

# ***Fire – A Boaties Nightmare***

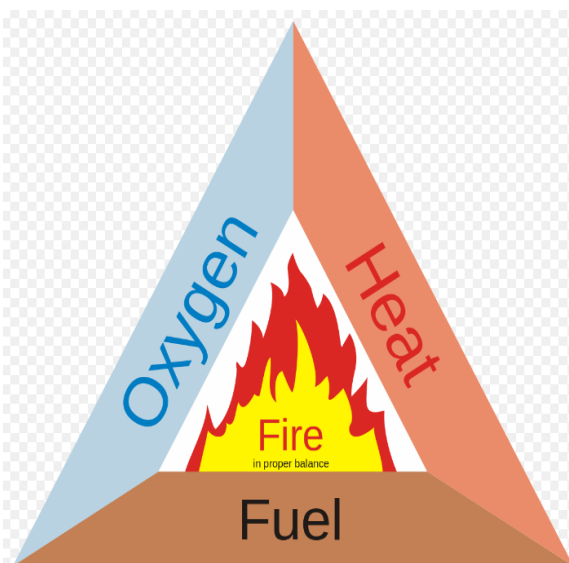


Fires don't discriminate with over 140 marine craft fires with total losses in excess of \$37M reported to and attended by Department of Fire and Emergency Services (previously FESA) in the last 10 years. In fact, during the 2012-2013 financial year there were 28 fires with losses of approx \$2.4M.

Fires are a real problem on board any vessel due to the confined space, the speed at which fire spreads and the intense heat generated. It is essential for all boat users to understand the principles of fire, the correct use of extinguishers and most importantly, the prevention of fire on board vessels. Few people are able to successfully fight a fire aboard a small vessel, therefore prevention is essential, and this is mainly done by good housekeeping.

## ***Understanding Fire***

Fire is a rapid chemical reaction producing energy in the form of heat and light. Oxygen, fuel and heat in their proper proportions are the basic components of combustion. The fourth component is the chemical flame chain reaction which is the rapid formation and consumption of certain atoms during combustion. If any of the 4 components are removed or interrupted, fire cannot exist and extinguishment will occur.



## ***Extinguishing Methods***

The four methods of extinguishing a fire are directly related to the 4 components. To extinguish a fire, you need to be able to:

- Cool – by reducing the temperature so that the temperature falls below the ignition point of that material
- Smother – if oxygen is excluded or limited from a fire the combustion process cannot continue
- Starving – by removing the combustible material itself, isolating the fuel supply or letting total consumption take place
- Inhibiting the Flame Chain Reaction – Certain chemicals can interrupt the chemical reaction taking place.

### ***Flammability***

All flammable materials have varying ranges of flammability. If too much or too little fuel is present (the concentration in air) burning will not take place. Petrol and Diesel have flammability ranges of approximately 2% - 8% but the fuel needs to be warm enough to give off vapours as it is the vapours from all combustible materials that burn. This flashpoint or ignition temperature (vapours produced) happens with petrol at about -40°C but diesel needs to be heated to >60°C.

Petrol and diesel have autoignition temperatures of 280 °C and 210 °C, respectively meaning that at these temperatures these fuels will spontaneously ignite without the need for the introduction of an external ignition source.

### ***Types of fires***

Fires involving various types of combustible matter (fuel) are divided into classes so that an appropriate extinguishing medium may be chosen.

#### **Class A – Ordinary Combustible Material.**

Fires which involve ordinary combustibles (wood, textile, plastic, paper etc) requires the cooling effect of water. Water is best applied in a spray or fog pattern as the increased surface area of the droplets can absorb heat quicker forming steam.

Plastics cover an extremely wide range of products and most burn with terrific intensity, are highly combustible, and the products of combustion smoke, gases and fumes are highly toxic.

#### **Class B – Flammable Liquids**

Fires involving petrol, diesel, kerosene, fats, etc are extinguished by the exclusion of oxygen or interfering with the flame chain reaction. Foam is primarily used as it floats on the surface eliminating the vapours of the fuel. A fire blanket works on the same principle and is a recommended acquisition for all households and boats.

#### **Class C – Flammable Gases**

This classification includes liquefied gases like LPG, methane, propane etc and these fires are extinguished by the removal of fuel by turning off the valve, crimping a supply line or letting the supply run out. It is most important with these fires to ensure the cylinders' internal pressure is reduced by cooling with water.

#### **Class D – Metal Fires**

Most metals will burn, some more intensely than others and at a range of temperatures and conditions. For each metal a specially designed extinguishing agent is required.

#### **Class E – Electrical Fires**

Electricity itself does not burn but an electric arc or short circuit may cause a fire in any of the above classes. In the case of electrical fires, if possible, first isolate the power supply and then treat as a normal fire. If isolation of the supply is not possible remember that water conducts electricity and a different extinguishing medium should be utilised.

### ***Fire Extinguishers***

Speed is of the essence and the hotter the fire the harder it is to extinguish but correct use of an extinguisher will effectively prevent a small fire getting out of control.

Advantages	Disadvantages
Quick action	Short duration
Portable	Not universal











One person operation	Reliability suspect
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While each extinguisher works in a different way the general method is the same (PASS)

- **P**ull the pin
- **A**im nozzle at the base of the fire
- **S**queeze the trigger handle
- **S**weeping pattern of nozzle from left to right

Once used, even if not empty, they should be replaced or recharged ASAP.

There are five basic types and it is essential to identify the correct type for the class of fire and their method of operation. This information is displayed on each extinguisher and the colour coding is standard throughout Australia. If extinguishers are to be useful, they should be located close to but **not next to** the hazard, be readily accessible, of the right type and the **occupants be familiar their mode of operation**. Their location and use should be included with your safety brief at the beginning of each voyage and everyone who comes aboard your vessel must know how to react in the event of fire.

ID SIGN	TYPICAL APPEARANCE	EXTINGUISHER TYPE (Cylinder Contains)	CLASS A Wood, Paper Textiles etc. (Normal Combustibles)	CLASS B Flammable Liquids Petrol, Paints	CLASS E Electrical Fires	CLASS F Cooking Oil, Animal Fats, Vegetable Oil
		DRY POWDER CHEMICAL	YES	YES	YES	NO
		Co2 CARBON DIOXIDE	NO	YES	YES	NO
		WATER	YES	NO	NO	NO
		FOAM	YES	YES	NO	NO
		WET CHEMICAL	YES	NO	NO	YES

**RED** with WHITE BAND – Dry Chemical Powder (DCP) (A, B, C, E Class)

Direct powder above the base of the fire in a rapid, side to side sweeping motion

Extinguishes by smothering and interrupts the chain flame reaction

They are the most popular as they are inexpensive, versatile, easy to use and easily replaced.

**WARNING** - the powder can tend to settle effecting use, so it is recommended to invert and shake the extinguisher regularly to loosen the powder.

**RED** with BLACK BAND – Carbon Dioxide (CO<sub>2</sub>) (B & E Class)

Discharge close to fire moving nozzle from side to side

Extinguishes by smothering and displacing oxygen, effective in confined spaces

After use ventilate confined areas well before entering

All **RED** – Water (A Class)

Direct stream at base of fire and can be used intermittently

Extinguishes by cooling, readily available and cheap

All **BLUE** or **RED** with **BLUE** BAND – Foam (AFFF) (A & B Class)

Direct stream over entire burning surface so it falls like flakes of snow  
 Foam floats on most flammable liquids forming a vapour proof layer which prevents reignition

**Maintenance**

- Be aware of corrosion
- Check gauge regularly
- Invert and shake DCP regularly to prevent powder settling.

REMEMBER, there is no point in having a fire extinguisher if it malfunctions at the time of an emergency or you don't know how to use it. Ensure you can get to it quickly in the event of a fire and store it on a visible location between the hazard and the exit.

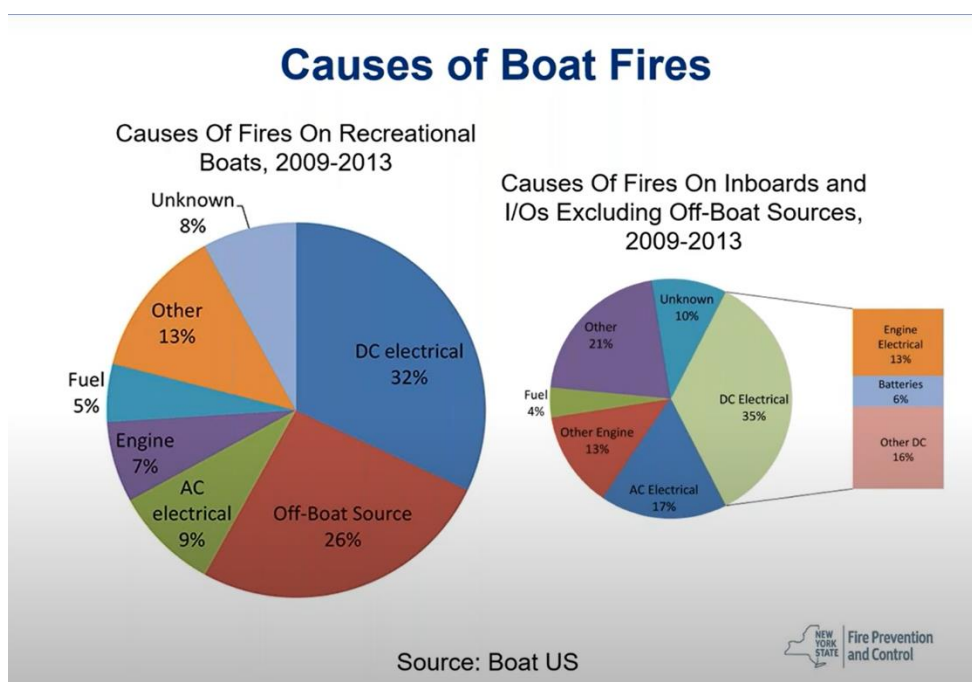
**Ignition Sources**

For a fire to occur you need an ignition source. These vary and include:

- Mechanical – turbos, exhaust manifold
- Electrical – Cheaper non tinned wiring, oversized fuses, corrosion, lithium batteries (more info below)
- Fuel or Gas – Cooking, Heating, Static electricity, Leaks
- Hard Stand – hot work, battery chargers

Oil and fuel leaks are often due to the failure of pipes and/or associated fittings. These failures can be caused by mechanical fatigue, vibration, chafing, degradation by sun, improper securing, poor quality fittings or improper repairs. A cracked fuel or hydraulic line might also cause an atomised spray of flammable liquid onto hot exhaust manifolds or turbo causing a fire to occur.

Some vision of different ignition tests of various boats is available on YouTube at [Foundation Findings #55 Boat Burn \(youtube.com\)](https://www.youtube.com/watch?v=FoundationFindings#55BoatBurn)



Off boat source includes fires spreading from adjacent vessels, facilities or buildings.

### ***Prevention***

About half of boat fires are caused by electrical problems (some may call understanding electricity a dark art or black magic) and just because it may be a 12 volt system it doesn't mean the risks are any less and it won't cause a fire. All electrical work should be carried out by a licensed electrician to be sure that it is intrinsically safe.

Fuel vapours account for many of the more explosive fires on board. Like LPG, petrol vapours are heavier than air so vapours may accumulate in the bilge. So before starting your engine, lift the cover and smell for fumes, particularly after refuelling. Electronic detection as well as checking with your nose can help prevent an explosion by an errant spark. A blower within the engine room should also be used to provide adequate ventilation.

Prevention of boat fires is assisted by regular maintenance, diligent housekeeping and common sense.

- Keep bilges clean of oil, fuel and dirty rags and degrease regularly
- Check hose clamps regularly
- Check electrical wiring for corrosion or loose connections regularly
- Check fuel, oil and gas systems for leaks, cracked lines and chafing regularly
- Turn off all appliances, engines etc and extinguish all flames before refuelling
- Check for vapours after refuelling and ventilate until clear
- Leave electrical or fuel system maintenance and repairs to trained personnel
- Always turn off gas at the cylinder
- No smoking on board or until after ventilation
- Wipe up all spills
- Never refill portable fuel tanks on board – always take them ashore
- Use only marine approved appliances and qualified tradies
- Always be careful when cooking and don't leave cooking unattended
- Thoroughly check all systems after long unused periods
- Don't place batteries on charge for extended periods of time as they can overheat causing a fire

### ***Lithium Ion Batteries***

The LiFePO<sub>4</sub> battery has the edge over other lithium-ion types, both in terms of cycle life (it lasts 4-5x longer), and safety. This is a key advantage because lithium-ion batteries can overheat and even catch fire, while LiFePO<sub>4</sub> is far more stable. After-market batteries or chargers, cheaper imports and the boat toys we carry on board are more of a risk. Things to consider when using battery operated tools or toys on board include:

- Salt water, heat & batteries are not a good combination.
- Store in cool dry place
- Burns at 2000C, produce toxic fumes and are difficult to extinguish
- When charging
  - Keep battery out of the sun
  - Do not charge immediately after use or when they are hot
  - 3 hrs max – set a timer
  - Don't leave tools and toys on board
  - Don't charge on combustible surfaces (bed, couch, carpet)
  - Don't leave unattended
  - Can you get out safely if a fire was to occur

Li ion batteries can also get damaged and become dangerous when dropped, overcharged or mistreated. If a battery is:

- Cracked
- Hissing
- Discoloured
- Venting gas
- Bulging
- Hot
- Leaking

**Or damaged in any way or you even suspect it is don't use it.**

More Lithium Battery information is available on Nautilus Marine site [Lithium-ion Battery Safety - Nautilus Marine Insurance \(nautilusinsurance.com.au\)](http://nautilusmarine.com.au) or the full detailed CSIRO report commissioned by ACCC is available here [Report: Lithium-ion battery safety \(productsafety.gov.au\)](http://productsafety.gov.au)

### ***Fire on-board***

In the event of a fire on board

- **Seal area** – close hatches/doors, reduce available oxygen.
- **Issue life jackets** – can you get to them quickly?
- **Send out a distress call** – How is your radio connected to power?
- **Shut down power** – can you get to all isolation switches easily?
- **Extinguish fire** – can you access the extinguisher quickly/do you know how to use it?
- **If necessary, abandon ship**

And finally, if people sleep on board, you should install smoke alarms.

## ***Fires don't discriminate, it can happen to you***



*"In the end, it's all about taking due care and paying attention to the basics. There is no such thing as shortcuts when it comes to fire prevention. You need to make sure that your craft is in good condition, that all the wiring and fuel systems are up to scratch and that, most importantly, your fire-fighting equipment is ready to go. You also need to think about what you need to do in the event of a fire and, even more importantly, you need to educate your passengers about standard fire drills". (Club Marine)*