Fire Protection Association

RISCAuthority

Fire Extinguisher Handbook

THE UK's NATIONAL FIRE SAFETY ORGANISATION

Protecting people, property, business and the environment

Fire Protection Association

Fire Extinguisher Handbook

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Foreword

Portable fire extinguishers are designed to be able to extinguish or contain a fire until the fire and rescue service can intervene.

Effective first-aid firefighting with an appropriate portable fire extinguisher can effectively stop a small fire from growing into a large fire, significantly reducing fire losses and interruption to the normal business operations in the private or public sectors. It is therefore critical to select the correct extinguishers, and then to appropriately position and, if required, maintain such equipment. This guide aims to provide the end-user with information about how to choose, use, and site fire extinguishers. It also offers advice on the maintenance and servicing requirements, to ensure that every portable extinguisher is operational and ready for use as required.

UK legislation requires that a risk assessment must be conducted in every workplace to identify the type of firefighting equipment that is necessary. This guide provides a simple introduction to assessing risk, highlighting the importance of providing appropriate fire protection equipment and fire training to employees.

It offers an introduction to extinguisher construction, describing how each type of extinguisher works, and an overview of the servicing procedures is also provided to assist end-users and service technicians alike to understand the necessary checks that ensure extinguishers that require regular maintenance will operate safely and effectively when required.

We hope that you will find this simple guide, a useful and informative supplement to your fire safety management needs.

Jonathan O'Neill OBE
Fire Protection Association

1 Legislation and standards

Most of us are aware of the legislative need to comply with fire safety regulations in the workplace, although we may not be sure which regulations apply. A rationalisation of fire safety legislation was introduced throughout the UK on 1 October 2006. Although the law is built on the basis of fire risk assessment, the legislation has been introduced slightly differently across England and Wales, Scotland, and Northern Ireland.

1.1 Fire safety legislation

In England and Wales, the relevant legislation is the Regulatory Reform (Fire Safety) Order 2005. In Scotland, the relevant legislation is two-fold, being Part 3 of the Fire (Scotland) Act 2005 and the Fire Safety (Scotland) Regulations 2006. In Northern Ireland, the relevant legislation is the Fire Safety (Northern Ireland) Regulations 2010.

In essence, each of the above pieces of legislation has the same intention: to ensure that all 'relevant persons' will be safe should a fire occur in 'relevant premises'. Enhanced provisions may be necessary to ensure property protection, too. The following important terms are generally defined in all parts of the UK:

- 'relevant persons' are any persons who are legally within 'relevant premises' or any persons who are or may be in the vicinity of 'relevant premises'

- ‘relevant premises’ are essentially any premises other than a single domestic residence

These pieces of legislation also describe the necessary provision of fire protection equipment within the workplace.

Article 13(1) of the Regulatory Reform (Fire Safety) Order 2005 requires that:
(a) the premises are, to the extent that is appropriate, equipped with appropriate firefighting equipment, fire detectors, and alarms; and
(b) any non-automatic firefighting equipment that is provided is easily accessible, simple to use, and indicated by signs.

Article 13(3) states that the responsible person must, where necessary:
(a) take measures for firefighting in the premises, adapted to the nature of the activities carried on there and the size of the undertaking, and of the premises concerned;
(b) nominate competent persons to implement those measures and ensure that the number of such persons, their training and the equipment available to them are adequate, taking into account the size of, and the specific hazards involved in the premises concerned; and
(c) arrange any necessary contacts with external emergency services, particularly as regards firefighting, rescue work, first aid, and emergency medical care.

The ‘responsible person’ is the person or persons responsible for, or having effective control over, fire safety provisions adopted in or appropriate to the premises or building or risk. A ‘competent person’ is defined in the Fire Safety Order as someone who ‘has sufficient training and experience or knowledge and other qualities to enable him properly to implement the measures’.

Similar provision is made in Scotland in Articles 12(1) and 12(3) of The Fire Safety (Scotland) Regulations 2006, and within the Fire Safety regulations (Northern Ireland) 2010 Article 12.

Therefore, consideration must be given to the provision of appropriate firefighting equipment. This is determined by the size, nature, and use of the workplace and the activities undertaken, recognising materials and the maximum number of people likely to be present. The responsible person has to take measures for firefighting, nominate a competent person to implement those measures, and establish contacts with the emergency services.

1.1.1 Training

Where the fire risk assessment identifies that firefighting equipment is necessary to safeguard people, the responsible person must ensure that the premises are appropriately equipped. Where portable firefighting equipment is deemed necessary, the responsible person may also be required to nominate a sufficient number of people to use it and ensure that they receive adequate training. A fire risk assessment that aims to ensure property protection and business continuity, in addition to life safety, may identify a need for an enhanced level of firefighting equipment and more trained operators.

Training can be given either individually or in small groups. Routine maintenance of equipment and fire drills provide suitable opportunities for training, particularly where extinguishers have to be discharged as part of the maintenance procedures. Some employees may be more likely to have to use fire equipment and their training must be given priority. These include:

- night watchmen, caretakers, security staff, patrol staff
- those working where few other staff are around
- people working on processes or in situations that are hazardous
- anyone working where there are flammable liquids, who should be trained to deal with difficult and dangerous flammable liquid fires
- anyone working where there is only one evacuation route
- key staff in workplaces where they provide care (hospitals, care homes, etc.), such that a full evacuation of the premise should be avoided where practicable

Members of an occupational fire brigade or factory fire team will obviously need more thorough training. People with no training should not be expected to attempt to use a fire extinguisher. However, all staff should be familiar with the location and basic operating procedures for the portable extinguishers located in your premises.

It should be explained to staff, during training sessions, that they may only attempt to tackle a fire if they are confident that they may do so without risk to themselves or to anybody else. In particular, they should not:

- attempt to fight a fire on their own
- let the fire come between them and their means of escape
- continue to fight the fire if it continues to grow or if it threatens to spread to containers or cylinders of flammable gases or highly flammable liquids, including aerosol containers
- continue to fight the fire if their initial attempts have not been successful

Fire safety instruction should begin on employees' first day as part of induction training. Follow-up training sessions should include instruction on the appliances available and practical guidance on their use. The competent person should bring the legal responsibility for training to the attention of the responsible person.

1.2 Pressure vessel legislation

The Pressure Equipment Regulations 1999 are the UK regulations covering the requirements of the Pressure Equipment Directive into UK law. They relate to the assurance of the safety of pressure equipment and include all portable fire extinguishers.

Portable fire extinguishers, compliant with the relevant part of the revised BS EN 3 standard and tested as compliant by a notified body, such as the British Standards Institution (BSI), are likely to meet the requirements of the Pressure Equipment Regulations. The following legislation is relevant:

- Statutory Instrument 1999 No. 2001: The Pressure Equipment Regulations 1999 and Statutory Instrument 2002 No. 1267: The Pressure Equipment (Amendment) Regulations 2002
- Statutory Instrument 2000 No. 128: Pressure Systems Safety Regulations 2000
- Statutory Instrument 2009 No. 1348: The Carriage of Dangerous Goods and Use of Transportable Pressure Receptacles Regulations 2009
- Directive 1999/36/EC – Transportable Pressure Equipment Directive (TPED)

1.3 Manufacturing standards

In the UK, the construction of fire extinguishers is covered by two standards – BS EN 3: *Portable fire extinguishers* and BS 6165: *Specification for small disposable fire extinguishers of the aerosol type*. The latter standard mainly covers the smaller size of fire extinguisher, while BS EN 3 covers fire extinguishers from 1 kg to 12 kg and 2–9 L capacity.

BS 5306-10: *Recommendations for colour coding to indicate the extinguishing media contained in portable fire extinguishers* provides recommendations on colour coding of extinguishers.

Standards are regularly updated and the current version should always be used.

Carbon dioxide extinguishers must also meet the requirements pressure vessel legislation (see section 1.2), and of BS EN 1802: *Transportable gas cylinders. Periodic inspection and testing of seamless aluminium alloy gas cylinders*, BS EN 1803: *Transportable gas cylinders. Periodic inspection and testing of welded carbon steel gas cylinders*, and BS EN 1968: *Transportable gas cylinders. Periodic inspection and testing of seamless steel gas cylinders*.

1.3.1 BS EN 3

The manufacture of portable fire extinguishers is governed by several parts of BS EN 3. The standard is of more relevance to extinguisher manufacturers than the end user or installer, but it specifies in detail the extinguisher characteristics, duration of operation, any residual charge, and the efficiency testing of portable fire extinguishers. The relevant parts are:

- BS EN 3-7: *Portable fire extinguishers. Characteristics, performance requirements and test methods*
- BS EN 3-8: *Portable fire extinguishers. Additional requirements to EN 3-7 for the construction, resistance to pressure and mechanical tests for extinguishers with a maximum allowable pressure equal to or lower than 30 bar*
- BS EN 3-9: *Portable fire extinguishers. Additional requirements to EN 3-7 for pressure resistance of CO_2 extinguishers*
- BS EN 3-10: *Portable fire extinguishers. Provisions for evaluating the conformity of a portable fire extinguisher to EN 3-7*

BS EN 3 defines a fire extinguisher as an ‘appliance containing an extinguishing medium which can be expelled by the action of internal pressure and be directed on to a fire’. A portable extinguisher is defined as ‘a fire extinguisher which is designed to be carried and operated by hand and which in working order has a mass of not more than 20 kg’.

The standard explains that portable fire extinguishers are described by the type of extinguishing medium they contain, defining current types as:

- water-based
- foam
- powder
- carbon dioxide

It also refers to halon, which is only available for use on aircraft, military use, and other specific applications, and as a clean agent. It specifies a minimum operation time for each size and type of extinguisher.

All fire extinguishers and cartridges have to hold a predetermined charge, which can be checked in several ways. In carbon dioxide extinguishers, the retention of charge is checked by weighing the extinguisher. Stored pressure extinguishers are fitted with some type of connection to allow the internal pressure to be tested. Extinguishers may also have a built-in pressure gauge.

Definitions are laid down as to acceptable leakage levels and significant leakage levels. There is also a dielectric test for certain water-based extinguishers to establish their suitability for use on live electric equipment, by measuring the conductivity of the discharge stream from the extinguisher. Powder extinguishers are subject to a compaction test to ensure that compaction of the powder will not prevent extinguishers from operating effectively.

All extinguishers have to be fitted with a valve to enable the operator to interrupt the flow of extinguishing medium temporarily and all extinguishers must operate in the upright position without the need to invert them in order to commence operation. To help control flow, operating levers are located on the upper parts of the extinguisher or at the end of the nozzle and, if a charge of over 3 kg or 3 L is used, a discharge hose at least 400 mm long has to be fitted. An extinguisher must be able to stand freely and/or be able to be fixed to a vertical surface and each extinguisher should be marked with the name of the manufacturer, a serial or batch number, the year of manufacture, and the test pressure in bar.

BS EN 3 also specifies the size of charges in portable fire extinguishers and the minimum quantity of extinguishing medium that can be used to extinguish a fire of a given size. Other features – like characteristics of effective operating temperatures, requirements for components, resistance to corrosion, brackets, extinguisher identification, and periodical checking – are defined, making BS EN 3 a comprehensive standard.

1.3.2 Colour coding

Extinguishers bodies are often coloured predominantly red, although polished metal types are available. They should carry a coloured zone of 3–10% of the external area to indicate the type of extinguishing medium used. Recommendations for the location of the colour indication and the colour-coding to be used are contained in BS 5306-10: *Fire extinguisher installation and equipment on premises. Colour coding to indicate the extinguishing medium contained within portable fire extinguishers. Code of practice*. (see Table 1).

The requirements of BS EN 3 and BS 5306-10 apply to new extinguishers only.

Table 1: Colour coding for extinguishing media (adapted from BS 7863 Table 1)

Extinguishing media	Colour
Water	Red
Foam	Pale cream
Powder (all except D type)	Blue
D type powders	Violet
Carbon dioxide	Black
Wet chemical	Canary yellow
Clean agent (including halons)	Green

1.3.3 BS 6165

This standard specifies requirements for non-refillable fire extinguishers of the aerosol type. This type of extinguisher has applications only in situations where small fires may occur and where the possibility of fire spreading to other materials is remote, or where people are present at the likely times of risk.

Since small disposable non-refillable fire extinguishers can be exposed to more severe environmental conditions, they are required to maintain their performance for longer periods than other aerosol dispensers. For example, they can be installed in cars or other vehicles where they might be repeatedly exposed to higher than normal temperatures for up to 5 years. For these reasons, the requirements of this standard for the strength and pressure resistance of the extinguisher bodies are more stringent than those specified for the otherwise similar aerosol containers in EC Directive 75/324/EEC of 20 May 1975.

The standard states: 'The extinguisher shall be marked with … the service expiry date which shall be not later than the end of the fifth year after filling' and the instruction 'Not to be refilled'. In other words, these extinguishers have a lifespan of no more than 5 years.

1.3.4 BS EN 1802, BS EN 1803, and BS EN 1968

These standards on transportable gas cylinders relate to seamless aluminium alloy gas cylinders, welded carbon steel gas cylinders and seamless steel gas cylinders. They specify the requirements for periodic inspection and testing to verify the integrity of the cylinders prior to being reintroduced into service. These standards require the tests to be carried out at 10-year intervals from the date of manufacture.

These tests are known by various names – such as hydraulic test, stretch test, or pressure test – and the tests must be conducted at an approved testing station.

1.4 Commissioning, installation, and maintenance standards

The commissioning installation and maintenance requirements for portable fire extinguishers are described in BS 5306. The relevant parts are:

- BS 5306-3: *Code of Practice for the commissioning and maintenance of portable fire extinguishers*
- BS 5306-8: *Fire extinguishing installations and equipment on premises. Selection and positioning of portable fire extinguishers*

BS 5306-3 outlines guidelines for the initial commissioning of fire extinguishers, as well as schedules for maintenance and for the handling of obsolescent types of extinguisher (see Chapter 6). It describes the procedures relating to five levels of maintenance:

- commissioning
- basic service
- extended service
- overhaul
- recharging

It also provides guidance on the mounting and labelling of extinguishers, and on the replacement of components, evaluating extinguishers' fitness for service, and the circumstances under which an extinguisher should be condemned.

BS 5306-8 provides guidance on the numbers and types of fire extinguishers to be installed, providing calculation methods to determine the number of fire extinguishers required (see Chapter 5). The calculation method is based on the fire extinguisher's firefighting performance (fire rating) and not on the capacity of the medium within the fire extinguisher. Although the fire rating of the fire extinguisher is achieved by an experienced operator, the calculation takes into consideration the fact that an inexperienced operator will use the extinguisher in the actual fire situation. The standard provides guidance on the numbers of appropriate fire extinguishers. It also includes recommendations on the training of operators. At the time of publishing BS 5306-8 is under review. This handbook will be updated once the new standard is published, which is anticipated to be by the end of 2020.

1.5 Third party accreditation

Third party certification schemes for fire protection products and related services are an effective means of providing the fullest possible assurances, offering a level of quality, reliability and safety that non-certificated organisations may lack. Third party quality assurance can offer a means of satisfying the requirement that goods and services you have purchased are fit for purpose, and are a means of demonstrating that you have complied with the law.

To ensure the level of assurance offered by third party schemes, you should always check whether the company operates a quality management scheme that meets the requirements BS EN ISO 9001. This approval should be provided through the UK Accreditation Service (UKAS) with accreditation to BS EN ISO/IEC 17021.

BAFE is a not-for-profit organisation which promotes quality within the fire protection industry. They operate scheme SP 101 as evidence that fire extinguisher service companies and engineers are competent, in order to safely undertake their roles. BAFE certification states that the manufacturer is claiming that the product is certified by BSI as complying with the appropriate standard. This claim can be checked by reference to the appropriate BAFE list on their website.

1.6 Extinguishers currently not compliant with the British Standards

Some portable fire extinguishers are on the market that do not comply with the recommendations in the British Standards; many of these have, however, been tested in accordance with BS EN 3 and can remain in use, subject to the findings of a suitable and sufficient fire risk assessment. Some examples are described below:

- A number of manufacturers produce chrome, stainless steel, or gold fire extinguishers which are often installed due to their aesthetic qualities; however, they do not comply with BS 5306-10 colour coding. It should be noted that British Standards are a guide and providing the fire risk assessment notes the types of extinguishers and comments on their suitability then they can be acceptable. Suitable control measures may include staff training to recognise the extinguisher types or additional signage.
- Britannia's P50 range of fire extinguishers have a unique selling point in that they do not require annual servicing and maintenance by a competent engineer. Therefore, they do not comply with BS 5306-3: *Servicing of portable extinguishers*. At the time of writing these have not been accredited by BAFE. The construction of these extinguishers is made up of a plastic lining with Kevlar reinforced yarn and plastic outer. The extinguisher cannot be inspected annually without dismantling the body in order to remove the outer plastic lining; however, because of this construction the manufacturer recommends an annual inspection by the customer and a return to manufacturer for a 10-yearly service. The extinguisher is fitted with two pressure gauges in order that if one was to fail the other should still be operational. Again, the fire risk assessment should identify whether the extinguishers have been suitably sited with relation to the hazards in the area and whether or not they are being inspected in accordance with the manufacturers' instructions.

2 Fire science and classes of fire

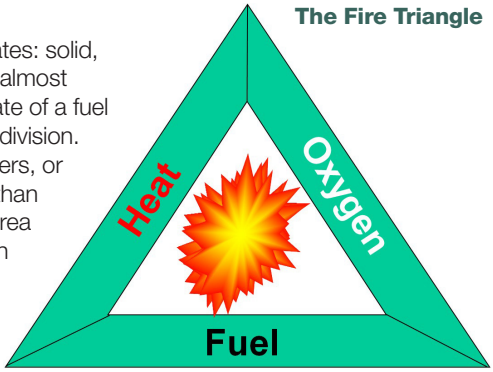
To understand the basics of practical firefighting, it is important to first understand what combustion is and what factors must be present for combustion to occur. This chapter introduces the basic concepts of fire science, describing how fires start and spread. The different methods of fire suppression and the main classes of fire are also defined to help explain why certain extinguishants may be more effective for use on fires involving particular materials.

2.1 Fire science

Combustion can be defined simply as: 'A chemical reaction evolving both heat and light energy'. However, three factors must be present in order to achieve combustion. These are fuel, heat, and oxygen. When all three factors are present in the correct proportions, combustion will occur.

This is often known as the Fire Triangle.

2.1.1 The Fire Triangle



The Fire Triangle

Fuel: All matter exists in one of three states: solid, liquid, or gas. Under normal conditions, almost anything will burn as fuel. The burning rate of a fuel depends on its configuration or state of division. Finely divided fuels, such as dust, powders, or shavings, will absorb heat more rapidly than bulky materials because of the greater area that is exposed to heat. As a result, such fuels will liberate flammable vapours more quickly and so burn more readily.

Flammable liquids release vapour in much the same way as solid fuels. The rate of release is greater for liquids than solids, since liquids have less closely packed molecules and will vaporise more readily. The ease or degree of vaporisation will depend on the product – for example, petrol will vaporise more rapidly than fuel oils, which, in turn, will release vapours more readily than lubricating oil.

Flammable gases are already in the required vapour state. With an adequate mix of oxygen and heat, ignition will be achieved. A flammable gas must mix with oxygen within its range of flammability, otherwise ignition cannot take place.

If there is insufficient gas in the mixture, it is said to be too lean and will not burn. This would represent its Lower Explosive Limit (LEL). If the gas-to-oxygen mix is too great, then the mix is said to be too rich and, again, ignition will not take place. This is its Upper Explosive Limit (UEL). The percentage mixes between the two limits is called the explosive range of flammability.

Heat is required to act on a fuel in order to commence the chemical reaction, which will produce the flammable vapours required for combustion. The amount of heat required to raise a substance to its ignition temperature will vary depending on the substance involved.

Oxygen is a supporter of combustion and must be present before combustion can be achieved. Normally a 16–20% concentration of oxygen is required to support combustion, but there are products that when subject to heat and the subsequent chemical decomposition, will liberate their own oxygen supply.

2.1.2 Temperatures

There are also critical temperatures to consider in understanding and controlling firefighting operations: flash point, fire point, and spontaneous ignition temperature.

- **Flash point** is the lowest temperature at which there is sufficient vaporisation of the substance to produce a vapour, which will flash momentarily on the application of a test flame.
- **Fire point** is the lowest temperature at which the heat from the combustion of a burning vapour is capable of producing sufficient vapour to enable combustion to continue. Once this temperature is reached then combustion will accelerate and the fire will rapidly grow in intensity.

- **Flash speed** is the rapid transfer of ignition between grouped open top containers of flammable liquids if any member of the group becomes ignited.
- The **auto-ignition temperature** can simply be defined as being the lowest temperature at which the substance will ignite spontaneously and will burn without a flame or other ignition source being applied.

Spontaneous combustion can take place in certain organic materials based on carbon, which will react with oxygen. If the fuel is a good thermal insulator, the heat generated cannot dissipate, resulting in a rise in temperature, which increases the rate of reaction until the ignition temperature is reached and combustion commences.

2.1.3 Fire spread

Having achieved combustion due to all three parts of the fire triangle being present in the correct proportions, the fire will spread. This occurs by one or more of the following mechanisms: radiation, convection, or conduction.

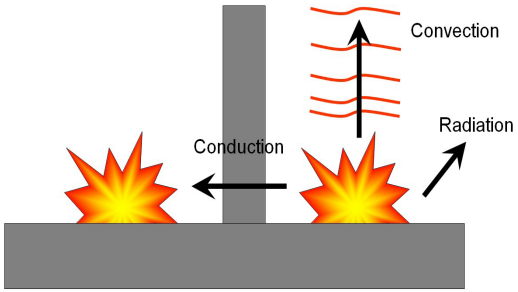
- **Convection** is the transfer of heat through the motion of heated matter, i.e. through the motion of smoke, air, gases, etc. produced by the fire. The fire produces gases that are lighter than air, which will rise towards high parts of a building. As these hot gases rise, cool gases and air will fall, so feeding the fire with a convection 'draught' cycle and also risking spread of the fire at higher levels. Smoke, gases, etc. can travel great distances via doors and open hatches/windows, and can start fires en route. Convection is the most common way a fire will spread in a building and can be prevented by fire separation and compartmentation.
- **Radiation** is the transfer of heat from a source across an intervening space without any contact between the bodies. The heat travels outward from the fire in straight lines. When it contacts a body it is absorbed, reflected, or transmitted. Absorbed heat raises the temperature of the absorbing body. If this absorption of heat is allowed to continue, then combustion may result, spreading the fire some distance away from its source. It can be prevented by increasing the space of separation or through the use of a fire-resistant barrier.
- **Conduction** is the transfer of heat through a solid body. Metal is an excellent conductor and heat transfer by conduction is a real hazard, with fire spread through steel joists and beams, steel doors, shutters and walls. With timely and careful application of a water spray to affected areas, heat transference by conduction can be greatly retarded.

A water spray pattern absorbs more heat from the affected metal, because the smaller water droplets present a greater surface area. At the same time, less water is used, so creating less water damage to premises. Insulating building steelwork with, for example, dry linings and spray coatings can prevent conduction.

2.1.4 Suppression methods

Firefighting systems, or suppression systems, work to extinguish or suppress a fire by attacking the triangle of combustion or breaking the subsequent chemical chain reaction. Removing one or more of the legs of the fire triangle or breaking the chain reaction sequence will result in the fire being extinguished. Fires can thus be extinguished in four ways or using a combination of these methods:

- **Cooling** is the cheapest and most commonly used method of fire extinguishment. The base of the fire is attacked with water to destroy the ability of the fire to sustain itself. Water is a very effective heat absorber. When properly applied, it absorbs heat from the fuel and, as a result, will cool the burning substance to below its critical fire temperature, reducing the amount of flammable vapours given off to sustain combustion.
- The exclusion of oxygen from a fire by **smothering** will bring about its extinction. This can be achieved by the use of inert gases, carbon dioxide, foam, or a fire blanket. However, care must be taken since the smothering of a fire produces little or no cooling effect, allowing flashover conditions to remain. If the fire is 'opened up' too early, the consequent inrush of oxygen may result in flashover occurring.
- **Starvation** or removal of fuel from a fire will, eventually, lead to its extinction. The fire triangle is broken by starving the fire of fuel – for example, by turning off the gas.
- A fire can be extinguished by breaking the chemical reaction of combustion, a process termed **chemical interference**. The extinguishing agents used in many modern portable fire extinguishers and fixed installation systems will attack the chemical reaction of combustion directly, breaking it down to extinguish the fire. However, caution must be exercised following the extinction of fire because flashover conditions may remain.



2.2 Classes of fire

BS EN 2 defines five classes of fire according to the material undergoing combustion:

- **Class A**: fires involving solid materials, usually of an organic nature, in which combustion normally takes places with the formation of glowing embers (such as paper, wood, and similar materials)
- **Class B**: fires involving liquids (such as petrol, paraffin, or alcohol) or liquefiable solids (such as rubber, wax, or tallow)
- **Class C**: fires involving gases (such as propane and butane)
- **Class D**: fires involving metals (such as magnesium, titanium, and aluminium)
- **Class F**: fires involving cooking media (vegetable or animal oils and fats) in cooking appliances

Fires involving electrical equipment are unclassified, since electricity is a source of heat. Although fires may start due to an electrical fault, they will involve materials from other classes, such as paper in a photocopier or fat in a deep fat fryer.

Extinguishers are tested for effectiveness and classified for use against each class of fire. Different types of fire must be attacked with different extinguishing media, and it can be dangerous to use the wrong one. For example, water conducts electricity, so its use on an electrical fire could be fatal. The colour of the extinguisher or coloured zone indicates the contents, and the label states the types of fire for which it is suitable.

Table 2 describes the type of extinguisher appropriate for use against each type of fire and the suppression method utilised.

Table 2: Suitability of extinguisher type by class of fire

Class	Type of fire	Extinguishing method	Type of extinguisher
	Fires involving solid materials, usually of an organic nature. Combustion takes place with the formation of glowing embers (carbonaceous fires)	• Cooling • Cooling and smothering • Smothering and chemical interference	Water Foam Powder (ABC type) Wet chemical
	Fires involving flammable liquids or liquefiable solids	• Smothering • Chemical interference • Smothering and chemical interference	Foam Carbon dioxide Powder (ABC type) Powder (BC type)
	Fires involving flammable gases	• Starvation: turn supply of gas off • Chemical interference (only to be done if gas supply can be stopped, otherwise leave to burn)	Powder (ABC type) Powder (BC type)
	Fires involving flammable metals *	• Smothering	Powder (D type)
	Fires involving electrical equipment	• Smothering • Smothering and chemical interference	Carbon dioxide Powder (ABC type)
	Fires involving cooking oils and fats	• Smothering and cooling	Wet chemical

Note – Halon fire extinguishers: Possession of halon is illegal for most users. Under the 1987 Montreal Protocol on substances that deplete the ozone layer, the production of halons identified as ozone-depleting compounds was banned. The ban was implemented and enforced in EC Regulation No. 3093/94, which prohibits the production of halons, and controls their supply and use. The use of Halon 1211 and 1301 is restricted to the 'critical users' listed by Annex V11 to EC Regulation No. 3093/94. This was implemented in the UK by the Environmental Protection (Controls on Ozone-Depleting Substances) Regulations 2002 and 2003. The regulations required systems and extinguishers to be 'decommissioned' and halons 'recovered'. Authorised disposal agents with the facilities and expertise are able to recover or destroy the halon.

* **Special fire extinguishers:** Fires involving flammable metals – for example, magnesium or titanium (D type) – should not be tackled with any extinguishers unless specialist training has been provided and only then using special D type extinguishers. Failure to follow this guidance may cause the fire to spread and/or cause serious injury to persons.

3 Extinguisher construction

As previously mentioned, BS EN 3 defines a fire extinguisher as an 'appliance containing an extinguishing medium which can be expelled by the action of internal pressure and be directed on to a fire'. Extinguishers, therefore, must provide a means for containing the extinguishant, as well as expelling it when required. This chapter considers the components that come together to form an extinguisher and how these interact to enable it to perform as required.

3.1 Extinguisher design

BS EN 3-7 describes the components of an extinguisher as:

- **body:** the shell without accessories
- **body fittings:** fixed or screwed onto the body, including:
  - control devices
  - hose assembly and/or horns and/or nozzles
  - head assembly
- **operating device**
- **extinguishing media**

Fire extinguishers employ two forms of operation:

- **stored pressure:** the extinguisher is kept pressurised at all times. Actuation of the extinguisher opens a valve, making the discharge pipe available for the extinguishing medium to pass through. This system is similar to the principle of an aerosol spray, and the pressurising gas is dry air or nitrogen (Note: carbon dioxide extinguishers are a special case, as they are a stored-pressure type, but do not have a pressurising gas or a gas cartridge. Halon 1211 extinguishers, which may be used only by 'critical users', are partly self-pressurised, with nitrogen used to top up existing pressure)
- **gas cartridge:** the extinguisher contains a small CO_2 gas cartridge fitted inside the cylinder. Upon actuation, the cartridge seal is broken releasing the gas, which then pressurises the extinguisher, forcing the extinguishing medium out through the discharge nozzle

3.1.1 Stored pressure

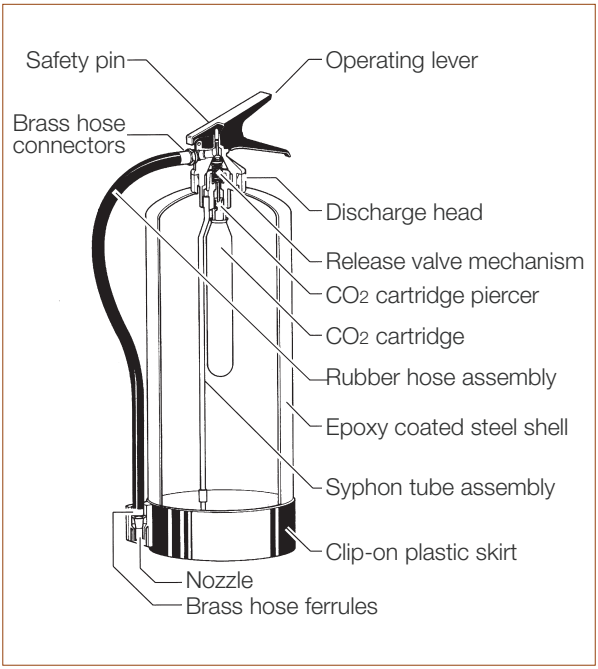
In stored pressure units, the body is under a constant pressure, which can be checked by means of one or more pressure gauges incorporated into the valve or body of the fire extinguisher. The extinguishing medium is expelled from the fire extinguisher by squeezing the handle which in turn operates the valve.

All stored pressure extinguishers operate in a similar manner. On operation of the extinguisher, the pressure stored within the top of the extinguisher (dry air or nitrogen) forces down on the extinguishing agent, forcing the agent up the syphon tube, through the headcap and hose, and onto the fire. All extinguishers are fitted with a squeeze grip lever. This is normally located on the top of the extinguisher, although some may have it as a part of the hose. The control enables discharge to be halted or restarted as needed.

Foam extinguishers can be fitted with either a foam-making branch or a spray nozzle. Wet chemical extinguishers are usually fitted with a spray lance.

3.1.2 Gas cartridge

In gas cartridge units (water-based and powder), the body is not under pressure until operation. The pressurising medium – carbon dioxide – is contained in a gas cartridge within the body of the extinguisher. Upon operation, the seal of the gas cartridge is pierced, releasing pressure into

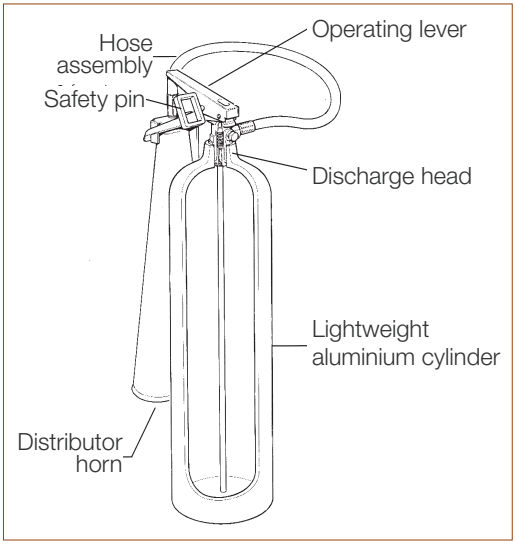


Components of a typical gas cartridge extinguisher

the body of the extinguisher and expelling the extinguishing medium from the fire extinguisher. Bodies of gas cartridges are made of the following materials:

- steel
- aluminium
- aluminium alloy

Cartridges used in most large powder extinguishers may have an internal dip tube to accelerate the carbon dioxide discharge. All gas cartridges are identified by the content's weight (for example, 55 g CO_2). Cartridges are also marked with empty and full weights, together with year of manufacture. Cartridges fitted to water-based extinguishers are plastic-coated for greater protection, while those fitted to powder extinguishers are usually painted only.



Typical CO_2 extinguisher (5 kg unit illustrated)

There are two types of gas cartridge:

- **piercing disc:** a cartridge with a diaphragm, which is pierced by a suitably shaped spindle
- **frangible pip:** a cartridge with a frangible pip, which is broken by a blunt spindle

The most common is the piercing disc type.

Cartridges are required to comply with BS EN 3 and, if recharged, should bear the date of recharging. The original manufacturing date should not be obscured. Cartridges should not be recharged if more than 10 years have elapsed since the most recent periodic hydraulic test. Hydraulic test dates are stamped onto the body or neck of the cartridge. BS 5306-3 now recommends that cartridges should be removed from service if more than 10 years have elapsed since the date of manufacture. This is because it is no longer cost effective to hydraulically test them.

During an annual service, all cartridge-operated extinguishers should be opened and a full internal inspection undertaken. Cartridges should be unscrewed from the headcap and checked for the following markings:

- manufacturer's name/logo
- type and weight of propellant
- empty weight
- full weight
- year of manufacture
- standard of manufacture

The weight of the cartridge should be checked against the full weight. If a loss of more than 10% of the content weight is noted the cartridge should be withdrawn from service. Corroded cartridges should be replaced because of the high pressure involved and the potential danger resulting from this.

If a company is BAFE registered, a corroded cartridge could be recorded as a discrepancy by a BSI inspector during an audit.

3.2 Extinguisher ratings

Extinguishers are marked or rated with a letter to indicate the class (or designation) of fire on which they can be used. The designations are always accompanied by a number, which indicates the size of the test fire that the extinguisher is capable of extinguishing under test conditions. For classes A, B, and F, the larger the number, the larger the test fire they can extinguish under test conditions.

For example, an extinguisher marked 13A is capable of extinguishing a Class A test fire of size 13. Similarly, an extinguisher marked 144B is capable of extinguishing a Class B test fire of 144; and an extinguisher marked 75F is capable of extinguishing a Class F test fire of size 75.

Some extinguishers have a dual rating, which indicates that the extinguisher is capable of extinguishing a test fire to the size and type shown. For example, a 13A/113B rating indicates that the extinguisher is capable of extinguishing a Class A fire to the size 13 and a Class B fire to the size 113, under test conditions.

A series of test fires for each class of fire are defined in BS EN 3, and used in BS 5306-8 to define the extinguisher rating system. The Class A test fire involves a specially measured crib fire of standard cross-section 0.5 m wide x 0.56 m high but of varying length.

The lengths of the standard test fires and corresponding ratings are defined in Annex I to BS EN 3. For example, a crib which measures 1.3 m long indicates that the rating for that extinguisher is 13A. For a crib 2.1 m long, the fire rating would be 21A.

Class B ratings denote the largest flammable liquid fire that can be extinguished under test conditions. Different size extinguishers have different ratings and these ratings are shown on the front of the extinguisher. The number relates directly to the volume of liquid used during the test fire, which is made up of a mixture of flammable heptane and water.

For fires involving flammable gases and metals (Class C and D fires), there are no established fire ratings. Both Class C and D fires are classed as ‘special risks’ and require specialist training in the use of the extinguishers. Fires involving flammable gases may be extinguished using either ABC or BC powder extinguishers, but should be extinguished only after closing the valve so shutting off the gas supply – if it is safe to do so.

Metal fires require special Class D powder extinguishers fitted with a lance type applicator, which applies the special powder gently over the burning metal so smothering the fire. No other types of extinguishers are suitable for this fire risk and should not be used. If other types are used, they could spread or inflame the fire, causing damage and possible injury to the operator.

For both Class C and D fire risk, always seek professional specialist advice.

4 Types of extinguishers

There are five main types of extinguishing medium; water, foam, powder, carbon dioxide, and wet chemical. Each is suitable for use on different classes of fire and has various benefits and limitations. This chapter describes the construction, use, and limitations of each type to help the user identify and specify the most suitable extinguisher for their premises.

4.1 Water

The effectiveness of an extinguishing agent on fires of ordinary solid combustible materials – such as wood, paper, textiles, and fabrics (Class A risks) – depends principally upon its cooling action. Water has better cooling properties than other agents and is best for use on fires involving those materials that may re-ignite if not adequately cooled. Also, water can penetrate readily to reach a deep-seated fire. Wetting agents in the extinguishant may enhance this ability.

Water conducts electricity and must not be used on live electrical equipment. However, in workplaces containing limited quantities of electrical equipment – for example, where there are lights, wiring and a few small motors only – it is not always necessary to provide special extinguishers to supplement the protection given by water extinguishers. If electrical equipment is present and only a water extinguisher is

provided, it should have passed the electrical conductivity test in BS EN 3, and will be marked as 'Passed 35kV conductivity test'; the exact wording may vary. Although these extinguishers provide an element of protection to the operator, a separate line of conductivity may provide an electrical shock risk. A water extinguisher that has not been successfully tested will be marked: 'WARNING Do not use on live electrical equipment'. Where desktop electronic equipment, such as computers and visual display units are used, a carbon dioxide extinguisher, as well as a water extinguisher is recommended. Employees must be taught to isolate electrical equipment before using a water extinguisher, whenever this can be done safely.

As water will freeze at 0 degrees placing water based extinguishers in colder environments could result in the contents being unable to travel up the syphon tube, or the extinguisher rupturing upon activation. Ethylene glycol (low-freeze additive) can be added to allow an extinguisher to work at lower temperatures. In some manufacturers' extinguishers this can cause corrosion over prolonged periods of time. The extinguisher may require refilling every year to ensure adequate protection. Any advice on the extinguisher labelling or the additive container should be followed with regards to the percentage of additive to be added to the extinguisher and additional service requirements.

Construction

Water extinguishers are available in stored pressure and gas cartridge forms, with stored pressure being the most common. The usual size for a water extinguisher is 9 L, but they are available in easy-to-handle 6- and 3-L formats.

The easy-to-handle extinguishers contain special additives which reduce the water's surface tension. These types of extinguishers give more firefighting capability per size than conventional water extinguishers. They discharge the firefighting agent in a spray pattern. They are not recommended for use on electrical risks, although they may have passed the 35 kV conductivity of discharge test.

The 9-L capacity extinguishers usually discharge their firefighting media in the form of a jet. This provides the operator with the ability to fight fires from a safer distance, but it is not safe to use on electrical risks.

Advantages

The advantages of water are as follows:

- good absorbance of heat
- cost effective
- readily available
- long range of jet
- good penetration properties
- good striking power of jet

Limitations

Water is the most common extinguishing medium. There are limitations in its use as it is only suitable for Class A materials. However, Class A materials are by far the most common fuel source, hence the popularity of the medium.

Water conducts electricity and is not suitable for electrical fires, nor should it be used on flammable liquids (as it may splash and spread the fire), flammable gases (as it may put out a fire, only for it to re-ignite explosively), and flammable metals and cooking oil fires (as it reacts violently, making the fire worse and posing a significant risk of injury to the operator of the extinguisher and others in the vicinity).

4.2 Water mist extinguishers

Water mist extinguishers are filled with deionised water and, when discharged, provide a super fine spray forming a mist jet containing over 22 billion droplets for each litre of water discharged.

The nozzles are designed so each droplet produced is approximately 25 microns in size and together creates an ultra-fine mist with superior firefighting capabilities. These deionised droplets are so small that they cannot conduct electricity and are therefore considered safe for use on electrical equipment at 1 m distance. Due to the effective curtain of mist produced, this extinguisher has good cooling properties and, when applied for use on Class B and small Class F fires, this mist also helps to prevent the continuation of oxygen supply.

This mist is often referred to as ‘dry water’ as it leaves almost no trace and produces little collateral damage.

4.3 Foam

Foam extinguishers are suitable for use on small fires involving flammable liquids and liquefiable solids, such as paints, oil, or fats (Class B), especially where these are in a container, a spillage, or when overheated – for example, paint pots. For deep-fat frying ranges, wet chemical extinguishers (Class F) should be used instead. Foam extinguishers may also be used in kitchens and oil-fired boilers, where there is a sill in the compartment to contain any oil leaks. It should also be noted that foam extinguishers are equally suitable for use on Class A fires.

Foam should be applied gently onto the surface of a contained burning liquid fire. This creates a barrier between the burning liquid and air and prevents the release of flammable vapours. Foams used in extinguishers produce low expansion foam, for example, AFFF. There are six main types of foam extinguisher, each developed to tackle specific classes of fire. All use aqueous solutions from which the foam is generated. The six types are:

- **aqueous film-forming foams (AFFF):** these foams contain fluorine surfactant chemicals, which produce a foam that acts initially as a blanket, but when the foam breaks down the liquid drain-off forms a film on the flammable liquid surface. This reduces the chance of re-ignition and improves cooling compared with other types of foam. AFFF is ideal for use on shallow spill fires. Most modern portable foam extinguishers use AFFF since it offers superior performance and is good for general fire protection
- **protein foams (P):** now rarely used in portable extinguishers, these use hydrolysed proteins as the foaming agent and act by forming a slow-spreading blanket of foam on the burning liquid surface
- **fluoroprotein foams (FP):** these behave in the same way as protein foams, but the fluorine-containing part of the compound gives greater foam stability and flame-quenching properties; therefore, they are useful on hydrocarbon fires
- **film-forming fluoroprotein foams (FFFP):** as the name suggests, these operate by forming a film to seal the surface of the liquid. They are similar to AFFF, but have better burn-back resistance
- **alcohol-resistant foam (AR):** this is a special risk foam for use on water-miscible solvent fires, such as cellulose and spirits. In view of the specialist nature of dealing with these risks, it is recommended that you consult with the extinguisher manufacturer or service provider to ensure that this product is the correct type of protection against your risk
- **eco-foam**: as with other firefighting foams, this media provides Class A and B firefighting performance with biodegradability qualities to minimise the harm to the environment. Currently, no standard exists, although the Department for Foods and Rural Affairs (Defra) has published guidelines on the environmental characteristics for these products and services. The products currently available are likely to comply with other European country standards; contact manufacturers for details

Construction

Foam extinguishers are available in stored pressure or gas cartridge forms, with stored pressure being the most common. On operation of this extinguisher, the pressure stored in the ullage space presses on the foam solution forcing it up the syphon tube, through the headcap and hose.

On operation of a gas-cartridge foam extinguisher, the gas released when the cartridge is pierced forces the foam solution, up the syphon tube, through the headcap and hose. In pre-mix designs, the foam concentrate is already mixed with the water before the extinguisher is activated; whereas in post-mix the foam or water additive concentrate (held in a sealed container at the bottom of the gassing tube) is only introduced into the water at the time of activation.

As is the case for some water extinguishers, most foam extinguishers deliver the foam as a spray, rather than a continuous jet. Some foam extinguishers may be fitted with a foam branchpipe which aspirates the foam. The most common sizes are 6- and 9-L capacity units, which are for industrial/commercial applications. Two- and 3-L models are available for the smaller risks.

Advantages

The advantages of foam are as follows:

- non-toxic
- suitable for multiple risks (Classes A and B)
- is effective against obstructed Class B fires
- prevents re-ignition of flammable liquids
- extinguishes fire progressively
- does not impair visibility

Limitations

Foam is ineffective against running fires since it is difficult to maintain the foam blanket. Hence, caution should be observed when using foam on free-flowing flammable liquid fires. Some water-miscible liquids, such as alcohols, will rapidly break down the foam, impairing the extinguishing action. If the fire risk assessment of the workplace indicates that this type of hazard exists, special alcohol-resistant foam extinguishers should be considered. Alcohol-resistant foam (AR) contains a polymerising agent that stabilises the foam against alcohol's solubility in water, forming a gelatinous seal. Powder extinguishers may offer an alternative and suitable firefighting media (see section 4.4).

Foam is not suitable for use on live electrical equipment, since it can cause a short circuit. Furthermore, if a short circuit does not occur, the operator may be left standing in a residual pool of water-based foam, which could conduct electricity. Spray foams with 35 kV BS EN 3 test approval, however, will provide users with a level of safety if inadvertently used on live electrical equipment.

As foam is a water-based extinguishing medium it may be necessary to add ethylene glycol if the extinguisher is to be stored in cold environments where the temperature may be below 0 degrees. (see section 4.1).

Although modern foam mediums tend to be compatible with most powders, users must ensure that, where a powder has been used, the foam is compatible.

4.4 Powder

These are useful multi-purpose extinguishers, which are suitable for dealing with fires in electrical equipment and flammable liquids, as well as Class A risks, such as wood, solids, and paper. However, powder may not readily penetrate the spaces inside electrical equipment and, since it does not have the cooling properties of water, re-ignition is common. The use of a powder also results in the medium being spread widely and, even after a small fire, a considerable period may be necessary to clear it up, particularly where it gets inside machinery.

Powder is generally the most suitable extinguishant for fires involving free-flowing flammable liquids. Powder acts more rapidly than foam and is particularly suitable for dealing with fires that may spread to surrounding materials before a complete foam blanket can form over the burning liquid.

It should be noted, however, that if both extinguishing agents are to be used in firefighting operations, the powder should be used first and the area then sealed with foam after the flames have been extinguished. This is because powder acts faster, then the foam cools and discourages re-ignition. It is also vital that the powder and foam are compatible.

Powder extinguishers deal more effectively with larger areas of burning liquid than other extinguishers of comparable size. They are effective too on fires involving free-flowing liquids, especially where the liquid spills over a fairly large area.

Class B and C fires are extinguished by reactivity of powder within the flame. Fire is a chain reaction whereby free radicals are generated. When finely divided particles of BC powders are introduced into the flame, the recombination of radicals is inhibited and the chain reaction is interrupted. Providing sufficient powder is available, the combustible air/vapour fuel mixture is diluted and available heat dissipated. Subsequently, the chain reaction is terminated and burning stops.

Class A fires are initially extinguished by a BC-type flame knock down. However, fires of this type frequently contain glowing embers which, if left, tend to re-ignite and regenerate the burning process. Powders containing phosphate/sulphate mixtures have melting points of 150°C to 180°C. In contact with hot smouldering materials, the powder grains fuse to give a sticky, oxygen impermeable, barrier. The pores in the material (from which flammable gases may be liberated) are blocked by the sticky residues and re-ignition prevented. Therefore, Class A fires require ABC powder instead of the BC alternative.

Class D fires are based on burning metals and particularly the alkali metals including sodium, potassium, caesium, and lithium. The problem with metal fires, generally, is that they react violently with other firefighting media. Water and any of the foam materials evolve an explosive gas–hydrogen. Carbon dioxide also gives a violent chemical reaction. Conventional powder extinguishers are of little use on metal fires because the velocity of application scatters the burning material – both BC and ABC type powders react with the burning metal. Only Class D powders should be used on this type of fire.

Application of Class D powders is most effectively achieved by a gentle pouring action to prevent the scattering of the burning material. This may be from an extinguisher fitted with a special lance or, in the case of small isolated risks, shovel application may be appropriate. In this way, complete coverage of the burning material is possible without spreading the metal. The high temperatures inherent in fires of this nature are sufficient to stimulate formulation of a semi-fluid crust, which binds together the powder particles. Air is excluded by the rugged crust and the fire is extinguished. Rapid dissipation of excess heat through the crust assists in cooling, thereby increasing the resistance to re-ignition.

There are four types of powder extinguisher:

- **ABC powders**: these are commonly referred to as general purpose, multi-purpose, or all purpose powders. They are also very effective against running fuel fires. The powder is a mono-ammonium phosphate, treated with flow and moisture repellent additives. ABC powders are suitable for use in stored pressure or gas cartridge

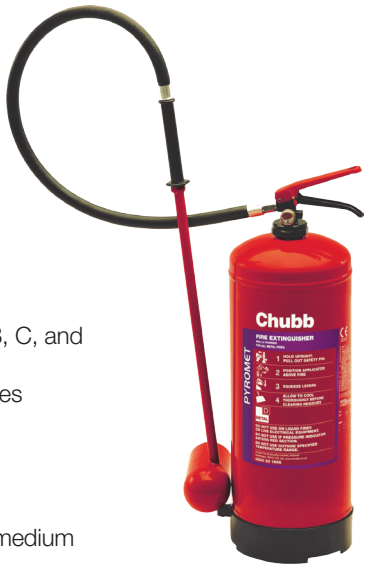
type extinguishers. They are non-toxic, and mass-for-mass offer the most effective firefighting medium

- **BC powders**: these are commonly referred to as standard powder. They contain sodium or potassium bicarbonate treated with flow and moisture repellent additives. They offer fast knock down and can be used in environments over a wide temperature range of –20°C to 60°C (EN 3 models). As the name suggests, these powders are recommended for use on Class B and C fires. They are particularly effective against fire involving alcohols, ketones, and esters
- **D powders**: these are suitable for fires involving metals. Once the type of metal has been established, specialist advice should be sought to identify the most suitable type of powder to be used. Generally speaking, for metal fires not involving lithium, a sodium chloride-based powder is appropriate, for example, Croda M28 F; and for metal fires involving lithium, graphite-based powder is more suitable, for example, Chubb L2, Ansul Lith-X. Powder should be applied gently to the burning metal through a low velocity applicator. This is to allow a thick blanket to be built up over the burning metal with the minimum of disturbance
- **high performance powders**: these are for special applications. An example is Monnex (potassium bicarbonate urea base), which is a type of BC powder. It is recommended for large Class B and C fires and is effective against fires containing alcohols, ketones, and esters

In view of the need to be specific in the choice of agent in relation to the fire risk, advice should be sought from manufacturers of extinguishers. They are in a position to advise which extinguishing media and specialist extinguisher to select for a given situation.

Construction

Powder extinguishers are available in sizes up to 12 kg capacity (maximum under BS EN 3) and in wheeled trolley versions carrying up to 150 kg (maximum in BS EN 1866: *Mobile fire extinguishers. Characteristics, performance and test methods*).



Advantages

The advantages of powder are as follows:

- multipurpose and often suitable for Class A, B, C, and electrical fires
- specialist powders are available for Class D fires
- safe to use on electrical equipment
- fast flame knock-down
- non-toxic
- effective against running fuel fires
- mass-for-mass, the most efficient firefighting medium

Limitations

It is important that the mixing or cross-contamination of different powders be avoided. Some mixtures react, sometimes after a long delay, producing water and carbon dioxide with consequent caking of the powder. In closed containers, this can result in a pressure rise, which could cause the extinguisher to explode.

It is important to fully consider BS 5306-8: 2012 at clause 5.4.3 when purchasing dry powder fire extinguishers. The discharge of a powder fire extinguisher within buildings can cause a sudden reduction in visibility and can also impair breathing, which could temporarily jeopardise escape, rescue, and other emergency action. For this reason, powder extinguishers should generally not be specified for use indoors, unless mitigated by a health and safety risk assessment.

4.5 Carbon dioxide

Carbon dioxide (CO_2) extinguishers are suitable for use on small fires involving flammable liquids and electrical equipment, particularly where it is necessary to avoid damage or contamination by foam or powder deposits.

Carbon dioxide is an inert gas (that is, it does not take part in a chemical reaction). It simply extinguishes the fire by displacement of oxygen by its bulk. Because it is a gas, it can reach fires in otherwise inaccessible locations.

Construction

Carbon dioxide extinguishers are pressure vessels and strict legal requirements cover their manufacture and use. Bodies are manufactured to BS EN 13322-1 and must incorporate a bursting disc or bursting valve. The disc is so designed that in the event of increased pressure from either overfilling or a temperature rise, it will safely vent the contents to the atmosphere. Carbon dioxide gas is stored in liquid form in the body. CO_2 remains liquid at 51 bar at 15°C. The ratio of expansion is approximately 450:1. In general terms, 1 kg of CO_2 in liquid state will produce about 0.5 m^3 of free gas.

Expansion of the gas may take place in the hose if fitted, but the major expansion takes place within the discharge horn. The main purpose of the design is to stop the entrainment of air by reducing the velocity. Without this, CO_2 acts in a similar way to a blow torch and would increase the intensity of the fire. Generally, CO_2 extinguishers have few components that require replacement on a regular basis, however, the discharge horn may become damaged from knocks resulting in cracks or splits and should be replaced if this occurs.

On operation of the extinguisher, a valve is opened and liquid carbon dioxide within the cylinder is forced up the syphon tube through either a swivel horn or a hose and horn. It is then discharged as a gas onto the fire. The discharge tube allows liquid CO_2 to be released from the base of the extinguisher instead of the gas pressure from the upper part of the extinguisher. Portable models are available in sizes up to 5 kg capacity, but these can be heavy to handle.

Advantages

The advantages of carbon dioxide are that it:

- does not conduct electricity
- is clean
- is quick to operate
- searches for the fire

Limitations

Carbon dioxide is an asphyxiant and has freezing capabilities. These mean that it is not user friendly. Care should be taken when using the extinguishers in basements or enclosed spaces as the gas can be an asphyxiant. The extinguishers are also noisy on operation. Carbon dioxide is unsuitable for extinguishing fires outdoors since the gas disperses on release.

4.6 Wet chemical

Wet chemical is a specialist extinguishing medium designed for use on fires involving cooking fats and oils (vegetable or animal), for example, in chip pans and deep fat fryers. Due to the specialist application of this firefighting medium, it has its own fire classification – Class F – although it is also able to extinguish Class A and, in some cases, Class B fires.

The wet chemical extinguishing medium generally includes aqueous solutions of potassium acetate, potassium carbonate, potassium citrate, or combinations of these materials.

Class F fires are extinguished by gentle application of the extinguishing medium. This requires an extinguisher with a lance type applicator providing an element of operator protection. When the firefighting medium is applied to the hot oil, it reacts to form a soap-like substance which provides a blanket between the burning oil and oxygen, so restricting the release of flammable vapours. This process is called saponification. The manufacturers of these products recommend that the total contents are discharged to maximise the cooling effect.

Construction

The design of these extinguishers often incorporate a lance to enable the foam to be discharged into the fryer from a safe distance and to prevent the scattering of the cooking oil by gently applying the medium onto the fire.

Typical sizes are 6- and 9-L capacity units, though BS EN 3 also permits 2- and 3-L capacity units.

Advantages

The advantages of wet chemical are as follows:

- multi-risk, suitable for use on Class A, B, and F fires (depending on model)
- prevents re-ignition of flammable liquids
- extinguishes fires progressively
- cools
- does not impair visibility
- meets requirements of BS EN 3 electrical test, providing users with a level of safety if inadvertently used on live electrical equipment

Limitations

Wet chemical extinguishers are not electrically safe. They are not suitable for use on flammable gases or metals. As wet chemical is a water-based extinguishing medium it may be necessary to add ethylene glycol if the extinguisher is to be stored in cold environments where the temperature may be below 0 degrees (see section 4.1).

Class F risks

BS 5306 Part 8 states that types of extinguishers other than Class F should not be sited where cooking oils or fats are the major factor in risk analysis. This means that in kitchens only wet chemical extinguishers should be in proximity of the cooking range containing cooking fats or oils, and is intended to avoid the risk of staff selecting the incorrect type of extinguisher.

4.7 Halon

Under the terms of the Montreal Protocol, implemented by European Commission (EC) Regulation 2037/2000, the use of chlorofluorocarbons (CFCs), including Halon 1211 in fire extinguishers and 1301 in fire suppressant systems, was banned from 31 December 2002, other than for critical users, defined in its Annex VII of the Regulation. The Regulation banned the refilling of existing systems, but allowed users until the end of December 2003 to decommission their systems.

Critical uses of Halon 1211 are:

- in hand-held fire extinguishers and fixed extinguisher equipment for engines for use on board aircraft
- on military ground vehicles, surface ships, and submarines
- in oil, gas, and petrochemical facilities
- in military and police fire extinguishers for use on persons
- in the channel tunnel
- in nuclear powered nuclear research facilities

From December 2002 it was an offence to supply halon, and from December 2003 it became an offence to possess halon extinguishers, except for the critical uses defined above.

In the UK, a limited number of approved service centres are able to offer decommissioning and maintenance services. The Fire Industry Association provides training for personnel authorised to maintain halon in critical uses and who can dispose of halon extinguishers.

5 Siting and provision

The number of extinguishers needed in a particular building is calculated according to the classification of fire. Whilst BS 5306 Part 8 gives clear indication as to the recommended provision of extinguishers, this is also subject to a suitable and sufficient fire risk assessment by a competent person, which may recommend additional or reduced coverage.

For Class A fires, a calculation is required based on the size of each individual floor area (in m^2) x 0.065. This results in an allocation of one 13 A rated extinguisher for general (Class A) protection to cover 200 m^2. If extinguishers with higher ratings were used then the total number required would be smaller.

In addition, the minimum rating for a workplace should be 26A per floor, with at least two Class A extinguishers provided on each floor within the building. A 9-L water or foam extinguisher can achieve a 13A rating and, often, another general Class A extinguisher, like powder, can also be used if the hazards present suggest this would

be appropriate. Mixing and matching is, therefore, possible to achieve the desired rating and protection.

Table 3 indicates the suitability of each extinguisher type for use on each type of fire and provides typical ratings for extinguishers by size.

With flammable liquids, the maximum areas for which Class B extinguishers are suitable are shown in Table 4 (see section 5.3).

With cooking fats/oils the maximum areas for which Class F extinguishers are suitable are shown in Table 5 (see section 5.4).

Carbon dioxide and powder extinguishers can be used on live electrical equipment, but whenever possible the apparatus should be isolated from the live circuit or the current turned off before the fire is tackled. It should always be turned off as soon as possible after firefighting to prevent re-ignition and await examination by a competent person to decide if it is safe to reactivate.

Examples of hazards for which carbon dioxide extinguishers are especially suitable include computers and delicate laboratory equipment, but they are of limited use in the open air. Care should be taken regarding the use of carbon dioxide extinguishers in basements or enclosed spaces owing to the asphyxiate nature of the gas.

The cooling properties of powder and carbon dioxide are limited. The gaseous agent gives no real protection against re-ignition, which may occur once the gas disperses. It is not as effective as foam on liquid fires in containers where the liquid is hot because it has been burning for some time or it has been heated in a process.

Table 3: Typical extinguisher sizes and ratings

Extinguisher type	Risk	Typical extinguisher sizes and ratings
Water Colour code – red	**Class A hazards:** solids, wood, paper, cloth. For general protection of ordinary combustible materials	9 L 13A 6 L 8A 6 L with additive 21A 3 L with additive 13A
Foam Colour code – cream	**Class B hazards:** liquids, fats, paints and oil. Some foam extinguishers, such as AFFF, are also suitable for combustible solids fires (Class A)	9 L 21A: 183B 6 L 13A: 144B 2 L 5A: 55B
Powder (multi-purpose) Colour code – blue	**Class A hazards:** solids, wood, paper, cloth **Class B hazards:** liquids, fats, paint, oil, and electrical equipment	9 kg 43A: 233B 6 kg 34A: 233B 3 kg 21A: 89B
Carbon dioxide Colour code – black	**Class B hazards:** liquids, fats, paint, oil, and electrical equipment	5 kg 70B 2 kg 34B
Wet chemical Colour code – yellow	**Class F hazards:** cooking oil fires. Also suitable for combustible solid fires (Class A)	6 L 75F 6 L 13A

No attempt should be made to put out the flame from a fire involving escaping gas (Class C fire) using an extinguisher because an explosion may result if unburnt gas escapes and then re-ignites. It is, therefore, necessary with fires involving gases to allow the gas to burn safely, while ensuring that the flames do not spread to nearby combustible materials, until the gas supply can be isolated at a marked and accessible gas valve.

5.1 How many extinguishers?

The basic scale given in section 5.2 is applicable to a wide range of fire risks/premises, but additional extinguishers should be provided at locations where the likelihood of fire is above average, or where a fire would be particularly intense.

5.2 Class A risks: 0.065 calculations

For Class A risks:

- there should be at least two Class A rated extinguishers sited on each floor of the building
- the total Class A rating for all extinguishers on that floor should not be less than 0.065 x floor area (m^2) and, in no case, less than 26A
- a 13A rated extinguisher will cover 200 m^2

5.2.1 Worked example

In a building, the floor dimensions are: 30 m x 20 m = 600 m^2 (floor area).

The minimum Class A rating for all extinguishers on that storey should not be less than:

600 m^2 x 0.065 = 39A

Therefore, the following options are available:

- 2 x 21A rated extinguishers
- 3 x 13A rated extinguishers
- 5 x 8A rated extinguishers

5.3 Class B risks

The following factors should be taken into account when providing extinguishers for Class B risks in a building:

- each room or enclosure should be considered separately
- risks more than 20 m apart should be considered separately
- containers sited within 20 m of another container should be assessed either as undivided groups or as divided groups:
    - in undivided groups – containers should be less than 2 m apart
    - in divided groups – two or more containers should be more than 2 m but less than 20 m apart

Flammable liquid risks can then be divided into two distinct hazard types: spilled or contained.

A spilled liquid hazard is where there is a reasonable risk that a flammable liquid could be spilt and ignited, such as, for example, bottles of liquid on a shelf in a retail store.

Table 4: Provision of foam extinguishers for single open top containers

Maximum area of exposed Class B m^2	Minimum quantity and minimum rating for each extinguisher
0.14	1 x 21B
0.23	1 x 34B
0.37	1 x 55B
0.47	1 x 70B
0.59	1 x 89B
0.75	1 x 113B
0.96	1 x 144B
1.22	1 x 183B
1.41	2 x 113B
1.80	2 x 144B
2.29	2 x 183B
2.88	3 x 144B
3.66	3 x 183B
4.66	3 x 233B
Note: In a real fire situation, it cannot be expected that an extinguisher will be capable of extinguishing a fire of equal area to the test fire. For Class B fires, a derating factor of 2.5 is therefore applied; that is, extinguishers are recommended as being suitable for extinguishing a real fire 40% of the area of the rated test fire. This is considered adequate when two extinguishers are installed, but if only one is to be installed the factor applied is 4.7.	

In order to decide on the correct size of fire extinguisher for a spilled flammable liquid risk, the anticipated volume of spillage in litres should be multiplied by 10. The B rating on the fire extinguisher should be equal to or greater than the number the calculation gives you. Therefore, a 144B rated fire extinguisher is suitable for 14.4 L of a flammable liquid that could be spilled.

Fires involving spilled flammable liquids will have variable quantities of the liquid and it is difficult to predict their severity. Under normal circumstances, spillages may be expected to spread to any depth up to a minimum of 1 mm.

Contained flammable liquids are often stored in bunded areas in order to ensure the contents are not spilled, making firefighting activities much harder. To determine the fire protection required for a contained Class B risk, the surface area of the container and the separation distance from other contained Class B risks should be considered. Where two containers are more than 20 m apart, each risk must be considered separately, as defined in BS 5306-8.

Table 4 (adapted from BS 5306-8) defines the maximum area of Class B fire (deep liquid) for which extinguishers are suitable. This table can be used to look up the nearest value to the surface area of the contained B risk; and by reading across the number and minimum fire rating of extinguishers needed to deal with a risk of that surface area can be found.

For foam extinguishers, the maximum manufactured size rating is 183B, which means the maximum area for one foam extinguisher is 1.22 m^2.

Additional reference should be made to BS 5306-8, Section 6.3.

5.4 Class F risks

For Class F risks, Table 5 should be used to decide the minimum rating of extinguisher which must be provided for the area of risk. The maximum travel distance to the extinguishers is 10 m.

If the area is greater than 0.4 m^2, then a fixed extinguishing system should be provided. In this case, an extinguisher should also be provided to protect against potential spillage of fire outside the coverage of the fixed system.

Table 5: Provision of wet chemical (Class F) extinguishers

Area of Class F fire risk – m^2	Extinguisher rating
0.015	1 x 5F
0.02	2 x 5F
0.04	1 x 25F
0.06	1 x 40F
0.11	1 x 75F
0.18	2 x 40F
0.24	2 x 75F
0.27	2 x 75F
0.30	2 x 75F
0.40	2 x 75F

5.5 Siting requirements

It is normal practice to locate extinguishers in conspicuous locations, either on wall brackets or on stands, ensuring that they can be easily seen and ready for immediate use. The normal position for the siting of extinguishers is near to exits or on escape routes, such as in corridors, stairways, landings, and lobbies. It is sometimes convenient to locate them below manual fire alarm call-points. If it is impractical to place extinguishers in conspicuous places, then signs should be used to draw attention to them. Extinguishers that are not stand-mounted, but up to and including those weighing 4 kg should be wall-mounted with the handle about 1.5 m from the floor. Heavier extinguishers should be mounted with their handles about 1 m above the floor.

The operator of the extinguisher should not have to travel more than 30 m from the fire in order to get to a Class A rated extinguisher. They should always be accessible and nothing should be placed in front of them, even temporarily. If an extinguisher is specified for a special fire risk then the extinguisher should be sited in close proximity to that risk, but not so close that a fire will render it inaccessible and useless.

Usually, extinguishers are grouped and positioned with other safety equipment, fire warning call-points, hose reels, and instruction notices to form a fire point.

Consistency in the location of fire points will help employees gain familiarity in where equipment and safety instruction may be found. Finding a suitable place for a fire point that is accessible, obvious, and does not obstruct routes, is worthy of some effort if portable firefighting equipment is to be used without hesitation. Designing a suitable recess in new buildings should be part of the safety considerations. These should be about 30 m apart.

A simple fire point

Extinguishers sited outside or in hazardous environments, such as corrosive environments, should be housed in containers to protect them from damage. Similarly, extinguishers placed in the open must be protected against extremes of temperature and inclement weather. In the latter case, the supplier or service engineer may add quantities of antifreeze to the contents. The temperature range of the extinguisher should be noted and the extinguisher should be sited in such a way that it should stay within its temperature limits. If an extinguisher is located in an area where there may be vandalism, consideration of using a local tamper alarm may be an effective solution.

To summarise, the following factors should be considered when siting fire extinguishers. They should be:

- on escape routes
- on stands
- elevated to a height so that the carry handle is 1.5 m from the floor for extinguishers up to 4 kg and 1 m for larger extinguishers
- adjacent to the risk
- near a door, inside or outside according to occupancy
- at the same position on each storey, in multi-storey buildings
- in groups forming ‘fire points’
- in shallow recesses, where possible
- away from extremes of temperature within extinguisher temperature ranges, corrosive environment and/or vandalism
- recommendations on the travel distance should be adhered to for each different risk (see Table 6)

Table 6: Recommended travel distances

Risk	Max travel distance
Class A	30 m
Class B	10 m
Class C	30 m
Class D	as per risk assessment
Class F	10 m
Electrical	10 m

In addition, the following should be considered when siting fire extinguishers, as initial provision or as additions to existing fire protection equipment in a building:

- **method of operation:** all extinguishers, where possible, should operate by the same method
- **ease of handling:** the occupiers should be capable of handling the types and sizes recommended
- **labelling:** where different types of extinguishers are sited together, they must be properly labelled to prevent the wrong extinguisher being used
- **suitability for risk:** extinguishers with suitable jet or spray nozzle or flexible hoses to suit the risk involved
- **maintenance arrangements:** extinguishers to be serviced to the latest standard
- **rating:** the fire rating requirement must be covered

6 Commissioning and servicing procedures

The commissioning and servicing of all portable fire extinguishers should only be undertaken by a 'competent person'. This is defined in BS 5306 Part 3: 2017 as:

person with the qualifications, training and experience, with access to the relevant tools, equipment and information, manuals and knowledge of any special procedures recommended by the manufacturer of an extinguisher, to carry out the relevant maintenance procedures.

The person who has been trained in the procedures involved should have passed an appropriate examination and must also be able to demonstrate practical experience and suitable ongoing professional development through refresher training every 3 years.

The responsible person in any premises must ensure that any person appointed to service fire extinguishers has received such training and has passed the appropriate examination. The responsible person is defined in BS 5306 Part 3: 2017 as:

person or persons responsible for, or having effective control over, fire safety provisions adopted in or appropriate to the premises or building or hazard where an extinguisher is installed.

There are two independent examination bodies currently recognised by British Approvals for Fire Equipment (BAFE):
- the British Fire Consortium (BFC)
- the Independent Fire Engineering and Distributors Association (IFEDA)

In addition, a number of organisations, including the Fire Protection Association (FPA) and the Fire Industry Association (FIA), offer training courses leading to BAFE examinations.

In addition to regular servicing (at least annually) by a competent person, the responsible person should also ensure that simple visual inspections of all extinguishers are undertaken at least once a month. These checks should be recorded.

6.1 Practical considerations

6.1.1 Specifying suitable extinguishers

Conformity to the relevant standards (see Chapter 1) can be checked by looking for independent third party certification to these standards, offered, for example, by the British Standards Institution Kitemark and the Loss Prevention Certification Board (LPCB).

Under the European Pressure Equipment Directive, all new fire extinguishers must carry a CE mark, signifying that manufacturers of the extinguishers claim that they comply with the Directive. However, the presence of a CE mark does not in any way give an indication of its performance as a fire extinguisher, which can be confirmed on an appropriate register.

Detail on where to site portable fire extinguishers is contained earlier within this handbook in Chapter 5.

6.1.2 Appointing a competent service technician

As previously mentioned, a competent person must have undergone an initial programme of training, including gaining on-the-job experience, and successfully completing an examination administered by an independent examination body.

A competent person should, ideally, be registered under the BAFE scheme for contract maintenance of portable fire extinguishers (incorporating the registered fire extinguisher service technicians' scheme), SP101/ST104.

A typical training course should include:
- on the job experience gained under the supervision of a competent person
- attendance of a training course
- **examinations:** the trainee must achieve a minimum standard in both theory and practical examinations administered by an independent examination body

Theoretical training on the initial training course should cover:

- provisions of BS 5306-3, BS 5306-8, BS 5306-9, BS EN 3-7, BS EN 2
- classes of fire as defined by BS EN 2
- legal requirements relating to the transportation of extinguishers (ADR)
- legal requirements set out in the Pressure Equipment (Safety) Regulations 2016
- disposal of extinguishing media
- safe working practices in both a workshop and on site
- health and safety issues affecting a service technician
- safety/advisory notices and product recalls issued by regulatory/trade bodies

The practical test should allow the trainee to demonstrate their skills in fault-finding and servicing of a number of portable fire extinguishers.

To maintain competency, ongoing professional development is considered essential and registered technicians should receive refresher training, and pass a written examination, at 3-yearly intervals.

6.1.3 Written reports and documentation

BS 5306-3 recommends that the competent person performing maintenance on portable fire extinguishers should produce a written report, which can be hard copy or electronic, for the responsible person.

The report should detail the following, which is extracted from 11.1 of BS 5306-3:

a) the status of all portable fire extinguishers included in the maintenance report, including:
   1) all in serviceable condition;
   2) all non-conforming equipment (condemned, corrective action required and/or are missing); and
   3) recommendations for appropriate corrective action or reference to where this information can be found;

b) a statement that, apart from non-conforming extinguishers as recorded, all portable fire extinguishers have been maintained in accordance with this standard, ie BS 5306-3;

c) the reason for any condemned extinguishers;

d) any permanent replacement extinguishers required to replace those extinguishers reported as condemned, corrective action required and/or missing;

e) details of any additional extinguishers or actions required to ensure that the level of fire protection cover at the premises is at least sufficient and, where applicable, in accordance with BS 5306-8, together with a statement concerning the responsible person's obligation under fire legislation to provide an appropriate level of fire-fighting equipment at all times;

f) an instruction that any replacement or additional extinguishers reported in d) or e) should be provided as soon as possible;

g) the name, postal address, and telephone number of the maintenance company;

h) the identification of the maintenance technician, and date(s) of maintenance;

i) acknowledgment/receipt of the written report by the responsible person, eg the signature of the responsible person or their representative, which should be obtained upon completion of the service visit and prior to the service technician leaving the premises, or a record of the reason why this is not possible (eg unmanned sites); or electronic acknowledgement;

j) instructions with regard to the fire risk assessment in accordance with 11.3;

k) instructions with regard to the fire logbook

In addition, the competent person should also provide the responsible person with a certificate of inspection, which should include:

- the name, full address, and telephone number of the maintenance company
- the date of maintenance
- service technician's ID
- a list of all portable extinguishers included in the maintenance programme, including all non-conforming equipment, and recommendations for appropriate corrective action or reference to where this information can be found
- a statement that, apart from non-conforming extinguishers as recorded, all portable fire extinguishers have been inspected and serviced in accordance with BS 5306-3
- signature of responsible person

The responsible person should sign the certificate after the maintenance work has been completed and before the technician has left the premises. If it is not possible to obtain the responsible person's signature (for example, on unmanned sites), the reason should be noted.

The following information, as a minimum, should be entered onto a service label for each type of extinguisher after completion of service, along with the full postal address of the servicing company:

- date of service
- type of service – basic, extended, or overhaul
- engineer's ID
- date of last discharge
- weight

6.1.4 Halon

Halon is no longer permitted as an extinguishant, except for 'critical uses', as it depletes the ozone layer (see section 5.6). There are special arrangements for the withdrawal of halon extinguishers from service.

6.1.5 Non-compliant extinguishers

Certain extinguishers are regarded as non-compliant because of the type, construction, method of operation or their condition.

Examples of such extinguishers are:

- non-refillable extinguishers that have reached their expiry date
- extinguishers manufactured after 2002 which do not carry the CE mark (excluding refurbished extinguishers, which do not carry the mark and cannot be condemned for not carrying it)
- extinguishers that are required to be inverted to use
- extinguishers with riveted bodies or plastic headcaps
- extinguishers used in the UK market containing instructions that are not written in English
- rusty or corroded extinguishers where the condition is such that it could impact on the operation and place the user at risk

These extinguishers should be marked CONDEMNED on the label and the reason noted on the written report (see section 6.1.3). The condemned extinguisher should be taken out of service and removed to a place where it cannot be used.

6.2 Commissioning

Since 2009 BS 5306-3 has clearly recommended that all portable fire extinguishers should be commission-serviced prior to installation into a building. The purpose of this service is to ensure the extinguisher has not become damaged during transporting it to the site, it is free from any deficiencies, and it is sited in the correct location in relation to the risks in that area.

The engineer should affix a service label to the extinguisher and undertake the inspections as per Table A1 of BS 5306-3.

6.3 Servicing schedules

Fire extinguishers are first-aid appliances and must be maintained to ensure their continued performance.

BS 5306-3 specifies the inspection and maintenance procedures to be carried out on fire extinguishers. It details actions to be undertaken by the user and by the competent person responsible for the maintenance of extinguishers in the premises.

It is recommended that maintenance procedures are carried out at least once per year, although a tolerance of 1 month either side of the 12 months is permitted.

6.3.1 User inspections

A regular visual inspection should be conducted by the responsible person. This should be carried out at least once a month. Visual inspections should confirm the following:

- has it been used?
- is it located in the designated place?
- is it unobstructed and visible, and are its operating instructions facing outwards?
- are the operating instructions clear and legible?
- has there been any damage sustained?
- does it have a reading in the operable range?
- are the seals or tamper indicators broken or missing?
- a check of the gauge on stored pressure units should be noted

The responsible person should ensure that a record of the results is maintained in the fire log book and arrange for the competent person to take any corrective actions required.

6.3.2 Inspection periods

BS 5306-3 outlines the inspection and maintenance procedures that range from basic and extended services to a complete overhaul of an extinguisher. It also identifies the maximum intervals permitted between inspections (see Table 6).These procedures should only be carried out by a competent person, and then only if suitable safety checks have been undertaken.

Before opening any extinguisher, any vent holes or devices should be checked. If vents are blocked, they should be clear before opening. All extinguishers should then be opened slowly to allow for the release of any residual pressure. A periodic discharge test should only be carried out after a check for corrosion has taken place. A corroded extinguisher body could burst, injuring the operator. If the safety pin is missing from an extinguisher, ensure it is in good working order and is full, before fitting a new pin and seal prior to carrying out the service.

In addition to the routine inspection periods outline in BS 5306-3 there may be occasions when the extinguisher will require opening or inspecting. Extinguishers will be opened, inspected, and re-filled after the extended service, which includes a full discharge test of the extinguisher. Other occasions when there may be the need to open an extinguisher include when it has been partially used or found to have the incorrect mass during the weight check. It is critical that the pressure has been released from any stored pressure extinguisher prior to opening it.

6.3.3 Recharging

Further information relating to the recharging of extinguishers is contained within BS 5306-9 Fire extinguishing installations and equipment on premises. Recharging of portable fire extinguishers. This standard deals with the refilling of extinguishers so as to maintain extinguishing performance and safety.

BS 5306-3 requires that gas cartridges conform to BS EN 3, so while BS EN 3 cartridges may be fitted to older BS 5423-approved extinguishers, the reverse is not true.

Propellants must be:

- chemically the same as that used originally
- chemically the same as that used originally, but with a different tracer gas to facilitate leak detection
- nitrogen or air, where air was used originally

All extinguishing medium should be emptied and discarded. (Note: halon is a special case and requires specific actions to be taken.) The following should be followed for refill charges:

- **carbon dioxide:** refill must comply with BS 6535-1
- **foam:** the manufacturer's specified refill charge
- **water:** tap or other potable water (not through an external tap or hose, because of the risk of Legionnaires' disease), following manufacturer's specification for any additives
- **powder:** as originally, previously, or currently specified by the manfacturer or to comply with BS 6643-2

After recharging in accordance with the manufacturer's instructions, the extinguisher should be marked with the following information:

- 'This extinguisher has been recharged by [name and address] in accordance with BS 5306-9 and the recommendations of BS 5306-3'
- the recharging date
- identification of the extinguishing medium if it is different from that originally used and marked on the extinguisher

Table 7: Maintenance intervals [A] (adapted from BS 5306-3)

Type of extinguisher	Basic service[B], [C], [D], [E]	Extended service [C], [E]	Overhaul [E]
Water and water based	Every 12 months	Every 5 years	—
Powder	Every 12 months	Every 5 years	—
Powder-primary sealed	Every 12 months	Every 10 years[F]	—
Halon [G]	Every 12 months	—	Every 10 years
Carbon dioxide [H]	Every 12 months	—	Every 10 years

(A) The intervals in this table disregard any recharging of the extinguisher.
(B) The maintenance intervals given for basic service have for practical purposes a tolerance of ±1 month.
(C) Intervals (other than carbon dioxide extinguishers) should be taken from:
- **basic service:** the date of commissioning or the last service;
- **extended service:**
  - *water, water-based and powder:* 5 years from the date of commissioning or 6 years from the date of manufacture of the extinguisher, whichever is sooner, and subsequently every 5 years from the date of the last extended service
  - *powder-primary sealed:* 10 years from the date of commissioning or 11 years from the date of manufacture of the extinguisher, whichever is sooner, and subsequently every 10 years from the date of the last extended service

(D) Intervals may be shortened on the recommendation of the competent person where inspection reveals environmental and/or special hazards, or at the request of the responsible person.
(E) Replacement of parts does not affect these intervals. For example, if the hose of a water-based extinguisher is replaced after the extinguisher has been in service for 6 months from commissioning, then the basic service should be carried out after a further 6 months.
(F) Primary sealed stored pressure extinguishers should be returned to the manufacturer/supplier for recharging.
(G) Service of this type of extinguisher may only be carried out if the extinguisher meets the criteria of the 'critical uses' in Annex VII of EC Regulation 2037/2000.
(H) Intervals for carbon dioxide extinguishers: BS EN 1802: 2002 (Clause 5), BS EN 1803: 2002 (Clause 5), and BS EN 1968: 2002 (Clause 5) require that the stamped date of manufacture or last overhaul be used.

6.3.4 Disposal of medium

In the United Kingdom there are a number of specialist firms who will collect bulk quantities of full or empty fire extinguishers for recycling. This option will often prove to be a cost effective way of disposing of a quantity of condemned or out-of-date fire extinguishers. Some fire extinguisher contents, such as foam and powder, can be recycled, therefore, this is a responsible way to dispose of the medium.

BS 5306-8 suggests that advice should be sought from extinguisher manufacturers and distributors concerning the disposal of medium.

BS 5306-3 states: 'Attention is drawn to environmental legislation, especially where this concerns the disposal of media that have been replaced during the course of the maintenance procedures'.

There are a number of legislative controls governing the disposal of unwanted media from fire extinguishers, such as Groundwater Regulations 1998, Water Resources Act

1991, Water Industries Act 1991, Environmental Protection (Duty of Care) Regulations 1991, Control of Pollution (Amendment) Act 1989/Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991, Hazardous Waste Regulations 2005, and the Trade Effluents (Prescribed Processes and Substances) Regulations 1989.

The following outlines actions to take for each type of media:

- **Firefighting foams:** In accordance with the Groundwater Regulations, these must not be discharged to groundwater. Foams (except PFOS-based foams) may be disposed of via foul sewer to a waste water treatment plant (sewage works), although there are some concerns regarding this and the engineer must check with the site whether it is permitted. PFOS foams must be disposed of by high temperature incineration. Between one and five extinguishers may be disposed of on-site via the foul water system. Where there are more than five extinguishers for disposal, foam should be collected in a secure container and transferred to a larger container at the service depot for disposal by licenced waste contractors.
- **Firefighting powders:** The method of disposal depends on the type of powder, and the powder manufacturer should be consulted to ascertain the appropriate route. Certain powder types are classed as hazardous waste and a hazardous waste consignment note must be completed and retained with disposal arranged through a licenced carrier. Some powder types may go to landfill sites in sealed containers, as they are classified biodegradable solid waste. Where agricultural use is considered a possible disposal option, it is necessary to consider whether the powder has a silicone coating as this will need to be removed. If discharge testing is conducted on site, care should be taken to avoid powder escaping into the environment. Discharge into a large canvas bag is recommended, and the bag should be sealed to prevent leaks.
- **Wet chemical:** These media should not be disposed via foul sewer or landfill sites. Again, the manufacturer should be consulted when considering disposal options, as Class F media contains a mixture of chemicals.
- **Water:** Suitable disposal is via foul water system unless additives have been added. Alternatively, these extinguishers can be used as part of staff training.
- **Carbon dioxide:** Normal practice is for these extinguishers to be returned to an approved service centre, which will arrange safe discharge of contents. These may also be used for staff training.

The Montreal Protocol and the Ozone Depleting Substances EC Regulation 2037/2000 introduced limitations on the use of halon. These have been updated by the Ozone Depleting Substances EC Regulation 1005/2009 and the Ozone-Depleting Substances (Qualifications) Regulations 2009.

6.3.5 Provision of replacement extinguishers

It is not advised or recommended that the engineer will simply mark up their service paperwork to state that there is an insufficient provision of extinguishers due to having condemned existing site extinguishers. In fact, BS 5306-3 clearly notes that discharged extinguishers should be recharged or replaced after use.

This can be achieved by making sufficient spares available to either the site or the engineer to ensure the recommendations of BS 5306-8 and the fire risk assessment are always adhered to.

Further information

British Standards

- BS EN 2: *Classification of fires*
- BS EN 3: *Portable fire extinguishers*
- BS EN 1802: *Transportable gas cylinders. Periodic inspection and testing of seamless aluminium alloy gas cylinders*
- BS EN 1803: *Transportable gas cylinders. Periodic inspection and testing of welded carbon steel gas cylinders*
- BS EN 1866: *Mobile fire extinguishers. Characteristics, performance and test methods*
- BS EN 1968: *Transportable gas cylinders*
- BS EN ISO 9001: *Quality management systems. Requirements*
- BS EN ISO 17021: *Conformity assessment. Requirements for bodies providing audit and certification of management systems*
- BS 5045: *Transportable gas containers*
- BS 5306-3: *Code of Practice for the commissioning and maintenance of portable fire extinguishers*
- BS 5306-8: *Fire extinguishing installations and equipment on premises. Selection and positioning of portable fire extinguishers*
- BS 6165: *Specification for small disposable fire extinguishers of the aerosol type*
- BS 6643-1: *Recharging fire extinguishers (manufactured to BS 5423: Specification for portable fire extinguishers). Specification for procedure and material*
- BS 6643-2: *Recharging fire extinguishers (manufactured to BS 5423: Specification for portable fire extinguisher). Specification for powder refill charges*
- BS 5306-10: *Recommendations for colour coding to indicate the extinguishing media contained in portable fire extinguishers*

BAFE schemes

- SP101/ST104: *Contract Maintenance of Portable Fire Extinguishers incorporating Registered Fire Extinguisher Service Technicians Scheme*
- SP103: *Refurbishment of Portable Fire Extinguishers*

Legislation

- Carriage of Dangerous Goods and Use of Transportable Pressure Receptacles Regulations 2009
- Control of Pollution (Amendment) Act 1989/Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991
- Environmental Protection (Controls on Ozone-Depleting Substances) Regulations 2002 and 2003
- Environmental Protection (Duty of Care) Regulations 1991
- F Gas Regulations 2006
- Fire (Scotland) Act 2005
- Fire and Rescue Services (Northern Ireland) Order 2006
- Fire Safety (Northern Ireland) Regulations 2006
- Fire Safety (Scotland) Regulations 2006
- Groundwater Regulations 1998
- Hazardous Waste Regulations 2005
- Montreal Protocol
- Ozone Depleting Substances Minimum Qualifications Regulations 2006
- Pressure Equipment (Amendment) Regulations 2002
- Pressure Equipment Regulations 1999
- Pressure Systems Safety Regulations 2000
- Regulatory Reform (Fire Safety) Order 2005
- Transportable Pressure Equipment Directive (TPED)
- Water Industries Act 1991
- Water Resources Act 1991

Other publications

- *Choosing and Using a Fire Extinguisher* (pocket card), Fire Protection Association
- *Essentials of Fire Safety Management*, Fire Protection Association
- *Extinguishing Fires at Work DVD*, Fire Protection Association
- *FPA Workplace Fire Safety Log Book*, Fire Protection Association
- *Fire Risk Assessment for Small Businesses*, Fire Protection Association
- *Fire Risk Management in the Workplace, A Guide for Employers*, Fire Protection Association
- *How to Use a Fire Extinguisher* (leaflet), Fire Protection Association

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Fire Extinguisher Handbook

Aimed at end-users, as well as maintenance technicians, this useful handbook provides an excellent introduction to the various types of extinguisher and their suitability for use on different classes of fire.

It explains extinguisher construction, how extinguishers work, and the legislation and standards that apply. The handbook emphasises the need for regular maintenance by a competent, third-party accredited contractor. It offers an overview of the servicing procedures, to assist end-users and service technicians alike to understand the checks necessary to ensure extinguishers will operate safely whenever required.

A booklet of forms and checklists is provided to aid the responsible person in maintaining a record of the fire extinguishers at the premises, their maintenance history and contractors' details. This also provides a range of checklists outlining the procedures that a competent person should undertake when commissioning or servicing each type of extinguisher.

Contents: Foreword; Legislation and standards; Classes of fire and fire science; Extinguisher construction; Types of extinguisher; Siting and provision; Commissioning and servicing procedures; Further information; Records and Checklists booklet.

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