

# Fire

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## 1 Fire Triangle

The fire triangle shows three required components:

**Fuel** to burn.

**Heat** to start the fire.

**Oxygen** to sustain the fire.

## 2 Consequences of fire

- Destruction of the data centre / server room itself.
- Destruction of the hardware inside the data centre / server room.
- Loss of data caused by the destruction of data centre equipment.
- Interruption to business continuity due to unavailability of the data centre during or after a fire event.

## 3 Data centre-specific factors

1. Data centres are not normally occupied in the normal course of work. In fact, a properly run data centre should rarely need humans inside it for extended periods. However, this means that fires are less likely to be noticed.
2. Smaller server closets are particularly at risk of being used as unofficial storage areas for equipment, paperwork and indeed rubbish. Any solid object is potential fuel for a fire and shouldn't be there.
3. Data centres run at elevated temperatures to conserve electrical power. While an office might be at 21C, a server room may be at 25C.
4. Elevated temperatures lead to lower relative humidity. Less dampness makes it easier for a fire to progress, and can worsen the effects of electrical sparks.
5. A large amount of electrical equipment is present in a relatively small area.
6. UPS systems include batteries. Lead-acid cells can vent hydrogen if overcharged, and lithium-ion batteries can easily catch fire.

## 4 Actions required

**Prevention** of fire outbreak.

**Mitigation** of effects a potential fire can have.











**Detection** of a fire at the earliest possible stage.

**Alerting** persons inside and responsible persons outside the data center environment that a fire has started.

**Suppression** of the fire.

## 5 Fire classes

Fires can be categorised into a number of classes depending on the type of fire, . Knowing the class of a fire helps when choosing how to fight it.

Class of Fire	Type of Fire	Type of Extinguisher	Extinguisher Identification	Symbol
<b>A</b>	Ordinary combustibles: wood, paper, rubber, fabrics, and many plastics	Water, Dry Powder, Halon		
<b>B</b>	Flammable Liquids and Gases: gasoline, oils, paint, lacquer, and tar	Carbon Dioxide, Dry Powder, Halon		
<b>C</b>	Fires involving Live Electrical Equipment	Carbon Dioxide, Dry Powder, Halon		
<b>D</b>	Combustible Metals or Combustible Metal Alloys	Special Agents		No Picture Symbol 
<b>K</b>	Fires in Cooking Appliances that involve Combustible Cooking Media: Vegetable or Animal Oils and Fats			

**Figure 1:** Fire classes

### 5.1 Prevention strategies

The easiest prevention strategies involve reducing the availability of fuel, heat and oxygen.

#### 5.1.1 Fuel

The easiest way to reduce the risk of fire in a data centre is to reduce the amount of fuel:

- All equipment should be either racked or wall mounted if relevant. Nothing should be allowed on the floor.
- Decommissioned or unused equipment should be removed.
- Wiring that is obsolete and unlikely to ever be reused should be fully removed.

- The data centre must not be used as a storage area, either for equipment nor paperwork.
- If a small working desk is provided inside the data centre, it must be for occasional use while performing a task and a “clean desk” policy must be in place.
- Rubbish (e.g. packing boxes) must be removed immediately from the data centre after any work is done. If packaging is not going to be immediately disposed of, it should be stored elsewhere outside the data centre.
- The data centre must be kept clean and free of dust.
- Manufacturer’s instructions regarding batteries in particular must be fully complied with.

## 5.2 Heat

In a closed volume of air, raising the temperature (as would be the case in a data centre) has two effects:

- Fires are easier to sustain.
- Reduced humidity, causing increased risk of sparks.

## 5.3 Oxygen

Oxygen is present at approximately in the air under normal conditions:

- Normally this is just a physical fact that has to be lived with!
- A very small number of data centres worldwide are equipped with a hypoxic air supply system which reduces the oxygen concentration to approximately . Fires cannot start or be sustained under these conditions.
- Although hypoxic air systems are not commonly deployed, reducing the oxygen content is a key part of gaseous fire suppression systems, which function differently.

# 6 Mitigation strategies

Sometimes, fire will damage or destroy the data centre, or the building in which it is situated.

- Just as we have redundancy levels in power and cooling, consider having a secondary data centre location. This will involve duplication of hardware, mirroring of data and configuration, and may involve complex network routing.
- Virtualisation can make it easier to migrate many workloads from one location to another.

# 7 Detection methods

Fire is detected normally by its byproducts: smoke and heat.

**Smoke detectors** signal an alarm when they detect smoke particles in the air. Two methods:

**Ionisation** detectors use radio isotopes to ionise the air, allowing it to conduct electric current. When a change is detected due to the presence of smoke, an alarm is triggered.

**Photoelectric** detectors use a light source passed through the air that is incident on a photoelectric cell. When the light becomes sufficiently obscured by smoke, an alarm is triggered.

**Heat detectors** signal an alarm based on temperature:

**Fixed temperature** detectors activate when the ambient temperature exceeds the threshold temperature.

**Rate-of-rise** temperature detectors activate when a the rise in temperature in a fixed period of time exceeds the maximum allowed.

## 7.1 Detector types

**Area** detectors are what we are familiar with from non-data centre environments. A detection head is placed in the overall area.

- Air conditioning system will dilute the air sufficiently that large quantities of smoke will be required before an alarm is raised.

**Aspirating** smoke detectors (ASDs) uses a fan to suck air from a sampling pipe with one or more sampling heads into a detection chamber.

## 7.2 Fire panel

A local fire panel is often provided in a data centre. Its main functions are:

- Receive inputs from detection devices.
- Alerting the presence of fire inside and outside the data centre using: audible warning devices (bell, syren, klaxon), visual warning devices (strobe), signalling staff and BMS.
- Activating fire suppression systems, HVAC shutdown, power shutdown.
- If the data centre is part of a larger facility, the data centre's fire alarm/alerting/suppression system will need to be interlocked correctly with the main system.
- Allowing remote visibility through the use of a remote annunciator, repeater or slave panel (same meaning for all!).

# 8 Extinguishants

Extinguishants are broadly divided into gaseous, removing oxygen and water, removing heat.