Para 11 of IS 2190:2010)

Periodic inspection of fire extinguishers shall include a check of at least the following items:

a. Location in designated place.



b. No obstruction to access or visibility.



c. Operating instructions on nameplate legible and facing outward.



d. Safety seals and tamper indicators not broken or missing.

e. Fullness determined by weighing or lifting.

f. Examination for obvious physical damage, corrosion, leakage, or clogged nozzle.



g. Pressure gauge reading or indicator in the operable range or position.



h. Condition of tyres, wheels, carriage, hose, and nozzle checked (for wheeled units).

Maintenance, servicing, and recharging shall be performed by **trained persons** and Record of the date of inspection, recharging, etc. should be maintained in the register.

SELECTION OF LOCATION (Ref: para 6 of IS 2190 : 2010)

When selecting locations for fire extinguishers, due consideration should be given to the nature of risk to be covered. Ex. Class of Fire risk involved.

The extinguishers should be placed in visible positions and shall be readily accessible for immediate use in all parts of occupancy.

Generally, fire extinguishers should be placed as near as possible to exits or stair lands without hindering the escape routes.

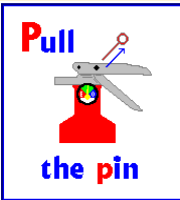





Extinguishers should be sited in such a way that the user may not have to travel more than 15 m from the site of the fire to reach the extinguishers.



HOW TO USE A FIRE EXTINGUISHER(PASS)

The use of a portable fire extinguisher, can be remembered easily as the **PASS** method. Using a fire extinguisher requires just 4 easy steps, each represented by a letter in the word **PASS**:

Pull	Pull the safety pin on the extinguisher.		Hold the extinguisher with the nozzle pointing away from you and release the locking mechanism. This will allow you to discharge the extinguisher.
Aim	Aim the hose of the extinguisher at the base of the fire.		If you aim at the flames (which is frequently the temptation), the extinguishing agent will fly right through and do no good. You need to hit the fuel.
Squeeze	Squeeze the top handle/ trigger/ lever to discharge the extinguishing material/ media.		This depresses a button that releases the pressurized extinguishing agent in the extinguisher. Remember to squeeze it slowly and evenly, so the extinguisher is as effective as possible.
Sweep	Sweep the nozzle from side to side (slowly) until the fire is completely out.		Start using the extinguisher from a safe distance away, then move forward. Once the fire is out, keep an eye on the area in case it re-ignites.

REFERENCES

1. IS 15683 : 2018 (First Revision) - Specification for Portable Fire Extinguishers - Performance and Construction.
2. IS 2190 : 2010 (Reaffirmed 2020) - 'Code of practice for selection, installation and maintenance of first-aid fire extinguishers'.

Disclaimer:

It is clarified that this pamphlet does not supersede any existing provisions laid down by Indian Standards, Railway Board, RDSO or Zonal Railways. The pamphlet is for guidance only and it is not a statutory document.

If you have any suggestion or comment, please write to:

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